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Food Technology/ Original Article

Food product preparation from the vinification of 'BRS Violeta' by-products

Abstract – The objective of this work was to manufacture pizza dough, truffle, and cake using the paste of a by-product from the vinification of 'BRS Violeta' grape, as well as to determine some bromatological characteristics of these products. The by-product was pressed to remove excess must and crushed to obtain the paste. The paste, pasteurized at 80°C for 3 min and frozen at -18°C, was characterized for total phenolic compounds (TPC), total monomeric anthocyanins (TMA), and dietary fiber. The food products were characterized for the following parameters: moisture, energy value, and protein, lipid, ash, dietary fiber, total carbohydrates, and TPC contents. The contents found in the paste were: 326 mg GAE 100 g^{-1}, for TPC; 185 mg mv35diglc 100g^{-1}, for TMA; and 10 g 100 g^{-1}, for dietary fibers. Based on the centesimal compositions of the food products, the pizza dough and truffle can be considered as a source of fiber and protein, respectively. The products show TPC contents between 51 and 63 mg GAE 100 g^{-1}. It is possible to prepare food products of good nutritional quality, using grape by-product paste, to minimize waste in the field.

Index terms: by-product, circular economy, functional food, phenolic compound.

Elaboração de produtos alimentícios a partir de coproduto da vinificação da BRS Violeta

Resumo – O objetivo deste trabalho foi elaborar massa de pizza, bombom tipo trufa e bolo, a partir da pasta de coproduto da vinificação da uva 'BRS Violeta', bem como determinar algumas características bromatológicas desses produtos. O coproduto foi prensado, para retirada do excesso de mosto, e triturado para obtenção da pasta. A pasta, pasteurizada a 80°C por 3 min e congelada a -18°C, foi caracterizada quanto aos compostos fenólicos totais (CFT), às antocianinas monoméricas totais (AMT) e à fibra alimentar. Os produtos alimentícios foram caracterizados quanto aos seguintes parâmetros: umidade, valor energético, e teores de proteínas, lipídios, cinzas, fibras alimentares, carboidratos totais e CFT. Os teores encontrados na pasta foram: o de CFT foi 326 mg GAE 100 g^{-1}; o de AMT foi 185 mg mv35diglc 100 g^{-1}; e o de fibra alimentar foi 10 g 100 g^{-1}. Com base nas composições centesimais dos produtos alimentícios, a massa de pizza e a trufa são consideradas fontes de fibras e proteínas, respectivamente. Os produtos apresentam teor de CFT entre 51 e 63 mg GAE 100 g^{-1}. É possível preparar produtos alimentícios de boa qualidade nutricional a partir de pasta de coproduto de uva, para minimizar o desperdício no campo.

Termos para indexação: coproduto, economia circular, alimentos funcionais, composto fenólico.

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Introduction

The use of by-products has three major concerns: reducing the waste and loss in the production chain; developing economical alternatives; and reducing food insecurity.

Almost 30% of the food produced globally is wasted or lost at some point along the production chain, causing serious environmental, economic, and social problems (Principato et al., 2019). The prevention and management of wastes and losses are the major obstacles for achieving sustainable global development and eradication of starvation and food insecurity (FAO, 2020).

Waste and loss were aggravated due to the COVID-19 pandemic that changed the consumers' habits. In Brazil, 9% increase of wine production was observed from 2021 to 2022. With record consumption achieved in 2020 and 2021, reaching a volume of around 4.1 millions of hectolitres (OIV, 2023).

Viticulture has progressively played a more important role in the Brazilian economy. Nowadays, the annual production is more than 1.7 million tonnes (Anuário..., 2022). It had positive impacts, increasing employments and income for small farmers, and for farmers who have a significant participation in the production chain (Mello & Machado, 2021). The result is that the increasing production of wine enlarged the production of by-products. During the production of wine, just the grape pomace, which is obtained after the fermentation and pressing stages, represents approximately 60% of the organic residue of the process (Portilla Rivera et al., 2021). Thus, if all the 1.7 million tonnes of grapes was allocated to wine production, it would represent 1.02 million tonnes of grape pomace. Usually, grape pomace is used as composting or disposal in open areas (Chowdhary et al., 2021).

