Selected biofuels characterization results and quality assessment report

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1. INTRODUCTION

The objective of this deliverable D3.2 is to present the results from the determination of the analytical characteristics of selected commercial residential heating solid biofuels within the BIOMASUD certification scheme, and to make a quality assessment of these solid biofuels. The study extends the scope of BIOMASUD certification scheme in order to (a) include new solid biofuels, not covered by the initial formulation of BIOMASUD (e.g. olive and vineyard prunings, pistachio shells), (b) to consider updates to the quality classes of solid biofuels covered by the initial formulation of BIOMASUD (e.g. olive stones, almond shells, etc.) through additional sampling and fuel analysis in the SUDOE EU space (Spain, Portugal, south of France), the geographical area of the initial BIOMASUD, and extending the sampling and analysis campaign to other Mediterranean countries participating in the project (Italy, Croatia, Slovenia, Greece and Turkey). Overall, the present report aims to contribute to the relevance of the BIOMASUD scheme as a tool to promote the use of Mediterranean biofuels for residential heating applications.

The characterization of the selected biofuels has been made by the laboratories of CIEMAT, BIOS, CERTH and CBE of samples sent by partners from the participating Mediterranean countries.

The results and conclusions of this deliverable will be used as the supporting information to establish the quality limits of the envisaged standards for southern European solid biofuels not included in any existing standard, as well as to assess the compliance of the selected solid biofuels (particularly those produced in the new adhered countries) with the requirements of their related quality standards (Task 3.3).

2. SELECTED BIOFUELS AND NUMBER OF SAMPLES COLLECTED PER COUNTRY

According to CIEMAT proposal and taking into account the results of D3.1, a number of southern European solid biofuels were selected for the study with the agreement of the rest of participants in this task: CBE (Portugal), BIOS (Austria), CERTH (Greece), AIEL (Italy), AVEBIOM (Spain), GIS (Slovenia), ZEZ (Croatia) and TUBITAK (Turkey).

The selected biofuels and the number of samples collected per country and biofuel for ulterior characterization and quality assessment are shown in Table 2.1.

Table 2.1. Selected biofuels and number of samples per biofuel

BIOMASSES	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES (OS)	2	10	14	3	4	10	5	48
ALMOND SHELLS (AS)		6	8	1		10		25
HAZELNUT SHELLS (HS)	10					5	10	25
PISTACHIO SHELLS (PS)		3				10	6	19
WALNUT SHELLS (WS)		4		2		6	10	22
PINE NUT SHELLS (PNS)				4		10		14
OLIVE TREE PRUNINGS (OTP)	10	12	4	8	10	20	10	74
OLIVE TREE PRUNINGS (OTP pellets)			2					2
VINEYARD PRUNINGS (VP)	18	16	9	18	17	24	10	112
VINEYARD PELLETS (VP pellets)			5			1		6
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

As can be seen in table 2.1, besides commercialized biofuels (dry fruit shells, olive stones, olive tree pruning and vineyard pruning pellets), biomasses identified to have an important potential to be used for thermal applications in the residential sector of the Mediterranean countries participating in the project have also been selected for study: this is the case of vineyard and olive tree prunings. It is important to remark that some of the cited biomasses, as it is the case for the different dry fruit shells, are actually commercial biofuels in some countries, but they are not utilized for this use in others, where they can therefore only be considered as raw materials. Moreover, in other cases the use of the selected biofuels is in the industrial sector mostly. Overall, the number of samples was a combined function of availability of the biofuels as well as of their importance as potential biomass sources in each country.

The quality assessment of the selected biofuels has been made taking into account the applicable Spanish UNE standards for olive stones UNE164003:2014 and some dry fruit shells (UNE164004:2014) whilst the fuel quality of vineyard and olive tree prunings and derived pellets has been assessed when applicable referred to ISO solid biofuels quality standard limits (ISO 17225-2 and ISO 17225-4). Analogously, for walnut shells and pistachio shells, not envisaged in any quality standard, fuel quality has been matched against the cited UNE quality standard for dry fruit shells.

As envisaged in the project DoA, each Mediterranean participant collected the samples in Table 2.1 from its respective country and delivered them to the corresponding laboratory partner for analysis. AVEBIOM and CIEMAT collected the samples from Spain jointly.

At proposal of CIEMAT, an agreement was also achieved among the laboratories for distribution of the country samples for analysis, as follows:

-BIOS: To determine samples from Turkey and Croatia, with the exception of skin and oil content of olive stones, and oil content of nut shells samples, as well as mercury content of all samples.

-CERTH: To determine samples from Greece and Slovenia, with the exception of mercury content, and including the determination of oil and skin content of two olive stones samples and oil content of 12 samples of nut shells from BIOS.

-CBE: To determine samples from Portugal and Italy, with the exception of mercury content, and including the determination of oil and skin content of two olive stones samples and oil content of 12 samples of nut shells from BIOS.

-CIEMAT: To determine samples from Spain, and also including the determination of oil and skin content of three olive stones samples and oil content of 12 samples of nut shells from BIOS, as well as mercury content of all samples. Moreover, as envisaged in the project DoA, the CIEMAT performed own sintering tests (see section 4) on all collected samples.

3. METHODS OF SAMPLING AND RELEVANT INFORMATION OF COLLECTED SAMPLES

The information associated to the collected samples, as per table 2.1, organized by type of biofuel/biomass and country is described in Annex I "Methods of sampling, location and description of collected samples". The collection of the different biofuels/biomasses was made according to an established procedure elaborated by CIEMAT and agreed with all partners in this task. The complete procedure is detailed in Annex I.

The information requested of collected samples in Annex I include the country of origin and location where each sample was collected, the sample suppliers (for industrial biofuel samples), and information related to the specific sampling procedure (in the case of olive stones and fruit shells samples), the crop variety and crop water supply (irrigation-rain fed) conditions (in the case of olive tree and vineyard pruning samples). A total of 347 samples are reported, corresponding to the final number of samples collected (Table 2.1). The origin of the different type of biofuels/biomass samples is located in European maps included in Annex II, following the order of the biofuels/biomass listed in the mentioned table.

4. ANALYTICAL AND STATISTICAL METHODS

The analytical samples were prepared according to the European Standard EN 14780 "Solid Biofuels - Methods for sample preparation", which consists of homogenization, dividing, milling and drying processes. In order to determine most of analytical parameters, European or their corresponding International standards for solid biofuels were used by all laboratories: BIOS, CBE, CERTH and CIEMAT.
The following table 5.1 shows the general analytical methods mentioned in the European standards or International standards of solid biofuels.

Table 4.1 Analytical methods and standards used in the laboratories

Property		**Analytical method**	**Standard**
Bulk density		Mass of a known volume	ISO 17828:2015
Particle size distribution		Separation into defined size fractions (sieves)	ISO 17827-1:2016, ISO 17827-2:2016
Mechanical durability of pellets		Pellet tester	ISO 17831-1:2015
Length and diameter of pellets		Caliper	ISO 17829:2015
Proximate analysis	Moisture	Drying at 105 ^{o}C	ISO 18134-2:2017
	Ash	Ashing at 550 ^{o}C	ISO 18122:2015
	Volatile matter	Heating at 900 ^{o}C	ISO 18123:2015
Ultimate analysis	Carbon, Hydrogen, Nitrogen	Elemental analyser equipped with infrared detectors and/or thermal conductivity detectors	ISO 16948:2015
	Sulphur and chlorine	Ion chromatography after sample combustion	ISO 16994:2016
Calorific value		Automatic calorimeter	ISO 18125:2017
Major elements		Digestion in a microwave furnace and analysis by ICP-AES, ICP-MS and GFAA	ISO 16967:2015
Minor elements		Digestion in a microwave furnace and analysis by ICP-MS, ICP-AES and GFAA. Thermal decomposition/gold amalgamation/absoprtion spectrophotometry for Hg	ISO 16968:2015
Fusibility test		Heating and image analysis	CEN/TS 15370-1:2006
Oil		Soxhlet extraction with n-hexane	EEC 2568/91
Skin		Manual sorting	ISO 658:2002

The skin content of olive stone samples was determined following ISO standards from seed committees. Concretely, the standard followed ISO 658 was prepared by the Technical Committee ISO/TC34 (Food products, Subcommittee SC 2, Oleaginous seeds and fruits and oilseed meals), but not from solid biofuels committees as CEN/TC 335 or ISO/TC 238.

Oil content of olive stones and shells was determined by the method published in the Official Journal of the European Communities, Commission Regulation (EEC) No. 2568/91 of 11 July 1991 on the characteristics of olive oil and olive-residue oil and on the relevant methods of analysis.

Ash melting behavior determination was made by optical microscopy method according to CEN/TS 15370-1 pre-standard.

In order to obtain additional information on the ash sintering tendency of the collected samples, two methods developed by CIEMAT were utilized in addition to the cited pre-standard. The first of them is a qualitative a method called the “disintegration method”; the second one (so called “sieving method”) is an extension of the first one to obtain quantified results.

Both tests were carried out by heating the biomass ashes previously produced at 550º C, in a laboratory furnace at different temperatures, e. g. 800º C, 1000º C, 1200 ºC and 1400º C. In this test loose ash was added to porcelain capsules, 0.3 g ash/capsule, that were rapidly heated at the established temperatures (one capsule per temperature) in air atmosphere.

Then, the alterations produced in the resultant ashes were observed such as the changes in the visual aspect and the easiness of manual ash disintegration (disintegration method).
Four levels of difficulty were established:
Level 1: very easy disintegration of the ash, which corresponds to dust
Level 2: easy disintegration of the ash, which corresponds to weak agglomerates or sinters
Level 3: difficult disintegration of the ash, which corresponds to hard sinters
Level 4: very difficult” disintegration of the ash, which corresponds to hard sinters or slags

The second method utilized “sieving method”, is based on the measure of the resistance of ash towards friction and/or disintegration. At the end of each heating temperature as described before, the ash obtained was placed in a small sieve (6 cm diameter) with a sieve aperture of 0.5 mm. The sieving process lasted 5 minutes and the level of vibration was fixed at a 5 power level by using a CISA device, model RP 15 with digital regulation from 5 to 15 power level. After sieving the following index was calculated:

Tendency to slag formation (TSF) = mass of sample remaining on the sieve / initial mass * 100

By considering the data obtained by both methods in other studies (results not shown) and with the aim of comparing the sieving results with the disintegration results, the following four levels are established:

Disintegration method	TSF
(1) dust-very easy disintegration:	< 50%
(2) weak sintered-easy disintegration:	50-80%
(3) hard sintered-difficult disintegration:	80-95%
(4) sintered or slag-very difficult disintegration:	> 95%

Finally, a theoretical method consisting on one ash composition ratio was considered as an alternative to predict the sintering behavior of the samples. The ratio (R), developed by CIEMAT [1] is:
$R = (CaO + MgO) / (K_2O + Na_2O)$
In general, it can be said that biomasses with R values higher than 2 should not present significant risk of sintering at the studied temperature interval.

For the statistical treatment of analytical results, means, standard deviations (S) and coefficient of variations (C.V.) have been calculated for every considered quality property. Box and whisker plots show the median and data dispersion.

5. ANALYTICAL RESULTS OF COLLECTED SAMPLES

In this section, the analytical results of the different selected biomasses/biofuels are compared in regard to fuel quality parameters. The reasons for significant deviations of analytical values of a determinate biofuel/biomass are discussed in a preliminary way that will be further investigated in Task 3.3.

Annex II show the analytical results for the biofuels considered depending on the country where samples were collected.

Bulk density

Bulk density has not been determined for olive tree and vineyard prunings because the sample preparation for these biofuels did not follow any industrial process (samples were collected manually on the field), and therefore results would not be representative of a real situation.

Bulk density results of the studied industrial biomasses and pellets are depicted in Table 5.1 and Figure 5.1. It is noteworthy that bulk densities of olive stones and some fruit shells, as pine nut shells (PNS), reach relatively high values (Figure 5.1) where the olive stone bulk density mean value is even higher than the one for OTP pellets (Table 5.1). With the exception of almond shells, it could be said that, given the same biofuel, the dispersion of the results obtained for bulk density is generally small, lying within narrow ranges (Figure 5.1).

Table 5.1. Mean, standard deviation (S), coefficient of variation (C.V.) and number of samples analyzed (n) for the bulk density of the biofuels considered.

	Bulk density (as received)			
Biofuel	**mean** (kg/m^3)	**S** (kg/m^3)	**CV** (%)	**n**
AS	410	90	23	16
HS	330	40	12	25
OS	730	60	8.1	27
OTP pellets	550	n.a.	n.a.	2
PNS	530	20	4.2	10
PS	320	20	5.0	19
VP pellets	710	10	0.8	5
WS	240	30	14	20

n.a. not applicable

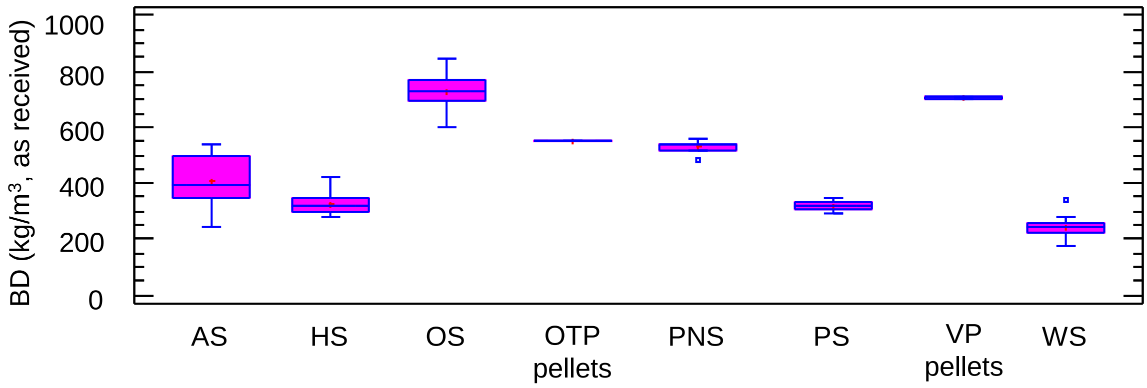


Figure 5.1.Box and whisker plots for the bulk density of the biofuels considered

Particle size

As in the case of bulk density and for the same reason, the study of this parameter was not considered for vineyard and olive tree prunings.

Accumulated particle sizes of the biofuels studied and retained on sieves with holes of 16 mm, 2 mm and 1 mm are shown in Table 5.2 and Figure 5.2, Table 5.3 and Figure 5.3 and Table 5.4 and Figure 5.4, respectively. As can be seen, results indicate that all biofuels pose an important proportion of particles below 2mm, which in the case of olive stones averages about 30%.

The particle size distribution of these biofuels is determined by the milling processing of fruits for oil and grain extraction, which, at the same time, influences the content of fines (fraction below 2mm) of the resulting product. The content of fines is limited for these biofuels in their corresponding standards and it can be reduced by applying an appropriate treatment (e.g. biomass screening).

Table 5.2. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the accumulated percentage of particles with size above 16 mm (as received) for the different biofuels considered.

Particle size above 16 mm				
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	35	31	87	25
HS	6.5	11	170	5
OS	0.00	<0.01	<0.01	41
PNS	0.06	0.14	260	12
PS	1.5	2.2	150	13
WS	72	23	32	12

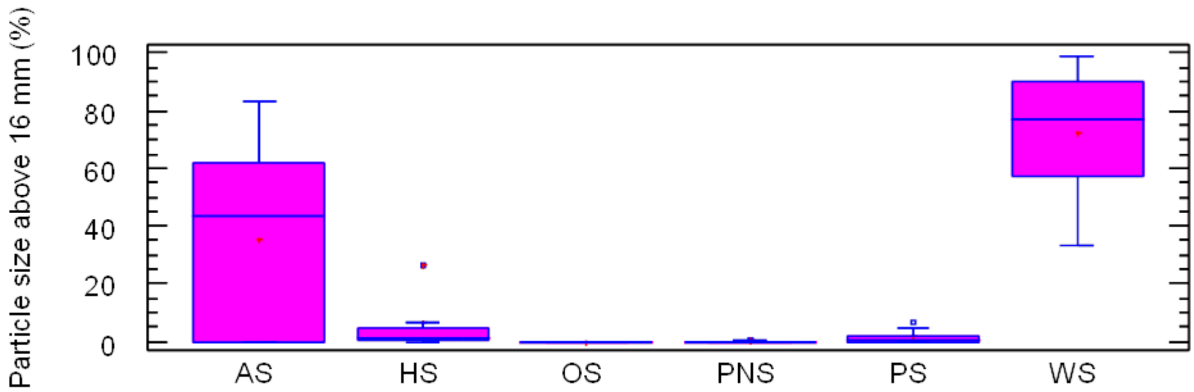


Figure 5.2 Box and whisker plots for the accumulated percentage of particles with size above 16 mm (as received) for the different biofuels considered.

Table 5.3. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the accumulated percentage of particles with size above 2 mm (as received) for the different biofuels considered.

	Particle size above 2 mm			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	94	12	13	25
HS	98	1.6	1.6	5
OS	71	15	22	41
PNS	99	0.67	0.68	12
PS	100	0.50	0.50	13
WS	100	0.34	0.34	12

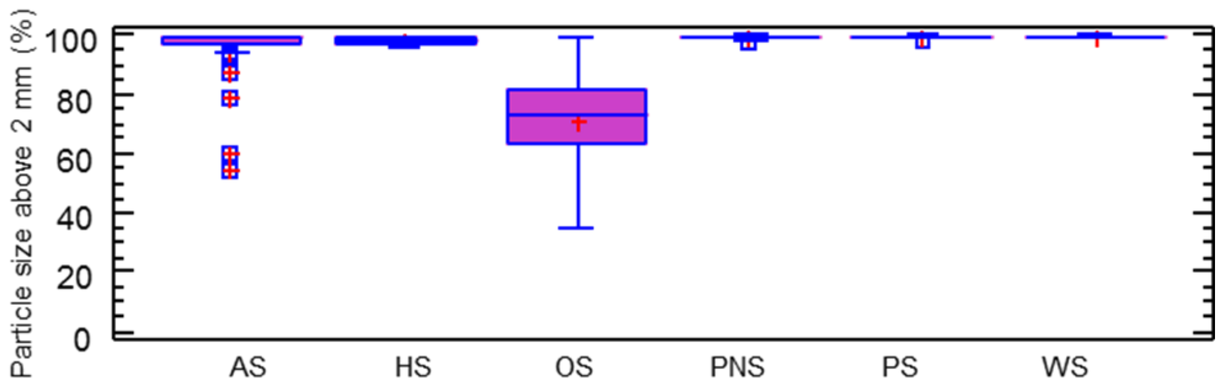


Figure 5.3. Box and whisker plots for the accumulated percentage of particles with size above 2 mm (as received) for the different biofuels considered.

Table 5.4. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the accumulated percentage of particles with size above 1 mm (as received) for the different biofuels considered.

	Particle size above 1 mm			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	98	3.6	3.6	25
HS	99	0.77	0.77	5
OS	98	4.5	4.6	41
PNS	100	0.17	0.17	12
PS	100	0.20	0.20	13
WS	100	0.20	0.20	12

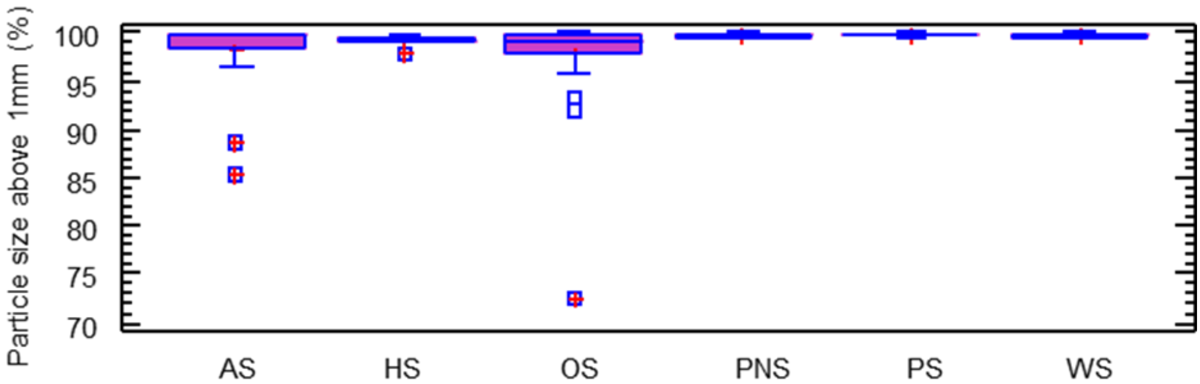


Figure 5.4 Box and whisker plots for the accumulated percentage of particles with size above 1 mm (as received) for the different biofuels considered.

Moisture

Although this parameter was obviously determined for all samples, an analysis of the results is not included in this section due to the fact that moisture content largely depends on sample collection, storage and transport conditions to laboratory, which was not made by following a standardized procedure.

Ash

As can be seen in Table 5.5 and Figure 5.5, the ash content of agricultural residues collected on field (OTP, VP), were higher than the ones observed for agroindustrial biomasses (OS and dry fruit shells). It is important to take into account that the values given in the cited Table and Figure should be considered next to the ash contents that can be naturally expected in this type of biomass (see section 3 and Annex II for sampling details).

Moreover, given the above fact, it can be hypothesized that the observed differences of ash content can mostly be associated to the fraction of leaves and bark that compose the pruning samples. These biomasses are mainly formed by twigs and small branches that contain an undefined and variable fraction of leaves, which increases ash levels. Twigs are also known to have higher ash contents than coarse branches because of their higher bark to wood ratio.

Table 5.5. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the ash content of the biofuels considered

	Ash (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	1.6	0.63	39	25
HS	1.2	0.18	15	25
OS	1.2	1.3	104	48
OTP	4.2	1.1	26	74
OTP pellets	3.4	n.a.	n.a.	2
PNS	1.6	0.29	18	14
PS	0.7	0.75	110	19
VP	3.4	0.49	14	112
VP pellets	4.5	0.16	4	6
WS	1.2	0.27	22	22

n.a.: not applicable

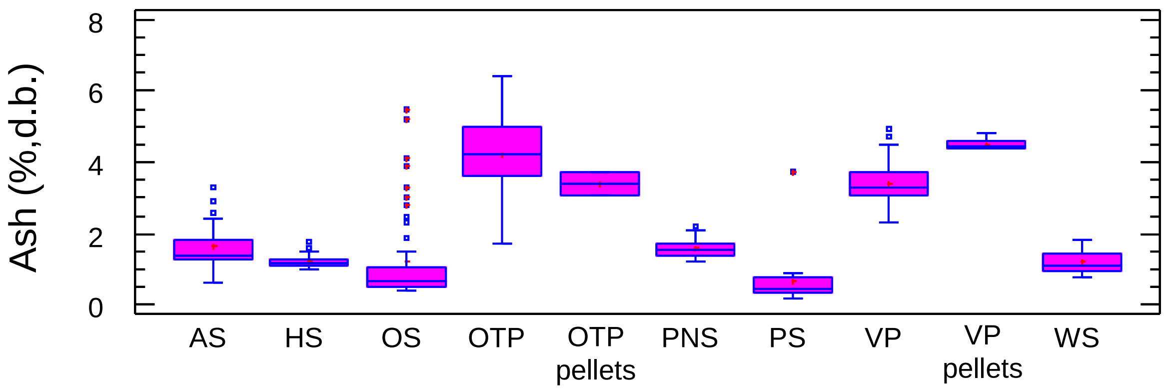


Figure 5.5. Box and whisker plots for the ash content of the biofuels considered

Oil

As can be seen in Table 5.6, mean oil content of studied dry fruit shells varied between 0.61% of pine nut shells to 4.4% of walnut shells, with very large deviations with respect to their average values.

Walnut shells observed the largest dispersion of results (Figure 5.6). The cited variations could be associated to the presence of a variable amount of oil rich fractions (fruit grain) accompanying shells, which depends on the procedure followed to clean the shell during fruit processing. The last hypothesis is supported by the results of the visual inspection of samples that was performed in the laboratory before analysis. This fact will be further investigated in Task 3.3.

The samples of olive stones present a mean oil content that according to information available is well exceeding the typical mean values for this biofuel in some countries like Spain. The reason for this fact might be found in the efficiency of the industrial process to separate olive stones from pulp and in general oil rich fractions of the fruit, which in general is lower if the olive stone is for industrial use in comparison to domestic use. As this matter is relevant to eventually set new oil limits in a revised standard, further research of this issue will be made in Task 3.3.

Finally, it is also worth mentioning the large variability and number of outliers found for oil content. In case of shells and stones, it could be possibly associated to the type of process (manual/mechanized) followed to separate shells from grains. Further investigation will be made in Task 3.3.

Table 5.6. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples (n) for the oil content of the biofuels considered

	Oil (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	2.0	1.2	59	24
HS	1.3	1.7	130	15
OS	1.9	2.8	140	46
PNS	0.61	0.37	61	14
PS	1.4	1.3	95	19
WS	4.4	3.8	87	22

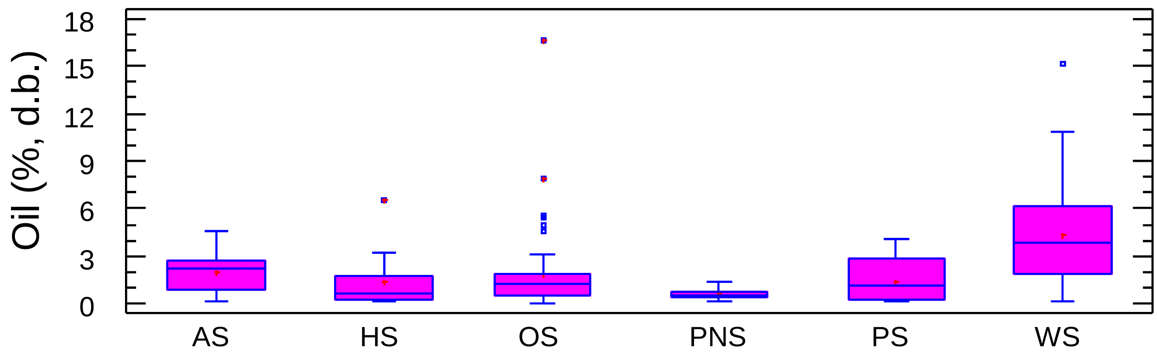


Figure 5.6. Box and whisker plots for the oil content of the biofuels considered

Skin

The content of skin is limited in the Spanish UNE standard for olive stones. In this project, the skin content was only determined in the olive stones coming from Italy and Spain only. Results are shown and discussed in section 6.

Volatiles, carbon, hydrogen and calorific value

Table 5.7 and Figure 7.7, Table 5.8 and Figure 5.8, Table 5.9 and Figure 5.9 and Table 5.10 and Figure 5.10, respectively, show the volatiles, carbon, and hydrogen contents and the calorific value of the studied biomasses.

As can be seen in Table 5.10 and Figure 5.10, olive stones and fruit shells generally present higher mean net calorific values and related carbon contents (Table 5.8 and Figure 5.8) than prunings and pellets. The known more elevated lignin contents of olive stones and some dry fruit shells in comparison with woody biomass could explain this fact, as lignin exhibits higher calorific values than cellulose. The oil contained in dry fruit shells and stones could also contribute to increase the calorific values of these biofuels. Moreover, the higher ash contents of prunings and pellets of prunings lead to somewhat lower C contents and consequently lower calorific values.

Hydrogen contents generally lie within the expected values for biomass and at relatively narrow ranges (Table 5.9 and Figure 5.9). Further investigation will be made in Task 3.3 regarding the high values of H found for some samples (one AS sample reached a H content of almost 9 %).

Table 5.7. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the volatile matter of the biofuels considered

	Volatile matter (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	79.2	1.9	2.4	25
HS	76.4	1.2	1.5	5
OS	79.5	3.1	3.9	41
OTP	80.4	1.6	1.9	54
OTP pellets	79.8	n.a.	n.a.	2
PNS	77.5	1.5	2.0	14
PS	84.1	2.3	2.7	13
VP	77.5	1.0	1.3	84
VP pellets	76.9	0.75	1.0	6
WS	78.9	2.0	2.5	12

n.a.: not applicable

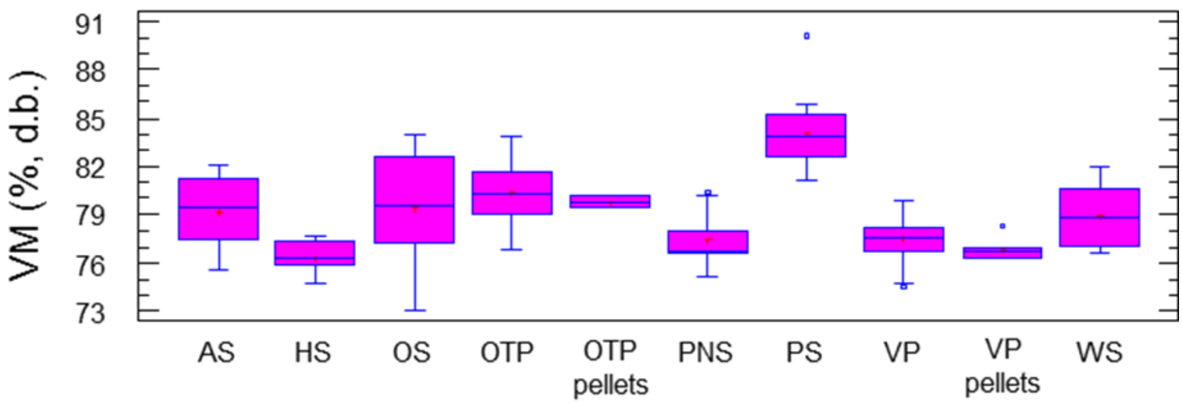


Figure 5.7. Box and whisker plots for the volatile matter of the biofuels considered

Table 5.8. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the carbon content of the biofuels considered

	Carbon (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	49.6	1.1	2.2	25
HS	52.1	0.50	1.0	25
OS	51.0	0.68	1.3	48
OTP	49.4	0.96	2.0	74
OTP pellets	48.2	n.a.	n.a.	2
PNS	51.3	1.2	2.3	14
PS	48.6	0.97	2.0	19
VP	48.2	0.77	1.6	112
VP pellets	48.7	0.47	1.0	6
WS	51.9	1.4	2.7	22

n.a.: not applicable

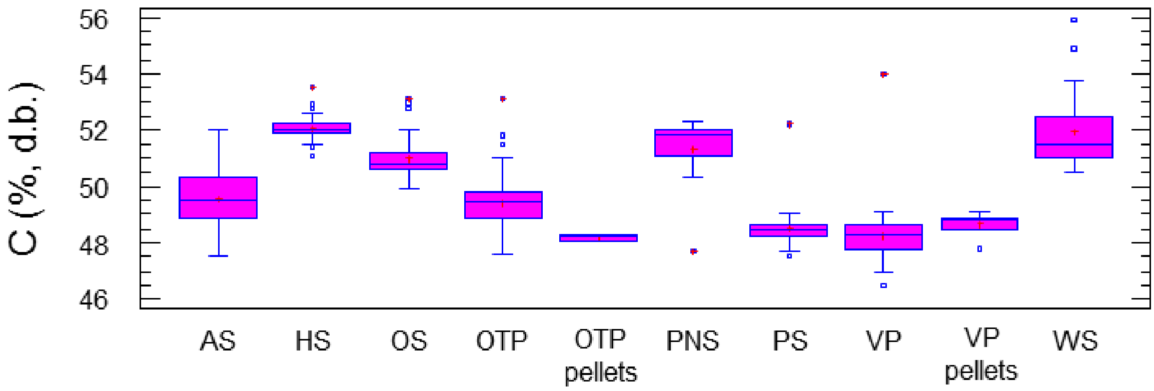


Figure 5.8. Box and whisker plots for the carbon content of the biofuels considered

Table 5.9. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the hydrogen content of the biofuels considered

	Hydrogen (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	6.4	0.68	11	25
HS	5.7	0.21	3.6	25
OS	6.5	0.59	9.2	48
OTP	6.4	0.42	6.6	74
OTP pellets	6.1	n.a.	n.a.	2
PNS	6.1	0.09	1.5	14
PS	6.3	0.43	6.9	19
VP	6.0	0.34	5.7	112
VP pellets	5.8	0.11	1.9	6
WS	6.3	0.63	10	22

n.a.: not applicable

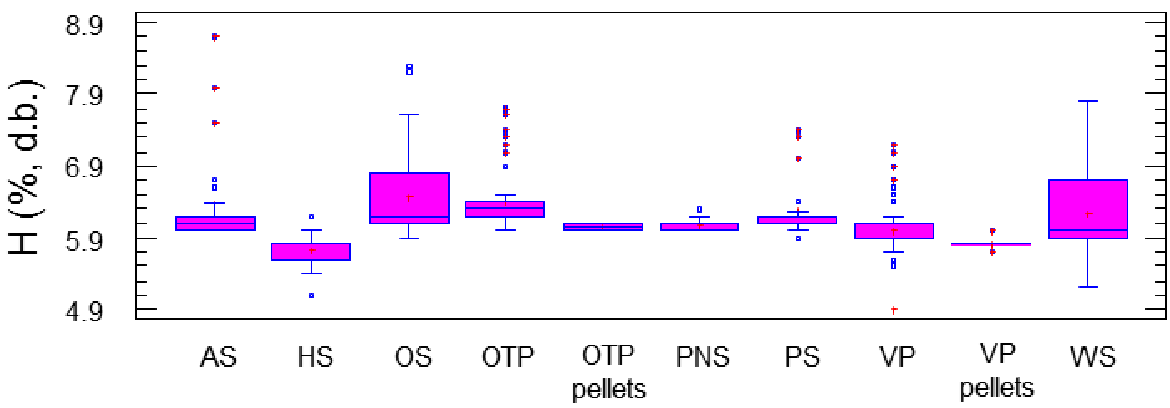


Figure 5.9. Box and whisker plots for the hydrogen content of the biofuels considered

Table 5.10. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (dry basis) of the biofuels considered.

	NCVo (d.b.)			
Biofuel	**mean** (MJ/kg)	**S** (MJ/kg)	**CV** (%)	**n**
AS	18.33	0.34	1.9	25
HS	19.19	0.30	1.6	25
OS	18.96	0.50	2.7	48
OTP	18.44	0.42	2.3	74
OTP pellets	17.95	n.a.	n.a.	2
PNS	19.32	0.13	0.7	14
PS	17.76	0.26	1.5	19
VP	17.60	0.34	1.9	112
VP pellets	17.74	0.28	1.6	6
WS	19.43	0.97	5.0	22

n.a.: not applicable

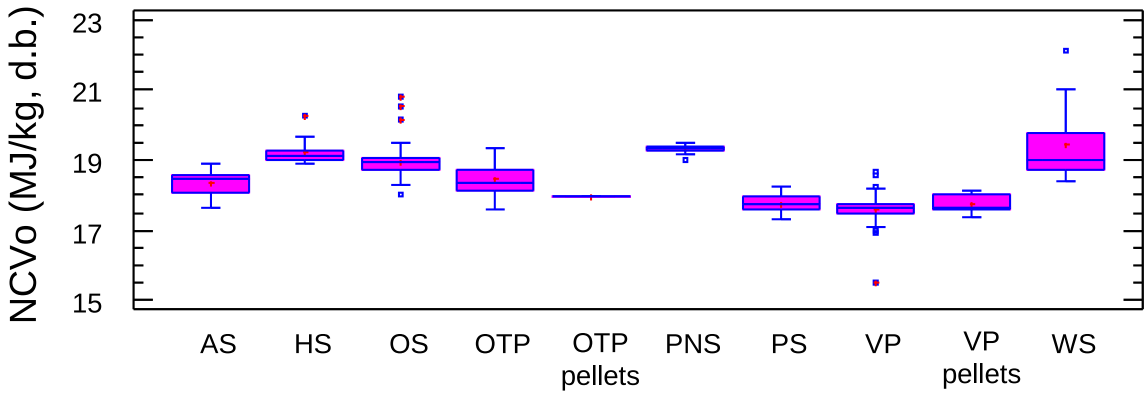


Figure 5.10. Box and whisker plots for the net calorific value at constant pressure (dry basis) of the biofuels considered

Nitrogen

Results regarding the nitrogen content of the analyzed samples are depicted in Table 5.11 and Figure 5.11.

The most remarkable comment is that, as can be seen in the cited Table and Figure, the nitrogen content of fruit shells is generally smaller than of prunings and their derived pellets. This can be expected due to, as cited in last section, the more lignin-rich structure of shells and the presence of nitrogenated fractions in prunings associated to the physiology of the tissues integrating these biomasses. The presence of leaves in pruning samples could also increase the N levels of these samples.

Table 5.11. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nitrogen content of the biofuels considered

	Nitrogen (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	0.36	0.23	64	25
HS	0.28	0.06	22	25
OS	0.30	0.30	100	48
OTP	0.93	0.33	35	74
OTP pellets	0.45	n.a.	n.a.	2
PNS	0.27	0.04	14	14
PS	0.27	0.24	88	19
VP	0.74	0.23	31	112
VP pellets	0.81	0.06	7.2	6
WS	0.45	0.31	69	22

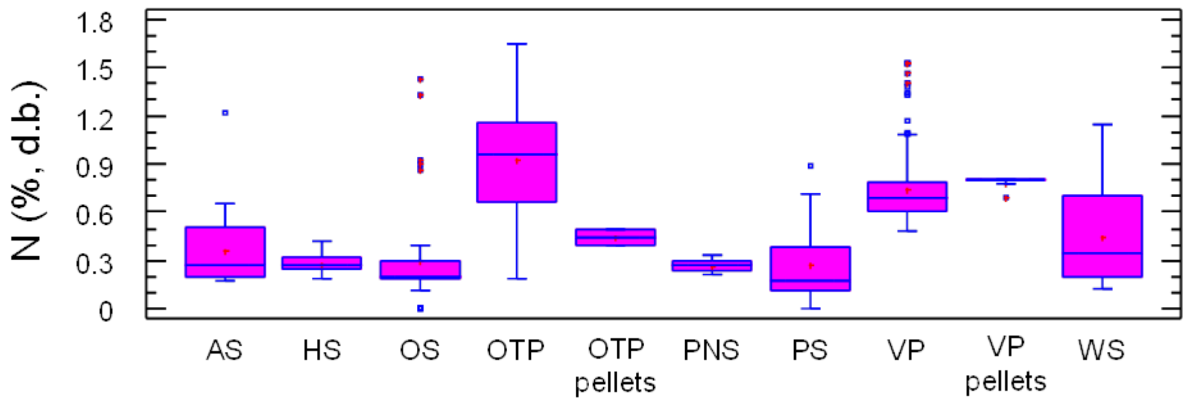


Figure 5.11. Box and whisker plots for the nitrogen content of the biofuels considered

Chlorine

With the exception of olive stones, the selected biofuels are characterized by relatively low chlorine contents (Table 5.12 and Figure 5.12).

The elevated chlorine contents noticed in olive stones were associated to the presence of an outstanding number of outliers (see Figure 5.13), mainly from Turkey and Greece which contributed to raise mean chlorine levels and enlarge the variability associated to this property. Cl-rich samples also exhibited extremely high contents of sodium, which seems to indicate that they come from table olives or the presence of a higher share of olive flesh. The inclusion of these samples in the analysis that will be performed in Task 3.3 is subjected to further investigation.

Table 5.12. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the chlorine content of the biofuels considered

	Chlorine (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	0.02	0.012	70	25
HS	0.02	0.008	48	25
OS	0.10	0.23	230	48
OTP	0.04	0.019	52	74
OTP pellets	0.04	n.a.	n.a.	2
PNS	0.03	0.029	100	14
PS	0.02	0.013	79	19
VP	0.02	0.024	96	112
VP pellets	0.02	<0.001	<0.001	6
WS	0.04	0.028	78	22

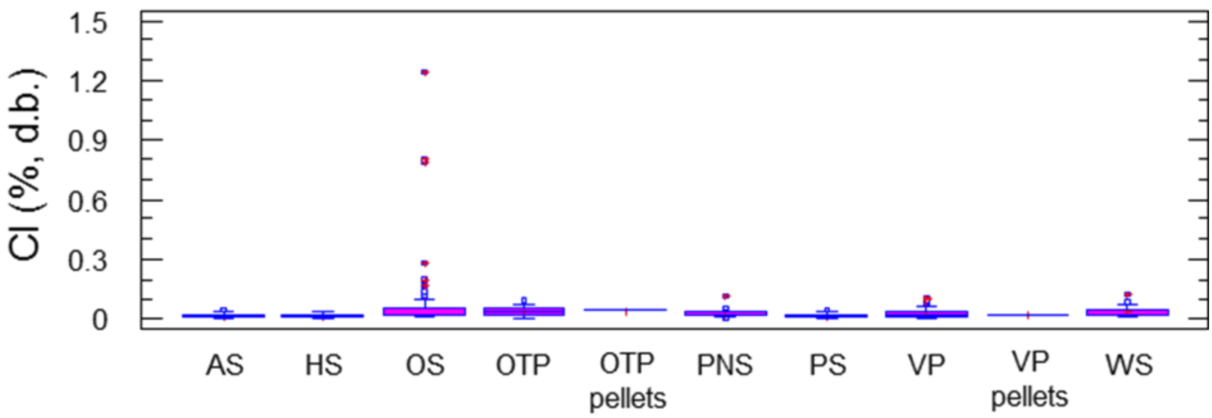


Figure 5.12 Box and whisker plots for the chlorine content of the biofuels considered

Sulfur

As can be seen in Table 5.13 and similarly to chlorine, the studied biomasses showed in general low contents of sulfur, comparable to woody biomasses. The possible causes explaining the number of upper outliers in olive stones (Figure 5.13) will be further investigated in Task 3.3. The higher (upper whisker) values shown for both types of prunings could be related to the use of sulphur as fungicide in the crops.

Table 5.13. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sulfur content of the biofuels considered

	Sulfur (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	0.01	0.007	49	25
HS	0.03	0.005	20	20
OS	0.02	0.021	90	48
OTP	0.08	0.030	40	74
OTP pellets	0.05	n.a.	n.a.	2
PNS	0.03	0.007	25	14
PS	0.02	0.012	53	15
VP	0.05	0.017	33	112
VP pellets	0.07	0.004	6.0	6
WS	0.02	0.013	55	22

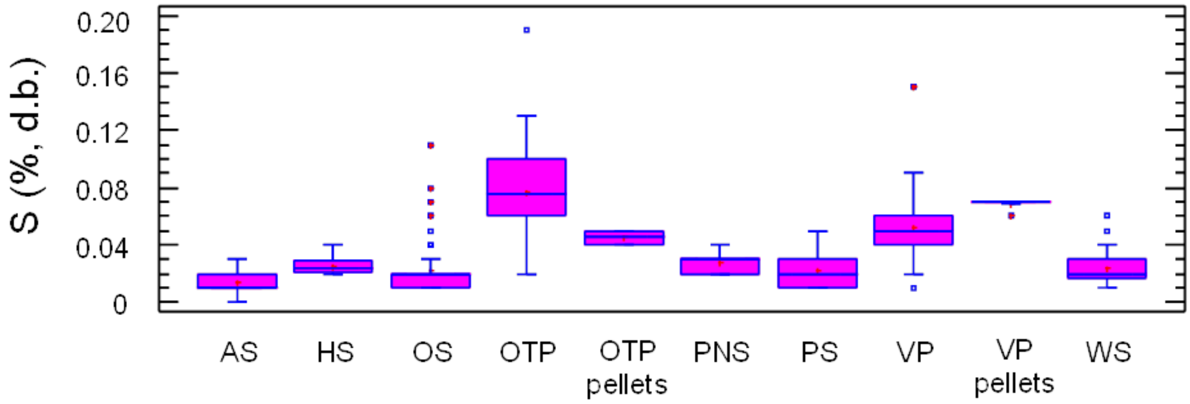


Figure 5.13. Box and whisker plots for the sulfur content of the biofuels considered

Ash forming elements

As can be seen in the following Tables (Tables 5.14 to 5.20) and Figures (Figures 5.14 to 5.20), the content of ash forming elements such as Ca, K, Mg and Al are generally higher in olive tree and vineyard prunings and their corresponding pellets than in olive stones and fruit shells. An important number of outliers are detected for the content of all elements, what should need to be analyzed in Task 3.3. It should also be highlighted the high Si contents (mean 0.44%) found for pine nut shells (Table 5.17 and Figure 5.17).

As it was previously mentioned, some samples of olive stones (and vineyard prunings) showed remarkable Na contents (Figure 5.16), which could be associated to the use of the fruits as table olives or the presence of a higher fruit flesh fraction in the biofuel. No plausible explanation was found for vineyard prunings, which will be examined in more detail in Task 3.3.

It is also worth mentioning the elevated contents of iron in the pellet samples of vineyard and olive tree prunings (Table 5.20 and Figure 5.20). Although further investigation is needed on this matter, which will be made in Task 3.3., the inclusion of metallic particles from the machinery during the production of the pellets would be a plausible explanation.

Table 5.14. Mean, standard deviation (S), coefficient of variation (C.V.), number of samples analyzed (n) for the calcium content of the biofuels considered

	Calcium (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	0.13	0.042	32	25
HS	0.18	0.048	26	25
OS	0.13	0.11	87	48
OTP	0.90	0.44	49	66
OTP pellets	0.92	n.a.	n.a.	2
PNS	0.04	0.029	71	12
PS	0.05	0.028	51	19
VP	0.58	0.23	40	102
VP pellets	1.0	0.075	7.4	6
WS	0.21	0.07	32	22

n.a.: not applicable

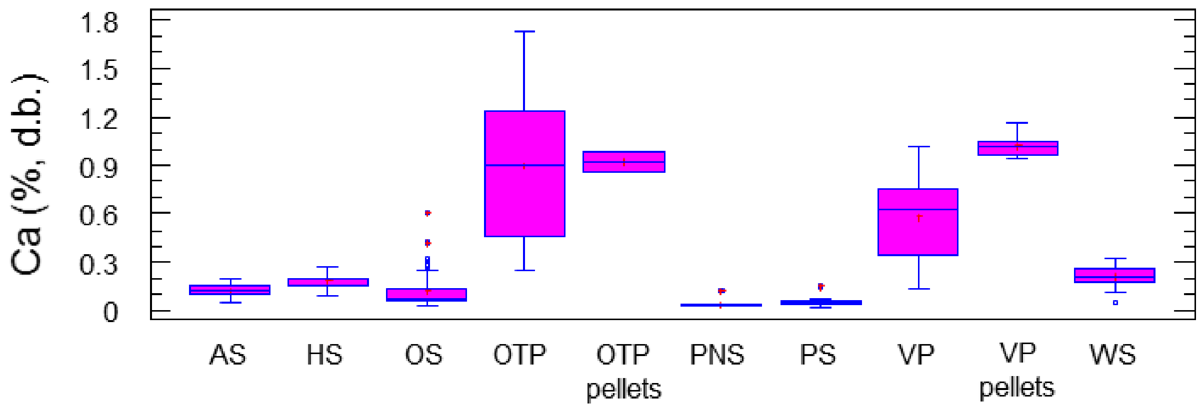


Figure 5.14. Box and whisker plots for the calcium content of the biofuels considered

Table 5.15. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the potassium content of the biofuels considered

	Potassium (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	0.46	0.24	53	25
HS	0.28	0.049	17	25
OS	0.23	0.28	120	48
OTP	0.56	0.22	39	66
OTP pellets	0.36	n.a.	n.a.	2
PNS	0.14	0.050	35	12
PS	0.23	0.37	160	19
VP	0.51	0.18	34	102
VP pellets	0.54	0.063	12	6
WS	0.24	0.084	35	22

n.a.: not applicable

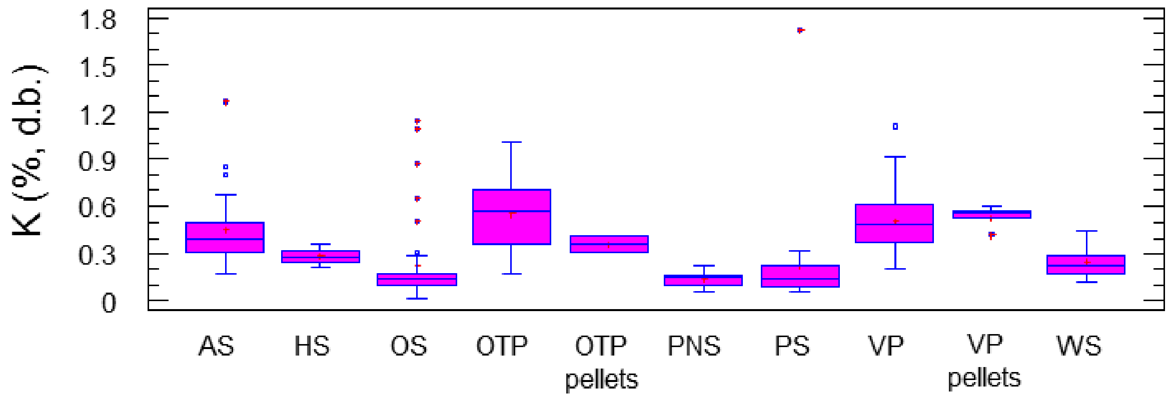


Figure 5.15. Box and whisker plots for the potassium content of the biofuels considered

Table 5.16. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the magnesium content of the biofuels considered

	Magnesium (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	0.030	0.021	69	25
HS	0.032	0.0047	15	25
OS	0.021	0.030	140	48
OTP	0.091	0.045	49	66
OTP pellets	0.058	n.a.	n.a.	2
PNS	0.043	0.0082	19	12
PS	0.015	0.0069	46	19
VP	0.14	0.039	28	102
VP pellets	0.18	0.015	8	6
WS	0.038	0.022	58	22

n.a.: not applicable

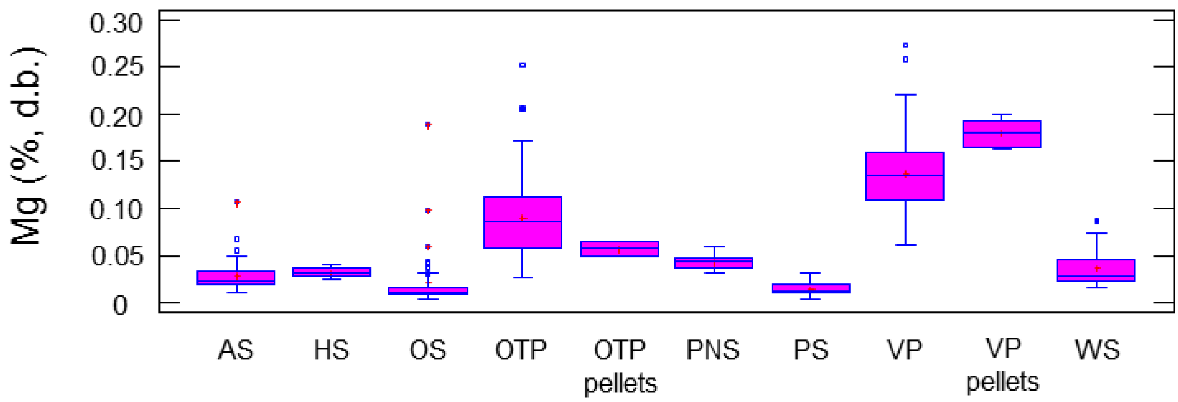


Figure 5.16. Box and whisker plots for the magnesium content of the biofuels considered

Table 5.17. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sodium content of the biofuels considered

Sodium (d.b.)				
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	0.025	0.037	150	25
HS	0.0020	0.0016	76	25
OS	0.062	0.189	310	48
OTP	0.046	0.063	140	66
OTP pellets	0.034	n.a.	n.a.	2
PNS	0.013	0.011	90	12
PS	0.0040	0.0050	120	19
VP	0.048	0.074	150	102
VP pellets	0.017	0.0026	15	6
WS	0.0033	0.0032	96	22

n.a.: not applicable

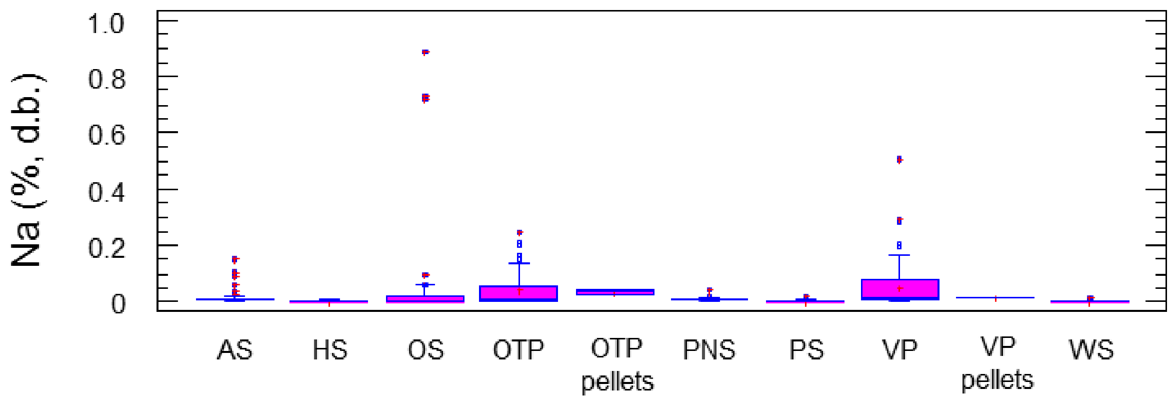


Figure 5.17. Box and whisker plots for the sodium content of the biofuels considered

Table 5.18. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the silicon content of the biofuels considered

Silicon (d.b.)				
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	0.063	0.066	100	25
HS	0.035	0.053	150	25
OS	0.091	0.18	200	48
OTP	0.21	0.22	110	66
OTP pellets	0.21	n.a.	n.a.	2
PNS	0.44	0.045	10	12
PS	0.013	0.017	140	19
VP	0.16	0.17	110	102
VP pellets	0.28	0.039	14	6
WS	0.020	0.028	140	22

n.a.: not applicable

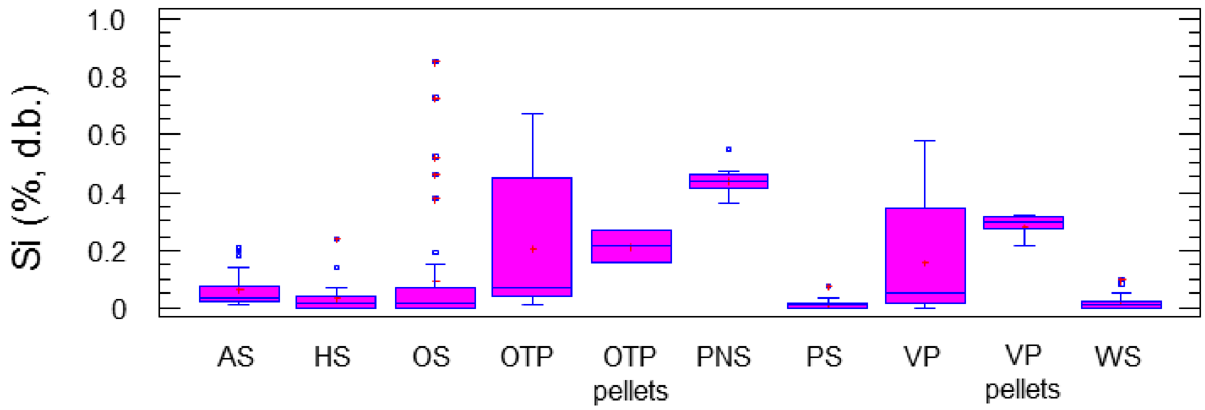


Figure 5.18. Box and whisker plots for the potassium content of the biofuels considered

Table 5.19. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the aluminium content of the biofuels considered

	Aluminium (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	0.011	0.016	150	25
HS	0.011	0.016	150	25
OS	0.019	0.039	200	48
OTP	0.039	0.036	92	66
OTP pellets	0.042	n.a.	n.a.	2
PNS	0.008	0.0053	70	12
PS	0.0032	0.0043	140	19
VP	0.031	0.039	130	102
VP pellets	0.060	0.0094	16	6
WS	0.008	0.010	130	22

n.a.: not applicable

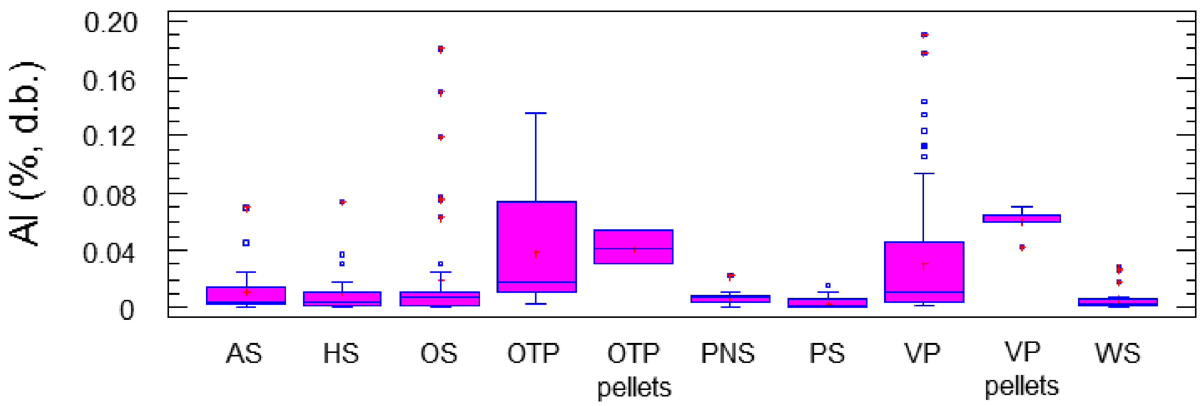


Figure 5.19. Box and whisker plots for the aluminium content of the biofuels considered

Table 5.20. Mean, standard deviation (S), coefficient of variation (C.V.), number of samples analyzed (n) for the iron content of the biofuels considered

	Iron (d.b.)			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	0.0046	0.0042	91	25
HS	0.0079	0.0094	120	25
OS	0.012	0.020	160	48
OTP	0.0094	0.0053	57	66
OTP pellets	0.030	n.a.	n.a.	2
PNS	0.0073	0.0051	70	12
PS	0.0030	0.0034	110	19
VP	0.0087	0.014	160	102
VP pellets	0.038	0.0075	20	6
WS	0.0048	0.0040	83	22

n.a.: not applicable

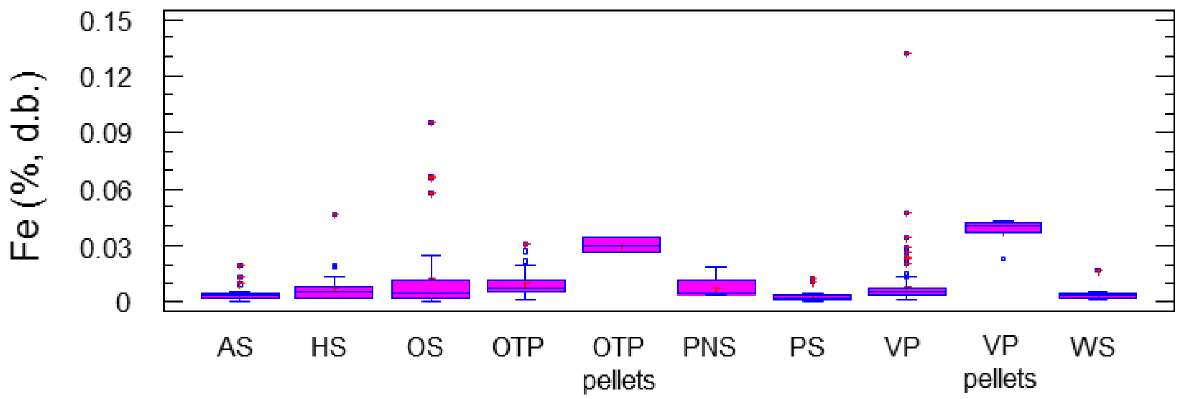


Figure 5.20. Box and whisker plots for the iron content of the biofuels considered

Trace elements

In general, it could be said that the contents of most trace elements in the analyzed samples are low, particularly for Cd, Cr, Hg, Ni and Pb. The content of these elements in a large number of samples was found to be even lower than the method quantification limits reported by the involved laboratories. This is the reason why a statistical treatment of the data is generally not possible and therefore, only the results for Cu and Zn are shown in this section.

The relatively high copper mean content observed for olive tree and vineyard prunings (Table 5.21 and Figure 5.21) could have its origin in the use of copper sulphate as pesticide in olive trees and vineyard plantations. The large variability observed in the content of this element (Figure 5.21) seem to support this hypothesis, given that the amount of metal that remains on the surface of the biomass depends of different factors, like the meteorological conditions and the time period since the last treatment was applied. Some vineyard pruning samples and their associated pellets exhibited high levels of Zn (Table 5.23 and Figure 5.22). Outliers found for the investigated properties will be further addressed in Task 3.3.

Table 5.21. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the copper content of the biofuels considered

	Copper (d.b.)			
Biofuel	**mean** (mg/kg)	**S** (mg/kg)	**CV** (%)	**n**
AS	3.3	2.7	81	25
HS	5.1	3.7	73	25
OS	4.2	3.6	84	48
OTP	20	20	99	69
OTP pellets	3.9	n.a.	n.a.	2
PNS	2.5	0.91	37	14
PS	13	22	160	19
VP	16	12	74	112
VP pellets	18	7.2	41	6
WS	7.0	8.3	120	22

n.a.: not applicable

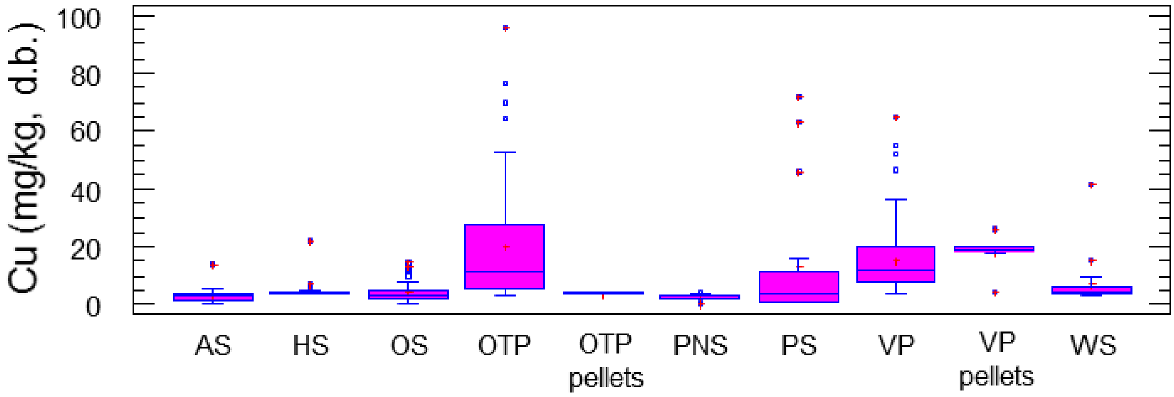


Figure 5.21. Box and whisker plots for the copper content of the biofuels considered

Table 5.22. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the zinc content of the biofuels considered.

	Zinc (d.b.)			
Biofuel	**mean** (mg/kg)	**S** (mg/kg)	**CV** (%)	**n**
AS	4.1	2.2	53	25
HS	5.3	4.1	78	25
OS	7.4	24	320	48
OTP	12	3.8	32	66
OTP pellets	3.7	n.a.	n.a.	2
PNS	8.0	2.9	36	14
PS	11	16	150	19
VP	37	35	94	112
VP pellets	46	15	33	6
WS	6.5	7.3	110	22

n.a.: not applicable

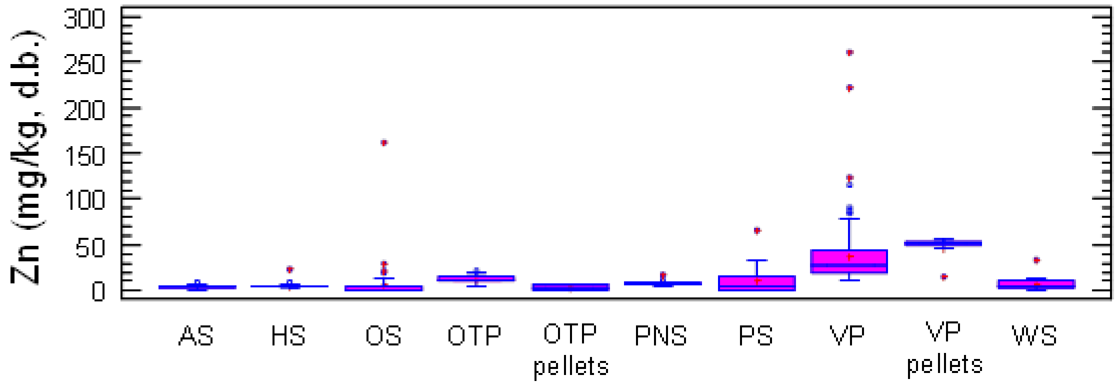


Figure 5.22. Box and whisker plots for the zinc content of the biofuels considered

Ash melting behaviour

Fusibility test was performed according to the technical specification CEN/TS 15370-1 on ash melting behavior. Table 5.23 and Figure 5.23, and Table 5.24 and Figure 5.24 show the results for shrinkage starting temperatures (SST) and deformation temperatures (DT), respectively. The rest of the involved temperatures, namely hemisphere (HT) and sphere temperatures (ST) were not detected in many cases and thus a statistical analysis for these parameters is not possible.

As can be seen in Table 5.23, SST averages 710-790 °C for all biofuels, excepting for VP pellets (1060 °C, but only two samples analyzed).

The dispersion is greater for DT (Table 5.24 and Figure 5.24), with mean values that vary between 820 °C and 1590 °C, offering two well differentiated groups: olive stones and dry fruit shells on the one hand, with DT ranging 820-1060 °C (with the exception of WS), and prunings, on the other, with DT varying from 1200-1590 °C. The different behaviour exhibited by walnut shells in comparison with the rest of dry fruit shells considered could be related to the higher alkaline-earth to alkaline oxides ratio exhibited by this biofuel. OTP and VP pellets show higher DT (1590 and 1380 °C, respectively) than their corresponding raw materials (1200-1210 °C) (see Table 5.24). It appears that troublesome fractions, such as thin branches and leaves, could be reduced, at least to some extent, during the logistic operations and pellet production process.

Table 5.23. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the shrinkage starting temperature (SST) of the biofuels considered

	SST			
Biofuel	**mean** (°C)	**S** (°C)	**CV** (%)	**n**
AS	720	60	7.7	21
HS	710	30	4.6	17
OS	720	90	13	41
OTP	780	130	17	60
OTP pellets	710	n.a.	n.a.	2
PNS	720	60	8.0	12
PS	700	130	19	15
VP	790	150	19	74
VP pellets	1060	n.a.	n.a.	2
WS	780	160	20	20

n.a.: not applicable

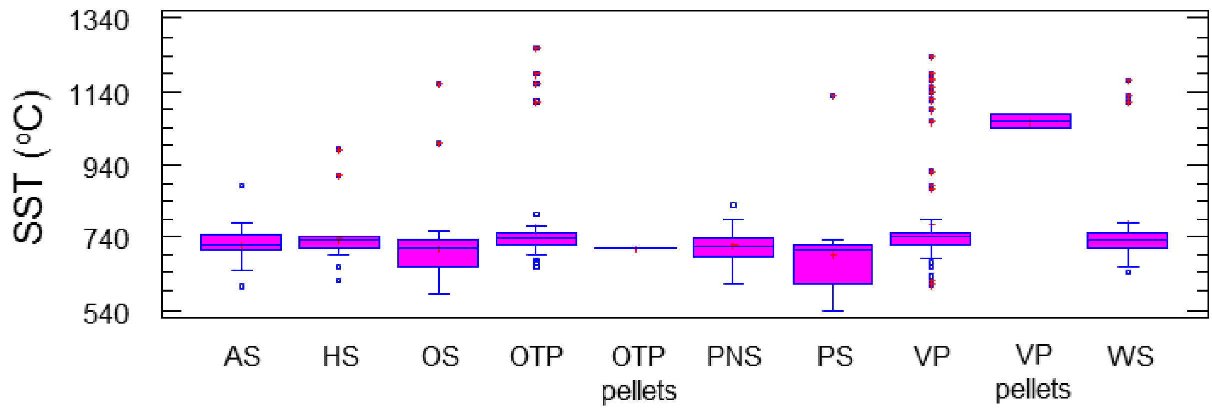


Figure 5.23. Box and whisker plots for the shrinkage starting temperature (SST) of the biofuels considered

Table 5.24. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the deformation temperature (DT) of the biofuels considered

	DT			
Biofuel	**mean** (°C)	**S** (°C)	**CV** (%)	**n**
AS	820	130	15	19
HS	1060	210	20	25
OS	1030	350	34	48
OTP	1210	260	21	69
OTP pellets	1590	n.a.	n.a.	2
PNS	940	80	8.5	12
PS	870	140	16	19
VP	1200	260	22	97
VP pellets	1380	n.a.	n.a.	2
WS	1220	250	20	22

n.a.: not applicable

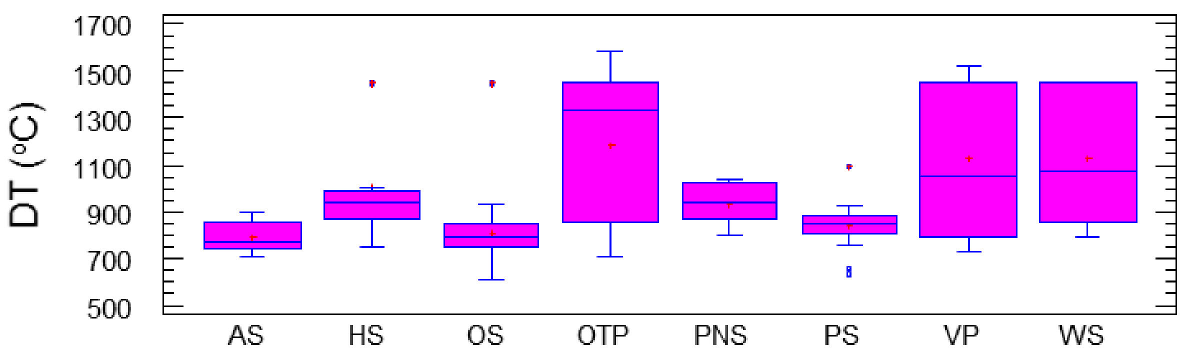


Figure 5.24. Box and whisker plots for the deformation temperature (DT) of the biofuels considered

The results of the ratio between alkaline earth oxides and alkaline oxides are plotted in figure 5.25. As can be seen, the results obtained are in general consistent with those described derived from the fusibility test, according to CEN/TS 15370-1. Prunings and their associated pellets, as well as walnut shells showed the best ash fusibility behavior (higher sintering ratios). However, only olive tree prunings and the studied pellets exhibited mean values that were able to surpass a sintering index of 2, which is, according to this predictive method, the minimum value that a biofuel should exceed to show a low sintering tendency.

Table 5.25. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sintering index of the biofuels considered (ratio between alkaline-earth oxides and alkaline oxides)

	Sintering index $(CaO+MgO)/(Na_2O+K_2O)$			
Biofuel	**mean**	**S**	**CV (%)**	**n**
AS	0.44	0.10	23	25
HS	1.0	0.36	37	25
OS	0.80	0.31	39	48
OTP	2.3	1.6	67	66
OTP pellets	2.9	n.a.	n.a.	2
PNS	0.75	0.31	41	12
PS	0.56	0.25	44	19
VP	1.8	0.94	53	102
VP pellets	2.6	0.29	11	6
WS	1.4	0.68	49	22

n.a.: not applicable

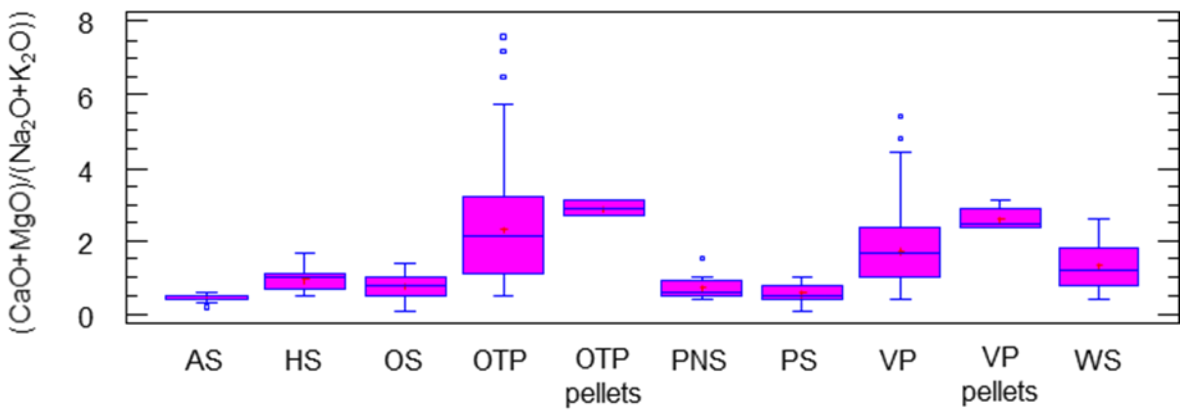


Figure 5.25. Box and whisker plots for the sintering index of the biofuels considered (ratio between alkaline-earth oxides and alkaline oxides)

The results for the disintegration and sieving methods are shown at temperatures of 800 °C (Tables and Figures 5.26-5.27), 1000°C (Tables and Figures 5.28-5.29), 1200°C (Tables and Figures 5.30-5.31) and 1400 °C (Tables and Figures 5.32-5.33). Both methods have shown good correlation between them at all temperatures. Among all the biofuels considered, these two in-house methods generally predict better fusibility behaviour for walnut shells, vineyard prunings and their associated raw materials. At the highest temperature tested, 1400 ^{o}C, the formation of hard sintered particles and slags was observed for all biofuels.

For some biofuels the results obtained from these two in-house methods are not fully consistent with those that can be derived from the fusibility test according to CEN/TS 15370-1 or the sintering index. However, they are generally in agreement with regard to the lowest sintering tendency exhibited by walnut shells and VP pellets.

Table 5.26. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the disintegration easiness at 800 ºC

	Disintegration easiness at 800 °C			
Biofuel	**mean**	**S**	**CV (%)**	**n**
AS	4	0.39	10	22
HS	3	1.1	36	15
OS	4	0.83	23	45
OTP	3	1.2	44	67
OTP pellets	4	n.a.	n.a.	2
PNS	2	1.1	62	14
PS	3	1.0	31	13
VP	2	1.3	55	101
VP pellets	1	0.41	35	6
WS	2	1.3	64	12

n.a.: not applicable

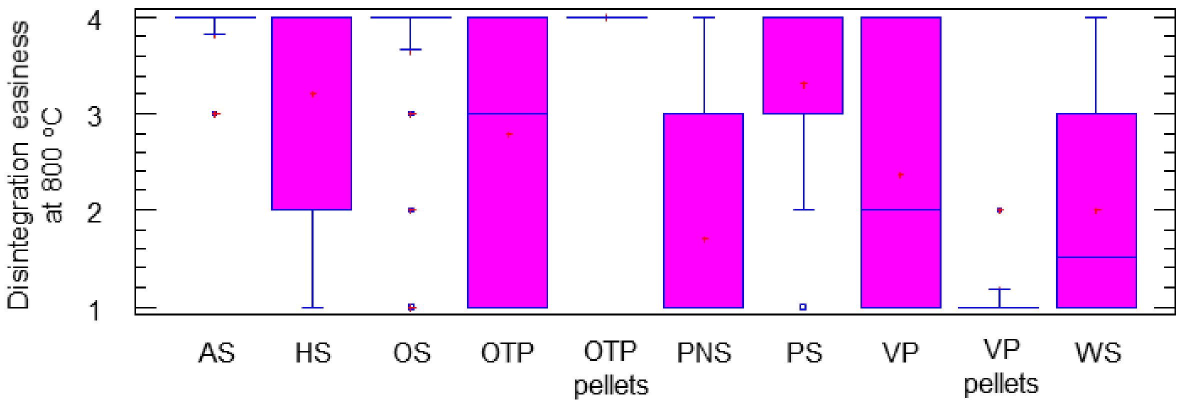


Figure 5.26. Box and whisker plots for the disintegration easiness at 800 ºC

Table 5.27. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the tendency of the considered biofuels to form slags at 800 °C, according to the sieving method. TSF: Tendency to slag formation, expressed in %.

	Sieving method, TSF at 800 °C			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	95	5.1	5.4	22
HS	88	19	21	15
OS	91	25	27	45
OTP	75	30.6	41	67
OTP pellets	95	n.a.	n.a.	2
PNS	61	30	49	14
PS	79	34	43	13
VP	64	35	55	101
VP pellets	31	27	87	6
WS	50	38	75	12

n.a.: not applicable

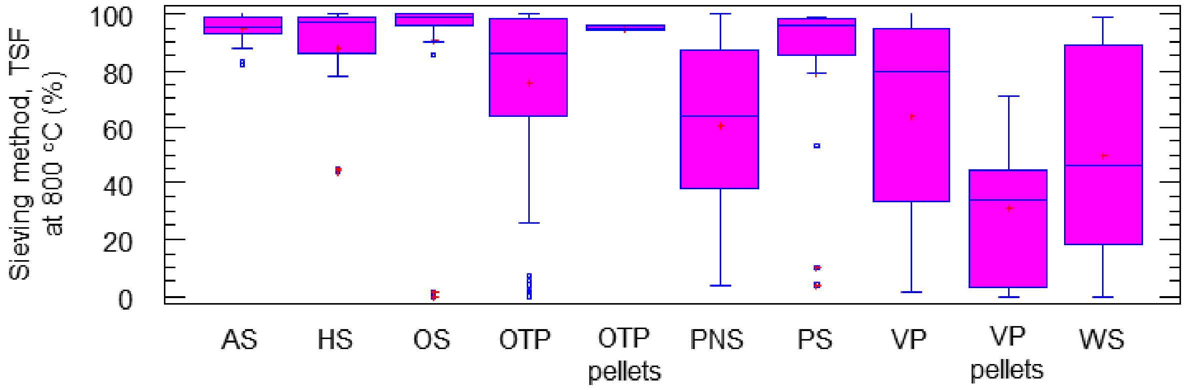


Figure 5.27. Box and whisker plots for the tendency of the considered biofuels to form slags at 800 °C, according to the sieving method. TSF: Tendency to slag formation, expressed in %.

Table 5.28. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the disintegration easiness at 1000 ºC

	Disintegration easiness at 1000 °C			
Biofuel	**mean**	**S**	**CV (%)**	**n**
AS	4	<0.1	<0.1	22
HS	4	0.52	13	15
OS	4	0.77	20	45
OTP	4	0.72	19	67
OTP pellets	4	n.a.	n.a.	2
PNS	4	<0.1	<0.1	14
PS	4	0.28	7.1	13
VP	4	0.82	23	101
VP pellets	3	0.82	31	6
WS	3	1.5	52	12

n.a.: not applicable

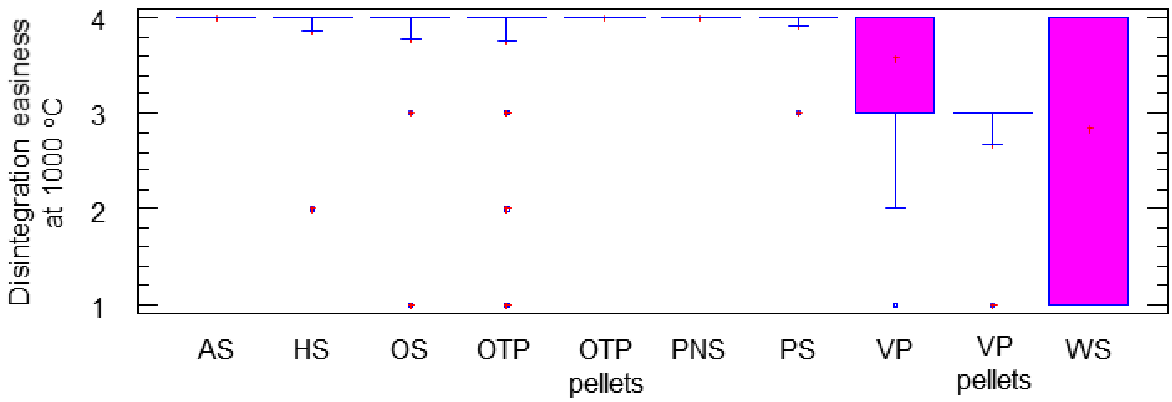


Figure 5.28 Box and whisker plots for the disintegration easiness at 1000 ºC

Table 5.29. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the tendency of the considered biofuels to form slags at 1000 °C, according to the sieving method. TSF: Tendency to slag formation, expressed in %.

Sieving method, TSF at 1000 °C				
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	100	<0.1	<0.1	22
HS	95	7.3	7.7	15
OS	94	15	16	45
OTP	94	15	16	67
OTP pellets	100	n.a.	n.a.	2
PNS	99	0.75	0.76	14
PS	97	4	4	13
VP	92	12	13	101
VP pellets	84	16	19	6
WS	74	36	49	12

n.a.: not applicable

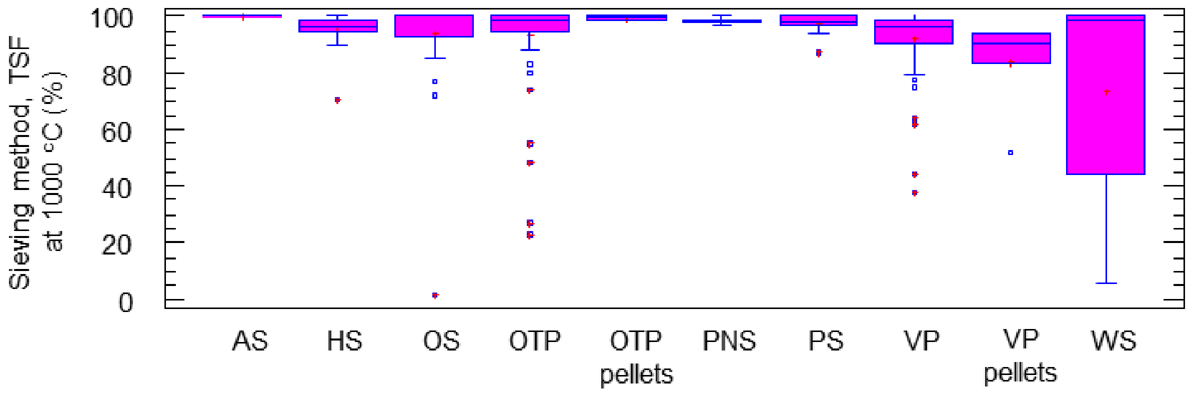


Figure 5.29. Box and whisker plots for the tendency of the considered biofuels to form slags at 1000 °C, according to the sieving method. TSF: Tendency to slag formation, expressed in %.

Table 5.30. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the disintegration easiness at 1200 ºC

Disintegration easiness at 1200 °C				
Biofuel	**mean**	**S**	**CV** (%)	**n**
AS	4	<0.1	<0.1	22
HS	4	0.52	13	15
OS	4	0.44	11	45
OTP	4	0.59	15	67
OTP pellets	4	n.a.	n.a.	2
PNS	4	<0.1	<0.1	14
PS	4	<0.1	<0.1	13
VP	4	0.64	17	101
VP pellets	3	0.98	35	6
WS	3	1.5	52	12

n.a.: not applicable

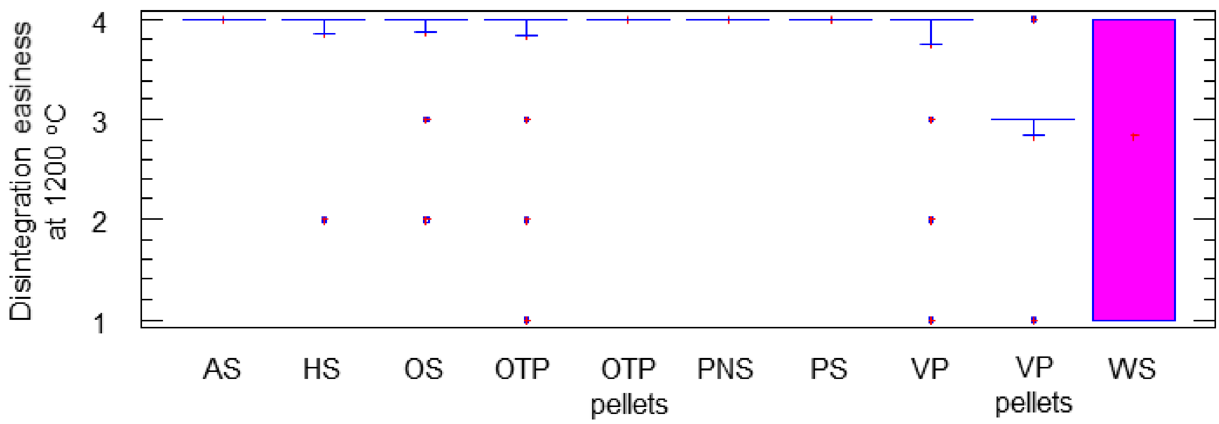


Figure 5.30. Box and whisker plots for the disintegration easiness at 1200 ºC

Table 5.31. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the tendency of the considered biofuels to form slags at 1200 °C, according to the sieving method. TSF: Tendency to slag formation, expressed in %.

