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Grape byproduct flour: perceptions in the juice and wine industries about residue destination

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ABSTRACT

Grape pomace flour, an important functional ingredient, is rarely found in the market and there is no known data in the literature to evaluate the reasons why. Therefore, the objective of this work was to analyze the perception of entrepreneurs and technicians regarding the transformation of grape pomace into products for human consumption and to evaluate the current destination given to this residue. The research was qualitative and was carried out from 2019 to 2020 through in-depth interviews with nine key informants from companies located in the Vale dos Vinhedos region, in Southern Brazil. The results showed that few companies produce flour/powders and seed oil from grape pomace, and that most of them destinate the residue for composting and animal feed. Moreover, the results show that grape pomace flour is perceived as a great potential raw material to develop new products for human consumption, but that the main obstacles for this use were the company's focus on beverage production, a lack of knowledge of specific technologies for this type of production, the large investments required for this new production chain, reduced labor in family-farming companies, and market uncertainties. Additionally, the concern of the companies to comply with environmental legislation was a strong motivator for the destination of the generated grape pomace. The present work brings important information for the grape-producing chain and the scientific community to evaluate the destination of the generated residues, aiming for the adoption of an eco-innovative approach to grape pomace.

Index terms: eco-innovation, food byproduct, food industry, grape pomace, sustainability.

Ideias centrais

- Environmental legislation was a strong motivator for the destination of the grape pomace.
- Barriers to process grape pomace to human consumption were identified.
- Focus on beverage production and lack of knowledge were cited.
- Reduced labor in family farming companies and market uncertainties were cited.

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Farinha de resíduo de uva: percepção de indústrias de sucos e vinhos sobre o destino do resíduo

RESUMO

A farinha de bagaço de uva, importante ingrediente funcional, raramente é encontrada no mercado e não há dados conhecidos na literatura que avaliem os motivos disso. Assim, o objetivo deste trabalho foi analisar a percepção de empresários e técnicos quanto ao à transformação do bagaço em produtos para consumo humano e avaliar a atual destinação dada a esse resíduo. A pesquisa foi qualitativa e realizada de 2019 a 2020 por meio de entrevistas, em profundidade, com nove informantes-chave de empresas localizadas na

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região do Vale dos Vinhedos, no Sul do Brasil. Os resultados mostraram que poucas empresas produzem farinhas/pós e óleo de semente de uva a partir do bagaço de uva, e que a maioria destina o resíduo para compostagem e alimentação animal. Além disso, os resultados mostram que a farinha de bagaço de uva é percebida como uma matéria-prima de grande potencial para o desenvolvimento de novos produtos para consumo humano, mas que os principais obstáculos para esse uso são a falta de conhecimento de tecnologias específicas para esse tipo de produção, os grandes investimentos requeridos nessa nova cadeia produtiva, a redução de mão de obra nas empresas de agricultura familiar e as incertezas do mercado. Adicionalmente, a preocupação das empresas com o cumprimento da legislação ambiental foi um forte motivador para a destinação do bagaço de uva gerado. O presente trabalho traz informações importantes para a cadeia produtiva da uva e a comunidade científica avaliarem a destinação dos resíduos gerados para a adoção de uma abordagem ecoinovadora do bagaço de uva.

Termos para indexação: ecoinovação, subproduto alimentar, indústria alimentícia, bagaço de uva, sustentabilidade.

INTRODUCTION

Grapes are fruits produced and consumed worldwide, and their processing generates a large volume of waste, mainly composed of peels, seeds, and stalks, which have been recently shown to present great concentrations of compounds with important biological qualities (Beres et al., 2017; Maurer et al., 2019)

In Brazil, the total amount of grapes processed in 2019 was 614.3 thousand metric tons in Rio Grande do Sul, the main state that produces and processes grapes in the country (IBRAVIN, 2019), generating approximately 125 tons of pomace, that is, 20% of residues (Karnopp et al., 2015). Therefore, there is a large volume of raw material available for the recovery of important functional ingredients and for use in the food production chain. Although some studies have reported the possible uses and applications of grape pomace, its disposal and underutilization are more common (Beres et al., 2017; Costa et al., 2019). Spigno et al. (2017) conducted a comprehensive review on the post-use of byproducts from grape processing and noted that the large volume of industrial waste was mainly destined for distillation and the production of tartaric acid and seed oil. These authors surveyed 16 European projects on the use of grape residue and observed that only one adopted the integral use of grape pomace to produce bakery products, whereas most of them assessed the potential use of polyphenols and oil extraction.

