

Evaluation of oil and flour for human nutrition obtained from conventional and organic grape seed Bordô from a winery in the South of Brazil

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SUMMARY: The south of Brazil is one of the largest producers of grapes, and as a consequence there is a large generation of waste that can be used as a profitable alternative source. The aim of this work was to obtain and evaluate oil and the flour for human consumption from the residue of cold-pressed Bordô from conventional and organic grape seeds in a winery in the south of Brazil. By cold pressing, the organic oil obtained higher yield. The quality parameters of the conventional oil were better, although with a higher index of peroxides and iodine. The conventional flour presented better results for quality and centesimal composition, mainly due to the higher fiber content and the fact that it did not contain high acidity or humidity. Therefore, the results of products were similar for both crops, but the conventional one was better. However, traces in the agrochemical residue analysis found for the conventional crop might better qualify the organic products.

KEYWORDS: *Centesimal composition; Flour; Oil; Quality*

RESUMEN: *Evaluación de aceites y harinas, para nutrición humana, obtenidos de semillas de uvas convencionales y orgánicas Bordô del sur de Brasil.* El sur de Brasil es uno de los mayores productores de uva, por lo que existe una gran generación de residuos que se pueden utilizar como fuente alternativa y rentabilizar. El objetivo de este trabajo es obtener y evaluar los aceites y las harinas, para nutrición humana, del residuo de prensado en frío de las semillas de uva convencionales y orgánicas de Bordô en una bodega del sur de Brasil. Al presionar en frío, el aceite orgánico se obtuvo con gran rendimiento. Los parámetros de calidad del aceite convencional fueron mejores, aunque con un mayor índice de peróxidos y de yodo. La harina de semillas convencionales presentó mejores parámetros de calidad y composición centesimal, principalmente debido al mayor contenido en fibra y no tuvieron acidez alta o humedad. Por lo tanto, los resultados de los productos fueron similares para ambos cultivos, pero el convencional fue mejor. Por otro lado, el análisis de trazas de residuos agroquímicos podrían calificar los productos como orgánicos.

PALABRAS CLAVE: *Aceite; Calidad; Composición centesimal; Harina*

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1. INTRODUCTION

Southern Brazil represents one of the largest grape producers in the country, with a record crop in 2017 of 750.612.622 t grapes (Ibravin, 2017). One of the major problems faced by wineries is the waste generation from their productive process, coming from its production process as the crushing and pressing of the grape for wine and juice. These residues are grape marc, consisting mainly of seeds and bark. An alternative for the wineries is the reuse of the residues for the development of products such as oil (Assumpção *et al.*, 2015) and flour from the residue of the cold-pressing of the grape seeds (Özvural and Vural, 2011), generating a source profitability that offers benefits to human health. In addition, the waste can be utilized in food, pharmaceutical or cosmetic industries (Freitas, 2007).

The oil and flour from grape seeds can be used in functional foods since they possess bioactive compounds. Grape-seed oil contains vitamin E (tocopherols), phenolic compounds and lipids (fatty acids) (Assumpção *et al.*, 2015). Linoleic and linolenic acids are considered essential fatty acids because they are not synthesized by the body, and they participate in the transport of oxygen to blood plasma and in the production of hemoglobin (Martin *et al.*, 2006).

The oil can be obtained by cold-pressing, a more interesting method for being a simple practice, suitable for large-scale production. This technique does not involve heat or chemical treatments, nor does it alter the quality of the seed and it can retain more components, without leaving chemical residues as the conventional method of solvent extraction does (Yu *et al.*, 2005). However, its yield is lower than from other methods (Vieira *et al.*, 2015).

The flour can be obtained from the residue of the cold-pressing of the seeds by grinding, and it can be a form of reuse for the winery and also present many properties as a source of antioxidants. According to Yu *et al.* (2005), antioxidants act in the prevention of aging and of chronic diseases such as the cardiacs and cancer, because they prevent the reactive oxygen species that cause DNA damage and the oxidative reactions performed by free radicals.

An increase in the consumption of organic products stems from the concern on the part of consumers regarding the ingestion of contaminants from conventional cultivation in the form of traces of agrochemicals (Pussemier *et al.*, 2006). According to studies, organic and conventional crops differ in relation to secondary minerals and plant metabolites, but organic cultivation may have lower levels of nitrates (Winter and Davis, 2006).