The concerns of waste and loss led to the concept of circular economy. This concept is based on the principles of sustainability. This new framework encompasses business models that combine innovation, competitiveness, productivity, income and industrial strategy aligned to environmental, socioeconomic, and climatic concerns (Mhatre et al., 2021). There is a need of sustainable strategies to deal with by-products and multiple value-added derivative products (Maicas & Mateo, 2020). As to vinification by-product, some economical alternatives are: alcoholic drink ("graspa"); oil extracted from seed for culinary, cosmetic, and pharmaceutical purposes; and dehydrated powder extracts and products with potential use as food ingredients. Such ingredients encompass aroma precursor compounds, source of phenolic compounds (PC), and source of fibers (Chowdhary et al., 2021). However, adding value to by-products mostly involves technologies, which are often complex, and expensive investments to small businesses.

The COVID-19 pandemic also affected the four pillars of food security: availability, access, use, and stability. Data collected between 2020 and 2022 show that moderate or severe forms of food insecurity are currently afflicting about 70.3 millions Brazilians (The state..., 2023). Developing alternatives that allow of the use of grape pomace are oriented towards the aforementioned three major concerns. It can deal with the increased amount of waste produced in the winemaking, within the circular economy framework. It represents to the small farmers an opportunity to add value to the pomace in its integral form, as they can use available and affordable resources to them. Finally, it can be used to produce food products, to cope with the increasing starvation.

The reasons for choosing pizza dough, truffle, and cake came from the fact that they are commonly consumed in the region where the by-product is collected; these products have a low formulation cost and are easy to prepare. Pizza is one of the most popular foods in the world, an excellent source of carbohydrates, and moderate source of proteins and other nutrients, depending on the many ingredients used (Della Corte et al., 2020). The demand for foods that are convenient to consume increased the interest in pre-baked pizza that contains healthy ingredients (Lan et al., 2020). The consumption of truffle-type candies increased in Brazil, due to the pandemic (Ruiz-Roso et al., 2020). Furthermore, some studies obtained good results when adding healthier ingredients to this type of candy, enhancing their nutritional profile (Strapasson, 2016; Ferreira et al., 2020). Finally, cake is a food product that can be consumed along the day. As a product with a wide variety of flavors and ingredients, cake has become increasingly popular, being one of the most consumed products, along with biscuits and chocolates (Konstantas et al., 2019). The addition of fruits, vegetables and by-products to cake formulations can improve their structural and nutritional characteristics (Fernandes et al., 2021).

The objective of this work was to manufacture pizza dough, truffle, and cake using the paste of a by-product from the vinification of 'BRS Violeta' grape, as well as to determine some bromatological characteristics of these products.

Materials and Methods

The vinification by-product used in the assay contained peel, pulp, and seed. It was obtained after the processing of 'BRS Violeta' grape into red wine (harvest season of 2018), at the Laboratório de Frutas e Hortaliças of Universidade Estadual Paulista, in the municipality of São José do Rio Preto, in the state of São Paulo, Brazil. Immediately after the winemaking process, the excess must of the by-product was manually removed, using a sieve and spoon. The sifted material was homogenized, using a food mixer PMX 700 (Philco Eletrônicos SA, Manaus, AM, Brazil), until reach a creamy texture. The paste was placed in an 800 mL reusable glass containers previously sterilized in boiling water. Then, it was immersed in hot water at 80°C for 3 min, in order to pasteurize, according to methodology adapted from Golombek et al. (2021). After pasteurization, the paste was cooled down to room temperature, using a polypropylene bowl for domestic and food use. The paste was frozen at -18°C, for preservation.