	Sieving method, TSF at 1200 °C			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	100	<0.1	<0.1	22
HS	98	4.2	4.3	15
OS	96	7.4	7.7	45
OTP	96	9.1	9.5	67
OTP pellets	100	n.a.	n.a.	2
PNS	99	2.1	2.1	14
PS	98	2.4	2.5	13
VP	94	10	10	101
VP pellets	80	28	35	6
WS	73	36	49	12

n.a.: not applicable

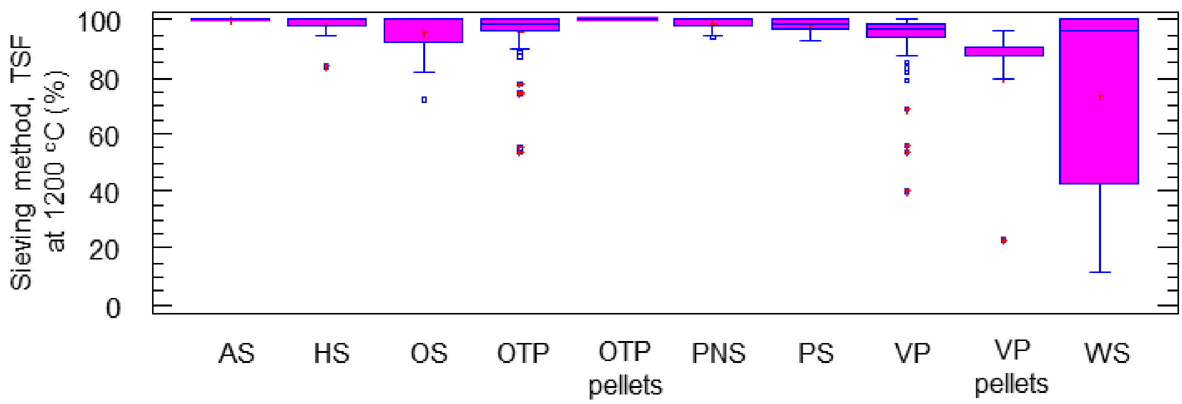


Figure 5.31 Box and whisker plots for the tendency of the considered biofuels to form slags at 1200 °C, according to the sieving method. TSF: Tendency to slag formation, expressed in %.

Table 5.32. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the disintegration easiness at 1400 ºC

	Disintegration easiness at 1400 °C			
Biofuel	**mean**	**S**	**CV (%)**	**n**
AS	4	<0.1	<0.1	22
HS	4	<0.1	<0.1	15
OS	4	<0.1	<0.1	45
OTP	4	0.26	6.7	67
OTP pellets	4	n.a.	n.a.	2
PNS	4	<0.1	<0.1	14
PS	4	<0.1	<0.1	13
VP	4	0.50	13	101
VP pellets	4	<0.1	<0.1	6
WS	3	1.4	42	12

n.a.: not applicable

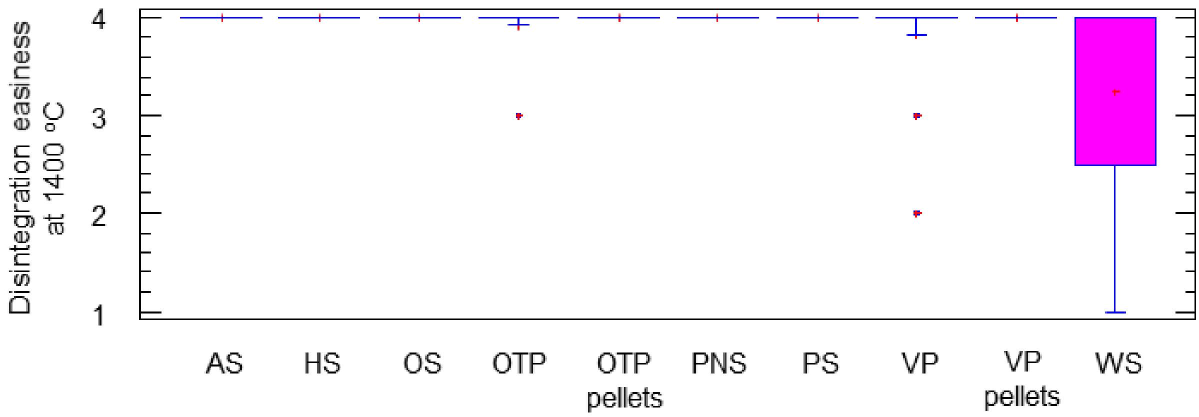


Figure 5.32. Box and whisker plots for the disintegration easiness at 1400 ºC

Table 5.33. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the tendency of the considered biofuels to form slags at 1400 °C, according to the sieving method. TSF: Tendency to slag formation, expressed in %.

	Sieving method, TSF at 1400 °C			
Biofuel	**mean** (%)	**S** (%)	**CV** (%)	**n**
AS	100	<0.1	<0.1	22
HS	100	0.76	0.77	15
OS	100	1.4	1.4	45
OTP	96	4.7	4.9	67
OTP pellets	100	n.a.	n.a.	2
PNS	100	<0.1	<0.1	14
PS	99	2.1	2.2	13
VP	93	9.8	11	101
VP pellets	96	3.7	3.8	6
WS	85	29	34	12

n.a.: not applicable

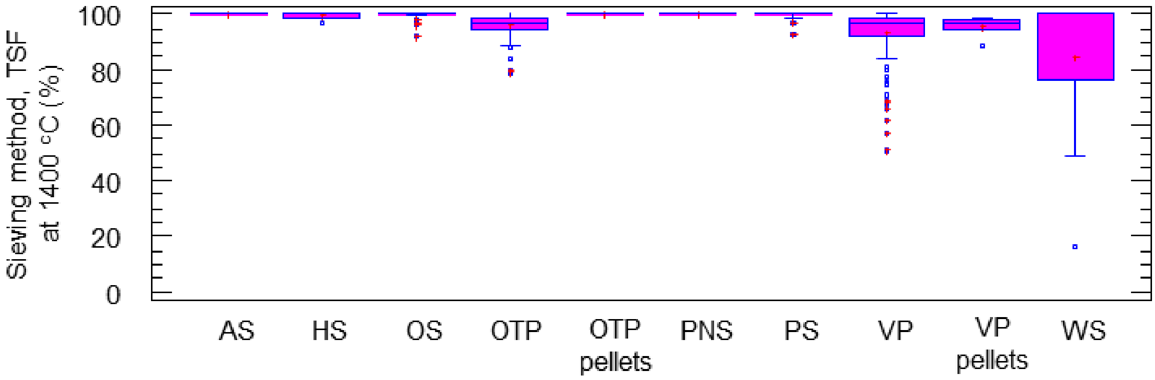


Figure 5.33. Box and whisker plots for the tendency of the considered biofuels to form slags at 1400 °C, according to the sieving method. TSF: Tendency to slag formation, expressed in %

In the following tables 5.34 and 5.35, the mean values for all the properties studied are summarized as a function of the type of biofuel considered. Maximum mean values for each property were highlighted in blue while minimum mean values were shaded in orange. See table 2.1 for the codes of every biofuel. Mean values showed in these tables should be taken only as an indication, as possible non representative values were included in calculations.

Table 5.34. Mean values for the main properties of the biofuels considered

Property	Units	AS	HS	OS	OTP	OPT pellets	PNS	PS	VP	VP pellets	WS
		Mean values for the biofuels considered									
BD	(kg/m^3, ar)	410	330	730	n.a.	550	530	320	n.a.	710	240
PS16	(%, ar)	35	6.5	<0.01	n.a.	n.a.	0.06	1.5	n.a.	n.a.	72
PS2	(%, ar)	94	98	71	n.a.	n.a.	99	100	n.a.	n.a.	100
PS1	(%, ar)	98	99	98	n.a.	n.a.	100	100	n.a.	n.a.	100
M	(%, w.b.)	11.0	13.6	14.8	26.8	9.7	12.9	11.3	36.3	10.0	10.2
Ash	(%, d.b.)	1.6	1.2	1.2	4.2	3.4	1.6	0.7	3.4	4.5	1.2
Oil	(%, d.b.)	2.0	1.3	1.9	n.a.	n.a.	0.6	1.4	n.a.	n.a.	4.4
Skin	(%, d.b.)	n.a.	n.a.	2.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
VM	(%, d.b.)	79.2	76.4	79.5	80.4	79.8	77.5	84.1	77.5	76.9	78.9
$GCV_{v,0}$	(MJ/kg, d.b.)	19.72	20.60	20.40	19.89	19.27	20.68	19.19	18.97	19.01	20.88
$GCV_{v,x}$	(MJ/kg, ar)	17.82	17.81	17.48	15.08	18.01	18.25	17.02	12.91	17.40	18.80
$NCV_{p,0}$	(MJ/kg, d.b.)	18.33	19.19	18.96	18.44	17.95	19.32	17.76	17.60	17.74	19.43
$NCV_{p,x}$	(MJ/kg, ar)	16.05	16.39	15.80	12.93	15.97	16.55	15.52	10.38	15.71	17.29
C	(%, d.b.)	49.6	52.1	51.0	49.4	48.2	51.3	48.6	48.2	48.7	51.9
H	(%, d.b.)	6.4	5.7	6.5	6.4	6.1	6.1	6.3	6.0	5.8	6.3
N	(%, d.b.)	0.36	0.28	0.30	0.93	0.45	0.27	0.27	0.74	0.81	0.45
Cl	(%, d.b.)	0.02	0.02	0.10	0.04	0.04	0.03	0.02	0.02	0.02	0.04
S	(%, d.b.)	0.01	0.03	0.02	0.08	0.05	0.03	0.02	0.05	0.07	0.02
Ca	(%, d.b.)	0.13	0.18	0.13	0.90	0.92	0.041	0.055	0.58	1.0	0.21
K	(%, d.b.)	0.46	0.28	0.23	0.56	0.36	0.14	0.23	0.51	0.54	0.24
Mg	(%, d.b.)	0.030	0.032	0.021	0.091	0.058	0.043	0.015	0.14	0.18	0.038
Si	(%, d.b.)	0.063	0.035	0.091	0.21	0.21	0.44	0.013	0.16	0.28	0.020
Na	(%, d.b.)	0.025	0.0020	0.062	0.046	0.034	0.013	0.0040	0.048	0.017	0.0033
Al	(%, d.b.)	0.011	0.011	0.019	0.039	0.042	0.0076	0.0032	0.031	0.060	0.0078
P	(%, d.b.)	0.015	0.025	0.013	0.087	0.074	0.029	0.023	0.11	0.12	0.040
Fe	(mg/kg, d.b.)	46	79	120	94	300	73	30	87	380	48
Mn	(mg/kg, d.b.)	3.6	41	5.7	20	16	13	1.3	28	26	12
Ti	(mg/kg, d.b.)	4.5	16	8.1	15	19	0.9	2.3	8.9	35	5.5
Cu	(mg/kg, d.b.)	3.3	5.1	4.2	20	3.9	2.5	13	16	18	7.0
Zn	(mg/kg, d.b.)	4.1	5.3	7.4	12	3.7	8.0	11	37	46	6.5

n.a.: not applicable; ar: as received; w.b.: wet basis; d.b.: dry basis

BD: bulk density; PS; accumulated particle size above the figure specified (in mm); M: moisture; VM: volatile matter; GCV: gross calorific value at constant volume; NCV: net calorific value at constant pressure

Table 5.35. Mean values for the ash melting behaviour related properties of the biofuels considered

Property	Units	AS	HS	OS	OTP	OPT pellets	PNS	PS	VP	VP pellets	WS
		Mean values for the biofuels considered									
Sintering Index		0.4	1.0	0.8	2.3	2.9	0.7	0.6	1.8	2.6	1.4
Fusibility test:											
SST	(ºC)	720	710	720	780	710	720	700	790	1060	780
DT	(ºC)	820	1060	1030	1210	1590	940	870	1200	1380	1220
HT	(ºC)	1080	1490	1420	1490	1590	1160	1330	1520	1590	1520
FT	(ºC)	1260	1500	1470	1500	1590	1260	1450	1520	1590	1520
Disintegration method:											
800 ºC		4	3	4	3	4	2	3	2	1	2
1000 ºC		4	4	4	4	4	4	4	4	3	3
1200 ºC		4	4	4	4	4	4	4	4	3	3
1400 ºC		4	4	4	4	4	4	4	4	4	3
Sieving method:											
800 ºC	(%)	95	88	91	75	95	61	79	64	31	50
1000 ºC	(%)	100	98	96	96	100	99	98	94	80	73
1200 ºC	(%)	100	95	94	94	100	99	97	92	84	74
1400 ºC	(%)	100	100	100	96	100	100	99	93	96	85

SST: shrinkage starting temperature; DT: deformation temperature, HT: hemisphere temperature; ST: sphere temperature

6. QUALITY ASSESSMENT

In this section, the quality of the analyzed samples is assessed for each particular biofuel and compared among countries and with the requirements set in their applicable standards, when available. The international standard ISO-17225-4 regarding wood chips has been used as a reference for vineyard and olive tree prunings. It is also worth mentioning that ISO 17225-4:2014 rules moisture, N, S, Cl, As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn for wood chips, class B. No limits are specified for classes A1 or A2 because, as long as samples are able to fulfill the origin, source, and ash limitations, they are supposed to exhibit acceptable values for the rest of the normative properties as well. The national Spanish standards UNE 164004:2014 and UNE 164005:2014 have been used for olive stones and dry fruit shells, respectively.

Tables and figures included in this section show the main quality properties of each solid biofuel/biomass as a function of the country where samples were collected. Tables show the mean, standard deviation (S), coefficient of variation (C.V.), and the number of samples analyzed (n) for every considered quality property. The box and whisker plots were the tool used to show the median and the dispersion of results as well as to identify any possible outlier. For each property, the requirements set by the corresponding standards for every quality class are also depicted in their corresponding box and whisker plots with dashed lines. Results are expressed on a dry basis (d.b.) unless stated otherwise (e.g. on a wet basis -w.b.).

By making use of the information provided in this section, it can be easily derived where the analyzed samples stand from a quality perspective, and whether or not the samples from a particular country fulfill the limits set in the existing related standards and thus the requirements for a particular quality class. Besides, the differences among samples collected in the different considered countries can be also discussed.

The individual results for every property of all the analyzed samples are shown in Annex II. The number of samples analyzed per property and biofuel can be derived from the afore-mentioned Annex II.

The results obtained for olive tree and vineyard pruning pellets are not discussed in this section due to the very limited number of samples collected, which would make a statistical analysis unreliable. The analytical results for each sample of pellets are also shown in Annex II.

As in section 5, the reasons for the deviations found for some samples from mean results (outliers) will be further investigated in Task 3.3.

6.1 OLIVE TREE PRUNINGS

As it has been previously mentioned in section 5, all the pruning samples analyzed in this study were manually collected to prevent, as far as it is reasonably possible, the inclusion of mineral impurities.

For comparison reasons, the requirements for wood chips quality classes A1, A2, and B, according to the ISO EN 17225-4:2014 standard, are depicted in every plot shown for prunings. The requirements for wood pellets are not shown in these graphs because they are so restrictive, particularly regarding the ash content, that they would be hardly met by this type of biofuel

Moisture

The results regarding the moisture content of the analyzed samples, as received, are shown in Table 6.1.1 and Figure 6.1.1. However, as commented in section 5, no standardized procedure has been followed to collect pruning samples, so that moisture contents shall be merely taken as indicative.

Generally, the moisture content of fresh olive tree prunings is in the range of 35-45 % w.b., and tends to decrease with time, depending also on weather conditions. The differences in the moisture contents in different countries indicate that there was considerable difference in the time that the prunings were left on the field before collection or/and that some time passed between sampling and the measurement of moisture.

As can be seen, large differences in the moisture content were observed across countries and even among samples collected in the same country, particularly in case of Spain and Slovenia.

Table 6.1.1. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the moisture content (as received, % w.b.) of olive tree prunings.

	Moisture (as received)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	33.3	6.1	18	10
Greece	15.4	8.3	54	12
Italy	11.6	0.58	5.1	4
Portugal	26.5	5.3	20	8
Slovenia	24.2	10	42	10
Spain	33.8	10	30	20
Turkey	28.6	3.7	13	10

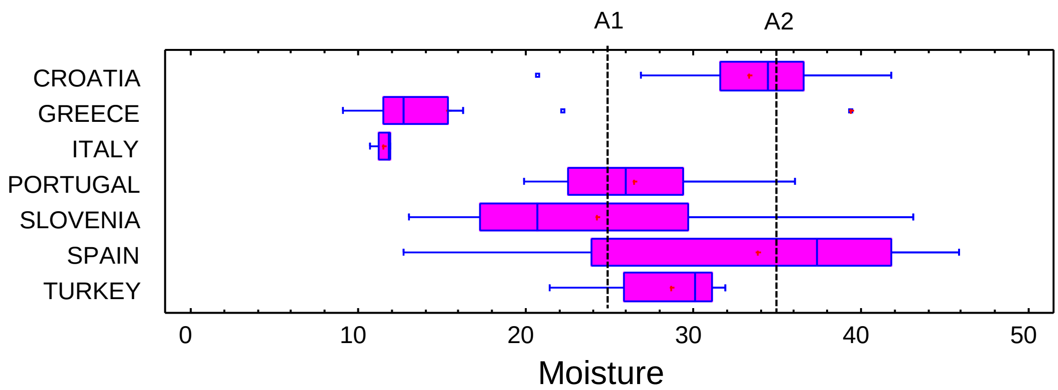


Figure 6.1.1. Box and whisker plots for the moisture content (% w.b., as received) of olive tree prunings

Ash

The results regarding the ash content of the analyzed samples are shown in Table 6.1.2 and Figure 6.1.2.

Ash content of olive tree prunings averaged 4.2 % (see Table 5.5). Samples from Italy, Portugal and Spain averaged 2.9 %, 3.5 % and 3.7 %, respectively. Higher mean ash contents were obtained for Croatian and Turkish samples (5.3-5.5 %). With a minimum value of 1.7 % and a maximum value of 6.4 %, none of the analyzed samples met the ash requirements stated in ISO EN 17225-4:2014 for wood chips, classes A1 (≤1.0 %) or A2 (≤1.5 %). Moreover, only a small fraction of the analyzed samples from Italy, Portugal and Spain complied with the ash requirement set for class B (≤3.0%). All samples from Croatia, Greece, Slovenia and Turkey clearly surpassed this limit.

Besides chips, this wooden biomass could be also used to manufacture pellets, but the obtained pelletized fuel, if no further management of the biomass is made, would not fulfill the ash requirements set in the ISO 17225-2:2014 standard for residential and commercial applications, classes A1 (≤0.7 %) or A2 (≤1.2 %). The limits set for industrial applications, classes I1 (≤1.0 %) and I2 (≤1.5 %), would not be met either. Only a very limited fraction of the analyzed samples complied with the ash content requirements for class I3 for industrial applications (≤3.0 %).

Table 6.1.2. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the ash content (%, d.b.) of olive tree prunings

	Ash (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	5.3	0.54	10	10
Greece	4.4	0.48	11	12
Italy	2.9	0.70	24	4
Portugal	3.5	1.5	42	8
Slovenia	4.0	0.35	8.8	10
Spain	3.7	1.0	28	20
Turkey	5.5	0.77	14	10

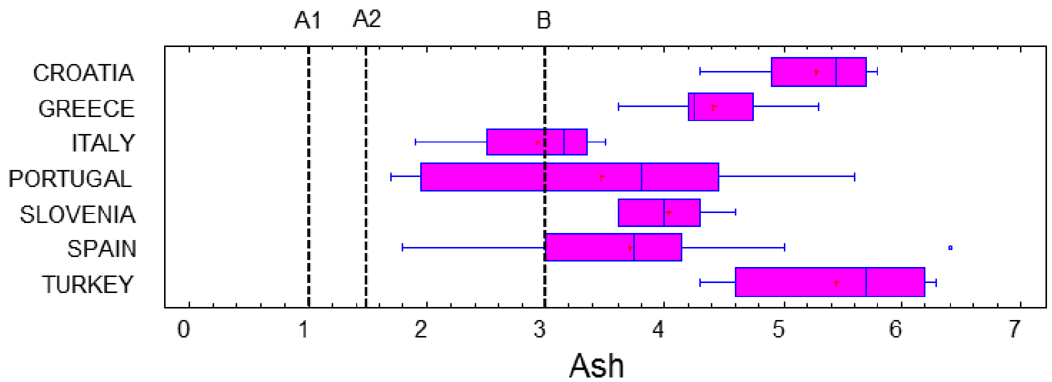


Figure 6.1.2. Box and whisker plots for the ash content (%, d.b.) of olive tree prunings

Calorific value

The results regarding the net calorific value at constant pressure of the analyzed samples are shown in Tables 6.1.3-6.1.4 (as received) and Figures 6.1.3-6.1.4 (dry basis).

On average, net calorific values at constant pressure on a dry basis were 18.44 MJ/kg (see Table 5.10).

Average net calorific values (as received, NCVx) were higher for Greek and Italian samples (Table 6.1.3), as a consequence of the lower moisture content of these samples (12-15 % as opposed to moisture levels of 26-34 % for the rest of the samples analyzed, Table 6.1.1). However, when comparing the net calorific values on a dry basis (Table 6.1.4), Croatian and Turkish samples exhibited higher mean values (18.80 and 18.91 MJ/kg, respectively) than samples coming from the rest of the countries (18.1-18.4 MJ/kg), in spite of their relatively higher ash contents (Table 6.1.2). This fact will be further investigated in Task 3.3.

No requirements were specified for net calorific values in the international standard of graded wood chips, but the minimum net calorific value, as received, should be stated and this is the reason that the as received value has been taken into consideration.

Table 6.1.3. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, as received) of olive tree prunings

	NCVx (as received)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Croatia	11.92	1.3	11	10
Greece	14.96	1.8	12	12
Italy	15.97	0.17	1.1	4
Portugal	12.86	1.2	10	8
Slovenia	13.18	2.2	17	10
Spain	11.55	2.1	18	20
Turkey	12.85	0.8	5.9	10

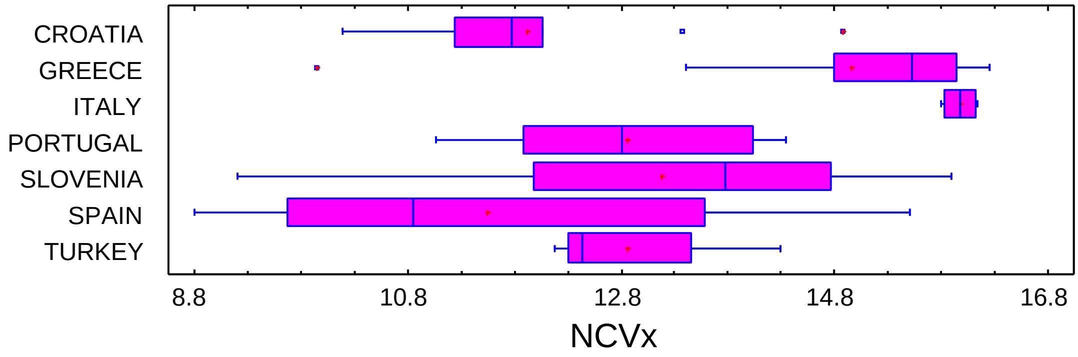


Figure 6.1.3. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, as received) of olive tree prunings

Table 6.1.4. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, dry basis) of olive tree prunings

	NCVo (d.b.)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Croatia	18.91	0.24	1.3	10
Greece	18.11	0.21	1.2	12
Italy	18.38	0.30	1.6	4
Portugal	18.36	0.52	2.8	8
Slovenia	18.14	0.28	1.5	10
Spain	18.43	0.36	1.9	20
Turkey	18.80	0.30	1.6	10

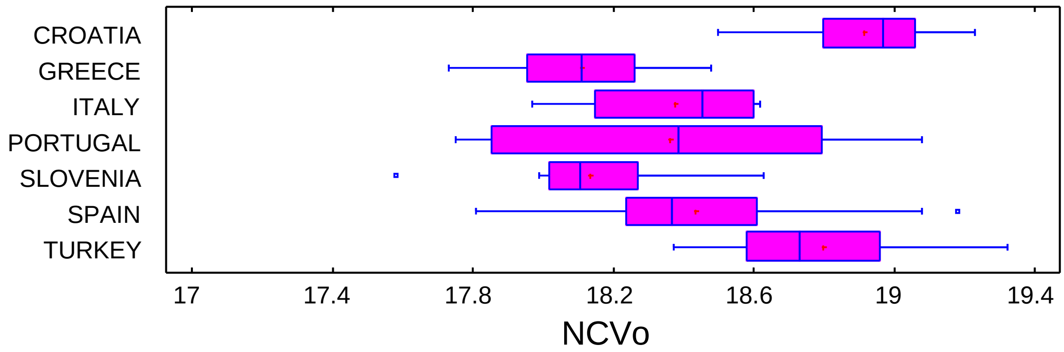


Figure 6.1.4. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, dry basis) of olive tree prunings

Nitrogen

The results regarding the nitrogen content of the analyzed samples are shown in Table 6.1.5 and Figure 6.1.5.

Samples from Croatia, Greece, Portugal and Spain averaged N contents between 0.77 and 0.98 %. In turn, Turkish and Slovenian samples averaged 1.2- 1.3 % N, clearly surpassing the N limit set for wood chips, class B (≤1.0 %). Italian samples showed the lowest N contents, and averaged 0.45 %, being all samples below the limit for class B.

Table 6.1.5. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nitrogen content (%, d.b.) of olive tree prunings

	Nitrogen (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.98	0.12	12	10
Greece	0.88	0.31	35	12
Italy	0.45	0.10	22	4
Portugal	0.80	0.46	57	8
Slovenia	1.3	0.24	19	10
Spain	0.77	0.23	30	20
Turkey	1.2	0.18	15	10

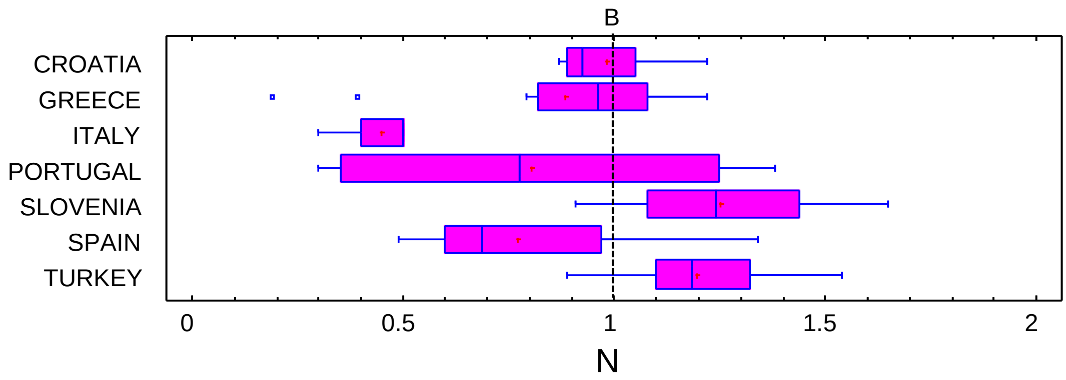


Figure 6.1.5. Box and whisker plots for the nitrogen content (%, d.b.) of olive tree prunings

Chlorine

The results regarding the chlorine content of the analyzed samples are shown in Table 6.1.6 and Figure 6.1.6.

As can be seen in Figure 6.1.6, the chlorine limit set for wood chips, class B (≤0.05 %), was attained by most of the samples coming from Italy, Portugal, Spain, Turkey, and Slovenia. Croatian and Greek samples showed, in general, higher Cl contents.

Table 6.1.6. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the chlorine content (%, d.b.) of olive tree prunings

	Chlorine (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.05	0.01	24	10
Greece	0.06	0.01	17	11
Italy	0.02	0.01	41	4
Portugal	0.03	0.03	84	8
Slovenia	0.04	0.02	40	10
Spain	0.02	0.01	40	20
Turkey	0.04	0.02	45	10

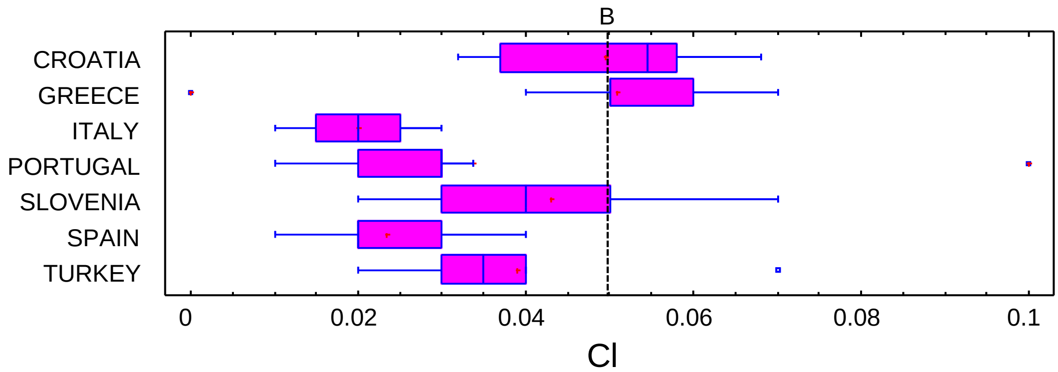


Figure 6.1.6. Box and whisker plots for the chlorine content (%, d.b.) of olive tree prunings

Sulfur

The results regarding the sulfur content of the analyzed samples are shown in Table 6.1.7 and Figure 6.1.7.

Most of the analyzed samples showed S contents below the limit set in the ISO standard for wood chips, class B (≤0.10 %). However, this limit was surpassed by most of the Turkish samples and a considerable proportion of the Croatian samples (Figure 6.1.7). The high sulfur content of these samples, as explained in section 5, could be associated with the use of this element in olive tree plantations as a fungicide.

Table 6.1.7. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sulfur content (%, d.b.) of olive tree prunings

	Sulfur (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.10	0.01	10	10
Greece	0.08	0.04	46	12
Italy	0.03	<0.001	<0.001	4
Portugal	0.07	0.04	60	8
Slovenia	0.06	0.01	22	10
Spain	0.07	0.02	32	20
Turkey	0.11	0.01	12	10

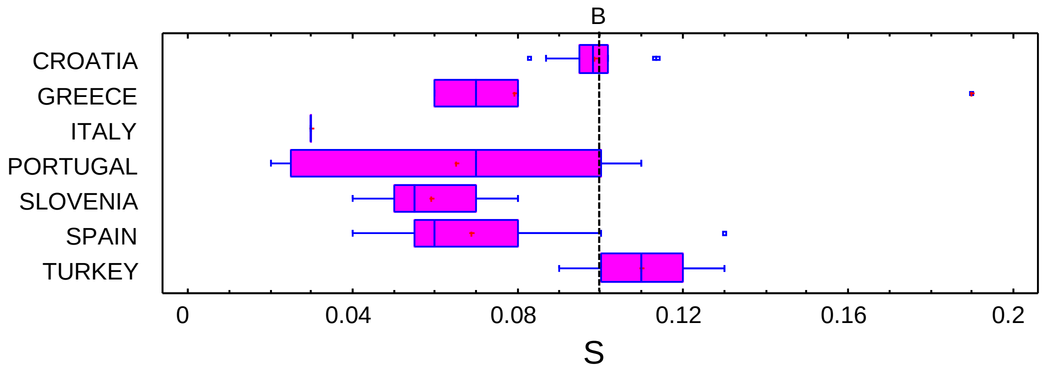


Figure *6.1.7. Box and whisker plots for the sulfur content (%, d.b.) of olive tree prunings*

Trace elements

In general, the levels of As, Cd, Cr, Pb, Hg, Ni, and Zn in olive tree prunings were very low, below the limits of the international standard of reference for wood chips (ISO 17225-4), and sometimes even below the quantification limits of the analytical methods utilized. Laboratories frequently reported e.g. Cd and Pb levels below the quantification limits of their methods. This is the reason why only some trace elements could be included in the statistical study and therefore in the tables and figures included in this section.

The results regarding the content of Cu, Hg, and Zn of the analyzed samples are shown in Tables 6.1.8-6.1.10 and Figures 6.1.8-6.1.10.

As can be seen, all samples exhibited values of Hg and Zn clearly below the limitations established in the international standards.

In turn, it should be highlighted that the Cu levels (Table 6.1.8 and Figure 6.1.8) found for the olive tree prunings collected in this project were fairly high, most samples clearly surpassing the limit of 10 mg/kg set by international standards for wood pellets and chips. The copper content of the olive tree prunings analyzed averaged 20 mg/kg (Table 5.21). With 9.7 mg/kg, Turkey was the only country with mean Cu contents slightly below the afore-mentioned reference limit. Samples for the rest of the considered countries highly exceeded this limit, averaging Cu levels between 11 mg/kg (Slovenia) and 33 mg/kg (Croatia). As explained in section 5, the high Cu levels found in this type of biomass could be associated to the copper containing chemicals (e. g. copper sulfate) that are commonly applied as fungicides to olive groves, as well as to vineyards and fruit tree plantations.

Table 6.1.8. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the copper content (mg/kg, d.b.) of olive tree prunings

	Copper (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	33	15	45	10
Greece	32	22	69	12
Italy	17	10	63	4
Portugal	22	24	110	3
Slovenia	11	6.8	62	10
Spain	16	24	150	20
Turkey	10	5.6	58	10

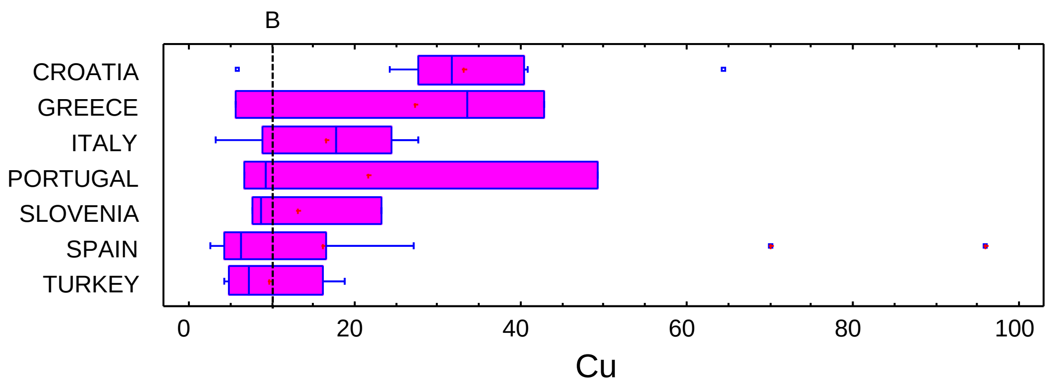


Figure 6.1.8. Box and whisker plots for the copper content (mg/kg, d.b.) of olive tree prunings.

Table 6.1.9. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the mercury content (mg/kg, d.b.) of olive tree prunings

	Mercury (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	0.016	0.004	27	10
Greece	0.011	0.007	64	12
Italy	0.002	<0.001	16	4
Portugal	0.009	0.008	80	8
Slovenia	0.011	0.002	16	10
Spain	0.017	0.008	48	20
Turkey	0.030	0.014	48	10

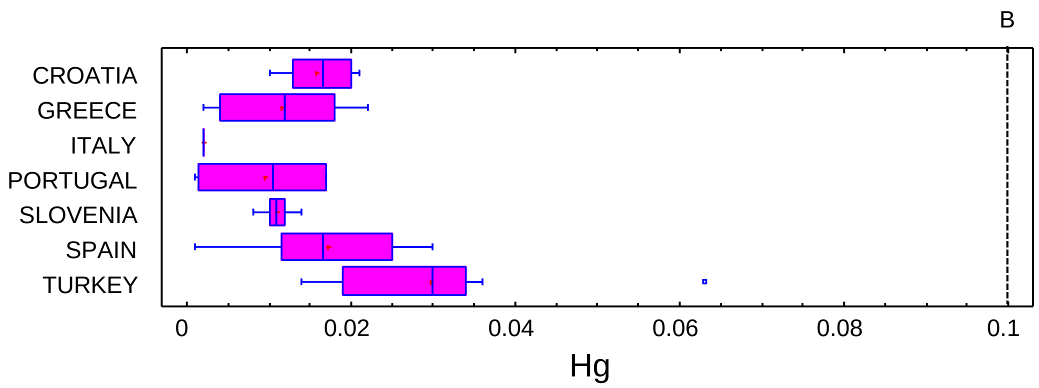


Figure 6.1.9. Box and whisker plots for the mercury content (mg/kg, d.b.) of olive tree prunings.

Table 6.1.10. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the zinc content (mg/kg, d.b.) of olive tree prunings

	Zinc (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	16	2.2	14	10
Greece	11	2.7	24	12
Italy	10	3.0	29	4
Slovenia	13	2.7	21	10
Spain	10	5.1	49	20
Turkey	12	1.3	11	10

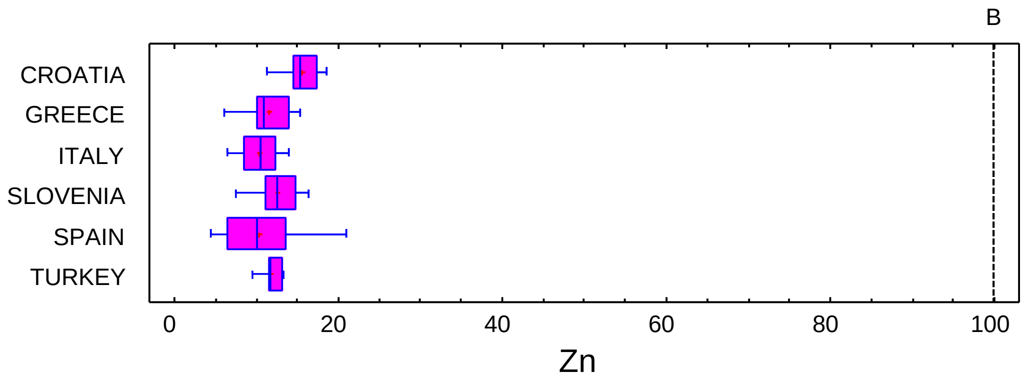


Figure 6.1.10. Box and whisker plots for the zinc content (mg/kg, d.b.) of olive tree prunings

6.2 VINEYARD PRUNINGS

As it was mentioned in previous sections, it should be taken into account that vineyard prunings, as well as olive tree prunings were manually collected in this study to prevent, as far as it is reasonably possible, the inclusion of mineral impurities.

For comparison reasons, the requirements for wood chips quality classes A1, A2, and B, according to the ISO EN 17225-4:2014 standard, are depicted in the plots of this section.

Moisture

The results regarding the moisture content of the analyzed samples, as received, are shown in Table 6.2.1 and Figure 6.2.1. However, as commented in section 5, no standardized procedure has been followed to collect pruning samples, so that moisture contents should be merely taken as indicative.

Generally, the moisture content of fresh olive tree prunings is in the range of 50 %, w.b. Lower values indicate that the material was left on the field for some time before collection or/and that some time passed between sampling and moisture content measurement in the laboratory.

As can be seen, large differences of the moisture content were observed across countries and even among samples collected in the same country, with the exception of Italy, Slovenia, and Turkey.

Table 6.2.1. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the moisture content (as received, % w.b) of vineyard prunings.

	Moisture (as received)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	35.5	7.5	21	18
Greece	31.7	10	32	16
Italy	12.7	1.1	8.7	9
Portugal	30.7	10	34	18
Slovenia	50.0	<0.01	<0.01	17
Spain	39.1	11	28	24
Turkey	46.1	1.9	4.2	10

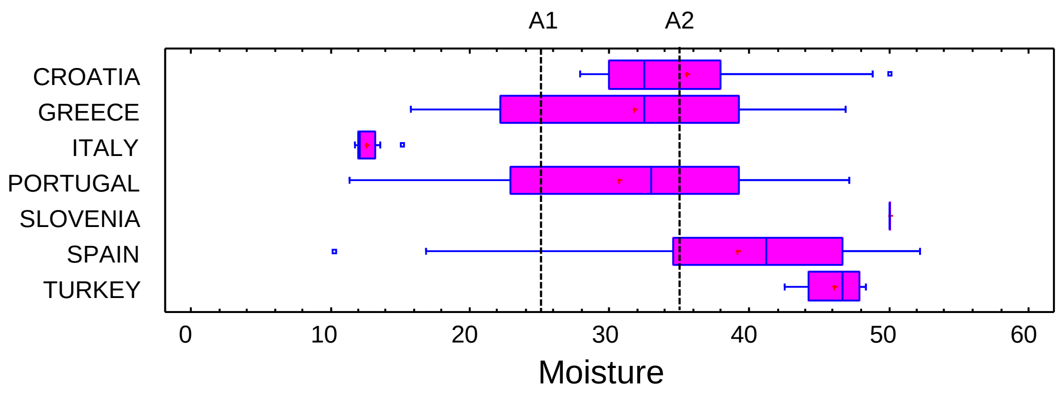


Figure 6.2.1. Box and whisker plots for the moisture content (% w.b., as received) of vineyard prunings

Ash

The results regarding the ash content of the analyzed samples are shown in Table 6.2.2 and Figure 6.2.2.

When comparing countries, it could be said that the vineyard prunings collected in Turkey and Greece averaged slightly higher mean ash contents (3.8 %, Table 5.5) than the rest of the countries, which averaged ash contents between 3.2 % and 3.4 % (Table 6.2.2).

Similarly to olive tree prunings, it should be highlighted that none of the analyzed samples met the ash requirements stated in the international standards for wood pellets/chips for residential applications, classes A1 (≤1.0 %) or A2 (≤1.5 %) (Figure 6.2.2). Vineyard prunings showed a minimum ash content of 2.3 % and a maximum value of 4.9 %. Moreover, only a small fraction of the analyzed samples (from Portugal and Spain) complied with the ash requirement set for wood pellets, class I3 (industrial use) or wood chips, class B (≤3.0 %). Therefore, in terms of meeting the quality requirements that are currently in place for wood chips and wood pellets, it could be said that the ash content of vineyard prunings as recollected on fiels, as well as in the case of olive tree prunings, is a major shortcoming for this type of biomass to be used in the residential sector, no matter the country where the biomass is grown.

Table 6.2.2. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the ash content (%, d.b.) vineyard prunings

	Ash (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	3.4	0.28	8.2	18
Greece	3.8	0.55	14	16
Italy	3.2	0.15	4.7	9.0
Portugal	3.2	0.56	18	18
Slovenia	3.4	0.37	11	17
Spain	3.3	0.54	17	24
Turkey	3.8	0.31	8.1	10

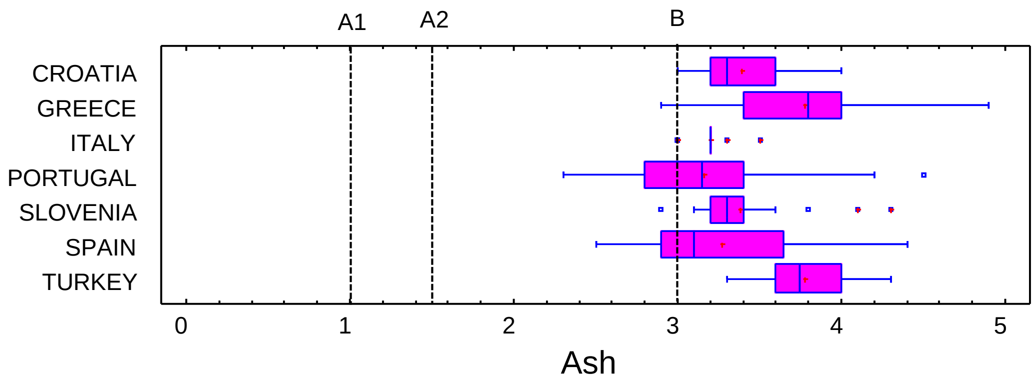


Figure 6.2.2. Box and whisker plots for the ash content (%, d.b.) of vineyard prunings

Calorific value

The results regarding the net calorific value at constant pressure of the analyzed samples are shown in Tables 6.2.3-6.2.4 and Figures 6.2.3-6.2.4.

No requirements are specified for net calorific values in the international standard that grades wood chips. The minimum net calorific value, as received, should be stated though, and they are shown in Table 6.2.3 and Figure 6.2.3. The clear differences observed among countries are connected with the different moisture levels in the collected samples (Table 6.2.1 and Figure 6.2.1).

On a dry basis, net calorific values at constant pressure averaged 17.60 MJ/kg (Table 5.10). Across countries, mean net calorific values at constant pressure ranged 17.35-17.95 MJ/kg (dry basis, Table 6.2.4). The observed differences in the calorific values on a dry basis among countries (Table 6.2.4) should be related, as already commented in section 5, to the ash content (Table 6.2.2) as well as to the bark and leaves fractions in the collected samples.

Table 6.2.3. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, as received) of vineyard prunings

	NCVx (as received)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Croatia	10.65	1.5	14	18
Greece	11.08	2.0	18	16
Italy	15.34	0.24	1.5	9
Portugal	11.47	2.2	19	18
Slovenia	7.53	0.17	2.3	17
Spain	9.84	2.2	22	24
Turkey	8.49	0.41	4.8	10

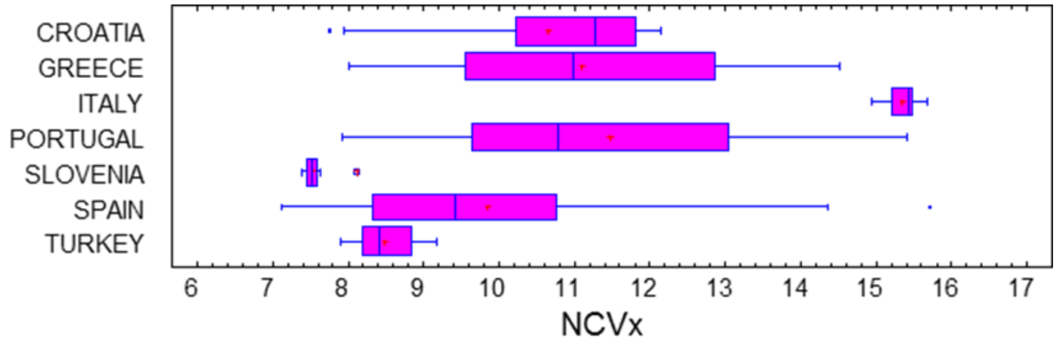


Figure 6.2.3. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, as received) of vineyard prunings

Table 6.2.4. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, dry basis) of vineyard prunings

	NCVo (d.b.)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Croatia	17.66	0.11	0.61	18
Greece	17.35	0.21	1.2	16
Italy	17.95	0.25	1.4	9
Portugal	17.48	0.58	3.3	18
Slovenia	17.50	0.34	2.0	17
Spain	17.73	0.13	0.74	24
Turkey	17.63	0.14	0.8	10

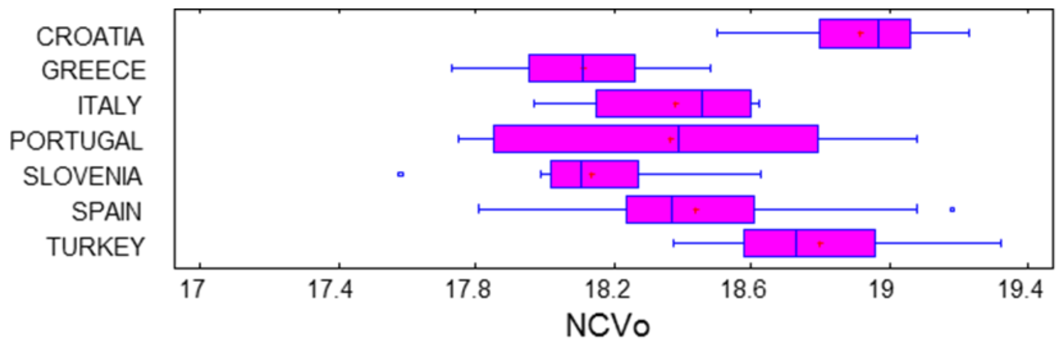


Figure 6.2.4. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, dry basis) of vineyard prunings

Nitrogen

As shown in Table 6.2.5 and Figure 6.2.5, the N limit set by the international standard on wood chips, class B (≤1.0 % N), was attained by all the analyzed samples, with the exception of samples coming from Slovenia. As stated in section 5, the reason why this occurs for this particular country has not been identified. Further investigation on this matter will be made in Task 3.3.

Table 6.2.5. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nitrogen content (%, d.b.) of vineyard prunings

	Nitrogen (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.61	0.11	19	18
Greece	0.68	0.13	19	16
Italy	0.71	0.060	8.4	9
Portugal	0.62	0.088	14	18
Slovenia	1.17	0.26	22	17
Spain	0.68	0.087	13	24
Turkey	0.69	0.11	16	10

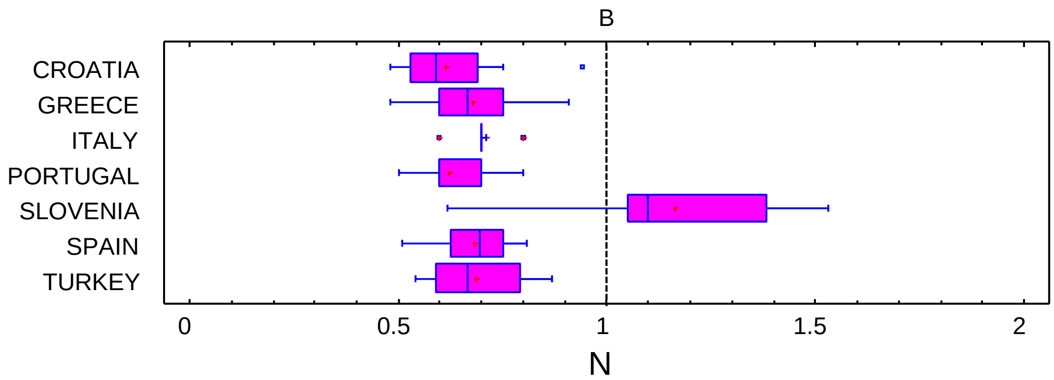


Figure 6.2.5. Box and whisker plots for the nitrogen content (%, d.b.) of vineyard prunings

Chlorine

The results regarding the chlorine content of the analyzed samples are shown in Table 6.2.6 and Figure 6.2.6. Calculations were made assigning a value of 0.00% of Cl to a Portuguese sample that showed contents below the quantification limit reported by the laboratory which performed the analysis (<0.01 %). Therefore, it should be taken into account that the mean and median for this country might have been underestimated.

As shown in Table 6.2.6 and Figure 6.2.6, Turkish samples clearly exceeded the Cl limit set by the international standard on wood chips, class B (≤0.05 %). Samples from the rest of the countries generally complied with the afore-mentioned specification.

Table 6.2.6. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the chlorine content (%, d.b.) of vineyard prunings

	Chlorine (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.01	0.004	38	18
Greece	0.03	0.014	55	16
Italy	0.01	0.010	75	9
Portugal (*)	0.02	0.018	79	18
Slovenia	0.02	0.021	87	15
Spain	0.02	0.007	38	24
Turkey	0.08	0.030	38	10

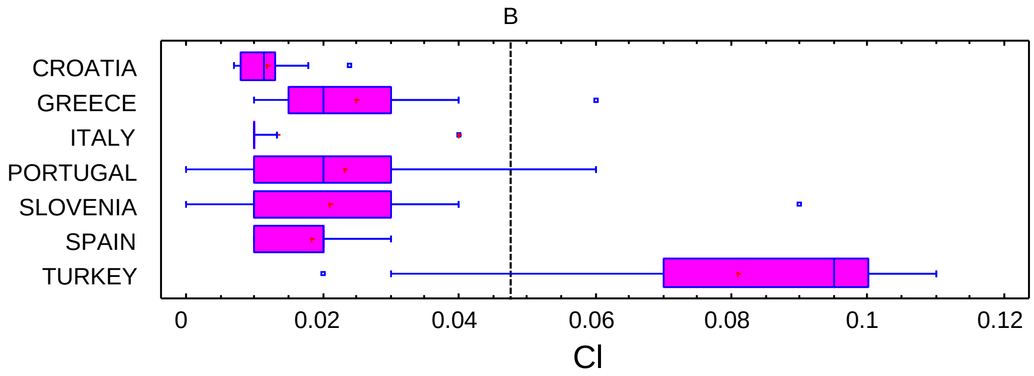


Figure 6.2.6. Box and whisker plots for the chlorine content (%, d.b.) of vineyard prunings

Sulfur

The results regarding the sulfur content of the analyzed samples are shown in Table 6.2.7 and Figure 6.2.7.

As shown in Table 6.2.7 and Figure 6.2.7, the sulfur limit set by the international standard on wood chips, class B (≤0.10 % S), was attained by all the analyzed samples, regardless of their country of origin, with the exception of a Slovenian sample that showed a content of 0.15 % S.

Table 6.2.7. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sulfur content (%, d.b.) of vineyard prunings

	Sulfur (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.05	0.007	13	18
Greece	0.04	0.014	32	16
Italy	0.06	0.003	5.7	9
Portugal	0.05	0.014	29	18
Slovenia	0.06	0.037	64	17
Spain	0.05	0.006	12	24
Turkey	0.05	0.006	12	10

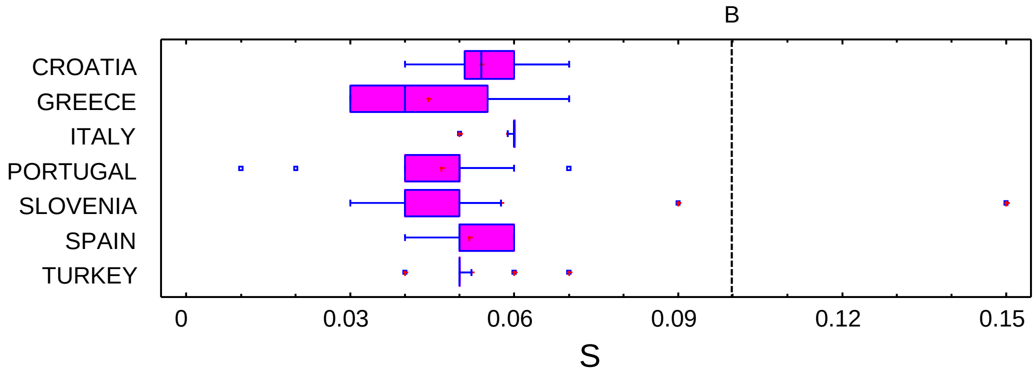


Figure 6.2.7. Box and whisker plots for the sulfur content (%, d.b.) of vineyard prunings

Trace elements

In general, the levels of most trace elements, with the exception of copper, were low and below the limits set by the international standards on solid biofuels. Laboratories frequently reported values below the limits of quantification of their methods.

The results regarding the Hg, Zn, and Cu of the analyzed samples are shown in Tables 6.2.8-6.2.10 and Figures 6.2.8-6.2.10.

However, some specific samples also showed levels above the limits set in the standards. It could be mentioned a Portuguese sample containing 13 mg/kg of Cr and 115 mg/kg of Zn, and two Spanish samples with 16 and 17 mg/kg of Ni content. Spanish samples averaged 1.0 mg/kg of As, the maximum limit established for graded quality wood chips, with a maximum content of 5.3 mg/kg, values generally higher than the samples coming from other countries. Additionally, some Greek samples showed extremely high contents of Pb (28 and 36 mg/kg) and Zn (221 and 261 mg/kg). The reasons for these deviations will be further investigated in Task 3.3.

Table 6.2.8. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the mercury content (mg/kg, d.b.) of vineyard prunings

	Mercury (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	0.002	<0.001	18	17
Greece	0.004	0.004	100	16
Italy	0.002	<0.001	13	9
Portugal	0.001	<0.001	26	18
Slovenia	0.002	0.001	63	17
Spain	0.002	0.001	32	24
Turkey	0.002	0.002	69	10

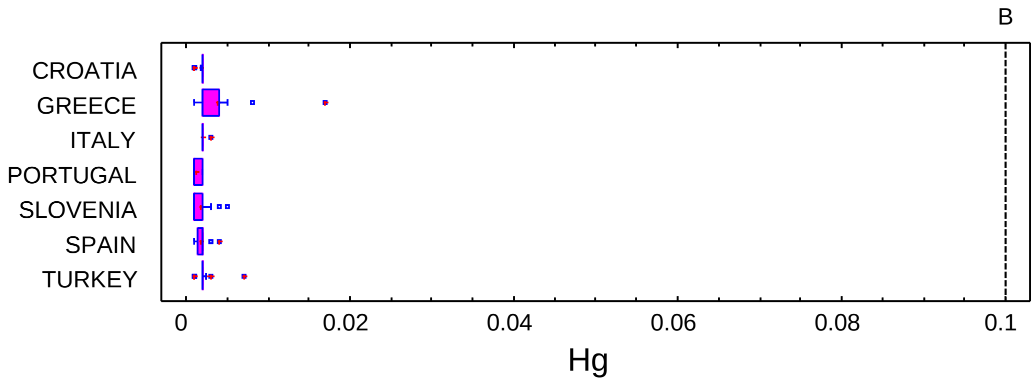


Figure 6.2.8. Box and whisker plots for the mercury content (mg/kg, d.b.) of vineyard prunings.

Table 6.2.9. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the zinc content (mg/kg, d.b.) of vineyard prunings.

	Zinc (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	38	22	59	18
Greece	75	70	93	16
Italy	32	7.5	23	9
Portugal	36	26	73	18
Slovenia	38	17	46	17
Spain	21	17	79	24
Turkey	20	6.0	30	10

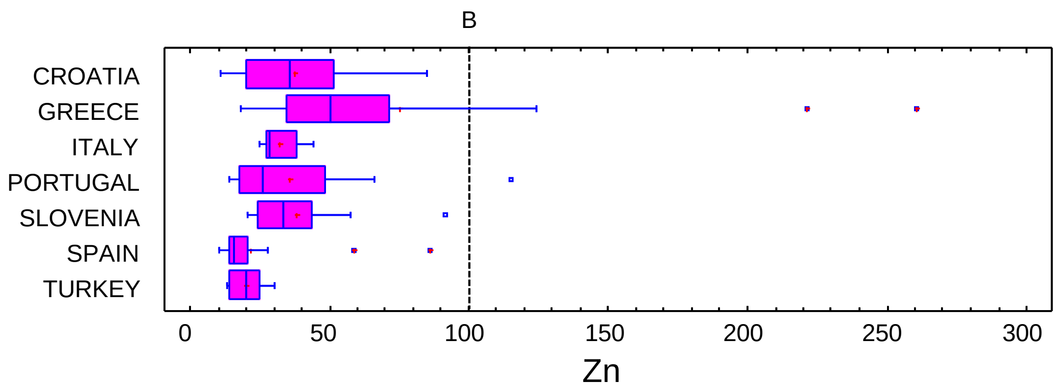


Figure 6.2.9. Box and whisker plots for the zinc content (mg/kg, d.b.) of vineyard prunings

As can be seen in Table 6.2.10 and Figure 6.2.10, and similarly to olive tree samples, the Cu levels found for the vineyard prunings collected in this project were relatively high (16 mg/kg, averaged over countries, see Table 5.21), most probably due to the copper fungicides that are commonly applied in vineyards. Mean Cu levels ranged from 11 mg/kg (Croatia) to 22 mg/kg (Italy), exceeding the limit of 10 mg/kg set by international standards for wood pellets and chips. Copper levels of olive tree and vineyard prunings should be carefully taken into further consideration when establishing future limitations. It should be studied whether or not the copper levels obtained could raise environmental issues during the combustion of these biofuels. This issue will be further addressed in Task 3.3.

Table 6.2.10. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the copper content (mg/kg, d.b.) of vineyard prunings

	Copper (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	11	5.5	50	18
Greece	19	12	63	16
Italy	22	15	65	9
Portugal	12	8.4	67	18
Slovenia	20	8.5	43	17
Spain	12	14	120	24
Turkey	18	13	75	10

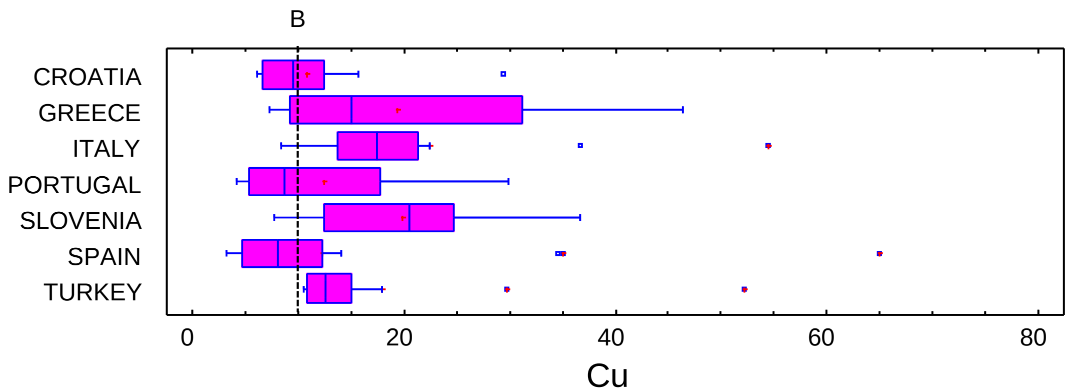


Figure 6.2.10. Box and whisker plots for the copper content (mg/kg, d.b.) of vineyard prunings

6.3 OLIVE STONES

For comparison reasons, the requirements for olive stones quality classes A1, A2, and B, according to the Spanish standard UNE 164005:2014 are depicted in the box and whisker plots of this section.

As it was mentioned in section 5, it is important to take into account that great part of the variability found in the quality properties of the olive stones and fruit shells analyzed in this study could be due to the different fractions of the pulp of the fruit that can be still present in these samples (not quantified). It is very difficult to quantify this fraction as some of these commercial samples have been already milled to the desired particle size by the producer.

Moisture

The results regarding the moisture content of the analyzed samples, as received, are shown in Table 6.3.1 and Figure 6.3.1. As mentioned, they should be merely taken as an indication.

Only the samples from Portugal and Spain averaged moisture contents below the A1 limit (≤12 %) set in the Spanish standard that grades olive stones. The mean moisture content of the olive stones collected in the rest of the countries surpassed this limit. Samples from Croatia and Turkey averaged moisture contents that exceeded the limit specified for class B (≤16 %).

Table 6.3.1. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the moisture content (as received, % w.b) of olive stones.

	Moisture (as received)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	17.8	n.a.	n.a.	2
Greece	14.5	5.5	38	10
Italy	14.9	4.5	31	14
Portugal	9.5	2.6	27	3
Slovenia	14.1	0.13	0.89	4
Spain	9.9	3.4	35	10
Turkey	27.6	14	52	5

n.a.: not applicable

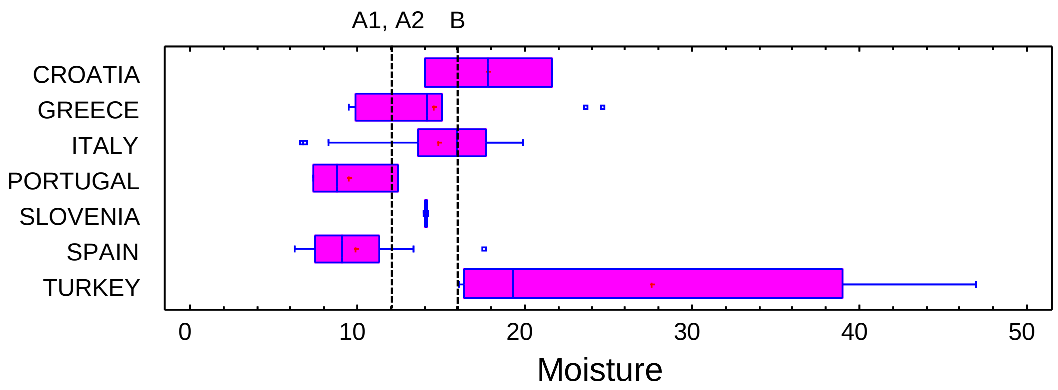


Figure 6.3.1. Box and whisker plots for the moisture content (% w.b., as received) of olive stones

Bulk density

The results regarding the bulk density of the analyzed samples are shown in Table 6.3.2 and Figure 6.3.2.

About 75% of the analyzed samples fulfilled the requirements set for the bulk density of olive stones, top quality class A1 (≥700 kg/m^3, as received). Most of the Spanish, Turkish and Croatian samples met this requirement. Greek olive stones had lower bulk density (680 kg/m^3), and only about 40% of these samples were found to be over the A1 specification.

Table 6.3.2. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the bulk density (kg/m^3, as received) of olive stones

	Bulk density (as received)			
Country	**mean** (kg/m^3)	**S** (kg/m^3)	**C.V.** (%)	**n**
Croatia	730	n.a.	n.a.	2
Greece	680	54	8.0	10
Spain	760	21	2.8	10
Turkey	750	64	8.5	5

n.a.: not applicable

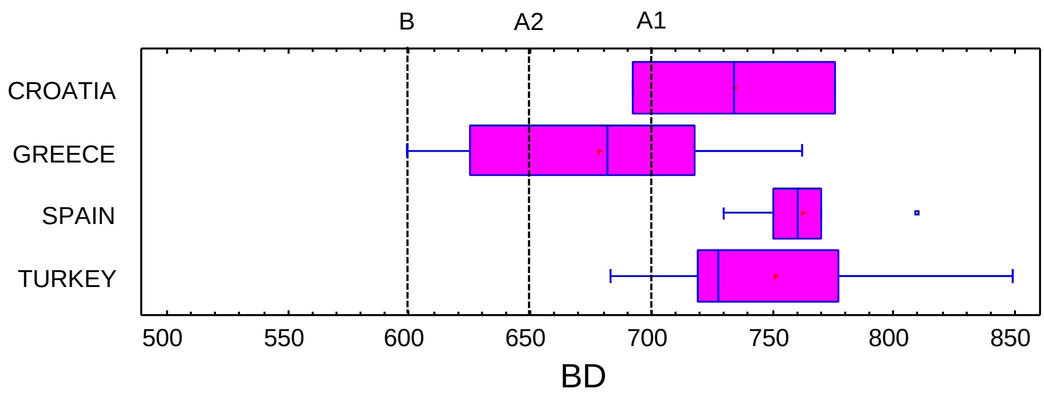


Figure 6.3.2. Box and whisker plots for the bulk density (kg/m^3, as received) of olive stones

Ash

The results regarding the ash content of the analyzed samples are shown in Table 6.3.3 and Figure 6.3.3.

Averaged over countries, the ash content of olive stones was 1.2 % (Table 5.5). As shown in Table 6.3.3, mean ash content ranged 0.4-0.7 % for Croatia, Slovenia and Spain, lying around the ash limitation imposed by the current Spanish standard for the top quality class, A1 (≤0.7 %). Mean ash content for Portugal olive stones was 0.8 %, slightly above the class A1 requirement, but below the A2 limit (≤1.0 %). Olive stones from Italy averaged 1.2 %, slightly over the A2 limit due to a sample with unusually high ash levels (5.2 %, depicted as an outlier in Figure 6.3.3), a consequence of the presence of a very high portion of olive skin (22 %, Figure 6.3.5). Turkish and Greek samples averaged 1.9 % and 2.1 % ash, respectively, clearly over the limit set for class B (≤1.5 %). High ash contents could be associated with either the use of olive stones coming from table olives (and therefore with high levels of Na and Cl) or to the utilization of inappropriate industrial processes to separate stones from pulp (and thus also high levels of pulp fraction, skin, oil, and/or mineral impurities from soil, such as Ca, Si, Fe, Al, or Ti). For example, it is known that some samples were not olive stones centrifugically extracted from the pomace, but rather exhausted olive cake that was aerodynamically separated into flesh and stones fractions. Task 3.3 will deal with the issue of selecting which samples are going to be taken into consideration to propose the specifications that will grade olive stones. In this sense, some of the outliers identified in the box and whisker plots depicted in this section for the different quality properties might be excluded.

Table 6.3.3. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the ash content (%, d.b.) of olive stones

	Ash (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.45	n.a.	n.a.	2
Greece	2.1	1.9	91	10
Italy	1.2	1.3	110	14
Portugal	0.80	0.36	45	3
Slovenia	0.40	<0.001	<0.001	4
Spain	0.71	0.15	21	10
Turkey	1.9	1.2	65	5

n.a.: not applicable

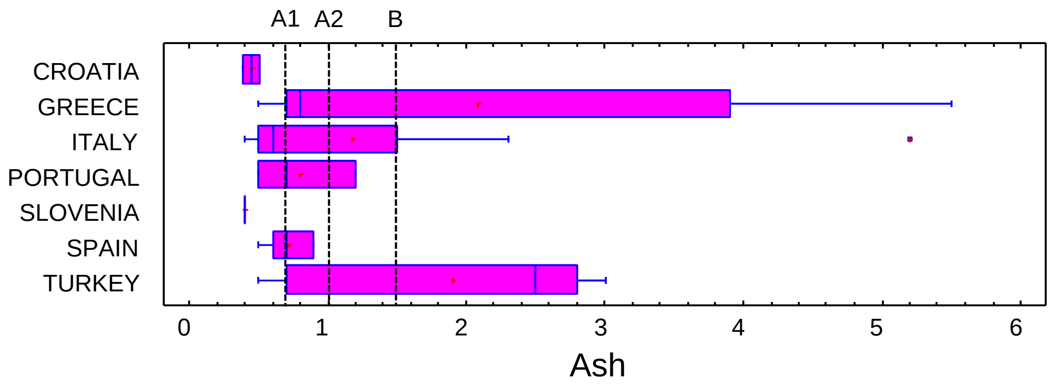


Figure 6.3.3. Box and whisker plots for the ash content (%, d.b.) of olive stones

Oil

The results regarding the oil content of the analyzed samples are shown in Table 6.3.4 and Figure 6.3.4.

The afore-mentioned Spanish standard sets tight limits regarding the oil content for this type of biomass: ≤0.6, ≤1.0, and ≤1.5 % for classes A1, A2, and B, respectively. Mean oil content for the olive stones coming from Spain, Portugal, and Slovenia was found to be 0.42 %, 0.62 %, and 0.66 % (Table 6.3.4), respectively, lying around the limit specified for the top quality class, A1 (Figure 6.3.4). In turn, Greek and Italian olive stones averaged 1.4% and 2.5 % oil content, respectively. Turkish olive stones showed the highest oil content, most samples surpassing the standard limits (Figure 6.3.4). Turkish samples averaged 6.3 % oil, with 3 out of 5 samples exhibiting oil contents ≥5 %. As was previously commented, high contents of oil could be a consequence of the presence of high fractions (not quantified) of olive pulp, an oil-rich material in general, in connection to the industrial processes developed for the separation of stones from pulp.

Table 6.3.4. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the oil content (%, d.b.) of olive stones

	Oil (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	1.4	1.2	83	10
Italy	2.5	1.4	57	14
Portugal	0.62	0.62	100	3
Slovenia	0.66	0.032	4.8	4
Spain	0.42	0.43	100	10
Turkey	6.3	6.5	100	5

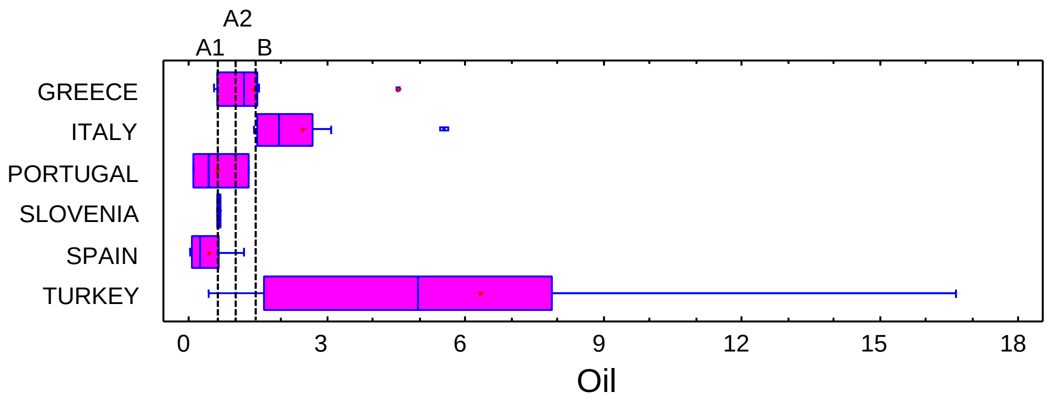


Figure 6.3.4. Box and whisker plots for the oil content (%, d.b.) of olive stones

Skin

The results regarding the skin content of the analyzed samples are shown in Table 6.3.5 and Figure 6.3.5.

The skin content was only analyzed in the olive stones coming from Spain and Italy (Table 6.3.5 and Figure 6.3.5). Spanish samples averaged 0.12 % skin, well below the limit of 1.0 % established for olive stones, class A1 in UNE 164003:2014. In turn, Italian samples exhibited much higher skin contents, averaging 3.4 %, with 7 out of 14 samples over 1.0 %. With skin contents of 8.4 % and 22 %, two of these Italian samples are shown as outliers in the box and whisker plot depicted in Figure 6.3.5. This figure also highlights the important dispersion found across the skin content of Italian samples (ranging 0.4-22 %), as opposed to the olive stone samples collected in Spain (all samples below 0.5 %). The reasons for these differences will be further investigated in Task 3.3 in order to propose the appropriate skin restrictions to grade olive stones.

Table 6.3.5. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the skin content (%, d.b.) of olive stones

	Skin (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Italy	3.4	5.9	170	14
Spain	0.12	0.12	96	10

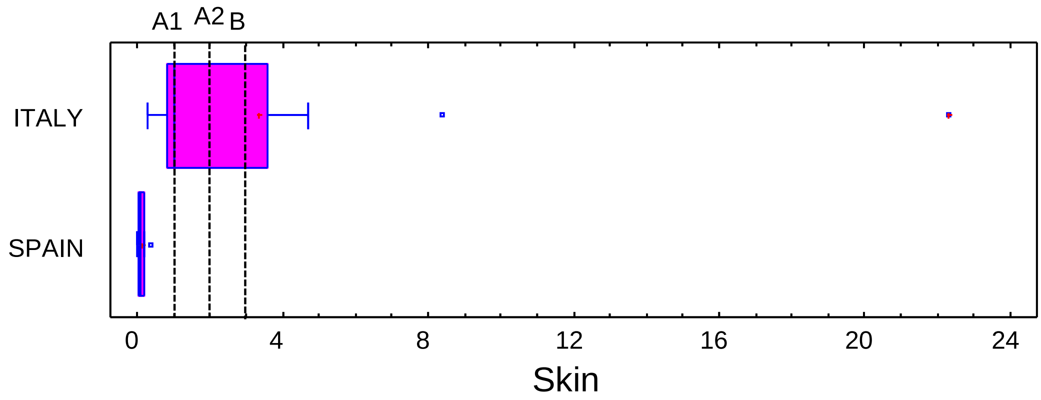


Figure 6.3.5. Box and whisker plots for the skin content (%, d.b.) of olive stones

Calorific value

The results regarding the net calorific value at constant pressure of the analyzed samples are shown in Tables 6.3.6-6.3.7 and Figures 6.3.6-6.3.7.

Olive stones from Turkey averaged the highest mean net calorific values on dry basis (19.7 MJ/kg, Table 6.3.7), possibly connected, as indicated in section 5, to the presence of oil-rich materials associated with stones (Figure 6.3.4) due to a different processing of the material for separation of pulp and other impurities. Mean calorific values were between 18.4 and 19.2 MJ/kg (d.b.) for the rest of the considered countries (Table 6.3.7).

Portuguese, Italian and Spanish samples averaged net calorific values, as received (Figure 6.3.6), higher than the minimum value set for top quality olive stones, class A1 (≥15.7 MJ/kg), in connection with their low moisture contents (Table 6.3.1). In turn, most Turkish samples did not fulfill the minimum value set for class B (≥14.9 MJ/kg), as a consequence of their elevated moisture (Figure 6.3.1).

Table 6.3.6. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, as received) of olive stones

	NCVx (as received)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Croatia	15.18	n.a.	n.a.	2
Greece	15.54	1.1	7.3	10
Italy	15.89	1.1	7.2	14
Portugal	17.16	0.76	4.5	3
Slovenia	15.45	0.26	1.7	4
Spain	16.85	0.70	4.1	10
Turkey	13.69	2.8	20	5

n.a.: not applicable

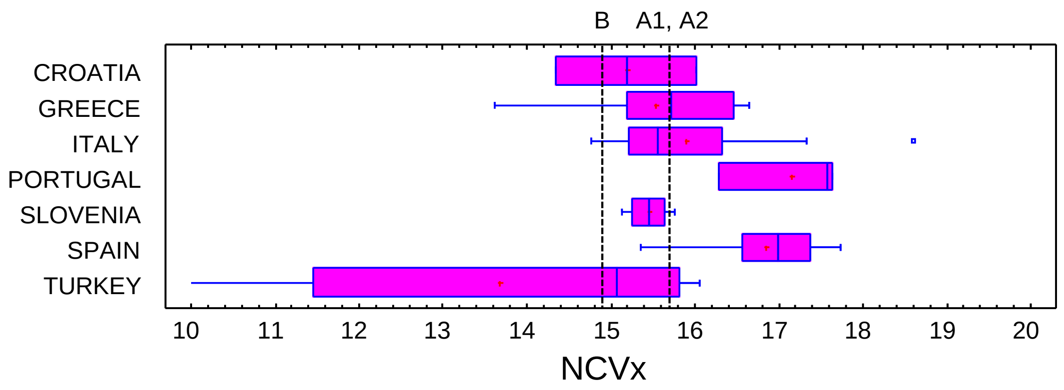


Figure 6.3.6. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, as received) of olive stones.

Table 6.3.7. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, dry basis) of olive stones

	NCVo (d.b.)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Croatia	18.81	n.a.	n.a.	2
Greece	18.59	0.24	1.3	10
Italy	19.09	0.43	2.3	14
Portugal	19.22	0.29	1.5	3
Slovenia	18.37	0.29	1.6	4
Spain	18.98	0.11	0.57	10
Turkey	19.74	0.74	3.7	5

n.a.: not applicable

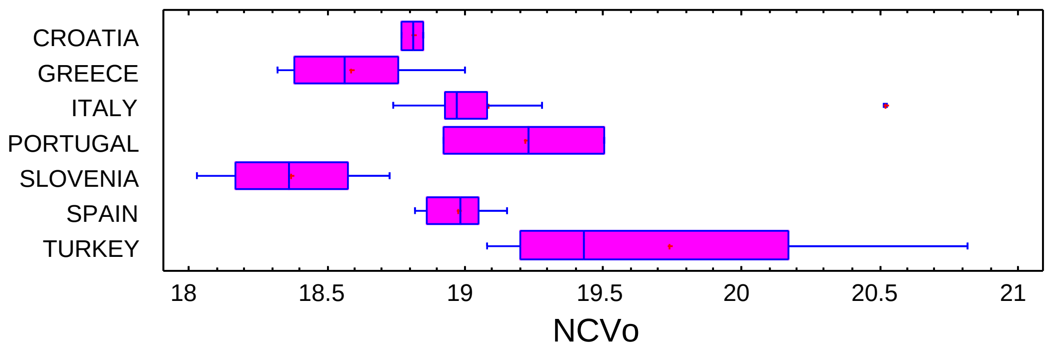


Figure 6.3.7. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, dry basis) of olive stones

Nitrogen

The results regarding the nitrogen content of the analyzed samples are shown in Table 6.3.8 and Figure 6.3.8.

It should be mentioned that calculations were made assigning a value of 0.00 % of N to two Turkish samples that showed N contents below the quantification limit reported by the laboratory which performed the analysis (<0.10 %). This assumption could underestimate to some extent the mean and median of Turkish samples, in particular their averaged value (Table 6.3.8). Croatia was not included in the box and whisker plot as both of the analyzed samples showed N contents below the quantification limit of the laboratory performing the analysis (<0.10 %).

Figure 6.3.8 shows that the N requirements for classes A1 (≤0.3 %) and A2 (≤0.4 %) were met by most of the analyzed samples, with the exception of an Italian sample and about half of the Greek samples.

Greek samples averaged 0.6 % (Table 6.3.8); the limit imposed by the Spanish standard to olive stones, class B.

The above-mentioned Italian sample was systematically identified as an outlier by the box and whisker plots depicted for most of the properties considered (see Figures 6.3.3-6.3.8 and the following figures 6.3.10 and 6.3.11). This sample was characterized by high levels of ash, skin, oil, calorific value, N, S and some heavy metals such as Cu, Cr, Ni and Pb (see Annex II for the analytical results of this particular sample).

Table 6.3.8. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nitrogen content (%, d.b.) of olive stones

	Nitrogen (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	<0.10	n.a.	n.a.	2
Greece	0.61	0.49	80	10
Italy	0.27	0.19	72	14
Portugal	0.20	<0.001	<0.001	3
Slovenia	0.27	0.090	34	4
Spain	0.17	0.040	24	10
Turkey	0.37	0.030	8.1	5

n.a.: not applicable

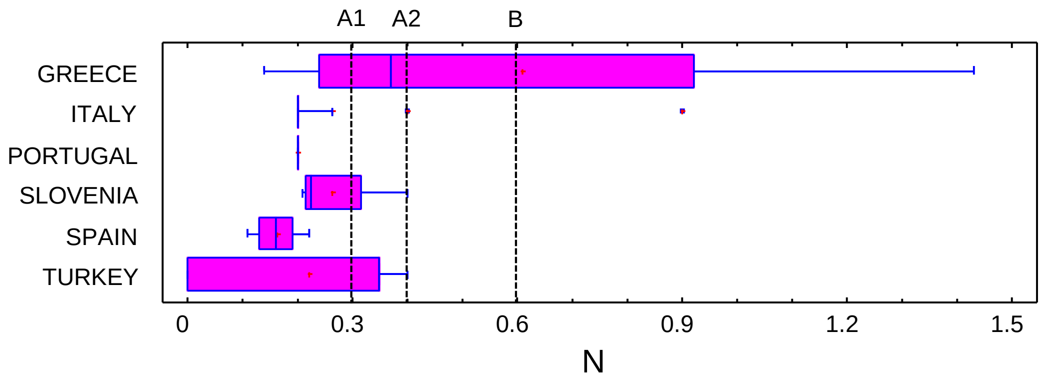


Figure 6.3.8. Box and whisker plots for the nitrogen content (%, d.b.) of olive stones

Chlorine

The results regarding the chlorine content of the analyzed samples are shown in Table 6.3.9 and Figure 6.3.9.

Cl limits were set at 0.03, 0.04 and 0.05 % for classes A1, A2, and B, respectively. As can be seen in Table 6.3.9 and Figure 6.3.9, Cl levels averaged 0.02 % for Spain and Slovenia, 0.03 % for Italy, and 0.04 % for Portugal and Croatia. Again, Greek (0.11 % Cl) and Turkish (0.58 % Cl) samples exhibited mean Cl contents clearly outside the limits set by the Spanish standard that grades olive stones. The raised levels noticed for some elements and the ash content of Greek and Turkish olive stones suggest high mineral fractions in these samples, probably due to the presence of undesirable impurities such as pulp or skin, or salt which is added to olive fruits for table use.

As mentioned in section 5, the average values obtained would be greatly reduced if these samples with high contents of oil, ash, Cl, and other elements, would be removed from the analysis.

Table 6.3.9. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the chlorine content (%, d.b.) of olive stones

	Chlorine (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.04	n.a.	n.a.	2
Greece	0.11	0.088	81	10
Italy	0.03	0.014	56	14
Portugal	0.04	0.042	96	3
Slovenia	0.02	0.010	43	4
Spain	0.02	0.015	75	10
Turkey	0.58	0.53	92	5

n.a.: not applicable

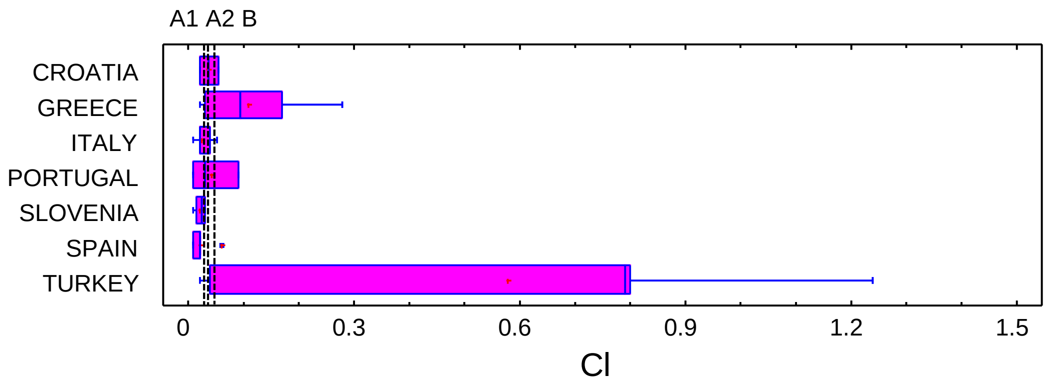


Figure 6.3.9. Box and whisker plots for the chlorine content (%, d.b.) of olive stones

Sulfur

The results regarding the sulfur content of the analyzed samples are shown in Table 6.3.10 and Figure 6.3.10.

Sulfur requirements for class A1 (≤0.02 %) were met by all the Croatian, Italian, Portuguese, Slovenian and Turkish samples (Figure 6.3.10). All Spanish samples met the S limit set for class A2 (≤0.03 %). In turn, some of the analyzed Greek samples as well as the Italian outlier that was previously identified exhibited higher S contents, well over the limit set for class B (≤0.05 %).