Grape seed oil may be used for frying because it presents heat stability and contributes a desirable

buttery flavor. However, grape seeds present high amounts of unsaturated fatty acids contained in the seed, and therefore it is necessary to verify the oxidative stability (Poiana *et al.*, 2009) of the oil and flour obtained from the cold-press residue of the seeds.

The objective of the present work was to obtain oil by cold pressing the Bordô seeds of conventional and organic cultivation and the flour of the residues resulting from the production of oil, as well as the evaluation of the quality and nutritional content of these products in a winery in the south of Brazil. The winery under study reached a maximum production capacity in this harvest of 2017 with 22000 t of grapes, generating about 20% of residue consisting of 11% bark, 3% seeds and 6% stalks, which currently are destined for silage (animal feed) or organic fertilization (incorporation into the soil). This case study was developed in line with the company's interest in using this residue to develop new products, as this would be sustainable and profitable, and many companies in the south of Brazil do not have this technology. In addition, oil and flour are considered functional foods, so it is important to ascertain quality and nutritional contents with a focus on omegas and vitamin E (tocopherols). Considering the quantity of seeds generated by the company, about 7-20% oil can be obtained according to Matthäus (2008), which would represent approximately 46.2-132 t of oil.

2. MATERIALS AND METHODS

2.1. Collection and preparation of material

Two bagasse samples of 200 kg were collected (barks and seeds), one from conventional and the other from organic Bordô grapes (*Vitis labrusca*), both from the 2017 harvest. The samples came from a juice production process of a winery from the Rio Grande do Sul State, Brazil, for the oil extraction. This bagasse was spread onto a flat surface of 15 m² in a closed room with absolute humidity of approximately 20 g/m³, without light for initial drying at room temperature of 21 °C for a period of 24 h in order to facilitate the separation of the bark and seeds. The separation was carried out with 3 mm mesh sieves and a blower. The seeds were stored in black plastic bags of 50 L, closed and placed in cardboard boxes and taken to the University laboratory located in Lajeado/RS, where they were kept refrigerated at 5 °C until moisture analysis and subsequent drying. For the determination of humidity, 30 g of sample were placed in an air circulation chamber with a temperature of 105 °C for 3 hours until constant weight, as adapted from the methodology of the Adolfo Lutz Institute (2008). This same methodology was used for seed drying.

2.2. Obtaining of seed oil from grapes

The oils from organic and conventional Bordô grape seeds were extracted after drying, by cold-pressing with the Scott Tech ERT 50 screw extruder, which operates with a 1.5 kW three-phase motor with a processing capacity of 20 kg/h. This equipment is a continuous system but was used in batch to avoid clogging by placing the whole seeds from 100 into 100 g to determine the total amount used. The working pressure of the equipment is not reported.

This process was carried out in a food company in the city of Garibaldi-RS. The oil obtained was allowed to decant for 24 hours at room temperature, and the oil and the residual sludge were separated. The oil filtration was performed by gravity after this period, using a sieve with 0.5 mm mesh to withdraw larger particles and the residual sludge was formed, and stored in closed marked transparent plastic bottles. The oil volume and mass obtained were used for gravimetric yield calculation. This parameter represents the mass amount obtained from the mass of pressed seeds, and it allows for the yield result

comparison of each crop, whether organic or conventional. The oil was sent to a certified company for the rendering of services located in the city of Garibaldi-RS, to evaluate the quality of the oil obtained from the seeds of the two types of cultivation, according to RDC n° 270/2005 and FAO/WHO (2015). The analyses were carried out by a rendering services laboratory located in Garibaldi-RS, as shown in Table 1.