For the integral use of grape pomace, it is necessary to take into account the fact that bioactive compounds are trapped in the food matrix by antioxidant fibers and, therefore, cannot be extracted with conventional solvents (Sant'Anna et al., 2014). Even the use of grape pomace for the production of phenolic extracts or extraction of seed oil does not solve the problem of generating organic waste, since this process results in an organic material that still needs to be correctly used. Researches on yogurt (Demirkol & Tarakci, 2018), cake (Carlini et al., 2021), and other products manufactured with the addition of grape byproducts were performed and yielded very interesting results, in which the additives increased the product's contents of fibers and phenolic compounds, as well as antioxidant activity.

In this scenario, grape pomace powder appears to be an interesting alternative to be used as a functional ingredient in the food industry. In Brazil, one grape pomace patent is available (BR 102015030876-0), entitled "*Farinha de trigo contendo farinha de bagaço de uva e processo de produção de farinha de trigo contendo farinha de bagaço de uva* (wheat flour containing grape pomace flour and wheat flour production process containing grape pomace flour)", belonging to the inventors of the technological sector of the food industry (Revista da Propriedade Industrial, 2016). In Spain, the grape pomace patent is ES 2 524 870 B2, namely: "*Tempero de origem vegetal com propriedades conservantes, substituto do sal e procedimento para sua obtenção* (vegetable seasoning with preservative properties, salt substitute, and procedure for obtaining it)" (UBU, 2020).

In the global grape-production chain, the production of grape pomace powder, as well as its incorporation into food formulations, is considered an eco-innovation since this term is defined as the development and application of a business model based on a new enterprise that incorporates sustainability throughout the operating chain based on the product's life cycle (UNEP, 2017).

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However, the implementation of strategies for food waste recovery requires great efforts, including undertaking laboratory research, conducting pilot studies for subsequent large-scale production, protecting intellectual property when the innovation is developed, high processing costs, and well-defined processes. These endeavors need to be managed in view of the seasonality of production and the large quantities of byproducts generated, which are prone to microbial deterioration, requiring a rapid treatment and appropriate storage. In addition, the limitations of industrial technologies can influence a company's decision making regarding the processing and sale of byproducts (Galanakis et al., 2016).

Finally, the evaluation of the perception of the main actors, that is, of the grape processing industries, on residue destination is an essential step in the study of the potential of transforming dry grape pomace production into an eco-innovation. However, in the literature, data are scarce about the current destination of grape waste and about the knowledge and prospects for its potential use as a functional ingredient. Therefore, this work aimed to identify the current destination given to this material by companies located in the Vale of Vinhedos region, in the state of Rio Grande do Sul, Brazil (Figure 1), as well as to analyze the perception of entrepreneurs and technicians regarding its use, the limitations of the transformation of grape pomace into products for human consumption, and the trends of eco-innovation in this area.