Table 6.3.10. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sulfur content (%, d.b.) of olive stones

	Sulfur (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.01	n.a.	n.a.	2
Greece	0.04	0.036	93	10
Italy	0.02	0.017	96	14
Portugal	0.01	0.006	43	3
Slovenia	0.01	0.005	40	4
Spain	0.02	0.007	29	10
Turkey	0.02	0.011	44	5

n.a.: not applicable

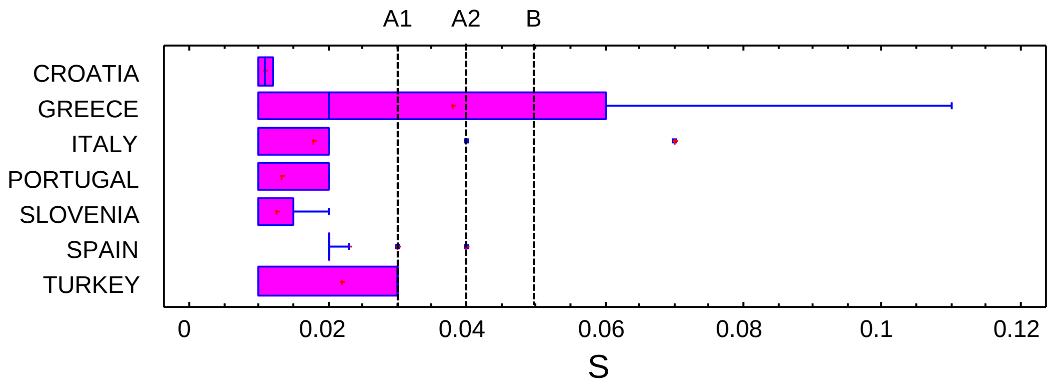


Figure 6.3.10. Box and whisker plots for the sulfur content (%, d.b.) of olive stones

Trace elements

The levels of As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn were generally low, and sometimes even below the quantification limits of the analytical methods utilized. The requirements set by the Spanish standard UNE 164003:2014 for the trace elements of olive stones were met by the vast majority of the analyzed samples, no matter their country of origin.

An exception is a Spanish sample with a very high level of lead, probably polluted with metalic particles coming from the machinery used during the processing of the biomass. Another exception is a Turkish sample that exhibited extremely high levels of chromium (12 mg/kg). The recurrent Italian outlier, already identified in the previous sections, also showed high levels of several trace elements, in particular a content of Zn (162 mg/kg), well over the limit of 20 mg/kg set in UNE 164003:20034.

The results regarding the copper content of the analyzed samples are shown in Table 6.3.11 and Figure 6.3.11. It should be pointed out that calculations were made assigning a value of 0.00 mg/kg of Cu to four Italian samples that showed a Cu content below the quantification limit reported by the laboratory which performed the analysis (<1.0 mg/kg), which might have led to the underestimation of the mean and median values calculated for the samples coming from this country.

Averaged over countries, copper levels were 4.2 mg/kg (Table 5.21), with all the analyzed samples below the limit of 15 mg/kg set for all the quality classes of olive stones (Figure 6.3.11). Across countries, mean copper contents ranged from 2.0 mg/kg (Slovenia) to 6.3 mg/kg (Greece) (Table 6.3.11).

Table 6.3.11. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the copper content (mg/kg, d.b.) of olive stones

	Copper (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	2.8	n.a.	n.a.	2
Greece	6.3	4.7	76	10
Italy	2.7	3.1	120	14
Portugal	4.0	0.79	20	3
Slovenia	2.0	0.13	6.5	4
Spain	5.4	3.9	72	10
Turkey	4.3	1.8	42	5

n.a.: not applicable

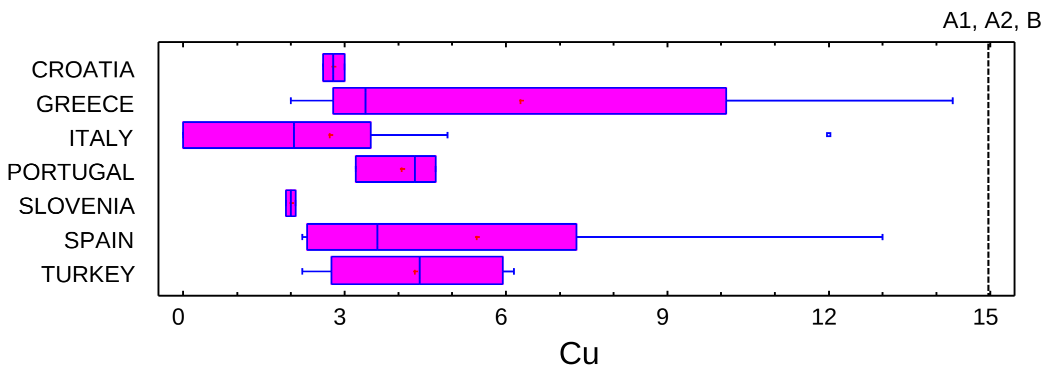


Figure 6.3.11. Box and whisker plots for the copper content (mg/kg, d.b.) of olive stones

6.4 ALMOND SHELLS

As previously mentioned, a national standard has been recently published in Spain (UNE 164004:2014), specifically setting the requirements for three different quality classes (A1, A2, and B) of dry fruit shells. The dry fruit shells included in this standard are almond, hazelnut, and pine nut shells. Therefore, the limits set for almond shells in this standard are the ones taken into consideration to discuss the quality of the almond shells analyzed.

Again, as in the case of olive stones, it should be taken into account that great part of the variability found in the quality properties of the fruit shells analyzed in this study could be due to the different fractions of almond grains that could be still present in these samples. This fraction could not be quantified as the particle size of these commercial samples was sometimes previously reduced by the producer.

For comparison reasons, the requirements for graded almond shells, according to the recent Spanish standard on fruit shells (UNE 164004:2014), are depicted in the box and whisker plots included in this section.

It is worth mentioning that only one sample of almond shells was collected in Portugal, and therefore no conclusions can be derived for Portuguese almond shells.

Moisture

The results regarding the moisture content of the analyzed samples, as received, are shown in Table 6.4.1 and Figure 6.4.1. As mentioned, they should be merely taken as an indication.

Almond shells from Greece and Spain showed relatively low moisture contents in most cases (averaging 10 %) and generally fulfilled the limit for almond shells, class A1 (≤12 %), according to UNE 164004:2014. Italian and Portuguese samples showed slightly higher moisture contents, but always complying with the class B specification (≤16 %).

Table 6.4.1. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the moisture content (% w.b., as received) of almond shells

	Moisture (as received)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	10.2	0.48	4.7	6
Italy	12.4	0.14	1.2	8
Portugal	13.2	n.a.	n.a.	1
Spain	10.1	1.5	15	10

n.a. : not applicable

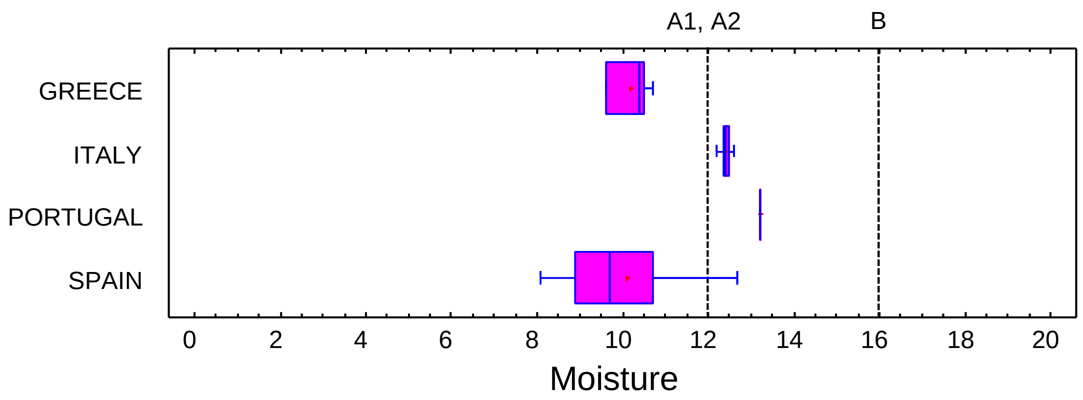


Figure 6.4.1. Box and whisker plots for the moisture content (% w.b., as received) of almond shells

Bulk density

The results regarding the bulk density of the analyzed samples are shown in Table 6.4.2 and Figure 6.4.2.

The bulk density was determined only for the Greek and Spanish almond shells. Spanish and Greek samples averaged 390 and 440 kg/m^3, respectively (Table 6.4.2). Most samples were found to be between the requirements for classes A2 and A1 (Figure 6.4.2).

Table 6.4.2. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the bulk density (kg/m^3, as received) of almond shells

	Bulk density (as received)			
Country	**mean** (kg/m^3)	**S** (kg/m^3)	**C.V.** (%)	**n**
Greece	440	64	15	6
Spain	390	100	27	10

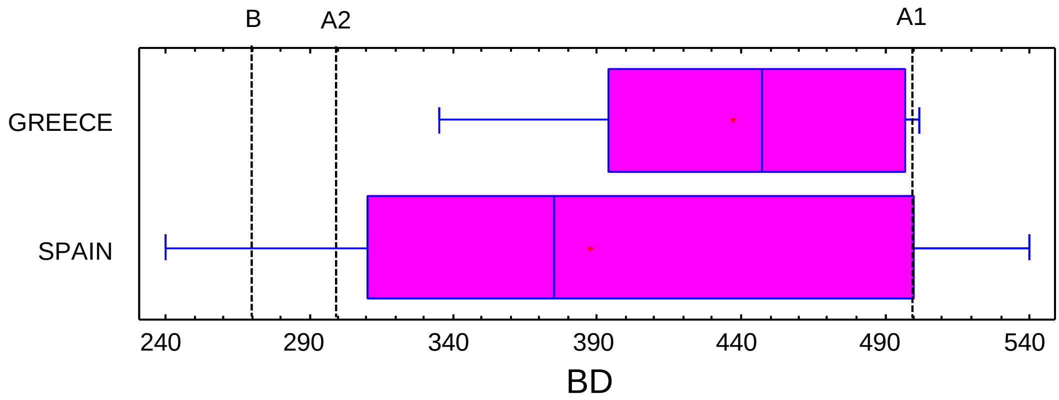


Figure 6.4.2. Box and whisker plots for the bulk density (kg/m^3, as received) of almond shells

Ash

The results regarding the ash content of the analyzed samples are shown in Table 6.4.3 and Figure 6.4.3.

Most of the samples collected in Italy, Portugal and Spain, fulfilled the requirement for almond shells, class B (≤2.0 %) (Figure 6.4.3). The ash content of the Italian and Spanish samples averaged 1.4 % (Table 6.4.3), below the limitation set for class A2 (≤1.5 %). Greek samples ranged 1.1-3.3 %, being some of them above the limitation of 2.0 % set for class B. It should be also mentioned that only two Spanish samples, out of the 25 samples analyzed, met the ash requirement set for the top quality class, A1 (≤0.7 %). Task 3.3 will address the question whether this limitation is too restrictive.

Table 6.4.3. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the ash content (%, d.b.) of almond shells

	Ash (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	2.3	0.84	37	6
Italy	1.4	0.15	11	8
Portugal	1.8	n.a.	n.a.	1
Spain	1.4	0.49	35	10

n.a. : not applicable

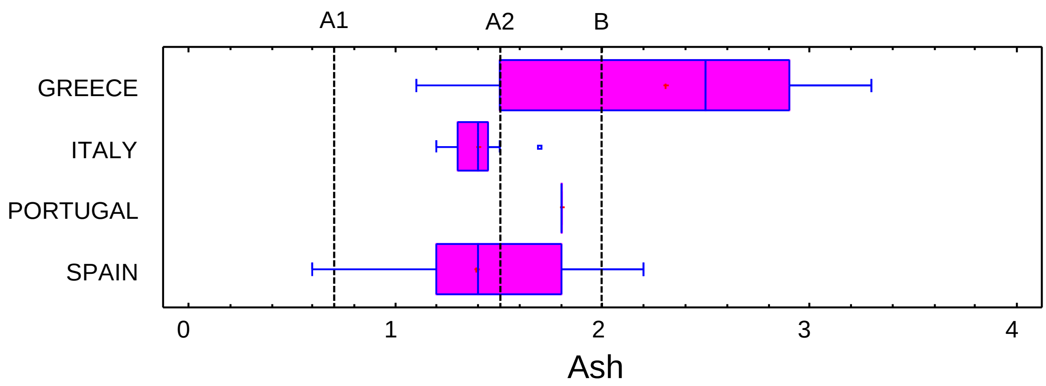


Figure 6.4.3. Box and whisker plots for the ash content (%, d.b.) of almond shells

Oil

The results regarding the oil content of the analyzed samples are shown in Table 6.4.4 and Figure 6.4.4.

With the exception of Spanish samples (Figure 6.4.4), all the almond shells that came from the rest of the countries exhibited oil contents well above the limitations set in the Spanish standard UNE 164004:20014 that grades almond shells (≤0.6, 1.0 and 1.5 % for classes A1, A2, and B, respectively).

Spanish almond shells averaged oil contents of 0.78 %, whereas Greek, Italian, and Portuguese samples showed mean contents varying between 2.0 and 2.9 % (Table 6.4.4). As previously mentioned, this could be a consequence of the presence of almonds, oil-rich fruits, in the analyzed samples.

Table 6.4.4. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the oil content (%, d.b.) of almond shells

	Oil (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	2.8	0.53	19	6
Italy	2.9	0.91	31	8
Portugal	2.0	n.a.	n.a.	1
Spain	0.78	0.61	78	9

n.a. : not applicable

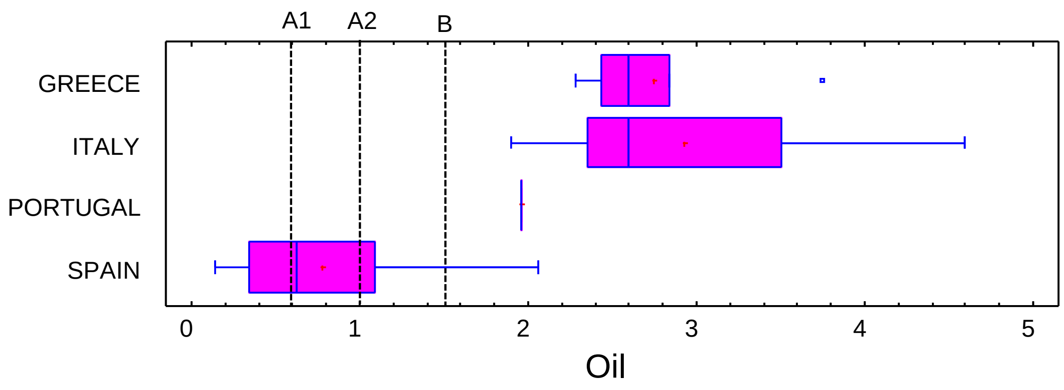


Figure 6.4.4. Box and whisker plots for the oil content (%, d.b.) of almond shells

Calorific value

The results regarding the calorific value of the analyzed samples are shown in Tables 6.4.5-6.5.6 and Figures 6.4.5-6.5.6.

As can be seen in Figure 6.4.5, all almond shells, no matter their country of origin, exhibited net calorific values well over the minimum requirement set in the Spanish standard for the top quality class A1 (≥15.0 MJ/kg, as received).

Mean net calorific values were maintained in a pretty narrow range across countries; from 16.0 to 16.1 MJ/kg, as received (Table 6.4.5), and from 18.2 to 18.8 MJ/kg, on a dry basis (Table 6.4.6).

Table 6.4.5. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, as received) of almond shells

	NCVx (as received)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Greece	16.13	0.37	2.3	6
Italy	15.97	0.15	0.93	8
Portugal	15.96	n.a.	n.a.	1
Spain	16.08	0.44	2.7	10

n.a. : not applicable

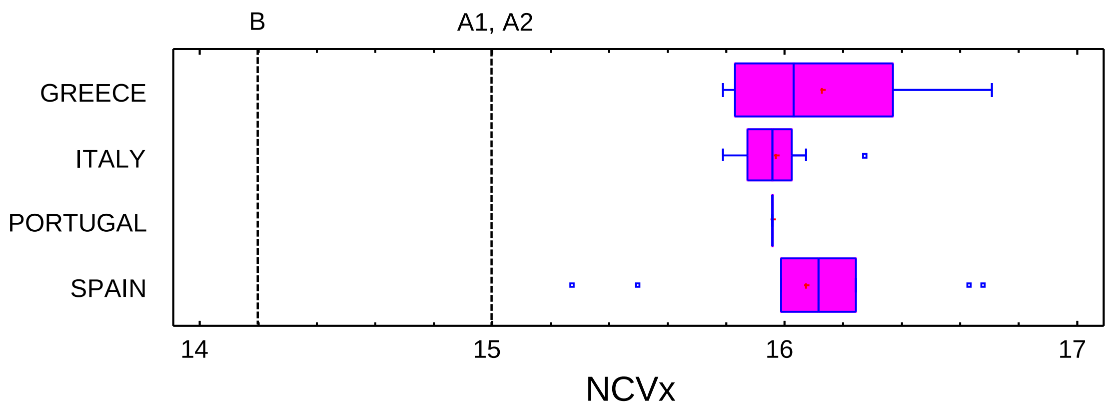


Figure 6.4.5. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, as received) of almond shells

Table 6.4.6. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, d.b.) of almond shells

	NCVo (d.b.)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Greece	18.23	0.34	1.9	6
Italy	18.58	0.16	0.84	8
Portugal	18.76	n.a.	n.a.	1
Spain	18.15	0.34	1.9	10

n.a. : not applicable

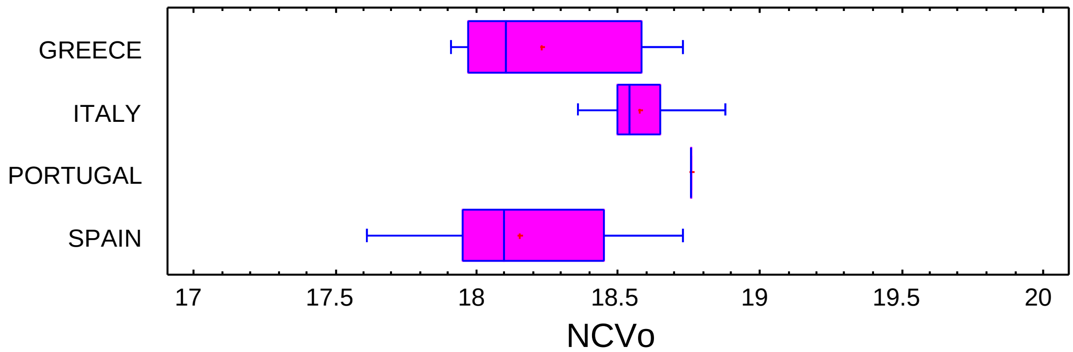


Figure 6.4.6. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, d.b.) of almond shells

Nitrogen

The results regarding the nitrogen content of the analyzed samples are shown in Table 6.4.7 and Figure 6.4.7.

Most of the Italian, Portuguese and Spanish samples met the A1 requirements for N (≤0.4 %, Figure 6.4.7). Two Spanish samples and most of the Greek samples surpassed this limit, but they were generally maintained within the maximum accepted level for class B (≤0.6 % N).

Table 6.4.7. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nitrogen content (%, d.b.) of almond shells

	Nitrogen (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	0.64	0.31	48	6
Italy	0.24	0.042	18	8
Portugal	0.20	n.a.	n.a.	1
Spain	0.31	0.14	44	10

n.a. : not applicable

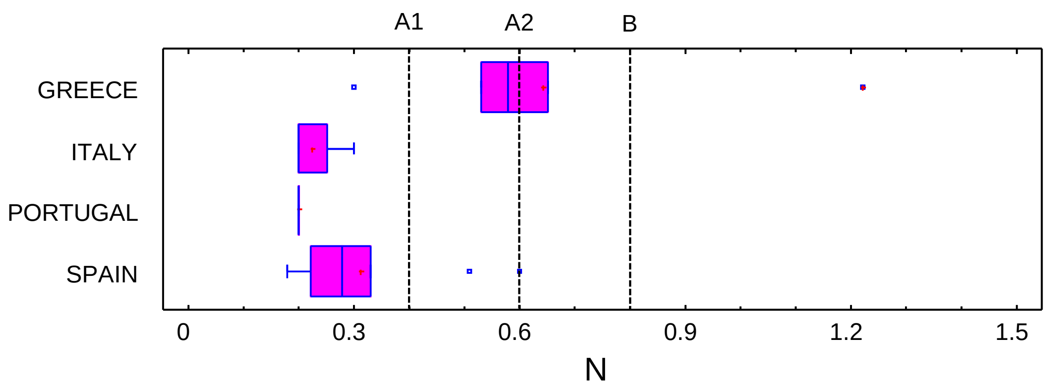


Figure 6.4.7. Box and whisker plots for the nitrogen content (%, d.b.) of almond shells

Chlorine

The results regarding the chlorine content of the analyzed samples are shown in Table 6.4.8 and Figure 6.4.8.

In general, Italian, Portuguese and most Spanish samples met A1/A2 requirements for Cl (≤0.02 %) and all of them complied with the limit set for class B (≤0.03 %). In turn, Greek samples exhibited higher Cl contents, sometimes even above the class B limitation (Figure 6.4.8), in connection with their elevated ash mineral contents (Figure 6.4.3).

Table 6.4.8. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the chlorine content (%, d.b.) of almond shells

	Chlorine (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	0.03	0.009	26	5
Italy	0.01	<0.001	<0.001	8
Portugal	0.01	n.a.	n.a.	1
Spain	0.02	0.010	60	10

n.a. : not applicable

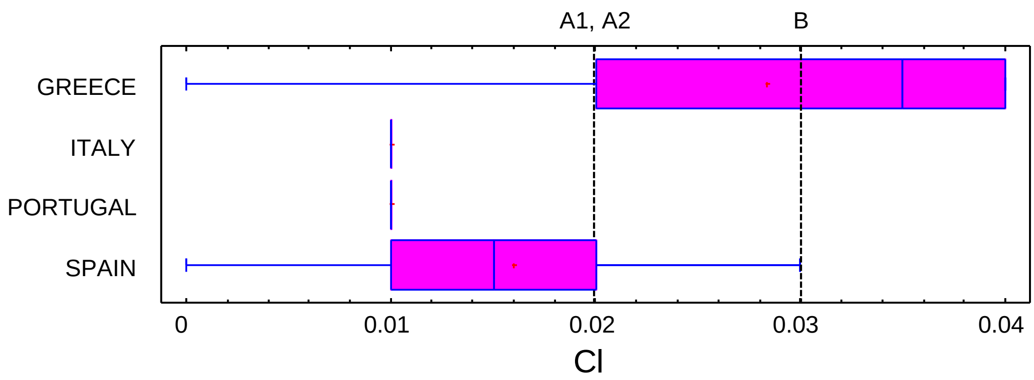


Figure 6.4.8. Box and whisker plots for the chlorine content (%, d.b.) of almond shells

Sulfur

The results regarding the sulfur content of the analyzed samples are shown in Table 6.4.9 and Figure 6.4.9.

The S requirement for class A1 (0.03 %) were attained by all samples (Figure 6.4.9). Across countries, almond shells averaged S contents of 0.01-0.02 % (Table 6.4.9).

Table 6.4.9. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sulphur content (%, d.b.) of almond shells

	Sulfur (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	0.02	0.005	31	6
Italy	0.01	<0.001	<0.001	8
Portugal	0.02	n.a.	n.a.	1
Spain	0.02	0.010	60	10

n.a. : not applicable

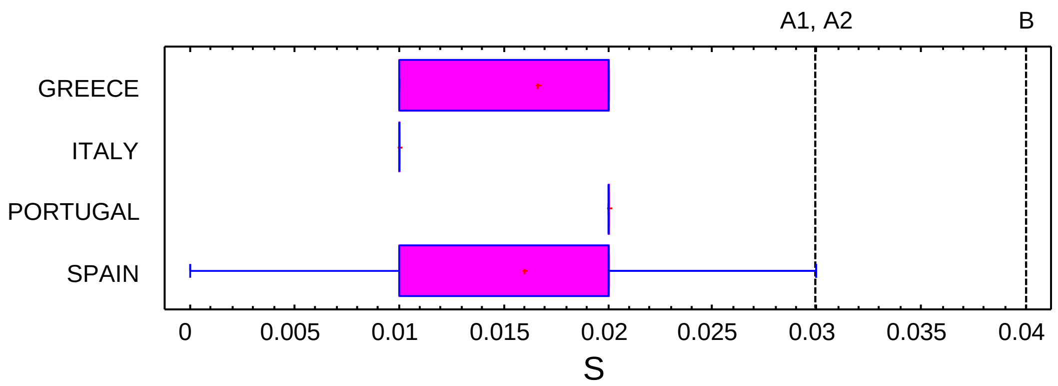


Figure 6.4.9. Box and whisker plots for the moisture content (%, as received) for the sulphur content (%, d.b.) of almond shells

Trace elements

In general, the levels of As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn for almond shells were generally very low, and sometimes even below the quantification limits of the analytical methods utilized.

The results regarding the copper content of the analyzed samples are shown in Table 6.4.10 and Figure 6.4.10.

The limits established in the Spanish standard of reference for trace elements were attained by all samples, excepting for a Greek sample with a very high Cu level (13.5 mg/kg) (Figure 6.4.10). Copper levels averaged 2.1-6.3 mg/kg across countries (Table 6.4.10)

Table 6.4.10. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the copper content (mg/kg, d.b.) of almond shells

	Copper (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Greece	6.3	3.8	60	6
Italy	2.1	0.76	36	8
Portugal	3.5	n.a.	n.a.	1
Spain	2.5	1.7	71	10

n.a. : not applicable

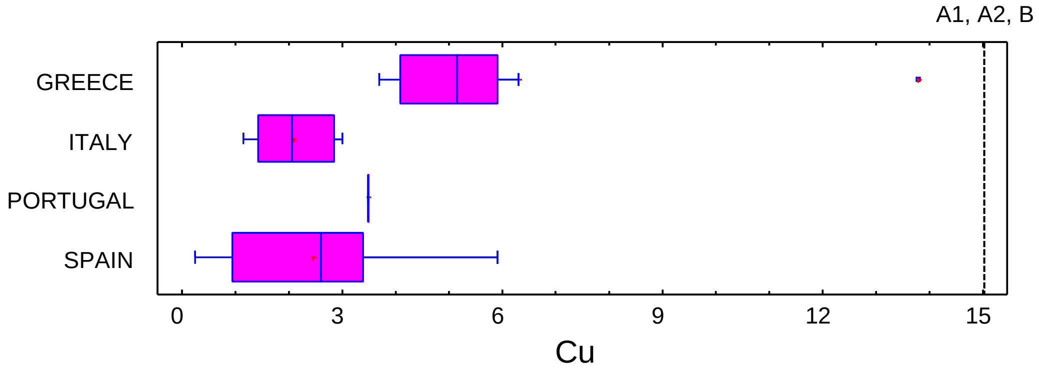


Figure 6.4.10. Box and whisker plots for the copper content (mg/kg, d.b.) of almond shells.

6.5 HAZELNUT SHELLS

As it was previously commented, the Spanish standard on dry fruit shells (UNE 164004:2014) also grades hazelnut shells. Therefore, the requirements set in this national standard for the three quality classes of hazelnut shells (A1, A2 and B) were depicted in the box and whisker plots included in this section.

It should be pointed out that hazelnut shells were only collected in three countries: Croatia, Spain, and Turkey.

Moisture

The results regarding the moisture content of the analyzed samples, as received, are shown in Table 6.5.1 and Figure 6.5.1. As mentioned, they should be merely taken as an indication.

The moisture content of the received samples averaged 11.7, 13.3, and 14.8 % for Spanish, Turkish, and Croatian samples, respectively (Table 6.5.1). With some exceptions, most of the collected samples exhibited moisture contents below the maximum limits set for class B (Figure 6.5.1).

Table 6.5.1. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the moisture content (% w.b., as received) of hazelnut shells

	Moisture (as received)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	14.8	1.4	9.7	10
Spain	11.7	1.7	14	5
Turkey	13.3	1.3	9.7	10

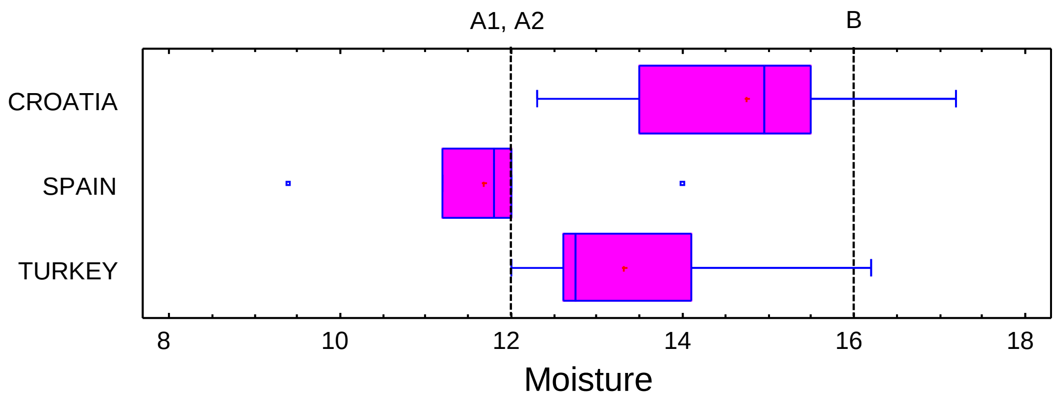


Figure 6.5.1. Box and whisker plots for the moisture content (% w.b., as received) of hazelnut shells

Bulk density

The results regarding the bulk density of the analyzed samples are shown in Table 6.5.2 and Figure 6.5.2.

None of the samples exhibited the minimum bulk density established for class A1 (≥ 500 kg/m^3, as received, Figure 6.5.2).

As can be seen in Table 6.5.2, hazelnut shells averaged bulk densities that ranged between 300 kg/m^3 (Turkey) and 380 kg/m^3 (Spain).

Table 6.5.2. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the bulk density (kg/m^3, as received) of hazelnut shells

Bulk density (as received)				
Country	**mean** (kg/m^3)	**S** (kg/m^3)	**C.V.** (%)	**n**
Croatia	330	33	9.9	10
Spain	380	29	7.7	5
Turkey	300	16	5.3	10

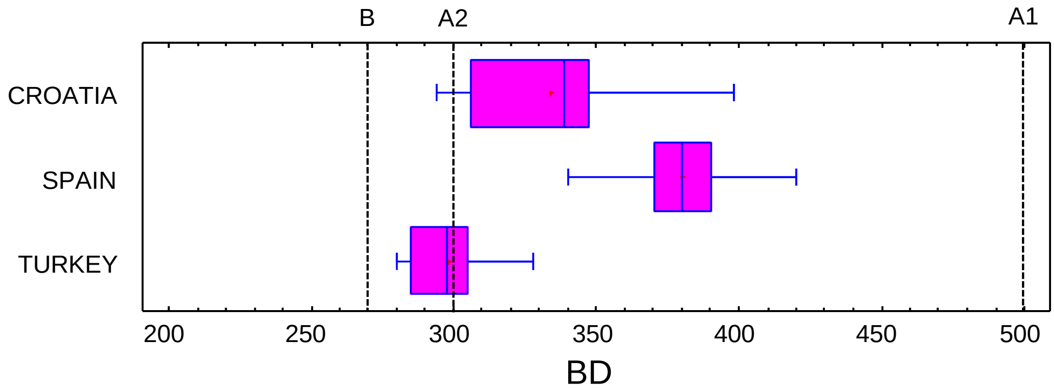


Figure 6.5.2. Box and whisker plots for the bulk density (kg/m^3, as received) of hazelnut shells

Ash

The results regarding the ash content of the analyzed samples are shown in Table 6.5.3 and Figure 6.5.3.

Excepting for two samples, which exhibited ash contents of 1.6 % and 1.8 %, the rest of the analyzed samples showed ash levels below the A2 requirement (≤1.5 %), and they ranged 0.9-1.5 % ash. None of them (Figure 6.5.3) met the restrictive ash requirement set for class A1 (≤0.7 %).

Table 6.5.3. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the ash content (%, d.b.) of hazelnut shells

	Ash (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	1.2	0.18	15	10
Spain	1.3	0.11	9.0	5
Turkey	1.2	0.22	18	10

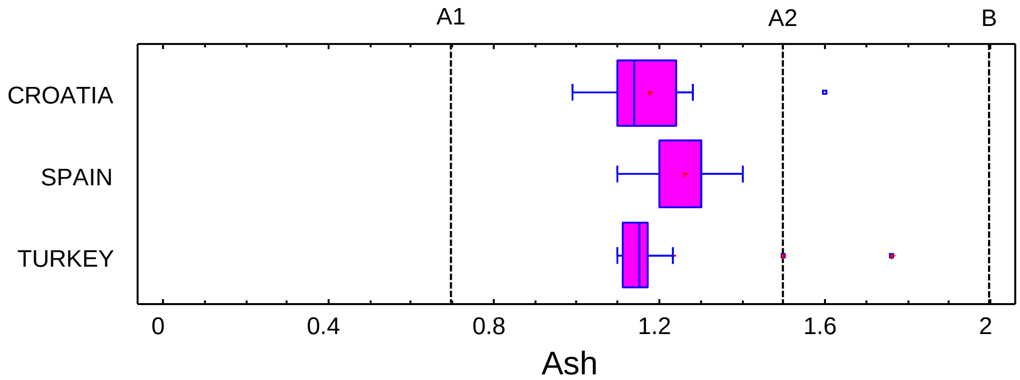


Figure 6.5.3. Box and whisker plots for the ash content (%, d.b.) of hazelnut shells

Oil

The results regarding the oil content of the analyzed samples are shown in Table 6.5.4 and Figure 6.5.4.

Oil content was analyzed only for the samples collected in Spain and Turkey. 8 out of 10 Turkish samples were below the oil maximum value set for hazelnut shells class A1 (≤0.6 % oil), and only one sample showed elevated levels of oil (2.7%). None of the five Spanish samples were below 0.6 % oil (Figure 6.5.4). Four Spanish samples showed oil contents ≥1.7 %, clearly above the class B limitation (≤1.5 %). As mentioned in the case of other dry fruit shells, high oil contents could be linked to the presence of hazelnut grains fraction in the samples (not quantified).

Table 6.5.4. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the oil content (%, d.b.) of hazelnut shells

	Oil (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Spain	2.8	2.3	83	5
Turkey	0.61	0.78	130	10

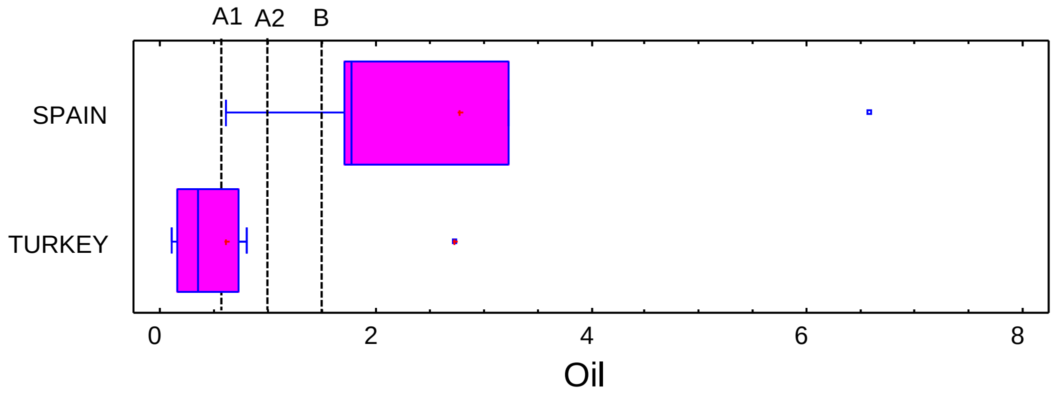


Figure 6.5.4. Box and whisker plots for the oil content (%, d.b.) of hazelnut shells

Calorific values

The results regarding the calorific value of the analyzed samples are shown in Tables 6.5.5-6.5.6 and Figures 6.5.5-6.5.6.

The minimum net calorific value set for top quality class A1 is 15.0 MJ/kg (as received). This requirement was met by all samples (Figure 6.5.5).

On a dry basis, net calorific values were maintained at a pretty narrow range (Figure 6.5.6), and averaged 19.0-19.6 MJ/kg, across countries (Table 6.5.6). The only exception was a Spanish sample that showed a very high calorific value of 20.2 MJ/kg (Figure 6.5.6), in connection to its elevated oil content (6.6 %, Figure 6.5.4), probably a consequence of the presence of high amounts of fruit grains in this sample.

Table 6.5.5. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, as received) of hazelnut shells

	NCVx (as received)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Croatia	16.14	0.40	2.5	10
Spain	17.06	0.64	3.8	5
Turkey	16.31	0.29	1.8	10

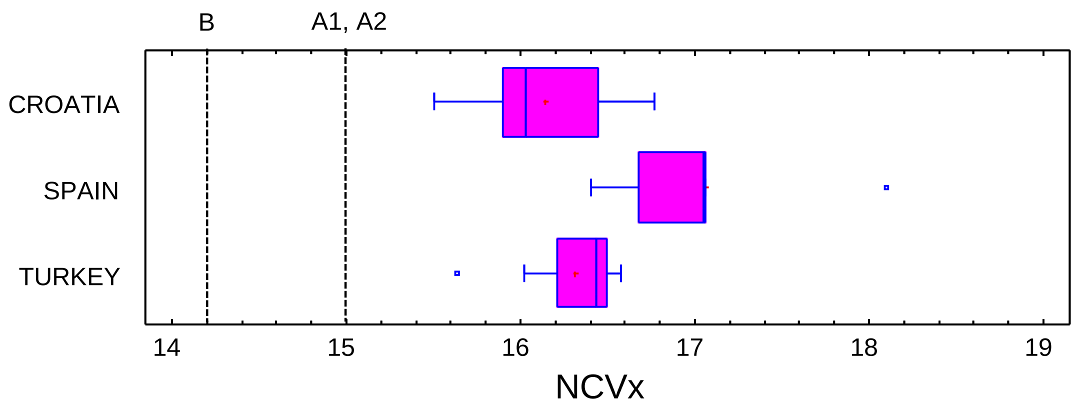


Figure 6.5.5. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, as received) of hazelnut shells

Table 6.5.6. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, d.b.) of hazelnut shells

	NCVo (d.b.)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Croatia	19.16	0.17	0.87	10
Spain	19.63	0.36	1.8	5
Turkey	19.00	0.090	0.47	10

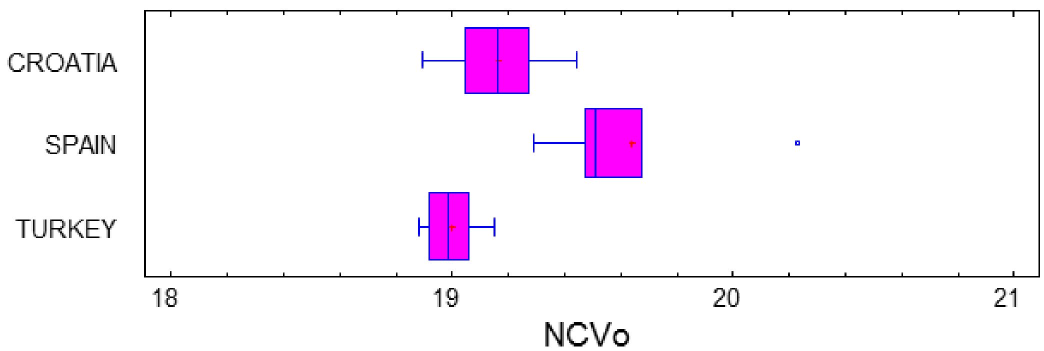


Figure 6.5.6. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, d.b.) of hazelnut shells

Nitrogen

The results regarding the nitrogen content of the analyzed samples are shown in Table 6.5.7 and Figure 6.5.7.

Most of the analyzed hazelnut shells fulfilled the N limitation set for class A1 (≤0.4 %, Figure 6.5.7).

Table 6.5.7. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nitrogen content (%, d.b.) of hazelnut shells

	Nitrogen (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.25	0.06	23	10
Spain	0.32	0.04	12	5
Turkey	0.28	0.06	23	10

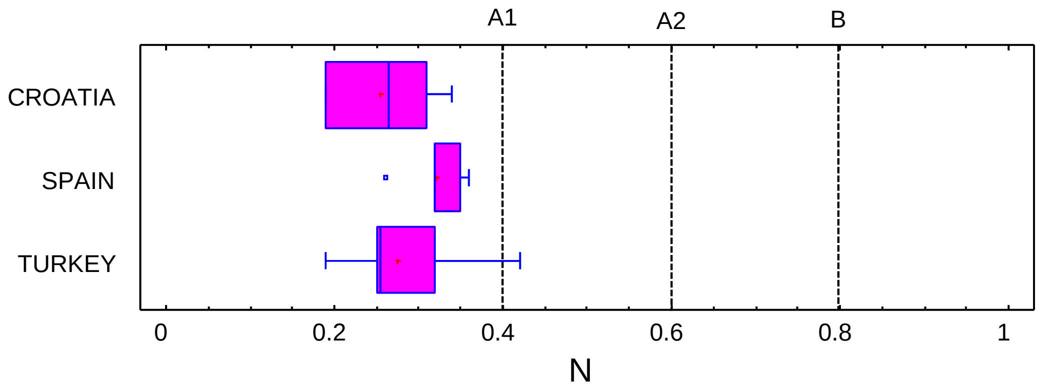


Figure 6.5.7. Box and whisker plots for the nitrogen content (%, d.b.) of hazelnut shells

Chlorine

The results regarding the chlorine content of the analyzed samples are shown in Table 6.5.8 and Figure 6.5.8.

All the Croatian and Turkish samples fulfilled the requirement set for chlorine for classes A1 and A2 (Figure 6.58). In turn, Spanish samples exhibited higher levels of chlorine, averaging 0.03 % (Table 6.5.8). All samples were below the limit of class B.

Table 6.5.8. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the chlorine content (%, d.b.) of hazelnut shells

	Chlorine (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.01	0.004	41	10
Spain	0.03	0.004	16	5
Turkey	0.01	0.003	23	10

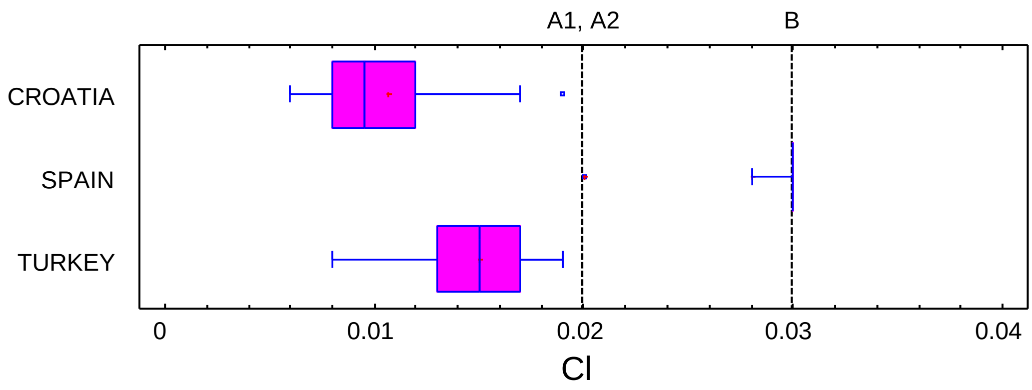


Figure 6.5.8. Box and whisker plots for the nitrogen content (%, d.b.) of hazelnut shells

Sulfur

The results regarding sulfur content of the analyzed samples are shown in Table 6.5.9 and Figure 6.5.9.

As can be seen in Figure 6.5.9, most of the analyzed samples met the sulfur criteria for classes A1 and A2 (≤0.03 %), and all of them for class B (≤0.04 %).

Table 6.5.9. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sulfur content (%, d.b.) of hazelnut shells

	Sulfur (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Croatia	0.02	0.003	14	10
Spain	0.03	0.007	24	5
Turkey	0.02	0.003	13	5

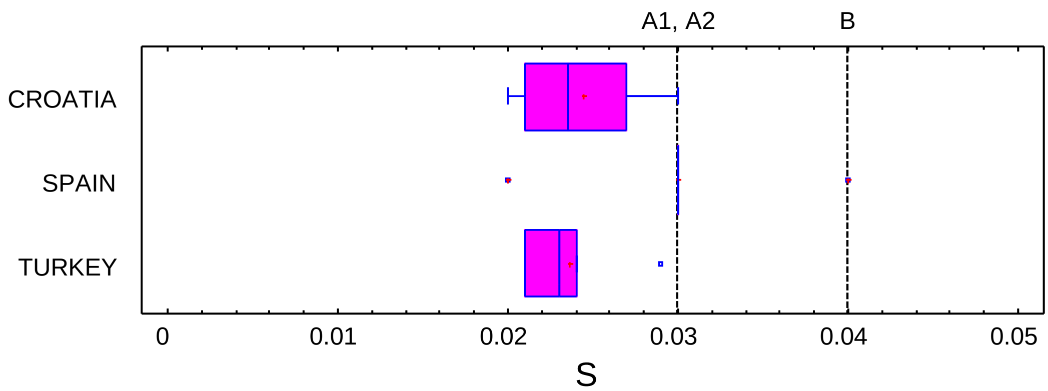


Figure 6.5.9. Box and whisker plots for the sulfur content (%, d.b.) of hazelnut shells

Trace elements

The contents of As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn were generally below the limits specified in the national Spanish standard that grades hazelnut shells, and sometimes even below the quantification limits of the analytical methods utilized.

Exceptions are two Turkish samples with high contents of Cr (11 and 13 mg/kg), and two Spanish samples, one of them with high contents of As (1.1 mg/kg) and another one with elevated content of Cu (22 mg/kg) and Zn (24 mg/kg).

The results regarding the content of Cu, Hg, Ni, and Zn of the analyzed hazelnut shells are shown in Tables 6.5.10-6.5.13 and Figures 6.5.10-6.5.13.

Table 6.5.10. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the copper content (mg/kg, d.b.) of hazelnut shells

	Copper (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	4.7	1.1	23	10
Spain	7.4	8.3	110	5
Turkey	4.3	0.43	10	10

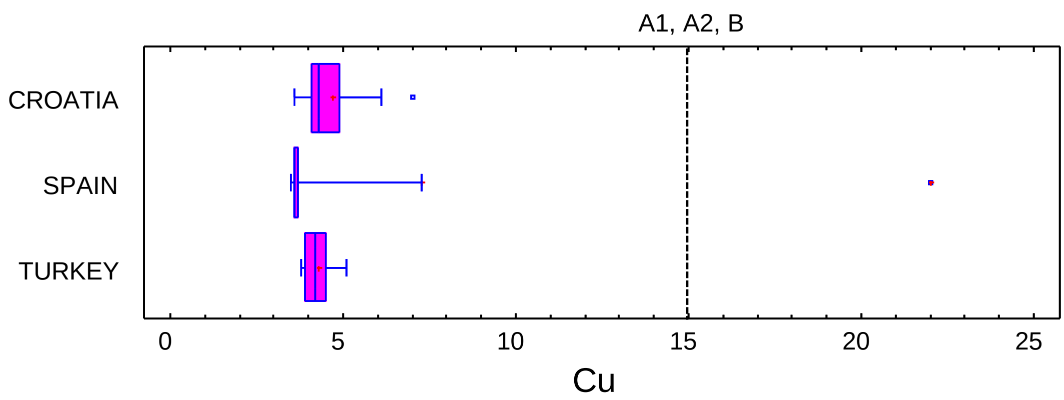


Figure 6.5.10. Box and whisker plots for the copper content (mg/kg, d.b.) of hazelnut shells

Table 6.5.11. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the mercury content (mg/kg, d.b.) of hazelnut shells

	Mercury (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	0.001	0.0001	17	10
Spain	0.001	0.0010	87	5
Turkey	0.001	0.0003	37	10

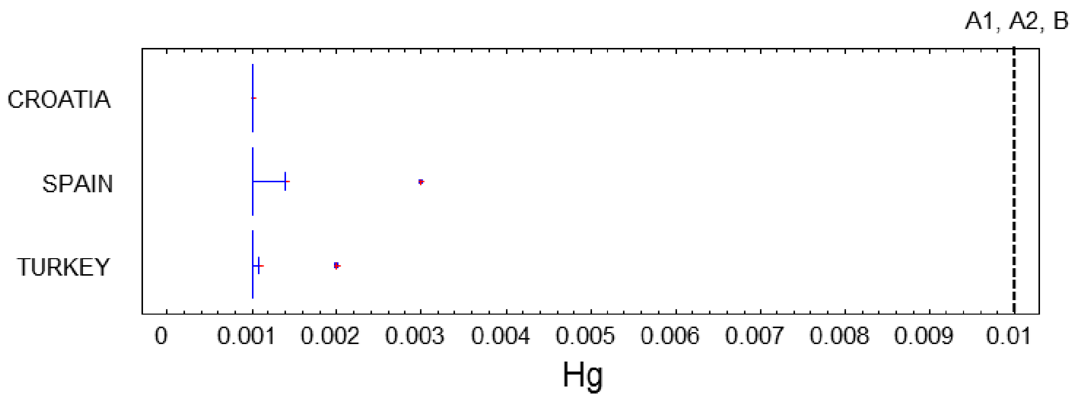


Figure 6.5.11. Box and whisker plots for the mercury content (mg/kg, d.b.) of hazelnut shells.

Table 6.5.12. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nickel content (mg/kg, d.b.) of hazelnut shells

	Nickel (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	2.0	1.6	78	10
Spain	3.5	1.6	46	5
Turkey	2.3	2.6	110	10

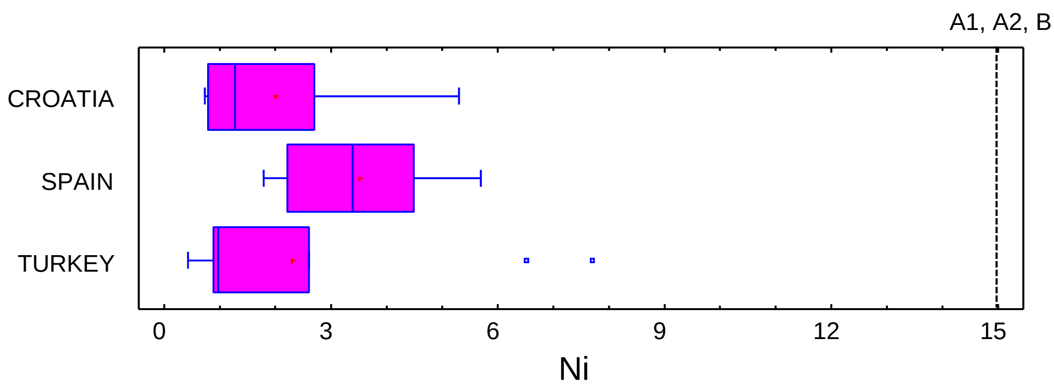


Figure 6.5.12. Box and whisker plots for the nickel content (mg/kg, d.b.) of hazelnut shells

Table 6.5.13. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the zinc content (mg/kg, d.b.) of hazelnut shells

		Zinc (d.b.)		
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Croatia	4.1	0.84	20	10
Spain	8.2	9.0	110	5
Turkey	4.9	1.2	24	10

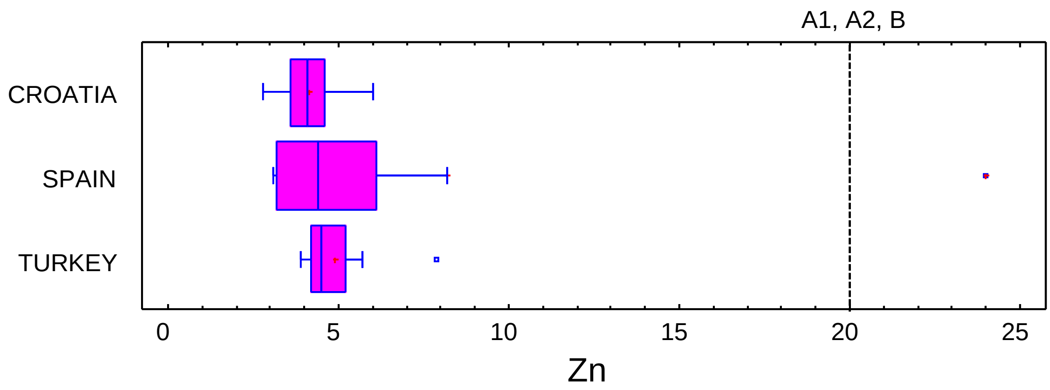


Figure 6.5.13. Box and whisker plots for the zinc content (mg/kg, d.b.) of hazelnut shells

6.6 WALNUT SHELLS

First of all, it should be mentioned that, as far as the authors know, there is no standard that grades walnut shells. Hence, the requirements set for other fruit shells in the national Spanish standard UNE 164004:2014, in particular the ones for almond and hazelnut shells, have been used in this section as a reference for comparison reasons. Therefore, the requirements for classes A1, A2, and B for almond and hazelnut shells were depicted in the box and whisker plots of walnut shells. As mentioned, even though these requirements are not specific for walnut shells, this comparison was included in this section because it might become useful to set the grounds to propose future specifications for walnut shells, which will be made in Task 3.3.

Moreover, it should be taken into account that only two Portuguese walnut shell samples were collected, and therefore the conclusions for the walnut shells in this country are very limited.

Moisture

The results regarding the moisture content of the analyzed samples, as received, are shown in Table 6.6.1 and Figure 6.6.1. As previously stated, they should be merely taken as an indication.

The mean moisture content of the analyzed samples (Table 6.6.1), as received, ranged, across countries, from 9.1 % (Spain) to 11.0 % (Greece). Most of samples complied with the limitations set for classes A1 and A2 in the standard used as reference, and all of them with the class B specifications (Figure 6.6.1).

Table 6.6.1. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the moisture content (% w.b., as received) of walnut shells

	Moisture (as received)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	11.0	0.96	8.7	4
Portugal	10.7	0.85	7.9	2
Spain	9.1	1.3	15	6
Turkey	10.4	1.7	16	10

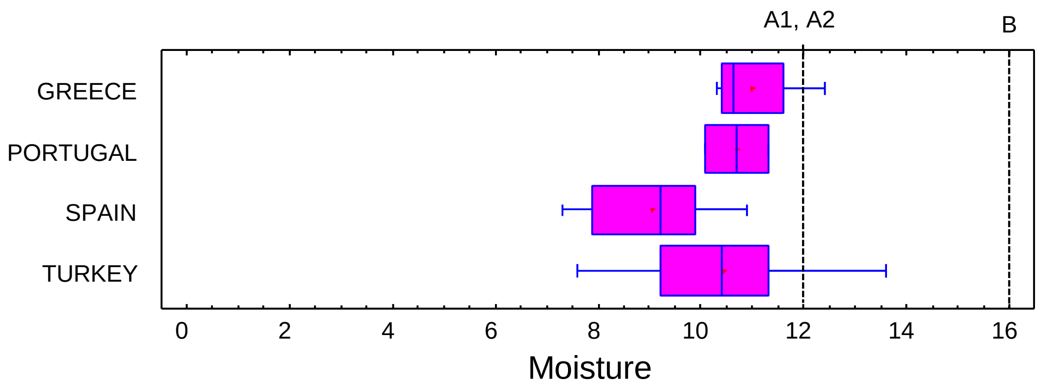


Figure 6.6.1. Box and whisker plots for the moisture content (% w.b., as received) of walnut shells

Bulk density

The results regarding the bulk density of the analyzed samples are shown in Table 6.6.2 and Figure 6.6.2.

Bulk density, as received, averaged 220, 250 and 270 kg/m^3 for Turkish, Greek and Spanish samples, respectively, and ranged 180-340 kg/m^3.

As it was previously commented, the limits depicted in the figures are corresponded with the requirements set by the Spanish standard for almond and hazelnut shells, and thus they might not be adequate to grade the bulk density of walnut shells. In fact, as shown in Table 5.1., the bulk density measured as received for the collected samples of walnut shells (240 kg/m^3), was much lower than those measured for almond (410 kg/m^3) or hazelnut (330 kg/m^3) shells.

Only one walnut sample fulfilled the minimum requirements set for almond and hazelnut shells, class A2 (≥300 kg/m^3), and none of them met the A1 requirements for either pine nut shells (≥470 kg/m^3) or almond and hazelnut shells (≥500 kg/m^3).

Table 6.6.2. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the bulk density (kg/m^3, as received) of walnut shells

	Bulk density (as received)			
Country	**mean** (kg/m^3)	**S** (kg/m^3)	**C.V.** (%)	**n**
Greece	250	25	10	4
Spain	270	41	15	6
Turkey	220	21	9.2	10

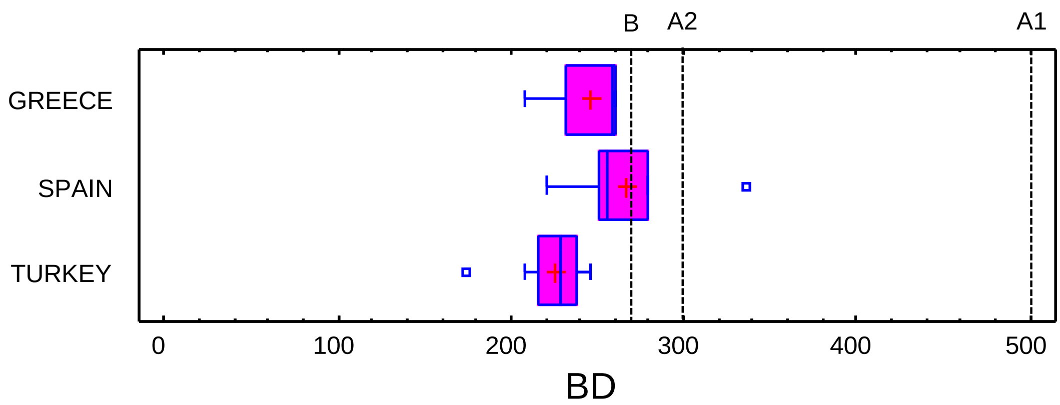


Figure 6.6.2. Box and whisker plots for the bulk density (kg/m^3, as received) of walnut shells

Ash

The results regarding the ash content of the analyzed samples are shown in Table 6.6.3 and Figure 6.6.3.

Ash content of all analyzed samples was relatively low, and averaged 1.2 % (Table 5.5). Mean ash levels were maintained between 1.1 and 1.6 %, across countries (Table 6.6.3), clearly surpassing the maximum value allowed for class A1 (≤0.7 %) in the standard that is being used as a reference. With the exception of the two Portuguese samples analyzed, the specifications for class A2 (≤1.5 %) were generally met. All samples complied with the B requirement (≤2.0 %).

Table 6.6.3. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the ash content (%, d.b.) of walnut shells

	Ash (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	1.1	0.26	25	4
Portugal	1.6	0.071	4.6	2
Spain	1.3	0.37	29	6
Turkey	1.2	0.17	14	10

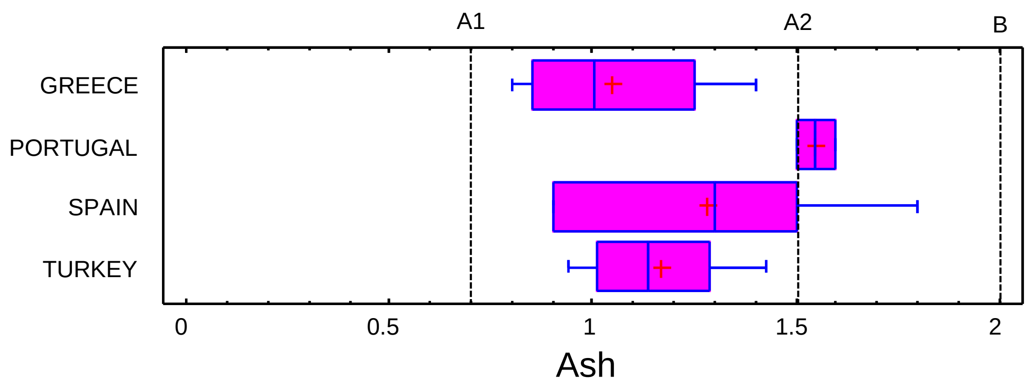


Figure 6.6.3. Box and whisker plots for the ash content (%, d.b.) of walnut shells

Oil

The results regarding the oil content of the analyzed samples are shown in Table 6.6.4 and Figure 6.6.4.

The oil content of walnut samples was high (Figure 6.6.4) due to the important rests of nut grains that were visually present in many of the analyzed samples (for example, one of the 6 Spanish samples was composed of almost entire walnuts, and showed 15 % of oil content). Both Portuguese samples also contained rests of the fruit and exhibited oil contents of 10 and 11 %. Spanish and Turkish samples showed a large variability for this parameter (Table 6.6.4 and Figure 6.6.4).

Most samples were far from meeting the oil criteria established for other dry fruit shells in UNE 164004:2014. However, mean contents could be greatly reduced if large grain fraction containing samples were removed from the calculations.

As in the case of olive stones and other fruit shells, high oil contents derived from high fractions of pulp and dry fruit grains could be related to low-performance industrial separation processes.

All the above-mentioned aspects will be treated in detail in the forth-coming Task 3.3.

Table 6.6.4. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the oil content (%, d.b.) of walnut shells

	Oil (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	3.8	0.43	11	4
Portugal	10	0.53	5.1	2
Spain	5.6	5.5	97	6
Turkey	2.6	2.0	76	10

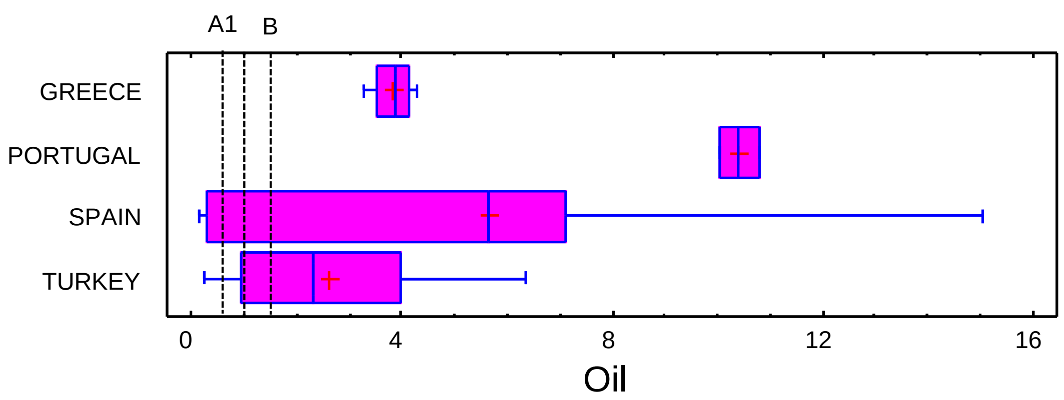


Figure 6.6.4. Box and whisker plots for the oil content (%, d.b.) of walnut shells

Calorific value

The results regarding the calorific value of the analyzed samples are shown in Tables 6.6.5-6.6.6 and Figures 6.6.5-6.6.6.

Net calorific values on a dry basis averaged 18.93, 19.26, 19.90, and 20.89 MJ/kg for Turkish, Greek, Spanish and Portuguese walnut samples, respectively (Table 6.6.6.). Net calorific values on a dry basis (Figure 6.6.6) followed similar patterns to the ones observed for the ash (Figure 6.6.3) and the oil (Figure 6.6.4) contents.

All samples complied with the minimum net calorific value, as received, stated in the Spanish standard for other fruit shells classes A1 and A2 (≥15 MJ/kg, Figure 6.6.5).

Table 6.6.5. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, as received) of walnut shells

	NCVx (as received)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Greece	16.87	0.75	4.4	4
Portugal	18.39	0.34	1.8	2
Spain	17.88	1.4	7.8	6
Turkey	16.88	0.55	3.2	10

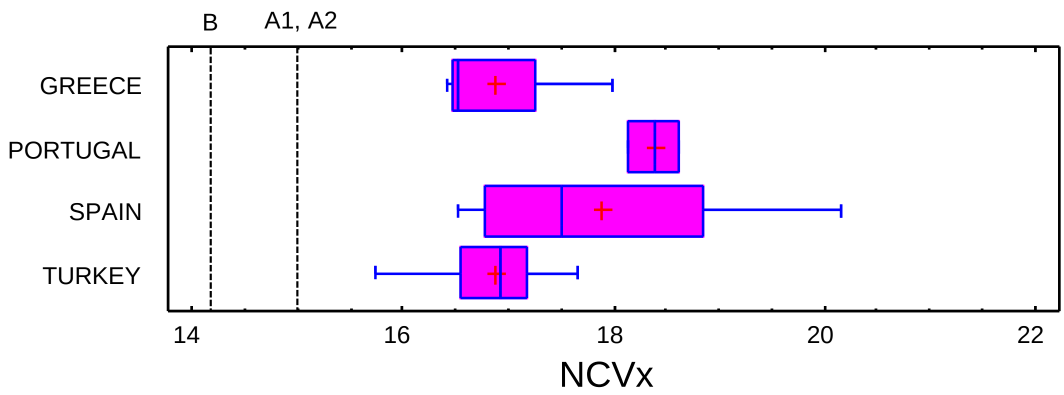


Figure 6.6.5. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, as received) of walnut shells.

Table 6.6.6. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, d.b.) of walnut shells

NCVo (d.b.)				
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Greece	19.26	0.78	4.0	4
Portugal	20.89	0.16	0.78	2
Spain	19.90	1.3	6.4	6
Turkey	18.93	0.40	2.1	10

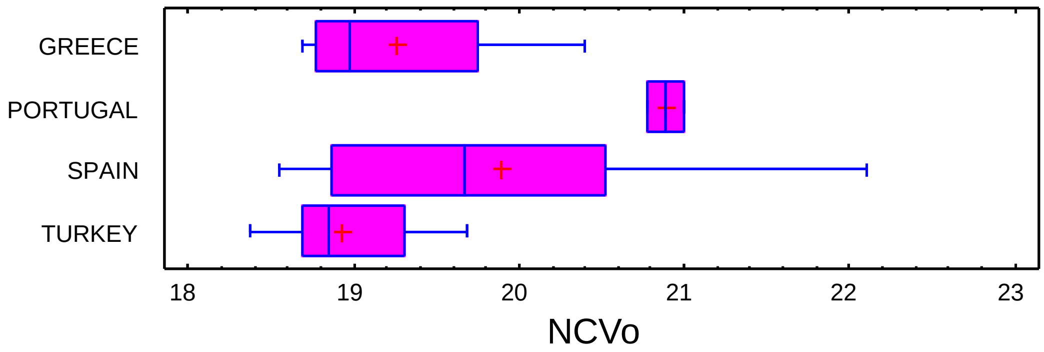


Figure 6.6.6. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, d.b.) of walnut shells

Nitrogen

The results regarding the nitrogen content of the analyzed samples are shown in Table 6.6.7 and Figure 6.6.7.

The N contents of walnut shells can be considered quite variable and different across countries. N averaged 0.2, 0.6, and 0.8 % for samples coming from Turkey, Greece and Spain, and Portugal, respectively (Table 6.6.7). In particular, the variability regarding the N levels of the Spanish samples was considered quite large. At this moment, no reason was found to explain this fact, and it would be taken into further consideration in Task 3.3.

Most Turkish samples met the N requirement specified for the top quality class A1 (≤0.4 %), whereas the vast majority of the rest of samples were not able to comply with this limit (Figure 6.6.7). In turn, all samples were below the limit set for class B (≤0.8 %), excepting for some Spanish samples (Figure 6.6.7).

Table 6.6.7. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nitrogen content (%, d.b.) of walnut shells

	Nitrogen (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	0.62	0.16	25	4
Portugal	0.80	<0.001	<0.001	2
Spain	0.57	0.44	77	6
Turkey	0.24	0.090	38	10

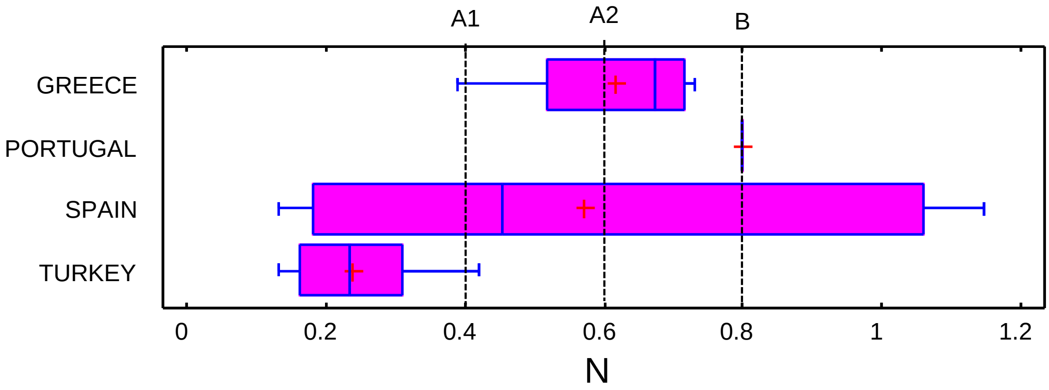


Figure 6.6.7. Box and whisker plots for the nitrogen content (%, d.b.) of walnut shells

Chlorine

The results regarding the chlorine content of the analyzed samples are shown in Table 6.6.8 and Figure 6.6.8.

Portuguese samples averaged 0.01 % of Cl, while Turkish, Spanish, and Portuguese samples averaged 0.03-0.04 % of Cl (Table 6.6.8).

As can be seen in Figure 6.6.8, excepting for the two Portuguese samples, the vast majority of the samples surpassed the limit set for classes A1 and A2 (≥0.02 %), and even the B limitation (≥0.03 %).

Table 6.6.8. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the chlorine content (%, d.b.) of walnut shells

	Chlorine (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	0.03	0.015	46	4
Portugal	0.01	<0.001	<0.001	2
Spain	0.04	0.017	42	6
Turkey	0.04	0.037	95	10

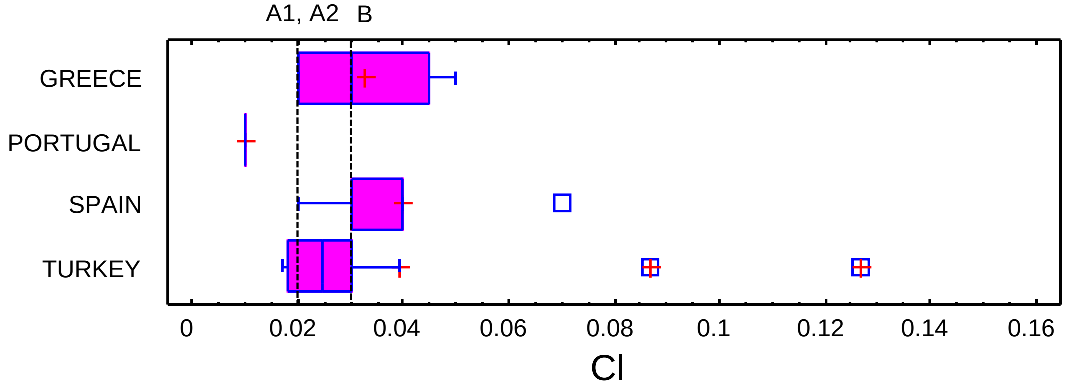


Figure 6.6.8. Box and whisker plots for the chlorine content (%, d.b.) of walnut shells

Sulfur

The results regarding the sulfur content of the analyzed samples are shown in Table 6.6.9 and Figure 6.6.9.

The S maximum levels specified for classes A1 and A2 (≤0.03 %) were met by the walnut shells collected in Greece and Turkey (Figure 6.6.9). In turn, Portuguese and Spanish samples showed higher S contents (Table and Figure 6.6.9). Two out of six Spanish samples as well as both Portuguese samples showed S values between 0.04 and 0.06 % (Figure 6.6.9).

Table 6.6.9. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sulfur content (%, d.b.) of walnut shells

	Sulfur (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	0.02	0.008	41	4
Portugal	0.05	0.007	16	2
Spain	0.03	0.016	51	6
Turkey	0.02	0.004	26	10

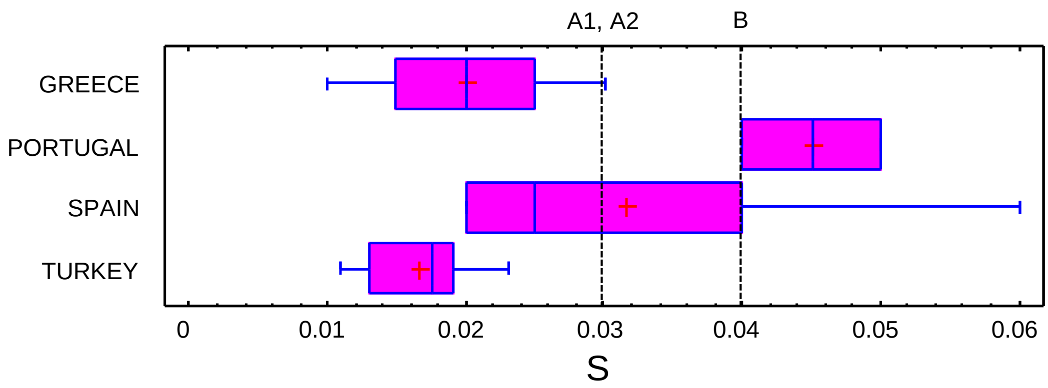


Figure 6.6.9. Box and whisker plots for the sulfur content (%, d.b.) of walnut shells

Trace elements

In general, the content of As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn in walnut shells were low, being sometimes even below the method quantification limits reported by the laboratories performing the analysis. With the exception of two samples, the limits set in the Spanish standard of reference for dry fruit shells (UNE 164004:2014) were attained by all the analyzed walnut shells.

The results regarding the content of Cu, Ni, and Zn of the analyzed walnut shells are shown in Tables 6.6.10-6.6.12 and Figures 6.6.10-6.6.12.

The Spanish sample which exhibited an oil content of 15 % showed a Zn value of 34 mg/kg (Figure 6.6.12), higher than the limit set in the Spanish standard for fruit shells (20 mg/kg), but again well below the limits set for Zn in the international standards for different solid biofuels. A Turkish sample also showed an extremely high value of Cu (42 mg/kg, Figure 6.6.10). Both samples were clearly identified as outliers in their corresponding box and whisker plots (Figures 6.6.10 and 6.6.12), and will be further investigated I Task 3.3.

Table 6.6.10. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the copper content (mg/kg, d.b.) of walnut shells

	Copper (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Greece	4.8	1.1	23	4
Portugal	6.9	0.52	7.6	2
Spain	7.9	3.9	49	6
Turkey	7.4	12	160	10

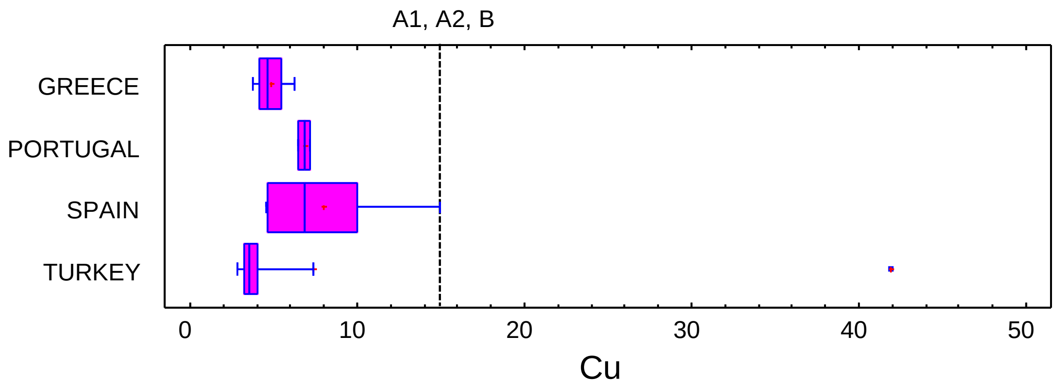


Figure 6.6.10. Box and whisker plots for the copper content (mg/kg, d.b.) of walnut shells

Table 6.6.11. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nickel content (mg/kg, d.b.) of walnut shells

	Nickel (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Greece	1.1	0.82	77	4
Portugal	0.97	0.16	16	2
Spain	3.6	2.3	64	6
Turkey	2.3	1.6	68	10

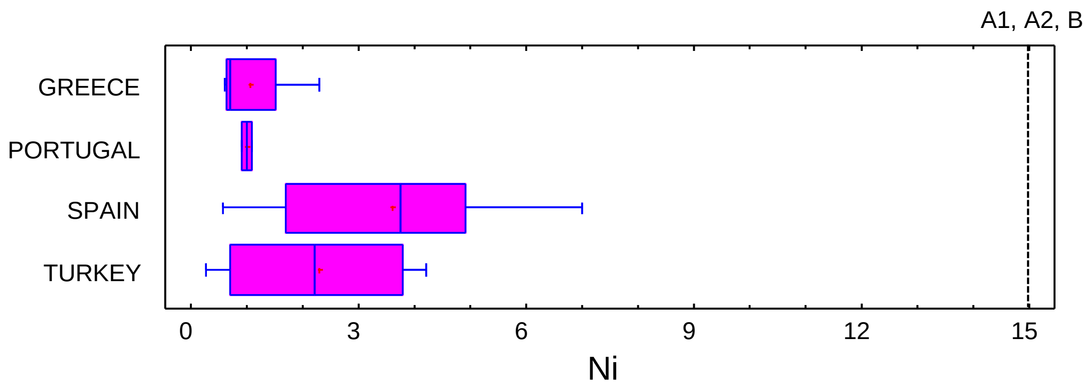


Figure 6.6.11. Box and whisker plots for the nickel content (mg/kg, d.b.) of walnut shells

Table 6.6.12. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the zinc content (mg/kg, d.b.) of walnut shells

	Zinc (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Greece	4.3	0.79	19	4
Portugal	11	0.76	6.6	2
Spain	13	11	87	6
Turkey	2.7	1.3	48	10

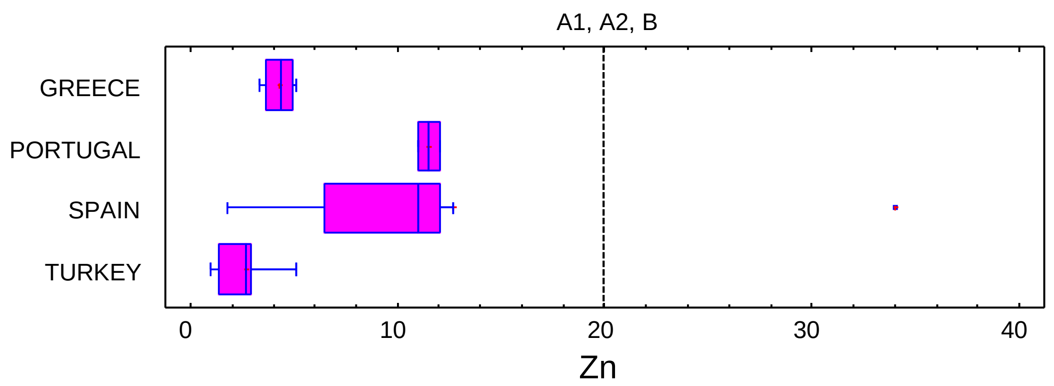


Figure 6.6.12. Box and whisker plots for the zinc content (mg/kg, d.b.) of walnut shells

6.7 PISTACHIO SHELLS

As was the case for walnut shells, to our knowledge, there is no standard that grades pistachio shells. Therefore, the requirements set in the national Spanish standard UNE 164004:2014 for almond and hazelnut shells are the ones used in this section for comparison reasons. The requirements set in the Spanish standard for almond and hazelnut shells for classes A1, A2, and B are therefore depicted in the box and whisker plots of pistachio shells and shall be only used as a reference. This comparison could become useful when addressing this issue in the forth-coming Task 3.3.

Moisture

The results regarding the moisture content of the analyzed samples, as received, are shown in Table 6.7.1 and Figure 6.7.1. As previously mentioned, the moisture content of the collected samples should be merely taken as indicative.

Moisture content, as received, averaged 9.2, 10.8 and 12.3 % for Greek, Turkish, and Spanish samples, respectively (Table 6.7.1). Most samples fulfilled the moisture criteria for class A1 established in the standard that is being used as a reference (Figure 6.7.1).

Table 6.7.1. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the moisture content (% w.b., as received) of pistachio shells

	Moisture (as received)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	9.2	0.81	9	3.0
Spain	12.3	6.3	52	10
Turkey	10.8	2.5	23	6

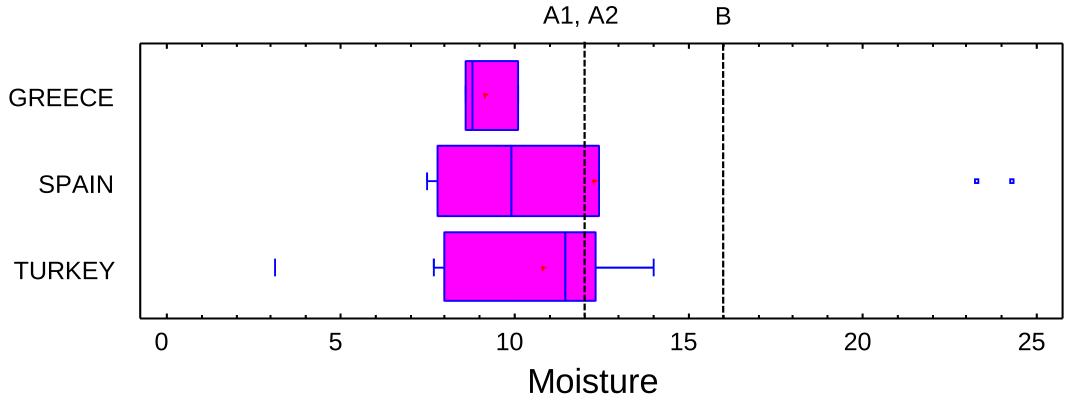


Figure 6.7.1. Box and whisker plots for the moisture content (% w.b., as received) of pistachio shells

Bulk density

The results regarding the bulk density of the analyzed samples are shown in Table 6.7.2 and Figure 6.7.2.

Mean bulk density, as received, was maintained at 310-320 kg/m^3 across countries (Table 6.7.2), and the individual values ranged 290-350 kg/m^3.

As showed in Table 5.1, the global mean for pistachio shells was 320 kg/m^3, very close to the bulk density obtained for hazelnut shells (330 kg/m^3), but far away from the average bulk density found for other dry fruit shells such as almond shells (410 kg/m^3) or pine nut shells (530 kg/m^3).

The bulk densities for the vast majority of the samples were slightly above the minimum requirement for almond and hazelnut shells, class A2 (Figure 6.7.2). None of the analyzed samples met the A1 bulk density minimum value requirement of 500 kg/m^3 set for almond and hazelnut shells (Table 6.7.2). As previously mentioned, the limits depicted in the box and whisker plots included in this section are the requirements for almond and hazelnut shells and they might not be the most adequate to grade pistachio shells.

Table 6.7.2. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the bulk density (kg/m^3, as received) of pistachio shells

	Bulk density (kg/m^3)			
Country	**mean** (kg/m^3)	**S** (kg/m^3)	**C.V.** (%)	**n**
Greece	310	4.7	1.5	3
Spain	310	16	5.0	10
Turkey	320	19	5.8	6

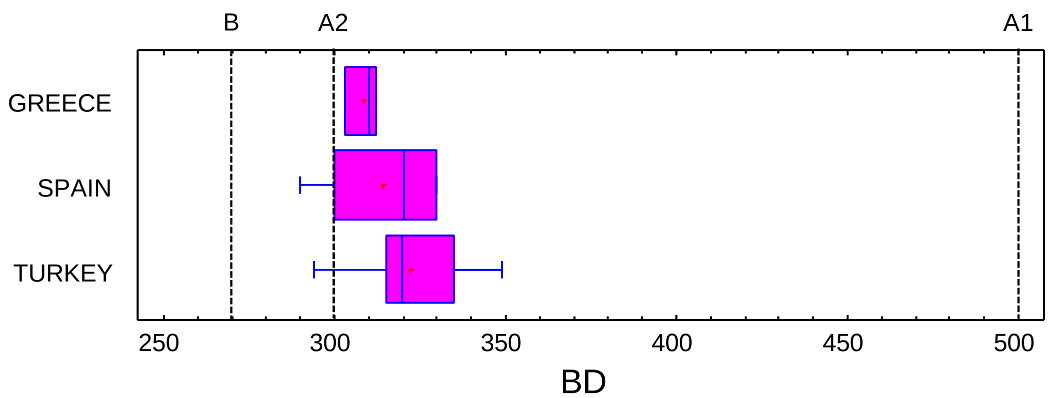


Figure 6.7.2. Box and whisker plots for the bulk density (kg/m^3, as received) of pistachio shells

Ash

The results regarding the ash content of the analyzed samples are shown in Table 6.7.3 and Figure 6.7.3.

Ash content of pistachio shells averaged 0.47, 0.52, and 1.0 % for Greek, Spanish, and Turkish samples, respectively (Table 6.7.3). Excepting for one Turkish sample which showed an exceptionally high ash content of 3.7 % (Figure 6.7.3), it could be said that the ash content of pistachio shells is relatively low, with all samples meeting the A2 requirement (≤1.5 %) and most of them meeting the A1 requirement (≤0.7 %) that was set for other types of fruit shells.