2.3. The production of flour

Organic and conventional flour were obtained using the residue of the seeds from cold pressing. An amount of 50 g of seeds was added during 1 min rotation of 27000 RPM in the Multipurpose Technical User TE-631/1 milling equipment, located in the laboratory of Universidade do Vale do Taquari - UNIVATES with an ambient temperature of 22 °C. This process was repeated 10 times to obtain 500 g of flour from each culture. The flour was subjected to a 35-mesh sieve to obtain a fine powder. The flour was packaged in black plastic bags and sent to the same laboratory as mentioned

TABLE 1. Physico-chemical analysis of oil and flour and the methodologies used by the service rendering laboratory located in Garibaldi-RS

Analysis	Methodology
Humidity and volatile substances ^o	Gravimetric
Density ^o	Norms IAL, 4 ^a ed. SP – 2005, item 215/IV
Refractive index ^o	AOAC 921.08, 2005 AOAC 993.20, 2005; AOAC 920.158, 2005
Iodine index ^o	and Compendio Brasileiro de Alimentacao Animal, 2009, method 31
Unsaponifiable matter ^o	AOAC 933.08, 2005 and Analytical Norms IAL, 2005, item 339/IV
Acidity index ^o	Norms IAL, 4 ^a ed. SP – 2005, item 325/IV
Peroxide value ^o	AOAC 965.33, 2005
Vitamin E ^o (Levels of Tocopherol: α -tocopherol, β - tocopherol, δ - tocopherol and γ - tocopherol)	LC-FLD – EM 12822:201 – Teste carried out in the laboratory of the Eurofins Group
Fatty acid ^o (C4:0;C6:0;C8:0;C10:0; C12:0;C14:0; C14:1;C16:0;C16:1;C17:0; C17:1;C18:0; C18:1;C18:2;C18:3;C20:0; C20:1;C22:0;C22:2;C22:1;C24:0; C24:1)	Norms IAL, 4 ^a ed. SP – 2005, item 056/IV, Method <i>Hartman & Lago</i> (Lab. Practice 22(8): 475, 1973) and Official method AOCS Ce 1f-96 (2001).
Humidity ^F	Gravimetric
Acidity index ^F	Norms IAL, 4 ^a ed. SP – 2005, item 016/IV
Total fat ^F	AOAC 922.06, 2005; AOAC 935.39, 2005.
Total food fiber ^F	AOAC INTERNATIONAL. Total, Soluble and Insoluble Dietary Fiber in Foods: Method 991.43
Fixed mineral residue ^F	Norms IAL, 4 ^a ed. SP – 2005, item 018/IV
Carbohydrates ^F	RDC n° 360 de 23/12/2003 - ANVISA
Protein ^F (N \times 5,75)	Kjeldhal – PNT24-AL – Procedure for determination of total protein
Vitamin E ^F (Perfil Tocopherol: α -tocopherol, β - tocopherol, δ - tocopherol e γ - tocopherol)	LC-FLD – EN 12822:201 – Test carried out in a laboratory of the Eurofins group

^oOil analysis, ^FFlour analysis

above for quality analysis and centesimal composition, as shown in Table 1.

The moisture analysis of the flour resulted in a percentage in g/100g, according to RDC n° 263/2005. For acidity comparison, there is no legislation regulating values, but the analysis was carried out to guarantee the quality regarding rancidity due to the presence of residual oil. The other analyses were performed to satisfy the Brazilian legislation for labels, which cites the nutrients present, but does not quantify values, according to RDC n° 360/2003.

3. RESULTS AND DISCUSSIONS

3.1. Moisture analysis and seed drying

The seed moisture analysis was performed to determine the water content present after the preliminary drying of the bagasse in the company under study. This is an important parameter to verify the possible occurrence of hydrolytic rancidity. The seeds were dried for oil and flour production. The results of the moisture analysis and the standard deviation of moisture are reported in Table 2.

Brazilian legislation does not specify a moisture value for seeds to be used for oil extraction. According to the study by Bruni *et al.*, (2014), Chardonnay seeds of Bagé-RS were dried at 40, 60 and 80 °C, with the averages for moisture on wet basis of approximately 43%, 43% and 42%, respectively. The results presented in this study are close to those found by Bruni *et al.*, (2014).

The preliminary seed drying was carried out on different days. Therefore, the moisture difference

between the two crops can be justified by the atmospheric conditions, as the air relative humidity equilibrates with the moisture of the seeds.