The methodology of Lago-Vanzela et al. (2011) was used to extract the total phenolic compounds (TPC) and the total monomeric anthocyanin compounds (TMA) from the paste. A sample of 50 g paste was put in 100 mL of extracting solution containing methanol and formic acid (at 97:3, v/v). A food mixer was used for 1 min, to homogenize the mixture (PMX 700, Philco). Then, it was subject to an ultrasonic bath USC-1850 (Ultronic do Brasil Ltda, Santa Rita, PB, Brazil) for 10 min. After the bath, it was centrifuged at 9,000 × *g* for 20 min at 5ºC (CR-G111, Hitachi). The supernatant was collected and reserved. The precipitate was subjected to three more sequential extractions using 50 mL of solution. The solution contained methanol, water, and formic acid (50:48.5:1.5, v/v/v). These three extractions were performed according to the same methodology of the first extraction. The supernatant obtained from the first extraction and from the following three extractions were combined into a single extract for each 50 g of the initial sample. These combined extracts were evaporated, using a rotary evaporator (Heidolph Instruments GmbH & Co., Schwabach, Baviera, Germany) at 40ºC, for the complete removal of methanol. After the evaporation, the obtained material was put into a volumetric flask (50 mL) in order to standardize the final volume of the extract. The resulted material was saved in amber glass bottles, properly sealed and frozen at -80°C for further analysis.

The Folin-Ciocalteu spectrophotometric method (Singleton et al., 1999) was used to determine the TPC content of the paste. An aliquot of 1.0 mol L^{-1} of the extract was added to 6.0 mL of water and 0.5 mL Folin-Ciocalteu's reagent solution (0.2 mol L^{-1}) (Alphatec, USA). The solution was left to rest for 5 min. Then, 1.5 mL of 20% (w/v) sodium carbonate (Impex, Brazil) were added. After the homogenization, distilled water was added to the solution until reach 10.0 mL total volume. The solution was left for reacting for 30 min at 25ºC. Then, it was subjected to absorbance reading at 760 nm, in a UV-Vis spectrophotometer Cary 60 UV-Vis (Agilent Technologie, Santa Clara, CA, USA). An analytical curve was built using gallic acid equivalent (GAE) at 50.0 to 750.0 mg L^{-1} in a linear range. The TPC results were expressed as mg GAE 100 g^{-1} in a wet basis. The TMA content was determined following the methodology suggested by Ribéreau-Gayon & Stonestreet (1965).

In order to determine the TMA content of the paste, an aliquot of 0.5 mL frozen extract was put into a solution of 0.5 mL of 0.1% HCl in ethanol and 10.0 mL of 2% HCl. The solution was homogenized in the vortex tube agitator MA162/2 (Marconi Equipamentos para laboratório Ltda, Piracicaba, SP, Brazil). Once homogenized, 2.5 mL of the previous solution was put in a test tube, to which 4.5 mL of distilled water were added; and the solution was then homogenized in the vortex tube agitator. A spectrophotometer (Cary 60 UV-Vis, Agilent) was used for absorbance reading at 520 nm. An analytical curve was built using malvidin 3,5-glycoside (mv35glc) in a linear range of 0.0 to 1,190.0 mg L^{-1}. The TMA results were expressed as mg mv35glc 100 g^{-1}.

The dietary fiber content was determined using the enzymatic-gravimetric method, based on the official method 985.29 (Horwitz, 2005).

For sample preparation, the paste was previously dried overnight, in a vacuum oven Q319V (Quimis Aparelhos Científicos Ltda., Diadema, SP, Brazil) at 70°C. The dried sample was crushed using a mixer (PMX 700, Philco) and passed through a 32 mesh sieve. The analysis was performed using 1 g of the prepared sample. The samples were subjected to three digestions: amylase, amyloglucosidase, and protease. After the digestion, the residue was isolated, and gravimetric measurements were carried out. The residue was expressed as fiber and polysaccharides, such as maltodextrin, resistant starch, modified starch, polydextrose, inulin, and fructooligosaccharides. The results were expressed in grams of total dietary fiber 100 g^{-1} of paste.