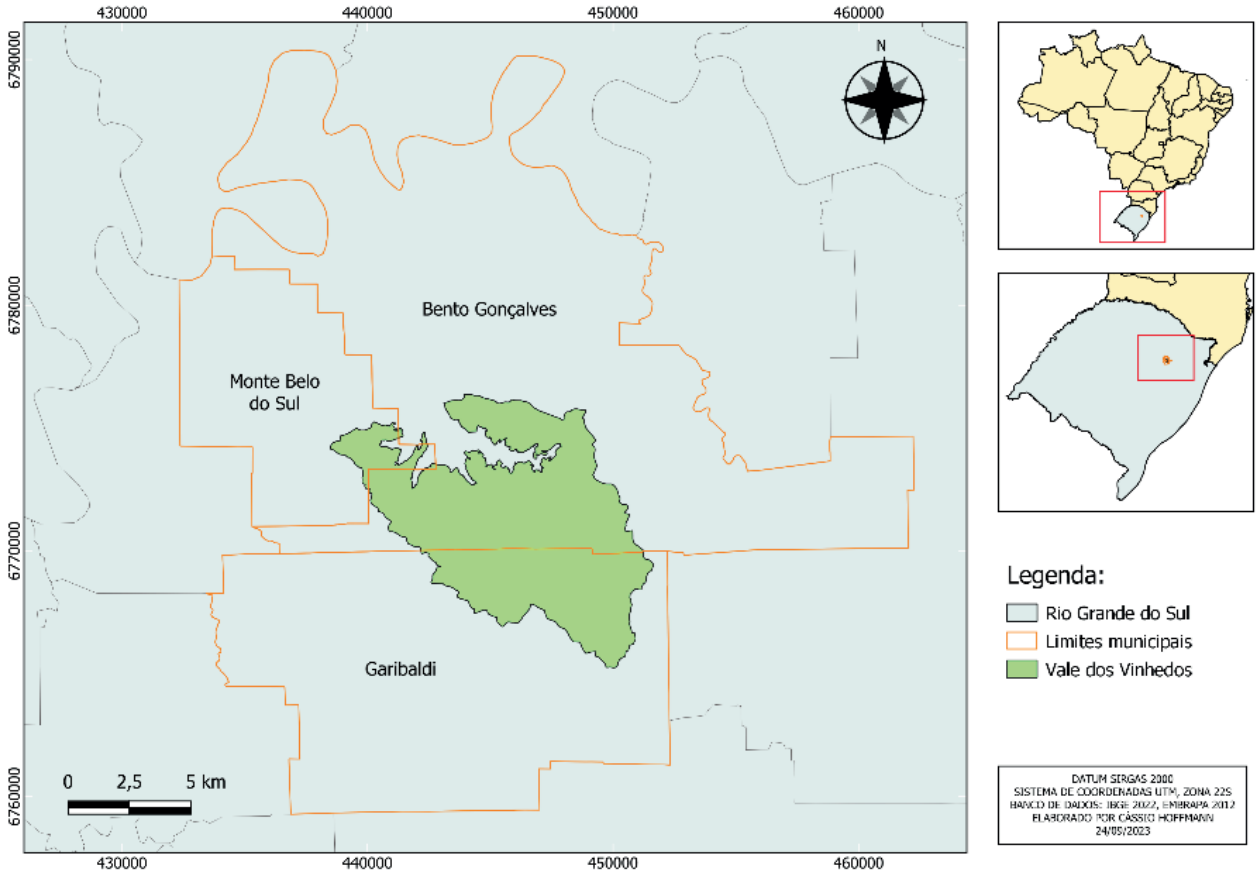

Figure 1. Location of the Vale dos Vinhedos region in the state of Rio Grande do Sul, Brazil.

METHODOLOGY

The present qualitative study was carried out from 2019 to 2020, involving in-depth interviews with key informants from wine-production properties and/or grape-processing companies located in the region of Vale do Vinhedos in the state of Rio Grande do Sul, Brazil. The region, in addition to being on the "*Via orgânica*" (organic) wine tourism route in the country, is characterized by the wide cultivation of grapes and the processing of fruit in the form of wines, juices, sparkling wines, and jellies.

The sampling was non probabilistic based on techniques for interviews with key informants (Gilchrist, 1992). The sample comprised key informants from distinct companies and properties that intended to produce or that were producing flour/powders and seed oil with grape marc, including organic producers, innovative companies, and regional references. The key informants were selected from the database of the Brazilian wine institute, Instituto Brasileiro do Vinho (IBRAVIN), using two criteria: the first was managers of companies that produce grape byproduct flour in the ecotourism route in the Vale dos Vinhedos region; and the second was technicians or managers of companies and properties that are considered local references in technical knowledge, present a significant wine-market share, and produce organic grapes/wines but not grape byproduct flour yet. Thirty emails were sent to the selected wineries with a known name in the market, and those that responded were contacted again. After the initial contact, the first interviewed informants suggested the inclusion of others they considered duly qualified on the subject. In total, ten companies/properties responded, and, of these, nine key informants agreed to participate in the survey.

A semi-structured protocol/questionnaire was used for the interviews (Table 1), and the session was conducted by a highly experienced qualitative-method moderator. The questions were grouped into two categories according to the destination given to grape pomace by the properties/companies. To characterize each participant, initial questions were asked on billing, annual grape production, the nature of production, the quantity/percentage of bagasse resulting from grape processing, and the products made on the premises of the property/company. To improve their sequence, these questions were pretested with a small grape producer and processor, but, according to the obtained results, no substantial changes were made to them.

Table 1. A semi-structured protocol/questionnaire for the interviews to analyse the destination given to grape pomace.