Table 6.7.3. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the ash content (%, d.b.) of pistachio shells

	Ash (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	0.47	0.12	25	3
Spain	0.52	0.24	47	10
Turkey	1.0	1.3	130	6

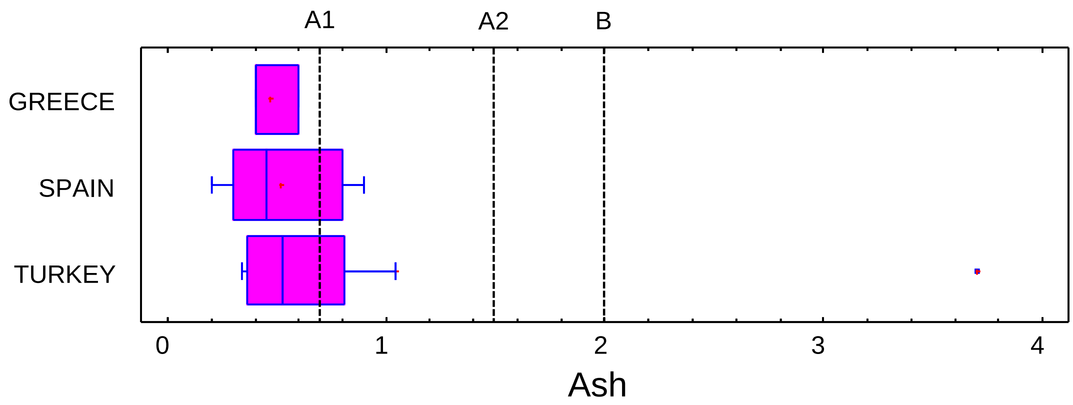


Figure 6.7.3. Box and whisker plots for the ash content (%, d.b.) of pistachio shells

Oil

The results regarding the oil content of the analyzed samples are shown in Table 6.7.4 and Figure 6.7.4.

Oil content averaged 1.0, 1.3, and 2.3 % for Turkish, Spanish, and Greek pistachio shells, respectively (Table 6.7.4).

All samples ranged from an oil content of 0.13 % to 4.1 %. Only a small fraction of samples were able to meet the A1 requirement of 0.6 % set for shells coming from other dry fruits such as almonds, hazelnuts or pine nuts (Figure 6.7.4).

Table 6.7.4. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the oil content (%, as d.b.) of pistachio shells

	Oil (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	2.3	1.9	82	3
Spain	1.3	1.0	77	10
Turkey	1.0	1.6	150	6

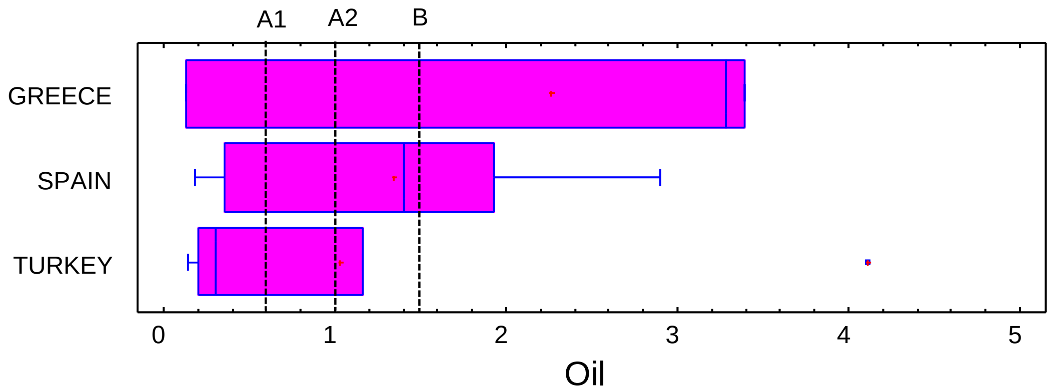


Figure 6.7.4. Box and whisker plots for the oil content (%, d.b.) of pistachio shells

Calorific value

The results regarding the net calorific value of the analyzed samples are shown in Tables 6.7.5-6.7.6 and Figures 6.7.5-6.7.6.

Net calorific values on a dry basis moved in a very narrow range, and averaged 17.61, 17.63 and 17.88 MJ/kg for Turkish, Greek, and Spanish samples, respectively (Table 6.7.6). With the exception of two Spanish samples with moisture contents above 20 % (Figure 6.7.1), most samples met the minimum requirement of 15 MJ/kg set for the net calorific value, as received, for other dry fruit shells, class A1 in the Spanish standard (Figure 6.7.5).

Table 6.7.5. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, as received) of pistachio shells

	NCVx (as received)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Greece	15.80	0.57	3.6	3
Spain	15.39	1.4	8.9	10
Turkey	15.61	0.42	2.7	6

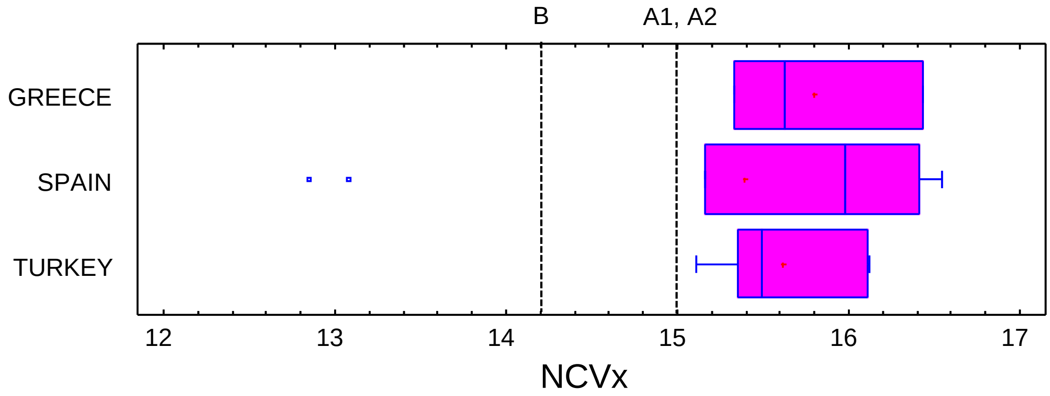


Figure 6.7.5. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, as received) of pistachio shells

Table 6.7.6. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, d.b.) of pistachio shells

	NCVo (d.b.)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Greece	17.64	0.50	2.8	3.0
Spain	17.88	0.20	1.1	10
Turkey	17.61	0.11	0.63	6

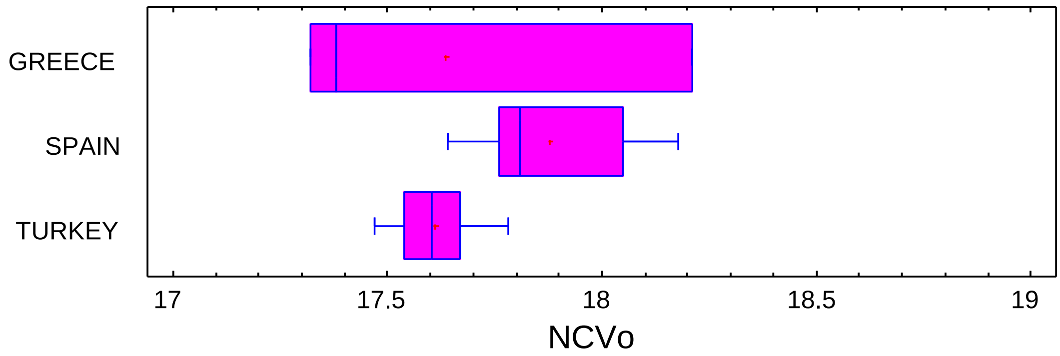


Figure 6.7.6. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, d.b.) of pistachio shells

Nitrogen

The results regarding the nitrogen content of the analyzed samples are shown in Table 6.7.7 and Figure 6.7.7.

It should be pointed out that calculations were made assigning a value of 0.00 % of N to three Turkish samples that showed N contents below the quantification limit reported by the laboratory which performed the analysis (0.10 %). This assumption might have underestimated to some extent the mean and median values calculated for the pistachio shells collected in Turkey (Table 6.7.7).

As was found for other fruit shells, the N levels showed high variability (Figure 6.7.7). With the exception of one Spanish sample, the rest of the analyzed samples fulfilled the N requirement set in the Spanish standard for class B of other fruit shells (Figure 6.7.7).

Table 6.7.7. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nitrogen content (%, d.b.) of pistachio shells

	Nitrogen (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	0.32	0.34	100	3
Spain	0.34	0.22	64	10
Turkey	0.13	0.19	150	6

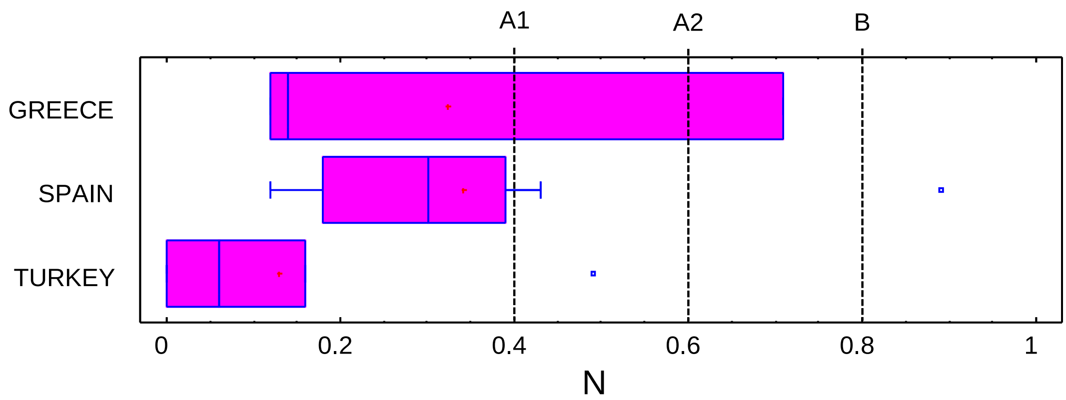


Figure 6.7.7. Box and whisker plots for the nitrogen content (%, d.b.) of pistachio shells

Chlorine

The results regarding the chlorine content of the analyzed samples are shown in Table 6.7.8 and Figure 6.7.8.

The pistachio shells averaged a chlorine content of 0.02 %, regardless of the country of origin (Table 6.7.8). With the exception of some Turkish samples, the rest of the analyzed pistachio shells met the Cl requirement set in the Spanish standard for class B (≤0.03 %) (Figure 6.7.8).

Table 6.7.8. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the chlorine content (%, d.b.) of pistachio shells

	Chlorine (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	0.02	0.012	49	3
Spain	0.02	0.005	31	6
Turkey	0.02	0.015	64	6

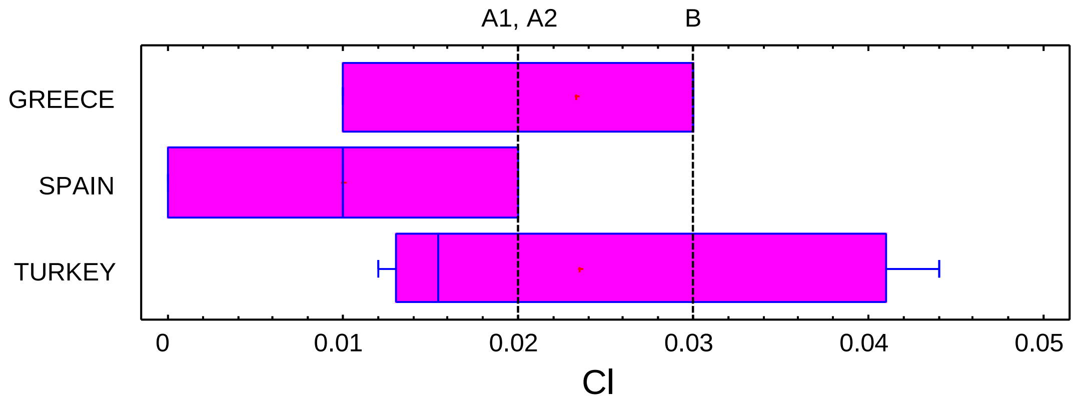


Figure 6.7.8. Box and whisker plots for the chlorine content (%, d.b.) of pistachio shells

Sulfur

The results regarding the sulfur content of the analyzed samples are shown in Table 6.7.9 and Figure 6.7.9.

Pistachio shells from Greece and Spain averaged a content of 0.02 % of sulfur and Turkish samples averaged 0.03 % (Table 6.7.8).

Therefore, excepting of one Spanish sample with a sulfur content of 0.05%, all Spanish and Greek samples met A1 and A2 class requirements set in the Spanish standard for the dry fruit shells taken as reference (Figure 6.7.9). All Turkish samples fulfilled class B requirements (Figure 6.7.9).

Table 6.7.9. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sulfur content (%, d.b.) of pistachio shells

	Sulfur (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Greece	0.02	0.012	69	3
Spain	0.02	0.012	49	10
Turkey	0.03	0.019	71	2

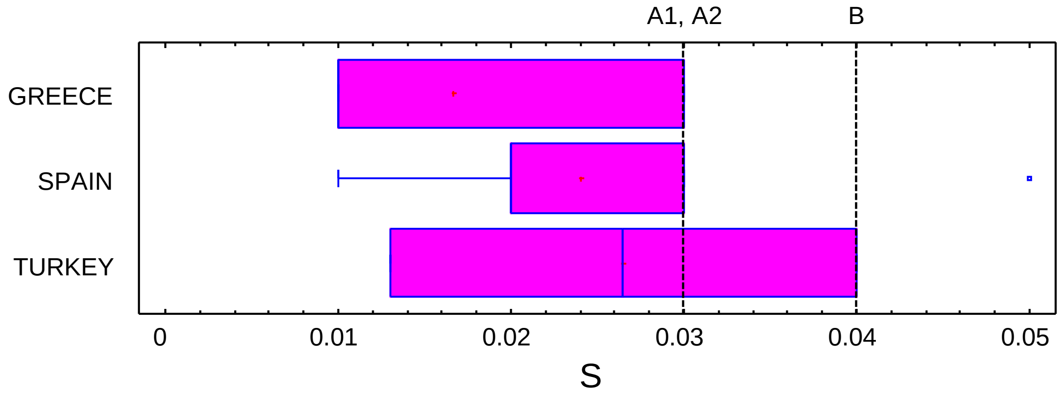


Figure 6.7.9. Box and whisker plots for the sulfur content (%, d.b.) of pistachio shells

Trace elements

In general, the content of As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn in pistachio shells were low, being sometimes even below the method quantification limits reported by the laboratories performing the analysis. Most samples fulfilled the requirements for these elements (Annex II) set in the Spanish standard of reference for dry fruit shells (UNE 164004:2014). As an example, Table 6.7.10 and Figure 6.7.10 show the results for the nickel content of the analyzed pistachio shells.

However, some Spanish pistachio samples showed contents of As, Cu, Cr, and Zn above the limits specified in the referenced standard (see individual results in Annex II and Figures 6.7.9 and 6.7.11 for the Cu and Zn content, respectively).

The results regarding the content of Cu, Ni, and Zn of the analyzed samples are shown in Tables 6.7.9-6.7.11 and Figures 6.7.9-6.7.11.

Copper contents averaged 1.6 and 6.5 mg/kg for Turkish and Spanish samples, respectively (Table 6.7.9). In contrast, all Greek samples (n=3) showed extremely high contents of Cu (Figure 6.7.9), ranging between 46 and 72 mg/kg, and averaging 60 mg/kg (Table 6.7.9). As stated before, the origin of copper might be in the pesticides used in this crop (e.g. copper sulfate). All these aspects will be taken into further consideration in Task 3.3.

Table 6.7.9. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the copper content (mg/kg, as d.b.) of pistachio shells

	Copper (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Greece	60	13	22	3
Spain	6.5	5.5	84	10
Turkey	1.6	1.0	61	6

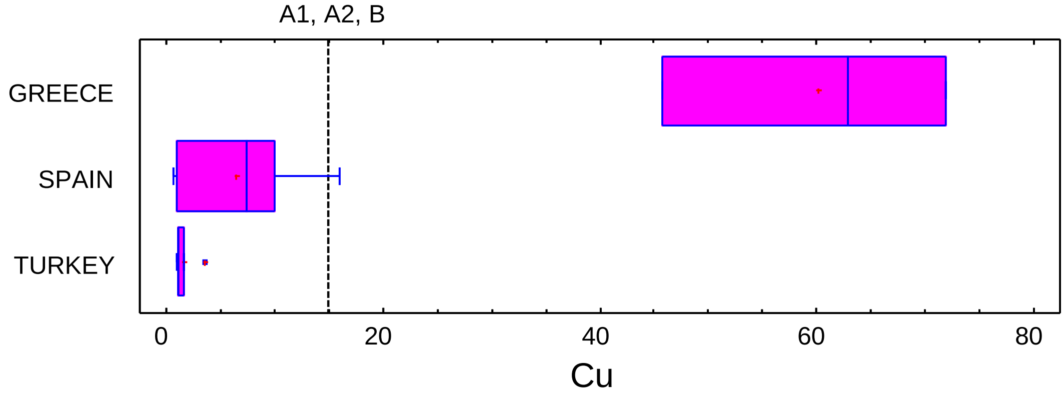


Figure 6.7.9. Box and whisker plots for the copper content (mg/kg, d.b.) of pistachio shells.

Table 6.7.10. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nickel content (mg/kg, as d.b.) of pistachio shells

	Nickel (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Greece	3.9	0.70	18	3
Spain	6.2	2.8	45	10
Turkey	0.60	0.39	66	6

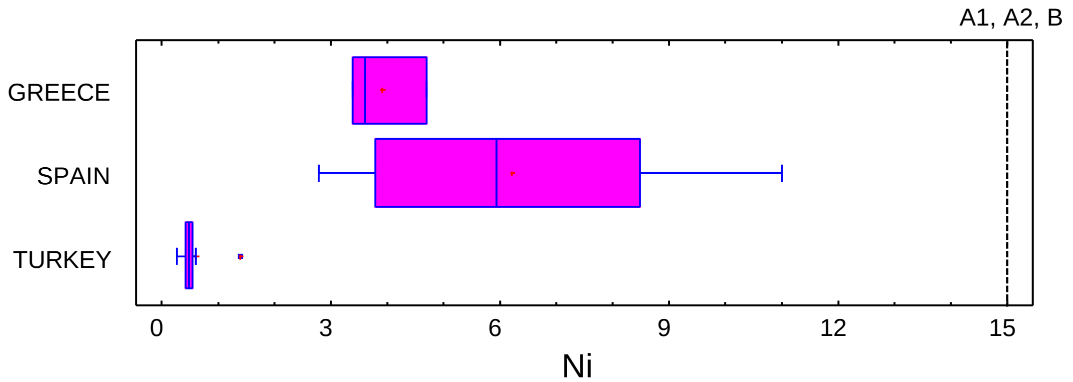


Figure 6.7.10. Box and whisker plots for the nickel content (mg/kg, d.b.) of pistachio shells

Table 6.7.11. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the zinc content (mg/kg, as d.b.) of pistachio shells

	Zinc (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Greece	5.8	1.5	25	3
Spain	18	20	110	10
Turkey	1.5	0.64	42	6

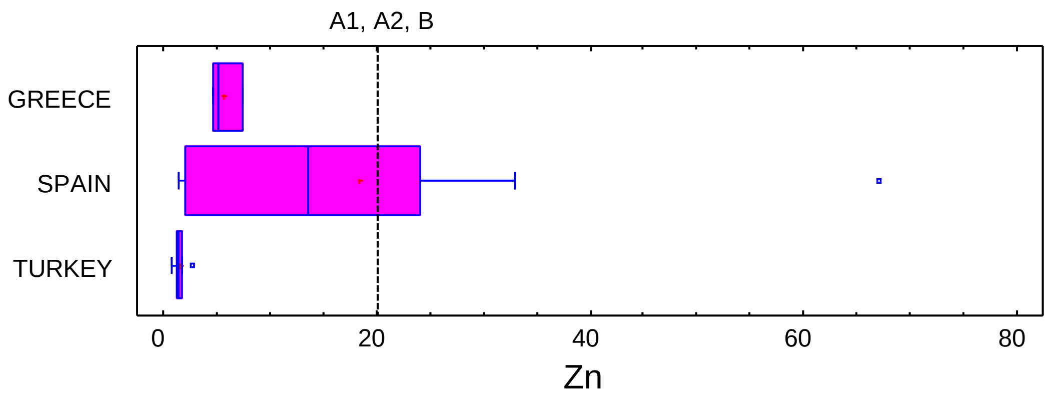


Figure 6.7.11. Box and whisker plots for the zinc content (mg/kg, d.b.) of pistachio shells

6.8 PINE NUT SHELLS

The Spanish standard UNE 164004:2014 grades pine nut shells, and thus the requirements specified in this standard for classes A1, A2 and B were included in the box and whisker plots of this section as a reference.

Unlike the rest of solid biofuels considered, it should be taken into account that pine nut shells were only collected in Portugal (4 samples) and Spain (10 samples).

Moisture

The results regarding the moisture content of the analyzed samples, as receive, are shown in Table 6.8.1 and Figure 6.8.1. These results should be merely taken as an indication.

Moisture contents averaged, as received, 12.8 % for the Portuguese samples and 12.9 % for the Spanish samples (Table 6.8.1).

As shown in Figure 6.8.1, the analyzed samples were generally below the limit set for class B (≤16 %, d.b), but exceeded the maximum value allowed in classes A1 and A2 (≤12 %, d.b.).

Table 6.8.1. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the moisture content (% w.b., as received) of pine nut shells

	Moisture (as received)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Portugal	12.8	1.5	11	4
Spain	12.9	1.6	12	10

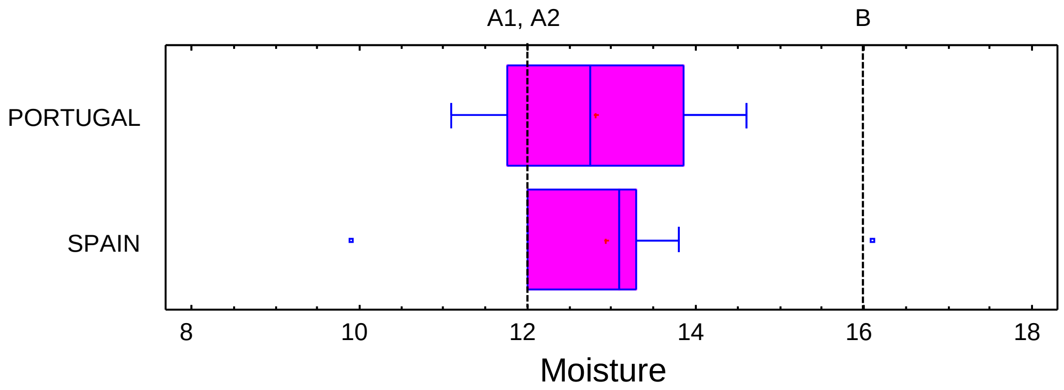


Figure 6.8.1. Box and whisker plots for the moisture content (% w.b., as received) of pine nut shells

Ash

The results regarding the ash content of the analyzed samples are shown in Table 6.8.2 and Figure 6.8.2.

Ash content of pine nut shells averaged 1.6 %, no matter their country of origin (Table 6.8.2). As shown in Figure 6.8.2, ash contents were generally below the B class limit (≤2.0 %). However, only 3 out of 14 samples met the A1 class requirement (≤1.3 %) set in the Spanish standard used as reference (Figure 6.8.2).

Table 6.8.2. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the ash content (%, d.b.) of pine nut shells

	Ash (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Portugal	1.6	0.42	27	4
Spain	1.6	0.24	15	10

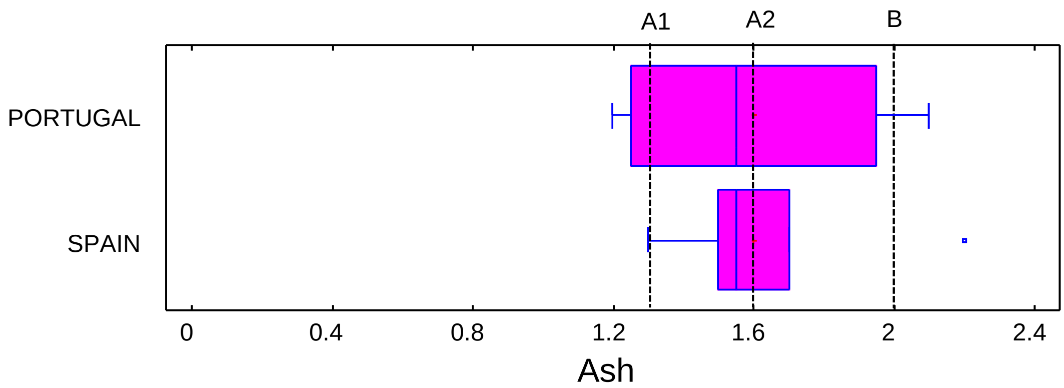


Figure 6.8.2. Box and whisker plots for the ash content (%, d.b.) of pine nut shells

Oil

The results regarding the oil content of the analyzed samples are shown in Table 6.8.3 and Figure 6.8.3.

Regardless of the country of origin, pine nut shells averaged 0.6 % of oil (Table 6.8.3), which is, at the same time, the maximum oil content allowed for pine nut shells, class A1, in the Spanish standard used as a reference (Figure 6.8.3). All samples fulfilled the oil requirement for pine nut shells, class B (≤1.5 %, Figure 6.8.3).

Table 6.8.3. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the oil content (%, d.b.) of pine nut shells

	Oil (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Portugal	0.64	0.64	99	4
Spain	0.59	0.25	42	10

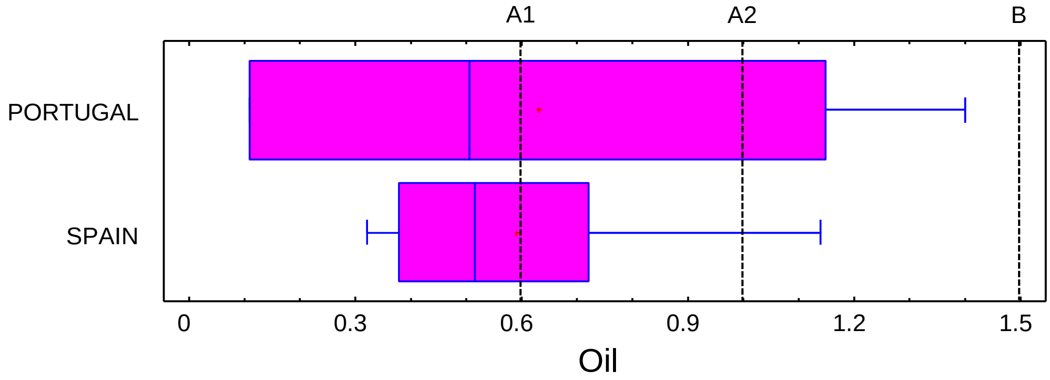


Figure 6.8.3. Box and whisker plots for the oil content (%, d.b.) of pine nut shells

Calorific value

The results regarding the net calorific values of the analyzed samples are shown in Tables 6.8.4-6.8.5 and Figures 6.8.4-6.8.5.

The calorific values of the analyzed pine nut shells were very similar, no matter the country where they were collected. Net calorific values averaged 16.5-16.6 MJ/kg, as received (Table 6.8.4), and 19.3 MJ/kg, on a dry basis (Table 6.8.5).

The vast majority of samples exhibited higher net calorific values, as received, than the minimum requirement set in the referenced Spanish standard for classes A1/A2 (≥16 MJ/kg, Figure 6.8.4).

Table 6.8.4. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, as received) of pine nut shells

	NCVx (as received)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Portugal	16.64	0.49	2.9	4
Spain	16.51	0.35	2.1	10

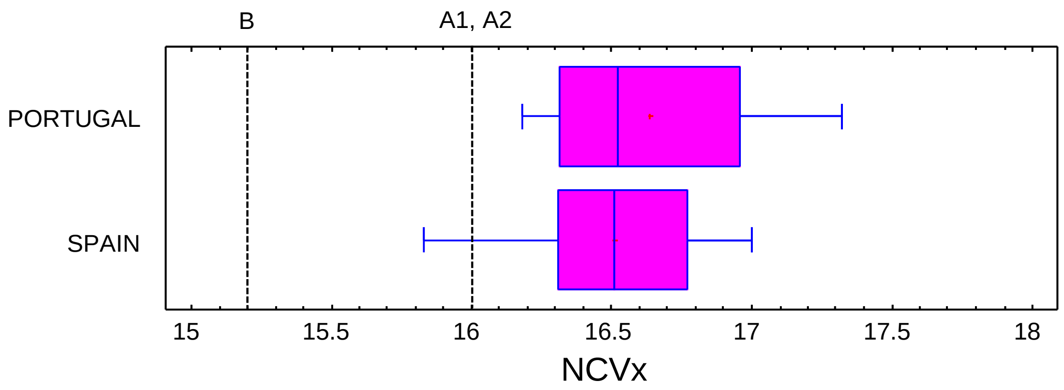


Figure 6.8.4. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, as received) of pine nut shells.

Table 6.8.5. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the net calorific value at constant pressure (MJ/kg, d.b.) of pine nut shells

	NCVo (d.b.)			
Country	**mean** (MJ/kg)	**S** (MJ/kg)	**C.V.** (%)	**n**
Portugal	19.31	0.043	0.22	4
Spain	19.33	0.16	0.81	10

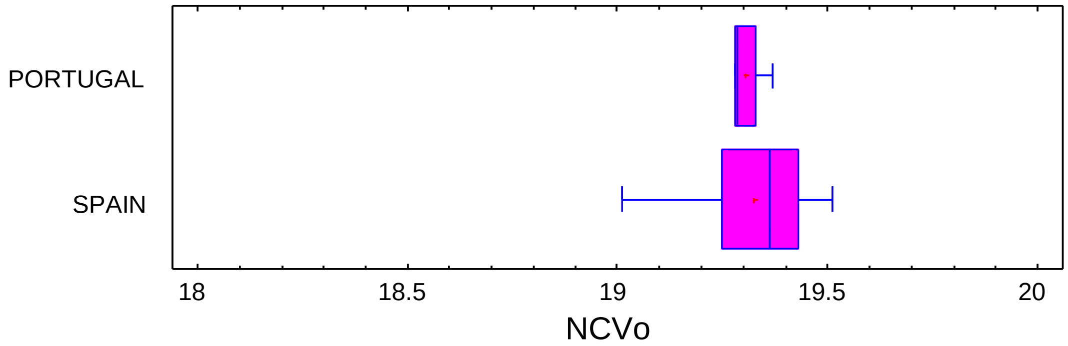


Figure 6.8.5. Box and whisker plots for the net calorific value at constant pressure (MJ/kg, d.b.) of pine nut shells

Nitrogen

The results regarding the nitrogen content of the analyzed samples are shown in Table 6.8.6 and Figure 6.8.6.

N contents were relatively low (Table 6.8.6) and clearly met the N specifications for pine nut shells (Figure 6.8.6), class A1 (≤0.4 %).

Table 6.8.6. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the nitrogen content (%, d.b.) of pine nut shells

	Nitrogen (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Portugal	0.30	<0.001	<0.001	4
Spain	0.25	0.04	14.7	10

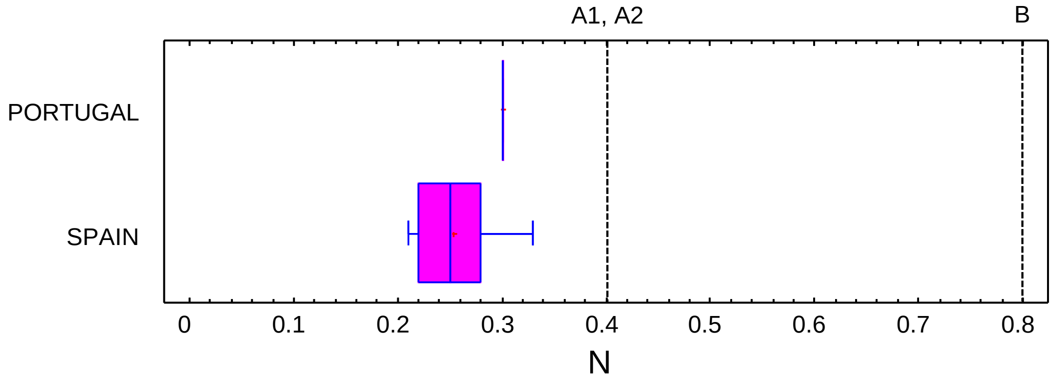


Figure 6.8.6. Box and whisker plots for the nitrogen content (%, d.b.) of pine nut shells

Chlorine

The results regarding the chlorine content of the analyzed samples are shown in Table 6.8.7 and Figure 6.8.7.

Spanish and Portuguese pine nut shells averaged 0.02 % and 0.04 % of Cl (Table 6.8.7), respectively.

All the analyzed Spanish samples but one fulfilled the S requirement for pine nut shells, class A2 (≤0.04 %, Figure 6.8.7). Portuguese samples showed higher variability regarding this parameter, ranging 0.01-0.12 % of Cl (Figure 6.8.7). The variability of chlorine content in Portuguese pine nut shells is not well explained and will be further investigated in Task 3.3.

Table 6.8.7. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the chlorine content (%, d.b.) of pine nut shells

	Chlorine (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Portugal	0.04	0.052	120	4
Spain	0.02	0.013	60	10

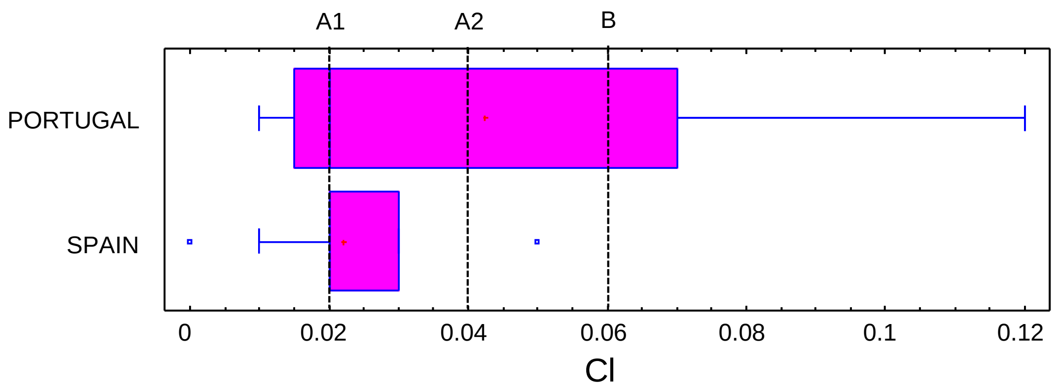


Figure 6.8.7. Box and whisker plots for the chlorine content (%, d.b.) of pine nut shells

Sulfur

The results regarding the sulfur content of the analyzed samples are shown in Table 6.8.8 and Figure 6.8.8.

The Portuguese samples averaged S content of 0.02 % and the Spanish samples 0.03 % (Table 6.8.8), close to the reference A1/A2 maximum limit values (Figure 6.8.8), but always below the maximum value of S accepted for class B (≤0.05 %).

Table 6.8.8. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the sulfur content (%, d.b.) of pine nut shells

	Sulfur (d.b.)			
Country	**mean** (%)	**S** (%)	**C.V.** (%)	**n**
Portugal	0.02	0.005	22	4
Spain	0.03	0.007	22	10

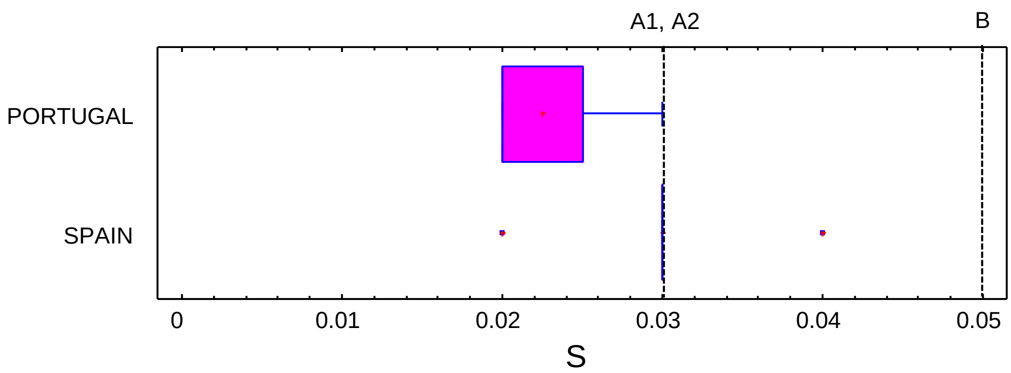


Figure 6.8.8. Box and whisker plots for the sulfur content (%, d.b.) of pine nut shells

Trace elements

The contents of As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn were generally low, being sometimes even below the method quantification limits reported by the laboratories performing the analysis. Most samples were well below the maximum levels allowed in the Spanish standard of reference (see Annex II for the individual analytical results) that grades pine nut shells.

The results regarding the content of Cu, Hg, and Zn of the analyzed pine nut shells are shown in Tables 6.8.9-6.8.11 and Figures 6.8.9-6.8.11.

The specifications for these elements were clearly met by all the pine nut shells analyzed.

Table 6.8.9. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the copper content (mg/kg, d.b.) of pine nut shells

		Copper (d.b.)		
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Portugal	1.6	0.97	62	4
Spain	2.8	0.62	22	10

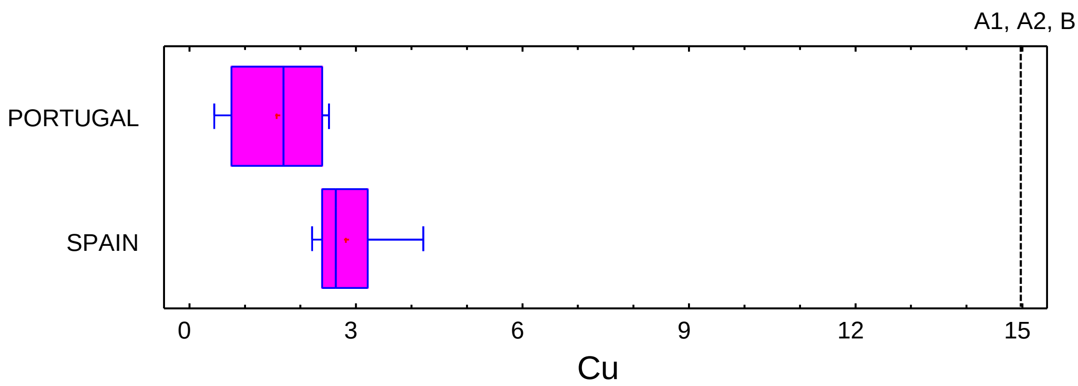


Figure 6.8.9. Box and whisker plots for the copper content (mg/kg, d.b.) of pine nut shells.

Table 6.8.10. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the mercury content (mg/kg, d.b.) of pine nut shells

		Mercury (d.b.)		
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Portugal	0.004	0.001	19	4
Spain	0.004	0.001	36	10

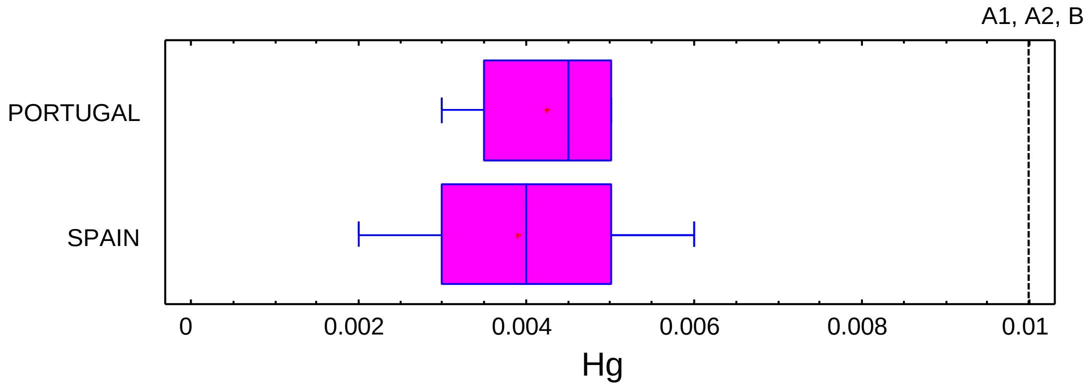


Figure 6.8.10. Box and whisker plots for the mercury content (mg/kg, d.b.) of pine nut shells.

Table 6.8.11. Mean, standard deviation (S), coefficient of variation (C.V.), and number of samples analyzed (n) for the zinc content (mg/kg, d.b.) of pine nut shells

	Zinc (d.b.)			
Country	**mean** (mg/kg)	**S** (mg/kg)	**C.V.** (%)	**n**
Portugal	10	4.8	48	4
Spain	7.2	1.5	21	10

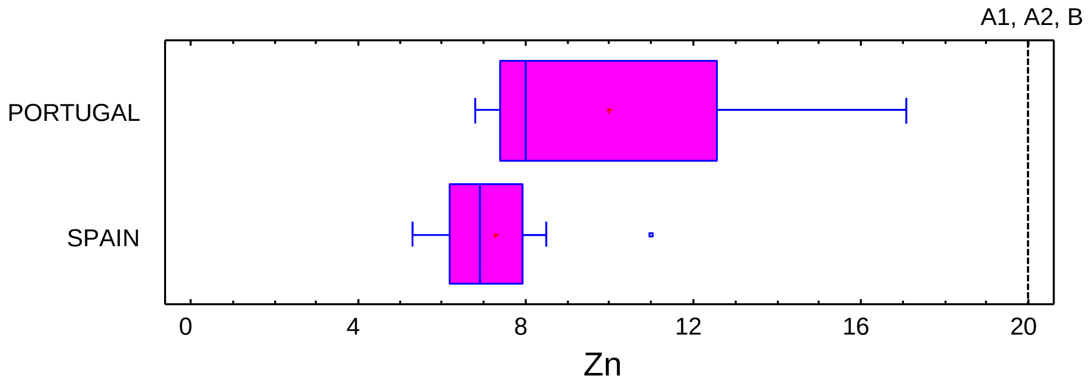


Figure 6.8.11. Box and whisker plots for the zinc content (mg/kg, d.b.) of pine nut shells

7. CONCLUSIONS

This report describes the results obtained from the characterization of more than 300 samples of olive tree and vineyard prunings, olive stones, and dry fruit shells collected in the Mediterranean countries participating in the project. The quality properties of these biofuels are summarized and discussed. The analytical results obtained were compared with the standards that are currently in place to grade these biofuels, when available.

The results described in this report will be taken into consideration to develop pre-normative work for standards that specifically grade these types of fuels and/or set new applicable quality requirements, if needed.

Considering the same type of biofuel, it is important to highlight that, for most of the analyzed properties, significant differences were found among the different countries where the samples were collected.

The bulk density of olive stones and some fruit shells like pine nut shells reached high values. The oil content of fruit shells and olive stones in relation to the quality of the emissions generated should be also studied in further detail.

In general, the contents of N and S, the contents of ash and, consequently, of some ash forming elements such as Ca, K and Mg, were usually lower in olive stones and fruit shells than in olive tree and vineyard prunings. Therefore, the net calorific values on a dry basis of olive stones and fruit shells, with the exception of pistachio shells, were generally higher than those measured for prunings.

It should be taken into account the higher tendency of these Mediterranean biofuels to form slags and sinters compared to wood biomass. Prunings and pruning pellets show better sintering behavior than olive stones and dry fruit shells, with the exception of walnut shells, which could be associated to their higher alkaline earth oxides to alkaline oxides ratio.

Based on the results of this project, olive tree and vineyard prunings are not generally expected to meet the quality requirements that are currently in place in the international standards that grade wood chips and wood pellets, with ash and copper contents being the most frequently limiting factors.

On the one hand and, in spite of being manually collected to avoid the inclusion of mineral impurities, only a very limited fraction of the pruning samples analyzed complied with the ash requirements for the class B of wood chips or wood pellets for either commercial and residential applications or for industrial use. This is probably due to the natural intrinsic composition of pruning samples, which contain twigs and small branches as well as different fractions of leaves. High bark-to-wood ratios or high fractions of leaves are known to increase ash content levels. Even higher ash contents will be expected if prunings are collected by mechanical systems through the addition of mineral impurities from soil.

On the other hand, the copper levels of olive tree and vineyard pruning samples frequently exceeded the limits set in the applicable international standards. Cu levels found in this type of biomass could be a consequence of the copper containing chemicals that are commonly applied to olive groves and vineyards as fungicides and insecticides to control pests and diseases. Further research is needed to determine whether the obtained copper levels would cause environmental concerns during the combustion of these biofuels.

Overall, it should be also taken into account that the fraction of leaves in prunings, or the fraction of pulp in stones and of fruit grain in shells are expected to highly affect the quality properties of these fuels.

The levels of As, Cd, Cr, Pb, Hg, Ni, and Zn were generally low and well below the limits set by the standards used as reference. These levels were sometimes even below the quantification limits of the analytical methods used by the laboratories involved in the analyses.

Even though an important variability among countries was found for some parameters, olive stones and fruit shells (without pulp, skin, or fruit grains) generally fulfil the requirements set in the corresponding Spanish standards for class B at least, for most of the physical and chemical normative properties, such as the ash content, N, S, Cl or trace elements.

8. ANNEXES

8.1 ANNEX I: Methods of sampling, location and description of the collected samples

METHODS OF SAMPLING

The traded biofuels must be collected as stated in Task 3.1. Please, see section A in order to know the volume of the laboratory sample to be sent to the corresponding laboratory.
The non-traded biofuels will be collected and prepared as stated in section B. Sub-section B1 describes the number of increments or elemental samples (see section C for definitions) to be collected for olive stones and almond shells. Sub-section B2 describes the number of increments or elemental samples to be collected for olive tree prunings (OTP) and vineyard prunings (VP) on the field sites.

A) TRADE FORM OF BIOFUELS

For these biofuels it is necessary to determine the bulk density and particle size distribution. According to bulk density ISO standard of solid biofuels:

- For biofuels with a nominal top size up to 12 mm and for pellets with a diameter equal or below 12 mm, 5 liters container must be used.
  Therefore, at least 10 liters of each sample are requested to be sent to the laboratory to perform these analyses.
- For biofuels with a nominal top size higher than 12 mm, 50 liters container must be used. Therefore, at least 70 liters of laboratory sample should be sent to the laboratory to perform the analyses.

Laboratory samples must be delivered in their own package if this is hermetic (case of plastic bags) or in sealed plastic bags inside appropriate package in order to minimize the risk of damage or alteration of the materials composition during transport.

B) NO TRADE FORM OF BIOFUELS

For these biofuels it is not significative (due they are not representative of any traded biofuel form) to perform the bulk density and particle size distribution tests. Therefore about 2 kg of laboratory sample should be sufficient to send to the corresponding laboratory to perform the due analyses. Previously, if required, a representative sample will be obtained of the lot sample (see definition in section C) by properly dividing the lot sample according to an appropriate method: Cone and quartering method is recommended. The sample must be then dried at room atmosphere to moisture content below 20% and mass variation below 2% during a drying period of one day. In the case biomass samples are delivered wet (water content higher than 20%), these should be sent to the laboratory of reference by urgent transport (e.g courier less than 48h). The exterior package must be resistant to crush in all cases.

Two types of non traded biofuels can be set up: 1/olive stones and fruit shells stored in the industrial plant, in piles, silos, etc and with low particle size; and 2/olive tree prunings and vineyard prunings with large particle size and normally collected on the field.

The procedures for collecting the laboratory samples for the two types of biofuels are here on described.

B1) OLIVE STONES AND FRUIT SHELLS

In order to obtain a representative sample of a lot or a combined sample of olive stones and fruit shells, the size and number of increments should be collected from the lot or combined sample according the following assumptions/procedures.
The size (volume) is a function of the particle size of the biofuel.

$$V = 0{,}5;\ d < 10\ mm$$

$$V = 0{,}05 \times d;\ d > 10\ mm$$

Where:
V is the minimum capacity of sampling device, litre
d is the nominal top size of fuel particles, mm

The number of increments for olive stones and fruit shells should be calculated according to:

Stationary material	**Moving material**
$N = 5 + 0{,}025 \times M$	$N = 3 + 0{,}025 \times M$

Where:
N is the number of increments
M is the mass of the lot in tons

In any case, as indicated in section B, a minimum sample of 2 kg should be collected to be delivered to the laboratory.

B2) OLIVE TREE PRUNINGS AND VINEYARD PRUNINGS

The increment of olive tree prunings (OTP) and vineyard prunings (VP) is specifically a branch.
When branches are collected on field the number of increments or branches of OTP and VP should be calculated according to:

OTP	$N = 3 + 1 \times A$
VP	$N = 9 + 3 \times A$

Where:
N is the number of branches
A is the area of the lot in Hectares

Notes: the area of the lot (A) is defined by the surface (e.g. crop parcel or a part of it…) we decide to take as the reference for samples collection. The surface value can be normally be estimated.
In collecting branches, as far as possible most common (size, form, weight etc..) of those existing on sampling site should be selected.

The branches collected on field integrating the combined samples should be chipped (indicative size < 5 cm particle size) prior to delivery, utilizing, for example, mechanical saw. In the case the weight of the combined sample is bigger than 2 kg, a representative sample can be obtained by the method of cone and quartering utilizing the chipped material.

In the case the samples are taken from piles or silos containing previously chipped or milled biomass, the same procedure (see Section B1) as for non-traded olives stones and almond shells will be followed.

Contamination with soil should be avoided when collecting the prunings. Leaves, when remaining, should be included in the sample. Branches of olive tree collected must be up to 10 cm diameter.

Tables below indicate the information that must accompany to biofuels (biomasses) collected (to be sent to laboratories)

In any case, as indicated in section B, a minimum sample of 2 kg should be collected to be delivered to the laboratory.

TERMS AND DEFINITIONS, according to ISO 16559

- Lot: defined quantity of fuel for which the quality is to be determined.

  Explanatory Note:
  - For olive stones and fruit shells, the lot is the biomass contained in the site (heap, silo…) or on the field surface where the biomass to be sampled is located.
  - For prunings the lot is the total biomass existing on the land surface of the farm or parcel that is taken as a reference for sampling.

- Combined sample: sample consisting of all the increments taken from a lot or sub-lot.

- Increment: portion of fuel extracted in a single operation of the sampling device.

- Laboratory sample: combined sample or sub-sample of a combined sample for use in a laboratory.

- Sublot: portion of a lot for which a test result is required.

- Subsample: portion of a sample

Data shown in the following tables for each collected biofuel (biomass), should be reported and sent together the samples to the corresponding laboratory.

Table for olive stone and fruit shell samples

Biofuel	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**	**Sample 5**	**Sample 6**	**Sample 7**	**Sample 8**	**Sample 9**	**Sample 10**
Origin (Location)										
;upplier (company name)										
Lot size (tons)										
mber of increments taken										
ding type if different to coning and quartering*										
ticle size range (mm) (if available or estimated)										
loisture content (% w.b.) (if available or estimated)										
Comments										

(*) Describe the alternative method followed.

Table for olive tree pruning and vineyard pruning samples

Biomass type:	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
Origin (Location)*										
Supplier (company name)										
Variety/Species										
Lot size (tons)										
Sampling area (Ha)										
Irrigation (l/m^2)										
Number of increments										
e of preparation, e. g. cutting with mechanical saw										
Dividing type if different to coning and quartering**										
Particle size range (mm) (available or estimated))										
Moisture content (% w.b.) (available or estimated)										
Comments										

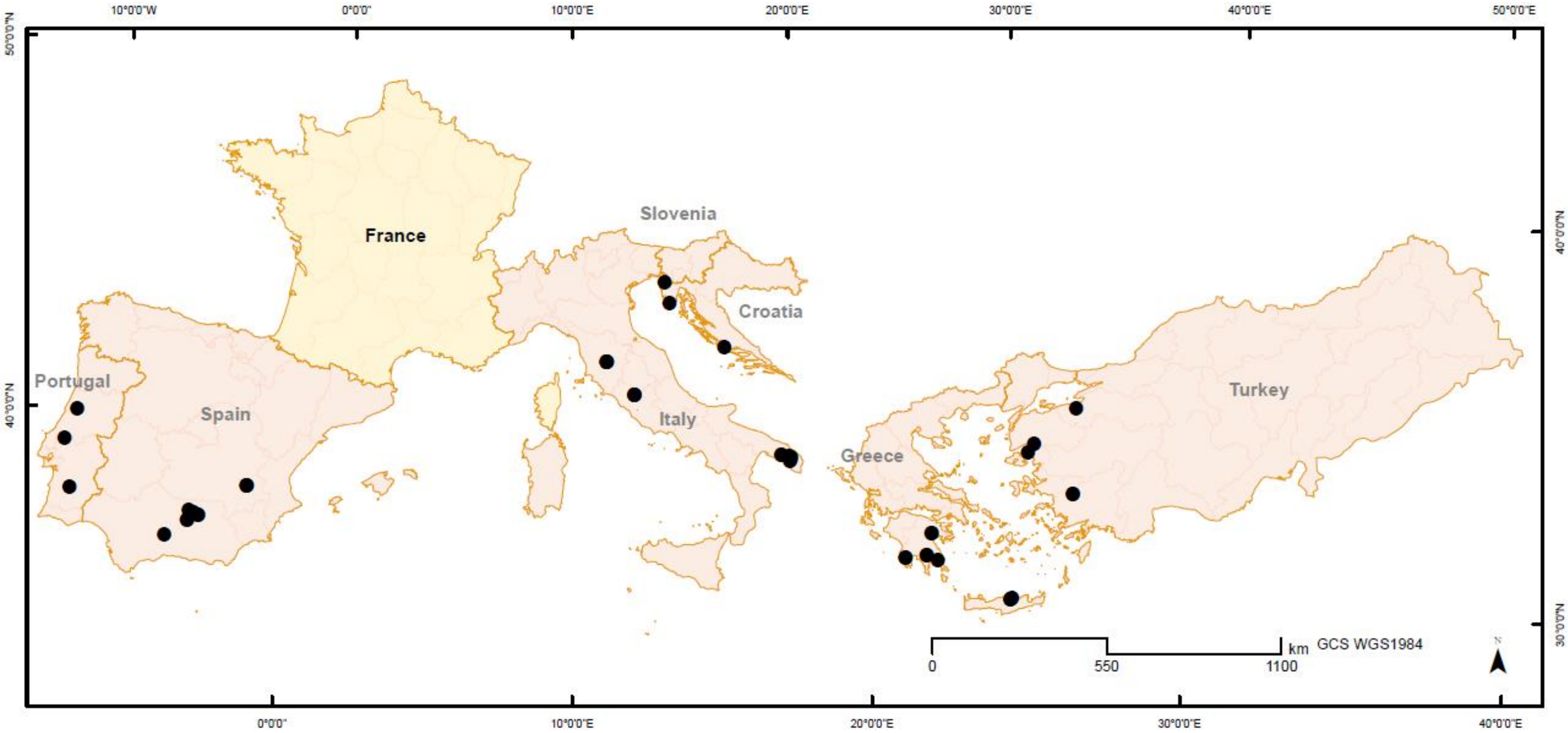
(*) Please, in comments indicate coordinates of the sampling place. As far as possible briefly describe the sampling site soil and climatic characteristics.

(**) Describe the alternative method followed.

➢ 8.1.1 Olive stone samples

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SUPPLIER (COMPANY NAME)	LOT SIZE (tons)	NUMBER OF INCREMENTS TAKEN	Particle size range (mm) (if available or estimated)	Moisture content (% w.b.) (if available or estimated)	COMMENTS
SPAIN	OLIVE STONES	Olive stones 1	1510401	P. I. de Romica; Avda. B esquina c/ 4-bis; Albacete (SPAIN)	SIERRA SEGURA					
SPAIN	OLIVE STONES	Olive stones 2	1510402	P. I. de Romica; Avda. B esquina c/ 4-bis; Albacete (SPAIN)	SIERRA SEGURA					
SPAIN	OLIVE STONES	Olive stones 3	1510403	P. I. de Romica; Avda. B esquina c/ 4-bis; Albacete (SPAIN)	SIERRA SEGURA					
SPAIN	OLIVE STONES	Olive stones 4	1510404	Calle Mariana de Carvajal y Saavedra, 49, 23009 Jaén (SPAIN)	PELÁEZ RENOVABLES, S.L. (PREMIUM)					
SPAIN	OLIVE STONES	Olive stones 5	1510405	Calle Mariana de Carvajal y Saavedra, 49, 23009 Jaén (SPAIN)	PELÁEZ RENOVABLES, S.L. (MIX)					
SPAIN	OLIVE STONES	Olive stones 6	1510406	Calle Alberquilla, 23400 Úbeda, Jaén (SPAIN)	ECOLOMA BIOCOMBUSTIBLES, S.L. (CALIDAD A)					
SPAIN	OLIVE STONES	Olive stones 7	1510407	Calle Alberquilla, 23400 Úbeda, Jaén (SPAIN)	ECOLOMA BIOCOMBUSTIBLES, S.L. (A GRANEL)					
SPAIN	OLIVE STONES	Olive stones 8	1510408	DOCTOR PULIDO TORRES, 23490 Estación Linares-Baeza, Jaén (SPAIN)	DANIEL ESPUNY, S.A.U. (A GRANEL)					
SPAIN	OLIVE STONES	Olive stones 9	1510409	Fábrica Calle Camino Viejo, s/n, ENCINAS REALES Córdoba 14913 (SPAIN)	OLIHUESO (A GRANEL)					
SPAIN	OLIVE STONES	Olive stones 10	1510410	Ctra. Madrid-Cadiz, Km. 293; Bailén (Jaén) 23710 (SPAIN)	GARZÓN GREEN ENERGY (ENSACADO)					
TURKEY	OLIVE STONES	Olive stones 1	10984	Bursa (TURKEY)	Marmarabirlik Marzey	5	5			
TURKEY	OLIVE STONES	Olive stones 2	11013	Aydın/Umurlu (TURKEY)	Özer	6	6.00			
TURKEY	OLIVE STONES	Olive stones 3	11014	Aydın/Umurlu (TURKEY)	Loras	10	5.00			
TURKEY	OLIVE STONES	Olive stones 4	11079	Balıkesir/Ayvalık (TURKEY)	-	4	4.00			
TURKEY	OLIVE STONES	Olive stones 5	11080	Balıkesir/Burhaniye (TURKEY)	-	2	2.00			
CROATIA	OLIVE STONES	Olive stones 1	11015	22 202 Primošten (CROATIA)	Primošten Burni (Cooperative)			n.a	0.1	Coordinates: Latitute (43°35'10.74"S), Longitute (15°55'22.86"I). Primošten (Šibenik Knin County) is located on the Croatian coast and
CROATIA	OLIVE STONES	Olive stones 2	11016	52216 Galižana (CROATIA)	Uljara Baioco Ltd.			n.a	n.a	Coordinates: Latitute (44°56'0.68"S), Longitute (13°52'5.94"I). Galižana
PORTUGAL	OLIVE STONES	Caroço_azeitona_Pt_1	65-17	São Vicente do Paúl (PORTUGAL)	Agri-mendes	2				
PORTUGAL	OLIVE STONES	Caroço_azeitona_Pt_2	66-17	Coimbra (PORTUGAL)	Alcoleos - Óleos de Alcarraques SA	1				
PORTUGAL	OLIVE STONES	Caroço_azeitona_Pt_3	67-17	Ferreira do Alentejo (PORTUGAL)	Casa Alta - Sociedade Transformadora de Bagaços, Lda	1				
ITALY	OLIVE STONES	Sample 005	89/17	Bosco Società Cooperativa Agricola (ITALY)	Bosco Società Cooperativa Agricola	20		4	10	
ITALY	OLIVE STONES	Sample 006	90/17	Bosco Società Cooperativa Agricola (ITALY)	Bosco Società Cooperativa Agricola	20		4	10	
ITALY	OLIVE STONES	Sample 1	133/17	CISUD (ITALY)	CISUD	4		8	15	
ITALY	OLIVE STONES	Sample 2	134/17	CISUD (ITALY)	CISUD	6		8	15	
ITALY	OLIVE STONES	Sample 3	135/17	CISUD (ITALY)	CISUD	5		8	15	
ITALY	OLIVE STONES	Sample 4	136/17	CISUD (ITALY)	CISUD	5		8	15	
ITALY	OLIVE STONES	Sample 5	137/17	CISUD (ITALY)	CISUD	4		8	15	
ITALY	OLIVE STONES	Sample FRANTOIO 001	138/17	OLIVICOLTORI TOSCANI ASSOCIATI (ITALY)	OLIVICOLTORI TOSCANI ASSOCIATI	5		8	15	
ITALY	OLIVE STONES	Sample FRANTOIO 002	139/17	OLIVICOLTORI TOSCANI ASSOCIATI (ITALY)	OLIVICOLTORI TOSCANI ASSOCIATI	5		8	15	
ITALY	OLIVE STONES	Sample SANSIFICIO 001	140/17	OLIVICOLTORI TOSCANI ASSOCIATI (ITALY)	OLIVICOLTORI TOSCANI ASSOCIATI	5		8	25	
ITALY	OLIVE STONES	Sample SANSIFICIO 002	141/17	OLIVICOLTORI TOSCANI ASSOCIATI (ITALY)	OLIVICOLTORI TOSCANI ASSOCIATI	5		8	25	
ITALY	OLIVE STONES	RIDOLFI NOC 001	142/17	Via Civita Castellana, 51, 01030 Corchiano VT, (ITALY)	Frantoio Vecchia Macina S.N.C.	7		8	15	
ITALY	OLIVE STONES	RIDOLFI NOC 002	143/17	Via Civita Castellana, 51, 01030 Corchiano VT, (ITALY)	Frantoio Vecchia Macina S.N.C.	8		8	15	
ITALY	OLIVE STONES	RIDOLFI NOC 003	144/17	Via Civita Castellana, 51, 01030 Corchiano VT, (ITALY)	Frantoio Vecchia Macina S.N.C.	5		8	15	
GREECE	OLIVE STONES	Olive stones 1	B20161221OLKAN1	Papoulia Messinias (GREECE)	Kanakis (Olive mill)	N/A		~1-3 mm	14.1	Olive stones separated from olive pulp. Production: 2015
GREECE	OLIVE STONES	Olive stones 2	B20161221OLKAN2	Papoulia Messinias (GREECE)	Kanakis (Olive mill)	N/A		~1-3 mm	14.1	Olive stones separated from olive pulp. Production: 2016
GREECE	OLIVE STONES	Olive stones 3	B20161221OLNIT	Nea Alikarnassos, Iraklio (GREECE)	Nitadoros (Olive mill)	N/A		~1-3 mm	9.5	Olive stones separated from olive pulp. Production: Dec. 2016
GREECE	OLIVE STONES	Olive stones 4	B20170206BSDOLKER1	13th km. National Road Spartis - Githiou (GREECE)	EAS Lakonias (Pomace mill)	N/A		~1-3 mm	23.6	Olive stones separated from crude olive pomace. Production: Jan.
GREECE	OLIVE STONES	Olive stones 5	B20170206BSDOLKER2	13th km. National Road Spartis - Githiou (GREECE)	EAS Lakonias (Pomace mill)	N/A		~1-3 mm	24.6	Olive stones separated from crude olive pomace. Production: Jan.
GREECE	OLIVE STONES	Olive stones 6	B20170215BSDOLKER1	Iraklion (GREECE)	Cretan Mills	N/A		~1-3 mm	9.8	Exhausted olive cake without previous stone extraction ("pirinoksilo")
GREECE	OLIVE STONES	Olive stones 7	B20170215BSDOLKER2	Iraklion (GREECE)	Cretan Mills	N/A		~1-3 mm	9.9	Exhausted olive cake without previous stone extraction ("pirinoksilo")

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SUPPLIER (COMPANY NAME)	LOT SIZE (tons)	NUMBER OF INCREMENTS TAKEN	Particle size range (mm) (if available or estimated)	Moisture content (% w.b.) (if available or estimated)	COMMENTS
GREECE	OLIVE STONES	Olive stones 8	B20170222BSDOLKER	Foiniki Molaon (GREECE)	Renieris (Olive mill)	N.A.		~1-3 mm	15.1	Olive stones separated from olive pulp. Production: Feb. 2017
GREECE	OLIVE STONES	Olive stones 9	B20170222BSDOLKER1	Nea Kios, Nafplio (GREECE)	ELSAP S.A. (Pomace mill)	N.A.		~1-3 mm	10.2	Aerodynamic separation from exhausted olive cake without previous stone extraction (“pirinoksilo”). Production: Feb. 2017
GREECE	OLIVE STONES	Olive stones 10	B20170222BSDOLKER2	Nea Kios, Nafplio (GREECE)	ELSAP S.A. (Pomace mill)	N.A.		~1-3 mm	14.1	Aerodynamic separation from exhausted olive cake without previous stone extraction (“pirinoksilo”). Production: Feb. 2017. Raw material
SLOVENIA	OLIVE STONES	Olive stones 1	B20170104BSDSFI1	Šmarje pro Kopru (SLOVENIA)	Santomas	10	4.00	3-4 mm		
SLOVENIA	OLIVE STONES	Olive stones 2	B20170104BSDSFI2	Šmarje pro Kopru (SLOVENIA)	Santomas	10	4.00	3-4 mm		
SLOVENIA	OLIVE STONES	Olive stones 3	B20170104BSDSFI3	Šmarje pro Kopru (SLOVENIA)	Santomas	10	4.00	3-4 mm		
SLOVENIA	OLIVE STONES	Olive stones 4	B20170104BSDSFI4	Šmarje pro Kopru (SLOVENIA)	Santomas	10	4.00	3-4 mm		

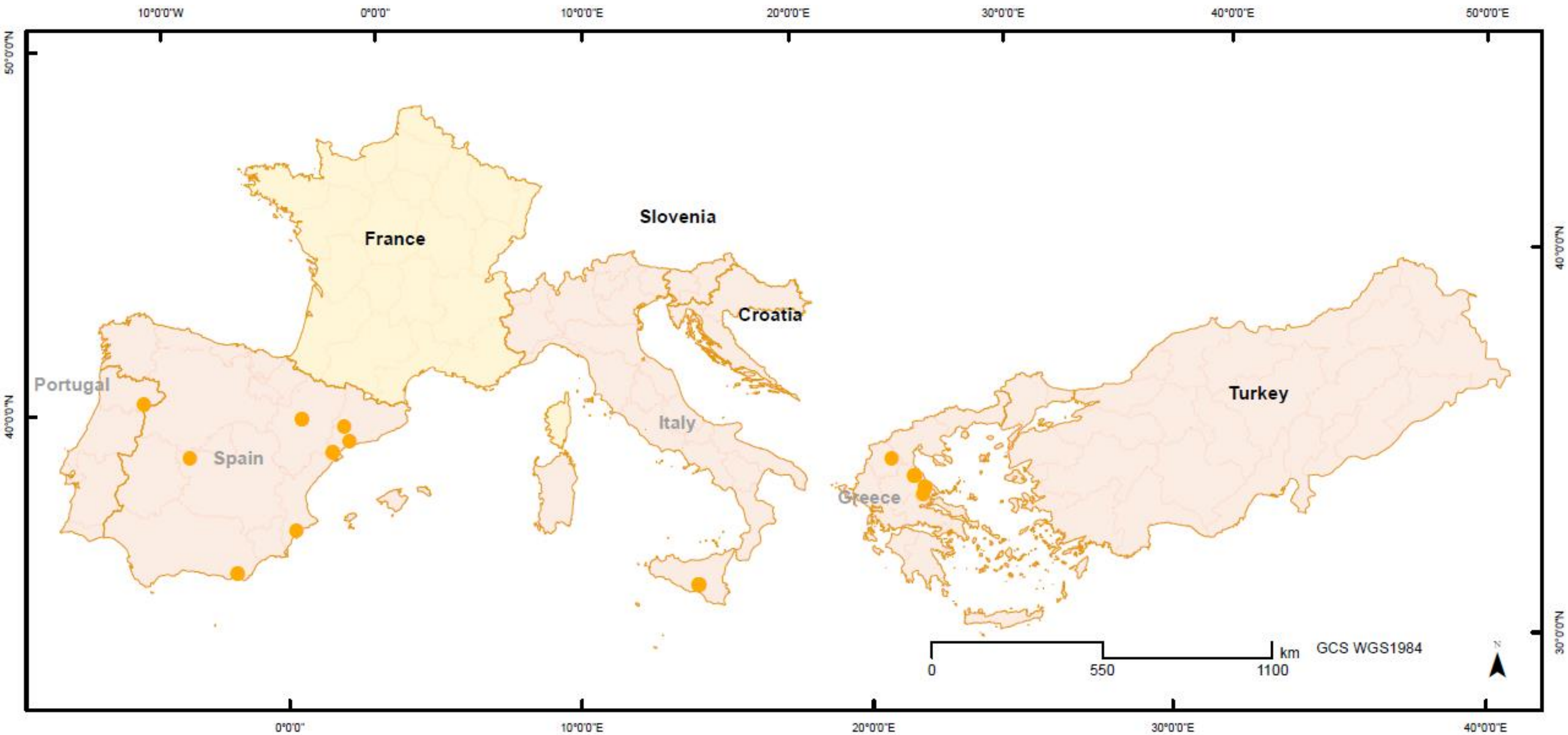


BIOMASS	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES	**2**	**10**	**14**	**3**	**4**	**10**	**5**	**48**
ALMOND SHELLS		6	8	1		10		**25**
HAZELNUT SHELLS	10					5	10	**25**
PISTACHIO SHELLS		3				10	6	**19**
WALNUT SHELLS		4		2		6	10	**22**
PINE NUT SHELLS				4		10		**14**
OLIVE TREE PRUNINGS	10	12	4	8	10	20	10	**74**
OLIVE TREE PELLETS			2					**2**
VINEYARD PRUNINGS	18	16	9	18	17	24	10	**112**
VINEYARD PELLETS			5			1		**6**
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

Olive stones: Distribution of samples collected by country (Table) and collection sites (map)

➢ 8.1.2 Almond shell samples

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SUPPLIER (COMPANY NAME)	LOT SIZE (tons)	NUMBER OF INCREMENTS TAKEN	Particle size range (mm) (if available or estimated)	Moisture content (% w.b.) (if available or estimated)	COMMENTS
SPAIN	ALMOND SHELLS	Almond shells 1	1519501	Carretera Raval de Cristo a Roquetes, 70; 43529 Roquetes, Tarragona (SPAIN)	FRUPINSA					
SPAIN	ALMOND SHELLS	Almond shells 2	1519502	Ronda Oest, 17, 25141 Torregrossa, Lleida (SPAIN)	BIOMASSA COTRANS, S.L.					
SPAIN	ALMOND SHELLS	Almond shells 3	1519503	CRTA. DE AGOST, KM 1,5.03690,SAN VICENTE DEL RASPEIG/SANT VICENT DEL RASPEIG, ALICANTE (SPAIN)	Almendras del Guadiana, S.L.					
SPAIN	ALMOND SHELLS	Almond shells 4	1519504	C/ Sierra Morena, Viator, Almería (SPAIN)	GRUPO BORGES					
SPAIN	ALMOND SHELLS	Almond shells 5	1519505	C/ JOAN OLIVER, 16-24, 43206 Reus, Tarragona (SPAIN)	UNIÓ CORPORACIÓ ALIMENTARIA					
SPAIN	ALMOND SHELLS	Almond shells 6	1519506	C/ Sierra Morena, Viator, Almería (SPAIN)	GRUPO BORGES					
SPAIN	ALMOND SHELLS	Almond shells 7	1205101	Ctra. Castellón, 0, 50720 Cartuja Baja, Zaragoza (SPAIN)	BIOEBRO					
SPAIN	ALMOND SHELLS	Almond shells 8	1205102	Carretera Raval de Cristo a Roquetes, 70; 43529 Roquetes - Tarragona (SPAIN)	FRUPINSA					
SPAIN	ALMOND SHELLS	Almond shells 9	1110303	CTRA CASTELLON KM 3,600, 50013 Zaragoza (SPAIN)	COMBUSTIBLES CRESPO, S.L.					
SPAIN	ALMOND SHELLS	Almond shells 10	1110304	C/ San Francisco, 21 - 45600 Talavera de la Reina, Toledo	TALAVERA DE LA REINA					
PORTUGAL	ALMOND SHELLS	Casca amêndoa Pt 1	68-17	Torre de Moncorvo (PORTUGAL)	Private owner	0.5				
ITALY	ALMOND SHELLS	BONGIOV 001	262/17	Ctr. Piano San Salvatore, 93013 Mazzarino CL (ITALY)	Mandorle di Sicilia Bongiovanni				10	
ITALY	ALMOND SHELLS	BONGIOV 002	263/17	Ctr. Piano San Salvatore, 93013 Mazzarino CL (ITALY)	Mandorle di Sicilia Bongiovanni				11	
ITALY	ALMOND SHELLS	BONGIOV 003	264/17	Ctr. Piano San Salvatore, 93013 Mazzarino CL (ITALY)	Mandorle di Sicilia Bongiovanni				12	
ITALY	ALMOND SHELLS	BONGIOV 004	265/17	Ctr. Piano San Salvatore, 93013 Mazzarino CL (ITALY)	Mandorle di Sicilia Bongiovanni				13	
ITALY	ALMOND SHELLS	BONGIOV 005	266/17	Ctr. Piano San Salvatore, 93013 Mazzarino CL (ITALY)	Mandorle di Sicilia Bongiovanni				14	
ITALY	ALMOND SHELLS	BONGIOV 006	267/17	Ctr. Piano San Salvatore, 93013 Mazzarino CL (ITALY)	Mandorle di Sicilia Bongiovanni				15	
ITALY	ALMOND SHELLS	BONGIOV 007	268/17	Ctr. Piano San Salvatore, 93013 Mazzarino CL (ITALY)	Mandorle di Sicilia Bongiovanni				16	
ITALY	ALMOND SHELLS	BONGIOV 008	269/17	Ctr. Piano San Salvatore, 93013 Mazzarino CL (ITALY)	Mandorle di Sicilia Bongiovanni				17	
GREECE	ALMOND SHELLS	Almond shells 1	B20161102BIO2	Sykourion Larisas (GREECE)	Agronuts	n.a.		~1 – 8 mm	9.6	
GREECE	ALMOND SHELLS	Almond shells 2	B20161102BIO3	Macrychori Larisas (GREECE)	G&G Almonds	n.a.		~8 – 16 mm	9.6	
GREECE	ALMOND SHELLS	Almond shells 3	B20161103BIO1	Volos Industrial Area (GREECE)	Moraitis	n.a.		~1 – 8 mm	10.4	
GREECE	ALMOND SHELLS	Almond shells 4	B20161103BIO2	Sesklo Magnisias (GREECE)	Pinnas Almonds	n.a.		~1 – 16 mm	10.4	
GREECE	ALMOND SHELLS	Almond shells 5	B20161103BIO3	Almiros Volou (GREECE)	KoNik Nuts	n.a.		~1 – 16 mm	10.7	
GREECE	ALMOND SHELLS	Almond shells 6	B20161207BIO	Mavrodendri Kozanis (GREECE)	Euaggelou	n.a.		~1 – 8 mm	10.5	

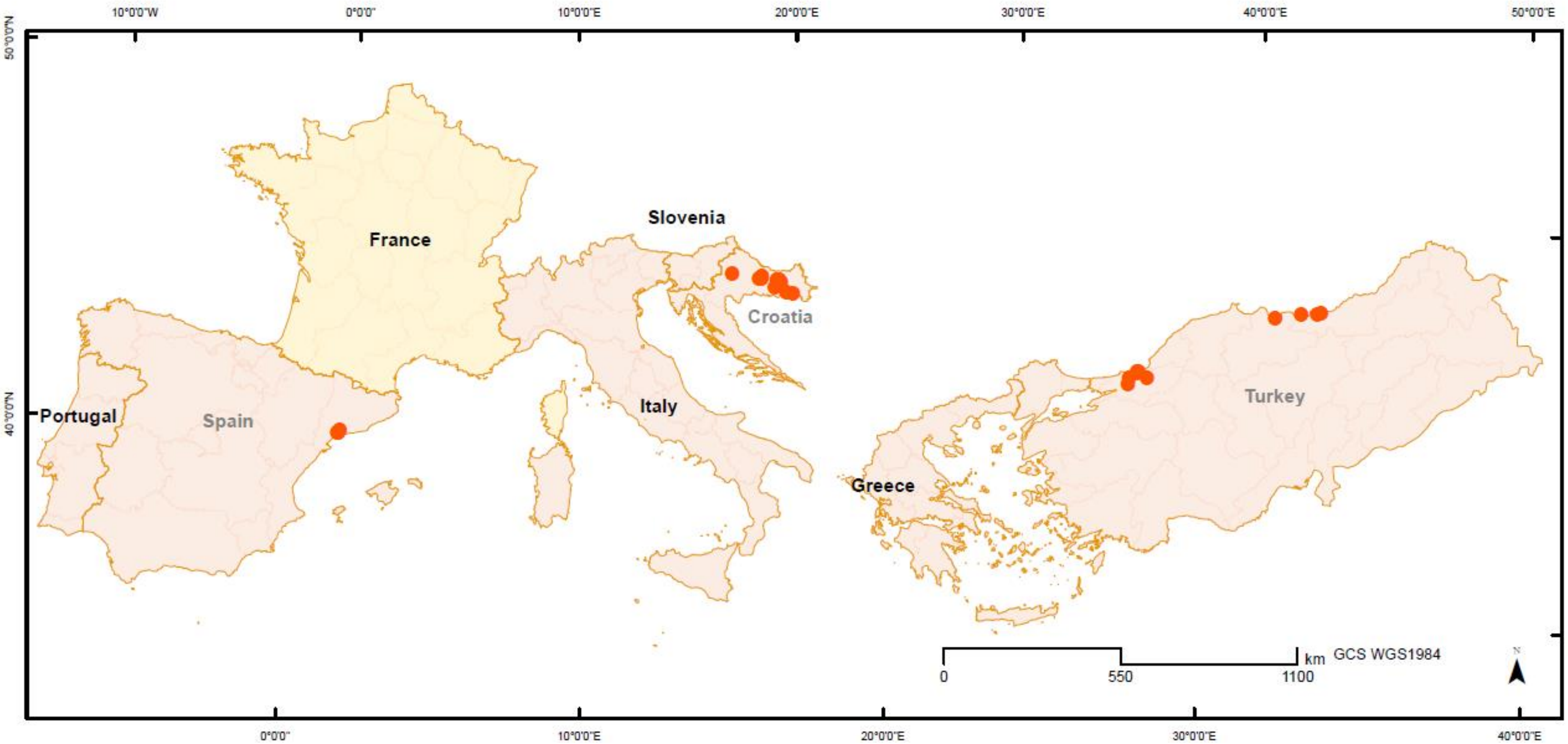


BIOMASS	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES	2	10	14	3	4	10	5	**48**
ALMOND SHELLS		**6**	**8**	**1**		**10**		**25**
HAZELNUT SHELLS	10					5	10	**25**
PISTACHIO SHELLS		3				10	6	**19**
WALNUT SHELLS		4		2		6	10	**22**
PINE NUT SHELLS				4		10		**14**
OLIVE TREE PRUNINGS	10	12	4	8	10	20	10	**74**
OLIVE TREE PELLETS			2					**2**
VINEYARD PRUNINGS	18	16	9	18	17	24	10	**112**
VINEYARD PELLETS			5			1		**6**
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

Almond shells: Distribution of samples collected by country (Table) and collection sites (map)

➢ 8.1.3 Hazelnut shell samples

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SUPPLIER (COMPANY NAME)	LOT SIZE (tons)	NUMBER OF INCREMENTS TAKEN	Particle size range (mm) (if available or estimated)	Moisture content (% w.b.) (if available or estimated)	COMMENTS
SPAIN	HAZELNUT SHELLS	AVELLANA-1	1701501	REUS, TARRAGONA (SPAIN)	UNIÓ FRUITS SECS (UNIÓ CORPORACIÓ ALIMENTÀRIA)	20	20			
SPAIN	HAZELNUT SHELLS	AVELLANA-2	1701502	LA SELVA DEL CAMP, TARRAGONA (SPAIN)	COSELVA - S. COOP. C. LTDA.	15	20			
SPAIN	HAZELNUT SHELLS	AVELLANA-3	1701503	REUS, TARRAGONA (SPAIN)	ARBORETO, S.A.T.	15	20			
SPAIN	HAZELNUT SHELLS	AVELLANA-4	1701504	REUS, TARRAGONA (SPAIN)	PAULINO SOLANELLAS	30	20			
SPAIN	HAZELNUT SHELLS	AVELLANA-5	1701505	EL MORELL, TARRAGONA (SPAIN)	J.M. PALAU	20	20			
TURKEY	HAZELNUT SHELLS	Hazelnut shells 1	10971	Samsun (TURKEY)	Samsun Directorate of Provincial Food, Agriculture And Livestock	20	10			
TURKEY	HAZELNUT SHELLS	Hazelnut shells 2	10972	Ordu (TURKEY)	Ordu Directorate of Provincial Food, Agriculture And Livestock	10	8			
TURKEY	HAZELNUT SHELLS	Hazelnut shells 3	10973	Ordu (TURKEY)	Pro Food	40	20			
TURKEY	HAZELNUT SHELLS	Hazelnut shells 4	10974	Ordu/Ünye (TURKEY)	Ozsoy Food (İsmail Özsoy)	30	15			
TURKEY	HAZELNUT SHELLS	Hazelnut shells 5	10975	Düzce (TURKEY)	Coskuner Hazelnut	20	10			
TURKEY	HAZELNUT SHELLS	Hazelnut shells 6	11083	Sakarya (TURKEY)	Özkan Entegre	50	20			
TURKEY	HAZELNUT SHELLS	Hazelnut shells 7	11084	Sakarya (TURKEY)	Özsan	20	10			
TURKEY	HAZELNUT SHELLS	Hazelnut shells 8	11085	Sakarya (TURKEY)	Kocaali Acar Farm	20	10			
TURKEY	HAZELNUT SHELLS	Hazelnut shells 9	11086	Sakarya (TURKEY)	Kocaali Fiskobirlik	30	15			
TURKEY	HAZELNUT SHELLS	Hazelnut shells 10	11087	Sakarya (TURKEY)	Cakmaklar	20	10			
CROATIA	HAZELNUT SHELLS	Hazelnut shells 1	11017	33515 Orahovica (CROATIA)	PP Orahovica	0.6	5.015	n.a.	0.05	
CROATIA	HAZELNUT SHELLS	Hazelnut shells 2	11018	34308 Jakšić (CROATIA)	OPG Vlado Sigurnjak	0.5	5.015	n.a.	n/a	
CROATIA	HAZELNUT SHELLS	Hazelnut shells 3	11019	35224 Sikirevci (CROATIA)	OPG Ilija	1	0.125	n.a.	n/a	
CROATIA	HAZELNUT SHELLS	Hazelnut shells 4	11020	31513 Seona (CROATIA)	OPG Antun Golubović	0.5	5.012	n.a.	n/a	
CROATIA	HAZELNUT SHELLS	Hazelnut shells 5	11028	35211 Bicko Selo (CROATIA)	OPG Ljubica Hodak	0.5	5.012	n.a.	n/a	
CROATIA	HAZELNUT SHELLS	Hazelnut shells 6	11029	31512 Feričanci (CROATIA)	OPG Josip Kotromanović	0.03	5.00	n.a.	0.16	
CROATIA	HAZELNUT SHELLS	Hazelnut shells 7	11030	43504 Munije (CROATIA)	OPG Marko Reljić	0.05	5.00	n.a.	n/a	
CROATIA	HAZELNUT SHELLS	Hazelnut shells 8	11031	43504 Končanica (CROATIA)	OPG Jasna Milde	0.01	5.00	n.a.	n/a	
CROATIA	HAZELNUT SHELLS	Hazelnut shells 9	11032	43500 Batiniska Rijeka (CROATIA)	Euro Fructus Ldt.	2	5.05	n.a.	n/a	
CROATIA	HAZELNUT SHELLS	Hazelnut shells 10	11033	10360 Sesvete (CROATIA)	Pantera Ltd.	0.3	5.01	n.a.	n/a	