The paste was used the preparation of pizza dough, truffle type candy, and cake. The ingredients of the pizza dough were: 100 g of sweet potato; 13 g of rice flour; 20 g of extra virgin olive oil; 20 g of the by-product paste; and 1 g of salt. The sweet potato was cooked in a pressure cooker for approximately 20 min; after cooling down, they were peeled and smashed using a potato masher. All ingredients were put in a polypropylene bowl and mixed manually. The mixture was evenly distributed in a greased pizza pan. The dough was baked in an oven at 180ºC for 15 min.

The ingredients of the truffle were: 395 g of condensed milk; 13 g of unsalted margarine; and 100 g of the by-product paste. All ingredients were put into a pan, mixed using a spoon, and heated in a stove at 180°C for 10 min.

The ingredients of the cake were: three eggs; 120 mL of soybean oil; 300 g of sugar; 100 g of the by-product paste; 120 g of wheat flour; and 10 g of baking powder. The eggs, oil, sugar, and paste were mixed using a domestic blender B-44-B (Mondial Eletrodomésticos Ltda., Conceição do Sacuípe, BA, Brazil), at the highest speed, for 5 min. Then, the mixture was put in a polypropylene bowl, and flour was added and mixed using a spoon. When properly homogenized, baking powder was added and slowly stirred up. The cake batter was poured into a previously greased cake Bundt pan. The cake was cooked in an oven at 180°C for 40 min.

Two units of each food product (pizza dough, truffle, and cake) were produced in order to carry out the analyses (n=2). Each unit of the products weighed 0.12, 0.5, and 1.0 kg, for pizza dough, truffle, and cake, respectively. All analyses were performed in triplicate for each unit of food product.

The centesimal composition of the food products was determined according to the methods by the Association of Official Analytical Chemists (Horwitz, 2005). Moisture was determined gravimetrically. Each food product sample of 5 g was placed in porcelain crucibles previously weighed. They were put in an oven 315 SE (Fanem, Guarulhos, SP, Brazil) at 105°C. Every three hours, the samples were weighed on an analytical balance AY220 (Shimadzu Scientific Instruments, Kyoto, Kyoto, Japan) until constant weight was attained. Then, the moisture results were obtained by the difference between the previous weight (wet) and the constant weight (dry). Moisture was expressed as grams of water per 100 g of wet sample (%). The lipid content was determined using the Bligh-Dyer's method. A sample of 50 g was subjected to a binary mixture of chloroform and methanol in 1:0.5 volume ratio. Then, the mixture was diluted with distilled water (3:4), which was the extraction medium. The mixture was stirred in a magnetic stirrer 753A (Fisatom Equipamentos Científicos, São Paulo, SP, Brazil) for 15 min, after which, 1 g of anhydrous sodium sulfate was added to remove traces of water present in the solution. The mixture passed through a separatory funnel. Once the phase separation was achieved, the lipid fraction was placed in an oven (315 SE, Fanem) at 105ºC, using beakers previously dried and weighed. The beakers were weighed every hour and kept in the oven until constant mass was attained. The results were expressed as grams of total lipids content per 100 g of sample (%). The protein content was determined using the Kjeldahl's method. For the digestion, 0.2 g of sample was weighed in a low-nitrogen weighing paper and transferred (the sample and the paper) to a micro Kjeldahl tube. For digestion, 0.05 mol L^{-1} sulfuric acid and catalytic agent were added to the tube. The tube was put in a digester 327A-2 (Quimis Aparelhos Científicos Ltda., Diadema, SP, Brazil) until digestion was complete (3 to 5 hours). After the digestion, distillation was carried out in a nitrogen distiller TE-0364 (Tecnal, Piracicaba, SP, Brazil) with recovery of the ammonia formed using an Erlenmeyer flask containing 0.033 mol L^{-1} boric acid. The resulting solution was finally titrated with 0.1 mol L^{-1} hydrochloric acid, using a phenolphthalein indicator. Total protein was calculated multiplying the total nitrogen by 6.25. The result was expressed as total protein per 100 g of sample (%). Total ash content was determined using the previous carbonized dry samples of the moisture analysis (5 g). They were incinerated in a muffle furnace Q318M (Quimis Aparelhos Científicos Ltda., Diadema, SP, Brazil) at 550°C. The results were expressed as grams of total ash content per 100 g of sample (%). The dietary fiber content was determined using the methodology described for the paste dietary fiber determination in the method 985.29 (Horwitz, 2005) with some modifications in the sample preparation. Because cake and truffle contain high levels of lipids, they were defatted with ether in a Soxhlet machine before drying in a vacuum oven at 70°C (Q319V, Quimis).