3.2. Oils results

3.2.1. Cold pressing extraction performance

The organic grape oil was obtained by using 30 kg of seeds for 1 liter of oil, representing a yield of 3.50%. The conventional oil was produced using approximately 41 kg of seeds to obtain 1L of oil, representing 2.44%. This variation in yield between the crops depends on the variety, degree of grape maturation, environmental factors, mode of preparation of the seeds before extraction, extraction method and mode of extraction (Fiori *et al.*, 2014).

According to the method of Vieira *et al.*, (2015), the yield obtained from the grape Bordô without specification of the cultivar by the cold pressing method, with drying of the seeds at 40 °C and 80 °C, respectively, presented 8 and 4% of oil. The difference in oil quantity between the two crops was clear, and there was a considerable variation when comparing the study by Vieira *et al.*, (2015).

3.2.2. Oil quality analyses

The results of the oil quality analyses are shown in Table 3.

Moisture in the oil. The results obtained for moisture were 0.352% for the organic oil and 0.159% for the conventional one, as shown in Table 3. It was verified that the value for the organic oil was above the permitted level and this could lead to deterioration (hydrolytic rancidity).

TABLE 2. Results of moisture analysis and the standard deviation (triplicate) in Grape Seeds

	Humid sample Mean (g)	Humidity loss (g)	Standard deviation	Humidity (%)
Bordô organic grape seed	29,99	11,37	0,13	37,93
Bordô conventional grape seed	30.00	6,80	0,02	22,68

TABLE 3. Results of the quality analyses of organic and conventional oil according to the parameters of FAO/WHO (2015) and RDC n° 270/2005

Analysis	FAO/WHO (2015)	RDC n° 270 (ANVISA. 2005)	Organic oil result	Conventional oil result
Humidity and volatile substances	0.20%	-	0.35%	0.16%
Density	0.920 a 0.926 g/mL	-	0.921 g/mL	0.926 g/mL
Refractive index	1.467 a 1.477	-	1.474	1.4738
Peroxide value	Maximum 15 meq/Kg	Maximum 15 meq/Kg	9.1 meq/Kg	9.22 meq/Kg
Acidity index	Maximum 4.0 mg KOH/g	Maximum 4.0 mg KOH/g	6.33 mg KOH/g	5.81 mg KOH/g
Iodine index	128 a 150 g I ₂ /100g	-	134 g I ₂ /100g	138 g I ₂ /100g
Unsaponifiable matter	≤ 20 g/Kg	-	7.35 g/Kg	9.33 g/Kg

Differences in moisture values may occur due to variations in the conditions of the exposed environment, since the oils were extracted at the food company on different days and decanted at different locations. Decantation of the organic oil was done at the food company where it was extracted and the conventional oil was decanted in the laboratory of the cellar under study, both over 24 hours. The variation can also be the result of the extraction process because heat (59 °C) is generated with the friction of the seeds, which could cause condensation in the equipment, adding water to the product. After decantation, the two oils were sent to the laboratory for analysis.

Density. The results of oil density or specific mass were 0.921 g/mL for the organic oil and 0.926 g/mL for the conventional oil. According to the Codex Alimentarius (FAO/WHO, 2015), the maximum permitted value is 0.920 to 0.926 g/ml; the values are within the indicated range, but it can be observed that the conventional oil had the highest density.

Oil refractive index. The refractive index, as presented in Table 3, for conventional and organic oils, presented values within the FAO/WHO specification (1.467 to 1.477) (2015) with values of 1.473 and 1.474, respectively. Regarding the cultivations, a small variation was noted, so it can be affirmed that both had approximately the same refractive index.

Peroxide index. According to FAO/WHO (2015) and RDC n° 270/2005, the peroxide index should be maximum 15 meq/kg for cold and virgin pressed oils. The results of the oils are in agreement with the established limits, with values of 9.1 meq/kg for organic oil and 9.2 meq/kg for the conventional oil. The conventional oil showed the highest degree of oxidation.

Acidity index. In this study, the acid index result was 6.33 mg KOH/g for organic grape oil Bordô and 5.81 mg KOH / g for the conventional one. According to FAO/WHO (2015) and RDC n° 270/2005, the acid value is at most 4.0 mg KOH/g, so the two oils are above the parameters, indicating that there is hydrolytic rancidity, with the largest for organic oil.