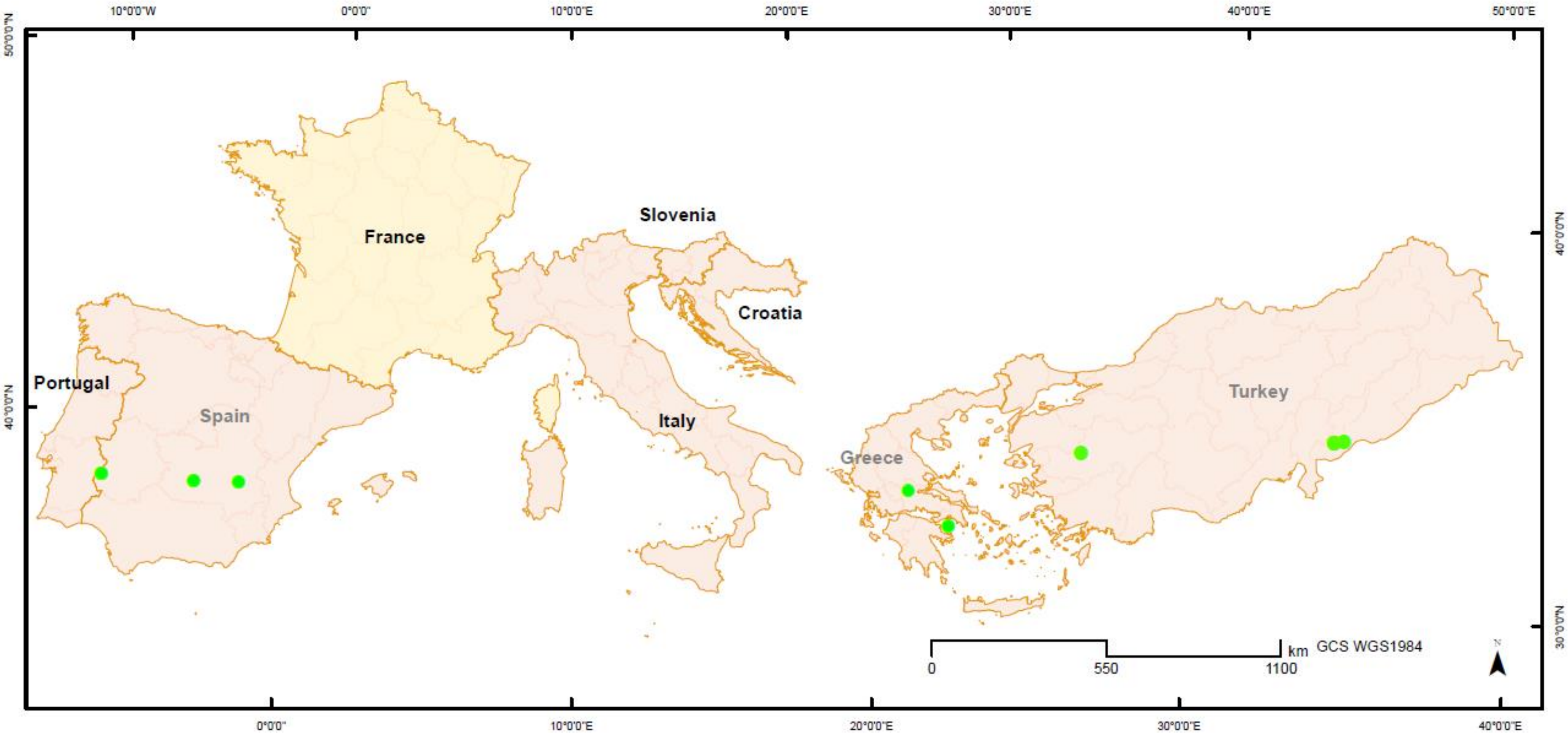


BIOMASS	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES	2	10	14	3	4	10	5	**48**
ALMOND SHELLS		6	8	1		10		**25**
HAZELNUT SHELLS	**10**					**5**	**10**	**25**
PISTACHIO SHELLS		3				10	6	**19**
WALNUT SHELLS		4		2		6	10	**22**
PINE NUT SHELLS				4		10		**14**
OLIVE TREE PRUNINGS	10	12	4	8	10	20	10	**74**
OLIVE TREE PELLETS			2					**2**
VINEYARD PRUNINGS	18	16	9	18	17	24	10	**112**
VINEYARD PELLETS			5			1		**6**
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

Hazelnut shells: Distribution of samples collected by country (Table) and collection sites (map)

➢ 8.1.4 Pistachio shell samples

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SUPPLIER (COMPANY NAME)	LOT SIZE (tons)	NUMBER OF INCREMENTS TAKEN	Particle size range (mm) (if available or estimated)	Moisture content (% w.b.) (if available or estimated)	COMMENTS
SPAIN	PISTACHIO SHELLS	PISTACHO-1	1616901	TORRALBA DE CALATRABA, CIUDAD REAL (SPAIN)	PISTACHOS EL SOL	5	6			
SPAIN	PISTACHIO SHELLS	PISTACHO-2	1616902	TORRALBA DE CALATRABA, CIUDAD REAL (SPAIN)	PISTACHOS EL SOL	5	8			
SPAIN	PISTACHIO SHELLS	PISTACHO-3	1616903	TORRALBA DE CALATRABA, CIUDAD REAL (SPAIN)	PISTACHOS EL SOL	5	8			
SPAIN	PISTACHIO SHELLS	PISTACHO-4	1616904	LA RODA, ALBACETE (SPAIN)	PISTACHOS DE LA MANCHA	10	5			
SPAIN	PISTACHIO SHELLS	PISTACHO-5	1616905	LA RODA, ALBACETE (SPAIN)	PISTACHOS DE LA MANCHA	15	7			
SPAIN	PISTACHIO SHELLS	PISTACHO-6	1616906	BADAJOZ (SPAIN)	BORGES (FRUTOS SECOS ESPAÑOLES)	20				
SPAIN	PISTACHIO SHELLS	PISTACHO-7	1616907	BADAJOZ (SPAIN)	BORGES (FRUTOS SECOS ESPAÑOLES)	15				
SPAIN	PISTACHIO SHELLS	PISTACHO-8	1616908	BADAJOZ (SPAIN)	BORGES (FRUTOS SECOS ESPAÑOLES)	20				
SPAIN	PISTACHIO SHELLS	PISTACHO-9	1616909	BADAJOZ (SPAIN)	BORGES (FRUTOS SECOS ESPAÑOLES)	20				
SPAIN	PISTACHIO SHELLS	PISTACHO-10	1616910	BADAJOZ (SPAIN)	BORGES (FRUTOS SECOS ESPAÑOLES)	30				
TURKEY	PISTACHIO SHELLS	Pistachio shells 1	10982	Gaziantep (TURKEY)	Leztat Agricultural Products	20	10			
TURKEY	PISTACHIO SHELLS	Pistachio shells 2	10983	Gaziantep (TURKEY)	Leztat Agricultural Products	10	5			
TURKEY	PISTACHIO SHELLS	Pistachio shells 3	11075	Gaziantep (TURKEY)	Fıstık Sepeti 1	10	5			
TURKEY	PISTACHIO SHELLS	Pistachio shells 4	11076	Gaziantep (TURKEY)	Fıstık Sepeti 2	50	25			
TURKEY	PISTACHIO SHELLS	Pistachio shells 5	11077	Gaziantep/Nizip (TURKEY)	Gaziantep Directorate of Provincial	20	10			
TURKEY	PISTACHIO SHELLS	Pistachio shells 6	11078	Sanlıurfa (TURKEY)	Şanlıurfa Directorate of Provincial Food, Agriculture	10	5			
GREECE	PISTACHIO SHELLS	Pistachio shells 1	B20161102BIO1	Kastri Fthiotidas (GREECE)	Skouras	n.a.		~3 - > 8 mm	8.6	
GREECE	PISTACHIO SHELLS	Pistachio shells 2	B20161117BIO	Aigina (GREECE)	Maltezou	n.a.		~3 - > 8 mm	8.8	
GREECE	PISTACHIO SHELLS	Pistachio shells 3	B20170317BSDPNSH	Aigina (GREECE)	Maltezou	n.a.		> 8 mm	10.1	

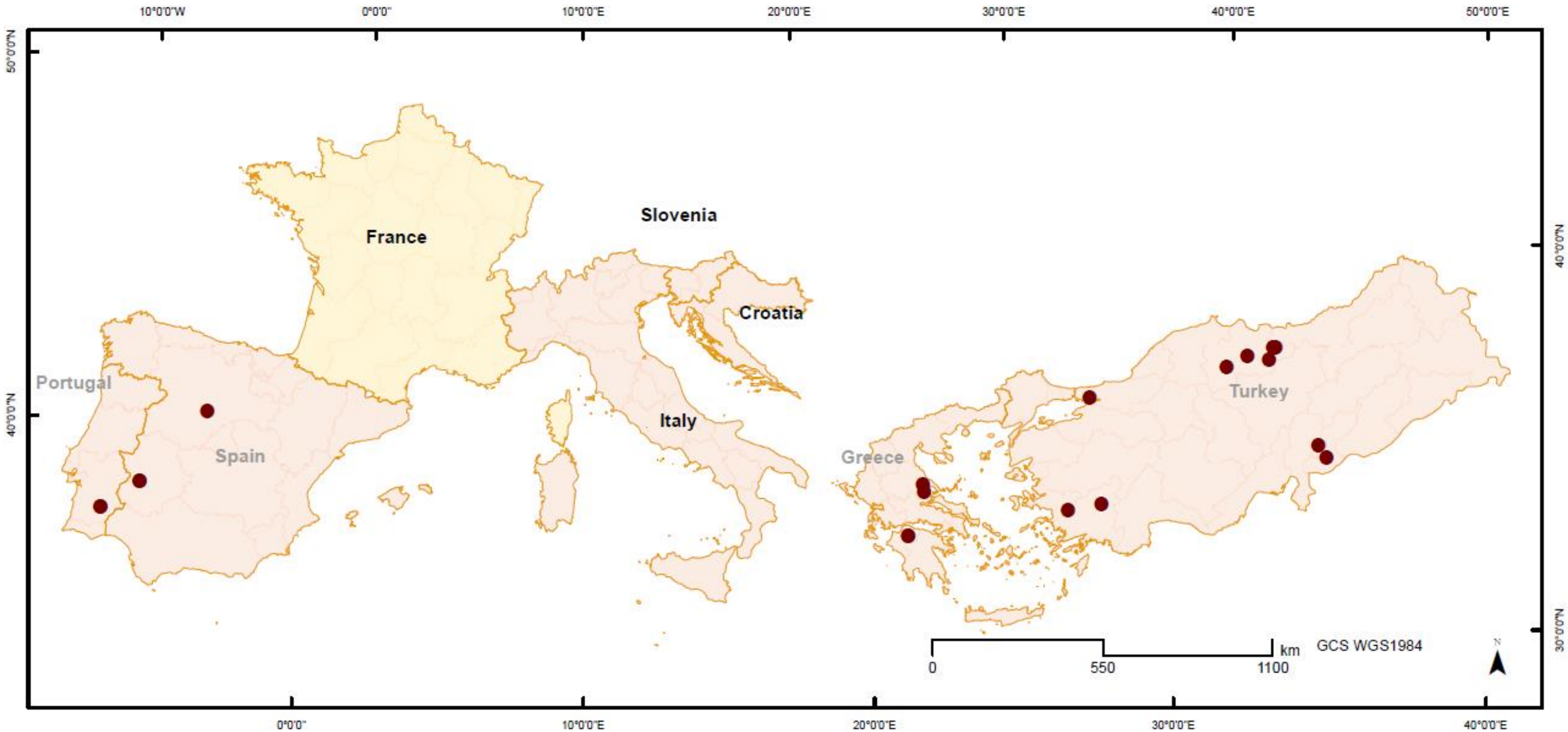


BIOMASS	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES	2	10	14	3	4	10	5	**48**
ALMOND SHELLS		6	8	1		10		**25**
HAZELNUT SHELLS	10					5	10	**25**
PISTACHIO SHELLS		**3**				**10**	**6**	**19**
WALNUT SHELLS		4		2		6	10	**22**
PINE NUT SHELLS				4		10		**14**
OLIVE TREE PRUNINGS	10	12	4	8	10	20	10	**74**
OLIVE TREE PELLETS			2					**2**
VINEYARD PRUNINGS	18	16	9	18	17	24	10	**112**
VINEYARD PELLETS			5			1		**6**
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

Pistachio shells: Distribution of samples collected by country (Table) and collection sites (map)

➢ 8.1.5 Walnut shell samples

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SUPPLIER (COMPANY NAME)	LOT SIZE (tons)	NUMBER OF INCREMENTS TAKEN	Particle size range (mm) (if available or estimated)	Moisture content (% w.b.) (if available or estimated)	COMMENTS
SPAIN	WALNUT SHELLS	NUEZ-1	1701401	PEDRAJAS DE SAN ESTEBAN, VALLADOLID (SPAIN)	BIOPIÑON					
SPAIN	WALNUT SHELLS	NUEZ-2	1701402	MONTIJO, BADAJOZ (SPAIN)	FRUTOS DE VETTONIA					
SPAIN	WALNUT SHELLS	NUEZ-3 (NUECES VANAS)	1701403	MONTIJO, BADAJOZ (SPAIN)	FRUTOS DE VETTONIA					
SPAIN	WALNUT SHELLS	NUEZ-4	1701404	EL MORELL, TARRAGONA (SPAIN)	MARTÍ LLAURADÓ					
SPAIN	WALNUT SHELLS	NUEZ-5	1701405	BADAJOZ (SPAIN)	BORGES (FRUTOS SECOS ESPAÑOLES)					
SPAIN	WALNUT SHELLS	NUEZ-6	1701406	BADAJOZ (SPAIN)	BORGES (FRUTOS SECOS ESPAÑOLES)					
TURKEY	WALNUT SHELLS	Wallnut shells 1	10976	Tokat (TURKEY)	Mr. Cemal	10	5			
TURKEY	WALNUT SHELLS	Wallnut shells 2	10977	Amasya (TURKEY)	Amasya Directorate of Provincial Food, Agriculture and Livestock	8	4			
TURKEY	WALNUT SHELLS	Wallnut shells 3	10978	Tokat/ Niksar (TURKEY)	Birr Fidancılık	20	10			
TURKEY	WALNUT SHELLS	Wallnut shells 4	10979	Tokat/ Niksar (TURKEY)	Cevizsan	20	10			
TURKEY	WALNUT SHELLS	Wallnut shells 5	10980	Corum (TURKEY)	Çorum Directorate of Provincial Food, Agriculture	10	5			
TURKEY	WALNUT SHELLS	Wallnut shells 6	10981	Gaziantep (TURKEY)	Leztat Agricultural Products	20	10			
TURKEY	WALNUT SHELLS	Wallnut shells 7	11034	Aydın (TURKEY)	Aydın Directorate of Provincial Food, Agriculture And Livestock	10	5			
TURKEY	WALNUT SHELLS	Wallnut shells 8	11035	Denizli (TURKEY)	Denizli Directorate of Provincial Food, Agriculture	10	5			
TURKEY	WALNUT SHELLS	Wallnut shells 9	11081	Adıyaman (TURKEY)	Adıyaman Directorate of Provincial Food, Agriculture And Livestock	20	10			
TURKEY	WALNUT SHELLS	Wallnut shells 10	11082	Kocaeli (TURKEY)	Kocaeli Directorate of Provincial Food, Agriculture	20	10			
PORTUGAL	WALNUT SHELLS	Casca_noz_Pt_1	778-16	Monte da Raposinha (PORTUGAL)	João Tété	1				
PORTUGAL	WALNUT SHELLS	Casca_noz_Pt_2	779-16	Monte da Raposinha (PORTUGAL)	João Tété	1				
GREECE	WALNUT SHELLS	Walnut shells 1	B20161103BIO4	Almiros Volou (GREECE)	KoNik Nuts	n.a.		~8 -> 16 mm	10.8	
GREECE	WALNUT SHELLS	Walnut shells 2	B20170111BSDKAR1	Ano Vlasia Kalavriton (GREECE)	N/A	n.a.		~3 –> 16 mm	10.3	
GREECE	WALNUT SHELLS	Walnut shells 3	B20170111BSDKAR2	Ano Vlasia Kalavriton (GREECE)	N/A	n.a.		~3 –> 16 mm	10.5	
GREECE	WALNUT SHELLS	Walnut shells 4	B20170323BSDNUTS	Rizomilos Magnisias (GREECE)	N/A	n.a.		~3 –> 16 mm	12.4	

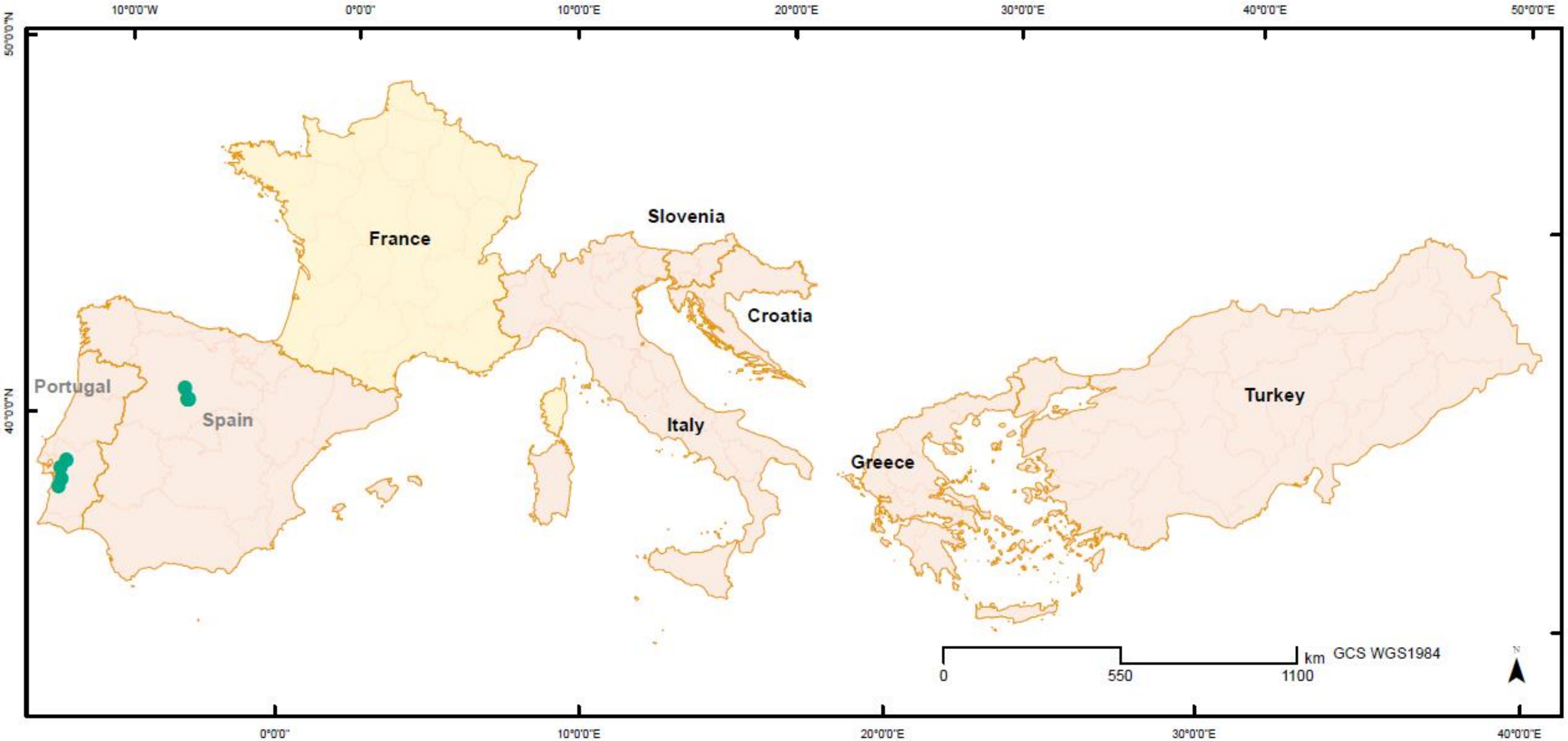


BIOMASS	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES	2	10	14	3	4	10	5	**48**
ALMOND SHELLS		6	8	1		10		**25**
HAZELNUT SHELLS	10					5	10	**25**
PISTACHIO SHELLS		3				10	6	**19**
WALNUT SHELLS		**4**		**2**		**6**	**10**	**22**
PINE NUT SHELLS				4		10		**14**
OLIVE TREE PRUNINGS	10	12	4	8	10	20	10	**74**
OLIVE TREE PELLETS			2					**2**
VINEYARD PRUNINGS	18	16	9	18	17	24	10	**112**
VINEYARD PELLETS			5			1		**6**
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

Walnut shells: Distribution of samples collected by country (Table) and collection sites (map)

8.1.6 Pine nut shell samples

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SUPPLIER (COMPANY NAME)	LOT SIZE (tons)	NUMBER OF INCREMENTS TAKEN	Particle size range (mm) (if available or estimated)	Moisture content (% w.b.) (if available or estimated)	COMMENTS
SPAIN	PINE NUT SHELLS	PIÑÓN-1	1616201	MATAPOZUELOS, VALLADOLID (SPAIN)	PIÑONES ROMÁN LORENZO	20				
SPAIN	PINE NUT SHELLS	PIÑÓN-2	1616202	PEDRAJAS DE SAN ESTEBAN, VALLADOLID (SPAIN)	BIOPIÑON	15				
SPAIN	PINE NUT SHELLS	PIÑÓN-3	1616203	PEDRAJAS DE SAN ESTEBAN, VALLADOLID (SPAIN)	HIJOS DE APOLINAR ARRANZ	8				
SPAIN	PINE NUT SHELLS	PIÑÓN-5	1616204	PEDRAJAS DE SAN ESTEBAN, VALLADOLID (SPAIN)	PIÑONES ANCAR S.L	20				
SPAIN	PINE NUT SHELLS	PIÑÓN-6	1616205	PEDRAJAS DE SAN ESTEBAN, VALLADOLID (SPAIN)	PIÑONES GARCÍA MARTÍN	25				
SPAIN	PINE NUT SHELLS	PIÑÓN-7	1616206	PEDRAJAS DE SAN ESTEBAN, VALLADOLID (SPAIN)	PIÑONES HIJOS DE LUIS SANZ	10				
SPAIN	PINE NUT SHELLS	PIÑÓN-8	1616207	PEDRAJAS DE SAN ESTEBAN, VALLADOLID (SPAIN)	COOPERATIVA PIÑONSOL	15				
SPAIN	PINE NUT SHELLS	PIÑÓN-9	1616208	PEDRAJAS DE SAN ESTEBAN, VALLADOLID (SPAIN)	PIÑONES LOZANO	20				
SPAIN	PINE NUT SHELLS	PIÑÓN-10	1616209	PEDRAJAS DE SAN ESTEBAN, VALLADOLID (SPAIN)	BIOMASAS HERRERO	5				
SPAIN	PINE NUT SHELLS	PIÑÓN-11	1616210	PEDRAJAS DE SAN ESTEBAN, VALLADOLID (SPAIN)	PIÑÓN EXPORT-IMPORT	10				
PORTUGAL	PINE NUT SHELLS	Casca_pinhão_Pt_1	780-16	Pegões (PORTUGAL)	Preparadora de Pinhões, lda	2				
PORTUGAL	PINE NUT SHELLS	Casca_pinhão_Pt_2	781-16	Coruche (PORTUGAL)	Grupo Cecílio, SA	3				
PORTUGAL	PINE NUT SHELLS	Casca_pinhão_Pt_3	103-17	Grândola (PORTUGAL)	Pineflavour	1				
PORTUGAL	PINE NUT SHELLS	Casca_pinhão_Pt_4	104-17	Alcácer do Sal (PORTUGAL)	Pinhão Mais-Transformacão de Frutos Secos Lda	1				



BIOMASS	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES	2	10	14	3	4	10	5	**48**
ALMOND SHELLS		6	8	1		10		**25**
HAZELNUT SHELLS	10					5	10	**25**
PISTACHIO SHELLS		3				10	6	**19**
WALNUT SHELLS		4		2		6	10	**22**
PINE NUT SHELLS				**4**		**10**		**14**
OLIVE TREE PRUNINGS	10	12	4	8	10	20	10	**74**
OLIVE TREE PELLETS			2					**2**
VINEYARD PRUNINGS	18	16	9	18	17	24	10	**112**
VINEYARD PELLETS			5			1		**6**
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

Pine nut shells: Distribution of samples collected by country (Table) and collection sites (map)

➢ 8.1.7 Olive tree pruning samples

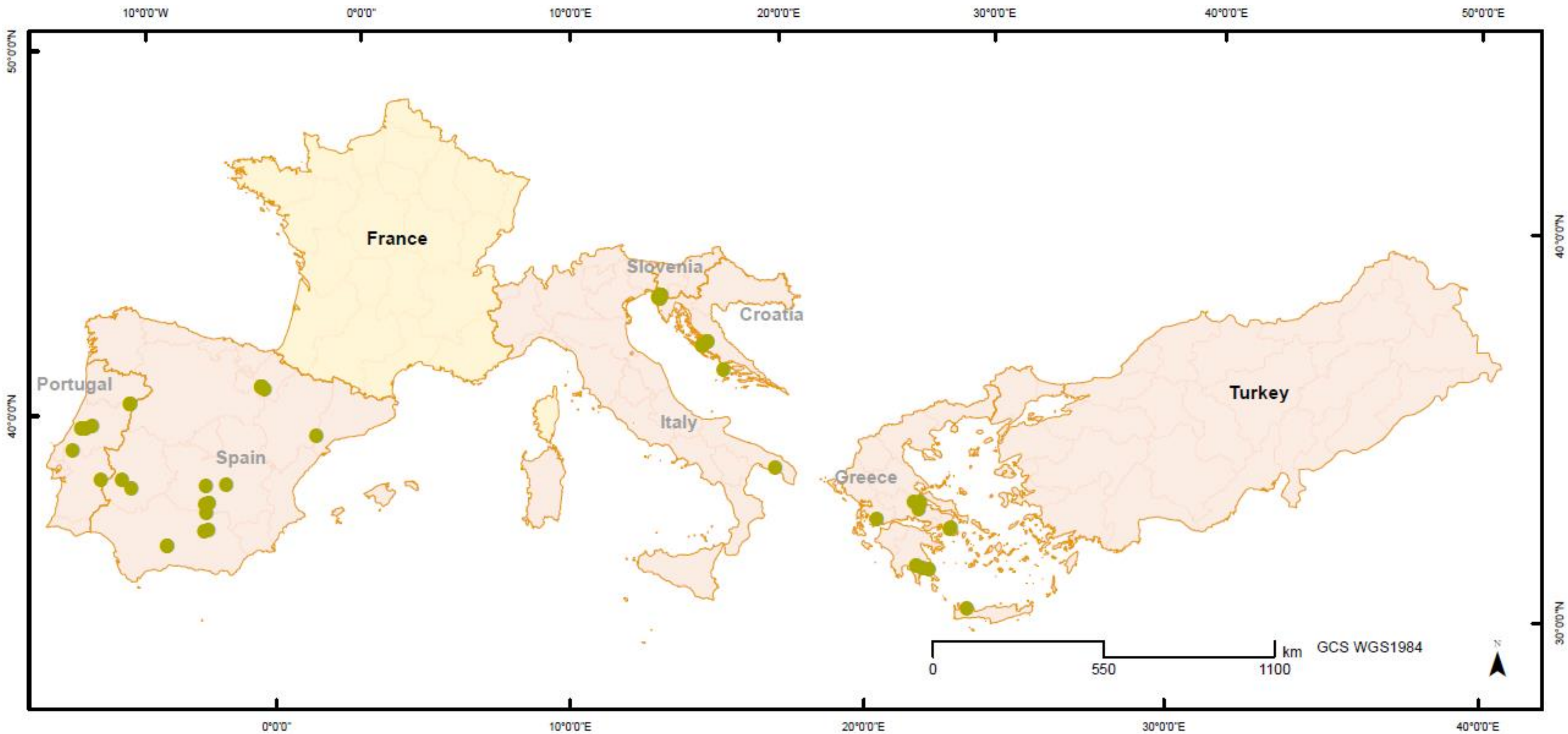
COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SAMPLING AREA (ha)	SUPPLIER (COMPANY NAME)	VARIETY/SPECIES	ANNUAL IRRIGATION (m3/ha)	TYPE OF PREPARATION	COMMENTS
SPAIN	OLIVE TREE PRUNING	OLIVO-2	1702201	BATEA, TARRAGONA (SPAIN)	9,33	JOSEP M. MAIJÓ	EMPELTRE	3000 m3/ha		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-3	1702202	SOCUÉLLAMOS, CIUDAD REAL (SPAIN)		COMBUSTIBLES DE LA MANCHA, S.L.	CORNICABRA	n.a.		SAMPLE TAKEN FROM A BULKHILL
SPAIN	OLIVE TREE PRUNING	OLIVO-4	1702203	VILLARRUBIA DE LOS OJOS, CIUDAD REAL (SPAIN)	1,1	SOC. COOPERATIVA EL PROGRESO	CORNICABRA	n.a.		SAMPLE TAKEN FROM A BULKHILL
SPAIN	OLIVE TREE PRUNING	OLIVO-5.1	1702204	VALDEPEÑAS, CIUDAD REAL (SPAIN)	4	ANTONIO LUIS BADILLO	PICUAL	SUPPORT IRRIGATION		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-5.2	1702205	VALDEPEÑAS, CIUDAD REAL (SPAIN)	0,89	ANTONIO LUIS BADILLO	CORNICABRA	SUPPORT IRRIGATION		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-6	1702206	SANTA CRUZ DE MUDELA, CIUDAD REAL (SPAIN)	1,67	ANTONIO LUIS BADILLO	CORNICABRA	SUPPORT IRRIGATION		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-7	1702207	ALDEAQUEMADA, JAÉN (SPAIN)	1,73	FRANCISCO MANZANARES	PICUAL	WITHOUT IRRIGATION		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-8	1702208	JÓDAR, JAÉN (SPAIN)		FRANCISCO JAVIER JIMÉNEZ RAMOS	PICUAL	n.a.		SAMPLE TAKEN FROM A BULKHILL
SPAIN	OLIVE TREE PRUNING	OLIVO-10.1	1702209	PALENCIANA, CÓRDOBA (SPAIN)		BIOMASA DE LA SUBBÉTICA	HOJIBLANCA	n.a.		SAMPLE TAKEN FROM A BULKHILL
SPAIN	OLIVE TREE PRUNING	OLIVO-10.2	1702210	PALENCIANA, CÓRDOBA (SPAIN)		BIOMASA DE LA SUBBÉTICA	HOJIBLANCA	n.a.		SAMPLE TAKEN FROM A BULKHILL
SPAIN	OLIVE TREE PRUNING	OLIVO-11	1702211	ÚBEDA, JAÉN (SPAIN)	0,52	FRANCISCO JAVIER JIMÉNEZ RAMOS (CORTIJO GUADIANA)	ARBEQUINA	n.a.		SAMPLE TAKEN FROM A BULKHILL
SPAIN	OLIVE TREE PRUNING	OLIVO-12	1702212	ALDEANUEVA DE EBRO, LA RIOJA (SPAIN)	0,74	COOP. BODEGA VIÑEDOS ALDEANUEVA DE EBRO	ARBEQUINA	15-20 DAYS FROM JUNE TO OCTOBER		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-13	1702213	LOBÓN, BADAJOZ (SPAIN)	2,1	UNKNOWN FARMER	VERDIAL	WITHOUT IRRIGATION		SAMPLE SENT BY THE PROVIDER
SPAIN	OLIVE TREE PRUNING	OLIVO-14	1702214	ALANGE, BADAJOZ (SPAIN)	138,4	FINCA PALACIO QUEMADO	MORISCA	WITHOUT IRRIGATION		SAMPLE SENT BY THE PROVIDER
SPAIN	OLIVE TREE PRUNING	OLIVO-15	1702215	QUEL, LA RIOJA (SPAIN)	0,18	RAÚL ORTEGA RAMIREZ	PICUAL	FLOOD IRRIGATION		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-16	1702216	QUEL, LA RIOJA (SPAIN)	0,18	RAÚL ORTEGA RAMIREZ	EMPELTRE	FLOOD IRRIGATION		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-17	1702217	QUEL, LA RIOJA (SPAIN)	0,38	RAÚL ORTEGA RAMIREZ	NEGRAL	FLOOD IRRIGATION		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-18	1702218	ARNEDO, LA RIOJA (SPAIN)	0,43	RAÚL ORTEGA RAMIREZ	ARBEQUINA	IRRIGATION. IN RAINY YEARS THE		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-19	1702219	ARNEDO, LA RIOJA (SPAIN)	0,12	RAÚL ORTEGA RAMIREZ	CARRASQUEÑA	IRRIGATION. IN RAINY YEARS THE		FRESHLY PRUNED
SPAIN	OLIVE TREE PRUNING	OLIVO-20	1702220	ARNEDO, LA RIOJA (SPAIN)	0,12	RAÚL ORTEGA RAMIREZ	REDONDILLA	IRRIGATION. IN RAINY YEARS THE		FRESHLY PRUNED
TURKEY	OLIVE TREE PRUNING	Olive tree pruning 1	11046	Manisa/Alaşehir (TURKEY)		Field			cutting with mechanical saw	
TURKEY	OLIVE TREE PRUNING	Olive tree pruning 2	11047	Manisa/Alaşehir (TURKEY)		Field			cutting with mechanical saw	
TURKEY	OLIVE TREE PRUNING	Olive tree pruning 3	11048	Manisa/Akhisar (TURKEY)		Field			cutting with mechanical saw	
TURKEY	OLIVE TREE PRUNING	Olive tree pruning 4	11049	Denizli/Sarıgöl (TURKEY)		Field			cutting with mechanical saw	
TURKEY	OLIVE TREE PRUNING	Olive tree pruning 5	11050	Aydın/Gencali (TURKEY)		Field			cutting with mechanical saw	
TURKEY	OLIVE TREE PRUNING	Olive tree pruning 6	11051	Aydın (TURKEY)		Field			cutting with mechanical saw	
TURKEY	OLIVE TREE PRUNING	Olive tree pruning 7	11052	Aydın/Ortaklar (TURKEY)		Field			cutting with mechanical saw	
TURKEY	OLIVE TREE PRUNING	Olive tree pruning 8	11053	Manisa/Turgutlu (TURKEY)		Field			cutting with mechanical saw	
TURKEY	OLIVE TREE PRUNING	Olive tree pruning 9	11054	Manisa/Saruhanlı (TURKEY)		Field			cutting with mechanical saw	
TURKEY	OLIVE TREE PRUNING	Olive tree pruning 10	11055	Manisa/Övezli (TURKEY)		Field			cutting with mechanical saw	

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SAMPLING AREA (ha)	SUPPLIER (COMPANY NAME)	VARIETY/SPECIES	ANNUAL IRRIGATION (m3/ha)	TYPE OF PREPARATION	COMMENTS
CROATIA	OLIVE TREE PRUNING	Olive tree pruning 1	11218	23423 Polača (CROATIA)	5,6	Opg Radoslav Bobanović	Oblica	X	Cutting with shears	
CROATIA	OLIVE TREE PRUNING	Olive tree pruning 2	11219	Polača 61 23423 Polača (CROATIA)	5,6	OPG Radoslav Bobanović	Ascolana	X	Cutting with shears	
CROATIA	OLIVE TREE PRUNING	Olive tree pruning 3	11220	(CROATIA)	5,6	OPG Radoslav Bobanović	Leccino	X	Cutting with shears	
CROATIA	OLIVE TREE PRUNING	Olive tree pruning 4	11221	23423 Polača (CROATIA)	5,6	OPG Radoslav Bobanović	Carolea	X	Cutting with shears	
CROATIA	OLIVE TREE PRUNING	Olive tree pruning 5	11222	23424 Polača (CROATIA)	10	OPG Josip Kulaš	Ascolana	X	Cutting with shears	
CROATIA	OLIVE TREE PRUNING	Olive tree pruning 6	11223	23425 Polača (CROATIA)	10	OPG Josip Kulaš	Oblica	X	Cutting with shears	
CROATIA	OLIVE TREE PRUNING	Olive tree pruning 7	11224	23426 Polača (CROATIA)	5	OPG Milenko Zagorac	Pendolino	X	Cutting with shears	
CROATIA	OLIVE TREE PRUNING	Olive tree pruning 8	11225	23427 Polača (CROATIA)	5	OPG Milenko Zagorac	Leccino	X	Cutting with shears	
CROATIA	OLIVE TREE PRUNING	Olive tree pruning 9	11226	23428 Polača (CROATIA)	5	OPG Milenko Zagorac	Ascolana	X	Cutting with shears	
CROATIA	OLIVE TREE PRUNING	Olive tree pruning 10	11227	Put gomilice 10, 21 222 Marina (CROATIA)	1	OPG Jakša Najev	Oblica	X	Cutting with shears	
PORTUGAL	OLIVE TREE PRUNING	Olival_Pt_1	36-17	Quinta d'Alva (PORTUGAL)	1	Sta. Casa da Mesiricórdia do Porto	Olive tree/Negrinha de Freixo	2,6 l/m2	cutting with mechanical saw	
PORTUGAL	OLIVE TREE PRUNING	Olival_Pt_2	37-17	Quinta d'Alva (PORTUGAL)	1	Sta. Casa da Mesiricórdia do Porto	Olive tree/Cornicabra	2,6 l/m^2	cutting with mechanical saw	
PORTUGAL	OLIVE TREE PRUNING	Olival_Pt_3	38-17	Quinta d'Alva (PORTUGAL)	1	Sta. Casa da Mesiricórdia do Porto	Olive tree/Manzanilha	2,6 l/m^2	cutting with mechanical saw	
PORTUGAL	OLIVE TREE PRUNING	Olival_Pt_4	39-17	Chão de Lamas (PORTUGAL)	0,5	Augusto Ferreira Mendes	Olive tree/Galega	No	cutting with mechanical saw	
PORTUGAL	OLIVE TREE PRUNING	Olival_Pt_5	40-17	Vila Nova do Ceira (PORTUGAL)	0,35	Cooperativa Social e Agroflorestal	Olive tree/Galega	NO	cutting with mechanical saw	
PORTUGAL	OLIVE TREE PRUNING	Olival_Pt_6	100-17	Tapeus, Soure (PORTUGAL)	0,5	Private owner	Olive tree		cutting with mechanical saw	
PORTUGAL	OLIVE TREE PRUNING	Olival_Pt_7	101-17	São Vicente do Paúl (PORTUGAL)	0,5	Private owner	Olive tree	Yes (no data)	cutting with mechanical saw	
PORTUGAL	OLIVE TREE PRUNING	Olival_Pt_8	102-17	Vila Viçosa (PORTUGAL)	5	João Galhardas	Olive tree/Galega	NO		
ITALY	OLIVE TREE PRUNING	RIDOLFI CIP 001	132/17	Via Civita Castellana, 51, 01030 Corchiano VT, (ITALY)		Frantoio Vecchia Macina S.N.C.	Core	NO	Harvesting and chipping	
ITALY	OLIVE TREE PRUNING	RIDOLFI CIP 001	130/17	Via Civita Castellana, 51, 01030 Corchiano VT, (ITALY)		Frantoio Vecchia Macina S.N.C.	Core	NO	Harvesting and chipping	
ITALY	OLIVE TREE PRUNING	RIDOLFI CIP 001	131/17	Via Civita Castellana, 51, 01030 Corchiano VT, (ITALY)		Frantoio Vecchia Macina S.N.C.	Core	NO	Harvesting and chipping	
ITALY	OLIVE TREE PRUNING	Sample 001	88/17	Societa' Agricola De Padova Antonio E Figli (ITALY)	3	Societa' Agricola De Padova Antonio E Figli	Olive tree	NO	fresh shredded and dried naturally	
GREECE	OLIVE TREE PRUNING	Olive tree pruning 1	B20161228BSDOLPR	Koropi X:37.890512 (GREECE)	0.23	Georgakis Stamatis	Koroneiki	Non Irrigated	Cutting with hand saw	(1), (2). Moisture content: 35%
GREECE	OLIVE TREE PRUNING	Olive tree pruning 2	B20170206BSDOLPR1	Sparti (GREECE)	0.16	Gkolemis Nikolaos	Koroneiki	Non Irrigated	Treated with chipper at the lab	(1), (2). Moisture content: 35%
GREECE	OLIVE TREE PRUNING	Olive tree pruning 3	B20170206BSDOLPR2	Sparti (GREECE)	N/A	Gkolemis Nikolaos	Koutsourelia	Fully irrigated	Treated with chipper on the field and at the lab	Sample collected from a pile of prunings left on the field for one month
GREECE	OLIVE TREE PRUNING	Olive tree pruning 4	B20170206BSDOLPR3	Monemvasia X: 36.810253 (GREECE)	0.7	Prokovakis Nikolaos	Koroneiki	Fully irrigated	Treated with chipper at the lab	(1), (2). Moisture content: 35%
GREECE	OLIVE TREE PRUNING	Olive tree pruning 5	B20170215BSDOLPR	Koropi (GREECE)	0.3	Georgakis Stamatis	Megaritiki	Non Irrigated	Treated with chipper at the lab	(1), (2). Moisture content: 35%
GREECE	OLIVE TREE PRUNING	Olive tree pruning 6	B20170223BSDOLPR	Gouria Etoloakarnanias (GREECE)	0.5	Acheloos Cooperative	Kalamon	Fully irrigated	Treated with chipper at the lab	(1), (2). Moisture content: 35%
GREECE	OLIVE TREE PRUNING	Olive tree pruning 7	B20170301BSDOLPR1	Agios Konstantinos X:38.744723 (GREECE)	4.5	Paparizos Mixalis	Kalamon	Fully irrigated	Treated with chipper at the lab	(1), (2). Moisture content: 35%
GREECE	OLIVE TREE PRUNING	Olive tree pruning 8	B20170301BSDOLPR2	Agios Konstantinos (GREECE)	4.5	Paparizos Mixalis	Amfissis	Fully irrigated	Treated with chipper at the lab	(1), (2). Moisture content: 35%
GREECE	OLIVE TREE PRUNING	Olive tree pruning 9	B20170301BSDOLPR3	Agios Seraphim (GREECE)	1	Mixos Paraskeuas	Megaritiki	Fully irrigated	Treated with chipper at the lab	(1), (2). Moisture content: 35%
GREECE	OLIVE TREE PRUNING	Olive tree pruning10	B20170302BSDOLPR	Livadeia (GREECE)	1	Anestis Georgios	Kothreiki	Non Irrigated	Treated with chipper at the lab	(1), (2). Moisture content: 35%
GREECE	OLIVE TREE PRUNING	Olive tree pruning 11	B20170323BSDOLPR	Skala Spartis (GREECE)	2.7	Tzanetos Karamixas	Kalamon	Fully irrigated	Treated with chipper at the lab	(1), (2). Moisture content: 35%
GREECE	OLIVE TREE PRUNING	Olive tree pruning 12	B20170319BSDOLPR	Chania (GREECE)	N/A	Tsivourakis Ioannis	Koroneiki	Fully irrigated	Treated with chipper at the lab	Sample sent directly by the farmer

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SAMPLING AREA (ha)	SUPPLIER (COMPANY NAME)	VARIETY/SPECIES	ANNUAL IRRIGATION (m3/ha)	TYPE OF PREPARATION	COMMENTS
SLOVENIA	OLIVE TREE PRUNING	Olive tree pruning 1	B20170502SLOV18	Ronk (SLOVENIA)		Danilo Markočič	Olea europaea L. Sort: Istrian White		Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content: 29,67%
SLOVENIA	OLIVE TREE PRUNING	Olive tree pruning 2	B20170502SLOV19	Sv.Peter pri Piranu (SLOVENIA)	1,5	Ivan Maklič	Olea europaea L. Sort: Carbo- gno di Pirano		Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content: 43,08%
SLOVENIA	OLIVE TREE PRUNING	Olive tree pruning 3	B20170502SLOV20	Sv.Peter pri Piranu (SLOVENIA)	1,5	Ivan Maklič	Olea europaea L. Sort: Istrian White		Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content: 20,95%
SLOVENIA	OLIVE TREE PRUNING	Olive tree pruning 4	B20170502SLOV21	Liminjan (SLOVENIA)	1,69	Vlado Munda	Olea europaea L. Sort: Frantoio	Fully irrigated	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content: 23,31%
SLOVENIA	OLIVE TREE PRUNING	Olive tree pruning 5	B20170502SLOV22	Liminjan (SLOVENIA)	1,69	Vlado Munda	Olea europaea L. Sort: Istrian White	Fully irrigated	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content: 20,45%
SLOVENIA	OLIVE TREE PRUNING	Olive tree pruning 6	B20170502SLOV23	Ronk (SLOVENIA)		Danilo Markočič	Olea europaea L. Sort: Leccino		Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content: 40,52%
SLOVENIA	OLIVE TREE PRUNING	Olive tree pruning 7	B20170502SLOV24	Valdoltra (SLOVENIA)		Aleksander Jevnikar	Olea europaea L. Sort: Istrian White		Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content: 17,55%
SLOVENIA	OLIVE TREE PRUNING	Olive tree pruning 8	B20170502SLOV25	Valdoltra (SLOVENIA)	0,75	Jurij Vonišek	Olea europaea L. Sort: mixture of Leccino and Istrian White		Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content: 16,7%
SLOVENIA	OLIVE TREE PRUNING	Olive tree pruning 9	B20170502SLOV26	Valdoltra (SLOVENIA)	3,6	Dušan Moljk	Olea europaea L. Sort: mixture of Leccino, Grinjan, Lichone		Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content: 13,01%
SLOVENIA	OLIVE TREE PRUNING	Olive tree pruning 10	B20170502SLOV27	Valdoltra (SLOVENIA)		Aleksander Jevnikar	Olea europaea L. Sort: Leccino		Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content: 17,25%

(1): Lot size estimated from field measurements performed by CERTH in the uP_running project

(2) Estimation of moisture content at the time of the field measurement based on the time the material was left on the field after pruning. Actual measurement at the laboratory available at the analytical fuel characterization results.

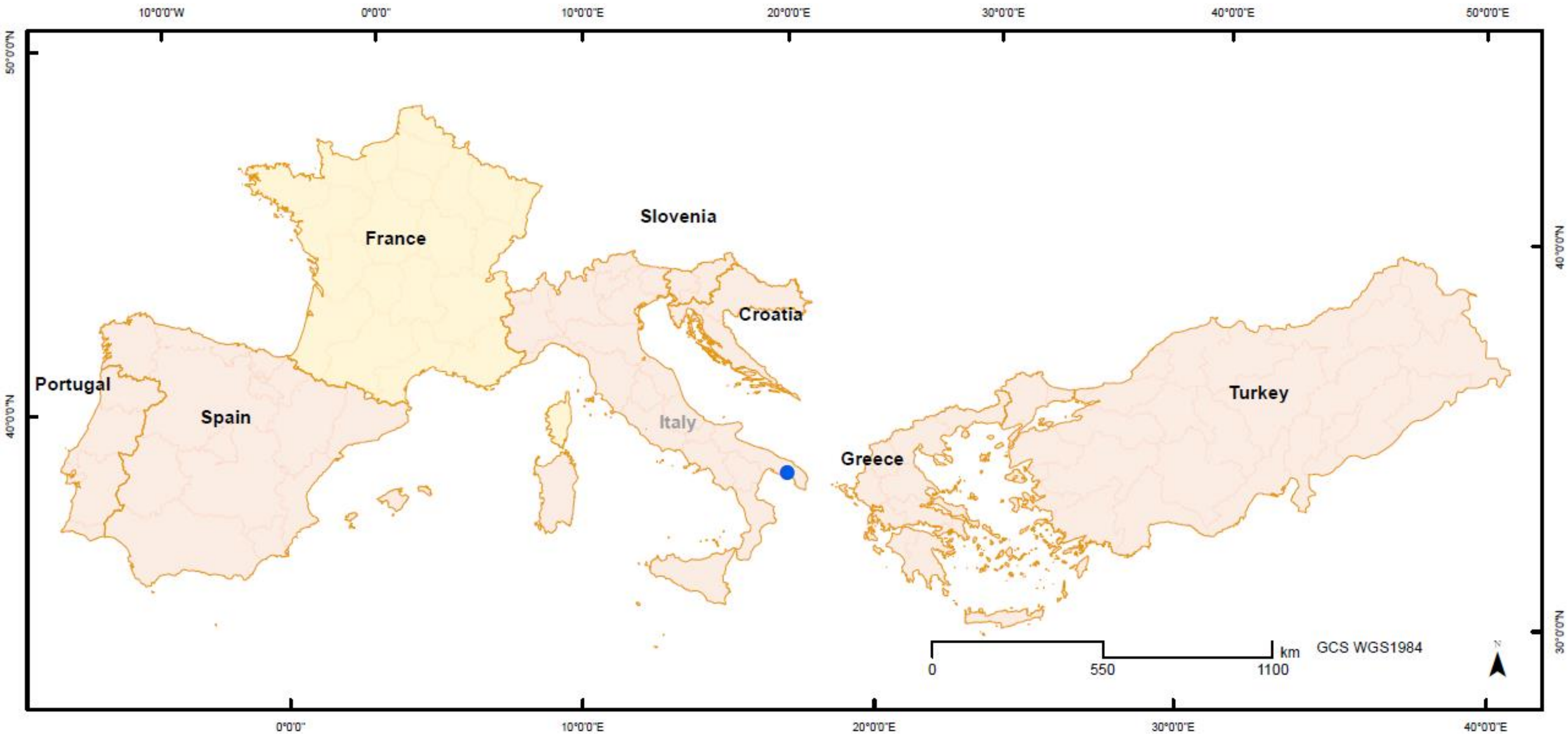


BIOMASS	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES	2	10	14	3	4	10	5	**48**
ALMOND SHELLS		6	8	1		10		**25**
HAZELNUT SHELLS	10					5	10	**25**
PISTACHIO SHELLS		3				10	6	**19**
WALNUT SHELLS		4		2		6	10	**22**
PINE NUT SHELLS				4		10		**14**
OLIVE TREE PRUNINGS	**10**	**12**	**4**	**8**	**10**	**20**	**10**	**74**
OLIVE TREE PELLETS			2					**2**
VINEYARD PRUNINGS	18	16	9	18	17	24	10	**112**
VINEYARD PELLETS			5			1		**6**
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

Olive tree prunings: Distribution of samples collected by country (Table) and collection sites (map)

➢ 8.1.8 Olive tree pruning pellet samples

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SUPPLIER (COMPANY NAME)	LOT SIZE (tons)	NUMBER OF INCREMENTS TAKEN	Particle size range (mm) (if available or estimated)	Moisture content (% w.b.) (if available or estimated)	COMMENTS
ITALY	OLIVE TREE PRUNING PELLETS	Sample 003	86-17	Societa' Agricola De Padova Antonio E Figli Srl (ITALY)	Societa' Agricola De Padova Antonio E Figli Srl	20			10	
ITALY	OLIVE TREE PRUNING PELLETS	Sample 004	87-17	Societa' Agricola De Padova Antonio E Figli Srl (ITALY)	Societa' Agricola De Padova Antonio E Figli Srl	20			10	



BIOMASS	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES	2	10	14	3	4	10	5	**48**
ALMOND SHELLS		6	8	1		10		**25**
HAZELNUT SHELLS	10					5	10	**25**
PISTACHIO SHELLS		3				10	6	**19**
WALNUT SHELLS		4		2		6	10	**22**
PINE NUT SHELLS				4		10		**14**
OLIVE TREE PRUNINGS	10	12	4	8	10	20	10	**74**
OLIVE TREE PELLETS			**2**					**2**
VINEYARD PRUNINGS	18	16	9	18	17	24	10	**112**
VINEYARD PELLETS			5			1		**6**
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

Olive tree pruning pellets:
Distribution of samples collected by country (Table) and collection sites (map)

➢ 8.1.9 Vineyard pruning samples

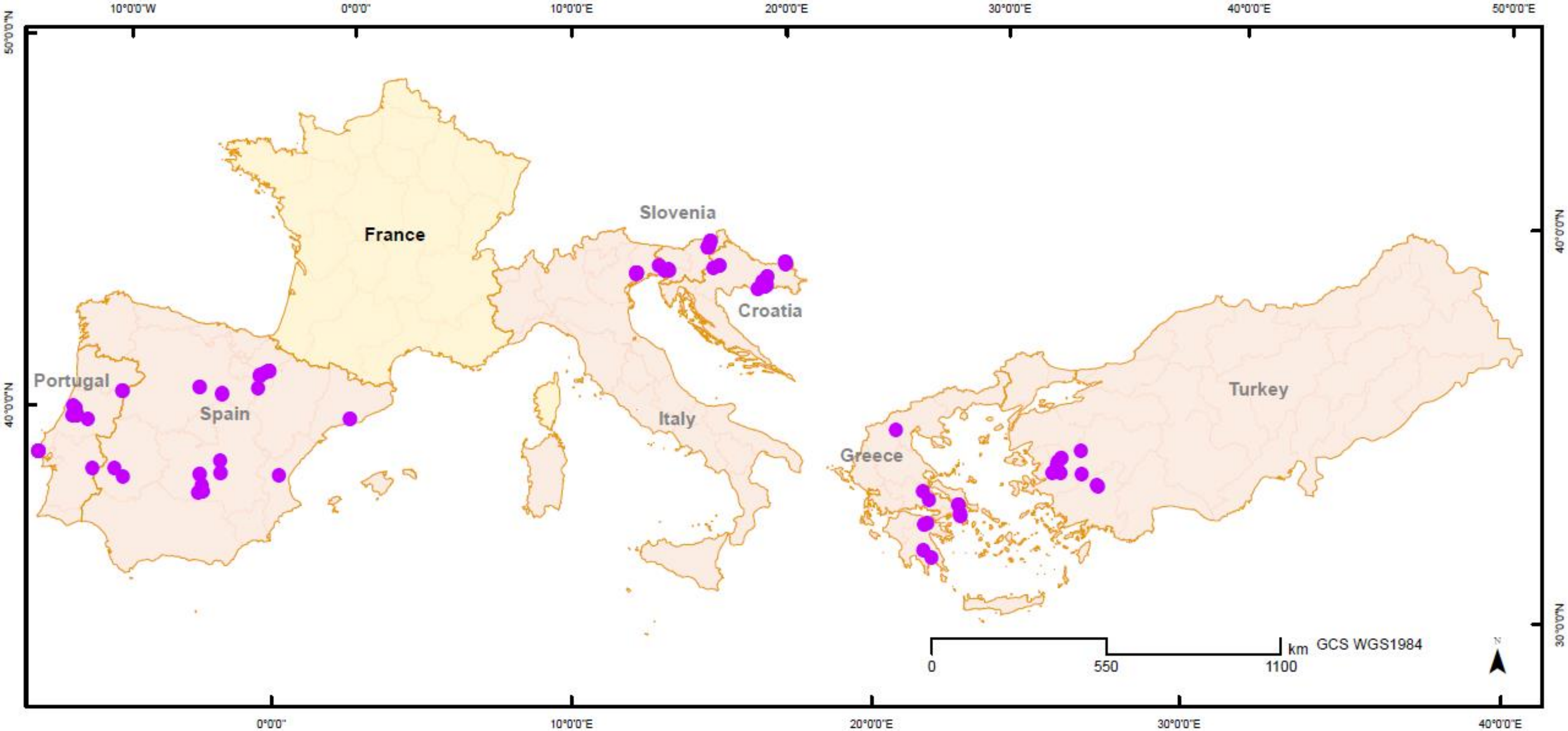
COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SAMPLING AREA (ha)	SUPPLIER (COMPANY NAME)	VARIETY/SPECIES	ANNUAL IRRIGATION (m3/ha)	TYPE OF PREPARATION	COMMENTS
SPAIN	VINEYARD PRUNING	VIÑA-1	1702101	VILAFRANCA DEL PENEDÉS, BARCELONA (SPAIN)	4,02	AYUNTAMIENTO VILAFRANCA DEL PENEDÉS	MACABEO	NO	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-2	1702102	VILAFRANCA DEL PENEDÉS, BARCELONA (SPAIN)		AYUNTAMIENTO VILAFRANCA DEL PENEDÉS	MACABEO	n.a.	Cutting with shears	SAMPLE TAKEN FROM A BULKHILL
SPAIN	VINEYARD PRUNING	VIÑA-3	1702103	CHESTE, VALENCIA (SPAIN)	0,54	BODEGAS REYMOS	MOSCATEL ALEJANDRIA	DRIP IRRIGATION (1200 m3/ha)	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-4	1702104	LOS HINOJOSOS, CUENCA (SPAIN)	11,45	FINCA ANTIGUA LOS HINOJOSOS	TEMPRANILLO	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-5	1702105	SOCUÉLLAMOS, CIUDAD REAL (SPAIN)		COMBUSTIBLES DE LA MANCHA, S.L.	AIRÉN	n.a.	Cutting with shears	SAMPLE TAKEN FROM A BULKHILL
SPAIN	VINEYARD PRUNING	VIÑA-5.5	1702106	SOCUÉLLAMOS, CIUDAD REAL (SPAIN)		COMBUSTIBLES DE LA MANCHA, S.L.	TEMPRANILLO	n.a.	Cutting with shears	SAMPLE TAKEN FROM A BULKHILL
SPAIN	VINEYARD PRUNING	VIÑA-6.1	1702107	VILLARRUBIA DE LOS OJOS, CIUDAD REAL (SPAIN)	2,24	SOCIEDAD COOPERATIVA EL PROGRESO	AIRÉN	SPRINKLER IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-6.2	1702108	VILLARRUBIA DE LOS OJOS, CIUDAD REAL (SPAIN)	2,24	SOCIEDAD COOPERATIVA EL PROGRESO	MACABEO	1500	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-7	1702109	VALDEPEÑAS, CIUDAD REAL (SPAIN)	3,3	ANTONIO LUIS BADILLO	AIRÉN	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-7.1	1702110	VALDEPEÑAS, CIUDAD REAL (SPAIN)	0,9	ANTONIO LUIS BADILLO	TEMPRANILLO	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-8	1702111	SANTA CRUZ DE MUDELA, CIUDAD REAL (SPAIN)	4,7	ANTONIO LUIS BADILLO	AIRÉN	n.a.	Cutting with shears	SAMPLE TAKEN FROM A BULKHILL
SPAIN	VINEYARD PRUNING	VIÑA-9	1703101	ATAUTA, SORIA (SPAIN)	3,28	PEDRO MARTINEZ FRESNO	TEMPRANILLO	SUPPORT IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-10	1703102	ATAUTA, SORIA (SPAIN)	0,06	PEDRO MARTINEZ FRESNO	TEMPRANILLO	WITHOUT IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-11	1703103	ALDEANUEVA DE EBRO, LA RIOJA (SPAIN)	0,74	COOP. BODEGA VIÑEDOS ALDEANUEVA DE EBRO	GARNACHA	n.a.	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-12	1703104	ALDEANUEVA DE EBRO, LA RIOJA (SPAIN)	0,04	COOP. BODEGA VIÑEDOS ALDEANUEVA DE EBRO	TEMPRANILLO	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-13	1703105	ALDEANUEVA DE EBRO, LA RIOJA (SPAIN)	0,64	COOP. BODEGA VIÑEDOS ALDEANUEVA DE EBRO	TEMPRANILLO	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-14	1703106	CAPARROSO, NAVARRA (SPAIN)	105,29	BODEGA PRINCIPE DE VIANA SL.	TEMPRANILLO	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-15	1703107	SANTACARA, NAVARRA (SPAIN)	18,25	BODEGA PRINCIPE DE VIANA SL.	SYRAH	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-16	1703108	SANTACARA, NAVARRA (SPAIN)	9,29	BODEGA PRINCIPE DE VIANA SL.	MERLOT	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-17	1703109	SANTACARA, NAVARRA (SPAIN)	11,65	BODEGA PRINCIPE DE VIANA SL.	CABERNET SAUVIGNON	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-18	1703110	SANTACARA, NAVARRA (SPAIN)	3,41	BODEGA PRINCIPE DE VIANA SL.	TEMPRANILLO	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-19	1703111	LOBÓN, BADAJOZ (SPAIN)	0,86	AGRICULTOR ANÓNIMO	PARDINA	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-20	1703112	ALANGE, BADAJOZ (SPAIN)	8,53	FINCA PALACIO QUEMADO	TEMPRANILLO	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
SPAIN	VINEYARD PRUNING	VIÑA-21	1703113	ÁGREDA, SORIA (SPAIN)	0,39	LUIS LAFUENTE FUENTELSAZ	TEMPRANILLO	DRIP IRRIGATION	Cutting with shears	FRESHLY PRUNED
TURKEY	VINEYARD PRUNING	Vineyard pruning 1	11036	Manisa/Akhisar (TURKEY)		Field			Cutting with mechanical saw	
TURKEY	VINEYARD PRUNING	Vineyard pruning 2	11037	Manisa/Akhisar (TURKEY)		Field			Cutting with mechanical saw	
TURKEY	VINEYARD PRUNING	Vineyard pruning 3	11038	Denizli/Sarıgöl (TURKEY)		Field			Cutting with mechanical saw	
TURKEY	VINEYARD PRUNING	Vineyard pruning 4	11039	Denizli/Sarıgöl (TURKEY)		Field			Cutting with mechanical saw	
TURKEY	VINEYARD PRUNING	Vineyard pruning 5	11040	Manisa/Turgutlu (TURKEY)		Field			Cutting with mechanical saw	
TURKEY	VINEYARD PRUNING	Vineyard pruning 6	11041	Manisa/ Dilek (TURKEY)		Field			Cutting with mechanical saw	
TURKEY	VINEYARD PRUNING	Vineyard pruning 7	11042	Manisa/ Dilek (TURKEY)		Field			Cutting with mechanical saw	

TURKEY	VINEYARD PRUNING	Vineyard pruning 8	11043	Manisa/ Osmaniye (TURKEY)		Field			Cutting with mechanical saw	
COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SAMPLING AREA (ha)	SUPPLIER (COMPANY NAME)	VARIETY/SPECIES	ANNUAL IRRIGATION (m3/ha)	TYPE OF PREPARATION	COMMENTS
TURKEY	VINEYARD PRUNING	Vineyard pruning 9	11044	Manisa/Saruhanlı (TURKEY)		Field			Cutting with mechanical saw	
TURKEY	VINEYARD PRUNING	Vineyard pruning 10	11045	Manisa/Tekeler (TURKEY)		Field			Cutting with mechanical saw	
CROATIA	VINEYARD PRUNING	Vineyard pruning 1	11228	35250 Oriovac (CROATIA)	0,5	OPG Damir Vučković	Cabernet Sauvignon	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 2	11229	35250 Oriovac (location 1) (CROATIA)	1	OPG Dragica Vučković	Cabernet Sauvignon	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 3	11230	35250 Oriovac (location 2) (CROATIA)	1	OPG Dragica Vučković	Cabernet Sauvignon	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 4	11231	35250 Oriovac (CROATIA)	0,29	OPG Margita Aladrović	Chardonnay	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 5	11232	35250 Oriovac (CROATIA)	0,05	OPG Mato Aladrović	Merlot	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 6	11233	35250 Oriovac (CROATIA)	1,5	Winery Josip Čaldarević	Riesling	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 7	11234	Banovo brdo - 31315 Karanac (CROATIA)	23,13	Belje d.d	Graševina	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 8	11235	Banovo brdo - 31315 Karanac (CROATIA)	7,45	Belje d.d	Graševina	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 9	11236	Banovo brdo - 31315 Karanac (CROATIA)	24,28	Belje d.d	Graševina	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 10	11237	Banovo brdo - 31315 Karanac (CROATIA)	16,43	Belje d.d	Merlot	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 11	11238	Bele IV 18, 10430 Samobor (CROATIA)	0,07	OPG Dubravka Fabek	Chardonnay/Kraljevina	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 12	11239	Stjepana Radića 203, 35253 Brodski Stupnik (CROATIA)	44	Winery Vinković	Graševina	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 13	11240	Vinogradska cesta 11, 35253 Brodski Stupnik (CROATIA)	0,6	OPG Damir Jukić	Merlot	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 14	11241	Zdenka Turkovića 12, 34340 Kutjevo (CROATIA)	4	OG Tandara	Riesling	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 15	11242	Jazbina 142, 10000 Zagreb (CROATIA)	10	Faculty of Agriculture	Traminer	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 16	11243	Jazbina 142, 10000 Zagreb (CROATIA)	10	Faculty of Agriculture	Chardonnay	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 17	11244	Brdo Sokolovac, 34000, Požega 34000, Požega (CROATIA)	1	OPG Sanja Vuković	Merlot	X	Cutting with shears	
CROATIA	VINEYARD PRUNING	Vineyard pruning 18	11245	Bana J. Jelačića 6a, 34340 Kutjevo (CROATIA)	8	OPG Robert Čamak	Graševina, Grey Pinot	X	Cutting with shears	

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SAMPLING AREA (ha)	SUPPLIER (COMPANY NAME)	VARIETY/SPECIES	ANNUAL IRRIGATION (m3/ha)	TYPE OF PREPARATION	COMMENTS
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_1	28-17	Quinta d'Alva (PORTUGAL)	10	Sta. Casa da Misericórdia do Porto	Vineyard/Tinta roriz	Yes (not significant)	Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_2	29-17	Quinta d'Alva (PORTUGAL)	10	Sta. Casa da Misericórdia do Porto	Vineyard/Touriga franca	Yes (not significant)	Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_3	30-17	Quinta d'Alva (PORTUGAL)	10	Sta. Casa da Misericórdia do Porto	Vineyard/Touriga nacional	Yes (not significant)	Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_4	31-17	Chão de Lamas (PORTUGAL)	0,5	Augusto Ferreira Mendes	Vineyard/Fernão Pires	NO	Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_5	32-17	Chão de Lamas (PORTUGAL)	0,5	Augusto Ferreira Mendes	Vineyard	NO	Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_6	33-17	Cidreira (PORTUGAL)	0,5	Herminio Rodrigues	Vineyard/Aragonês	NO	Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_7	34-17	Cidreira (PORTUGAL)	0,5	Herminio Rodrigues	Vineyard/Arinto	NO	Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_8	35-17	Vila Nova do Ceira (PORTUGAL)	0,5	Cooperativa Cantanhede	Vineyard/Syrah	NO	Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_9	91-17	Tapeus, Soure (PORTUGAL)	0,5	Private owner	Vineyard		Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_10	92-17	Colares (PORTUGAL)	0,5	Adega Regional de Colares, CRL	Vineyard/Galega		Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_11	93-17	Colares (PORTUGAL)	0,5	Adega Regional de Colares, CRL	Vineyard/Malvasia		Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_12	94-17	Colares (PORTUGAL)	0,5	Adega Regional de Colares, CRL	Vineyard/Ramisco		Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_13	95-17	Colares (PORTUGAL)	0,5	Adega Regional de Colares, CRL	Vineyard/Molar		Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_14	96-17	Colares (PORTUGAL)	0,5	Adega Regional de Colares, CRL	Vineyard		Manual	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_15	97-17	Lamas (Tapada de Sabogos) (PORTUGAL)	5	Maria Fernanda Mendes	Vineyard/Fernão Pires branco		Manual (Cutting with electric scissors)	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_16	98-17	Lamas (Tapada de Sabogos) (PORTUGAL)	5	Maria Fernanda Mendes	Vineyard/Castelão tinto		Manual (Cutting with electric scissors)	
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_17	99-17	Vila Viçosa (PORTUGAL)	5	João Galhardas	Alicant Bouchet	Yes (no data)		
PORTUGAL	VINEYARD PRUNING	Vinha_Pt_18	248-17	Pampilhosa da Serra (PORTUGAL)	0,5	José Nunes Mendes	Vineyard			
ITALY	VINEYARD PRUNING	Sample 1	782/16	Coop. COAL (ITALY)		Coop. Coal	Vineyard pruning Prosecco	NO	Mechanical - Chipped and sifted	Moisture content: 15%. Particle size range: 45 mm.
ITALY	VINEYARD PRUNING	Sample 4	783/16	AGRIVITENERGY (ITALY)		Coop. Coal	Vineyard pruning Prosecco	NO	Mechanical - Chipped and sifted	Moisture content: 15%. Particle size range: 45 mm.
ITALY	VINEYARD PRUNING	Sample 11	784/16	Rusalen (ITALY)		Rusalen	Vineyard pruning Prosecco	NO	Manual - Chipped only (prunings and stumps)	Moisture content: 15%. Particle size range: 45 mm.
ITALY	VINEYARD PRUNING	001- 17.3.17	249-17	Spagnol Azienda Agricola (ITALY)	N.A.	Spagnol Azienda Agricola	Vineyard pruning Prosecco	N.A.	Collected in bales and then mechanical chips	Moisture content: 15%. Particle size range: 45 mm.
ITALY	VINEYARD PRUNING	Sample 2 - 17.3.17	250-17	Azienda Agricola Furlan (ITALY)		Azienda Agricola Furlan	Vineyard pruning Prosecco	NO	Collected in bales and then mechanical chips	Moisture content: 15%. Particle size range: 45 mm.
ITALY	VINEYARD PRUNING	Sample 3 - 17.3.17	251-17	Az. Agr. Cecchetto (ITALY)		Az. Agr. Cecchetto	Vineyard pruning Prosecco	NO	Collected in bales and then mechanical chips	Moisture content: 15%. Particle size range: 45 mm.
ITALY	VINEYARD PRUNING	Sample 4 - 17.3.17	252-17	Moletto Soc. Agr. (ITALY)		Moletto Soc. Agr.	Vineyard pruning Prosecco	NO	Collected in bales and then mechanical chips	Moisture content: 15%. Particle size range: 45 mm.
ITALY	VINEYARD PRUNING	Sample 5 - 17.3.17	253-17	Vitivinicola Canova (ITALY)		Vitivinicola Canova	Vineyard pruning Prosecco	NO	Collected in bales and then mechanical chips	Moisture content: 15%. Particle size range: 45 mm.
ITALY	VINEYARD PRUNING	Sample 6 - 17.3.17	254-17	Via Riviera Pompeo Molmenti, 64, 31045 Villanova di Motta di Livenza TV, (ITALY)		Capo di Vigna Soc. Coop Agr	Vineyard pruning Prosecco	NO	Collected in bales and then mechanical chips	Moisture content: 15%. Particle size range: 45 mm.
GREECE	VINEYARD PRUNING	Vineyard pruning 1	B20170201BSDPR1	Koropi X:37.9010 (GREECE)	0.15	Georgakis Stamatis	Sangiovese	Non Irrigated	Hand cut with pruning tool	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 2	B20170201BSDPR2	Koropi X:37.9010 (GREECE)	0.15	Georgakis Stamatis	Sangiovese	Non Irrigated	Hand cut with pruning tool	Sample collected from pruning pile left on the field for about a year
GREECE	VINEYARD PRUNING	Vineyard pruning 3	B20170221BSDPR	Naousa X:40.649826 (GREECE)	50	Fountoulis George	Xinomavro	Fully irrigated	Hand cut with pruning tool	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 4	B20170221BSDPRV1	Spata (GREECE)	N/A	Agricultural University	Assyrtiko	Fully irrigated	Treated with chipper at the lab	(1), (2)

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SAMPLING AREA (ha)	SUPPLIER (COMPANY NAME)	VARIETY/SPECIES	ANNUAL IRRIGATION (m3/ha)	TYPE OF PREPARATION	COMMENTS
GREECE	VINEYARD PRUNING	Vineyard pruning 5	B20170221BSDPRV2	Spata (GREECE)	N/A	Agricultural University	Sangiovese	Fully irrigated	Treated with chipper at the lab	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 6	B20170302BSDPRV1	Agios Seraphim (GREECE)	0.6	Batsogiannis Anastasios	Merlot	Fully irrigated	Treated with chipper at the lab	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 7	B20170302BSDPRV2	Livadeia (GREECE)	0.72	Anestis George	Cabernet and Chardonnay	Fully irrigated	Treated with chipper at the lab	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 8	B20170321BSDPRV1	Kapandriti X:38.2459 (GREECE)	8.3	Papageorgiou Kostas	Merlot	Fully irrigated	Treated with chipper at the lab	
GREECE	VINEYARD PRUNING	Vineyard pruning 9	B20170321BSDPRV2	Kapandriti X: 38.2459 (GREECE)	8.3	Papageorgiou Kostas	Agiorgitiko	Fully irrigated	Treated with chipper at the lab	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 10	B20170321BSDPRV3	Kapandriti X:38.2459 (GREECE)	8.3	Papageorgiou Kostas	Xinomavro	Fully irrigated	Treated with chipper at the lab	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 11	B20170323BSDPRV1	Sparti X:37.114670 (GREECE)	0.2	Koulogiannis George	Agiorgitiko	Fully irrigated	Treated with chipper at the lab	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 12	B20170323BSDPRV2	Skala Lakonias (GREECE)	0.05	Tzanetos Karamixas	Assyrtiko	Fully irrigated	Treated with chipper at the lab	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 13	B20170324BSDPRV1	Nemea (GREECE)	0.7	Mazos Hlias	Korointhiaki Stafida	Fully irrigated	Treated with chipper at the lab	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 14	B20170324BSDPRV2	Nemea X:37.8338 (GREECE)	0.5	Mazos Hlias	Agiorgitiko	Fully irrigated	Treated with chipper at the lab	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 15	B20170324BSDPRV3	Nemea (GREECE)	0.05	Mazos Mixail	Roditis	Fully irrigated	Treated with chipper at the lab	(1), (2)
GREECE	VINEYARD PRUNING	Vineyard pruning 16	B20170324BSDPRV4	Nemea (GREECE)	N/A	Mazos Hlias	Soultanina	Fully irrigated	Treated with chipper at the lab	
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 1	B20170502SLOV1	Ritoznoj (SLOVENIA)		Kmetija Frešer	Laški rizling (welschriesling)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 2	B20170502SLOV2	Ritoznoj (SLOVENIA)		Vehovar Boris	Sivi pinot (pinot grigio, pinot gris, ruländer)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 3	B20170502SLOV3	Kozana (SLOVENIA)		Andrej Murenc	Sauvignon (sauvignon blanc)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 4	B20170502SLOV4	Kozana (SLOVENIA)		Andrej Murenc	Rebula (ribolla gialla)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 5	B20170502SLOV5	Vrhpolje (SLOVENIA)		Andreja Škvarč	Rebula (ribolla gialla)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 6	B20170502SLOV6	Ritoznoj (SLOVENIA)		Vehovar Boris	Rumeni muškat (gelber muskateller, muscat à petits grains)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 7	B20170502SLOV7	Ritoznoj (SLOVENIA)		Vehovar Boris	Traminec (gewürztraminer, traminer)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 8	B20170502SLOV8	Dragučova (SLOVENIA)		Protner Bojan	Chardonnay (marillon blanc)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 9	B20170502SLOV9	Ritoznoj (SLOVENIA)		Kmetija Frešer	Renski rizling (Riesling)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 10	B20170502SLOV10	Ritoznoj (SLOVENIA)		Boris Vehovar	Chardonnay (marillon blanc)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 11	B20170502SLOV11	Ritoznoj (SLOVENIA)		Kmetija Frešer	Modri pinot (pinot noir)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 12	B20170502SLOV12	Dragučova (SLOVENIA)		Protner Bojan	Rizvanec(Mueller- Thurgau)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 13	B20170502SLOV13	Dragučova (SLOVENIA)		Protner Bojan	Laški rizling (welschriesling)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 14	B20170502SLOV14	Fram (SLOVENIA)		Robert Greif	Laški rizling (welschriesling)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 15	B20170502SLOV15	Fram (SLOVENIA)		Robert Greif	Sauvignon (sauvignon blanc)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 16	B20170502SLOV16	Komen (SLOVENIA)		Vinakras z.o.o.	Malvazija (malvasia, malvasie blanche)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)
SLOVENIA	VINEYARD PRUNING	Vineyard pruning 17	7	Planina (SLOVENIA)		Darja Marc	Merlot (merlo, merlou)	NO	Pre-cutting with garden scissors and milling with laboratory mill RETSCH SM200	Moisture content before drying 45-50% (dried for 120 h at 40ºC)

(1): Lot size estimated from field measurements performed by CERTH in the uP_running project. (2) Estimation of moisture content at the time of the field measurement based on the time the material was left on the field after pruning. Actual measurement at the laboratory available at the analytical fuel characterization results.