The carbohydrate content was estimated by the difference of the sum of the other components, subtracting 100 from the average calculated. The energy values of the products were calculated as 4 kcal g^{-1} of carbohydrate or proteins, and 9 kcal g^{-1} of lipid (Anvisa, 2020).

Before the extraction of the phenolic compounds (PC), the truffle and the cake were defatted according to the recommendation by Hu et al. (2016). Defatting was not necessary for the pizza dough. For PC determination, a 2 g sample was added to 10 mL of hexane and stirred up in a vortex tube agitator for 1 min. Then, the sample was subjected to an ultrasonic bath for 10 min, after which, it was centrifuged at 4,000 × *g* for 10 min at 22°C. The supernatant was discarded. This procedure was performed twice. The samples were dried in a vacuum oven for 24 h at 22°C and weighed for later extraction of the phenolic compounds. For the PC extraction, 2 g each sample were added to 10 mL of 70% methanol. The mixture was sonicated in an ultrasonic bath for 10 min, and then, it was centrifuged at 4,000 × *g* for 10 min at 22°C; the extract volume was standardized, and the TPC content was determined using the supernatant obtained according to the methodology described for the paste.

Since the sample size (n=2) is too small, a descriptive analysis of the data was performed. Boxplot charts were plotted to show the results. All the discussion of the results was based on the median values. The software JASP 0.16.1.0 (JASP Team, Amsterdam, The Netherlands) was used for the statistical analysis.

Results and Discussions

The paste of 'BRS Violeta' grape was obtained using materials and appliances that are normally available in the households. The suggested food products here are simple and can be prepared in small scale using available resources in the farm or in the cooperatives.

The 'BRS Violeta' paste showed TMA and TPC contents of 186 mg mv35diglc 100 g^{-1} and 326 mg GAE 100 g^{-1}, respectively. The results for TMA corroborate those by Barcia et al. (2014), who evaluated the vinification by-product of 'BRS Violeta' grape (180 and 200 mg mv35diglc 100 g^{-1}). The results of the present work show the potential of the paste as an ingredient that contains compounds with bioactive properties, highlighting the importance of the use of vinification by-products of 'BRS Violeta'.

Dietary fiber content of the paste was 10.02 g 100 g^{-1}. Dehydrated winemaking by-products of 'Red Pinot' and 'Benitaka' grapes showed dietary fiber content of 50 g 100 g^{-1} (Sousa et al., 2014; Beres et al., 2016). The 'BRS Violeta' paste obtained in the present work had a low fiber content in comparison to those of by-products from 'Red Pinot' and 'Benitaka'. However, taking into account that the paste of the present study was handmade, the result is still very positive. Cultivars or varieties may present variations in fiber concentrations, as well as in the proportions of skin, pulp and seeds, which are normally present in the by-product of grape processing into juice and wine. Consequently, by-products derived from them will also have different fiber compositions (Lago-Vanzela et al., 2011; Zhu et al., 2015). The dietary fiber and phenolic contents are concentrated in the paste, and this indicates the potential of BRS Violeta paste as a bioactive source in several food products. In laboratory tests, these compounds are associated to some biological activities that have promising effects, such as anticancer, antibacterial, anti-inflammatory, antioxidant, anti-hypercholesterolemic and antidiabetic ones (Zhu et al., 2015).