Iodine index. According to FAO/WHO (2015), the iodine index for grape oil should be 128 to 150 g I₂/100g. In the analysis, the organic grape oil had a value of 134 g I₂/100g and the conventional oil showed 138 g I₂/100g, within the specified range. It was verified that the conventional oil had a higher iodine index. This result can attribute to higher unsaturation and high oxygen reaction susceptibility, favoring the occurrence of oxidative rancidity.

Unsaponifiable matter. In the verification of the unsaponifiable matter, both oils were within the value established by the FAO/WHO (2015) standard, with values of 9.33 g / kg for the conventional and 7.35 g/kg for the organic oil. This result is

satisfactory as it means that the products are within the standards of identity and quality for grape seed as established by FAO/WHO (2015). Therefore, the product will have the established color (pigments) and odor (aliphatic alcohols) parameters (Instituto Adolfo Lutz, 2008).

Vitamin E. Regarding the determination of vitamin E, the data are shown in Table 4. According to Table 4, the results of alpha-tocopherol, delta-tocopherol and gamma-tocopherol presented values above the table by FAO/WHO (2015), for organic as well as for conventional oil. According to Mustacich *et al.*, (2009), this excess in tocopherol does not harm the health, because in its study in rats, it was verified that the liver alters the functions of secretion allowing the release of vitamin E, thus regulating the rate in the body and does not cause harm.

According to Silva *et al.*, (2006), the amount of vitamin E in fruits can vary with the species, maturation, genetic changes, storage and processing.

Determination of fatty acids. The results of the fatty acid analyses were compared with the FAO/WHO (2015) parameters, which are presented in Table 5.

According to the results, the fatty acid levels in the organic and conventional oil were within the FAO/WHO (2015) tabulated parameters. According to Table 5, variations were observed in relation to the cultivations, being that the organic oil presented higher contents of palmitic acid (C 16:0), palmitoleic (C 16:1), stearic (C 18:0), oleic (C 18:1) and linolenic acid (C 18:3); whereas the conventional one had higher values for linoleic acid (C 18:2) and eicosanoic acid (C 20:1).

3.2.3. Organic versus conventional cultivation of Bordô grape seed oil

As for quality parameters, variations were observed for organic cultivation, and the values for moisture and acidity index were higher. For the conventional oil, the values for peroxide index and iodine index were higher when compared to the organic oil. When analyzing vitamin E for both cultivations, the results were above that specified by the

TABLE 4. Results obtained from vitamin E analysis of organic and conventional oil

Vitamin E (levels of tocopherols)	FAO/WHO (2015) (mg/kg)	Grape seed oil (mg/kg)	
		Organic oil	Conventional oil
α-tocopherol	16.0 – 38.0	203	219
β-tocopherol	ND ^a – 89.0	13.5	14.7
δ-tocopherol	ND ^a – 4.0	30.1	42.3
γ-tocopherol	ND ^a – 73.0	117	219

^aNon detectable

TABLE 5. Results obtained from fatty acid analysis of organic and conventional oils

Fatty acid	FAO/WHO (2015) (%)	Grape seed oil	
		Organic oil(%)	Conventional oil(%)
Caproic acid – C 6:0	ND ^a	< 0.10	< 0.10
Caprylic acid – C 8:0	ND ^a	< 0.10	< 0.10
Capric acid – C 10:0	ND ^a	< 0.10	< 0.10
Lauric acid – C 12:0	ND ^a	< 0.10	< 0.10
Myristic acid – C 14:0	ND ^a – 0.30	< 0.10	< 0.10
Palmitic acid – C 16:0	5.5 – 11.00	6.83	6.41
Palmitoleic acid – C 16:1	ND ^a - 1.20	0.15	0.12
Heptadecanoic acid – C 17:0	ND ^a - 0.20	< 0.10	< 0.10
Cis-10-Heptadecanoic acid – C 17:1	ND ^a - 0.10	< 0.10	< 0.10
Stearic acid – C 18:0	3.00 - 6.50	3.67	3.4
Oleic acid – C 18:1	12.00 – 28.00	20.7	18.91
Linoleic acid – C 18:2	58.00 – 78.00	62.81	65.34
Linolenic acid – C 18:3	ND ^a - 1.00	0.4	0.39
Arachidic acid – C 20:0	ND ^a - 1.00	0.19	0.19
Eicosanoic acid – C 20:1	ND ^a – 0.30	0.17	0.18
Behenic acid – C 22:0	ND ^a – 0.50	< 0.10	< 0.10
Cis-13.16-Docosadienoic acid – C 22:2	ND ^a	< 0.10	< 0.10
Erucid acid – C 22:1	ND ^a – 0.30	< 0.10	< 0.10
Lignoceric acid – C 24:0	ND ^a - 0.40	< 0.10	< 0.10
Nervonic acid – C 24:1	ND ^a	< 0.10	< 0.10