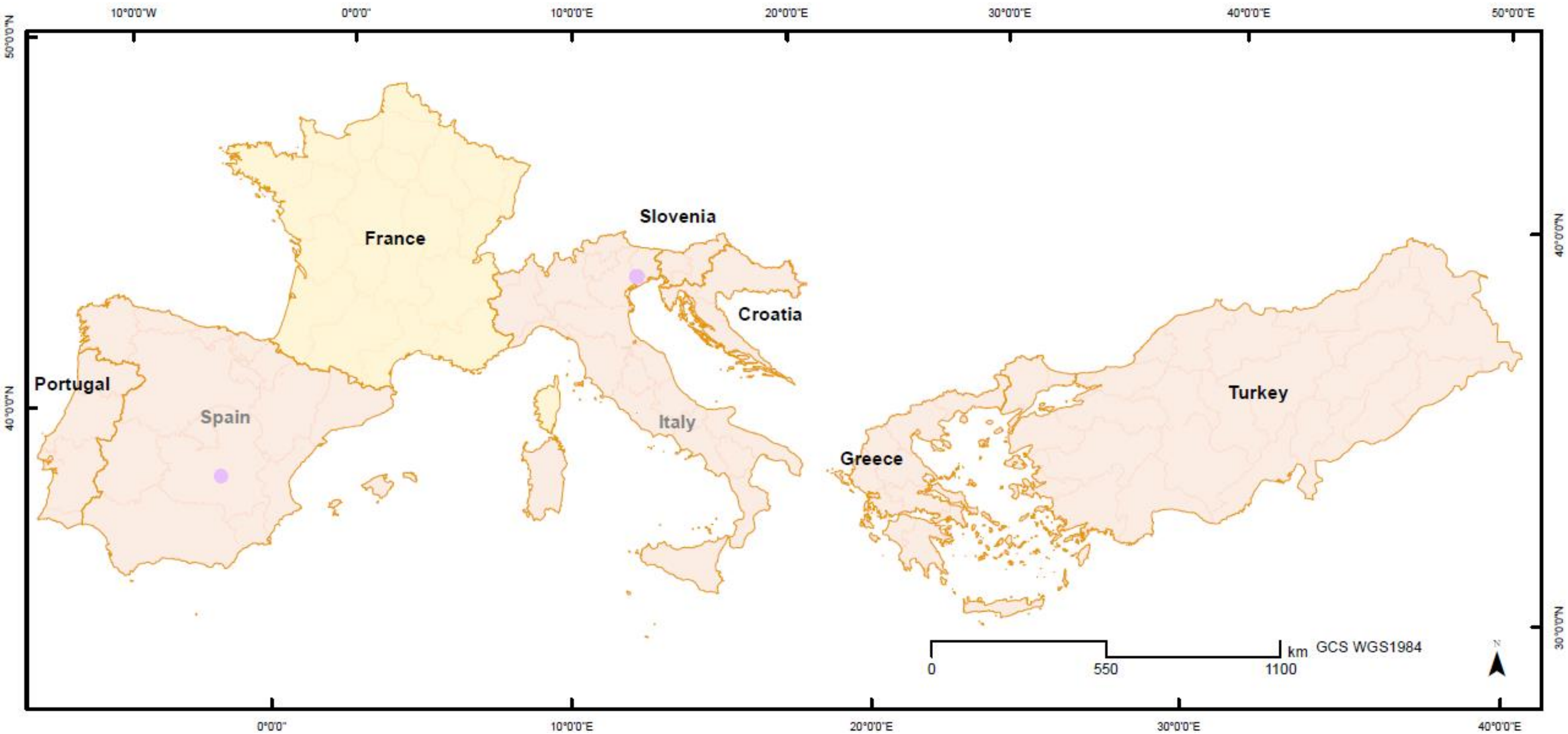


BIOMASS	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES	2	10	14	3	4	10	5	**48**
ALMOND SHELLS		6	8	1		10		**25**
HAZELNUT SHELLS	10					5	10	**25**
PISTACHIO SHELLS		3				10	6	**19**
WALNUT SHELLS		4		2		6	10	**22**
PINE NUT SHELLS				4		10		**14**
OLIVE TREE PRUNINGS	10	12	4	8	10	20	10	**74**
OLIVE TREE PELLETS			2					**2**
VINEYARD PRUNINGS	**18**	**16**	**9**	**18**	**17**	**24**	**10**	**112**
VINEYARD PELLETS			5			1		**6**
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

Vineyard prunings: Distribution of samples collected by country (Table) and collection sites (map)

➢ 8.1.10 Vineyard pruning pellet samples

COUNTRY	BIOMASS TYPE	REF. SAMPLE	ORIGINAL REFERENCE	LOCATION	SUPPLIER (COMPANY NAME)	LOT SIZE (tons)	Particle size range (mm) (if available or estimated)	Moisture content (% w.b.) (if available or estimated)	COMMENTS
SPAIN	VINEYARD PRUNING PELLETS	PÉLETS SARMIENTO-1	1702105	SOCUÉLLAMOS, CIUDAD REAL (SPAIN)	COMBUSTIBLES DE LA MANCHA, S.L.	60			
ITALY	VINEYARD PRUNING PELLETS	Sample 12	785/16	Coop. COAL (ITALY)	Coop. Coal	30		10	
ITALY	VINEYARD PRUNING PELLETS	Sample 1-2/2017	82/17	AGRIVITENERGY (ITALY)	Coop. Coal	100	25-30	10	
ITALY	VINEYARD PRUNING PELLETS	Sample 2-2/2017	83/17	AGRIVITENERGY (ITALY)	Coop. Coal	100	25-30	10	
ITALY	VINEYARD PRUNING PELLETS	Sample 3-2/2017	84/17	AGRIVITENERGY (ITALY)	Az. Agr. Rusalen Giovanni	25	25-30	10	
ITALY	VINEYARD PRUNING PELLETS	Sample 4-2/2017	85/17	AGRIVITENERGY (ITALY)	Cooperativa Energia e Ambiente	25	25-30	10	



BIOMASS	CROATIA	GREECE	ITALY	PORTUGAL	SLOVENIA	SPAIN	TURKEY	TOTAL
OLIVE STONES	2	10	14	3	4	10	5	**48**
ALMOND SHELLS		6	8	1		10		**25**
HAZELNUT SHELLS	10					5	10	**25**
PISTACHIO SHELLS		3				10	6	**19**
WALNUT SHELLS		4		2		6	10	**22**
PINE NUT SHELLS				4		10		**14**
OLIVE TREE PRUNINGS	10	12	4	8	10	20	10	**74**
OLIVE TREE PELLETS			2					**2**
VINEYARD PRUNINGS	18	16	9	18	17	24	10	**112**
VINEYARD PELLETS			**5**			**1**		**6**
TOTAL SAMPLES	**40**	**51**	**42**	**36**	**31**	**96**	**51**	**347**

Vineyard pruning pellets:
Distribution of samples collected by country (Table) and collection sites (map)

8.2 ANNEX II: Analytical results of physical and chemical characterization

8.2.1 Analytical results for the samples collected in Croatia

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)	Bulk density (kg/m^3)
CROATIA	Hazelnut shells 1	11017	13.2	1.10	52.3	5.8	0.27	0.023	0.008	20.81	18.05	19.36	16.64	338
CROATIA	Hazelnut shells 2	11018	15.9	1.28	52.1	5.6	0.33	0.027	0.012	20.61	17.33	19.19	15.92	310
CROATIA	Hazelnut shells 3	11019	17.2	1.18	52.1	5.6	0.20	0.023	0.009	20.47	16.95	19.05	15.51	294
CROATIA	Hazelnut shells 4	11020	14.5	1.12	52.9	5.6	0.26	0.024	0.012	20.87	17.85	19.44	16.44	306
CROATIA	Hazelnut shells 5	11028	14.8	1.60	51.4	5.4	0.34	0.030	0.019	20.27	17.27	18.90	15.90	297
CROATIA	Hazelnut shells 6	11029	15.5	1.24	52.0	5.7	0.31	0.026	0.006	20.58	17.38	19.14	15.95	398
CROATIA	Hazelnut shells 7	11030	13.5	0.99	52.1	5.6	0.19	0.020	0.008	20.51	17.73	19.09	16.34	339
CROATIA	Hazelnut shells 8	11031	15.5	0.99	51.9	5.6	0.19	0.021	0.010	20.40	17.25	18.99	15.84	367
CROATIA	Hazelnut shells 9	11032	15.1	1.16	52.2	5.6	0.19	0.021	0.006	20.64	17.53	19.22	16.12	347
CROATIA	Hazelnut shells 10	11033	12.3	1.10	52.0	5.1	0.27	0.029	0.017	20.57	18.05	19.27	16.77	341
CROATIA	Olive stones 1	11015	14.0	0.51	50.8	6.0	<0,1	0.012	0.054	20.34	17.49	18.85	16.03	776
CROATIA	Olive stones 2	11016	21.6	0.39	50.8	5.9	<0,1	0.010	0.021	20.25	15.87	18.77	14.34	692
CROATIA	Olive tree pruning 1	11218	34.0	5.5	49.9	6.2	1.02	0.098	0.035	20.53	13.55	18.98	11.82	
CROATIA	Olive tree pruning 2	11219	35.1	5.4	49.8	6.3	0.89	0.087	0.068	20.80	13.49	19.23	11.74	
CROATIA	Olive tree pruning 3	11220	34.8	5.7	49.6	6.2	0.87	0.113	0.055	20.42	13.32	18.86	11.58	
CROATIA	Olive tree pruning 4	11221	39.4	5.8	49.5	6.2	0.89	0.102	0.058	20.34	12.32	18.80	10.54	
CROATIA	Olive tree pruning 5	11222	36.6	5.6	50.0	6.3	0.88	0.096	0.055	20.53	13.01	18.96	11.24	
CROATIA	Olive tree pruning 6	11223	41.8	4.9	50.2	6.3	1.13	0.100	0.041	20.64	12.02	19.06	10.19	
CROATIA	Olive tree pruning 7	11224	32.5	5.1	49.4	6.2	1.05	0.098	0.032	20.06	13.53	18.50	11.82	
CROATIA	Olive tree pruning 8	11225	31.6	4.6	49.8	6.2	0.94	0.095	0.054	20.13	13.76	18.57	12.06	
CROATIA	Olive tree pruning 9	11226	26.9	5.8	49.7	6.3	1.22	0.114	0.059	20.55	15.03	18.99	13.37	
CROATIA	Olive tree pruning 10	11227	20.7	4.3	50.4	6.3	0.91	0.083	0.037	20.76	16.47	19.19	14.88	

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
CROATIA	**Vineyard pruning 1**	11228	31.5	3.3	48.3	5.9	0.49	0.044	0.013	19.18	13.14	17.69	11.48
CROATIA	**Vineyard pruning 2**	11229	35.3	3.1	48.8	5.9	0.53	0.044	0.012	19.24	12.45	17.76	10.75
CROATIA	**Vineyard pruning 3**	11230	32.7	3.2	48.2	5.9	0.49	0.040	0.008	19.19	12.92	17.70	11.26
CROATIA	**Vineyard pruning 4**	11231	29.4	3.9	48.1	5.9	0.57	0.053	0.013	18.95	13.38	17.47	11.76
CROATIA	**Vineyard pruning 5**	11232	36.3	4.0	48.8	5.8	0.94	0.070	0.017	19.11	12.17	17.65	10.47
CROATIA	**Vineyard pruning 6**	11233	30.0	3.3	48.8	5.9	0.70	0.061	0.010	19.18	13.43	17.69	11.79
CROATIA	**Vineyard pruning 7**	11234	29.9	3.4	48.5	5.9	0.52	0.056	0.012	19.15	13.43	17.66	11.80
CROATIA	**Vineyard pruning 8**	11235	29.5	3.2	48.6	5.9	0.60	0.060	0.015	19.27	13.58	17.78	11.95
CROATIA	**Vineyard pruning 9**	11236	28.2	3.4	48.4	5.9	0.55	0.055	0.011	19.17	13.77	17.68	12.15
CROATIA	**Vineyard pruning 10**	11237	27.9	3.2	48.7	5.8	0.58	0.051	0.013	19.09	13.76	17.62	12.16
CROATIA	**Vineyard pruning 11**	11238	35.3	3.2	48.6	5.9	0.65	0.051	0.018	19.19	12.41	17.70	10.71
CROATIA	**Vineyard pruning 12**	11239	48.8	3.7	48.2	5.8	0.71	0.060	0.024	19.15	9.80	17.68	7.96
CROATIA	**Vineyard pruning 13**	11240	50.0	3.7	48.9	5.9	0.61	0.055	0.007	19.24	9.62	17.76	7.76
CROATIA	**Vineyard pruning 14**	11241	37.9	3.2	48.6	5.9	0.75	0.054	0.009	19.24	11.94	17.76	10.22
CROATIA	**Vineyard pruning 15**	11242	32.3	3.0	48.6	5.9	0.48	0.048	0.008	19.10	12.93	17.62	11.27
CROATIA	**Vineyard pruning 16**	11243	30.4	3.1	48.1	5.9	0.56	0.054	0.007	18.87	13.13	17.39	11.49
CROATIA	**Vineyard pruning 17**	11244	48.1	3.6	48.7	5.8	0.69	0.060	0.007	19.21	9.98	17.74	8.14
CROATIA	**Vineyard pruning 18**	11245	45.0	3.5	48.3	5.9	0.63	0.053	0.009	18.96	10.42	17.49	8.62

Country	Biofuel	Original reference	Al (% d.b.)	Ba (% d.b.)	Ca (% d.b.)	Fe (% d.b.)	K (% d.b.)	Mg (% d.b.)	Mn (% d.b.)	Na (% d.b.)	P (% d.b.)	S (% d.b.)	Si (% d.b.)	Sr (% d.b.)	Ti (% d.b.)	Zn (% d.b.)
CROATIA	**Hazelnut shells 1**	11017	0.0063	0.0012	0.1090	0.0055	0.3360	0.0349	0.0086	0.0010	0.0337	0.0290	0.0161	0.00000	0.00125	0.00041
CROATIA	**Hazelnut shells 2**	11018	0.0011	0.0008	0.1760	0.0020	0.3660	0.0391	0.0056	0.0012	0.0434	0.0335	0.0012	0.00000	0.00036	0.00037
CROATIA	**Hazelnut shells 3**	11019	0.0007	0.0002	0.1660	0.0025	0.3520	0.0283	0.0009	0.0003	0.0325	0.0255	<0,001	0.00000	0.00014	0.00028
CROATIA	**Hazelnut shells 4**	11020	0.0022	0.0005	0.1370	0.0025	0.3450	0.0277	0.0029	0.0005	0.0298	0.0250	0.0049	0.00000	0.00046	0.00036
CROATIA	**Hazelnut shells 5**	11028	0.0379	0.0005	0.1540	0.0199	0.3560	0.0374	0.0013	0.0033	0.0449	0.0310	0.1360	0.00000	0.00609	0.00041
CROATIA	**Hazelnut shells 6**	11029	0.0179	0.0003	0.1570	0.0114	0.3190	0.0331	0.0009	0.0028	0.0377	0.0263	0.0638	0.00000	0.00372	0.00046
CROATIA	**Hazelnut shells 7**	11030	0.0010	0.0008	0.1100	0.0019	0.3100	0.0262	0.0053	0.0005	0.0188	0.0208	<0,00107	0.00000	0.00027	0.00041
CROATIA	**Hazelnut shells 8**	11031	0.0077	0.0008	0.1130	0.0053	0.2870	0.0314	0.0112	0.0009	0.0250	0.0235	0.0197	0.00000	0.00107	0.00060
CROATIA	**Hazelnut shells 9**	11032	0.0020	0.0005	0.1560	0.0024	0.3470	0.0331	0.0048	0.0005	0.0229	0.0203	0.0050	0.00000	0.00051	0.00035
CROATIA	**Hazelnut shells 10**	11033	0.0166	0.0006	0.0939	0.0106	0.3070	0.0293	0.0058	0.0033	0.0297	0.0287	0.0489	0.00000	0.00299	0.00047
CROATIA	**Olive stones 1**	11015	0.0008	0.0001	0.0657	0.0025	0.1310	0.0110	0.0017	0.0192	0.0070	0.0128	<0,000517	0.00000	0.00016	0.00009
CROATIA	**Olive stones 2**	11016	0.0002	0.0000	0.0620	0.0018	0.1050	0.0080	0.0003	0.0013	0.0056	0.0110	<0,000538	0.00000	0.00006	0.00011
CROATIA	**Olive tree pruning 1**	11218	0.0108	0.0002	1.5500	0.0068	0.5970	0.0959	0.0035	0.0068	0.1040	0.1040	0.0339	0.00000	0.00102	0.00176
CROATIA	**Olive tree pruning 2**	11219	0.0097	0.0002	1.3800	0.0061	0.8500	0.0849	0.0035	0.0058	0.1320	0.0917	0.0273	0.00000	0.00075	0.00168
CROATIA	**Olive tree pruning 3**	11220	0.0092	0.0003	1.6000	0.0054	0.6710	0.0907	0.0027	0.0078	0.1150	0.1160	0.0257	0.00000	0.00068	0.00152
CROATIA	**Olive tree pruning 4**	11221	0.0093	0.0002	1.5600	0.0056	0.7080	0.0988	0.0025	0.0079	0.1320	0.1120	0.0227	0.00000	0.00070	0.00157
CROATIA	**Olive tree pruning 5**	11222	0.0108	0.0002	1.4500	0.0057	0.8310	0.0532	0.0034	0.0124	0.1080	0.1010	0.0233	0.00000	0.00069	0.00131
CROATIA	**Olive tree pruning 6**	11223	0.0116	0.0001	1.2300	0.0054	0.7350	0.0959	0.0033	0.0091	0.1140	0.1030	0.0246	0.00000	0.00062	0.00173
CROATIA	**Olive tree pruning 7**	11224	0.0122	0.0002	1.4300	0.0054	0.5700	0.0981	0.0030	0.0123	0.1000	0.0998	0.0274	0.00000	0.00059	0.00114
CROATIA	**Olive tree pruning 8**	11225	0.0082	0.0002	1.2300	0.0045	0.6190	0.0891	0.0020	0.0065	0.1350	0.0978	0.0189	0.00000	0.00044	0.00145
CROATIA	**Olive tree pruning 9**	11226	0.0194	0.0002	1.7200	0.0066	0.6670	0.1150	0.0023	0.0078	0.1240	0.1200	0.0337	0.00000	0.00078	0.00186
CROATIA	**Olive tree pruning 10**	11227	0.0161	0.0002	0.9260	0.0089	0.9220	0.0686	0.0022	0.0065	0.1100	0.0850	0.0357	0.00000	0.00114	0.00150
CROATIA	**Vineyard pruning 1**	11228	0.0038	0.0003	0.7470	0.0023	0.6000	0.1170	0.0039	0.0019	0.1150	0.0486	0.0067	0.00000	0.00028	0.00365
CROATIA	**Vineyard pruning 2**	11229	0.0038	0.0003	0.6270	0.0024	0.5540	0.1410	0.0015	0.0016	0.1230	0.0474	0.0074	0.00000	0.00028	0.00244
CROATIA	**Vineyard pruning 3**	11230	0.0019	0.0003	0.6730	0.0020	0.6360	0.1340	0.0012	0.0014	0.1390	0.0446	<0,001	0.00000	0.00020	0.00447
CROATIA	**Vineyard pruning 4**	11231	0.0141	0.0007	0.8810	0.0071	0.7350	0.0892	0.0009	0.0040	0.1650	0.0540	0.0405	0.00000	0.00111	0.00347
CROATIA	**Vineyard pruning 5**	11232	0.0048	0.0006	0.9220	0.0034	0.5980	0.1720	0.0013	0.0033	0.1860	0.0732	0.0108	0.00000	0.00041	0.00851
CROATIA	**Vineyard pruning 6**	11233	0.0028	0.0020	0.7340	0.0034	0.6090	0.1180	0.0038	0.0032	0.1210	0.0619	0.0063	0.00000	0.00026	0.00363
CROATIA	**Vineyard pruning 7**	11234	0.0066	0.0004	0.7360	0.0036	0.5530	0.1430	0.0030	0.0025	0.1030	0.0558	0.0182	0.00000	0.00046	0.00112
CROATIA	**Vineyard pruning 8**	11235	0.0064	0.0004	0.7150	0.0035	0.4820	0.1810	0.0037	0.0039	0.1030	0.0613	0.0149	0.00000	0.00047	0.00150
CROATIA	**Vineyard pruning 9**	11236	0.0056	0.0004	0.7370	0.0034	0.6590	0.1360	0.0025	0.0030	0.1240	0.0576	0.0127	0.00000	0.00048	0.00128
CROATIA	**Vineyard pruning 10**	11237	0.0103	0.0005	0.6890	0.0063	0.5730	0.1330	0.0050	0.0031	0.1330	0.0517	0.0287	0.00000	0.00085	0.00366
CROATIA	**Vineyard pruning 11**	11238	0.0014	0.0006	0.6010	0.0015	0.7660	0.0986	0.0030	0.0020	0.1050	0.0518	<0,001	0.00000	0.00012	0.00203
CROATIA	**Vineyard pruning 12**	11239	0.0052	0.0011	0.7100	0.0032	0.8270	0.0896	0.0023	0.0033	0.1620	0.0613	0.0151	0.00000	0.00051	0.00178
CROATIA	**Vineyard pruning 13**	11240	0.0054	0.0006	0.7900	0.0033	0.6200	0.1140	0.0013	0.0021	0.1550	0.0570	0.0111	0.00000	0.00046	0.00794
CROATIA	**Vineyard pruning 14**	11241	0.0095	0.0017	0.6230	0.0057	0.6860	0.0911	0.0042	0.0029	0.1310	0.0571	0.0257	0.00000	0.00114	0.00557
CROATIA	**Vineyard pruning 15**	11242	0.0017	0.0019	0.5730	0.0020	0.6830	0.0892	0.0046	0.0054	0.1040	0.0490	<0,001	0.00000	0.00068	0.00251
CROATIA	**Vineyard pruning 16**	11243	0.0019	0.0024	0.6180	0.0022	0.6940	0.0957	0.0042	0.0063	0.1260	0.0583	<0,001	0.00000	0.00021	0.00259
CROATIA	**Vineyard pruning 17**	11244	0.0014	0.0009	0.7810	0.0016	0.6110	0.1040	0.0020	0.0020	0.1740	0.0613	<0,001	0.00000	0.00015	0.00689
CROATIA	**Vineyard pruning 18**	11245	0.0017	0.0020	0.6900	0.0019	0.7460	0.0942	0.0063	0.0022	0.1340	0.0557	<0,001	0.00000	0.00026	0.00513

Country	Biofuel	Original reference	As (mg/kg d.b.)	Cd (mg/kg d.b.)	Cr (mg/kg d.b.)	Cu (mg/kg d.b.)	Hg (mg/kg d.b.)	Ni (mg/kg d.b.)	Pb (mg/kg d.b.)	Zn (mg/kg d.b.)
CROATIA	**Hazelnut shells 1**	11017	0.03	0.03	3.3	7.0	0.001	2.3	0.04	4.1
CROATIA	**Hazelnut shells 2**	11018	< 0,01	0.03	1.72	6.1	0.001	1.47	0.02	3.7
CROATIA	**Hazelnut shells 3**	11019	< 0,01	0.01	1.38	3.6	0.001	0.95	0.02	2.8
CROATIA	**Hazelnut shells 4**	11020	< 0,01	0.02	0.84	4.2	0.001	0.72	0.05	3.6
CROATIA	**Hazelnut shells 5**	11028	0.07	0.02	8.8	4.1	0.001	5.3	0.14	4.1
CROATIA	**Hazelnut shells 6**	11029	0.05	0.01	6.4	3.7	0.001	3.9	0.10	4.6
CROATIA	**Hazelnut shells 7**	11030	< 0,01	0.02	0.72	4.3	0.001	0.73	0.01	4.1
CROATIA	**Hazelnut shells 8**	11031	0.02	0.02	1.53	4.9	0.001	1.09	0.16	6.0
CROATIA	**Hazelnut shells 9**	11032	< 0,01	0.01	0.94	4.3	0.001	0.78	0.05	3.5
CROATIA	**Hazelnut shells 10**	11033	0.03	0.01	4.3	4.6	0.001	2.7	0.07	4.7
CROATIA	**Olive stones 1**	11015	< 0.01	<0.01	4.5	3.0	0.001	2.3	0.01	0.94
CROATIA	**Olive stones 2**	11016	< 0.01	<0.01	0.98	2.6	<0.001	0.60	< 0.02	1.05
CROATIA	**Olive tree pruning 1**	11218	0.10	0.07	2.2	40.4	0.020	2.4	0.18	17.6
CROATIA	**Olive tree pruning 2**	11219	0.07	0.07	1.62	27.6	0.020	2.3	0.18	16.8
CROATIA	**Olive tree pruning 3**	11220	0.05	0.06	1.26	40.8	0.010	1.94	0.14	15.2
CROATIA	**Olive tree pruning 4**	11221	0.04	0.06	1.08	36.7	0.013	1.91	0.13	15.7
CROATIA	**Olive tree pruning 5**	11222	0.09	0.04	1.06	29.6	0.021	1.81	0.17	13.1
CROATIA	**Olive tree pruning 6**	11223	0.07	0.03	0.88	27.8	0.018	1.58	0.16	17.3
CROATIA	**Olive tree pruning 7**	11224	0.04	0.06	0.80	34.0	0.018	2.0	0.13	11.4
CROATIA	**Olive tree pruning 8**	11225	0.04	0.03	0.77	24.3	0.010	1.79	0.10	14.5
CROATIA	**Olive tree pruning 9**	11226	0.06	0.04	1.02	64.5	0.015	2.3	0.15	18.6
CROATIA	**Olive tree pruning 10**	11227	0.06	0.03	1.81	5.9	0.013	1.61	0.19	15.0
CROATIA	**Vineyard pruning 1**	11228	0.03	<0,01	0.67	6.3	0.002	1.02	0.06	36.5
CROATIA	**Vineyard pruning 2**	11229	0.04	<0,01	0.72	6.5	0.002	0.87	0.12	24.4
CROATIA	**Vineyard pruning 3**	11230	0.02	0.01	1.63	6.2	0.001	1.43	0.04	44.7
CROATIA	**Vineyard pruning 4**	11231	0.09	0.01	2.4	13.0	0.002	2.2	0.09	34.7
CROATIA	**Vineyard pruning 5**	11232	0.08	0.02	1.41	12.5	0.002	1.54	0.07	85.1
CROATIA	**Vineyard pruning 6**	11233	0.05	0.10	1.00	15.7	0.002	3.1	0.17	36.3
CROATIA	**Vineyard pruning 7**	11234	0.04	<0,01	0.87	13.1	0.002	1.12	0.11	11.2
CROATIA	**Vineyard pruning 8**	11235	0.06	<0,01	0.77	12.4	0.002	1.01	0.13	15.0
CROATIA	**Vineyard pruning 9**	11236	0.05	0.01	1.29	9.8	0.002	1.33	0.11	12.8
CROATIA	**Vineyard pruning 10**	11237	0.03	0.01	2.7	11.9	0.002	2.2	0.10	36.6
CROATIA	**Vineyard pruning 11**	11238	0.02	0.02	0.68	29.4	0.002	1.26	0.06	20.3
CROATIA	**Vineyard pruning 12**	11239	0.07	0.03	0.90	11.8	0.002	1.58	0.07	17.8
CROATIA	**Vineyard pruning 13**	11240	0.03	0.01	1.00	9.1		1.92	0.09	79.4
CROATIA	**Vineyard pruning 14**	11241	0.05	0.12	1.73	8.6	0.002	3.6	0.11	55.7
CROATIA	**Vineyard pruning 15**	11242	0.02	0.05	0.82	6.6	0.001	1.96	0.23	25.1
CROATIA	**Vineyard pruning 16**	11243	0.02	0.03	0.54	6.1	0.001	1.64	0.15	25.9
CROATIA	**Vineyard pruning 17**	11244	0.03	0.02	0.45	9.3	0.002	1.72	0.07	68.9
CROATIA	**Vineyard pruning 18**	11245	0.05	0.05	0.73	7.9	0.002	2.0	0.07	51.3

Country	Biofuel	Original	SST	DT	HT	FT	Disintegration				Sieving (0.50 mm sieve)				Sintering Index
		reference	(ºC)	(ºC)	(ºC)	(ºC)	800 ºC	1000 ºC	1200 ºC	1400 ºC	800 ºC	1000 ºC	1200 ºC	1400 ºC	
CROATIA	**Hazelnut shells 1**	11017	620	990	1400	>1550	2	4	4	4	78	96	100	100	0.5
CROATIA	**Hazelnut shells 2**	11018	690	920	>1550	>1550	4	4	4	4	94	100	100	100	0.7
CROATIA	**Hazelnut shells 3**	11019	660	1010	>1550	>1550	4	4	4	4	99	93	99	100	0.7
CROATIA	**Hazelnut shells 4**	11020	704	1040	>1550	>1550	4	4	4	4	100	96	100	100	0.6
CROATIA	**Hazelnut shells 5**	11028	980	1230	1290	1300	1	2	2	4	44	71	84	100	0.6
CROATIA	**Hazelnut shells 6**	11029	690	1260	1360	1380	3	4	4	4	97	98	95	99	0.7
CROATIA	**Hazelnut shells 7**	11030	730	750	>1550	>1550	4	4	4	4	99	100	100	100	0.5
CROATIA	**Hazelnut shells 8**	11031	700	1050	>1550	>1550	2	4	4	4	87	97	97	99	0.6
CROATIA	**Hazelnut shells 9**	11032	720	990	>1550	>1550	4	4	4	4	100	100	100	100	0.7
CROATIA	**Hazelnut shells 10**	11033	710	950	>1550	>1550	1	4	4	4	45	90	98	99	0.5
CROATIA	**Olive stones 1**	11015	670	790	>1550	>1550	4	4	4	4	100	100	100	100	0.6
CROATIA	**Olive stones 2**	11016	720	900	>1550	>1550	4	4	4	4	95	94	100	100	0.8
CROATIA	**Olive tree pruning 1**	11218	750	1280	>1550	>1550	1	4	4	4	26	99	100	99	3.2
CROATIA	**Olive tree pruning 2**	11219	730	740	>1550	>1550	4	4	4	4	99	97	100	100	2.0
CROATIA	**Olive tree pruning 3**	11220	690	1250	>1550	>1550	4	4	4	4	96	99	96	99	2.9
CROATIA	**Olive tree pruning 4**	11221	750	760	>1550	>1550	4	4	4	4	92	99	99	96	2.7
CROATIA	**Olive tree pruning 5**	11222	660	890	>1550	>1550	2	4	4	4	86	99	100	100	2.1
CROATIA	**Olive tree pruning 6**	11223	720	730	>1550	>1550	1	4	4	4	73	99	100	100	2.1
CROATIA	**Olive tree pruning 7**	11224	730	1280	>1550	>1550	1	4	4	4	53	98	99	99	3.1
CROATIA	**Olive tree pruning 8**	11225	700	760	>1550	>1550	3	4	4	4	85	97	89	93	2.5
CROATIA	**Olive tree pruning 9**	11226	710	750	>1550	>1550	3	4	4	4	82	100	97	96	3.2
CROATIA	**Olive tree pruning 10**	11227	670	710	>1550	>1550	3	4	4	4	84	100	100	100	1.3
CROATIA	**Vineyard pruning 1**	11228	710	750	>1550	>1550	1	3	3	3	14	75	98	71	1.7
CROATIA	**Vineyard pruning 2**	11229	710	730	>1550	>1550	1	3	3	3	15	89	98	81	1.7
CROATIA	**Vineyard pruning 3**	11230	720	750	>1550	>1550	1	4	4	4	26	89	100	100	1.5
CROATIA	**Vineyard pruning 4**	11231	720	730	>1550	>1550	4	4	4	4	98	100	100	99	1.6
CROATIA	**Vineyard pruning 5**	11232	720	1260	>1550	>1550	1	4	4	3	45	92	96	75	2.2
CROATIA	**Vineyard pruning 6**	11233	730	750	>1550	>1550	2	3	4	4	74	84	100	100	1.7
CROATIA	**Vineyard pruning 7**	11234	730	740	>1550	>1550	1	4	4	2	17	94	98	66	1.9
CROATIA	**Vineyard pruning 8**	11235	740	1240	>1550	>1550	1	3	4	2	17	90	94	57	2.2
CROATIA	**Vineyard pruning 9**	11236	710	890	>1550	>1550	1	3	4	4	16	95	100	100	1.6
CROATIA	**Vineyard pruning 10**	11237	740	750	>1550	>1550	1	2	4	2	11	84	94	51	1.7
CROATIA	**Vineyard pruning 11**	11238	710	740	>1550	>1550	4	4	4	4	100	99	100	100	1.1
CROATIA	**Vineyard pruning 12**	11239	700	790	>1550	>1550	4	4	4	4	100	99	100	100	1.1
CROATIA	**Vineyard pruning 13**	11240	750	1240	>1550	>1550	4	4	4	4	95	93	90	92	1.7
CROATIA	**Vineyard pruning 14**	11241	740	870	>1550	>1550	2	4	4	4	67	92	100	100	1.2
CROATIA	**Vineyard pruning 15**	11242	700	890	>1550	>1550	3	4	4	4	99	100	100	100	1.2
CROATIA	**Vineyard pruning 16**	11243	730	760	>1550	>1550	4	4	4	4	99	100	100	100	1.2
CROATIA	**Vineyard pruning 17**	11244	680	1160	>1550	>1550	4	4	4	4	99	91	90	92	1.7
CROATIA	**Vineyard pruning 18**	11245	730	760	>1550	>1550	3	4	4	4	99	100	100	100	1.3

8.2.2 Analytical results of the samples collected in Greece

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	VM (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
GREECE	**Olive stones 1**	B20161221OLKAN1	14.1	0.5	77.2	50.6	7.0	0.35	0.020	0.020	19.83	17.04	18.32	15.40
GREECE	**Olive stones 2**	B20161221OLKAN2	14.1	0.6	77.7	50.5	6.9	0.14	0.010	0.030	19.87	17.06	18.38	15.44
GREECE	**Olive stones 3**	B20161221OLNIT	9.5	0.8	76.2	50.8	6.9	0.24	0.020	0.070	20.15	18.24	18.64	16.64
GREECE	**Olive stones 4**	B20170206BSDOLKER1	23.6	0.7	76.7	51.2	7.6	0.19	0.010	0.120	20.23	15.45	18.58	13.61
GREECE	**Olive stones 5**	B20170206BSDOLKER2	24.6	0.8	77.0	53.1	7.3	0.39	0.010	0.030	20.48	15.45	18.89	13.65
GREECE	**Olive stones 6**	B20170215BSDOLKER1	9.8	3.9	73.1	49.9	6.4	0.86	0.060	0.200	19.83	17.89	18.43	16.39
GREECE	**Olive stones 7**	B20170215BSDOLKER2	9.9	3.3	73.7	50.8	6.4	0.92	0.050	0.170	19.95	17.97	18.55	16.46
GREECE	**Olive stones 8**	B20170222BSDOLKER	15.1	0.7	74.3	50.9	7.5	0.24	0.010	0.030	19.94	16.93	18.32	15.19
GREECE	**Olive stones 9**	B20170222BSDOLKER1	10.2	5.5	74.6	50.2	7.1	1.33	0.110	0.280	20.31	18.24	18.76	16.60
GREECE	**Olive stones 10**	B20170222BSDOLKER2	14.1	4.1	77.3	51.0	7.1	1.43	0.080	0.140	20.53	17.64	19.00	15.98
GREECE	**Almond shells 1**	B20161102BIO2	9.6	3.3	76.6	51.7	6.7	0.53	0.020	0.020	19.65	17.77	18.19	16.22
GREECE	**Almond shells 2**	B20161102BIO3	9.6	1.1	77.7	52.0	6.6	0.30	0.010	n.d.	20.15	18.23	18.73	16.71
GREECE	**Almond shells 3**	B20161103BIO1	10.4	2.6	76.5	50.1	8.7	1.22	0.020	0.040	19.79	17.72	17.91	15.79
GREECE	**Almond shells 4**	B20161103BIO2	10.4	2.4	77.3	50.5	8.0	0.61	0.020	0.040	19.69	17.63	17.97	15.84
GREECE	**Almond shells 5**	B20161103BIO3	10.7	2.9	75.6	50.6	7.5	0.65	0.020	0.030	19.65	17.55	18.02	15.83
GREECE	**Almond shells 6**	B20161207BIO	10.5	1.5	77.3	50.2	6.6	0.55	0.010	0.040	20.02	17.92	18.58	16.37
GREECE	**Pistachio shells 1**	B20161102BIO1	8.6	0.6	81.9	52.2	7.4	0.71	0.030	0.030	19.80	18.10	18.21	16.43
GREECE	**Pistachio shells 2**	B20161117BIO	8.8	0.4	82.3	47.9	7.3	0.14	0.010	0.030	18.96	17.29	17.38	15.63
GREECE	**Pistachio shells 3**	B20170317BSDPNSH	10.1	0.4	82.6	47.5	7.0	0.12	0.010	0.010	18.85	16.95	17.32	15.33
GREECE	**Walnut shells 1**	B20161103BIO4	10.8	0.9	77.3	51.0	7.0	0.73	0.020	0.050	20.35	18.16	18.84	16.54
GREECE	**Walnut shells 2**	B20170111BSDKAR1	10.3	1.1	76.6	51.5	7.2	0.39	0.010	0.020	20.26	18.17	18.69	16.51
GREECE	**Walnut shells 3**	B20170111BSDKAR2	10.5	1.4	76.6	53.7	7.8	0.65	0.030	0.020	22.10	19.77	20.40	17.99
GREECE	**Walnut shells 4**	B20170323BSDNUTS	12.4	0.8	77.0	51.5	5.3	0.70	0.020	0.040	20.28	17.25	19.11	16.43

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	VM (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
GREECE	**Olive tree pruning 1**	B20161228BSDOLPR	22.2	4.2	78.5	49.5	7.7	0.96	0.060	0.050	19.58	15.24	17.91	13.40
GREECE	**Olive tree pruning 2**	B20170206BSDOLPR1	9.1	4.2	78.5	51.5	7.6	0.19	0.080	0.060	19.75	17.96	18.11	16.25
GREECE	**Olive tree pruning 3**	B20170206BSDOLPR2	9.1	4.2	78.7	53.1	7.3	0.39	0.060	0.050	19.66	17.88	18.08	16.22
GREECE	**Olive tree pruning 4**	B20170206BSDOLPR3	12.1	4.9	78.8	49.7	7.1	0.79	0.060	0.050	19.68	17.30	18.14	15.65
GREECE	**Olive tree pruning 5**	B20170215BSDOLPR	11.4	4.0	79.4	51.8	6.5	0.90	0.070	0.070	19.78	17.52	18.37	15.99
GREECE	**Olive tree pruning 6**	B20170223BSDOLPR	14.5	4.2	79.1	49.5	7.7	0.96	0.080	0.060	19.40	16.60	17.73	14.82
GREECE	**Olive tree pruning 7**	B20170301BSDOLPR1	13.1	5.1	80.1	50.8	7.6	1.22	0.080	0.040	19.84	17.23	18.21	15.50
GREECE	**Olive tree pruning 8**	B20170301BSDOLPR2	12.3	4.6	80.2	51.0	7.4	1.08	0.060	0.050	20.08	17.61	18.48	15.91
GREECE	**Olive tree pruning 9**	B20170301BSDOLPR3	11.7	3.6	79.7	49.3	6.9	1.03	0.190	n.d.	19.40	17.13	17.90	15.52
GREECE	**Olive tree pruning 10**	B20170302BSDOLPR	13.4	4.3	79.4	49.1	7.3	0.85	0.060	0.050	19.88	17.22	18.31	15.53
GREECE	**Olive tree pruning 11**	B20170323BSDOLPR	39.4	4.3	78.9	49.0	7.2	1.15	0.070	0.060	19.57	11.86	18.00	9.94
GREECE	**Olive tree pruning 12**	B20170319BSDOLPR	16.3	5.3	76.9	49.6	6.5	1.08	0.080	0.070	19.53	16.35	18.11	14.77
GREECE	**Vineyard pruning 1**	B20170201BSDPR1	39.8	4.9	74.5	47.3	6.5	0.69	0.060	0.040	18.56	11.18	17.14	9.36
GREECE	**Vineyard pruning 2**	B20170201BSDPR2	15.7	4.3	76.8	48.7	6.6	0.87	0.060	0.030	19.11	16.11	17.68	14.52
GREECE	**Vineyard pruning 3**	B20170221BSDPR	42.3	4.7	76.3	48.3	6.1	0.66	0.050	0.020	18.55	10.71	17.23	8.91
GREECE	**Vineyard pruning 4**	B20170221BSDPRV1	17.1	3.9	76.8	47.9	6.9	0.81	0.070	0.040	18.79	15.58	17.30	13.92
GREECE	**Vineyard pruning 5**	B20170221BSDPRV2	23.5	3.8	77.0	49.0	7.1	0.84	0.050	0.060	18.72	14.31	17.18	12.56
GREECE	**Vineyard pruning 6**	B20170302BSDPRV1	20.8	2.9	77.3	48.6	7.2	0.65	0.070	0.030	18.85	14.93	17.29	13.19
GREECE	**Vineyard pruning 7**	B20170302BSDPRV2	18.7	3.8	76.8	49.0	6.9	0.68	0.040	0.010	18.85	15.33	17.35	13.65
GREECE	**Vineyard pruning 8**	B20170321BSDPRV1	36.9	3.5	76.3	48.4	6.6	0.58	0.040	0.030	19.17	12.10	17.73	10.29
GREECE	**Vineyard pruning 9**	B20170321BSDPRV2	36.6	3.0	76.9	48.0	6.4	0.65	0.040	0.020	18.98	12.04	17.59	10.27
GREECE	**Vineyard pruning 10**	B20170321BSDPRV3	38.8	3.4	76.9	48.0	6.4	0.48	0.030	0.030	18.90	11.56	17.50	9.76
GREECE	**Vineyard pruning 11**	B20170323BSDPRV1	46.9	3.9	76.7	47.6	6.5	0.53	0.030	0.020	18.70	9.93	17.29	8.03
GREECE	**Vineyard pruning 12**	B20170323BSDPRV2	45.3	4.0	76.6	47.2	6.6	0.67	0.040	0.020	18.41	10.07	16.97	8.18
GREECE	**Vineyard pruning 13**	B20170324BSDPRV1	28.1	3.4	76.7	47.6	6.7	0.62	0.040	0.020	18.57	13.35	17.11	11.62
GREECE	**Vineyard pruning 14**	B20170324BSDPRV2	32.3	3.4	76.7	47.2	6.6	0.52	0.030	0.010	18.77	12.71	17.34	10.95
GREECE	**Vineyard pruning 15**	B20170324BSDPRV3	32.6	3.5	77.2	48.3	6.2	0.67	0.030	0.010	18.85	12.72	17.51	11.01
GREECE	**Vineyard pruning 16**	B20170324BSDPRV4	31.8	4.0	77.2	48.5	6.1	0.91	0.030	0.010	18.76	12.79	17.42	11.10

Country	Biofuel	Original reference	Al (% d.b.)	Ca (% d.b.)	Fe (% d.b.)	K (% d.b.)	Mg (% d.b.)	Mn (% d.b.)	Na (% d.b.)	Si (% d.b.)	Ti (% d.b.)	Zn (% d.b.)
GREECE	**Olive stones 1**	B20161221OLKAN1	0.0090	0.0560	0.0042	0.1004	0.0116	0.0004	0.0052	0.0509	0.00030	0.00000
GREECE	**Olive stones 2**	B20161221OLKAN2	0.0079	0.0471	0.0032	0.0704	0.0096	0.0004	0.0049	0.0378	0.00024	0.00000
GREECE	**Olive stones 3**	B20161221OLNIT	0.0157	0.0676	0.0056	0.0830	0.0176	0.0004	0.0447	0.1115	0.00048	0.00000
GREECE	**Olive stones 4**	B20170206BSDOLKER1	0.0131	0.0704	0.0061	0.1519	0.0118	0.0004	0.0148	0.0834	0.00035	0.00000
GREECE	**Olive stones 5**	B20170206BSDOLKER2	0.0166	0.0766	0.0109	0.1670	0.0077	0.0004	0.0148	0.1014	0.00040	0.00000
GREECE	**Olive stones 6**	B20170215BSDOLKER1	0.0768	0.2796	0.0234	1.1513	0.0437	0.0008	0.0983	0.4598	0.00234	0.00004
GREECE	**Olive stones 7**	B20170215BSDOLKER2	0.0634	0.2442	0.0165	1.0933	0.0409	0.0007	0.0640	0.3775	0.00165	0.00000
GREECE	**Olive stones 8**	B20170222BSDOLKER	0.0250	0.0548	0.0232	0.0658	0.0153	0.0004	0.0424	0.0855	0.00042	0.00000
GREECE	**Olive stones 9**	B20170222BSDOLKER1	0.1502	0.4169	0.0660	1.0923	0.1892	0.0022	0.0418	0.7227	0.00330	0.00016
GREECE	**Olive stones 10**	B20170222BSDOLKER2	0.1185	0.3223	0.0574	0.8762	0.0988	0.0012	0.0521	0.5219	0.00246	0.00008
GREECE	**Almond shells 1**	B20161102BIO2	0.0700	0.2049	0.0195	1.2675	0.0551	0.0007	0.0891	0.2053	0.00165	0.00002
GREECE	**Almond shells 2**	B20161102BIO3	0.0219	0.1277	0.0036	0.2938	0.0239	0.0004	0.0323	0.0790	0.00066	0.00000
GREECE	**Almond shells 3**	B20161103BIO1	0.0226	0.1953	0.0055	0.8512	0.0491	0.0005	0.0663	0.1794	0.00156	0.00000
GREECE	**Almond shells 4**	B20161103BIO2	0.0245	0.1567	0.0043	0.6804	0.0686	0.0005	0.1015	0.2040	0.00144	0.00001
GREECE	**Almond shells 5**	B20161103BIO3	0.0461	0.2039	0.0099	0.8033	0.1076	0.0006	0.1517	0.2033	0.00145	0.00000
GREECE	**Almond shells 6**	B20161207BIO	0.0146	0.0873	0.0057	0.4986	0.0224	0.0005	0.0378	0.1367	0.00075	0.00000
GREECE	**Pistachio shells 1**	B20161102BIO1	0.0151	0.0274	0.0110	0.1663	0.0218	0.0002	0.0041	0.0739	0.00036	0.00000
GREECE	**Pistachio shells 2**	B20161117BIO	0.0116	0.0373	0.0130	0.0846	0.0228	0.0002	0.0064	0.0357	0.00024	0.00000
GREECE	**Pistachio shells 3**	B20170317BSDPNSH	0.0076	0.0555	0.0022	0.0988	0.0134	0.0001	0.0029	0.0241	0.00024	0.00000
GREECE	**Walnut shells 1**	B20161103BIO4	0.0185	0.1506	0.0052	0.1630	0.0343	0.0006	0.0038	0.0516	0.00045	0.00000
GREECE	**Walnut shells 2**	B20170111BSDKAR1	0.0262	0.1337	0.0045	0.2444	0.0166	0.0028	0.0099	0.0834	0.00066	0.00000
GREECE	**Walnut shells 3**	B20170111BSDKAR2	0.0273	0.1788	0.0034	0.2808	0.0230	0.0036	0.0078	0.0984	0.00070	0.00001
GREECE	**Walnut shells 4**	B20170323BSDNUTS	0.0273	0.0477	0.0166	0.2446	0.0345	0.0006	0.0131	0.0494	0.00048	0.00000

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GREECE	**Olive tree pruning 1**	B20161228BSDOLPR	0.0827	0.5645	0.0214	0.5221	0.1016	0.0042	0.1693	0.4066	0.00210	0.00000
GREECE	**Olive tree pruning 2**	B20170206BSDOLPR1	0.0773	0.3994	0.0113	0.2873	0.1226	0.0025	0.2117	0.5531	0.00210	0.00000
GREECE	**Olive tree pruning 3**	B20170206BSDOLPR2	0.0853	0.5355	0.0181	0.3595	0.2071	0.0013	0.1508	0.4019	0.00252	0.00000
GREECE	**Olive tree pruning 4**	B20170206BSDOLPR3	0.1054	0.4435	0.0132	0.6007	0.0990	0.0044	0.0823	0.6684	0.00245	0.00000
GREECE	**Olive tree pruning 5**	B20170215BSDOLPR	0.0828	0.4580	0.0080	0.5796	0.0660	0.0024	0.0540	0.4876	0.00240	0.00000
GREECE	**Olive tree pruning 6**	B20170223BSDOLPR	0.0823	0.2873	0.0063	0.4952	0.0903	0.0013	0.0160	0.5901	0.00252	0.00000
GREECE	**Olive tree pruning 7**	B20170301BSDOLPR1	0.1352	0.5758	0.0051	0.5534	0.1204	0.0020	0.0500	0.6095	0.00306	0.00003
GREECE	**Olive tree pruning 8**	B20170301BSDOLPR2	0.0980	0.3956	0.0046	0.6224	0.1219	0.0023	0.0386	0.5957	0.00230	0.00000
GREECE	**Olive tree pruning 9**	B20170301BSDOLPR3	0.0947	0.2524	0.0018	0.3902	0.1123	0.0014	0.0292	0.4990	0.00216	0.00000
GREECE	**Olive tree pruning 10**	B20170302BSDOLPR	0.1230	0.3195	0.0047	0.7383	0.0710	0.0022	0.1398	0.4812	0.00258	0.00005
GREECE	**Olive tree pruning 11**	B20170323BSDOLPR	0.0925	0.4180	0.0056	0.6033	0.0529	0.0022	0.1673	0.5345	0.00258	0.00005
GREECE	**Olive tree pruning 12**	B20170319BSDOLPR	0.1134	0.6360	0.0106	0.8650	0.1399	0.0053	0.2475	0.4871	0.00318	0.00000
GREECE	**Vineyard pruning 1**	B20170201BSDPR1	0.1774	0.3190	0.1323	0.5297	0.1666	0.0059	0.0735	0.5767	0.00245	0.00128
GREECE	**Vineyard pruning 2**	B20170201BSDPR2	0.1896	0.2576	0.0477	0.3242	0.1694	0.0043	0.0606	0.4889	0.00258	0.00000
GREECE	**Vineyard pruning 3**	B20170221BSDPR	0.1231	0.3986	0.0343	0.5029	0.1354	0.0014	0.0672	0.5043	0.00235	0.00000
GREECE	**Vineyard pruning 4**	B20170221BSDPRV1	0.0854	0.2180	0.0101	0.2496	0.1790	0.0059	0.1459	0.5347	0.00195	0.00000
GREECE	**Vineyard pruning 5**	B20170221BSDPRV2	0.0935	0.2402	0.0046	0.3116	0.1463	0.0042	0.1649	0.4556	0.00228	0.00000
GREECE	**Vineyard pruning 6**	B20170302BSDPRV1	0.0841	0.1441	0.0067	0.2407	0.1569	0.0032	0.1175	0.3225	0.00174	0.00010
GREECE	**Vineyard pruning 7**	B20170302BSDPRV2	0.1125	0.2436	0.0084	0.2892	0.1832	0.0034	0.2048	0.4693	0.00228	0.00000
GREECE	**Vineyard pruning 8**	B20170321BSDPRV1	0.0504	0.3612	0.0238	0.4330	0.1505	0.0025	0.0249	0.3955	0.00175	0.00043
GREECE	**Vineyard pruning 9**	B20170321BSDPRV2	0.1050	0.1977	0.0057	0.2988	0.1251	0.0024	0.1251	0.3528	0.00150	0.00000
GREECE	**Vineyard pruning 10**	B20170321BSDPRV3	0.1336	0.2441	0.0054	0.3590	0.1255	0.0020	0.2788	0.3801	0.00204	0.00000
GREECE	**Vineyard pruning 11**	B20170323BSDPRV1	0.1443	0.2543	0.0066	0.6143	0.0842	0.0027	0.2964	0.4161	0.00234	0.00000
GREECE	**Vineyard pruning 12**	B20170323BSDPRV2	0.0436	0.3380	0.0104	0.7276	0.1852	0.0036	0.0116	0.4276	0.00240	0.00021
GREECE	**Vineyard pruning 13**	B20170324BSDPRV1	0.0279	0.3529	0.0048	0.6905	0.1027	0.0027	0.0354	0.3618	0.00170	0.00010
GREECE	**Vineyard pruning 14**	B20170324BSDPRV2	0.0819	0.2686	0.0048	0.6712	0.1190	0.0031	0.0779	0.3910	0.00204	0.00000
GREECE	**Vineyard pruning 15**	B20170324BSDPRV3	0.0448	0.3581	0.0039	0.5705	0.1691	0.0042	0.0931	0.3122	0.00175	0.00000
GREECE	**Vineyard pruning 16**	B20170324BSDPRV4	0.1136	0.3364	0.0064	0.6184	0.1632	0.0044	0.1900	0.3980	0.00200	0.00000

Country	Biofuel	Original reference	As (mg/kg d.b.)	Cd (mg/kg d.b.)	Cr (mg/kg d.b.)	Cu (mg/kg d.b.)	Hg (mg/kg d.b.)	Ni (mg/kg d.b.)	Pb (mg/kg d.b.)	Zn (mg/kg d.b.)
GREECE	**Olive stones 1**	B20161221OLKAN1	0.0	0.1	0.2	2.0	0.001	0.3	0.0	0.9
GREECE	**Olive stones 2**	B20161221OLKAN2	0.0	0.0	0.4	3.1	<0.001	0.3	0.0	0.9
GREECE	**Olive stones 3**	B20161221OLNIT	0.0	0.0	0.6	3.3	0.002	0.5	0.0	2.4
GREECE	**Olive stones 4**	B20170206BSDOLKER1	0.0	0.1	0.3	2.8	0.002	0.2	0.7	5.3
GREECE	**Olive stones 5**	B20170206BSDOLKER2	0.0	0.0	0.6	2.5	0.002	0.2	0.7	5.3
GREECE	**Olive stones 6**	B20170215BSDOLKER1	0.0	0.0	6.8	7.8	0.002	4.5	2.1	11.3
GREECE	**Olive stones 7**	B20170215BSDOLKER2	0.0	0.0	4.3	10.1	0.001	3.3	2.3	12.0
GREECE	**Olive stones 8**	B20170222BSDOLKER	0.0	0.0	0.7	3.5	0.002	0.5	0.4	10.6
GREECE	**Olive stones 9**	B20170222BSDOLKER1	0.0	0.0	1.9	14.3	0.002	2.5	2.2	29.2
GREECE	**Olive stones 10**	B20170222BSDOLKER2	0.0	0.0	5.6	13.3	0.003	4.5	1.6	19.3
GREECE	**Almond shells 1**	B20161102BIO2	0.0	0.0	7.1	5.3	0.001	5.3	0.0	6.0
GREECE	**Almond shells 2**	B20161102BIO3	0.0	0.0	0.8	5.9	0.001	0.5	0.0	3.1
GREECE	**Almond shells 3**	B20161103BIO1	0.0	0.0	3.3	13.8	<0.001	2.8	0.0	7.4
GREECE	**Almond shells 4**	B20161103BIO2	0.0	0.0	0.9	3.7	<0.001	0.9	0.7	3.0
GREECE	**Almond shells 5**	B20161103BIO3	0.0	0.0	0.7	4.1	<0.001	1.2	0.0	4.8
GREECE	**Almond shells 6**	B20161207BIO	0.0	0.0	2.5	5.0	0.001	2.0	13.5	5.5
GREECE	**Pistachio shells 1**	B20161102BIO1	0.0	0.0	2.2	71.9	<0.001	4.7	0.6	7.4
GREECE	**Pistachio shells 2**	B20161117BIO	0.0	0.0	1.4	45.7	<0.001	3.6	0.3	5.1
GREECE	**Pistachio shells 3**	B20170317BSDPNSH	0.0	0.0	1.8	62.9	<0.001	3.4	0.4	4.7
GREECE	**Walnut shells 1**	B20161103BIO4	0	0	0.36	4.59	0.001	0.7	0.3	3.9
GREECE	**Walnut shells 2**	B20170111BSDKAR1	0	0	0.385	4.631	0.002	0.6	0.4	5.1
GREECE	**Walnut shells 3**	B20170111BSDKAR2	0.0	0.0	0.5	6.3	0.001	0.7	0.6	4.8
GREECE	**Walnut shells 4**	B20170323BSDNUTS	0	0.152	3.28	3.744	0.001	2.3	0.0	3.3

Country	Biofuel	Original reference	As (mg/kg d.b.)	Cd (mg/kg d.b.)	Cr (mg/kg d.b.)	Cu (mg/kg d.b.)	Hg (mg/kg d.b.)	Ni (mg/kg d.b.)	Pb (mg/kg d.b.)	Zn (mg/kg d.b.)
GREECE	**Olive tree pruning 1**	B20161228BSDOLPR	0.0	0.0	0.8	32.8	0.003	1.8	0.0	10.3
GREECE	**Olive tree pruning 2**	B20170206BSDOLPR1	0.0	0.0	1.6	47.0	0.009	1.3	0.0	14.3
GREECE	**Olive tree pruning 3**	B20170206BSDOLPR2	0.0	0.0	1.4	52.9	0.005	1.0	0.0	15.3
GREECE	**Olive tree pruning 4**	B20170206BSDOLPR3	0.0	0.0	2.0	43.1	0.019	2.1	0.0	14.0
GREECE	**Olive tree pruning 5**	B20170215BSDOLPR	0.0	0.0	0.8	5.5	0.017	0.0	0.0	10.0
GREECE	**Olive tree pruning 6**	B20170223BSDOLPR	0.0	0.0	1.6	10.9	0.020	2.3	0.0	13.0
GREECE	**Olive tree pruning 7**	B20170301BSDOLPR1	0.0	0.0	0.9	42.8	0.014	2.0	0.0	6.0
GREECE	**Olive tree pruning 8**	B20170301BSDOLPR2	0.0	0.0	1.1	31.7	0.022	2.6	0.0	11.7
GREECE	**Olive tree pruning 9**	B20170301BSDOLPR3	0.0	0.9	1.4	76.3	0.014	2.8	0.0	10.1
GREECE	**Olive tree pruning 10**	B20170302BSDOLPR	0.0	0.0	0.7	5.6	0.010	1.7	0.0	10.5
GREECE	**Olive tree pruning 11**	B20170323BSDOLPR	0.0	0.0	0.7	33.5	0.002	0.9	0.0	11.0
GREECE	**Olive tree pruning 12**	B20170319BSDOLPR	0.0	0.0	1.2	4.8	0.002	2.3	0.0	7.6
GREECE	**Vineyard pruning 1**	B20170201BSDPR1	0.0	1.1	4.9	21.1	0.002	4.9	35.9	260.9
GREECE	**Vineyard pruning 2**	B20170201BSDPR2	0.0	0.0	1.4	33.5	0.005	3.4	28.3	221.0
GREECE	**Vineyard pruning 3**	B20170221BSDPR	0.0	0.0	1.8	46.4	0.003	2.6	0.0	18.3
GREECE	**Vineyard pruning 4**	B20170221BSDPRV1	0.0	<0.4	1.6	17.6	0.002	2.0	0.0	35.9
GREECE	**Vineyard pruning 5**	B20170221BSDPRV2	0.0	0.0	1.2	19.9	0.004	2.8	0.0	46.0
GREECE	**Vineyard pruning 6**	B20170302BSDPRV1	0.0	0.0	1.1	9.2	0.002	1.0	0.0	33.4
GREECE	**Vineyard pruning 7**	B20170302BSDPRV2	0.0	0.0	1.1	12.5	0.002	1.5	0.0	48.6
GREECE	**Vineyard pruning 8**	B20170321BSDPRV1	0.0	0.0	3.0	31.8	0.004	2.5	2.6	124.3
GREECE	**Vineyard pruning 9**	B20170321BSDPRV2	0.0	0.0	1.1	30.5	0.002	1.1	0.0	71.1
GREECE	**Vineyard pruning 10**	B20170321BSDPRV3	0.0	0.0	1.4	34.2	0.002	1.2	0.0	71.4
GREECE	**Vineyard pruning 11**	B20170323BSDPRV1	0.0	0.0	1.0	8.9	0.017	1.6	0.0	57.7
GREECE	**Vineyard pruning 12**	B20170323BSDPRV2	0.0	0.0	1.4	7.8	0.008	1.0	0.0	51.6
GREECE	**Vineyard pruning 13**	B20170324BSDPRV1	0.0	0.0	0.7	7.3	0.001	0.0	0.0	28.9
GREECE	**Vineyard pruning 14**	B20170324BSDPRV2	0.0	0.0	1.3	10.6	0.002	0.0	0.0	38.1
GREECE	**Vineyard pruning 15**	B20170324BSDPRV3	0.0	0.0	1.2	9.2	0.002	1.1	1.3	33.6
GREECE	**Vineyard pruning 16**	B20170324BSDPRV4	0.0	0.0	1.0	10.0	0.003	0.0	0.0	60.6

Country	Biofuel	Original reference	SST (ºC)	DT (ºC)	HT (ºC)	FT (ºC)	Disintegration 800 ºC	1000 ºC	1200 ºC	1400 ºC	Sieving (0.50 mm sieve) 800 ºC	1000 ºC	1200 ºC	1400 ºC	Sintering Index
GREECE	**Olive stones 1**	B20161221OLKAN1	732	823	1462	1483	4	4	4	4	99	100	100	100	0.8
GREECE	**Olive stones 2**	B20161221OLKAN2	746	857	1423	1437	4	4	4	4	100	100	100	100	0.9
GREECE	**Olive stones 3**	B20161221OLNIT	724	806	1462	1513	4	4	4	4	100	100	100	100	0.8
GREECE	**Olive stones 4**	B20170206BSDOLKER1	721	849	1425	1433	4	4	4	4	100	100	100	100	0.6
GREECE	**Olive stones 5**	B20170206BSDOLKER2	714	845	1447	1472	4	4	4	4	99	100	100	100	0.5
GREECE	**Olive stones 6**	B20170215BSDOLKER1	647	684	1518	1527	4	4	4	4	100	100	100	100	0.3
GREECE	**Olive stones 7**	B20170215BSDOLKER2	634	710	>1550	1550	4	4	4	4	100	100	100	100	0.3
GREECE	**Olive stones 8**	B20170222BSDOLKER	666	713	>1550	>1550	4	4	4	4	97	100	100	100	0.8
GREECE	**Olive stones 9**	B20170222BSDOLKER1	614	813	>1550	>1550									0.7
GREECE	**Olive stones 10**	B20170222BSDOLKER2	697	816	1403	1415									0.5
GREECE	**Almond shells 1**	B20161102BIO2	703	840	1468	1485	4	4	4	4	93	100	100	100	0.2
GREECE	**Almond shells 2**	B20161102BIO3	755	862	>1550	>1551	4	4	4	4	95	100	100	100	0.6
GREECE	**Almond shells 3**	B20161103BIO1	747	851	>1550	>1551	4	4	4	4	100	100	100	100	0.3
GREECE	**Almond shells 4**	B20161103BIO2	727	866	1529	>1550									0.4
GREECE	**Almond shells 5**	B20161103BIO3	749	859	1493	>1550									0.4
GREECE	**Almond shells 6**	B20161207BIO	722	862	>1550	>1550									0.2
GREECE	**Pistachio shells 1**	B20161102BIO1	1128	1206	1506	>1550	3	4	4	4	85	95	93	100	0.4
GREECE	**Pistachio shells 2**	B20161117BIO	697	810	1351	1417	4	4	4	4	97	100	100	100	0.8
GREECE	**Pistachio shells 3**	B20170317BSDPNSH	727	1050	>1550	>1550	4	4	4	4	96	94	100	100	0.8
GREECE	**Walnut shells 1**	B20161103BIO4	752	878	1460	1469	2	4	4	4	61	100	100	100	1.3
GREECE	**Walnut shells 2**	B20170111BSDKAR1	739	860	1503	1506	1	4	4	4	46	100	100	100	0.7
GREECE	**Walnut shells 3**	B20170111BSDKAR2	764	1231	>1550	>1550	4	4	4	4	99	100	100	100	0.8
GREECE	**Walnut shells 4**	B20170323BSDNUTS	740	1138	1500	1510	1	2	2	4	33	72	81	100	0.4
GREECE	**Olive tree pruning 1**	B20161228BSDOLPR	724	1373	1420	1437	4	4	4	4	94	93	96	100	1.1
GREECE	**Olive tree pruning 2**	B20170206BSDOLPR1	747	1070	1524	1529	1	3	4	3	46	74	97	88	1.2
GREECE	**Olive tree pruning 3**	B20170206BSDOLPR2	740	1148	1453	1476	2	2	3	3	71	80	78	90	1.7
GREECE	**Olive tree pruning 4**	B20170206BSDOLPR3	723	1086	1415	1431	4	4	3	4	94	100	87	88	0.9
GREECE	**Olive tree pruning 5**	B20170215BSDOLPR	735	1090	1422	1431									1.0
GREECE	**Olive tree pruning 6**	B20170223BSDOLPR	717	1182	1488	1494									0.9
GREECE	**Olive tree pruning 7**	B20170301BSDOLPR1	736	1184	1494	1515									1.4
GREECE	**Olive tree pruning 8**	B20170301BSDOLPR2	731	1183	1474	1492									0.9
GREECE	**Olive tree pruning 9**	B20170301BSDOLPR3	728	1135	1548	>1550	2	2	3	4	53	55	74	84	1.1
GREECE	**Olive tree pruning 10**	B20170302BSDOLPR	727	1196	1407	1433									0.5
GREECE	**Olive tree pruning 11**	B20170323BSDOLPR	734	1164	1437	1453									0.7
GREECE	**Olive tree pruning 12**	B20170319BSDOLPR	728	1192	1417	1444									0.8
GREECE	**Vineyard pruning 1**	B20170201BSDPR1	702	1080	1520	1533									1.0
GREECE	**Vineyard pruning 2**	B20170201BSDPR2	715	1099	1494	1509									1.4
GREECE	**Vineyard pruning 3**	B20170221BSDPR	730	865	1433	1454									1.1
GREECE	**Vineyard pruning 4**	B20170221BSDPRV1	709	1169	1520	1535	2	3	4	4	79	84	97	97	1.2
GREECE	**Vineyard pruning 5**	B20170221BSDPRV2	727	1174	>1550	>1550	2	2	3	3	71	84	90	93	1.0
GREECE	**Vineyard pruning 6**	B20170302BSDPRV1	738	1138	1507	1524									1.0
GREECE	**Vineyard pruning 7**	B20170302BSDPRV2	736	1184	1494	1515									1.0
GREECE	**Vineyard pruning 8**	B20170321BSDPRV1	723	1123	>1550	>1550									1.4
GREECE	**Vineyard pruning 9**	B20170321BSDPRV2	728	1169	1471	1494	1	3	3	4	55	82	93	98	0.9
GREECE	**Vineyard pruning 10**	B20170321BSDPRV3	726	1123	>1550	>1550	2	2	3	4	77	79	93	90	0.7
GREECE	**Vineyard pruning 11**	B20170323BSDPRV1	757	1180	1475	1488	3	3	2	4	82	91	83	100	0.4
GREECE	**Vineyard pruning 12**	B20170323BSDPRV2	746	1178	>1550	>1550									0.9
GREECE	**Vineyard pruning 13**	B20170324BSDPRV1	740	1181	1440	1460									0.8
GREECE	**Vineyard pruning 14**	B20170324BSDPRV2	753	1185	1474	1491									0.6
GREECE	**Vineyard pruning 15**	B20170324BSDPRV3	727	1181	1417	1461									1.0
GREECE	**Vineyard pruning 16**	B20170324BSDPRV4	744	1192	1437	1458									0.7

Country	Biofuel	Original reference	Bulk density (kg/m3)	Oil (% d.b.)	63 %	45 %	31.5 %	16 %	8 %	3.15 %	2 %	1 %	< 1 %
GREECE	**Olive stones 1**	B20161221OLKAN1	718	0.53	0.00	0.00	0.00	0.00	0.00	13.92	38.24	45.49	2.35
GREECE	**Olive stones 2**	B20161221OLKAN2	712	0.55	0.00	0.00	0.00	0.00	0.00	13.43	47.39	38.81	0.37
GREECE	**Olive stones 3**	B20161221OLNIT	616	0.62	0.00	0.00	0.00	0.00	0.00	22.67	49.23	27.52	0.58
GREECE	**Olive stones 4**	B20170206BSDOLKER1	599	1.48	0.00	0.00	0.00	0.00	0.00	8.35	54.26	36.17	1.22
GREECE	**Olive stones 5**	B20170206BSDOLKER2	625	1.52	0.00	0.00	0.00	0.00	0.00	12.44	53.23	33.54	0.79
GREECE	**Olive stones 6**	B20170215BSDOLKER1	762	1.06	0.00	0.00	0.00	0.00	0.00	4.59	29.74	64.07	1.60
GREECE	**Olive stones 7**	B20170215BSDOLKER2	731	1.30	0.00	0.00	0.00	0.00	0.00	18.24	43.89	37.47	0.40
GREECE	**Olive stones 8**	B20170222BSDOLKER	696	1.12	0.00	0.00	0.00	0.00	0.00	3.31	34.70	58.09	3.90
GREECE	**Olive stones 9**	B20170222BSDOLKER1	667	4.55	0.00	0.00	0.00	0.00	0.00	23.00	33.08	39.73	4.19
GREECE	**Olive stones 10**	B20170222BSDOLKER2	659	1.37	0.00	0.00	0.00	0.00	0.00	13.01	32.42	46.58	7.99
GREECE	**Almond shells 1**	B20161102BIO2	502	2.43	0.00	0.00	0.00	0.00	0.86	39.14	19.48	29.14	11.38
GREECE	**Almond shells 2**	B20161102BIO3	394	2.28	0.00	0.00	0.00	0.00	96.15	3.12	0.18	0.37	0.18
GREECE	**Almond shells 3**	B20161103BIO1	497	2.47	0.00	0.00	0.00	0.00	4.01	33.20	17.55	30.53	14.71
GREECE	**Almond shells 4**	B20161103BIO2	432	2.84	0.00	0.00	0.00	3.07	12.27	48.56	14.26	19.49	2.35
GREECE	**Almond shells 5**	B20161103BIO3	335	2.73	0.00	0.00	0.00	5.46	85.97	8.00	0.19	0.19	0.19
GREECE	**Almond shells 6**	B20161207BIO	462	3.75	0.00	0.00	0.00	0.00	16.93	61.41	9.45	10.04	2.17
GREECE	**Pistachio shells 1**	B20161102BIO1	310	3.39	0.00	0.00	0.00	0.00	71.05	25.61	1.58	1.23	0.53
GREECE	**Pistachio shells 2**	B20161117BIO	303	3.28	0.00	0.00	0.00	0.00	79.44	19.57	0.20	0.59	0.20
GREECE	**Pistachio shells 3**	B20170317BSDPNSH	312	0.13	0.00	0.00	0.00	0.00	97.35	1.94	0.18	0.18	0.35
GREECE	**Walnut shells 1**	B20161103BIO4	257	3.25	0.00	0.00	0.00	85.66	14.16	0.18	0.00	0.00	0.00
GREECE	**Walnut shells 2**	B20170111BSDKAR1	259	3.92	0.00	0.00	0.00	33.60	56.97	8.84	0.00	0.20	0.39
GREECE	**Walnut shells 3**	B20170111BSDKAR2	260	3.82	0.00	0.00	0.00	33.27	51.57	14.57	0.20	0.00	0.39
GREECE	**Walnut shells 4**	B20170323BSDNUTS	208	4.30	0.00	0.00	0.00	66.73	23.68	8.02	0.59	0.39	0.59

➢ 8.2.3 Analytical results of the samples collected in Italy

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	VM (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
ITALY	**Almond shells 1**	262/17	12.2	1.40	81.5	49.1	6.0	0.2	0.01	0.01	19.82	18.07	18.51	15.96
ITALY	**Almond shells 2**	263/17	12.6	1.30	81.6	48.8	6.1	0.2	0.01	0.01	19.81	18.22	18.48	15.85
ITALY	**Almond shells 3**	264/17	12.4	1.40	81.3	49.3	6.1	0.2	0.01	0.01	19.87	18.52	18.55	15.95
ITALY	**Almond shells 4**	265/17	12.3	1.40	81.4	49.7	6.1	0.3	0.01	0.01	20.20	18.41	18.88	16.27
ITALY	**Almond shells 5**	266/17	12.6	1.20	82.1	49.0	6.1	0.2	0.01	0.01	19.86	18.13	18.53	15.89
ITALY	**Almond shells 6**	267/17	12.4	1.50	81.3	48.9	6.0	0.2	0.01	0.01	19.67	17.88	18.36	15.79
ITALY	**Almond shells 7**	268/17	12.4	1.70	80.8	49.2	6.2	0.3	0.01	0.01	20.05	18.29	18.71	16.07
ITALY	**Almond shells 8**	269/17	12.4	1.30	81.5	48.9	6.1	0.2	0.01	0.01	19.93	18.25	18.59	15.98
ITALY	**Olive stones 1**	89/17	17.7	0.80	82.6	50.7	6.0	0.2	0.01	0.01	20.30	17.40	19.00	15.21
ITALY	**Olive stones 2**	90/17	8.3	5.2	77.0	51.9	6.5	0.9	0.07	0.01	21.93	20.46	20.52	18.61
ITALY	**Olive stones 3**	133/17	13.8	2.3	78.8	50.2	6.1	0.4	0.04	0.05	20.24	17.89	18.91	15.97
ITALY	**Olive stones 4**	134/17	19.1	0.60	82.7	50.5	6.1	0.2	0.01	0.05	20.30	16.87	18.97	14.88
ITALY	**Olive stones 5**	135/17	19.9	0.60	83.2	50.9	6.2	0.2	0.01	0.02	20.43	17.04	19.08	14.79
ITALY	**Olive stones 6**	136/17	15.7	0.50	83.7	50.8	6.1	0.2	0.01	0.01	20.41	17.67	19.08	15.70
ITALY	**Olive stones 7**	137/17	13.6	0.80	82.7	51.2	6.2	0.2	0.01	0.02	20.63	18.18	19.28	16.33
ITALY	**Olive stones 8**	138/17	17.4	0.50	84.0	50.6	6.2	0.2	0.01	0.02	20.28	17.08	18.93	15.21
ITALY	**Olive stones 9**	139/17	19.6	0.50	83.8	50.7	6.1	0.2	0.01	0.02	20.29	16.74	18.96	14.76
ITALY	**Olive stones 10**	140/17	6.7	1.90	80.6	50.0	6.1	0.2	0.02	0.04	20.07	18.85	18.74	17.33
ITALY	**Olive stones 11**	141/17	6.9	1.50	81.2	50.3	6.1	0.2	0.02	0.04	20.12	19.03	18.79	17.33
ITALY	**Olive stones 12**	142/17	15.9	0.50	83.7	50.7	6.1	0.2	0.01	0.02	20.29	17.35	18.96	15.57
ITALY	**Olive stones 13**	143/17	16.0	0.40	83.7	50.7	6.2	0.2	0.01	0.02	20.32	17.38	18.97	15.55
ITALY	**Olive stones 14**	144/17	17.6	0.40	83.7	50.7	6.1	0.2	0.01	0.02	20.34	17.04	19.01	15.24

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	VM (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
ITALY	Olive tree pruning 1	88/17	10.7	1.90	82.1	48.1	6.1	0.3	0.03	0.03	19.30	18.16	17.97	15.79
ITALY	Olive tree pruning 2	132/17	11.9	3.2	79.8	49.6	6.0	0.5	0.03	0.02	19.64	18.38	18.33	15.86
ITALY	Olive tree pruning 3	130/17	11.7	3.1	79.6	49.7	6.0	0.5	0.03	0.01	19.89	18.79	18.58	16.13
ITALY	Olive tree pruning 4	131/17	11.9	3.5	79.5	49.8	6.1	0.5	0.03	0.02	19.95	18.77	18.62	16.10
ITALY	Olive tree pruning pellets 1	86-17	10.2	3.1	80.2	48.1	6.0	0.4	0.04	0.04	19.25	17.87	17.94	15.87
ITALY	Olive tree pruning pellets 2	87-17	9.3	3.7	79.4	48.3	6.1	0.5	0.05	0.04	19.28	18.15	17.95	16.07
ITALY	Vineyard pruning 1	782/16	13.2	3.2	77.8	48.7	6.0	0.7	0.06	0.01	19.46	17.93	18.16	15.44
ITALY	Vineyard pruning 2	783/16	15.1	3.2	78.4	48.6	5.9	0.7	0.06	0.01	19.44	17.91	18.16	15.04
ITALY	Vineyard pruning 3	784/16	13.6	3.0	78.1	48.6	5.9	0.6	0.06	0.04	19.51	17.97	18.23	15.42
ITALY	Vineyard pruning 4	249-17	12.0	3.2	78.1	48.0	5.9	0.7	0.06	0.01	18.82	17.78	17.53	14.94
ITALY	Vineyard pruning 5	250-17	12.0	3.2	78.1	48.2	6.0	0.7	0.06	0.01	18.92	17.62	17.62	15.21
ITALY	Vineyard pruning 6	251-17	12.3	3.5	77.9	48.3	5.8	0.7	0.06	0.01	19.34	18.22	18.08	15.55
ITALY	Vineyard pruning 7	252-17	11.9	3.2	77.8	48.3	5.9	0.8	0.06	0.01	19.17	18.19	17.89	15.46
ITALY	Vineyard pruning 8	253-17	12.1	3.3	78.5	48.1	5.9	0.8	0.05	0.01	19.07	18.01	17.79	15.35
ITALY	Vineyard pruning 9	254-17	11.8	3.0	77.8	47.9	5.8	0.7	0.06	0.01	19.35	18.15	18.08	15.66
ITALY	Vineyard pruning pellets 1	785-17	10.5	4.6	77.0	49.1	6.0	0.8	0.06	0.02	19.33	17.51	18.02	15.87
ITALY	Vineyard pruning pellets 2	82-17	10.4	4.4	76.5	48.8	5.8	0.8	0.07	0.02	19.41	17.86	18.14	16.00
ITALY	Vineyard pruning pellets 3	83-17	10.3	4.4	76.3	48.9	5.8	0.8	0.07	0.02	18.92	17.37	17.65	15.58
ITALY	Vineyard pruning pellets 4	84-17	10.2	4.4	78.3	48.5	5.8	0.8	0.07	0.02	18.65	17.20	17.39	15.37
ITALY	Vineyard pruning pellets 5	85-17	9.7	4.5	76.3	48.9	5.8	0.8	0.07	0.02	18.84	17.32	17.58	15.64

Country	Biofuel	Original reference	Al (%	Ba (%	Ca (%	Fe (%	K (%	Mg (%	Mn (%	Na (%	P (%	S (%	Si (%	Sr (%	Ti (%	Zn (%
ITALY	**Almond shells 1**	262/17	0.0038	0.0001	0.1200	0.0035	0.3360	0.0216	0.0003	0.0095	0.0192	0.0082	0.0300	0.00156	0.00018	0.00022
ITALY	**Almond shells 2**	263/17	0.0032	0.0001	0.1078	0.0030	0.3080	0.0154	0.0003	0.0088	0.0110	0.0069	0.0253	0.00165	0.00014	0.00015
ITALY	**Almond shells 3**	264/17	0.0061	0.0002	0.1598	0.0049	0.4760	0.0289	0.0004	0.0122	0.0204	0.0112	0.0476	0.00221	0.00029	0.00029
ITALY	**Almond shells 4**	265/17	0.0050	0.0001	0.1200	0.0040	0.3240	0.0180	0.0003	0.0096	0.0119	0.0074	0.0372	0.00168	0.00024	0.00017
ITALY	**Almond shells 5**	266/17	0.0032	0.0001	0.1000	0.0027	0.2800	0.0150	0.0002	0.0076	0.0095	0.0056	0.0240	0.00140	0.00015	0.00012
ITALY	**Almond shells 6**	267/17	0.0048	0.0001	0.1260	0.0042	0.3920	0.0224	0.0003	0.0097	0.0168	0.0073	0.0378	0.00168	0.00024	0.00021
ITALY	**Almond shells 7**	268/17	0.0045	0.0001	0.1425	0.0041	0.4200	0.0240	0.0003	0.0105	0.0180	0.0090	0.0405	0.00180	0.00021	0.00023
ITALY	**Almond shells 8**	269/17	0.0044	0.0001	0.1500	0.0044	0.3750	0.0225	0.0003	0.0107	0.0165	0.0108	0.0420	0.00180	0.00020	0.00023
ITALY	**Olive stones 1**	89/17	0.0207	0.0002	0.1260	0.0198	0.1530	0.0135	0.0008	0.0077	0.0090	0.0074	0.0756	0.00022	0.00117	0.00016
ITALY	**Olive stones 2**	90/17	0.1800	0.0013	0.6000	0.0950	0.6500	0.0600	0.0036	0.0365	0.0850	0.0475	0.8500	0.00105	0.01050	0.00120
ITALY	**Olive stones 3**	133/17	0.0759	0.0006	0.1955	0.0667	0.5060	0.0368	0.0019	0.0193	0.0391	0.0299	0.1932	0.00129	0.00437	0.00074
ITALY	**Olive stones 4**	134/17	0.0084	0.0001	0.1050	0.0077	0.1330	0.0112	0.0002	0.0052	0.0084	0.0047	0.0392	0.00016	0.00070	0.00014
ITALY	**Olive stones 5**	135/17	0.0070	0.0001	0.1120	0.0084	0.1400	0.0182	0.0005	0.0084	0.0091	0.0064	0.0301	0.00015	0.00050	0.01540
ITALY	**Olive stones 6**	136/17	0.0032	0.0000	0.0600	0.0034	0.0960	0.0056	0.0004	0.0040	0.0048	0.0040	0.0120	0.00010	0.00019	0.00012
ITALY	**Olive stones 7**	137/17	0.0091	0.0001	0.0840	0.0060	0.1610	0.0091	0.0005	0.0057	0.0084	0.0057	0.0392	0.00012	0.00058	0.00013
ITALY	**Olive stones 8**	138/17	0.0001	0.0000	0.0560	0.0007	0.1040	0.0080	0.0002	0.0015	0.0068	0.0032	0.0044	0.00009	0.00002	0.00007
ITALY	**Olive stones 9**	139/17	0.0002	0.0000	0.0600	0.0010	0.1000	0.0076	0.0002	0.0016	0.0068	0.0036	0.0052	0.00012	0.00003	0.00012
ITALY	**Olive stones 10**	140/17	0.0094	0.0002	0.2880	0.0096	0.2880	0.0304	0.0006	0.0272	0.0192	0.0160	0.0720	0.00050	0.00064	0.00037
ITALY	**Olive stones 11**	141/17	0.0306	0.0002	0.2520	0.0234	0.3060	0.0252	0.0006	0.0099	0.0198	0.0126	0.1494	0.00036	0.00198	0.00032
ITALY	**Olive stones 12**	142/17	0.0002	0.0000	0.0330	0.0005	0.0840	0.0060	0.0002	0.0008	0.0054	0.0036	0.0036	0.00036	0.00005	0.00005
ITALY	**Olive stones 13**	143/17	0.0002	0.0001	0.0440	0.0006	0.1160	0.0080	0.0002	0.0010	0.0072	0.0044	0.0052	0.00048	0.00003	0.00006
ITALY	**Olive stones 14**	144/17	0.0004	0.0001	0.0500	0.0009	0.1400	0.0095	0.0003	0.0014	0.0090	0.0055	0.0055	0.00060	0.00000	0.00011
ITALY	**Olive tree pruning 1**	88/17	0.0088	0.0002	0.4400	0.0050	0.2600	0.0300	0.0006	0.0220	0.0520	0.0150	0.0540	0.00132	0.00028	0.00042
ITALY	**Olive tree pruning 2**	132/17	0.0164	0.0013	0.8990	0.0071	0.2790	0.0558	0.0040	0.0211	0.0651	0.0229	0.0868	0.01364	0.00040	0.00062
ITALY	**Olive tree pruning 3**	130/17	0.0182	0.0013	0.9570	0.0079	0.2772	0.0594	0.0046	0.0218	0.0693	0.0267	0.0924	0.01386	0.00046	0.00073
ITALY	**Olive tree pruning 4**	131/17	0.0173	0.0012	0.9280	0.0077	0.2944	0.0576	0.0038	0.0214	0.0672	0.0259	0.0864	0.01248	0.00045	0.00070
ITALY	**Olive tree pruning pellets 1**	86-17	0.0304	0.0004	0.8580	0.0267	0.3135	0.0495	0.0012	0.0271	0.0627	0.0290	0.1584	0.00211	0.00142	0.00122
ITALY	**Olive tree pruning pellets 2**	87-17	0.0533	0.0006	0.9840	0.0336	0.4100	0.0656	0.0019	0.0410	0.0861	0.0390	0.2706	0.00226	0.00230	0.00098
ITALY	**Vineyard pruning 1**	782/16	0.0213	0.0005	0.6636	0.0104	0.3711	0.1371	0.0019	0.0086		0.0600	0.0575	0.00154	0.00108	0.00270
ITALY	**Vineyard pruning 2**	783/16	0.0131	0.0004	0.6625	0.0071	0.3483	0.1239	0.0016	0.0074		0.0600	0.0301	0.00149	0.00078	0.00286
ITALY	**Vineyard pruning 3**	784/16	0.0081	0.0011	0.9429	0.0049	0.3479	0.1163	0.0015	0.0064		0.0600	0.0164	0.00141	0.00048	0.00257
ITALY	**Vineyard pruning 4**	249-17	0.0086	0.0004	0.7260	0.0053	0.4950	0.1353	0.0009	0.0116	0.1287	0.0429	0.0825	0.00135	0.00030	0.00244
ITALY	**Vineyard pruning 5**	250-17	0.0133	0.0004	0.7480	0.0078	0.4760	0.1496	0.0011	0.0119	0.1224	0.0442	0.1224	0.00136	0.00071	0.00272
ITALY	**Vineyard pruning 6**	251-17	0.0099	0.0004	0.7140	0.0058	0.5100	0.1360	0.0011	0.0122	0.1360	0.0374	0.0918	0.00150	0.00044	0.00231
ITALY	**Vineyard pruning 7**	252-17	0.0068	0.0004	0.7980	0.0053	0.6080	0.1596	0.0011	0.0148	0.1634	0.0456	0.0988	0.00167	0.00023	0.00323
ITALY	**Vineyard pruning 8**	253-17	0.0075	0.0003	0.6900	0.0048	0.4200	0.1290	0.0010	0.0114	0.1170	0.0360	0.0780	0.00123	0.00027	0.00249
ITALY	**Vineyard pruning 9**	254-17	0.0051	0.0003	0.7360	0.0042	0.4800	0.1440	0.0011	0.0112	0.1280	0.0416	0.0736	0.00128	0.00019	0.00262
ITALY	**Vineyard pruning pellets 1**	785-17	0.0700	0.0011	0.9429	0.0432	0.4185	0.1637	0.0029	0.0140		0.0600	0.2138	0.00197	0.00405	0.00537
ITALY	**Vineyard pruning pellets 2**	82-17	0.0611	0.0011	0.9870	0.0409	0.5640	0.1833	0.0026	0.0188	0.1316	0.0517	0.3149	0.00183	0.00371	0.00611
ITALY	**Vineyard pruning pellets 3**	83-17	0.0611	0.0009	1.0340	0.0390	0.5640	0.1927	0.0027	0.0188	0.1363	0.0517	0.3008	0.00183	0.00371	0.00564
ITALY	**Vineyard pruning pellets 4**	84-17	0.0650	0.0010	1.0500	0.0425	0.6000	0.2000	0.0029	0.0185	0.1400	0.0550	0.3200	0.00175	0.00385	0.00550
ITALY	**Vineyard pruning pellets 5**	85-17	0.0598	0.0009	0.9660	0.0368	0.5520	0.1794	0.0025	0.0175	0.1242	0.0552	0.2852	0.00170	0.00345	0.00552

Country	Biofuel	Original reference	As (mg/kg d.b.)	Cd (mg/kg d.b.)	Cr (mg/kg d.b.)	Cu (mg/kg d.b.)	Hg (mg/kg d.b.)	Ni (mg/kg d.b.)	Pb (mg/kg d.b.)	Zn (mg/kg d.b.)
ITALY	**Almond shells 1**	262/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	2.4	0.001	<1,00(LQ)	<0,60(LQ)	3.7
ITALY	**Almond shells 2**	263/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	3.0	0.001	<1,00(LQ)	<0,60(LQ)	<2,50(LQ)
ITALY	**Almond shells 3**	264/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	1.48	<0.001	<1,00(LQ)	<0,60(LQ)	2.6
ITALY	**Almond shells 4**	265/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	1.70	<0.001	<1,00(LQ)	<0,60(LQ)	2.9
ITALY	**Almond shells 5**	266/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	2.9	0.001	<1,00(LQ)	<0,60(LQ)	5.0
ITALY	**Almond shells 6**	267/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	2.8	0.001	<1,00(LQ)	<0,60(LQ)	6.0
ITALY	**Almond shells 7**	268/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	1.34	0.001	<1,00(LQ)	<0,60(LQ)	4.8
ITALY	**Almond shells 8**	269/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	1.14	0.001	<1,00(LQ)	<0,60(LQ)	4.5
ITALY	**Olive stones 1**	89/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	3.0	0.001	<1,00(LQ)	<0,60(LQ)	<5,00(LQ)
ITALY	**Olive stones 2**	90/17	<0,5(LQ)	<0,1(LQ)	4.5	12.0	0.004	2.7	1.64	6.3
ITALY	**Olive stones 3**	133/17	<0,5(LQ)	<0,1(LQ)	0.69	4.9	0.002	<0,1(LQ)	<0,60(LQ)	8.8
ITALY	**Olive stones 4**	134/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	<1,0(LQ)	0.001	<1,00(LQ)	<0,60(LQ)	<5,00(LQ)
ITALY	**Olive stones 5**	135/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	1.54	0.001	<1,00(LQ)	<0,60(LQ)	162.5
ITALY	**Olive stones 6**	136/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	<1,0(LQ)	<0.001	<1,00(LQ)	<0,60(LQ)	<5,00(LQ)
ITALY	**Olive stones 7**	137/17	<0,5(LQ)	<0,1(LQ)	0.51	<1,0(LQ)	0.001	<1,00(LQ)	<0,60(LQ)	<5,00(LQ)
ITALY	**Olive stones 8**	138/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	<1,0(LQ)	<0.001	<1,00(LQ)	<0,60(LQ)	<5,00(LQ)
ITALY	**Olive stones 9**	139/17	<0,5(LQ)	<0,1(LQ)	<0,13 (LQ)	3.5	0.001	<1,00(LQ)	<0,60(LQ)	<2,50(LQ)
ITALY	**Olive stones 10**	140/17	<0,5(LQ)	<0,1(LQ)	1.79	4.6	0.001	5.0	<0,60(LQ)	<2,50(LQ)
ITALY	**Olive stones 11**	141/17	<0,5(LQ)	<0,1(LQ)	0.69	2.7	0.001	<1,00(LQ)	<0,60(LQ)	<5,00(LQ)
ITALY	**Olive stones 12**	142/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	1.81	<0.001	<1,00(LQ)	<0,60(LQ)	<5,00(LQ)
ITALY	**Olive stones 13**	143/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	2.1	<0.001	<1,00(LQ)	<0,60(LQ)	<5,00(LQ)
ITALY	**Olive stones 14**	144/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	2.0	<0.001	<1,00(LQ)	<0,60(LQ)	<5,00(LQ)
ITALY	**Olive tree pruning 1**	88/17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	3.2	0.002	<1,00(LQ)	<0,60(LQ)	14.0
ITALY	**Olive tree pruning 2**	132/17	<0,5(LQ)	<0,1(LQ)	1.41	21.3	0.002	<1,00(LQ)	<0,60(LQ)	10.6
ITALY	**Olive tree pruning 3**	130/17	<0,5(LQ)	<0,1(LQ)	0.50	14.4	0.002	<1,00(LQ)	<0,60(LQ)	6.5
ITALY	**Olive tree pruning 4**	131/17	<0,5(LQ)	<0,1(LQ)	1.23	27.7	0.002	<1,00(LQ)	<0,60(LQ)	10.3
ITALY	**Olive tree pruning pellets 1**	86-17	<0,5(LQ)	<0,1(LQ)	0.82	3.4	0.004	<1,00(LQ)	<0,60(LQ)	7.3
ITALY	**Olive tree pruning pellets 2**	87-17	<0,5(LQ)	<0,1(LQ)	1.19	4.5	0.007	<1,00(LQ)	<0,60(LQ)	<5,00(LQ)
ITALY	**Vineyard pruning 1**	782/16	<0,78 (LQ)	0.03	2.44	21.4	0.003	1.13	<1,93 (LQ)	27.0
ITALY	**Vineyard pruning 2**	783/16	<0,78 (LQ)	0.02	1.12	17.4	0.002	0.86	<1,93 (LQ)	28.6
ITALY	**Vineyard pruning 3**	784/16	<0,78 (LQ)	0.01	0.80	17.0	0.002	0.77	<1,93 (LQ)	25.7
ITALY	**Vineyard pruning 4**	249-17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	13.8	0.002	<1,00(LQ)	<0,60(LQ)	25.0
ITALY	**Vineyard pruning 5**	250-17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	11.4	0.002	<1,00(LQ)	<0,60(LQ)	31.3
ITALY	**Vineyard pruning 6**	251-17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	8.4	0.002	<1,00(LQ)	<0,60(LQ)	27.5
ITALY	**Vineyard pruning 7**	252-17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	21.0	0.002	<1,00(LQ)	<0,60(LQ)	43.2
ITALY	**Vineyard pruning 8**	253-17	<0,5(LQ)	<0,1(LQ)	1.10	54.5	0.002	<1,00(LQ)	<0,60(LQ)	44.0
ITALY	**Vineyard pruning 9**	254-17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	36.7	0.002	<1,00(LQ)	<0,60(LQ)	38.1
ITALY	**Vineyard pruning pellets 1**	785-17	<0,78 (LQ)	0.04	1.70	26.0	0.003	1.15	<1,93 (LQ)	53.7
ITALY	**Vineyard pruning pellets 2**	82-17	<0,5(LQ)	<0,1(LQ)	1.01	19.9	0.004	0.81	0.87	56.5
ITALY	**Vineyard pruning pellets 3**	83-17	<0,5(LQ)	<0,1(LQ)	1.00	18.5	0.004	0.57	0.71	49.5
ITALY	**Vineyard pruning pellets 4**	84-17	<0,5(LQ)	<0,1(LQ)	3.2	19.1	0.004	1.72	0.99	50.7
ITALY	**Vineyard pruning pellets 5**	85-17	<0,5(LQ)	<0,1(LQ)	1.02	18.4	0.004	0.92	<0,6(LQ)	51.3