The results concerning the centesimal composition and energy content of the pizza dough, cake, and truffle, using the 'BRS Violeta' paste are presented (Figure 1).

The pizza dough of 'BRS Violeta' paste showed 54.78% moisture. This result is higher than the values reported by Viana et al. (2020), for gluten-free dough and the traditional dough, with 21.67%

and 27.00%, respectively; the low moisture reported can be the result of longer baking time and higher temperature used to prepare such dough – 20 min at 250°C – as mentioned by these authors. Reducing the moisture of the developed product would improve its microbiological stability.

The pizza dough of 'BRS Violeta' paste showed lower contents of carbohydrates, lipids, proteins, ash, and energy, in comparison with the gluten-free dough reported by Viana et al. (2020), who found 48.38% of carbohydrates, 17.90% of lipids, 5.25% of proteins, 1.90% of ash, and 376 kcal of energy value. Analyzing pizza dough made of wheat flour, Pacheco de Delahaye et al. (2005) found 0.42% of ash. The dietary fiber content, the content was 4.70% in the dough made of 'BRS Violeta' paste, which is very close to the gluten-free pizza dough. Viana et al. (2020) reported a dietary fiber content of 5.0%. According to RDC 54 of November 12, 2012 (Anvisa, 2012), a food product is considered as a source of fiber, if it has more than 3%. The dough made of 'BRS Violeta' paste can be considered a source of fibers.

The truffle of 'BRS Violeta' paste had 40.62% moisture, which is close to the content (40.13%) in the truffle using banana 'Cavendish' peel (Marian & Licodiedoff, 2019). However, comparing with the regular truffle recipe that uses condensed milk, margarine, and cocoa powder, the truffle of 'BRS Violeta' paste has higher moisture content. The traditional truffle showed 6.54% moisture (Marian & Licodiedoff, 2019). Since water is a substrate for chemical and biochemical reactions, a higher water content can accelerate the food degradation process, which can cause sensory changes and the food susceptibility to microbial growth (Moschopoulou et al., 2019). Therefore, the producer should store the