^aNon detectable, defined as $\leq 0.05\%$

FAO/WHO (2015). The fatty acid analyses results were in agreement with the legislation for both cultivations; the linolenic and eicosanoic acids were higher in the conventional oil; whereas palmitic, palmitoleic, stearic, oleic and linoleic acids had higher concentrations in the organic oil. In general, the conventional oil presented better results and differences were verified between the cultivations regarding quality analyses.

3.3. Results of the flour obtained from the residue of cold pressed seeds

3.3.1. Flour quality analysis

The results from the analysis of the flour obtained from the residue of cold pressed seeds of both cultivations are presented in Table 6.

According to RDC n° 263/2005 the maximum moisture parameter should be 15%, therefore the samples were in compliance with the legislation, emphasizing that the organic cultivation had the highest value. The difference in moisture between the flour of the two cultivations can be explained by the possible aggregation of moisture during handling and preparation.

As mentioned in the methodology, there is no legislation that limits acidity values. This analysis was

performed only to verify the quality of the flour, as there may be rancidity due to the presence of residual oil. According to the acidity analysis of the flour, the organic cultivation showed 8.67 mg KOH/g and the conventional cultivation showed 7.36 mg KOH/g. Comparing the results, the organic flour had a higher acidity index which may be related to the higher moisture content or to characteristics of the cultivation.

3.3.2. Analysis of the centesimal composition of flours

As mentioned in the methodology, RDC n° 360/2003 cites the necessary nutrients in a label but does not present parameters for the analyses, so the discussion for the flour will not be compared with standard values. The results obtained are described in Table 6.

Total Fat. For the total fat, 1.72% and 7.05% were obtained for organic and conventional flour, respectively. This variation in fat between the cultures may be related to the residual oil of the seed pressing. This higher total fat value may favor lipid rancidity, and therefore it can be degraded more easily (Moretto and Fett, 1998).

The ideal oil quality is one that is reduced in fat so as not to be degraded easily. Regarding the

TABLE 6. Results on humid basis of analysis of the centesimal composition and quality of flour obtained from the residue of cold pressing of grape seeds

Analysis	Legislation	Organic flour	Conventional flour
Humidity	RDC n° 263/2005: Maximum 15%	6.73 %	3.68 %
Acidity index	-	8.67 mg KOH/g	7.36 mg KOH/g
Total fat	-	1.72 %	7.05 %
Total food fiber	-	62.70 %	69.70 %
Ashes	-	2.33 %	2.13 %
Carbohydrates	-	17.80 %	8.29 %
Total protein	-	8.71 %	9.17 %
Vitamin E	α -tocopherol	2.17 mg/100g	2.05 mg/100g
	β -tocopherol	<0.50 mg/100g	<0.50 mg/100g
	δ -tocopherol	<0.50 mg/100g	<0.50 mg/100g
	γ -tocopherol	1.84 mg/100g	2.07 mg/100g

results, conventional flour had more total fat and can be more easily degraded.

A measurement of 5 g (one tablespoon) of conventional grape flour corresponded to 0.35 g of total fats. The recommended daily supply of total fat, according to RDC n° 360/2003, is 55 g/d, and this measurement of conventional grape flour was equal to 0.64% of daily requirements. The organic seed flour corresponded to 0.16% of the daily recommendation.

Total food fiber. With the analysis of total dietary fiber content of the Bordô grape flour, 62.70% was found for organic flour and 69.70% for conventional. According to RDC n° 54/2012, if the fiber content is higher than 6%, the product is rich in fiber. Therefore, it can be included in the labeling of the flour that they are rich in fiber.