Country	Biofuel	Original	SST	DT	HT	FT	Disintegration				Sieving (0.50 mm sieve)				Sintering Index
		reference	(ºC)	(ºC)	(ºC)	(ºC)	800 ºC	1000 ºC	1200 ºC	1400 ºC	800 ºC	1000 ºC	1200 ºC	1400 ºC	
ITALY	**Almond shells 1**	262/17					4	4	4	4	92	100	100	100	0.5
ITALY	**Almond shells 2**	263/17					4	4	4	4	96	100	100	100	0.5
ITALY	**Almond shells 3**	264/17	661	738	750	790	4	4	4	4	101	100	100	100	0.5
ITALY	**Almond shells 4**	265/17	651	723	774	843	4	4	4	4	97	100	100	100	0.5
ITALY	**Almond shells 5**	266/17					4	4	4	4	92	100	100	100	0.5
ITALY	**Almond shells 6**	267/17	648	712	726	736	4	4	4	4	96	100	100	100	0.4
ITALY	**Almond shells 7**	268/17	601	729	742	757	4	4	4	4	99	100	100	100	0.5
ITALY	**Almond shells 8**	269/17					4	4	4	4	94	100	100	100	0.5
ITALY	**Olive stones 1**	89/17	640	1400	1410	1440	1	1	2	4	1	72	87	100	1.0
ITALY	**Olive stones 2**	90/17	710	1160	1180	1200	1	1	4	4	0	2	100	100	1.1
ITALY	**Olive stones 3**	133/17	1000	1230	1270	1290	1	1	2	4	1	92	97	100	0.5
ITALY	**Olive stones 4**	134/17	1160	>1590	>1590	>1590	4	4	4	4	99	93	92	96	1.0
ITALY	**Olive stones 5**	135/17	670	>1590	>1590	>1590	3	4	4	4	85	99	100	98	1.0
ITALY	**Olive stones 6**	136/17	660	>1590	>1590	>1590	3	4	4	4	100	96	96	92	0.8
ITALY	**Olive stones 7**	137/17	690	>1590	>1590	>1590	2	3	3	4	85	103	98	100	0.7
ITALY	**Olive stones 8**	138/17	660	>1590	>1590	>1590	4	4	4	4	90	88	83	100	0.7
ITALY	**Olive stones 9**	139/17	690	>1590	>1590	>1590	4	4	4	4	99	77	82	100	0.8
ITALY	**Olive stones 10**	140/17	690	1370	1370	1430	4	4	4	4	99	102	92	100	1.2
ITALY	**Olive stones 11**	141/17	700	1390	1400	1470	3	4	4	4	90	98	98	98	1.0
ITALY	**Olive stones 12**	142/17	660	>1590	>1590	>1590	4	4	4	4	100	100	100	100	0.6
ITALY	**Olive stones 13**	143/17	660	1220	>1590	>1590	4	4	4	4	94	100	100	100	0.5
ITALY	**Olive stones 14**	144/17	680	>1590	>1590	>1590	4	4	4	4	85	100	100	100	0.5
ITALY	**Olive tree pruning 1**	88/17	710	>1590	>1590	>1590	4	4	4	4	100	100	99	96	2.0
ITALY	**Olive tree pruning 2**	132/17	720	>1590	>1590	>1590	4	4	4	4	95	100	101	99	3.7
ITALY	**Olive tree pruning 3**	130/17	1160	>1590	>1590	>1590	3	4	4	4	85	100	100	98	4.0
ITALY	**Olive tree pruning 4**	131/17	660	>1590	>1590	>1590	1	4	4	4	41	100	101	98	3.7
ITALY	**Olive tree pruning pellets 1**	86-17	710	>1590	>1590	>1590	4	4	4	4	94	100	100	100	3.1
ITALY	**Olive tree pruning pellets 2**	87-17	710	>1590	>1590	>1590	4	4	4	4	96	99	101	100	2.7
ITALY	**Vineyard pruning 1**	782/16	1140	>1590	>1590	>1590	1	4	4	4	51	94	100	100	2.5
ITALY	**Vineyard pruning 2**	783/16	1120	>1590	>1590	>1590	1	4	4	4	33	98	100	100	2.7
ITALY	**Vineyard pruning 3**	784/16	1150	>1590	>1590	>1590	2	4	4	4	75	97	100	99	3.6
ITALY	**Vineyard pruning 4**	249-17					2	3	4	4	92	85	99	100	2.0
ITALY	**Vineyard pruning 5**	250-17					3	4	4	4	99	100	100	98	2.2
ITALY	**Vineyard pruning 6**	251-17					3	4	4	4	96	99	100	99	2.0
ITALY	**Vineyard pruning 7**	252-17					4	2	4	4	88	96	96	96	1.8
ITALY	**Vineyard pruning 8**	253-17					2	1	4	4	77	62	99	99	2.3
ITALY	**Vineyard pruning 9**	254-17					1	1	4	4	25	64	98	97	2.2
ITALY	**Vineyard pruning pellets 1**	785-17	1080	>1590	>1590	>1590	1	1	1	4	3	52	23	89	3.1
ITALY	**Vineyard pruning pellets 2**	82-17					1	3	3	4	27	94	91	98	2.4
ITALY	**Vineyard pruning pellets 3**	83-17					2	3	3	4	71	94	96	98	2.5
ITALY	**Vineyard pruning pellets 4**	84-17					1	3	3	4	41	88	87	99	2.4
ITALY	**Vineyard pruning pellets 5**	85-17					1	3	3	4	44	93	91	95	2.4

Country	Biofuel	Original reference	63 %	45 %	31.5 %	16 %	8 %	3.15 %	2 %	1 %	< 1 %
ITALY	**Almond shells 1**	262/17	0.00	0.00	0.00	74.64	21.46	3.44	0.20	0.16	0.10
ITALY	**Almond shells 2**	263/17	0.00	0.00	0.00	65.21	27.33	6.19	0.51	0.49	0.28
ITALY	**Almond shells 3**	264/17	0.00	0.00	0.00	62.91	28.29	8.10	0.31	0.21	0.17
ITALY	**Almond shells 4**	265/17	0.00	0.00	0.00	67.68	27.14	4.62	0.25	0.19	0.12
ITALY	**Almond shells 5**	266/17	0.00	0.00	0.00	59.06	33.02	6.78	0.49	0.39	0.27
ITALY	**Almond shells 6**	267/17	0.00	0.00	0.00	67.30	26.58	5.43	0.28	0.24	0.17
ITALY	**Almond shells 7**	268/17	0.00	0.00	0.00	61.40	31.68	6.43	0.23	0.13	0.14
ITALY	**Almond shells 8**	269/17	0.00	0.00	0.00	60.19	31.68	7.01	0.45	0.39	0.29
ITALY	**Olive stones 1**	89/17	0.00	0.00	0.00	0.00	0.00	19.82	41.37	36.67	2.14
ITALY	**Olive stones 2**	90/17	0.00	0.00	0.00	0.00	0.00	14.91	21.89	35.59	27.61
ITALY	**Olive stones 3**	133/17	0.00	0.00	0.00	0.00	0.00	32.49	30.63	29.96	6.93
ITALY	**Olive stones 4**	134/17	0.00	0.00	0.00	0.00	0.00	34.01	41.27	24.02	0.70
ITALY	**Olive stones 5**	135/17	0.00	0.00	0.00	0.00	0.00	33.61	39.99	25.20	1.20
ITALY	**Olive stones 6**	136/17	0.00	0.00	0.00	0.00	0.00	25.12	42.98	29.32	2.59
ITALY	**Olive stones 7**	137/17	0.00	0.00	0.00	0.00	0.00	31.15	35.59	29.62	3.64
ITALY	**Olive stones 8**	138/17	0.00	0.00	0.00	0.00	0.00	64.56	23.83	11.12	0.49
ITALY	**Olive stones 9**	139/17	0.00	0.00	0.00	0.00	0.00	65.23	24.19	9.79	0.78
ITALY	**Olive stones 10**	140/17	0.00	0.00	0.00	0.00	0.00	31.98	40.87	26.98	0.17
ITALY	**Olive stones 11**	141/17	0.00	0.00	0.00	0.00	0.00	28.92	40.20	30.70	0.18
ITALY	**Olive stones 12**	142/17	0.00	0.00	0.00	0.00	0.00	46.71	41.21	11.66	0.42
ITALY	**Olive stones 13**	143/17	0.00	0.00	0.00	0.00	0.00	48.05	39.43	11.60	0.92
ITALY	**Olive stones 14**	144/17	0.00	0.00	0.00	0.00	0.00	60.48	33.07	6.15	0.30
ITALY	**Olive tree pruning 1**	88/17	9.66	0.00	6.13	37.67	35.43	10.26	0.53	0.09	0.23
ITALY	**Olive tree pruning 2**	132/17	0.00	0.00	0.26	17.06	33.68	35.56	4.44	5.89	3.11
ITALY	**Olive tree pruning 3**	130/17	1.67	0.00	0.55	16.67	35.07	35.06	3.98	5.02	1.98
ITALY	**Olive tree pruning 4**	131/17	0.00	0.00	0.00	15.09	32.43	30.36	5.54	8.27	8.31
ITALY	**Vineyard pruning 1**	782/16	5.93	0.00	5.83	30.35	25.24	26.31	5.01	1.23	0.11
ITALY	**Vineyard pruning 2**	783/16	5.02	0.00	4.22	27.67	23.41	31.90	5.72	1.94	0.11
ITALY	**Vineyard pruning 3**	784/16	3.14	0.00	6.61	33.18	23.63	27.30	4.72	1.34	0.08
ITALY	**Vineyard pruning 4**	249-17	3.86	0.00	2.11	34.88	24.84	28.30	3.80	1.04	1.18
ITALY	**Vineyard pruning 5**	250-17	6.21	0.28	2.87	38.09	21.55	24.14	4.16	1.22	1.49
ITALY	**Vineyard pruning 6**	251-17	4.33	0.00	1.04	40.03	21.92	26.64	3.90	0.95	1.19
ITALY	**Vineyard pruning 7**	252-17	8.00	0.00	2.31	39.96	21.78	23.54	2.88	0.73	0.80
ITALY	**Vineyard pruning 8**	253-17	4.30	0.00	1.71	33.32	27.89	25.96	4.27	1.11	1.44
ITALY	**Vineyard pruning 9**	254-17	6.90	0.00	2.80	33.96	26.98	24.35	3.10	0.91	0.99

Country	Biofuel	Original reference	Bulk density (kg/m3)	Skin (%	Durability (%)	Length (mm)	Oil (% d.b.)
ITALY	**Almond shells 1**	262/17					2.5
ITALY	**Almond shells 2**	263/17					3.4
ITALY	**Almond shells 3**	264/17					1.9
ITALY	**Almond shells 4**	265/17					3.6
ITALY	**Almond shells 5**	266/17					2.7
ITALY	**Almond shells 6**	267/17					2.2
ITALY	**Almond shells 7**	268/17					4.6
ITALY	**Almond shells 8**	269/17					2.5
ITALY	**Olive stones 1**	89/17		4.7			5.5
ITALY	**Olive stones 2**	90/17		22.3			5.6
ITALY	**Olive stones 3**	133/17		8.4			2.0
ITALY	**Olive stones 4**	134/17		0.8			1.9
ITALY	**Olive stones 5**	135/17		1.2			1.5
ITALY	**Olive stones 6**	136/17		1.3			2.5
ITALY	**Olive stones 7**	137/17		3.6			1.4
ITALY	**Olive stones 8**	138/17		0.4			2.7
ITALY	**Olive stones 9**	139/17		0.9			3.1
ITALY	**Olive stones 10**	140/17		0.3			2.0
ITALY	**Olive stones 11**	141/17		0.5			1.7
ITALY	**Olive stones 12**	142/17		1.1			1.4
ITALY	**Olive stones 13**	143/17		0.8			1.7
ITALY	**Olive stones 14**	144/17		0.8			1.5
ITALY	**Olive tree pruning pellets 1**	86-17	550		97.6	13.9	
ITALY	**Olive tree pruning pellets 2**	87-17	550		96.9	12.8	
ITALY	**Vineyard pruning pellets 1**	785-17	710		99.0	15.1	
ITALY	**Vineyard pruning pellets 2**	82-17	700		99.0	14.2	
ITALY	**Vineyard pruning pellets 3**	83-17	700		98.9	14.6	
ITALY	**Vineyard pruning pellets 4**	84-17	710		98.7	14.5	
ITALY	**Vineyard pruning pellets 5**	85-17	710		98.9	14.5	

➢ 8.2.4 Analytical results of the samples collected in Portugal

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	VM (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
PORTUGAL	**Almond shells**	68-17	13.2	1.8	80.4	49.7	6.2	0.20	0.02	0.01	20.11	17.92	18.76	15.96
PORTUGAL	**Olive Stones 1**	65-17	8.8	0.7	82.2	51.5	6.4	0.20	0.01	0.03	20.89	19.22	19.50	17.57
PORTUGAL	**Olive Stones 2**	66-17	12.4	1.2	79.8	50.4	6.1	0.20	0.02	0.09	20.25	18.02	18.92	16.28
PORTUGAL	**Olive Stones 3**	67-17	7.4	0.5	83.7	50.9	6.2	0.20	0.01	0.01	20.58	19.18	19.23	17.63
PORTUGAL	**Pine nut shells 1**	780-16	12.4	1.8	77.5	52.3	6.3	0.30	0.03	0.12	20.65	18.77	19.28	16.59
PORTUGAL	**Pine nut shells 2**	781-16	11.1	2.1	79.2	52.0	6.2	0.30	0.02	0.01	21.13	19.01	19.28	17.32
PORTUGAL	**Pine nut shells 3**	103-17	14.6	1.20	80.1	47.7	6.1	0.30	0.02	0.02	20.70	19.02	19.37	16.18
PORTUGAL	**Pine nut shells 4**	104-17	13.1	1.30	80.4	50.9	6.0	0.30	0.02	0.02	20.60	18.91	19.29	16.45
PORTUGAL	**Olive tree puning 1**	36-17	31.1	2.1	83.5	48.1	6.1	0.30	0.02	0.01	19.08	17.72	17.75	11.47
PORTUGAL	**Olive tree puning 2**	37-17	21.3	4.8	80.6	49.3	6.5	1.30	0.10	0.03	20.30	19.12	18.89	14.35
PORTUGAL	**Olive tree puning 3**	38-17	27.4	1.7	83.9	47.9	6.3	0.30	0.02	0.01	19.22	18.01	17.85	12.29
PORTUGAL	**Olive tree puning 4**	39-17	24.6	1.8	82.7	47.8	6.2	0.40	0.03	0.03	19.21	18.08	17.86	12.87
PORTUGAL	**Olive tree puning 5**	40-17	36.1	3.8	80.9	49.2	6.4	0.97	0.09	0.03	20.09	18.72	18.70	11.06
PORTUGAL	**Olive tree puning 6**	100-17	27.6	5.6	78.9	48.9	6.4	1.38	0.11	0.10	19.94	18.49	18.55	12.76
PORTUGAL	**Olive tree puning 7**	101-17	19.9	3.8	80.4	48.6	6.1	0.58	0.05	0.03	19.54	18.19	18.22	14.11
PORTUGAL	**Olive tree puning 8**	102-17	23.8	4.1	81.0	49.7	6.4	1.20	0.10	0.03	20.48	18.90	19.08	13.95
PORTUGAL	**Vineyard pruning 1**	28-17	37.8	2.3	79.9	47.7	6.1	0.70	0.05	0.01	18.84	17.43	17.52	9.97
PORTUGAL	**Vineyard pruning 2**	29-17	40.1	3.2	77.7	47.7	6.0	0.50	0.04	0.01	18.87	17.30	17.56	9.54
PORTUGAL	**Vineyard pruning 3**	30-17	40.8	3.0	78.4	47.3	6.1	0.60	0.05	0.00	18.85	17.50	15.53	9.38
PORTUGAL	**Vineyard pruning 4**	31-17	39.9	2.7	78.8	47.2	6.1	0.50	0.05	0.02	18.78	17.43	17.45	9.51
PORTUGAL	**Vineyard pruning 5**	32-17	39.3	2.4	79.2	47.6	6.1	0.50	0.05	0.01	18.78	16.88	17.45	9.64
PORTUGAL	**Vineyard pruning 6**	33-17	47.2	4.2	76.6	47.0	6.1	0.60	0.05	0.02	18.54	16.74	17.21	7.93
PORTUGAL	**Vineyard pruning 7**	34-17	38.3	3.4	78.6	47.3	6.0	0.60	0.05	0.02	18.71	17.40	17.40	9.80
PORTUGAL	**Vineyard pruning 8**	35-17	36.0	2.7	78.3	48.3	6.1	0.70	0.05	0.01	19.04	17.73	17.71	10.46
PORTUGAL	**Vineyard pruning 9**	91-17	32.7	3.1	77.5	47.1	6.0	0.70	0.05	0.06	18.92	17.71	17.62	11.05
PORTUGAL	**Vineyard pruning 10**	92-17	22.9	2.8	77.9	47.5	6.0	0.50	0.04	0.05	18.90	17.81	17.60	13.00
PORTUGAL	**Vineyard pruning 11**	93-17	24.1	2.8	77.9	47.6	5.9	0.60	0.04	0.03	19.25	18.00	17.96	13.04
PORTUGAL	**Vineyard pruning 12**	94-17	33.3	4.5	75.5	46.5	5.9	0.60	0.05	0.05	18.24	17.05	16.95	10.49
PORTUGAL	**Vineyard pruning 13**	95-17	29.0	3.2	76.6	47.3	5.9	0.70	0.05	0.05	18.80	17.57	17.51	11.72
PORTUGAL	**Vineyard pruning 14**	96-17	27.6	3.2	77.0	47.2	5.9	0.60	0.06	0.03	19.84	18.03	18.55	12.87
PORTUGAL	**Vineyard pruning 15**	97-17	16.6	3.1	77.7	48.1	6.0	0.70	0.07	0.01	19.04	17.80	17.73	14.38
PORTUGAL	**Vineyard pruning 16**	98-17	15.1	3.5	77.3	47.7	6.0	0.70	0.01	0.01	18.89	17.74	17.58	14.56
PORTUGAL	**Vineyard pruning 17**	99-17	11.4	3.2	78.5	47.6	6.0	0.60	0.02	<0,01(LQ)	19.00	17.67	17.69	15.39
PORTUGAL	**Vineyard pruning 18**	248-17	19.7	3.6	76.4	48.0	6.0	0.80	0.06	0.03	18.92	17.66	17.62	13.67
PORTUGAL	**Wallnut shells 1**	778-16	11.3	1.5	81.2	53.0	6.7	0.80	0.04	0.01	22.22	20.65	20.77	18.15
PORTUGAL	**Wallnut shells 2**	779-16	10.1	1.6	82.0	52.5	6.7	0.80	0.05	0.01	22.45	20.50	21.00	18.63

Country	Biofuel	Original reference	Al (% d.b.)	Ba (% d.b.)	Ca (% d.b.)	Fe (% d.b.)	K (% d.b.)	Mg (% d.b.)	Mn (% d.b.)	Na (% d.b.)	S (% d.b.)	Si (% d.b.)	Sr (% d.b.)	Ti (% d.b.)	Zn (% d.b.)
PORTUGAL	**Almond shells**	68-17	0.0072	0.0004	0.0625	0.0032	0.2859	0.0204	0.0005	0.0046	0.0200	0.0228	0.00037	0.00029	0.00023
PORTUGAL	**Olive Stones 1**	65-17	0.0070	0.0001	0.0797	0.0244	0.1672	0.0099	0.0005	0.0142	0.0100	0.0456	0.00013	0.00031	0.00048
PORTUGAL	**Olive Stones 2**	66-17	0.0024	0.0001	0.0706	0.0038	0.2808	0.0101	0.0003	0.0347	0.0200	0.0036	0.00023	0.00012	0.00025
PORTUGAL	**Olive Stones 3**	67-17	0.0031	0.0001	0.0619	0.0028	0.0777	0.0110	0.0004	0.0030	0.0100	0.0117	0.00018	0.00020	0.00012
PORTUGAL	**Pine nut shells 1**	780-16	0.0065	0.0000	0.0298	0.0031	0.0861	0.0305	0.0012	0.0464	0.0300	0.4098	0.00009	0.00006	0.00068
PORTUGAL	**Pine nut shells 2**	781-16	0.0067	0.0000	0.0344	0.0041	0.0483	0.0317	0.0011	0.0059	0.0200	0.4094	0.00009	0.00006	0.00080
PORTUGAL	**Vineyard pruning 1**	28-17	0.0033	0.0002	0.6350	0.0032	0.1993	0.1673	0.0019	0.0025	0.0500	0.0081	0.00129	0.00030	0.00193
PORTUGAL	**Vineyard pruning 2**	29-17	0.0121	0.0011	0.9176	0.0070	0.4471	0.1365	0.0049	0.0029	0.0400	0.0346	0.00543	0.00076	0.00482
PORTUGAL	**Vineyard pruning 3**	30-17	0.0045	0.0005	0.7420	0.0051	0.4249	0.1804	0.0016	0.0118	0.0500	0.0082	0.00538	0.00029	0.00287
PORTUGAL	**Vineyard pruning 4**	31-17	0.0017	0.0011	0.6041	0.0048	0.3802	0.1978	0.0015	0.0068	0.0500	0.0082	0.00068	0.00015	0.00161
PORTUGAL	**Vineyard pruning 5**	32-17	0.0014	0.0011	0.6078	0.0066	0.3164	0.1506	0.0017	0.5098	0.0500	0.0084	0.00082	0.00012	0.00165
PORTUGAL	**Vineyard pruning 6**	33-17	0.0031	0.0010	1.0029	0.0039	0.6070	0.1199	0.0009	0.0093	0.0500	0.0054	0.00234	0.00022	0.00215
PORTUGAL	**Vineyard pruning 7**	34-17	0.0034	0.0878	0.9885	0.0039	0.4200	0.0878	0.0014	0.0086	0.0500	0.0011	0.00268	0.00027	0.00241
PORTUGAL	**Vineyard pruning 8**	35-17	0.0026	0.0004	0.6010	0.0043	0.3722	0.1453	0.0010	0.0108	0.0500	0.0010	0.00131	0.00022	0.00252
PORTUGAL	**Wallnut shells 1**	778-16	0.0033	0.0005	0.3213	0.0027	0.2013	0.0859	0.0020	0.0031	0.0400	0.0008	0.00070	0.00024	0.00120
PORTUGAL	**Wallnut shells 2**	779-16	0.0054	0.0004	0.2964	0.0020	0.1689	0.0715	0.0019	0.0039	0.0500	0.0040	0.00064	0.00014	0.00110

Country	Biofuel	Original reference	As (mg/kg d.b.)	Cd (mg/kg d.b.)	Cr (mg/kg d.b.)	Cu (mg/kg d.b.)	Hg (mg/kg d.b.)	Ni (mg/kg d.b.)	Pb (mg/kg d.b.)	Zn (mg/kg d.b.)
PORTUGAL	**Almond shells**	68-17	<0,78 (LQ)	0.06	0.49	3.5	0.001	0.33	<1,93 (LQ)	2.3
PORTUGAL	**Olive Stones 1**	65-17	<0,78 (LQ)	<0,01 (L.Q)	1.46	4.7	0.001	0.85	<1,93 (LQ)	4.8
PORTUGAL	**Olive Stones 2**	66-17	<0,78 (LQ)	0.04	0.04	3.2	0.001	0.31	<1,93 (LQ)	2.5
PORTUGAL	**Olive Stones 3**	67-17	<0,78 (LQ)	0.05	0.04	4.3	0.001	0.60	<1,93 (LQ)	1.23
PORTUGAL	**Pine nut shells 1**	780-16	<0,78 (LQ)	0.04	3.6	2.3	0.005	1.8	<1,93 (LQ)	6.8
PORTUGAL	**Pine nut shells 2**	781-16	<0,78 (LQ)	0.01	3.5	2.5	0.005	2.1	<1,93 (LQ)	8.0
PORTUGAL	**Pine nut shells 3**	103-17		<0,5(LQ)	<0,1(LQ)	0.45	0.003	<1,00(LQ)	<0,60(LQ)	17.1
PORTUGAL	**Pine nut shells 4**	104-17		<0,5(LQ)	<0,1(LQ)	1.07	0.004	<1,00(LQ)	<0,60(LQ)	8.0
PORTUGAL	**Olive tree puning 1**	36-17					0.001			
PORTUGAL	**Olive tree puning 2**	37-17					0.017			
PORTUGAL	**Olive tree puning 3**	38-17					0.001			
PORTUGAL	**Olive tree puning 4**	39-17					0.002			
PORTUGAL	**Olive tree puning 5**	40-17					0.017			
PORTUGAL	**Olive tree puning 6**	100-17		<0,1 (LQ)	<0,3 (LQ)	9.2	0.015		<0,60 (LQ)	
PORTUGAL	**Olive tree puning 7**	101-17		<0,1 (LQ)	0.42	49.2	0.006		<0,60 (LQ)	
PORTUGAL	**Olive tree puning 8**	102-17		<0,1 (LQ)	0.30	6.6	0.017	2.4	<0,60 (LQ)	
PORTUGAL	**Vineyard pruning 1**	28-17	<0,78(L.Q)	<0,01(L.Q)	0.71	4.2	0.002	0.37	<1,93(L.Q)	19.3
PORTUGAL	**Vineyard pruning 2**	29-17	<0,78(L.Q)	0.02	1.49	6.6	0.001	1.22	<1,93(L.Q)	48.2
PORTUGAL	**Vineyard pruning 3**	30-17	<0,78(L.Q)	<0,01(L.Q)	7.1	6.6	0.001	3.5	<1,93(L.Q)	28.7
PORTUGAL	**Vineyard pruning 4**	31-17	<0,78(L.Q)	<0,01(L.Q)	9.0	16.5	0.001	4.0	<1,93(L.Q)	16.1
PORTUGAL	**Vineyard pruning 5**	32-17	<0,78(L.Q)	<0,01(L.Q)	13.3	17.7	0.001	6.1	<1,93(L.Q)	16.5
PORTUGAL	**Vineyard pruning 6**	33-17	<0,78(L.Q)	<0,01(L.Q)	4.7	22.4	0.001	2.9	<1,93(L.Q)	21.5
PORTUGAL	**Vineyard pruning 7**	34-17	<0,78(L.Q)	<0,01(L.Q)	4.0	19.4	0.001	2.2	<1,93(L.Q)	24.1
PORTUGAL	**Vineyard pruning 8**	35-17	<0,78(L.Q)	<0,01(L.Q)	5.4	7.1	0.001	2.9	<1,93(L.Q)	25.2
PORTUGAL	**Vineyard pruning 9**	91-17	<0,5(LQ)	<0,01(L.Q)	<0,30(LQ)	10.4	0.001	<1,00(LQ)	<0,6(LQ)	15.8
PORTUGAL	**Vineyard pruning 10**	92-17	<0,5(LQ)	<0,01(L.Q)	<0,30(LQ)	6.4	0.002	<1,00(LQ)	<0,6(LQ)	63.6
PORTUGAL	**Vineyard pruning 11**	93-17	<0,5(LQ)	<0,01(L.Q)	<0,30(LQ)	4.7	0.002	<1,00(LQ)	<0,6(LQ)	26.6
PORTUGAL	**Vineyard pruning 12**	94-17	<0,5(LQ)	<0,01(L.Q)	<0,30(LQ)	5.3	0.001	<1,00(LQ)	<0,6(LQ)	28.8
PORTUGAL	**Vineyard pruning 13**	95-17	<0,5(LQ)	<0,01(L.Q)	<0,30(LQ)	13.8	0.002	<1,00(LQ)	<0,6(LQ)	41.6
PORTUGAL	**Vineyard pruning 14**	96-17	<0,5(LQ)	<0,01(L.Q)	<0,30(LQ)	15.5	0.001	<1,00(LQ)	<0,6(LQ)	13.8
PORTUGAL	**Vineyard pruning 15**	97-17	<0,5(LQ)	<0,01(L.Q)	0.39	29.9	0.001	<1,00(LQ)	<0,6(LQ)	51.3
PORTUGAL	**Vineyard pruning 16**	98-17	<0,5(LQ)	<0,01(L.Q)	<0,30(LQ)	28.3	0.001	<1,00(LQ)	<0,6(LQ)	66.1
PORTUGAL	**Vineyard pruning 17**	99-17	<0,5(LQ)	<0,01(L.Q)	<0,30(LQ)	4.6	0.002	<1,00(LQ)	<0,6(LQ)	17.4
PORTUGAL	**Vineyard pruning 18**	248-17	<0,5(LQ)	<0,1(LQ)	<0,30(LQ)	4.7	0.001	<1,00(LQ)	<0,6(LQ)	115.2
PORTUGAL	**Wallnut shells 1**	778-16	<0,78 (LQ)	0.01	0.48	7.22	0.001	1.1	<1,93 (LQ)	12.0
PORTUGAL	**Wallnut shells 2**	779-16	<0,78 (LQ)	0.01	0.37	6.5	<0.001	0.9	<1,93 (LQ)	11.0

Country	Biofuel	Original reference	SST (°C)	DT (°C)	HT (°C)	FT (°C)	Disintegration 800 °C	1000 °C	1200 °C	1400 °C	Sieving (0.50 mm sieve) 800 °C	1000 °C	1200 °C	1400 °C	Sintering Index
PORTUGAL	**Almond shells**	68-17	750	1280	1290	1310	4	4	4	4	82	100	100	100	0.3
PORTUGAL	**Olive Stones 1**	65-17	660	1470	1480	1500	4	4	4	4	94	100	100	100	0.6
PORTUGAL	**Olive Stones 2**	66-17	590	762	840	1100	4	4	4	4	100	100	100	100	0.3
PORTUGAL	**Olive Stones 3**	67-17	710	>1590	>1590	>1590	3	4	4	4	98	94	100	100	1.1
PORTUGAL	**Pine nut shells 1**	780-16	610	800	880	1040	4	4	4	4	100	98	100	100	0.6
PORTUGAL	**Pine nut shells 2**	781-16	660	1010	1220	1300	3	4	4	4	90	99	99	100	1.5
PORTUGAL	**Pine nut shells 3**	103-17					1	4	4	4	39	98	95	100	
PORTUGAL	**Pine nut shells 4**	104-17					1	4	4	4	38	99	94	100	
PORTUGAL	**Olive tree puning 1**	36-17	798	1588	1588	1588	1	4	4	4	39	99	99	100	
PORTUGAL	**Olive tree puning 2**	37-17	695	1588	1588	1588	3	4	4	4	95	98	99	100	
PORTUGAL	**Olive tree puning 3**	38-17	706	1588	1588	1588	3	4	4	4	89	99	97	99	
PORTUGAL	**Olive tree puning 4**	39-17	704	1588	1588	1588	4	4	4	4	97	95	96	99	
PORTUGAL	**Olive tree puning 5**	40-17	735.5	1588	1588	1588	1	4	4	4	86	97	99	97	
PORTUGAL	**Olive tree puning 6**	100-17	674	1480	1588	1588	4	4	4	4	99	99	99	94	
PORTUGAL	**Olive tree puning 7**	101-17					4	4	4	4	100	99	99	98	
PORTUGAL	**Olive tree puning 8**	102-17					4	4	4	4	97	96	98	95	
PORTUGAL	**Vineyard pruning 1**	28-17	1090	>1590	>1590	>1590	1	3	2	4	40	94	79	85	4.8
PORTUGAL	**Vineyard pruning 2**	29-17	880	>1590	>1590	>1590	1	4	3	4	62	96	93	97	2.8
PORTUGAL	**Vineyard pruning 3**	30-17	1140	>1590	>1590	>1590	1	4	4	4	48	98	90	94	2.5
PORTUGAL	**Vineyard pruning 4**	31-17	1180	>1590	>1590	>1590	3	4	4	4	93	94	89	92	2.5
PORTUGAL	**Vineyard pruning 5**	32-17	920	>1590	>1590	>1590	4	4	4	4	101	100	87	100	1.0
PORTUGAL	**Vineyard pruning 6**	33-17	710	>1590	>1590	>1590	4	4	4	4	99	99	98	100	2.2
PORTUGAL	**Vineyard pruning 7**	34-17	720	>1590	>1590	>1590	4	4	4	4	99	100	99	100	3.0
PORTUGAL	**Vineyard pruning 8**	35-17	870	>1590	>1590	>1590	1	4	4	4	45	94	98	100	2.4
PORTUGAL	**Vineyard pruning 9**	91-17					4	4	4	4	98	98	97	100	
PORTUGAL	**Vineyard pruning 10**	92-17	685	1525	1588	1588	4	4	4	4	100	99	97	98	
PORTUGAL	**Vineyard pruning 11**	93-17					4	4	4	4	99	95	99	96	
PORTUGAL	**Vineyard pruning 12**	94-17					4	4	4	4	99	98	98	92	
PORTUGAL	**Vineyard pruning 13**	95-17					4	4	4	4	99	97	96	98	
PORTUGAL	**Vineyard pruning 14**	96-17					4	4	4	4	99	94	100	96	
PORTUGAL	**Vineyard pruning 15**	97-17					4	4	4	4	100	91	95	90	
PORTUGAL	**Vineyard pruning 16**	98-17					4	4	4	4	100	99	99	96	
PORTUGAL	**Vineyard pruning 17**	99-17					1	4	4	4	80	100	100	99	
PORTUGAL	**Vineyard pruning 18**	248-17					4	4	4	4	98	101	97	97	
PORTUGAL	**Wallnut shells 1**	778-16	1130	1590	>1590	>1590	1	1	1	1	0	51	11	16	2.4
PORTUGAL	**Wallnut shells 2**	779-16	1110	1590	>1590	>1590	2	1	1	1	46	18	43	49	2.6

Country	Biofuel	Original reference	Oil (% d.b.)	63 %	45 %	31.5 %	16 %	8 %	3.15 %	2 %	1 %	< 1 %
PORTUGAL	**Almond shells**	68-17	1.96				45.29	50.13	3.65	0.35	0.39	0.20
PORTUGAL	**Olive Stones 1**	65-17	1.31	0	0	0.00	0.00	0.00	20.19	42.72	34.05	3.04
PORTUGAL	**Olive Stones 2**	66-17	0.10	0	0	0.00	0.00	0.00	25.55	37.43	35.86	1.15
PORTUGAL	**Olive Stones 3**	67-17	0.45	0	0	0.00	0.00	0.00	22.88	50.70	24.58	1.84
PORTUGAL	**Pine nut shells 1**	780-16	0.11	0	0	0.00	0.00	91.01	8.91	0.05	0.02	0.01
PORTUGAL	**Pine nut shells 2**	781-16	0.11	0	0	0.00	0.00	68.54	30.62	0.50	0.30	0.04
PORTUGAL	**Pine nut shells 3**	103-17	1.4									
PORTUGAL	**Pine nut shells 4**	104-17	0.9									
PORTUGAL	**Olive tree puning 1**	36-17		100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PORTUGAL	**Olive tree puning 2**	37-17		100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PORTUGAL	**Olive tree puning 3**	38-17		100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PORTUGAL	**Olive tree puning 4**	39-17		100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PORTUGAL	**Olive tree puning 5**	40-17		100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PORTUGAL	**Olive tree puning 6**	100-17		100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PORTUGAL	**Olive tree puning 7**	101-17		100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PORTUGAL	**Olive tree puning 8**	102-17		100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PORTUGAL	**Vineyard pruning 1**	28-17		100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PORTUGAL	**Vineyard pruning 2**	29-17		100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PORTUGAL	**Vineyard pruning 7**	34-17		100	0	0	0	0	0	0	0	0
PORTUGAL	**Vineyard pruning 8**	35-17		100	0	0	0	0	0	0	0	0
PORTUGAL	**Wallnut shells 1**	778-16	10.03	0	0	8.05	61.23	25.59	4.56	0.17	0.24	0.17
PORTUGAL	**Wallnut shells 2**	779-16	10.79	0	0	11.14	66.53	17.89	3.57	0.22	0.36	0.28

8.2.5 Analytical results of the samples collected in Slovenia

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	VM (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
SLOVENIA	**Olive stones 1**	B20170104BSDSFI1	14.1	0.4	77.1	52.0	7.0	0.21	0.010	0.030	20.23	17.39	18.73	15.75
SLOVENIA	**Olive stones 2**	B20170104BSDSFI2	14.1	0.4	77.0	51.3	8.3	0.23	0.010	0.030	20.11	17.27	18.31	15.38
SLOVENIA	**Olive stones 3**	B20170104BSDSFI3	14.2	0.4	77.3	51.2	8.2	0.40	0.020	0.020	19.81	17.00	18.03	15.13
SLOVENIA	**Olive stones 4**	B20170104BSDSFI4	13.9	0.4	77.3	51.1	7.5	0.22	0.010	0.010	20.04	17.25	18.42	15.52
SLOVENIA	**Olive tree pruning 1**	B20170502SLOV18	29.7	3.6	79.0	48.4	6.1	1.47	0.070	0.050	19.42	13.65	18.09	11.99
SLOVENIA	**Olive tree pruning 2**	B20170502SLOV19	43.1	4.6	78.8	47.9	6.0	0.97	0.050	0.040	19.34	11.00	18.02	9.20
SLOVENIA	**Olive tree pruning 3**	B20170502SLOV20	21.0	4.0	79.0	48.4	6.4	1.23	0.050	0.070	19.37	15.30	17.58	13.69
SLOVENIA	**Olive tree pruning 4**	B20170502SLOV21	23.3	4.3	79.8	49.2	6.5	1.65	0.070	0.070	19.54	14.99	18.12	13.33
SLOVENIA	**Olive tree pruning 5**	B20170502SLOV22	20.5	3.6	78.2	47.7	6.2	1.08	0.040	0.020	19.38	15.41	18.05	13.85
SLOVENIA	**Olive tree pruning 6**	B20170502SLOV23	40.5	4.0	79.2	47.7	6.5	1.25	0.060	0.050	19.67	11.71	18.27	9.88
SLOVENIA	**Olive tree pruning 7**	B20170502SLOV24	17.6	4.0	78.8	47.6	6.4	0.91	0.050	0.040	19.39	15.97	17.99	14.39
SLOVENIA	**Olive tree pruning 8**	B20170502SLOV25	16.7	4.2	78.1	48.7	6.4	1.39	0.070	0.030	19.64	16.36	18.24	14.78
SLOVENIA	**Olive tree pruning 9**	B20170502SLOV26	13.0	3.6	79.5	49.2	6.5	1.12	0.050	0.030	20.03	17.43	18.63	15.89
SLOVENIA	**Olive tree pruning 10**	B20170502SLOV27	17.3	4.4	78.3	48.9	6.4	1.44	0.080	0.030	19.75	16.34	18.37	14.77
SLOVENIA	**Vineyard pruning 1**	B20170502SLOV1	50.0	3.3	77.6	54.0	5.9	1.52	0.050	0.010	18.78	9.39	17.49	7.53
SLOVENIA	**Vineyard pruning 2**	B20170502SLOV2	50.0	3.2	76.7	48.7	4.9	1.38	0.040	0.010	18.66	9.33	17.59	7.57
SLOVENIA	**Vineyard pruning 3**	B20170502SLOV3	50.0	3.3	76.7	48.9	6.1	1.17	0.040	0.030	18.85	9.42	17.53	7.54
SLOVENIA	**Vineyard pruning 4**	B20170502SLOV4	50.0	4.3	75.9	47.8	5.8	1.40	0.150	n.d.	18.44	9.22	17.18	7.37
SLOVENIA	**Vineyard pruning 5**	B20170502SLOV5	50.0	4.1	76.0	47.8	5.9	1.34	0.090	0.010	18.51	9.26	17.22	7.39
SLOVENIA	**Vineyard pruning 6**	B20170502SLOV6	50.0	3.4	76.9	48.2	6.5	1.53	0.040	0.010	18.75	9.38	17.34	7.45
SLOVENIA	**Vineyard pruning 7**	B20170502SLOV7	50.0	3.3	76.8	48.9	6.5	1.33	0.050	0.040	18.79	9.40	17.38	7.47
SLOVENIA	**Vineyard pruning 8**	B20170502SLOV8	50.0	2.9	76.2	48.8	6.4	1.06	0.040	0.020	18.84	9.42	17.45	7.50
SLOVENIA	**Vineyard pruning 9**	B20170502SLOV9	50.0	3.3	76.4	49.0	6.7	1.47	0.040	0.010	18.75	9.38	17.31	7.43
SLOVENIA	**Vineyard pruning 10**	B20170502SLOV10	50.0	3.3	77.2	49.1	6.6	1.05	0.030	0.010	18.64	9.32	17.21	7.39
SLOVENIA	**Vineyard pruning 11**	B20170502SLOV11	50.0	3.3	76.4	49.0	6.5	1.10	0.050	0.090	18.76	9.38	17.35	7.46
SLOVENIA	**Vineyard pruning 12**	B20170502SLOV12	50.0	3.2	76.7	48.3	6.0	0.62	0.040	0.030	18.74	9.37	17.44	7.50
SLOVENIA	**Vineyard pruning 13**	B20170502SLOV13	50.0	3.1	77.2	48.7	5.9	0.86	0.050	0.030	18.71	9.35	17.42	7.49
SLOVENIA	**Vineyard pruning 14**	B20170502SLOV14	50.0	3.1	77.0	48.4	5.7	0.96	0.050	0.030	18.87	9.44	17.63	7.59
SLOVENIA	**Vineyard pruning 15**	B20170502SLOV15	50.0	3.1	76.7	48.2	5.8	0.85	0.030	0.020	18.95	9.47	17.68	7.62
SLOVENIA	**Vineyard pruning 16**	B20170502SLOV16	50.0	3.6	78.1	47.4	5.6	1.09	0.150	n.d.	18.85	9.43	17.63	7.60
SLOVENIA	**Vineyard pruning 17**	7	50.0	3.8	74.8	47.8	5.7	1.08	0.040	0.010	19.92	9.96	18.69	8.12

Country	Biofuel	Original reference	Al (% d.b.)	Ca (% d.b.)	Fe (% d.b.)	K (% d.b.)	Mg (% d.b.)	Mn (% d.b.)	Na (% d.b.)	Si (% d.b.)	Ti (% d.b.)	Zn (% d.b.)
SLOVENIA	**Olive stones 1**	B20170104BSDSFI1	0.0074	0.0762	0.0016	0.0834	0.0089	0.0004	0.0045	0.0149	0.00020	0.00000
SLOVENIA	**Olive stones 2**	B20170104BSDSFI2	0.0088	0.0772	0.0025	0.0826	0.0087	0.0004	0.0047	0.0187	0.00024	0.00000
SLOVENIA	**Olive stones 3**	B20170104BSDSFI3	0.0075	0.0688	0.0014	0.0671	0.0075	0.0004	0.0060	0.0221	0.00024	0.00000
SLOVENIA	**Olive stones 4**	B20170104BSDSFI4	0.0078	0.0597	0.0012	0.0799	0.0086	0.0004	0.0055	0.0329	0.00028	0.00000
SLOVENIA	**Olive tree pruning 1**	B20170502SLOV18	0.0670	0.3294	0.0090	0.5731	0.0731	0.0018	0.1670	0.4050	0.00180	0.00003
SLOVENIA	**Olive tree pruning 2**	B20170502SLOV19	0.0676	0.5764	0.0078	0.5883	0.0644	0.0009	0.0837	0.4867	0.00276	0.00000
SLOVENIA	**Olive tree pruning 3**	B20170502SLOV20	0.0500	0.4660	0.0100	0.5984	0.0676	0.0016	0.0684	0.4444	0.00200	0.00000
SLOVENIA	**Olive tree pruning 4**	B20170502SLOV21	0.0585	0.4485	0.0120	0.5633	0.0619	0.0017	0.0839	0.5405	0.00258	0.00000
SLOVENIA	**Olive tree pruning 5**	B20170502SLOV22	0.0508	0.4403	0.0068	0.6185	0.0468	0.0014	0.0594	0.4187	0.00216	0.00004
SLOVENIA	**Olive tree pruning 6**	B20170502SLOV23	0.0928	0.3788	0.0080	0.7092	0.0440	0.0020	0.1996	0.4344	0.00200	0.00000
SLOVENIA	**Olive tree pruning 7**	B20170502SLOV24	0.0944	0.2740	0.0072	0.6376	0.0440	0.0008	0.1676	0.5484	0.00160	0.00000
SLOVENIA	**Olive tree pruning 8**	B20170502SLOV25	0.0815	0.3402	0.0046	0.6779	0.0395	0.0013	0.1126	0.5813	0.00210	0.00000
SLOVENIA	**Olive tree pruning 9**	B20170502SLOV26	0.0860	0.2833	0.0094	0.5749	0.0353	0.0018	0.1260	0.4626	0.00144	0.00000
SLOVENIA	**Olive tree pruning 10**	B20170502SLOV27	0.0739	0.3700	0.0057	0.7168	0.0471	0.0013	0.1329	0.5984	0.00176	0.00007
SLOVENIA	**Vineyard pruning 1**	B20170502SLOV1	0.0399	0.2333	0.0092	0.3224	0.1231	0.0050	0.0868	0.3389	0.00066	0.00000
SLOVENIA	**Vineyard pruning 2**	B20170502SLOV2	0.0272	0.2746	0.0061	0.3370	0.1206	0.0074	0.0925	0.3424	0.00064	0.00013
SLOVENIA	**Vineyard pruning 3**	B20170502SLOV3	0.0320	0.3683	0.0043	0.3307	0.1046	0.0023	0.0749	0.3419	0.00033	0.00000
SLOVENIA	**Vineyard pruning 4**	B20170502SLOV4	0.0426	0.5349	0.0052	0.3836	0.1290	0.0030	0.1079	0.3827	0.00043	0.00000
SLOVENIA	**Vineyard pruning 5**	B20170502SLOV5	0.0447	0.4256	0.0078	0.3387	0.1570	0.0037	0.0828	0.3780	0.00082	0.00000
SLOVENIA	**Vineyard pruning 6**	B20170502SLOV6	0.0435	0.2968	0.0102	0.3947	0.0983	0.0051	0.0874	0.3611	0.00068	0.00000
SLOVENIA	**Vineyard pruning 7**	B20170502SLOV7	0.0515	0.2109	0.0066	0.4323	0.1086	0.0066	0.1251	0.3548	0.00033	0.00000
SLOVENIA	**Vineyard pruning 8**	B20170502SLOV8	0.0267	0.2268	0.0052	0.2859	0.0806	0.0017	0.0716	0.3924	0.00058	0.00007
SLOVENIA	**Vineyard pruning 9**	B20170502SLOV9	0.0597	0.2762	0.0076	0.5399	0.0726	0.0026	0.1422	0.3719	0.00066	0.00000
SLOVENIA	**Vineyard pruning 10**	B20170502SLOV10	0.0465	0.2924	0.0063	0.5775	0.0746	0.0043	0.1000	0.3544	0.00132	0.00000
SLOVENIA	**Vineyard pruning 11**	B20170502SLOV11	0.0587	0.2429	0.0149	0.5742	0.1066	0.0023	0.0812	0.3812	0.00099	0.00000
SLOVENIA	**Vineyard pruning 12**	B20170502SLOV12	0.0323	0.3123	0.0042	0.5309	0.0874	0.0016	0.0726	0.3338	0.00064	0.00000
SLOVENIA	**Vineyard pruning 13**	B20170502SLOV13	0.0660	0.2381	0.0081	0.5298	0.1135	0.0019	0.1376	0.3317	0.00031	0.00000
SLOVENIA	**Vineyard pruning 14**	B20170502SLOV14	0.0626	0.1848	0.0127	0.5487	0.1017	0.0019	0.1073	0.3227	0.00062	0.00000
SLOVENIA	**Vineyard pruning 15**	B20170502SLOV15	0.0750	0.1826	0.0118	0.5155	0.1035	0.0019	0.0936	0.3404	0.00062	0.00000
SLOVENIA	**Vineyard pruning 16**	B20170502SLOV16	0.0450	0.1948	0.0040	0.7384	0.1447	0.0148	0.0292	0.3744	0.00072	0.00033
SLOVENIA	**Vineyard pruning 17**	7	0.0608	0.3747	0.0084	0.5749	0.0821	0.0015	0.0768	0.3952	0.00076	0.00000

Country	Biofuel	Original reference	As (mg/kg d.b.)	Cd (mg/kg d.b.)	Cr (mg/kg d.b.)	Cu (mg/kg d.b.)	Hg (mg/kg d.b.)	Ni (mg/kg d.b.)	Pb (mg/kg d.b.)	Zn (mg/kg d.b.)
SLOVENIA	**Olive stones 1**	B20170104BSDSFI1	0.0	0.0	0.3	1.9	<0.001	0.2	0.1	1.3
SLOVENIA	**Olive stones 2**	B20170104BSDSFI2	0.0	0.0	0.4	2.1	<0.001	0.2	0.0	1.2
SLOVENIA	**Olive stones 3**	B20170104BSDSFI3	0.0	0.0	0.3	2.1	<0.001	0.1	0.0	0.8
SLOVENIA	**Olive stones 4**	B20170104BSDSFI4	0.0	0.0	0.3	1.9	<0.001	0.2	0.0	1.6
SLOVENIA	**Olive tree pruning 1**	B20170502SLOV18	0.0	0.0	1.3	23.2	0.012	0.8	0.0	7.4
SLOVENIA	**Olive tree pruning 2**	B20170502SLOV19	0.0	0.0	1.0	3.9	0.010	0.9	0.0	9.8
SLOVENIA	**Olive tree pruning 3**	B20170502SLOV20	0.0	0.0	3.4	5.6	0.014	2.1	0.0	13.0
SLOVENIA	**Olive tree pruning 4**	B20170502SLOV21	0.0	0.0	0.7	11.2	0.011	1.0	0.0	12.2
SLOVENIA	**Olive tree pruning 5**	B20170502SLOV22	0.0	0.0	0.5	7.7	0.008	0.0	0.0	11.2
SLOVENIA	**Olive tree pruning 6**	B20170502SLOV23	0.0	0.0	0.9	4.2	0.010	1.3	0.0	16.4
SLOVENIA	**Olive tree pruning 7**	B20170502SLOV24	0.0	0.0	1.5	21.9	0.013	1.8	0.0	13.6
SLOVENIA	**Olive tree pruning 8**	B20170502SLOV25	0.0	0.0	1.1	13.4	0.010	2.3	0.0	12.1
SLOVENIA	**Olive tree pruning 9**	B20170502SLOV26	0.0	0.0	3.5	9.5	0.011	3.2	0.0	14.8
SLOVENIA	**Olive tree pruning 10**	B20170502SLOV27	0.0	0.0	1.6	8.6	0.011	1.0	0.0	15.2
SLOVENIA	**Vineyard pruning 1**	B20170502SLOV1	0.0	0.0	1.8	13.9	0.005	2.9	0.0	32.5
SLOVENIA	**Vineyard pruning 2**	B20170502SLOV2	0.0	0.0	2.2	10.7	0.001	3.5	0.0	41.4
SLOVENIA	**Vineyard pruning 3**	B20170502SLOV3	0.0	0.0	0.7	24.7	0.002	2.5	0.0	37.9
SLOVENIA	**Vineyard pruning 4**	B20170502SLOV4	0.0	0.0	0.0	29.1	0.003	0.5	0.0	52.2
SLOVENIA	**Vineyard pruning 5**	B20170502SLOV5	0.0	0.0	0.7	24.1	0.002	0.9	0.0	22.6
SLOVENIA	**Vineyard pruning 6**	B20170502SLOV6	0.0	0.0	1.2	24.2	0.001	3.8	1.0	24.5
SLOVENIA	**Vineyard pruning 7**	B20170502SLOV7	0.0	0.0	1.5	21.3	0.001	1.8	0.0	23.3
SLOVENIA	**Vineyard pruning 8**	B20170502SLOV8	0.0	0.0	0.9	28.6	0.002	1.3	0.0	23.5
SLOVENIA	**Vineyard pruning 9**	B20170502SLOV9	0.0	0.0	1.2	12.5	0.004	2.6	0.0	31.8
SLOVENIA	**Vineyard pruning 10**	B20170502SLOV10	0.0	0.0	0.7	10.6	0.001	2.8	0.0	40.1
SLOVENIA	**Vineyard pruning 11**	B20170502SLOV11	0.0	<0.3	2.0	36.7	0.001	2.0	0.0	33.5
SLOVENIA	**Vineyard pruning 12**	B20170502SLOV12	0.0	0.0	2.4	31.2	0.002	1.3	0.0	43.4
SLOVENIA	**Vineyard pruning 13**	B20170502SLOV13	0.0	0.0	4.3	18.8	0.001	4.7	0.0	20.6
SLOVENIA	**Vineyard pruning 14**	B20170502SLOV14	0.0	0.0	3.7	20.5	0.001	3.7	0.0	28.5
SLOVENIA	**Vineyard pruning 15**	B20170502SLOV15	0.0	0.0	1.2	10.7	0.001	3.0	0.9	45.3
SLOVENIA	**Vineyard pruning 16**	B20170502SLOV16	0.0	0.0	1.7	7.7	0.001	3.1	0.0	91.4
SLOVENIA	**Vineyard pruning 17**	7	0.0	0.0	1.4	13.7	0.001	2.9	0.0	57.4

Country	Biofuel	Original reference	SST (ºC)	DT (ºC)	HT (ºC)	FT (ºC)	Disintegration 800	1000	1200	1400	Sieving (0.50 mm sieve) 800	1000	1200	1400	Sintering Index
SLOVENIA	**Olive stones 1**	B20170104BSDSFI1	731	844	>1550	>1550	4	4	4	4	98	100	100	100	1.1
SLOVENIA	**Olive stones 2**	B20170104BSDSFI2	743	860	1424	1437	4	4	4	4	98	100	100	100	1.2
SLOVENIA	**Olive stones 3**	B20170104BSDSFI3	746	849	1438	1446	4	4	4	4	99	100	100	100	1.2
SLOVENIA	**Olive stones 4**	B20170104BSDSFI4	754	858	1422	1432	4	4	4	4	99	100	100	100	0.9
SLOVENIA	**Olive tree pruning 1**	B20170502SLOV18	741	1197	1405	1429	3	4	4	4	97	99	100	89	0.6
SLOVENIA	**Olive tree pruning 2**	B20170502SLOV19	728	1188	1413	1435	4	4	4	4	99	100	98	98	1.1
SLOVENIA	**Olive tree pruning 3**	B20170502SLOV20	733	1197	1392	1424	4	4	4	4	97	99	98	98	0.9
SLOVENIA	**Olive tree pruning 4**	B20170502SLOV21	740	1200	1428	1467	3	4	4	4	85	101	90	88	0.9
SLOVENIA	**Olive tree pruning 5**	B20170502SLOV22	724	1199	1473	1488	3	4	4	4	81	103	100	97	0.8
SLOVENIA	**Olive tree pruning 6**	B20170502SLOV23	724	1188	1438	1469	4	4	4	4	100	103	98	97	0.5
SLOVENIA	**Olive tree pruning 7**	B20170502SLOV24	729	1133	1520	1525	4	4	4	4	97	102	97	95	0.5
SLOVENIA	**Olive tree pruning 8**	B20170502SLOV25	739	1117	1522	1524	4	4	4	4	98	103	100	99	0.6
SLOVENIA	**Olive tree pruning 9**	B20170502SLOV26	735	1152	1429	1460	3	4	4	4	92	103	100	99	0.5
SLOVENIA	**Olive tree pruning 10**	B20170502SLOV27	737	1122	1517	1521	2	4	4	4	82	97	94	93	0.6
SLOVENIA	**Vineyard pruning 1**	B20170502SLOV1	729	1169	1488	1509	3	4	4	4	89	96	97	93	1.1
SLOVENIA	**Vineyard pruning 2**	B20170502SLOV2	756	1170	1514	1523	3	4	4	4	91	98	98	95	1.1
SLOVENIA	**Vineyard pruning 3**	B20170502SLOV3	747	1191	1499	1504	4	4	4	4	90	100	96	89	1.4
SLOVENIA	**Vineyard pruning 4**	B20170502SLOV4	727	1173	1416	1451	3	4	4	4	74	100	100	100	1.6
SLOVENIA	**Vineyard pruning 5**	B20170502SLOV5	745	1162	1450	1470	4	4	4	4	86	89	93	78	1.7
SLOVENIA	**Vineyard pruning 6**	B20170502SLOV6	730	1166	1510	1521	3	4	4	4	87	100	99	89	1.0
SLOVENIA	**Vineyard pruning 7**	B20170502SLOV7	731	1187	1516	1523	4	4	4	4	81	100	95	92	0.7
SLOVENIA	**Vineyard pruning 8**	B20170502SLOV8	744	1184	1535	1542	2	4	4	4	87	94	98	99	1.0
SLOVENIA	**Vineyard pruning 9**	B20170502SLOV9	733	1176	1538	1543	3	4	4	4	82	83	95	94	0.6
SLOVENIA	**Vineyard pruning 10**	B20170502SLOV10	741	1186	1515	1521	4	4	4	4	99	95	89	95	0.6
SLOVENIA	**Vineyard pruning 11**	B20170502SLOV11	741	1176	>1550	>1550	1	4	4	4	51	97	98	95	0.6
SLOVENIA	**Vineyard pruning 12**	B20170502SLOV12	736	1176	1502	1511	4	4	4	4	98	97	85	95	0.8
SLOVENIA	**Vineyard pruning 13**	B20170502SLOV13	742	1181	1514	1519	4	4	4	4	91	98	96	97	0.6
SLOVENIA	**Vineyard pruning 14**	B20170502SLOV14	742	1183	1501	1513	4	4	4	4	99	92	94	97	0.5
SLOVENIA	**Vineyard pruning 15**	B20170502SLOV15	746	1176	1526	1531	3	2	2	2	91	62	69	62	0.6
SLOVENIA	**Vineyard pruning 16**	B20170502SLOV16	745	1163	1501	1506	4	4	4	4	97	99	99	92	0.6
SLOVENIA	**Vineyard pruning 17**	7	737	1166	1501	1503	4	3	3	3	93	85	82	76	0.8

Country	Biofuel	Original reference	Oil (% d.b.)	63 %	45 %	31.5 %	16 %	8 %	3.15 %	2 %	1 %	< 1 %
SLOVENIA	**Olive stones 1**	B20170104BSDSFI1	0.64	0.00	0.00	0.00	0.00	0.00	20.84	56.60	22.37	0.19
SLOVENIA	**Olive stones 2**	B20170104BSDSFI2	0.67	0.00	0.00	0.00	0.00	0.00	24.95	57.06	17.80	0.19
SLOVENIA	**Olive stones 3**	B20170104BSDSFI3	0.70	0.00	0.00	0.00	0.00	0.00	24.07	58.12	17.81	0.00
SLOVENIA	**Olive stones 4**	B20170104BSDSFI4	0.63	0.00	0.00	0.00	0.00	0.00	27.13	55.43	17.44	0.00

8.2.6 Analytical results of the samples collected in Spain

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	VM (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
SPAIN	**Almond shells 1**	1519501	10.7	1.4	78.4	50.3	6.1	0.20	0.02	0.01	19.78	17.67	18.45	16.22
SPAIN	**Almond shells 2**	1519502	8.9	1.3	79.4	50.3	6.0	0.22	0.02	0.02	19.80	18.04	18.49	16.63
SPAIN	**Almond shells 3**	1519503	9.6	1.5	78.9	50.0	6.0	0.28	0.02	0.02	19.26	17.41	17.95	15.99
SPAIN	**Almond shells 4**	1519504	8.9	2.2	78.3	49.3	6.0	0.28	0.02	0.03	19.37	17.64	18.06	16.24
SPAIN	**Almond shells 5**	1519505	9.7	1.2	79.5	50.5	6.1	0.28	0.02	0.02	20.06	18.12	18.73	16.68
SPAIN	**Almond shells 6**	1519506	10.2	1.8	79.6	49.5	6.0	0.24	0.02	0.03	19.56	17.57	18.26	16.14
SPAIN	**Almond shells 7**	1205101	12.4	0.7	76.9	47.7	6.0	0.60	0.00	0.01	19.08	16.72	17.77	15.27
SPAIN	**Almond shells 8**	1205102	8.1	0.6	77.4	47.5	6.0	0.51	0.00	0.01	18.92	17.39	17.61	15.99
SPAIN	**Almond shells 9**	1110303	9.7	1.4	80.3	48.6	6.1	0.18	0.01	0.00	19.41	17.53	18.08	16.09
SPAIN	**Almond shells 10**	1110304	12.7	1.8	78.6	48.6	6.1	0.33	0.03	0.01	19.44	16.98	18.12	15.50
SPAIN	**Hazelnut shells 1**	1701501	11.2	1.3	75.9	51.4	5.8	0.35	0.03	0.03	20.77	18.44	19.51	17.05
SPAIN	**Hazelnut shells 2**	1701502	12.0	1.1	76.3	51.1	5.9	0.26	0.02	0.03	20.58	18.11	19.29	16.68
SPAIN	**Hazelnut shells 3**	1701503	14.0	1.4	74.8	51.5	5.9	0.32	0.03	0.02	20.76	17.85	19.47	16.40
SPAIN	**Hazelnut shells 4**	1701504	11.8	1.3	77.3	52.8	6.0	0.32	0.03	0.03	20.97	18.50	19.67	17.06
SPAIN	**Hazelnut shells 5**	1701505	9.4	1.2	77.7	53.5	6.2	0.36	0.04	0.03	21.58	19.55	20.23	18.10
SPAIN	**Olive stones 1**	1510401	8.7	0.9	78.3	50.7	5.9	0.18	0.04	0.06	20.30	18.54	19.02	17.15
SPAIN	**Olive stones 2**	1510402	17.6	0.7	77.9	51.1	6.0	0.22	0.03	0.02	20.46	16.86	19.15	15.35
SPAIN	**Olive stones 3**	1510403	9.9	0.7	79.3	50.3	6.1	0.19	0.02	0.02	20.18	18.18	18.85	16.75
SPAIN	**Olive stones 4**	1510404	7.7	0.9	79.9	50.1	6.1	0.19	0.02	0.01	20.15	18.60	18.82	17.18
SPAIN	**Olive stones 5**	1510405	7.2	0.9	79.6	50.8	6.2	0.22	0.02	0.02	20.30	18.84	18.95	17.41
SPAIN	**Olive stones 6**	1510406	13.3	0.7	79.7	51.0	6.1	0.13	0.02	0.02	20.38	17.67	19.05	16.19
SPAIN	**Olive stones 7**	1510407	11.3	0.7	79.6	51.1	6.1	0.13	0.02	0.02	20.31	18.01	18.98	16.56
SPAIN	**Olive stones 8**	1510408	7.5	0.6	80.4	50.5	6.1	0.11	0.02	0.01	20.30	18.78	18.98	17.37
SPAIN	**Olive stones 9**	1510409	9.5	0.5	80.3	50.9	6.0	0.14	0.02	0.01	20.17	18.25	18.86	16.83
SPAIN	**Olive stones 10**	1510410	6.3	0.5	80.1	51.2	6.0	0.14	0.02	0.01	20.40	19.12	19.09	17.74

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	VM (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
SPAIN	**Olive tree pruning 1**	1702201	38.2	4.3	81.8	49.9	6.3	1.02	0.09	0.02	20.45	16.13	19.08	14.54
SPAIN	**Olive tree pruning 2**	1702202	26.4	3.9	81.4	49.6	6.1	0.67	0.06	0.02	19.96	14.69	18.64	13.07
SPAIN	**Olive tree pruning 3**	1702203	42.4	3.8	81.8	48.9	6.2	0.56	0.05	0.02	19.58	11.28	18.24	9.47
SPAIN	**Olive tree pruning 4**	1702204	36.6	3.7	82.0	49.8	6.2	0.62	0.06	0.01	20.08	12.73	18.73	10.98
SPAIN	**Olive tree pruning 5**	1702205	40.4	5.0	82.1	49.1	6.2	0.97	0.09	0.03	19.92	11.87	18.58	10.08
SPAIN	**Olive tree pruning 6**	1702206	41.7	4.6	81.9	48.9	6.1	0.79	0.08	0.01	19.74	11.51	18.41	9.71
SPAIN	**Olive tree pruning 7**	1702207	41.9	3.2	82.3	50.2	6.3	0.64	0.06	0.01	20.39	11.85	19.02	10.03
SPAIN	**Olive tree pruning 8**	1702208	21.4	2.8	82.1	48.9	6.1	0.53	0.05	0.02	19.56	15.38	18.24	13.81
SPAIN	**Olive tree pruning 9**	1702209	24.0	3.6	81.9	49.2	6.2	0.77	0.06	0.02	19.71	14.98	18.36	13.37
SPAIN	**Olive tree pruning 10**	1702210	20.6	4.0	81.2	49.1	6.1	0.97	0.08	0.04	19.71	15.65	18.39	14.10
SPAIN	**Olive tree pruning 11**	1702211	20.1	3.3	81.6	49.0	6.1	0.58	0.05	0.02	19.53	15.61	18.20	14.05
SPAIN	**Olive tree pruning 12**	1702212	43.0	4.8	79.1	49.2	6.2	1.34	0.10	0.02	19.84	11.31	18.49	9.49
SPAIN	**Olive tree pruning 13**	1702213	12.7	2.4	81.6	48.9	6.2	0.54	0.04	0.03	19.39	16.93	18.11	15.50
SPAIN	**Olive tree pruning 14**	1702214	23.9	1.8	82.1	48.0	6.2	0.49	0.04	0.02	19.10	14.54	17.81	12.97
SPAIN	**Olive tree pruning 15**	1702215	45.9	6.4	81.6	50.0	6.5	1.19	0.13	0.04	20.55	11.12	19.18	9.25
SPAIN	**Olive tree pruning 16**	1702216	45.6	3.4	80.6	48.7	6.3	0.68	0.06	0.03	19.53	10.62	18.23	8.80
SPAIN	**Olive tree pruning 17**	1702217	40.7	3.8	81.2	48.5	6.4	0.69	0.07	0.03	19.35	11.47	17.96	9.65
SPAIN	**Olive tree pruning 18**	1702218	35.3	3.8	81.3	49.3	6.4	0.97	0.08	0.02	19.69	12.74	18.30	10.98
SPAIN	**Olive tree pruning 19**	1702219	36.6	2.7	81.6	49.2	6.3	0.76	0.06	0.04	19.71	12.50	18.34	10.73
SPAIN	**Olive tree pruning 20**	1702220	38.5	2.7	81.6	49.2	6.4	0.67	0.06	0.02	19.76	12.15	18.37	10.36
SPAIN	**Pistachio shells 1**	1616901	23.3	0.5	90.1	48.4	6.1	0.18	0.02	0.01	19.12	14.67	17.79	13.08
SPAIN	**Pistachio shells 2**	1616902	24.3	0.6	84.5	48.4	6.1	0.24	0.02	<0.01	19.09	14.45	17.76	12.85
SPAIN	**Pistachio shells 3**	1616903	10.4	0.9	83.0	48.5	6.1	0.28	0.02	<0.01	19.16	17.17	17.83	15.72
SPAIN	**Pistachio shells 4**	1616904	12.4	0.3	85.8	48.2	6.1	0.12	0.01	<0.01	18.98	16.62	17.65	15.16
SPAIN	**Pistachio shells 5**	1616905	12.3	0.3	85.2	47.9	6.0	0.17	0.01	<0.01	18.95	16.62	17.64	15.17
SPAIN	**Pistachio shells 6**	1616906	7.9	0.4	82.9	48.5	6.2	0.43	0.03	0.02	19.53	17.99	18.18	16.55
SPAIN	**Pistachio shells 7**	1616907	7.8	0.2	85.2	48.7	6.2	0.39	0.02	0.02	19.41	17.89	18.05	16.46
SPAIN	**Pistachio shells 8**	1616908	7.5	0.8	83.8	48.3	6.1	0.39	0.03	0.01	19.27	17.83	17.94	16.41
SPAIN	**Pistachio shells 9**	1616909	7.5	0.8	81.2	47.7	6.1	0.89	0.05	0.02	19.10	17.67	17.77	16.26
SPAIN	**Pistachio shells 10**	1616910	9.4	0.4	84.7	49.0	6.4	0.32	0.03	0.02	19.57	17.73	18.18	16.24

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (% d.b.)	VM (% d.b.)	C (% d.b.)	H (% d.b.)	N (% d.b.)	S (% d.b.)	Cl (% d.b.)	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
SPAIN	**Pine nut shells 1**	1616201	16.1	1.5	76.7	51.4	6.1	0.25	0.03	0.01	20.67	17.34	19.34	15.83
SPAIN	**Pine nut shells 2**	1616202	13.8	1.3	77.9	51.8	6.0	0.28	0.03	0.00	20.62	17.78	19.32	16.31
SPAIN	**Pine nut shells 3**	1616203	13.3	1.5	76.6	52.0	6.0	0.21	0.03	0.02	20.68	17.93	19.38	16.47
SPAIN	**Pine nut shells 4**	1616204	13.2	1.6	76.7	51.9	6.1	0.22	0.03	0.02	20.76	18.02	19.43	16.55
SPAIN	**Pine nut shells 5**	1616205	12.7	1.7	76.5	51.9	6.1	0.25	0.02	0.03	20.84	18.19	19.51	16.72
SPAIN	**Pine nut shells 6**	1616206	9.9	2.2	75.1	51.1	6.0	0.33	0.04	0.02	20.44	18.42	19.14	17.00
SPAIN	**Pine nut shells 7**	1616207	13.0	1.7	76.2	51.4	6.0	0.26	0.04	0.03	20.55	17.88	19.25	16.43
SPAIN	**Pine nut shells 8**	1616208	13.3	1.6	76.8	50.3	6.1	0.21	0.02	0.02	20.34	17.63	19.01	16.15
SPAIN	**Pine nut shells 9**	1616209	12.0	1.5	78.0	51.8	6.0	0.24	0.03	0.02	20.69	18.21	19.38	16.77
SPAIN	**Pine nut shells 10**	1616210	12.0	1.4	76.7	52.0	6.1	0.28	0.03	0.05	20.83	18.33	19.50	16.87
SPAIN	**Vineyard pruning 1**	1702101	52.2	3.8	78.0	47.3	5.9	0.80	0.05	0.02	18.85	9.01	17.56	7.12
SPAIN	**Vineyard pruning 2**	1702102	24.2	3.1	78.9	48.3	5.9	0.75	0.04	0.01	19.14	14.51	17.85	12.94
SPAIN	**Vineyard pruning 3**	1702103	25.0	4.4	78.1	48.1	5.8	0.79	0.06	0.03	19.03	14.27	17.77	12.71
SPAIN	**Vineyard pruning 4**	1702104	39.0	2.8	78.9	48.4	5.9	0.62	0.05	0.01	19.13	11.67	17.84	9.93
SPAIN	**Vineyard pruning 5**	1702105	33.3	4.4	78.0	47.9	5.8	0.65	0.06	0.02	18.84	12.56	17.57	10.91
SPAIN	**Vineyard pruning 6**	1702106	41.0	3.2	77.9	48.4	5.9	0.74	0.05	0.01	19.05	11.24	17.77	9.48
SPAIN	**Vineyard pruning 7**	1702107	45.5	3.9	77.8	47.5	5.9	0.73	0.06	0.03	18.82	10.26	17.53	8.44
SPAIN	**Vineyard pruning 8**	1702108	41.5	2.7	78.8	48.3	5.9	0.73	0.05	0.01	19.01	11.12	17.73	9.36
SPAIN	**Vineyard pruning 9**	1702109	47.5	3.2	78.5	47.8	5.9	0.59	0.05	0.01	18.81	9.87	17.52	8.04
SPAIN	**Vineyard pruning 10**	1702110	47.4	2.9	79.0	48.3	5.9	0.51	0.04	0.01	19.11	10.05	17.82	8.22
SPAIN	**Vineyard pruning 11**	1702111	48.0	3.4	78.7	47.8	5.9	0.54	0.04	0.02	18.83	9.79	17.54	7.95
SPAIN	**Vineyard pruning 12**	1703101	45.0	3.0	78.3	48.1	5.9	0.73	0.06	0.02	19.03	10.47	17.75	8.66
SPAIN	**Vineyard pruning 13**	1703102	43.0	2.5	78.1	48.3	5.9	0.64	0.05	0.02	18.99	10.83	17.71	9.04
SPAIN	**Vineyard pruning 14**	1703103	39.4	3.8	77.4	47.5	6.0	0.69	0.05	0.03	18.74	11.36	17.50	9.64
SPAIN	**Vineyard pruning 15**	1703104	33.6	2.7	77.8	48.1	5.9	0.65	0.05	0.02	19.10	12.68	17.81	11.01
SPAIN	**Vineyard pruning 16**	1703105	50.0	2.9	77.9	48.6	5.9	0.64	0.05	0.02	19.30	9.66	18.02	7.79
SPAIN	**Vineyard pruning 17**	1703106	40.4	3.1	77.1	48.3	5.8	0.63	0.05	0.03	19.07	11.36	17.80	9.62
SPAIN	**Vineyard pruning 18**	1703107	42.6	2.9	77.5	48.2	5.9	0.76	0.06	0.02	19.11	10.97	17.82	9.19
SPAIN	**Vineyard pruning 19**	1703108	46.0	3.4	78.3	48.1	5.8	0.75	0.06	0.01	19.03	10.27	17.76	8.47
SPAIN	**Vineyard pruning 20**	1703109	39.0	2.9	79.5	47.9	5.9	0.52	0.05	0.02	19.00	11.59	17.72	9.85
SPAIN	**Vineyard pruning 21**	1703110	52.2	2.9	79.9	48.1	5.9	0.75	0.05	0.01	19.00	9.08	17.71	7.19
SPAIN	**Vineyard pruning 22**	1703111	10.3	4.2	78.8	48.4	5.9	0.70	0.05	0.02	19.09	17.12	17.81	15.72
SPAIN	**Vineyard pruning 23**	1703112	16.9	3.5	78.9	48.5	6.1	0.62	0.05	0.02	19.10	15.87	17.77	14.36
SPAIN	**Vineyard pruning 24**	1703113	35.6	3.0	77.5	48.6	6.0	0.81	0.06	0.02	19.15	12.33	17.85	10.62
SPAIN	**Vineyard pellets 1**	1702801	9.1	4.8	76.9	47.8	5.7	0.69	0.07	0.02	18.90	17.18	17.66	15.83
SPAIN	**Walnut shells 1**	1701401	10.9	0.9	79.2	51.6	6.3	0.38	0.02	0.02	20.94	18.66	19.57	17.17
SPAIN	**Walnut shells 2**	1701402	8.7	1.5	78.4	52.0	6.3	0.53	0.03	0.07	21.14	19.31	19.77	17.84
SPAIN	**Walnut shells 3**	1701403	7.3	1.8	80.3	54.9	7.0	1.15	0.04	0.04	22.03	20.43	20.52	18.85
SPAIN	**Walnut shells 4**	1701404	7.9	1.5	81.1	55.9	6.9	1.06	0.06	0.03	23.59	21.73	22.10	20.16
SPAIN	**Walnut shells 5**	1701405	9.9	0.9	80.2	50.9	5.9	0.13	0.02	0.04	20.15	18.16	18.87	16.76
SPAIN	**Walnut shells 6**	1701406	9.7	1.1	77.2	50.5	5.9	0.18	0.02	0.04	19.84	17.91	18.55	16.52

Country	Biofuel	Original reference	Al (% d.b.)	Ba (% d.b.)	Ca (% d.b.)	Fe (% d.b.)	K (% d.b.)	Mg (% d.b.)	Mn (% d.b.)	Na (% d.b.)	P (% d.b.)	S (% d.b.)	Si (% d.b.)	Sr (% d.b.)	Ti (% d.b.)	Zn (% d.b.)
SPAIN	**Almond shells 1**	1519501	0.0013	0.0001	0.1060	0.0015	0.4156	0.0192	0.0002	0.0073	0.0156	0.0045	0.0185	0.00033	0.00012	0.00016
SPAIN	**Almond shells 2**	1519502	0.0036	0.0001	0.1227	0.0031	0.3346	0.0227	0.0003	0.0052	0.0110	0.0061	0.0314	0.00127	0.00028	0.00019
SPAIN	**Almond shells 3**	1519503	0.0020	0.0001	0.1131	0.0019	0.3928	0.0233	0.0002	0.0062	0.0134	0.0058	0.0237	0.00108	0.00016	0.00015
SPAIN	**Almond shells 4**	1519504	0.0030	0.0001	0.1463	0.0026	0.6420	0.0359	0.0003	0.0085	0.0186	0.0083	0.0349	0.00137	0.00024	0.00023
SPAIN	**Almond shells 5**	1519505	0.0010	0.0001	0.1121	0.0016	0.2958	0.0194	0.0002	0.0086	0.0141	0.0062	0.0161	0.00103	0.00008	0.00017
SPAIN	**Almond shells 6**	1519506	0.0021	0.0001	0.1385	0.0021	0.5534	0.0270	0.0002	0.0078	0.0134	0.0062	0.0248	0.00124	0.00017	0.00016
SPAIN	**Almond shells 7**	1205101	0.0002	0.0000	0.0623	0.0007	0.1960	0.0154	0.0002	0.0043	0.0055	0.0041	0.0063	0.00051	0.00000	0.00007
SPAIN	**Almond shells 8**	1205102	0.0001	0.0000	0.0552	0.0007	0.1740	0.0102	0.0002	0.0032	0.0059	0.0037	0.0058	0.00032	0.00000	0.00007
SPAIN	**Almond shells 9**	1110303	0.0045	0.0002	0.1680	0.0039	0.3920	0.0364	0.0004	0.0071	0.0182	0.0108	0.0294	0.00168	0.00018	0.00036
SPAIN	**Almond shells 10**	1110304	0.0146	0.0004	0.1980	0.0137	0.4320	0.0324	0.0007	0.0092	0.0234	0.0139	0.0774	0.00198	0.00063	0.00076
SPAIN	**Hazelnut shells 1**	1701501	0.0074	0.0005	0.2730	0.0070	0.2210	0.0377	0.0009	0.0042	0.0221	0.0182	0.0338	0.00156	0.00046	0.00090
SPAIN	**Hazelnut shells 2**	1701502	0.0034	0.0004	0.2200	0.0041	0.2420	0.0374	0.0011	0.0040	0.0165	0.0165	0.0220	0.00099	0.00022	0.00037
SPAIN	**Hazelnut shells 3**	1701503	0.0168	0.0006	0.2520	0.0140	0.2100	0.0364	0.0011	0.0042	0.0210	0.0168	0.0630	0.00120	0.00090	0.00132
SPAIN	**Hazelnut shells 4**	1701504	0.0048	0.0004	0.2600	0.0047	0.2080	0.0377	0.0008	0.0025	0.0260	0.0195	0.0111	0.00143	0.00043	0.00051
SPAIN	**Hazelnut shells 5**	1701505	0.0029	0.0003	0.2040	0.0028	0.2160	0.0408	0.0009	0.0014	0.0444	0.0180	0.0055	0.00074	0.00012	0.00048
SPAIN	**Olive stones 1**	1510401	0.0052	0.0001	0.1399	0.0069	0.1761	0.0316	0.0004	0.0039	0.0080	0.0079	0.0194	0.00029	0.00019	0.00029
SPAIN	**Olive stones 2**	1510402	0.0032	0.0001	0.1157	0.0055	0.1381	0.0257	0.0002	0.0027	0.0060	0.0067	0.0126	0.00022	0.00020	0.00021
SPAIN	**Olive stones 3**	1510403	0.0047	0.0001	0.0996	0.0044	0.1430	0.0179	0.0003	0.0060	0.0062	0.0062	0.0183	0.00035	0.00026	0.00010
SPAIN	**Olive stones 4**	1510404	0.0098	0.0001	0.1536	0.0080	0.1490	0.0129	0.0005	0.0024	0.0068	0.0084	0.0398	0.00059	0.00059	0.00016
SPAIN	**Olive stones 5**	1510405	0.0064	0.0002	0.1396	0.0054	0.1737	0.0135	0.0004	0.0020	0.0082	0.0083	0.0225	0.00098	0.00041	0.00015
SPAIN	**Olive stones 6**	1510406	0.0025	0.0001	0.1127	0.0033	0.1412	0.0117	0.0004	0.0024	0.0065	0.0069	0.0134	0.00049	0.00017	0.00019
SPAIN	**Olive stones 7**	1510407	0.0043	0.0001	0.0996	0.0036	0.1471	0.0096	0.0003	0.0015	0.0063	0.0061	0.0166	0.00076	0.00026	0.00010
SPAIN	**Olive stones 8**	1510408	0.0023	0.0001	0.0863	0.0023	0.1326	0.0087	0.0003	0.0015	0.0052	0.0061	0.0102	0.00064	0.00015	0.00008
SPAIN	**Olive stones 9**	1510409	0.0004	0.0001	0.1077	0.0006	0.0968	0.0106	0.0003	0.0013	0.0045	0.0055	0.0044	0.00105	0.00004	0.00009
SPAIN	**Olive stones 10**	1510410	0.0013	0.0001	0.0793	0.0016	0.1059	0.0087	0.0003	0.0024	0.0050	0.0053	0.0076	0.00030	0.00014	0.00007
SPAIN	**Olive tree pruning 1**	1702201	0.0103	0.0006	1.1180	0.0069	0.4730	0.1118	0.0022	0.0069	0.0688	0.0559	0.0516	0.03870	0.00065	0.00206
SPAIN	**Olive tree pruning 2**	1702202	0.0218	0.0003	1.3260	0.0121	0.2067	0.0507	0.0012	0.0059	0.0507	0.0468	0.0741	0.00312	0.00133	0.00234
SPAIN	**Olive tree pruning 3**	1702203	0.0167	0.0004	1.0640	0.0103	0.3686	0.0684	0.0009	0.0091	0.0532	0.0456	0.0684	0.00357	0.00106	0.00114
SPAIN	**Olive tree pruning 4**	1702204	0.0163	0.0003	1.1840	0.0093	0.2257	0.0851	0.0011	0.0052	0.0481	0.0481	0.0703	0.00444	0.00107	0.00063
SPAIN	**Olive tree pruning 5**	1702205	0.0200	0.0006	1.7000	0.0120	0.2850	0.1350	0.0017	0.0160	0.0650	0.0650	0.0700	0.00480	0.00110	0.00110
SPAIN	**Olive tree pruning 6**	1702206	0.0101	0.0014	1.4720	0.0064	0.3266	0.1288	0.0007	0.0035	0.0506	0.0552	0.0598	0.00377	0.00064	0.00055
SPAIN	**Olive tree pruning 7**	1702207	0.0163	0.0008	0.8320	0.0096	0.3520	0.0576	0.0010	0.0045	0.0672	0.0384	0.0768	0.00384	0.00118	0.00096
SPAIN	**Olive tree pruning 8**	1702208	0.0059	0.0003	0.8120	0.0042	0.2324	0.0896	0.0010	0.0042	0.0392	0.0392	0.0420	0.00812	0.00036	0.00129
SPAIN	**Olive tree pruning 9**	1702209	0.0112	0.0010	0.8640	0.0065	0.2808	0.1008	0.0021	0.0540	0.0576	0.0468	0.0504	0.01656	0.00072	0.00144
SPAIN	**Olive tree pruning 10**	1702210	0.0172	0.0011	0.9600	0.0108	0.5600	0.0480	0.0014	0.0084	0.1560	0.0600	0.0880	0.00400	0.00112	0.01080
SPAIN	**Olive tree pruning 11**	1702211	0.0112	0.0010	0.8910	0.0066	0.2805	0.0990	0.0021	0.0561	0.0594	0.0495	0.0660	0.01683	0.00073	0.00139
SPAIN	**Olive tree pruning 12**	1702212	0.0202	0.0013	1.1520	0.0125	0.6240	0.0576	0.0017	0.0096	0.1824	0.0720	0.1056	0.00480	0.00139	0.00768
SPAIN	**Olive tree pruning 13**	1702213	0.0137	0.0005	0.6720	0.0084	0.2256	0.0672	0.0006	0.0074	0.0576	0.0288	0.0528	0.00408	0.00086	0.00050
SPAIN	**Olive tree pruning 14**	1702214	0.0038	0.0015	0.5040	0.0031	0.1764	0.0270	0.0004	0.0020	0.0360	0.0175	0.0113	0.00216	0.00025	0.00045
SPAIN	**Olive tree pruning 15**	1702215	0.0506	0.0020	1.6640	0.0307	0.5696	0.1728	0.0029	0.0160	0.1152	0.0768	0.1792	0.01280	0.00314	0.00179
SPAIN	**Olive tree pruning 16**	1702216	0.0126	0.0004	0.6120	0.0082	0.6460	0.0476	0.0012	0.0051	0.0952	0.0408	0.0510	0.00646	0.00082	0.00119
SPAIN	**Olive tree pruning 17**	1702217	0.0122	0.0005	0.9120	0.0084	0.5320	0.0684	0.0020	0.0057	0.0684	0.0494	0.0532	0.01102	0.00068	0.00095
SPAIN	**Olive tree pruning 18**	1702218	0.0091	0.0007	0.9880	0.0065	0.4180	0.0646	0.0014	0.0049	0.0646	0.0418	0.0456	0.00874	0.00057	0.00095
SPAIN	**Olive tree pruning 19**	1702219	0.0092	0.0004	0.6210	0.0062	0.3510	0.0486	0.0006	0.0038	0.0459	0.0324	0.0459	0.00513	0.00062	0.00070
SPAIN	**Olive tree pruning 20**	1702220	0.0065	0.0003	0.6480	0.0049	0.4050	0.0567	0.0006	0.0027	0.0513	0.0351	0.0324	0.00513	0.00041	0.00084