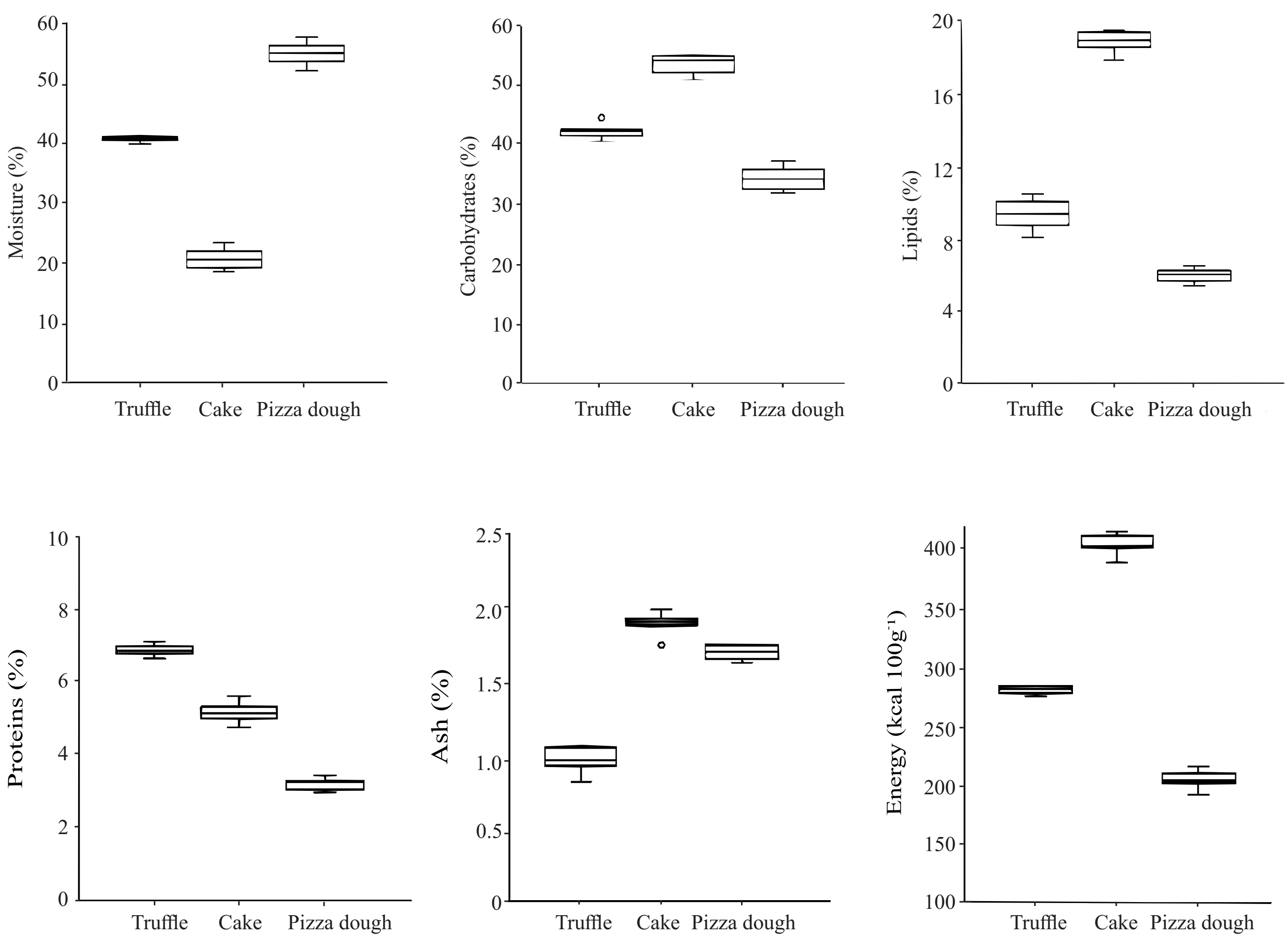

Figure 1. The boxplot of the results for moisture, carbohydrates, lipids, proteins, ashes, and energy of the pizza dough, cake, and truffle candy prepared from a past of 'BRS Violeta' grape by-product.

truffle made of 'BRS Violeta' paste under refrigeration, to extend its shelf life.

The higher moisture could be related to the fiber content of the truffle of 'BRS Violeta' paste of 2.99%. Fiber has a high capacity of retaining water (Spinei & Oroian, 2021). The dietary fiber content of the truffle of 'BRS Violeta' paste is higher than the fiber content of the regular truffle (2.18%) (Marian & Licodiedoff, 2019) and lower than the truffle made of 'Tannat' by-products (8.10%) (Strapasson, 2016).

The contents of carbohydrates, lipids, protein, and energy of the truffle of 'BRS Violeta' paste were of 42.38%, 9.35%, 6.86%, and 281 kcal, respectively; truffle made of by-products of red 'Tannat' grape vinification showed higher contents these mentioned parameters – 52%, 13%, 9% and 364 kcal –, respectively (Strapasson, 2016). The truffle of 'BRS Violeta' paste showed of ash content of 0.99%, which is lower than that of the regular truffle (1.5%) and that of the truffle made of banana peel (2.0%) (Marian & Licodiedoff, 2019). According to RDC 54 of November 12, 2012 (Anvisa, 2012), the food product is considered a source of protein, if it has more than 6%. The truffe of 'BRS Violeta' paste can be considered a source of protein. It can please the consumer and aggregate nutritional value.