In 5g of flour from organic and conventional Bordô grapes 12.5% and 13.9% of the recommended daily supply of total food fiber were found, respectively, which is 25 g/d (RDC 360/2003).

Protein. The organic Bordô grape flour presented 8.71% of the protein content (conversion factor of 5.75 - N proteic) and 9.17% for the conventional flour. Regarding the results, the conventional one presented the greatest amount of protein, excellent for human health.

The recommended daily supply of protein is 75 g/d (RDC n° 360/2003), and the flour of organic and conventional Bordô grapes contained, respectively, 0.58% and 0.61% of the daily supply in 5 g.

Carbohydrates. In the carbohydrate quantification, 17.80% of organic flour and 8.29% of conventional flour were obtained, presenting a great difference between the cultivations. The recommended daily supply of protein is 300 g/d (RDC n° 360/2003), and the flour from organic and conventional Bordô grapes contained, respectively, 0.3% and 0.14% of the daily supply in 5 g.

Ash. For the ash result, 2.33 and 2.13% were found for the organic and conventional Bordô flour, respectively, resulting in a small variation.

Vitamin E. The tocopherol profile was analyzed for the quantification of vitamin E. α -tocopherol had the highest concentration when compared to the others in the profile. Comparing conventional and organic seed flours, the variation is minimal, which can be justified due to species, maturation, genetic changes, storage and processing (Silva *et al.*, 2006). Absorbed vitamin E is taken up by the liver, and therefore only α -tocopherol is preferentially secreted into low-density lipoprotein (LDL).

3.3.3. Organic versus conventional cultivation for flour

Regarding the quality analysis, the organic flour presented higher amounts of moisture and acidity, which may be indicative of rancidity (hydrolytic). Thus, the flour from conventional cultivation presented the best quality results. Analyzing the results of the analysis of centesimal composition according to RDC n° 360/2003, the organic flour had a higher carbohydrate content and vitamin E (α -tocopherol). However, the conventional cultivation flour had the best results for total (more easily degraded) fat, fiber and protein. In general, conventional flour is best for having a higher amount of fiber and not exhibiting high moisture or acidity. Difference existed between the cultures regarding the analysis of quality and centesimal composition.

3.4. Nutritional comparison of oils and flours

According to the fatty acid analysis of oils, the α -linolenic acid content (omega-3) presented in Table 5 for organic and conventional oil is 0.40 % and 0.39 %. According to RDC n° 54/2012, if the

omega-3 content presents a value greater than 0.3%, the product can be considered a source of omega-3. Linoleic acid (omega-6) was present at 62.81% and 65.34% for conventional and organic oil, respectively, and this product can be claimed high in omega-6 content in the labeling because it is above 3% according to RDC n° 54/2012.

The daily recommended supply of vitamin E is 10 mg/d (RDC n° 360/2003) and the organic and conventional grape flour contained, respectively, 1.08 and 1.02 % of the daily supply. For the calculation of the daily supply, only α -tocopherol values were used because this is the main vitamin E compound absorbed by the organism (Otten *et al.*, 2006). Analyzing the results presented in Tables 5 and 8, it can be stated that the composition of tocopherols (vitamin E) of the oil presents about 8 times more than in the flour. Regarding the crops, the oil and the flour obtained from conventional cultivation presented more tocopherols.

With these results, it is important to use residuals from the wineries to develop products that bring benefits to human nutrition, especially highlighting these bioactive compounds of omegas and vitamin E (tocopherols). However, in these analyses the oil was highlighted as a source of omega-3 and 6. Vitamin E was present in greater quantity in the oil than in the flour.

4. CONCLUSION

It was observed that the seed pre-drying process must be carried out on the same day or in a controlled environment to avoid differences in the quality results. The cold pressing technique presented a yield variation between the crops, with the organic one of greater value. The products obtained from the conventional culture seeds presented the best results. In general, the results of oil and flour were similar, but the conventional one is of better quality and centesimal composition. In relation to the contents of omega-3 and 6 and Vitamin E (tocopherols), the oil was more nutritious for human health than the flour. Therefore, the use of seeds to obtain oil and flour is an alternative in the development of products. One suggestion for future work would be to check traces of agrochemicals that could qualify the organic product as better.

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