Country	Biofuel	Original reference	Al (% d.b.)	Ba (% d.b.)	Ca (% d.b.)	Fe (% d.b.)	K (% d.b.)	Mg (% d.b.)	Mn (% d.b.)	Na (% d.b.)	P (% d.b.)	S (% d.b.)	Si (% d.b.)	Sr (% d.b.)	Ti (% d.b.)	Zn (% d.b.)
SPAIN	**Pistachio shells 1**	1616901	0.0070	0.0001	0.0600	0.0041	0.1150	0.0135	0.0001	0.0110	0.0185	0.0120	0.0090	0.00043	0.00011	0.00050
SPAIN	**Pistachio shells 2**	1616902	0.0035	0.0000	0.0660	0.0011	0.1620	0.0150	0.0001	0.0022	0.0192	0.0126	0.0050	0.00048	0.00005	0.00033
SPAIN	**Pistachio shells 3**	1616903	0.0012	0.0001	0.0756	0.0026	0.2430	0.0243	0.0002	0.0024	0.0720	0.0189	0.0162	0.00015	0.00011	0.00099
SPAIN	**Pistachio shells 4**	1616904	0.0005	0.0000	0.0420	0.0011	0.0630	0.0114	0.0000	0.0007	0.0099	0.0087	0.0072	0.00026	0.00002	0.00015
SPAIN	**Pistachio shells 5**	1616905	0.0003	0.0000	0.0450	0.0009	0.0660	0.0123	0.0000	0.0007	0.0093	0.0087	0.0057	0.00030	0.00002	0.00016
SPAIN	**Pistachio shells 6**	1616906	0.0007	0.0001	0.0320	0.0020	0.1160	0.0084	0.0001	0.0023	0.0140	0.0052	0.0064	0.00012	0.00007	0.00020
SPAIN	**Pistachio shells 7**	1616907	0.0003	0.0000	0.0200	0.0012	0.0500	0.0046	0.0001	0.0016	0.0060	0.0024	0.0026	0.00011	0.00003	0.00009
SPAIN	**Pistachio shells 8**	1616908	0.0004	0.0001	0.0560	0.0024	0.2240	0.0184	0.0002	0.0068	0.0344	0.0096	0.0168	0.00031	0.00006	0.00009
SPAIN	**Pistachio shells 9**	1616909	0.0004	0.0002	0.0528	0.0024	0.2400	0.0200	0.0003	0.0047	0.0448	0.0112	0.0104	0.00021	0.00006	0.00061
SPAIN	**Pistachio shells 10**	1616910	0.0004	0.0001	0.0520	0.0034	0.0960	0.0120	0.0001	0.0015	0.0140	0.0056	0.0014	0.00037	0.00005	0.00084
SPAIN	**Pine nut shells 1**	1616201	0.0072	0.0000	0.0360	0.0038	0.1200	0.0450	0.0015	0.0086	0.0255	0.0138	0.4650	0.00008	0.00000	0.00120
SPAIN	**Pine nut shells 2**	1616202	0.0008	0.0000	0.0364	0.0113	0.0910	0.0403	0.0012	0.0029	0.0143	0.0112	0.4290	0.00005	0.00000	0.00078
SPAIN	**Pine nut shells 3**	1616203	0.0044	0.0000	0.0315	0.0119	0.1440	0.0345	0.0013	0.0120	0.0122	0.0105	0.4500	0.00008	0.00006	0.00072
SPAIN	**Pine nut shells 4**	1616204	0.0075	0.0000	0.0336	0.0043	0.1600	0.0464	0.0013	0.0099	0.0352	0.0134	0.4480	0.00008	0.00006	0.00109
SPAIN	**Pine nut shells 5**	1616205	0.0109	0.0001	0.0391	0.0048	0.1649	0.0493	0.0012	0.0126	0.0340	0.0145	0.4760	0.00009	0.00010	0.00109
SPAIN	**Pine nut shells 6**	1616206	0.0220	0.0007	0.1320	0.0189	0.2090	0.0462	0.0015	0.0097	0.0242	0.0172	0.5500	0.00022	0.00040	0.00088
SPAIN	**Pine nut shells 7**	1616207	0.0102	0.0001	0.0238	0.0058	0.2210	0.0493	0.0011	0.0073	0.0374	0.0187	0.4420	0.00005	0.00017	0.00102
SPAIN	**Pine nut shells 8**	1616208	0.0053	0.0000	0.0352	0.0122	0.1600	0.0592	0.0018	0.0091	0.0592	0.0176	0.4160	0.00008	0.00000	0.00107
SPAIN	**Pine nut shells 9**	1616209	0.0038	0.0000	0.0255	0.0032	0.1500	0.0390	0.0009	0.0083	0.0165	0.0131	0.4350	0.00011	0.00008	0.00071
SPAIN	**Pine nut shells 10**	1616210	0.0059	0.0000	0.0322	0.0041	0.1386	0.0434	0.0012	0.0196	0.0350	0.0154	0.3640	0.00007	0.00007	0.00119
SPAIN	**Vineyard pruning 1**	1702101	0.0068	0.0005	0.8740	0.0038	0.6080	0.1520	0.0025	0.0175	0.0950	0.0418	0.0353	0.00346	0.00038	0.00315
SPAIN	**Vineyard pruning 2**	1702102	0.0273	0.0007	0.6820	0.0130	0.2945	0.1612	0.0025	0.0090	0.0651	0.0372	0.1147	0.00205	0.00149	0.00186
SPAIN	**Vineyard pruning 3**	1702103	0.0616	0.0009	0.8800	0.0286	0.4400	0.2200	0.0034	0.0352	0.0836	0.0484	0.2244	0.00392	0.00304	0.00242
SPAIN	**Vineyard pruning 4**	1702104	0.0101	0.0003	0.5040	0.0056	0.3920	0.1260	0.0011	0.0067	0.0672	0.0308	0.0336	0.00244	0.00062	0.00202
SPAIN	**Vineyard pruning 5**	1702105	0.0484	0.0006	0.8800	0.0229	0.5280	0.1804	0.0023	0.0097	0.0660	0.0528	0.1540	0.01584	0.00268	0.00273
SPAIN	**Vineyard pruning 6**	1702106	0.0141	0.0003	0.6720	0.0074	0.4160	0.1696	0.0009	0.0096	0.0736	0.0416	0.0480	0.00320	0.00080	0.00448
SPAIN	**Vineyard pruning 7**	1702107	0.0036	0.0004	0.8580	0.0027	0.5850	0.1872	0.0005	0.0144	0.0741	0.0468	0.0250	0.00819	0.00020	0.00152
SPAIN	**Vineyard pruning 8**	1702108	0.0038	0.0003	0.5670	0.0030	0.4050	0.1944	0.0015	0.0105	0.0864	0.0432	0.0262	0.00540	0.00027	0.00267
SPAIN	**Vineyard pruning 9**	1702109	0.0086	0.0004	0.7360	0.0051	0.4160	0.1696	0.0016	0.0189	0.0704	0.0384	0.0416	0.00320	0.00051	0.00608
SPAIN	**Vineyard pruning 10**	1702110	0.0102	0.0006	0.6960	0.0058	0.3190	0.1247	0.0006	0.0125	0.0725	0.0406	0.0464	0.00284	0.00058	0.00406
SPAIN	**Vineyard pruning 11**	1702111	0.0126	0.0008	0.7820	0.0071	0.4420	0.2210	0.0007	0.0112	0.0714	0.0374	0.0544	0.00333	0.00071	0.00167
SPAIN	**Vineyard pruning 12**	1703101	0.0022	0.0003	0.5700	0.0026	0.4200	0.1350	0.0013	0.0075	0.0630	0.0330	0.0420	0.00165	0.00012	0.00129
SPAIN	**Vineyard pruning 13**	1703102	0.0035	0.0004	0.5750	0.0025	0.3250	0.1150	0.0010	0.0058	0.0500	0.0325	0.0425	0.00090	0.00035	0.00078
SPAIN	**Vineyard pruning 14**	1703103	0.0243	0.0005	0.7980	0.0137	0.4180	0.2736	0.0031	0.0494	0.0760	0.0532	0.1520	0.01178	0.00198	0.00141
SPAIN	**Vineyard pruning 15**	1703104	0.0219	0.0005	0.5940	0.0132	0.3240	0.1431	0.0016	0.0267	0.0891	0.0297	0.0999	0.00459	0.00140	0.00111
SPAIN	**Vineyard pruning 16**	1703105	0.0081	0.0006	0.6090	0.0058	0.4060	0.1044	0.0007	0.0110	0.0957	0.0377	0.0406	0.00276	0.00052	0.00148
SPAIN	**Vineyard pruning 17**	1703106	0.0155	0.0003	0.7130	0.0099	0.3720	0.1519	0.0029	0.0465	0.0744	0.0403	0.0868	0.00961	0.00096	0.00226
SPAIN	**Vineyard pruning 18**	1703107	0.0052	0.0004	0.6090	0.0041	0.4350	0.1595	0.0017	0.0093	0.0841	0.0406	0.0348	0.00754	0.00029	0.00122
SPAIN	**Vineyard pruning 19**	1703108	0.0048	0.0004	0.7480	0.0041	0.4080	0.1428	0.0044	0.0082	0.0680	0.0374	0.0374	0.01122	0.00027	0.00214
SPAIN	**Vineyard pruning 20**	1703109	0.0038	0.0003	0.7540	0.0038	0.3190	0.1479	0.0073	0.0099	0.0696	0.0348	0.0348	0.00638	0.00017	0.00290
SPAIN	**Vineyard pruning 21**	1703110	0.0052	0.0002	0.7830	0.0041	0.2088	0.2581	0.0028	0.0238	0.0841	0.0406	0.0377	0.00435	0.00029	0.00241
SPAIN	**Vineyard pruning 22**	1703111	0.0462	0.0029	1.0080	0.0269	0.4116	0.2016	0.0039	0.0168	0.0714	0.0412	0.2226	0.00420	0.00403	0.00134
SPAIN	**Vineyard pruning 23**	1703112	0.0119	0.0002	1.0150	0.0077	0.2870	0.0630	0.0013	0.0046	0.0490	0.0455	0.0665	0.01190	0.00081	0.00070
SPAIN	**Vineyard pruning 24**	1703113	0.0153	0.0002	0.6600	0.0096	0.3900	0.1500	0.0024	0.0057	0.1320	0.0450	0.0630	0.00126	0.00069	0.00600
SPAIN	**Vineyard pellets 1**	1702801	0.0422	0.0009	1.1520	0.0230	0.5280	0.1632	0.0017	0.0130	0.0768	0.0528	0.2736	0.01008	0.00211	0.00163
SPAIN	**Walnut shells 1**	1701401	0.0023	0.0003	0.1170	0.0030	0.2070	0.0261	0.0007	0.0027	0.0405	0.0090	0.0162	0.00025	0.00021	0.00058
SPAIN	**Walnut shells 2**	1701402	0.0015	0.0004	0.2550	0.0026	0.3150	0.0465	0.0009	0.0038	0.0570	0.0165	0.0180	0.00050	0.00009	0.00101
SPAIN	**Walnut shells 3**	1701403	0.0010	0.0007	0.2700	0.0040	0.3240	0.0882	0.0023	0.0029	0.1206	0.0097	0.0252	0.00040	<loq	0.00171
SPAIN	**Walnut shells 4**	1701404	0.0027	0.0002	0.1800	0.0032	0.2850	0.0735	0.0009	0.0020	0.1500	0.0149	0.0042	0.00117	0.00017	0.00123
SPAIN	**Walnut shells 5**	1701405	0.0025	0.0004	0.2070	0.0040	0.1170	0.0234	0.0011	0.0026	0.0117	0.0071	0.0090	0.00108	0.00027	0.00064
SPAIN	**Walnut shells 6**	1701406	0.0028	0.0002	0.1760	0.0024	0.2310	0.0374	0.0004	0.0012	0.0099	0.0072	0.0053	0.00121	0.00019	0.00021

Country	Biofuel	Original reference	As (mg/kg d.b.)	Cd (mg/kg d.b.)	Cr (mg/kg d.b.)	Cu (mg/kg d.b.)	Hg (mg/kg d.b.)	Ni (mg/kg d.b.)	Pb (mg/kg d.b.)	Zn (mg/kg d.b.)
SPAIN	**Almond shells 1**	1519501	<0.1	<0.1	1.1	3.8	<0.001	1.1	<1.0	4.7
SPAIN	**Almond shells 2**	1519502	<0.1	<0.1	<1.0	5.9	<0.001	<1.0	<1.0	3.6
SPAIN	**Almond shells 3**	1519503	<0.1	<0.1	<1.0	2.7	<0.001	<1.0	<1.0	4.1
SPAIN	**Almond shells 4**	1519504	<0.1	<0.1	<1.0	3.4	<0.001	<1.0	<1.0	4.3
SPAIN	**Almond shells 5**	1519505	<0.1	<0.1	<1.0	3.3	<0.001	<1.0	<1.0	6.0
SPAIN	**Almond shells 6**	1519506	<0.1	<0.1	<1.0	2.5	<0.001	<1.0	<1.0	1.5
SPAIN	**Almond shells 7**	1205101	<0.1	0.48	0.48	0.4	<0.001	0.94	6.8	0.7
SPAIN	**Almond shells 8**	1205102	<0.1	0.5	1.3	1.5	<0.001	0.78	4.2	0.66
SPAIN	**Almond shells 9**	1110303	<0.05	<0.05	3.1	0.23	<0.001	1.3	4.3	4.5
SPAIN	**Almond shells 10**	1110304	<0.05	<0.05	5.2	0.94	0.003	2.8	7.9	9.5
SPAIN	**Hazelnut shells 1**	1701501	0.48	<0.10	1.2	3.6	0.001	4.5	<1.0	4.4
SPAIN	**Hazelnut shells 2**	1701502	0.34	<0.10	1.0	3.7	0.001	2.2	<1.0	3.1
SPAIN	**Hazelnut shells 3**	1701503	1.1	<0.10	2.3	3.5	0.001	5.7	<1.0	3.2
SPAIN	**Hazelnut shells 4**	1701504	0.35	<0.10	3.2	3.6	0.001	1.8	<1.0	6.1
SPAIN	**Hazelnut shells 5**	1701505	0.22	<0.10	9.3	22	0.003	3.4	1.1	24
SPAIN	**Olive stones 1**	1510401	< 0.1	< 0.1	< 1	2.2	<0.001	< 1	15	1.2
SPAIN	**Olive stones 2**	1510402	< 0.1	< 0.1	< 1	2.3	<0.001	< 1	< 1	1.8
SPAIN	**Olive stones 3**	1510403	< 0.1	< 0.1	< 1	2.6	<0.001	< 1	< 1	2.2
SPAIN	**Olive stones 4**	1510404	< 0.1	< 0.1	< 1	2.3	<0.001	< 1	< 1	< 1
SPAIN	**Olive stones 5**	1510405	< 0.1	< 0.1	< 1	2.3	<0.001	1.0	< 1	1.1
SPAIN	**Olive stones 6**	1510406	< 0.1	< 0.1	< 1	13	<0.001	< 1	< 1	7.9
SPAIN	**Olive stones 7**	1510407	< 0.1	< 0.1	< 1	11	<0.001	< 1	< 1	6.2
SPAIN	**Olive stones 8**	1510408	< 0.1	< 0.1	< 1	6.9	<0.001	< 1	< 1	3.7
SPAIN	**Olive stones 9**	1510409	< 0.1	< 0.1	< 1	7.3	<0.001	< 1	< 1	4.1
SPAIN	**Olive stones 10**	1510410	< 0.1	0.18	< 1	4.6	<0.001	< 1	< 1	3.7
SPAIN	**Olive tree pruning 1**	1702201	1.1	<0.10	2.3	4.4	0.015	5.3	<1.0	13
SPAIN	**Olive tree pruning 2**	1702202	2.4	<0.10	4.1	2.7	0.015	9.2	<1.0	6.4
SPAIN	**Olive tree pruning 3**	1702203	3.5	<0.10	5.6	6.8	0.013	12	<1.0	4.9
SPAIN	**Olive tree pruning 4**	1702204	4.2	<0.10	6.8	9.8	0.022	13	<1.0	4.4
SPAIN	**Olive tree pruning 5**	1702205	0.89	<0.10	3.4	5.6	0.026	3.9	3.2	11
SPAIN	**Olive tree pruning 6**	1702206	1.0	<0.10	1.9	5.8	0.029	3.6	<1.0	6.7
SPAIN	**Olive tree pruning 7**	1702207	6.1	<0.10	10	5.8	0.030	24	<1.0	9.3
SPAIN	**Olive tree pruning 8**	1702208	1.6	<0.10	3.1	27	0.006	6.4	<1.0	4.4
SPAIN	**Olive tree pruning 9**	1702209	1.2	<0.10	4.4	96	0.018	5.7	<1.0	7.7
SPAIN	**Olive tree pruning 10**	1702210	1.6	<0.10	3.7	15	0.017	6.3	<1.0	6.8
SPAIN	**Olive tree pruning 11**	1702211	1.0	<0.10	2.9	70	0.010	3.8	<1.0	14
SPAIN	**Olive tree pruning 12**	1702212	2.1	<0.10	5.8	20	0.013	7.8	<1.0	19
SPAIN	**Olive tree pruning 13**	1702213	<0.10	<0.10	2.3	4.1	0.001	<1.0	<1.0	4.4
SPAIN	**Olive tree pruning 14**	1702214	0.22	<0.10	2.1	7.9	0.009	2.2	<1.0	12
SPAIN	**Olive tree pruning 15**	1702215	1.4	<0.10	7.7	18	0.020	14	<1.0	11
SPAIN	**Olive tree pruning 16**	1702216	1.3	<0.10	9.6	6.8	0.024	14	<1.0	21
SPAIN	**Olive tree pruning 17**	1702217	0.67	<0.10	6.9	4.0	0.027	6.5	<1.0	15
SPAIN	**Olive tree pruning 18**	1702218	0.47	<0.10	3.9	4.0	0.016	4.3	<1.0	11
SPAIN	**Olive tree pruning 19**	1702219	0.48	<0.10	3.3	2.8	0.006	4.7	<1.0	7.5
SPAIN	**Olive tree pruning 20**	1702220	0.38	<0.10	6.3	5.7	0.027	3.6	1.4	18

Country	Biofuel	Original reference	As (mg/kg d.b.)	Cd (mg/kg d.b.)	Cr (mg/kg d.b.)	Cu (mg/kg d.b.)	Hg (mg/kg d.b.)	Ni (mg/kg d.b.)	Pb (mg/kg d.b.)	Zn (mg/kg d.b.)
SPAIN	**Pistachio shells 1**	1616901	2.6	<0.10	3.3	1.1	0.004	7.8	<1.0	5.0
SPAIN	**Pistachio shells 2**	1616902	0.57	<0.10	1.3	0.74	0.001	2.8	<1.0	2.1
SPAIN	**Pistachio shells 3**	1616903	0.77	<0.10	1.8	5.4	0.002	3.2	<1.0	11
SPAIN	**Pistachio shells 4**	1616904	1.3	<0.10	1.7	0.90	0.002	6.0	<1.0	2.0
SPAIN	**Pistachio shells 5**	1616905	0.52	<0.10	1.0	0.67	0.001	3.8	<1.0	1.5
SPAIN	**Pistachio shells 6**	1616906	0.27	<0.10	13	10	0.005	8.8	1.6	23
SPAIN	**Pistachio shells 7**	1616907	0.43	<0.10	9.6	11	0.004	8.5	1.2	33
SPAIN	**Pistachio shells 8**	1616908	0.17	<0.10	8.4	9.5	0.003	5.9	<1.0	16
SPAIN	**Pistachio shells 9**	1616909	0.11	<0.10	4.3	9.7	0.006	4.4	<1.0	24
SPAIN	**Pistachio shells 10**	1616910	0.25	<0.10	13	16	0.003	11	4	67
SPAIN	**Pine nut shells 1**	1616201	0.23	<0.10	1.0	2.7	0.005	2.2	<1.0	8.5
SPAIN	**Pine nut shells 2**	1616202	<0.10	<0.10	<1.0	2.2	0.002	<1.0	<1.0	7.1
SPAIN	**Pine nut shells 3**	1616203	<0.10	<0.10	<1.0	2.4	0.004	1.2	<1.0	6.7
SPAIN	**Pine nut shells 4**	1616204	1.1	<0.10	2.6	2.3	0.004	4.3	<1.0	6.2
SPAIN	**Pine nut shells 5**	1616205	0.21	<0.10	5.0	2.4	0.003	3.2	<1.0	5.8
SPAIN	**Pine nut shells 6**	1616206	<0.10	<0.10	1.0	2.6	0.002	<1.0	<1.0	5.3
SPAIN	**Pine nut shells 7**	1616207	0.40	<0.10	1.4	3.3	0.003	3.4	<1.0	6.6
SPAIN	**Pine nut shells 8**	1616208	0.74	<0.10	2.4	4.2	0.004	4.1	<1.0	11
SPAIN	**Pine nut shells 9**	1616209	0.44	<0.10	1.6	2.9	0.006	2.9	<1.0	7.9
SPAIN	**Pine nut shells 10**	1616210	<0.10	<0.10	<1.0	3.2	0.006	<1.0	<1.0	7.6
SPAIN	**Vineyard pruning 1**	1702101	0.73	<0.10	3.2	8.2	0.001	2.5	<1.0	28
SPAIN	**Vineyard pruning 2**	1702102	5.3	<0.10	9.1	10.8	0.001	16	<1.0	15
SPAIN	**Vineyard pruning 3**	1702103	1.3	<0.10	3.1	13.9	0.002	4.8	<1.0	21
SPAIN	**Vineyard pruning 4**	1702104	2.7	<0.10	6.3	9.8	0.004	6.4	<1.0	86
SPAIN	**Vineyard pruning 5**	1702105	0.56	<0.10	3.6	4.6	0.002	1.7	<1.0	26
SPAIN	**Vineyard pruning 6**	1702106	1.6	<0.10	4.3	5.3	0.003	5.0	<1.0	22
SPAIN	**Vineyard pruning 7**	1702107	0.45	<0.10	2.4	3.3	0.002	1.9	<1.0	17
SPAIN	**Vineyard pruning 8**	1702108	0.34	<0.10	4.2	3.5	0.002	1.8	<1.0	59
SPAIN	**Vineyard pruning 9**	1702109	4.6	<0.10	7.7	3.5	0.002	17	<1.0	14
SPAIN	**Vineyard pruning 10**	1702110	0.12	<0.10	2.8	3.5	0.002	<1.0	<1.0	14
SPAIN	**Vineyard pruning 11**	1702111	0.27	<0.10	2.3	3.8	0.002	1.1	<1.0	15
SPAIN	**Vineyard pruning 12**	1703101	0.69	<0.10	4.2	13.7	0.002	7.6	<1.0	13
SPAIN	**Vineyard pruning 13**	1703102	0.36	<0.10	3.2	34.6	0.002	2.8	2.3	16
SPAIN	**Vineyard pruning 14**	1703103	0.36	<0.10	2.4	9.7	0.001	2.6	<1.0	12
SPAIN	**Vineyard pruning 15**	1703104	0.69	<0.10	4.2	14	0.002	7.6	<1.0	13
SPAIN	**Vineyard pruning 16**	1703105	0.36	<0.10	3.2	35	0.002	2.8	2.3	16
SPAIN	**Vineyard pruning 17**	1703106	0.36	<0.10	2.4	9.7	0.001	2.6	<1.0	12
SPAIN	**Vineyard pruning 18**	1703107	0.16	<0.10	1.5	65	0.002	1.1	4.8	19
SPAIN	**Vineyard pruning 19**	1703108	<0.10	<0.10	1.1	4.8	0.002	<1.0	<1.0	18
SPAIN	**Vineyard pruning 20**	1703109	0.45	<0.10	3.1	7.7	0.002	3.1	<1.0	20
SPAIN	**Vineyard pruning 21**	1703110	0.38	<0.10	1.9	8.2	0.001	4.1	<1.0	16
SPAIN	**Vineyard pruning 22**	1703111	1.1	<0.10	6.1	5.6	0.003	9.8	<1.0	10
SPAIN	**Vineyard pruning 23**	1703112	0.19	<0.10	1.8	7.0	0.002	1.1	<1.0	15
SPAIN	**Vineyard pruning 24**	1703113	0.95	<0.10	4.9	7.9	0.001	9.1	<1.0	20
SPAIN	**Vineyard pellets 1**	1702801	0.37	<0.10	1.7	4.2	0.002	<1.0	<1.0	15
SPAIN	**Walnut shells 1**	1701401	0.48	<0.10	2.5	6.5	0.001	4.3	<1.0	12
SPAIN	**Walnut shells 2**	1701402	0.16	<0.10	2.4	7.2	0.001	3.2	<1.0	10
SPAIN	**Walnut shells 3**	1701403	0.16	<0.10	6.8	15	0.002	7.0	<1.0	34
SPAIN	**Walnut shells 4**	1701404	<0.10	<0.10	1.2	10	0.001	0.57	<1.0	12
SPAIN	**Walnut shells 5**	1701405	<0.10	<0.10	1.2	4.5	<0.001	1.7	<1.0	6.5
SPAIN	**Walnut shells 6**	1701406	0.37	<0.10	2.7	4.6	<0.001	4.9	<1.0	1.8

Country	Biofuel	Original reference	SST (ºC)	DT (ºC)	HT (ºC)	FT (ºC)	Disintegration				Sieving (0.50 mm sieve)				Sintering Index
							800	1000	1200	1400	800	1000	1200	1400	
SPAIN	**Almond shells 1**	1519501	720	800	1100	1200	3	4	4	4	83	100	100	100	0.4
SPAIN	**Almond shells 2**	1519502	720	740	780	1320	4	4	4	4	100	100	100	100	0.5
SPAIN	**Almond shells 3**	1519503	730	750	760	840	3	4	4	4	95	100	100	100	0.4
SPAIN	**Almond shells 4**	1519504	730	760	870	> 1450	3	4	4	4	94	100	100	100	0.3
SPAIN	**Almond shells 5**	1519505	700	760	840	> 1450	3	4	4	4	88	100	100	100	0.5
SPAIN	**Almond shells 6**	1519506	720	770	820	> 1450	4	4	4	4	98	100	100	100	0.4
SPAIN	**Almond shells 7**	1205101	780	nd	830	> 1400	4	4	4	4	100	100	100	100	0.5
SPAIN	**Almond shells 8**	1205102	880	nd	nd	> 1400	4	4	4	4	99	100	100	100	0.4
SPAIN	**Almond shells 9**	1110303	700	900	nd	> 1450	4	4	4	4	93	100	100	100	0.6
SPAIN	**Almond shells 10**	1110304	720	750	nd	> 1450	4	4	4	4	98	100	100	100	0.6
SPAIN	**Hazelnut shells 1**	1701501	740	840	nd	> 1450	4	4	4	4	98	98	100	100	1.6
SPAIN	**Hazelnut shells 2**	1701502	740	> 1450	> 1450	> 1450	3	4	4	4	86	99	99	100	1.3
SPAIN	**Hazelnut shells 3**	1701503	710	750	nd	> 1450	4	4	4	4	98	96	99	100	1.6
SPAIN	**Hazelnut shells 4**	1701504	740	> 1450	> 1450	> 1450	4	4	4	4	100	96	100	100	1.7
SPAIN	**Hazelnut shells 5**	1701505	730	> 1450	> 1450	> 1450	4	4	4	4	97	95	100	97	1.4
SPAIN	**Olive stones 1**	1510401	720	> 1450	> 1450	> 1450	4	4	4	4	99	93	92	97	1.1
SPAIN	**Olive stones 2**	1510402	730	880	nd	> 1450									1.2
SPAIN	**Olive stones 3**	1510403	710	740	1380	> 1450	4	4	4	4	98	99	87	100	0.9
SPAIN	**Olive stones 4**	1510404	730	790	1440	> 1450	4	4	4	4	96	85	89	100	1.3
SPAIN	**Olive stones 5**	1510405	720	760	nd	> 1450	4	4	4	4	97	93	86	100	1.0
SPAIN	**Olive stones 6**	1510406	730	710	nd	> 1450	4	4	4	4	98	93	88	100	1.0
SPAIN	**Olive stones 7**	1510407	730	760	1450	> 1450	4	4	4	4	100	98	92	100	0.9
SPAIN	**Olive stones 8**	1510408	720	800	990	> 1450	4	4	4	4	98	94	72	100	0.8
SPAIN	**Olive stones 9**	1510409	740	790	1030	> 1450	4	4	4	4	100	93	72	100	1.4
SPAIN	**Olive stones 10**	1510410	720	760	nd	> 1450	4	4	4	4	96	91	100	100	1.0
SPAIN	**Olive tree pruning 1**	1702201	770	1390	1450	> 1450	1	4	4	4	2	83	100	95	3.0
SPAIN	**Olive tree pruning 2**	1702202	1260	1420	1420	1430	1	1	2	3	0	23	75	91	7.6
SPAIN	**Olive tree pruning 3**	1702203	750	1340	1420	1430	4	4	4	4	94	96	99	96	3.5
SPAIN	**Olive tree pruning 4**	1702204	1110	nd	1350	1410	1	1	1	3	1	27	55	79	6.5
SPAIN	**Olive tree pruning 5**	1702205	1160	1360	1370	1390	1	1	1	3	5	48	54	80	7.2
SPAIN	**Olive tree pruning 6**	1702206	1110	nd	1360	1390	1	3	4	4	0	90	94	100	5.7
SPAIN	**Olive tree pruning 7**	1702207	760	760	> 1450	> 1450	1	4	4	4	4	95	98	92	2.9
SPAIN	**Olive tree pruning 8**	1702208	770	1350	1410	1420	1	4	4	4	54	94	97	97	4.5
SPAIN	**Olive tree pruning 9**	1702209	770	1380	1430	> 1450	1	4	4	4	64	88	93	98	3.4
SPAIN	**Olive tree pruning 10**	1702210	740	nd	1090	> 1450	3	4	4	4	85	95	96	97	2.1

Country	Biofuel	Original reference	SST (ºC)	DT (ºC)	HT (ºC)	FT (ºC)	Disintegration 800	1000	1200	1400	Sieving (0.50 mm sieve) 800	1000	1200	1400	Sintering Index
SPAIN	**Olive tree pruning 11**	1702211	730	> 1450	> 1450	> 1450	2	4	4	4	73	97	99	97	3.4
SPAIN	**Olive tree pruning 12**	1702212	730	> 1450	> 1450	> 1450	2	3	4	4	84	95	96	94	2.2
SPAIN	**Olive tree pruning 13**	1702213	750	> 1450	> 1450	> 1450	3	4	4	4	71	92	92	93	3.8
SPAIN	**Olive tree pruning 14**	1702214	760	> 1450	> 1450	> 1450	3	4	4	4	75	98	97	101	3.5
SPAIN	**Olive tree pruning 15**	1702215	760	> 1450	> 1450	> 1450	2	4	4	4	55	90	89	95	3.7
SPAIN	**Olive tree pruning 16**	1702216	700	750	nd	> 1450	4	4	4	4	99	95	100	99	1.2
SPAIN	**Olive tree pruning 17**	1702217	740	820	nd	> 1450	4	4	4	4	100	99	100	96	2.2
SPAIN	**Olive tree pruning 18**	1702218	750	> 1450	> 1450	> 1450	3	4	4	4	66	99	99	100	2.9
SPAIN	**Olive tree pruning 19**	1702219	730	870	nd	> 1450	4	4	4	4	100	100	99	97	2.2
SPAIN	**Olive tree pruning 20**	1702220	750	850	nd	> 1450	1	4	4	4	53	100	99	99	2.0
SPAIN	**Pistachio shells 1**	1616901	590	760	750	> 1450	4	4	4	4	96	97	94	97	0.7
SPAIN	**Pistachio shells 2**	1616902	720	850	nd	> 1450	4	4	4	4	98	98	97	93	0.6
SPAIN	**Pistachio shells 3**	1616903	710	1100	1410	1430	1	3	4	4	4	98	99	100	0.5
SPAIN	**Pistachio shells 4**	1616904	720	880	nd	> 1450	4	4	4	4	98	99	97	100	1.0
SPAIN	**Pistachio shells 5**	1616905	730	910	nd	> 1450	4	4	4	4	99	100	96	100	1.0
SPAIN	**Pistachio shells 6**	1616906	610	880	1150	> 1450	2	4	4	4	53	100	100	100	0.4
SPAIN	**Pistachio shells 7**	1616907	580	640	nd	> 1450	2	4	4	4	93	100	100	100	0.6
SPAIN	**Pistachio shells 8**	1616908	700	810	nd	> 1450	3	4	4	4	99	99	98	100	0.4
SPAIN	**Pistachio shells 9**	1616909	540	860	1390	> 1450	4	4	4	4	10	87	100	100	0.4
SPAIN	**Pistachio shells 10**	1616910	700	840	nd	> 1450	4	4	4	4	97	98	100	100	0.8
SPAIN	**Pine nut shells 1**	1616201	730	1040	1280	1370	1	4	4	4	25	99	98	100	0.8
SPAIN	**Pine nut shells 2**	1616202	740	1030	1290	1380	1	4	4	4	4	97	98	100	1.0
SPAIN	**Pine nut shells 3**	1616203	720	860	1150	1270	2	4	4	4	70	99	100	100	0.5
SPAIN	**Pine nut shells 4**	1616204	710	980	1170	1300	3	4	4	4	87	100	100	100	0.6
SPAIN	**Pine nut shells 5**	1616205	710	950	1180	1280	1	4	4	4	33	97	99	100	0.6
SPAIN	**Pine nut shells 6**	1616206	830	940	1180	1230	1	4	4	4	51	99	100	100	1.0
SPAIN	**Pine nut shells 7**	1616207	790	880	1100	1170	1	4	4	4	85	98	100	100	0.4
SPAIN	**Pine nut shells 8**	1616208	720	1020	1160	1290	1	4	4	4	78	99	100	100	0.7
SPAIN	**Pine nut shells 9**	1616209	680	880	1150	1300	1	4	4	4	58	99	100	100	0.5
SPAIN	**Pine nut shells 10**	1616210	690	870	1140	1190	3	4	4	4	95	99	100	100	0.6

Country	Biofuel	Original reference	SST (ºC)	DT (ºC)	HT (ºC)	FT (ºC)	Disintegration 800	Disintegration 1000	Disintegration 1200	Disintegration 1400	Sieving (0.50 mm sieve) 800	Sieving (0.50 mm sieve) 1000	Sieving (0.50 mm sieve) 1200	Sieving (0.50 mm sieve) 1400	Sintering Index
SPAIN	**Vineyard pruning 1**	1702101	750	> 1450	> 1450	> 1450	1	4	4	4	17	100	97	98	2.0
SPAIN	**Vineyard pruning 2**	1702102	1240	1300	nd	> 1450	1	1	2	2	3	44	56	69	3.3
SPAIN	**Vineyard pruning 3**	1702103	1060	1210	nd	> 1450	1	2	2	4	61	78	79	95	2.8
SPAIN	**Vineyard pruning 4**	1702104	750	> 1450	> 1450	> 1450	3	4	4	4	93	100	100	97	1.9
SPAIN	**Vineyard pruning 5**	1702105	790	1090	nd	> 1450	1	3	4	4	43	89	96	93	2.4
SPAIN	**Vineyard pruning 6**	1702106	750	> 1450	> 1450	> 1450	1	3	4	4	35	98	98	96	2.4
SPAIN	**Vineyard pruning 7**	1702107	730	> 1450	> 1450	> 1450	3	4	4	4	90	100	99	98	2.1
SPAIN	**Vineyard pruning 8**	1702108	750	> 1450	> 1450	> 1450	1	4	4	4	37	98	99	92	2.2
SPAIN	**Vineyard pruning 9**	1702109	750	> 1450	> 1450	> 1450	1	4	4	4	25	101	100	98	2.5
SPAIN	**Vineyard pruning 10**	1702110	750	> 1450	> 1450	> 1450	4	4	4	4	94	100	99	96	3.0
SPAIN	**Vineyard pruning 11**	1702111	760	> 1450	> 1450	> 1450	2	4	4	4	61	99	98	99	2.7
SPAIN	**Vineyard pruning 12**	1703101	740	920	nd	> 1450	2	4	4	4	80	99	98	99	2.0
SPAIN	**Vineyard pruning 13**	1703102	750	> 1450	> 1450	> 1450	3	4	4	4	93	99	99	97	2.5
SPAIN	**Vineyard pruning 14**	1703103	740	> 1450	> 1450	> 1450	1	3	3	4	52	86	89	96	2.8
SPAIN	**Vineyard pruning 15**	1703104	750	> 1450	> 1450	> 1450	1	3	3	4	26	85	89	93	2.5
SPAIN	**Vineyard pruning 16**	1703105	740	> 1450	> 1450	> 1450	1	4	4	4	54	98	98	96	2.0
SPAIN	**Vineyard pruning 17**	1703106	720	> 1450	> 1450	> 1450	3	4	4	4	90	99	99	99	2.5
SPAIN	**Vineyard pruning 18**	1703107	740	> 1450	> 1450	> 1450	3	4	4	4	82	96	99	99	2.1
SPAIN	**Vineyard pruning 19**	1703108	770	> 1450	> 1450	> 1450	1	4	4	4	55	94	97	99	2.6
SPAIN	**Vineyard pruning 20**	1703109	760	> 1450	> 1450	> 1450	4	4	4	4	95	99	100	90	3.3
SPAIN	**Vineyard pruning 21**	1703110	1170	> 1450	> 1450	> 1450	1	1	1	3	1	38	40	80	5.4
SPAIN	**Vineyard pruning 22**	1703111	1190	> 1450	> 1450	> 1450	1	1	1	3	1	44	54	68	3.4
SPAIN	**Vineyard pruning 23**	1703112	760	> 1450	> 1450	> 1450	3	4	4	4	84	98	97	98	4.4
SPAIN	**Vineyard pruning 24**	1703113	740	> 1450	> 1450	> 1450	1	4	4	3	8	95	94	84	2.5
SPAIN	**Vineyard pellets 1**	1702801	1,040	1,170	nd	> 1451	1	3	4	4	0	83	90	96	2.9
SPAIN	**Walnut shells 1**	1701401	710	> 1450	> 1450	> 1450	2	4	4	4	82	100	100	100	0.8
SPAIN	**Walnut shells 2**	1701402	710	> 1450	> 1450	> 1450	4	4	4	4	98	99	92	98	1.1
SPAIN	**Walnut shells 3**	1701403	720	> 1450	> 1450	> 1450	1	1	1	1	7	38	43	55	1.3
SPAIN	**Walnut shells 4**	1701404	1170	1240	1430	1450	1	1	1	4	1	6	11	100	1.1
SPAIN	**Walnut shells 5**	1701405	750	> 1450	> 1450	> 1450	1	4	4	4	29	99	100	100	2.3
SPAIN	**Walnut shells 6**	1701406	730	800	nd	> 1450	4	4	4	4	96	100	100	100	1.1

Country	Biofuel	Original reference	63 %	45 %	31.5 %	16 %	8 %	3.15 %	2 %	1 %	< 1 %
SPAIN	**Almond shells 1**	1519501	0.00	0.00	0.00	0.00	0.00	0.00	99.55	0.29	0.16
SPAIN	**Almond shells 2**	1519502	0.00	0.00	0.00	43.74	0.00	0.00	56.09	-0.12	0.29
SPAIN	**Almond shells 3**	1519503	0.00	0.00	0.00	3.13	0.00	0.00	90.54	3.08	3.24
SPAIN	**Almond shells 4**	1519504	0.00	0.00	0.00	61.93	0.00	0.00	37.15	0.31	0.61
SPAIN	**Almond shells 5**	1519505	0.00	0.00	0.00	38.03	0.00	0.00	59.32	1.21	1.44
SPAIN	**Almond shells 6**	1519506	0.00	0.00	0.00	27.13	0.00	0.00	72.59	0.08	0.20
SPAIN	**Almond shells 7**	1205101	0.00	0.34	46.86	35.98	9.77	4.77	1.01	0.60	0.67
SPAIN	**Almond shells 8**	1205102	0.00	0.00	0.00	0.00	28.45	65.59	5.26	0.56	0.14
SPAIN	**Almond shells 9**	1110303	0.00	0.00	0.00	53.66	39.98	6.11	0.09	0.00	0.16
SPAIN	**Almond shells 10**	1110304	0.00	0.00	0.00	0.00	54.64	31.30	7.38	3.36	3.33
SPAIN	**Hazelnut shells 1**	1701501	0.00	0.00	0.00	1.08	67.97	25.19	1.54	2.08	2.13
SPAIN	**Hazelnut shells 2**	1701502	0.00	0.00	0.00	0.46	50.88	42.98	3.25	1.66	0.75
SPAIN	**Hazelnut shells 3**	1701503	0.00	0.00	0.00	26.31	66.85	5.82	0.31	0.27	0.44
SPAIN	**Hazelnut shells 4**	1701504	0.00	0.00	0.00	4.55	76.75	16.40	0.66	0.88	0.77
SPAIN	**Hazelnut shells 5**	1701505	0.00	0.00	0.00	0.00	94.84	4.93	0.04	0.05	0.14
SPAIN	**Olive stones 1**	1510401	0.00	0.00	0.00	0.00	0.00	0.00	67.58	31.51	0.91
SPAIN	**Olive stones 2**	1510402	0.00	0.00	0.00	0.00	1.38	0.00	72.36	22.37	3.89
SPAIN	**Olive stones 3**	1510403	0.00	0.00	0.00	0.00	0.00	0.00	79.29	20.09	0.61
SPAIN	**Olive stones 4**	1510404	0.00	0.00	0.00	0.00	0.00	0.00	99.54	0.45	0.01
SPAIN	**Olive stones 5**	1510405	0.00	0.00	0.00	0.00	0.00	0.00	83.33	16.57	0.09
SPAIN	**Olive stones 6**	1510406	0.00	0.00	0.00	0.00	0.00	0.00	87.75	12.16	0.09
SPAIN	**Olive stones 7**	1510407	0.00	0.00	0.00	0.00	0.00	0.00	78.63	21.05	0.32
SPAIN	**Olive stones 8**	1510408	0.00	0.00	0.00	0.00	0.00	0.00	91.71	8.22	0.08
SPAIN	**Olive stones 9**	1510409	0.00	0.00	0.00	0.00	0.00	0.00	79.28	20.67	0.05
SPAIN	**Olive stones 10**	1510410	0.00	0.00	0.00	0.00	0.00	0.00	72.34	27.53	0.13
SPAIN	**Pistachio shells 1**	1616901	0.00	0.00	0.00	0.15	94.16	4.50	0.18	0.37	0.65
SPAIN	**Pistachio shells 2**	1616902	0.00	0.00	0.00	0.23	96.32	2.92	0.11	0.12	0.30
SPAIN	**Pistachio shells 3**	1616903	0.00	0.00	0.00	1.23	98.23	0.46	0.01	0.01	0.06
SPAIN	**Pistachio shells 4**	1616904	0.00	0.00	0.00	0.00	99.84	0.10	0.01	0.01	0.04
SPAIN	**Pistachio shells 5**	1616905	0.00	0.00	0.00	0.16	99.81	0.01	0.00	0.01	0.01
SPAIN	**Pistachio shells 6**	1616906	0.00	0.00	0.00	4.54	93.68	1.50	0.04	0.11	0.13
SPAIN	**Pistachio shells 7**	1616907	0.00	0.00	0.00	1.98	96.52	1.34	0.05	0.07	0.04
SPAIN	**Pistachio shells 8**	1616908	0.00	0.00	0.00	3.95	93.71	1.48	0.14	0.41	0.31
SPAIN	**Pistachio shells 9**	1616909	0.00	0.00	0.00	6.74	91.55	1.18	0.11	0.17	0.26
SPAIN	**Pistachio shells 10**	1616910	0.00	0.00	0.00	0.41	98.70	0.76	0.02	0.03	0.07

Country	Biofuel	Original reference	63 %	45 %	31.5 %	16 %	8 %	3.15 %	2 %	1 %	< 1 %
SPAIN	**Pine nut shells 1**	1616201	0.00	0.00	0.00	0.47	87.98	10.84	0.27	0.21	0.23
SPAIN	**Pine nut shells 2**	1616202	0.00	0.00	0.00	0.00	44.22	54.93	0.49	0.24	0.11
SPAIN	**Pine nut shells 3**	1616203	0.00	0.00	0.00	0.00	45.97	53.23	0.49	0.20	0.12
SPAIN	**Pine nut shells 4**	1616204	0.00	0.00	0.00	0.00	43.97	55.00	0.54	0.31	0.18
SPAIN	**Pine nut shells 5**	1616205	0.00	0.00	0.00	0.20	40.22	58.06	0.77	0.46	0.29
SPAIN	**Pine nut shells 6**	1616206	0.00	0.00	0.00	0.00	25.69	71.47	1.58	0.83	0.43
SPAIN	**Pine nut shells 7**	1616207	0.00	0.00	0.00	0.00	16.99	77.71	2.89	1.93	0.49
SPAIN	**Pine nut shells 8**	1616208	0.00	0.00	0.00	0.00	14.60	85.28	0.05	0.02	0.05
SPAIN	**Pine nut shells 9**	1616209	0.00	0.00	0.00	0.00	37.18	60.62	1.05	0.72	0.43
SPAIN	**Pine nut shells 10**	1616210	0.00	0.00	0.00	0.00	37.18	60.62	1.05	0.72	0.43
SPAIN	**Walnut shells 1**	1701401	0.00	0.00	0.00	76.24	21.25	2.10	0.07	0.10	0.23
SPAIN	**Walnut shells 2**	1701402	0.00	0.00	2.49	79.36	14.71	2.89	0.09	0.17	0.29
SPAIN	**Walnut shells 3**	1701403	0.00	0.00	58.28	40.78	0.65	0.16	0.01	0.02	0.09
SPAIN	**Walnut shells 4**	1701404	0.00	0.00	0.00	47.90	43.05	7.76	0.27	0.41	0.60
SPAIN	**Walnut shells 5**	1701405	0.00	0.00	0.68	94.34	4.63	0.19	0.00	0.04	0.12
SPAIN	**Walnut shells 6**	1701406	0.00	0.00	0.00	96.70	3.08	0.18	0.00	0.00	0.03

Country	Biofuel	Original reference	Bulk density (kg/m3)	Oil (%	Skin (%	Durability (%)	Length (mm)
SPAIN	**Almond shells 1**	1519501	510	0.14			
SPAIN	**Almond shells 2**	1519502	310	0.22			
SPAIN	**Almond shells 3**	1519503	500	0.63			
SPAIN	**Almond shells 4**	1519504	240	1.26			
SPAIN	**Almond shells 5**	1519505	400	1.09			
SPAIN	**Almond shells 6**	1519506	260	< 0.1			
SPAIN	**Almond shells 7**	1205101	380	0.50			
SPAIN	**Almond shells 8**	1205102	540	0.34			
SPAIN	**Almond shells 9**	1110303	360	2.06			
SPAIN	**Almond shells 10**	1110304	370	0.77			
SPAIN	**Hazelnut shells 1**	1701501	380	1.77			
SPAIN	**Hazelnut shells 2**	1701502	420	0.61			
SPAIN	**Hazelnut shells 3**	1701503	340	1.71			
SPAIN	**Hazelnut shells 4**	1701504	370	3.23			
SPAIN	**Hazelnut shells 5**	1701505	390	6.57			
SPAIN	**Olive stones 1**	1510401	810	0.64	0.21		
SPAIN	**Olive stones 2**	1510402	730	1.20	0.17		
SPAIN	**Olive stones 3**	1510403	770	0.35	0.11		
SPAIN	**Olive stones 4**	1510404	740	0.03	0.12		
SPAIN	**Olive stones 5**	1510405	770	0.04	0.41		
SPAIN	**Olive stones 6**	1510406	750	0.50	0.08		
SPAIN	**Olive stones 7**	1510407	760	1.10	0.01		
SPAIN	**Olive stones 8**	1510408	760	0.16	0.01		
SPAIN	**Olive stones 9**	1510409	760	0.13	0.04		
SPAIN	**Olive stones 10**	1510410	770	0.08	0.08		
SPAIN	**Pistachio shells 1**	1616901	320	0.41			
SPAIN	**Pistachio shells 2**	1616902	320	0.35			
SPAIN	**Pistachio shells 3**	1616903	300	1.28			
SPAIN	**Pistachio shells 4**	1616904	330	0.18			
SPAIN	**Pistachio shells 5**	1616905	330	0.25			
SPAIN	**Pistachio shells 6**	1616906	310	2.84			
SPAIN	**Pistachio shells 7**	1616907	320	1.73			
SPAIN	**Pistachio shells 8**	1616908	290	1.52			
SPAIN	**Pistachio shells 9**	1616909	290	1.93			
SPAIN	**Pistachio shells 10**	1616910	330	2.90			
SPAIN	**Pine nut shells 1**	1616201	480	0.32			
SPAIN	**Pine nut shells 2**	1616202	520	0.38			
SPAIN	**Pine nut shells 3**	1616203	540	0.38			
SPAIN	**Pine nut shells 4**	1616204	540	0.63			
SPAIN	**Pine nut shells 5**	1616205	550	0.83			
SPAIN	**Pine nut shells 6**	1616206	520	0.72			
SPAIN	**Pine nut shells 7**	1616207	530	0.48			
SPAIN	**Pine nut shells 8**	1616208	540	0.51			
SPAIN	**Pine nut shells 9**	1616209	520	0.52			
SPAIN	**Pine nut shells 10**	1616210	560	1.14			
SPAIN	**Vineyard pellets 1**	1702801				99.2	12.0
SPAIN	**Walnut shells 1**	1701401	280	6.19			
SPAIN	**Walnut shells 2**	1701402	250	5.13			
SPAIN	**Walnut shells 3**	1701403	220	15.08			
SPAIN	**Walnut shells 4**	1701404	340	7.10			
SPAIN	**Walnut shells 5**	1701405	260	0.13			
SPAIN	**Walnut shells 6**	1701406	250	0.27			

➢ 8.2.7 Analytical results of the samples collected in Turkey

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (%	C (%	H (%	N (%	S (%	Cl (%	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
TURKEY	**Hazelnut shells 1**	10971	14.3	1.16	51.9	5.7	0.27	0.024	0.019	20.36	17.44	18.92	16.02
TURKEY	**Hazelnut shells 2**	10972	14.1	1.17	52.6	5.7	0.22	0.021	0.015	20.51	17.63	19.06	16.21
TURKEY	**Hazelnut shells 3**	10973	16.2	1.10	52.2	5.8	0.26	0.023	0.008	20.41	17.10	18.95	15.64
TURKEY	**Hazelnut shells 4**	10974	12.7	1.50	52.3	5.8	0.42	0.029	0.012	20.62	18.01	19.15	16.58
TURKEY	**Hazelnut shells 5**	10975	12.0	1.12	52.0	5.8	0.19	0.021	0.013	20.35	17.90	18.88	16.49
TURKEY	**Hazelnut shells 6**	11083	12.7	1.16	52.0	5.7	0.32		0.017	20.54	17.94	19.10	16.54
TURKEY	**Hazelnut shells 7**	11084	13.7	1.10	52.0	5.8	0.25		0.015	20.51	17.70	19.05	16.27
TURKEY	**Hazelnut shells 8**	11085	12.8	1.11	52.1	5.8	0.25		0.019	20.46	17.84	19.00	16.43
TURKEY	**Hazelnut shells 9**	11086	12.6	1.14	52.0	5.8	0.32		0.015	20.45	17.86	18.98	16.44
TURKEY	**Hazelnut shells 10**	11087	12.1	1.76	51.7	5.8	0.25		0.017	20.35	17.89	18.89	16.49
TURKEY	**Olive stones 1**	10984	16.1	3.0	51.6	6.4	0.40	0.03	1.24	21.01	17.63	19.43	16.07
TURKEY	**Olive stones 2**	11013	39.0	2.5	53.0	6.7	0.35	0.03	0.79	21.82	13.30	20.17	11.46
TURKEY	**Olive stones 3**	11014	47.0	2.8	52.8	6.6	0.35	0.03	0.80	22.45	11.90	20.82	9.99
TURKEY	**Olive stones 4**	11079	16.4	0.7	51.2	6.2	<0,1	0.01	0.04	20.74	17.34	19.20	15.82
TURKEY	**Olive stones 5**	11080	19.3	0.5	51.4	6.2	<0,1	0.01	0.02	20.63	16.65	19.08	15.08
TURKEY	**Olive tree pruning 1**	11046	29.7	6.0	50.6	6.3	1.10	0.11	0.03	20.81	14.63	19.24	12.94
TURKEY	**Olive tree pruning 2**	11047	31.9	5.4	50.6	6.3	1.25	0.13	0.04	20.89	14.23	19.32	12.51
TURKEY	**Olive tree pruning 3**	11048	31.8	6.2	50.6	6.2	1.54	0.12	0.02	20.51	13.99	18.96	12.28
TURKEY	**Olive tree pruning 4**	11049	25.9	6.2	50.2	6.2	1.21	0.11	0.04	20.36	15.09	18.82	13.46
TURKEY	**Olive tree pruning 5**	11050	31.1	6.0	49.8	6.1	1.11	0.12	0.07	20.10	13.85	18.57	12.17
TURKEY	**Olive tree pruning 6**	11051	30.4	6.3	49.8	6.0	1.16	0.11	0.04	20.09	13.98	18.58	12.33
TURKEY	**Olive tree pruning 7**	11052	29.8	4.6	49.4	6.1	0.89	0.09	0.07	19.90	13.97	18.37	12.30
TURKEY	**Olive tree pruning 8**	11053	23.6	4.3	49.4	6.2	1.32	0.10	0.03	20.26	15.48	18.72	13.87
TURKEY	**Olive tree pruning 9**	11054	21.4	5.0	50.2	6.2	1.02	0.10	0.02	20.21	15.89	18.66	14.30
TURKEY	**Olive tree pruning 10**	11055	30.8	4.5	50.2	6.2	1.34	0.11	0.03	20.28	14.03	18.74	12.35

Country	Biofuel	Original reference	Moisture (% w.b.)	Ash (%	C (%	H (%	N (%	S (%	Cl (%	GCVv,0 (MJ/kg)	GCVv,x (MJ/kg)	NCVp,0 (MJ/kg)	NCVp,x (MJ/kg)
TURKEY	**Pistachio shells 1**	10982	14.0	3.7	49.0	6.1	0.49	0.040	0.041	19.31	16.60	17.78	15.11
TURKEY	**Pistachio shells 2**	10983	10.6	0.81	48.6	6.1	0.16	0.013	0.014	19.10	17.07	17.57	15.62
TURKEY	**Pistachio shells 3**	11075	12.3	0.48	48.6	6.1	<0,1		0.013	19.16	16.81	17.64	15.35
TURKEY	**Pistachio shells 4**	11076	12.3	0.57	48.6	5.9	0.12		0.044	19.16	16.80	17.67	15.36
TURKEY	**Pistachio shells 5**	11077	7.7	0.34	48.5	6.0	<0,1		0.017	18.98	17.51	17.47	16.11
TURKEY	**Pistachio shells 6**	11078	8.0	0.36	48.5	6.1	<0,1		0.012	19.06	17.53	17.54	16.12
TURKEY	**Vineyard pruning 1**	11036	42.6	4.3	48.6	5.5	0.67	0.06	0.10	18.98	10.89	17.59	9.17
TURKEY	**Vineyard pruning 2**	11037	44.0	4.1	48.9	5.5	0.66	0.05	0.09	18.90	10.59	17.50	8.85
TURKEY	**Vineyard pruning 3**	11038	46.8	3.6	48.6	5.5	0.59	0.05	0.09	18.85	10.04	17.45	8.25
TURKEY	**Vineyard pruning 4**	11039	47.9	3.3	48.6	5.6	0.87	0.07	0.10	19.19	10.01	17.78	8.20
TURKEY	**Vineyard pruning 5**	11040	46.6	3.6	48.5	5.5	0.54	0.05	0.10	19.11	10.21	17.72	8.43
TURKEY	**Vineyard pruning 6**	11041	46.7	3.5	48.7	5.5	0.56	0.05	0.10	19.11	10.18	17.72	8.40
TURKEY	**Vineyard pruning 7**	11042	44.3	4.0	48.9	5.8	0.71	0.05	0.03	19.29	10.74	17.82	8.94
TURKEY	**Vineyard pruning 8**	11043	48.0	3.6	48.8	5.8	0.65	0.04	0.11	19.09	9.92	17.63	8.09
TURKEY	**Vineyard pruning 9**	11044	48.4	3.9	48.9	5.6	0.79	0.05	0.07	18.83	9.71	17.40	7.89
TURKEY	**Vineyard pruning 10**	11045	45.3	3.9	48.7	5.7	0.81	0.05	0.02	19.15	10.47	17.72	8.69
TURKEY	**Wallnut shells 1**	10976	11.8	0.94	51.8	6.0	0.31	0.019	0.018	20.81	18.35	19.30	16.90
TURKEY	**Wallnut shells 2**	10977	10.0	1.13	52.7	6.2	0.42	0.023	0.019	21.25	19.12	19.69	17.65
TURKEY	**Wallnut shells 3**	10978	11.3	1.01	50.9	5.9	0.16	0.013	0.017	20.22	17.93	18.74	16.51
TURKEY	**Wallnut shells 4**	10979	11.0	1.29	51.1	6.0	0.23	0.018	0.028	20.20	17.98	18.69	16.54
TURKEY	**Wallnut shells 5**	10980	13.6	0.97	50.7	6.0	0.14	0.011	0.017	19.88	17.19	18.38	15.73
TURKEY	**Wallnut shells 6**	10981	9.2	1.25	50.9	5.9	0.13	0.011	0.127	20.04	18.20	18.55	16.80
TURKEY	**Wallnut shells 7**	11034	10.6	1.12	51.9	5.7	0.32	0.022	0.029	20.76	18.56	19.32	17.19
TURKEY	**Wallnut shells 8**	11035	9.0	1.37	51.0	5.2	0.20	0.015	0.087	20.10	18.30	18.76	17.04
TURKEY	**Wallnut shells 9**	11081	7.6	1.43	51.5	6.0	0.24	0.017	0.021	20.43	18.89	18.93	17.49
TURKEY	**Wallnut shells 10**	11082	10.2	1.14	51.4	5.8	0.24	0.018	0.030	20.41	18.32	18.94	16.93

Country	Biofuel	Original reference	Al (% d.b.)	Ba (% d.b.)	Ca (% d.b.)	Fe (% d.b.)	K (% d.b.)	Mg (% d.b.)	Mn (% d.b.)	Na (% d.b.)	P (% d.b.)	S (% d.b.)	Si (% d.b.)	Sr (% d.b.)	Ti (% d.b.)	Zn (% d.b.)
TURKEY	**Hazelnut shells 1**	10971	0.0023	0.0008	0.2020	0.0029	0.2570	0.0305	0.0031	0.0008	0.0192	0.0244	0.0023	0.00000	0.00032	0.00040
TURKEY	**Hazelnut shells 2**	10972	0.0025	0.0012	0.2060	0.0027	0.2860	0.0294	0.0033	0.0012	0.0192	0.0263	0.0026	0.00000	0.00080	0.00039
TURKEY	**Hazelnut shells 3**	10973	0.0030	0.0016	0.1790	0.0029	0.2790	0.0259	0.0037	0.0012	0.0154	0.0273	0.0046	0.00000	0.00027	0.00042
TURKEY	**Hazelnut shells 4**	10974	0.0303	0.0013	0.2320	0.0183	0.3050	0.0368	0.0042	0.0040	0.0271	0.0324	0.0730	0.00000	0.00509	0.00057
TURKEY	**Hazelnut shells 5**	10975	0.0024	0.0007	0.2140	0.0030	0.2660	0.0283	0.0044	0.0006	0.0143	0.0245	0.0090	0.00000	0.00030	0.00079
TURKEY	**Hazelnut shells 6**	11083	0.0115	0.0009	0.1800	0.0082	0.2550	0.0276	0.0066	0.0018	0.0196	0.0248	0.0440	0.00000	0.00271	0.00044
TURKEY	**Hazelnut shells 7**	11084	0.0053	0.0006	0.2010	0.0058	0.2450	0.0264	0.0052	0.0012	0.0156	0.0229	0.0144	0.00000	0.00084	0.00043
TURKEY	**Hazelnut shells 8**	11085	0.0045	0.0008	0.1990	0.0052	0.2550	0.0260	0.0060	0.0019	0.0173	0.0261	0.0127	0.00000	0.00087	0.00046
TURKEY	**Hazelnut shells 9**	11086	0.0086	0.0011	0.1970	0.0069	0.2640	0.0290	0.0075	0.0017	0.0190	0.0264	0.0397	0.00000	0.00126	0.00050
TURKEY	**Hazelnut shells 10**	11087	0.0746	0.0011	0.2010	0.0461	0.2540	0.0347	0.0065	0.0062	0.0175	0.0249	0.2400	0.00000	0.00970	0.00052
TURKEY	**Olive stones 1**	10984	0.0011	0.0001	0.0502	0.0030	0.1940	0.0145	0.0004	0.8870	0.0291	0.0321	0.0017	0.00000	0.00022	0.00052
TURKEY	**Olive stones 2**	11013	0.0003	0.0003	0.1700	0.0251	0.0244	0.0140	0.0003	0.7190	0.0228	0.0284	<0,0011	0.00000	0.00011	0.00047
TURKEY	**Olive stones 3**	11014	0.0005	0.0003	0.3010	0.0128	0.0126	0.0135	0.0002	0.7310	0.0124	0.0347	<0,00113	0.00000	0.00128	0.00204
TURKEY	**Olive stones 4**	11079	0.0021	0.0001	0.0578	0.0048	0.2070	0.0166	0.0005	0.0024	0.0110	0.0147	0.0083	0.00000	0.00034	0.00014
TURKEY	**Olive stones 5**	11080	0.0001	0.0001	0.0650	0.0019	0.1230	0.0121	0.0004	0.0004	0.0056	0.0101	<0,001	0.00000	0.00003	0.00006
TURKEY	**Olive tree pruning 1**	11046	0.0376	0.0009	1.3200	0.0269	0.8710	0.2530	0.0018	0.0069	0.0912	0.1350	0.0897	0.00000	0.00314	0.00132
TURKEY	**Olive tree pruning 2**	11047	0.0273	0.0007	1.0600	0.0196	0.9910	0.2060	0.0015	0.0055	0.0965	0.1420	0.0646	0.00000	0.00231	0.00118
TURKEY	**Olive tree pruning 3**	11048	0.0169	0.0013	1.5100	0.0137	0.9130	0.1130	0.0032	0.0047	0.1300	0.1300	0.0625	0.00000	0.00127	0.00122
TURKEY	**Olive tree pruning 4**	11049	0.0240	0.0011	1.4400	0.0170	0.7020	0.1360	0.0031	0.0069	0.0817	0.1120	0.0688	0.00000	0.00171	0.00094
TURKEY	**Olive tree pruning 5**	11050	0.0153	0.0007	1.3300	0.0118	1.0100	0.1260	0.0011	0.0041	0.0986	0.1340	0.0444	0.00000	0.00135	0.00134
TURKEY	**Olive tree pruning 6**	11051	0.0183	0.0010	1.5500	0.0140	0.9200	0.1410	0.0014	0.0039	0.0923	0.1230	0.0509	0.00000	0.00137	0.00116
TURKEY	**Olive tree pruning 7**	11052	0.0153	0.0005	0.9660	0.0108	0.8550	0.1050	0.0010	0.0048	0.0979	0.0936	0.0358	0.00000	0.00125	0.00116
TURKEY	**Olive tree pruning 8**	11053	0.0188	0.0005	1.1000	0.0133	0.4540	0.1570	0.0018	0.0052	0.0784	0.1100	0.0500	0.00000	0.00171	0.00115
TURKEY	**Olive tree pruning 9**	11054	0.0259	0.0007	1.2200	0.0158	0.9010	0.1070	0.0023	0.0035	0.0997	0.1090	0.0714	0.00000	0.00181	0.00103
TURKEY	**Olive tree pruning 10**	11055	0.0246	0.0005	1.1600	0.0168	0.5330	0.1660	0.0019	0.0040	0.0910	0.1220	0.0730	0.00000	0.00229	0.00131
TURKEY	**Pistachio shells 1**	10982	0.0058	0.0001	0.1530	0.0046	1.7200	0.0317	0.0001	0.0030	0.0475	0.0446	0.0163	0.00000	0.00194	0.00027
TURKEY	**Pistachio shells 2**	10983	0.0019	0.0001	0.0689	0.0014	0.3210	0.0141	0.0001	0.0010	0.0220	0.0154	0.0048	0.00000	0.00022	0.00017
TURKEY	**Pistachio shells 3**	11075	0.0013	0.0002	0.0587	0.0010	0.1790	0.0114	0.0001	0.0015	0.0177	0.0120	0.0029	0.00000	0.00019	0.00012
TURKEY	**Pistachio shells 4**	11076	0.0012	0.0002	0.0582	0.0011	0.1760	0.0114	0.0001	0.0217	0.0176	0.0117	0.0025	0.00000	0.00017	0.00013
TURKEY	**Pistachio shells 5**	11077	0.0006	0.0001	0.0420	0.0006	0.1040	0.0077	0.0001	0.0011	0.0068	0.0069	<0,00102	0.00000	0.00006	0.00008
TURKEY	**Pistachio shells 6**	11078	0.0006	0.0001	0.0334	0.0013	0.1380	0.0065	0.0001	0.0009	0.0102	0.0078	<0,001	0.00000	0.00043	0.00015
TURKEY	**Vineyard pruning 1**	11036	0.0336	0.0018	0.7400	0.0203	0.9070	0.1380	0.0025	0.0170	0.0941	0.0592	0.1170	0.00000	0.00302	0.00203
TURKEY	**Vineyard pruning 2**	11037	0.0127	0.0017	0.6280	0.0084	1.1100	0.0963	0.0013	0.0149	0.1310	0.0541	0.0392	0.00000	0.00100	0.00134
TURKEY	**Vineyard pruning 3**	11038	0.0071	0.0013	0.7180	0.0053	0.8720	0.1100	0.0014	0.0137	0.1390	0.0506	0.0178	0.00000	0.00055	0.00236
TURKEY	**Vineyard pruning 4**	11039	0.0087	0.0011	0.5370	0.0070	0.6630	0.1850	0.0012	0.0717	0.1560	0.0644	0.0233	0.00000	0.00074	0.00139
TURKEY	**Vineyard pruning 5**	11040	0.0075	0.0025	0.6770	0.0055	0.7220	0.1340	0.0016	0.0658	0.1170	0.0477	0.0210	0.00000	0.00059	0.00306
TURKEY	**Vineyard pruning 6**	11041	0.0078	0.0023	0.6060	0.0061	0.6760	0.1330	0.0015	0.0811	0.0981	0.0467	0.0220	0.00000	0.00062	0.00247
TURKEY	**Vineyard pruning 7**	11042	0.0077	0.0027	0.7610	0.0054	0.9130	0.1430	0.0044	0.0039	0.0993	0.0544	0.0270	0.00000	0.00051	0.00142
TURKEY	**Vineyard pruning 8**	11043	0.0054	0.0014	0.7890	0.0043	0.6140	0.1970	0.0030	0.0302	0.0840	0.0499	0.0151	0.00000	0.00040	0.00192
TURKEY	**Vineyard pruning 9**	11044	0.0047	0.0018	0.7760	0.0039	0.8130	0.1750	0.0040	0.0141	0.1520	0.0544	0.0141	0.00000	0.00038	0.00267
TURKEY	**Vineyard pruning 10**	11045	0.0067	0.0026	0.7710	0.0049	0.8350	0.1410	0.0048	0.0032	0.1020	0.0539	0.0231	0.00000	0.00042	0.00159

Country	Biofuel	Original reference	Al (% d.b.)	Ba (% d.b.)	Ca (% d.b.)	Fe (% d.b.)	K (% d.b.)	Mg (% d.b.)	Mn (% d.b.)	Na (% d.b.)	P (% d.b.)	S (% d.b.)	Si (% d.b.)	Sr (% d.b.)	Ti (% d.b.)	Zn (% d.b.)
TURKEY	**Wallnut shells 1**	10976	0.0019	0.0003	0.2040	0.0035	0.2100	0.0258	0.0005	0.0007	0.0227	0.0204	0.0060	0.00000	0.00045	0.00028
TURKEY	**Wallnut shells 2**	10977	0.0046	0.0004	0.2580	0.0058	0.1760	0.0454	0.0006	0.0010	0.0482	0.0282	0.0089	0.00000	0.00082	0.00041
TURKEY	**Wallnut shells 3**	10978	0.0036	0.0003	0.2270	0.0037	0.1680	0.0247	0.0009	0.0012	0.0094	0.0137	0.0045	0.00000	0.00029	0.00013
TURKEY	**Wallnut shells 4**	10979	0.0055	0.0005	0.2390	0.0051	0.2890	0.0339	0.0006	0.0015	0.0230	0.0199	0.0121	0.00000	0.00064	0.00026
TURKEY	**Wallnut shells 5**	10980	0.0013	0.0003	0.2430	0.0045	0.1710	0.0181	0.0006	0.0008	0.0090	0.0130	<0,00109	0.00000	0.00047	0.00010
TURKEY	**Wallnut shells 6**	10981	0.0007	0.0002	0.1500	0.0014	0.4410	0.0181	0.0009	0.0015	0.0180	0.0124	<0,00117	0.00000	0.00013	0.00014
TURKEY	**Wallnut shells 7**	11034	0.0015	0.0004	0.3190	0.0045	0.1610	0.0263	0.0011	0.0006	0.0358	0.0228	0.0017	0.00000	0.00027	0.00029
TURKEY	**Wallnut shells 8**	11035	0.0016	0.0002	0.2120	0.0025	0.3940	0.0235	0.0008	0.0036	0.0230	0.0155	<0,00112	0.00000	0.00032	0.00027
TURKEY	**Wallnut shells 9**	11081	0.0281	0.0004	0.1780	0.0168	0.3630	0.0310	0.0013	0.0040	0.0267	0.0174	0.0502	0.00000	0.00434	0.00051
TURKEY	**Wallnut shells 10**	11082	0.0017	0.0009	0.2640	0.0047	0.2050	0.0252	0.0016	0.0011	0.0268	0.0174	0.0021	0.00000	0.00021	0.00027

Country	Biofuel	Original reference	As (mg/kg d.b.)	Cd (mg/kg d.b.)	Cr (mg/kg d.b.)	Cu (mg/kg d.b.)	Hg (mg/kg d.b.)	Ni (mg/kg d.b.)	Pb (mg/kg d.b.)	Zn (mg/kg d.b.)
TURKEY	**Hazelnut shells 1**	10971	0.01	< 0,01	1.24	4.2	0.002	0.94	0.02	4.0
TURKEY	**Hazelnut shells 2**	10972	< 0,01	< 0,01	0.52	4.2	0.001	0.43	0.03	3.9
TURKEY	**Hazelnut shells 3**	10973	0.02	0.01	0.74	4.3	0.001	0.56	0.04	4.2
TURKEY	**Hazelnut shells 4**	10974	0.04	0.03	10.6	4.8	0.001	6.5	0.11	5.7
TURKEY	**Hazelnut shells 5**	10975	0.01	0.02	2.3	5.1	0.001	1.69	0.04	7.9
TURKEY	**Hazelnut shells 6**	11083	0.04	0.02	4.1	4.0	0.001	2.6	0.09	4.4
TURKEY	**Hazelnut shells 7**	11084	0.06	0.01	1.26	3.9	0.001	0.98	0.06	4.3
TURKEY	**Hazelnut shells 8**	11085	0.02	0.02	1.06	3.9	0.001	0.89	0.09	4.6
TURKEY	**Hazelnut shells 9**	11086	0.03	0.02	1.15	3.8	0.001	0.87	0.08	5.0
TURKEY	**Hazelnut shells 10**	11087	0.15	0.03	12.9	4.5	0.001	7.7	0.37	5.2
TURKEY	**Olive stones 1**	10984	0.053	<0,01	2.624	5.935	<0.001	1.385	0.070	5.16
TURKEY	**Olive stones 2**	11013	0.025	<0,01	7.128	4.407	0.001	3.860	0.040	4.66
TURKEY	**Olive stones 3**	11014	0.026	<0,01	12.486	6.143	0.001	6.952	0.244	20.4
TURKEY	**Olive stones 4**	11079	0.056	<0,01	7.361	2.769	<0.001	3.470	0.022	1.38
TURKEY	**Olive stones 5**	11080	0.022	<0,01	3.276	2.207	0.001	1.631	< 0,02	0.563
TURKEY	**Olive tree pruning 1**	11046	1.31	0.0231	2.61	18.7	0.063	2.03	0.414	13.2
TURKEY	**Olive tree pruning 2**	11047	0.918	0.0239	1.85	16.2	0.036	1.61	0.322	11.8
TURKEY	**Olive tree pruning 3**	11048	0.218	0.0163	1.9	4.8	0.019	2.89	0.406	12.2
TURKEY	**Olive tree pruning 4**	11049	0.429	0.0194	1.35	8.16	0.034	2.11	0.301	9.42
TURKEY	**Olive tree pruning 5**	11050	0.231	< 0,02	1.39	16.2	0.028	1.51	0.166	13.4
TURKEY	**Olive tree pruning 6**	11051	0.225	0.0166	1.49	12.6	0.032	1.56	0.185	11.6
TURKEY	**Olive tree pruning 7**	11052	0.17	0.0181	1.29	5.72	0.034	1.94	0.199	11.6
TURKEY	**Olive tree pruning 8**	11053	0.239	0.0309	2.94	4.31	0.019	2.34	0.238	11.5
TURKEY	**Olive tree pruning 9**	11054	0.178	< 0,02	2.29	4.35	0.014	2.55	0.228	10.3
TURKEY	**Olive tree pruning 10**	11055	0.292	0.0374	3.61	6.41	0.018	2.86	0.287	13.1
TURKEY	**Pistachio shells 1**	10982	0.03	< 0,01	2.0	3.5	0.001	1.38	0.05	2.7
TURKEY	**Pistachio shells 2**	10983	0.01	< 0,01	0.72	1.68	0.001	0.47	0.02	1.72
TURKEY	**Pistachio shells 3**	11075	<0,01	<0,01	0.72	1.12	<0.001	0.43	< 0,02	1.22
TURKEY	**Pistachio shells 4**	11076	0.01	<0,01	0.83	1.13	<0.001	0.50	< 0,02	1.33
TURKEY	**Pistachio shells 5**	11077	<0,01	<0,01	0.58	0.98	<0.001	0.27	< 0,02	0.78
TURKEY	**Pistachio shells 6**	11078	<0,01	<0,01	1.07	1.09	<0.001	0.55	< 0,02	1.48

Country	Biofuel	Original reference	As (mg/kg d.b.)	Cd (mg/kg d.b.)	Cr (mg/kg d.b.)	Cu (mg/kg d.b.)	Hg (mg/kg d.b.)	Ni (mg/kg d.b.)	Pb (mg/kg d.b.)	Zn (mg/kg d.b.)
TURKEY	**Vineyard pruning 1**	11036	0.265	< 0,02	4.735	29.730	0.003	4.526	0.139	20.3
TURKEY	**Vineyard pruning 2**	11037	0.133	< 0,02	1.834	12.764	0.001	2.741	0.064	13.4
TURKEY	**Vineyard pruning 3**	11038	0.071	< 0,02	1.113	12.400	0.002	2.559	0.059	23.6
TURKEY	**Vineyard pruning 4**	11039	0.270	< 0,02	1.973	11.528	0.007	2.427	0.054	13.9
TURKEY	**Vineyard pruning 5**	11040	0.157	< 0,02	1.586	13.618	0.002	2.694	0.068	30.6
TURKEY	**Vineyard pruning 6**	11041	0.158	< 0,02	1.307	14.980	0.002	2.462	0.096	24.7
TURKEY	**Vineyard pruning 7**	11042	0.133	< 0,02	1.121	10.857	0.002	2.939	0.118	14.2
TURKEY	**Vineyard pruning 8**	11043	0.072	< 0,02	1.115	52.253	0.001	2.898	0.062	19.2
TURKEY	**Vineyard pruning 9**	11044	0.066	< 0,02	0.842	10.459	0.002	2.746	0.057	26.7
TURKEY	**Vineyard pruning 10**	11045	0.120	< 0,02	1.065	10.494	0.002	3.002	0.118	15.9
TURKEY	**Wallnut shells 1**	10976	0.01	< 0,01	4.6	3.7	0.001	2.8	0.05	2.8
TURKEY	**Wallnut shells 2**	10977	0.03	< 0,01	5.3	4.9	<0.001	3.6	0.05	4.1
TURKEY	**Wallnut shells 3**	10978	0.01	< 0,01	2.5	3.3	<0.001	1.54	0.04	1.31
TURKEY	**Wallnut shells 4**	10979	0.02	< 0,01	2.2	4.0	<0.001	1.61	0.05	2.6
TURKEY	**Wallnut shells 5**	10980	< 0,01	< 0,01	0.60	3.4	<0.001	0.43	0.12	0.99
TURKEY	**Wallnut shells 6**	10981	< 0,01	< 0,01	0.41	2.8	<0.001	0.28	< 0,01	1.39
TURKEY	**Wallnut shells 7**	11034	0.01	< 0,01	6.1	3.2	<0.001	4.0	0.02	2.9
TURKEY	**Wallnut shells 8**	11035	0.02	< 0,01	1.62	2.8	<0.001	0.69	0.03	2.7
TURKEY	**Wallnut shells 9**	11081	0.06	<0,01	6.4	41.9	0.001	3.8	0.06	5.1
TURKEY	**Wallnut shells 10**	11082	0.02	<0,01	7.1	4.0	0.001	4.2	0.04	2.7

Country	Biofuel	Original reference	SST (ºC)	DT (ºC)	HT (ºC)	FT (ºC)	Disintegration 800 ºC	1000	1200	1400	Sieving (0.50 mm sieve) 800 ºC	1000	1200	1400	Sintering Index
TURKEY	**Hazelnut shells 1**	10971	740	940	>1550	>1550									1.1
TURKEY	**Hazelnut shells 2**	10972	720	940	>1550	>1550									1.0
TURKEY	**Hazelnut shells 3**	10973	740	1000	>1550	>1550									0.9
TURKEY	**Hazelnut shells 4**	10974	720	1300	1450	1480									1.0
TURKEY	**Hazelnut shells 5**	10975	740	1220	>1550	>1550									1.1
TURKEY	**Hazelnut shells 6**	11083	730	870	>1550	>1550									1.0
TURKEY	**Hazelnut shells 7**	11084	740	900	>1550	>1550									1.1
TURKEY	**Hazelnut shells 8**	11085	720	1100	>1550	>1550									1.0
TURKEY	**Hazelnut shells 9**	11086	740	880	>1550	>1550									1.0
TURKEY	**Hazelnut shells 10**	11087	910	1150	1200	1220									1.1
TURKEY	**Olive stones 1**	10984	590	610	650	710	4	4	4	4	100	100	100	100	0.1
TURKEY	**Olive stones 2**	11013	590	640	1010	1490	4	4	4	4	100	100	100	100	0.3
TURKEY	**Olive stones 3**	11014	580	650	>1550	>1550	4	4	4	4	100	100	100	100	0.4
TURKEY	**Olive stones 4**	11079	690	930	>1550	>1550	4	4	4	4	99	98	100	100	0.4
TURKEY	**Olive stones 5**	11080	720	770	>1550	>1550	4	4	4	4	100	96	100	100	0.8
TURKEY	**Olive tree pruning 1**	11046	750	1330	>1550	>1550	3	4	4	4	85	96	100	97	2.2
TURKEY	**Olive tree pruning 2**	11047	720	1270	>1550	>1550	4	4	4	4	99	100	100	100	1.5
TURKEY	**Olive tree pruning 3**	11048	760	1330	>1550	>1550	4	4	4	4	99	100	100	100	2.1
TURKEY	**Olive tree pruning 4**	11049	720	1330	>1550	>1550	4	4	4	4	94	98	99	99	2.6
TURKEY	**Olive tree pruning 5**	11050	690	1290	>1550	>1550	4	4	4	4	99	100	100	100	1.7
TURKEY	**Olive tree pruning 6**	11051	730	980	>1550	>1550	4	4	4	4	100	100	100	100	2.2
TURKEY	**Olive tree pruning 7**	11052	690	890	>1550	>1550	4	4	4	4	100	100	100	100	1.5
TURKEY	**Olive tree pruning 8**	11053	1190	1250	>1550	>1550	4	4	4	4	98	95	99	96	3.3
TURKEY	**Olive tree pruning 9**	11054	740	940	>1550	>1550	4	4	4	4	99	100	100	100	1.7
TURKEY	**Olive tree pruning 10**	11055	750	1190	>1550	>1550	1	4	4	4	7	96	96	97	2.9
TURKEY	**Pistachio shells 1**	10982	620	820	870	880									0.1
TURKEY	**Pistachio shells 2**	10983	690	860	1090	>1550									0.3
TURKEY	**Pistachio shells 3**	11075	720	920	>1550	>1550									0.5
TURKEY	**Pistachio shells 4**	11076	570	660	>1550	>1550									0.4
TURKEY	**Pistachio shells 5**	11077	700	790	>1550	>1550									0.6
TURKEY	**Pistachio shells 6**	11078	720	920	>1550	>1550									0.3

Country	Biofuel	Original reference	SST (ºC)	DT (ºC)	HT (ºC)	FT (ºC)	Disintegration 800 ºC	Disintegration 1000 ºC	Disintegration 1200 ºC	Disintegration 1400 ºC	Sieving (0.50 mm sieve) 800 ºC	Sieving (0.50 mm sieve) 1000 ºC	Sieving (0.50 mm sieve) 1200 ºC	Sieving (0.50 mm sieve) 1400 ºC	Sintering Index
TURKEY	**Vineyard pruning 1**	11036	670	940	>1550	>1550	1	4	4	4	7	96	96	97	1.1
TURKEY	**Vineyard pruning 2**	11037	610	970	>1550	>1550	1	4	4	4	7	96	96	97	0.8
TURKEY	**Vineyard pruning 3**	11038	630	920	>1550	>1550	1	4	4	4	7	96	96	97	1.1
TURKEY	**Vineyard pruning 4**	11039	630	1020	>1550	>1550	1	4	4	4	7	96	96	97	1.2
TURKEY	**Vineyard pruning 5**	11040	620	1010	>1550	>1550	1	4	4	4	7	96	96	97	1.2
TURKEY	**Vineyard pruning 6**	11041	630	1000	>1550	>1550	1	4	4	4	7	96	96	97	1.2
TURKEY	**Vineyard pruning 7**	11042	720	790	>1550	>1550	1	4	4	4	7	96	96	97	1.2
TURKEY	**Vineyard pruning 8**	11043	680	900	>1550	>1550	1	4	4	4	7	96	96	97	1.8
TURKEY	**Vineyard pruning 9**	11044	660	740	>1550	>1550	1	4	4	4	7	96	96	97	1.4
TURKEY	**Vineyard pruning 10**	11045	710	1320	>1550	>1550	1	4	4	4	7	96	96	97	1.3
TURKEY	**Wallnut shells 1**	10976	720	1160	>1550	>1550									1.3
TURKEY	**Wallnut shells 2**	10977	750	1380	>1550	>1550									2.1
TURKEY	**Wallnut shells 3**	10978	720	1390	>1550	>1550									1.8
TURKEY	**Wallnut shells 4**	10979	730	1130	>1550	>1550									1.1
TURKEY	**Wallnut shells 5**	10980	750	1160	>1550	>1550									1.8
TURKEY	**Wallnut shells 6**	10981	680	790	>1550	>1550									0.5
TURKEY	**Wallnut shells 7**	11034	660	1350	>1550	>1550									2.5
TURKEY	**Wallnut shells 8**	11035	640	910	>1550	>1550									0.7
TURKEY	**Wallnut shells 9**	11081	690	1140	1460	1500									0.7
TURKEY	**Wallnut shells 10**	11082	710	1250	>1550	>1550									1.7

Country	Biofuel	Original reference	Bulk density (kg/m3)	Oil (% d.b.)
TURKEY	**Hazelnut shells 1**	10971	300	2.73
TURKEY	**Hazelnut shells 2**	10972	280	0.26
TURKEY	**Hazelnut shells 3**	10973	300	0.16
TURKEY	**Hazelnut shells 4**	10974	285	0.72
TURKEY	**Hazelnut shells 5**	10975	282	0.28
TURKEY	**Hazelnut shells 6**	11083	318	0.45
TURKEY	**Hazelnut shells 7**	11084	305	0.16
TURKEY	**Hazelnut shells 8**	11085	295	0.11
TURKEY	**Hazelnut shells 9**	11086	328	0.44
TURKEY	**Hazelnut shells 10**	11087	288	0.80
TURKEY	**Olive stones 1**	10984	728	4.97
TURKEY	**Olive stones 2**	11013	777	7.89
TURKEY	**Olive stones 3**	11014	849	16.66
TURKEY	**Olive stones 4**	11079	683	1.62
TURKEY	**Olive stones 5**	11080	719	0.45
TURKEY	**Pistachio shells 1**	10982	294	4.11
TURKEY	**Pistachio shells 2**	10983	335	1.16
TURKEY	**Pistachio shells 3**	11075	315	0.24
TURKEY	**Pistachio shells 4**	11076	318	0.20
TURKEY	**Pistachio shells 5**	11077	321	0.14
TURKEY	**Pistachio shells 6**	11078	349	0.36
TURKEY	**Wallnut shells 1**	10976	224	3.98
TURKEY	**Wallnut shells 2**	10977	216	6.36
TURKEY	**Wallnut shells 3**	10978	245	0.92
TURKEY	**Wallnut shells 4**	10979	225	2.27
TURKEY	**Wallnut shells 5**	10980	238	0.23
TURKEY	**Wallnut shells 6**	10981	235	0.33
TURKEY	**Wallnut shells 7**	11034	233	4.68
TURKEY	**Wallnut shells 8**	11035	208	2.38
TURKEY	**Wallnut shells 9**	11081	177	3.04
TURKEY	**Wallnut shells 10**	11082	246	1.86

9. BIBLIOGRAPHY

[1] M.J. Fernández, J.E. Carrasco, Comparing methods for predicting the sintering of biomass ash in combustion, Fuel 84 (2005) 1893-1900.