The cake of 'BRS Violeta' paste showed 20.39% moisture. Values between 19.52% and 23.43% were reported for cake preparation containing up to 10% of by-product flour from 'Muscat Hamburg' to replace wheat flour (Nakov et al., 2020). As to the centesimal composition, the cake prepared from the 'BRS Violeta' paste showed lower contents of lipids and energy than the results reported by Strapasson (2016), for the cake made of 'Tannat' by-product flour, which had 11.1% lipid content and 378 kcal 100 g^{-1} energy. The cake made of 'BRS Violeta' paste showed 56.67% carbohydrates, 5.16% proteins, and 1.53% dietary fibers; these contents are higher than the results for those reported by Strapasson (2016), for the cake made of 'Tannat' by-product flour, which showed content of 59.1% carbohydrate, 10.3% protein, and 8.1% dietary fiber.

From the nutritional point of view, the food products made of 'BRS Violeta' paste may contribute to the daily intake of essential nutrients. For an adult, the Brazilian law (Anvisa, 2020) recommends a daily intake of 2,000 kcal, 300 g carbohydrates, 50 g proteins, 65 g total fat, and 25 g dietary fibers. In the consumption of one truffle (25 g), the following needs should be met: 4% of the total energy; 4% of carbohydrates; 3% of proteins; 4% of total fat; and 3% of fibers. For a piece of 60 g of cake, the daily needs met should be 12%, 11%, 6%, 17%, and 4%, respectively. For a slice of 40 g of pizza, the daily needs met should be 4%, 5%, 3%, 4%, and 7%, respectively. The dietary fibers content in all products was a positive aspect. In a nationwide survey, the Brazilians' intake of fibers was considered insufficient in general (Passos et al., 2020). The cake from 'BRS Violeta' paste showed the highest lipid content; the most caloric product was cake, and the less caloric one was the pizza dough. However, more ingredients are likely to be added to prepare the foods, which would increase the caloric value.

To the best of our knowledge, there is no legislation establishing a daily intake recommendation for TPC, due to the great variety of compounds included in the TPC group. Genetic factors, environmental conditions of the production region, degree of maturation, and bioaccessibility of the bioactive compounds affect a lot of contents of these compounds in grapes (Williamson & Holst, 2008; Del Bó et al., 2019; Dutra et al., 2023).

Studies conducted in Spain and Poland reported a significant decrease of cardiovascular disease risk, for the consumption of 1,170 and 2,632 mg of TPC in a daily basis, respectively (Del Bó et al., 2019). Among the food products made of 'BRS Violeta' paste, the truffle and cake showed higher levels of TPC (62.5 and 58.9 mg GAE 100 g^{-1}, respectively) than the pizza dough (50.2 mg GAE 100 g^{-1}). Although the TPC contents observed in the present study are smaller, there is still an alternative for introducing these compounds in the diet. Rossi et al. (2018) reported an experiment with children in a school in Argentine, in which food was introduced with 412 mg TPC per day. The sources were infusions and sugar products, which are less interesting than the products of 'BRS Violeta' paste.

Another relevant aspect of the 'BRS Violeta' paste is that it was pasteurized and frozen, which reduces the perishability of the co-products of the 'BRS Violeta' grape vinification, avoiding degradation of the bioactive compounds, aggregating value to the paste. The 'BRS Violeta' paste allowed of the preparation of pizza dough, cake, and truffle, supporting a production within the principles of circular economy. It reduces losses and waste in the viticulture, encouraging the local production of value-added products, and it is an alternative income for small farmers.

Conclusions

1. The 'BRS Violeta' by-product paste can be used as bioingredient in the preparation of food products.

2. Pizza dough and truffe made of the 'BRS Violeta' by-product paste are sources of fibers and proteins, respectively.

3. The 'BRS Violeta' by-product paste and the food products made of it are doable using local resources.

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