1. According to the classification criteria of the winery by billing, proposed by IBRAVIN (2009), the total annual billing of the winery is (R$): ( ) Micro: up to 2,400,000.00 ( ) Small: 2,400.001.00 to 10.500.000,00 ( ) Average: 10.500.001.00 to 30.000.000 ( ) Large: > than 30.000.001.00
2. What was the annual quantity of grapes produced on the property or in its cooperatives last year?
3. Last year, did the company need to buy grapes from other properties/companies to complement the demanded production of juices, wines, and/or grape derivatives?
4. What was the quantity of grapes processed in the property/company last year?
5. What was the quantity/percentage of bagasse resulting from grape processing last year?
6. What products are produced on the property/company?
7. What is the destination given to the residues (bagasse) generated during grape processing at the winery?
8. Is there any treatment for this residue before it disposal? If so, what is it?
9. Why does the company not produce grape marc flour for human consumption?
10. Do you know any company that transforms grape bagasse into a food product for human consumption?
13. Does the processing of this bagasse take place on the same property/company that produces juices, wines, and/or grape derivatives?
14. From what kind of production process does the used bagasse come from?
15. Why the interest in this destination?
16. How did you find out about the possibility of transforming grape-processing residues into flour for human consumption?
17. Did any company provide technical assistance for the implementation of grape-residue processing?
18. How long has the property/company been producing and selling grape marc flour for human consumption?
19. Does the commercialization of this by-product generate satisfactory profits for the property/company?
20. Is the market demand for this by-product satisfactory for the property/company?
21. What legislation is adopted for the production of grape marc flour?

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The nine volunteers (key informants) signed a consent and awareness form approved by the ethics committee of Universidade Federal do Rio Grande do Sul. The interviews were carried out online using the Google Meet software between May and June 2020 and lasted 40 minutes each. For data analysis, the answers (statements) of the interviewees were fully transcribed. The main sentences of their statements considered the results of the present work were those selected, in common agreement, by the authors according to the criterion of addressing the study hypotheses. Using a double-translation approach, the sentences were translated from Portuguese to English by the authors, and, afterwards, from English to Portuguese by a fourth independent person. If there was a perfect match, the statement was kept; otherwise, the sentence was changed and reanalyzed until an agreement was reached (Rodrigues et al., 2017; Maschio et al., 2023).

RESULTS AND DISCUSSION

Characterization of the properties/companies

The characterization of the properties/companies, whose key informants were interviewed, is summarized in Table 2.

Table 2. Characterization of the properties/companies (letter code) located in the state of Rio Grande do Sul, Brazil, whose key informants were interviewed in 2020[(1)].

Code	Q1	Q2	Q3	Q4	Q5	Q6	Q7
A	Small	Enologist and quality analyst	About 500 tons	No	530 tons	19%	2
B	Large	Quality control process sector	61.779,135 tons	No	61.779,135 tons	15%	7
C	Large	Executive director	20.400 tons	Yes	20.400 tons	15%	4
D	Large	Agronomist	500 tons	Yes	13.000 tons	10 to 12%	3
E	Small/medium	Enologist and technical director	1.100 tons	Yes	4.000 tons	12 to 18%	6
F	Small	Nutritionist	400 tons	Yes	400 tons	30%	4
G	Micro (family farming)	Owner	40 tons	Yes	60 tons	20%	2
H	Micro (family farming)	Owner	62–65 tons	No	30 tons	27%	3
I	*	Owner	*	*	*	*	2

[(1)]Q1, size classification; Q2, role of participant; Q3, annual quantity of grapes produced on the property or by its cooperatives in 2018 or 2019; Q4, acquisition of grapes from other properties/companies to complement the company's demand in 2018 or 2019; Q5, number of grapes processed by the property/company in 2018 or 2019; Q6, percentage of grape pomace generated; and Q7, number of types of products from grapes. *Does not carry out grape processing.

Three of the nine companies participating in the survey were classified as large, one as small/medium, ~two as small, and two as micro according to the number of grapes processed by the property/company in 2018 or 2019 (Q5 in Table 2); the last group complemented their classification by communicating that they belong to the family-farming modality.

According to the key informants (interviewees), the companies produce the following beverages: wines, juices, sparkling wines, coolers, sweet filtrate, brandy, semi-sparkling wine, and/or beer. Company I purchases grape pomace from another company to extract oil from the seeds and produce flour from them. Company E, in addition to beverages, produces jams and cosmetics from the grapes. Company F produces grape juice and uses the remaining materials to produce vinegars, grape seed oil, and grape skin and seed flours, all of which are certified organic foods; this company not only added value to the grape byproduct but reported the use of organic raw material for the production of new foods. According to Barcellos et al. (2015), this action also represents an eco-innovation in the food sector.

The industrialization of grapes in these companies located in the state of Rio Grande do Sul generated between 10 and 30% grape pomace in 2018 or 2019, respectively. Similar percentages were observed in a previous study by Muhlack et al. (2018).

Uses of pomace from grape processing

The destination given to the grape pomace by the companies evaluated in the present study, as well as other potential uses according to the literature is summarized in Figure 2.

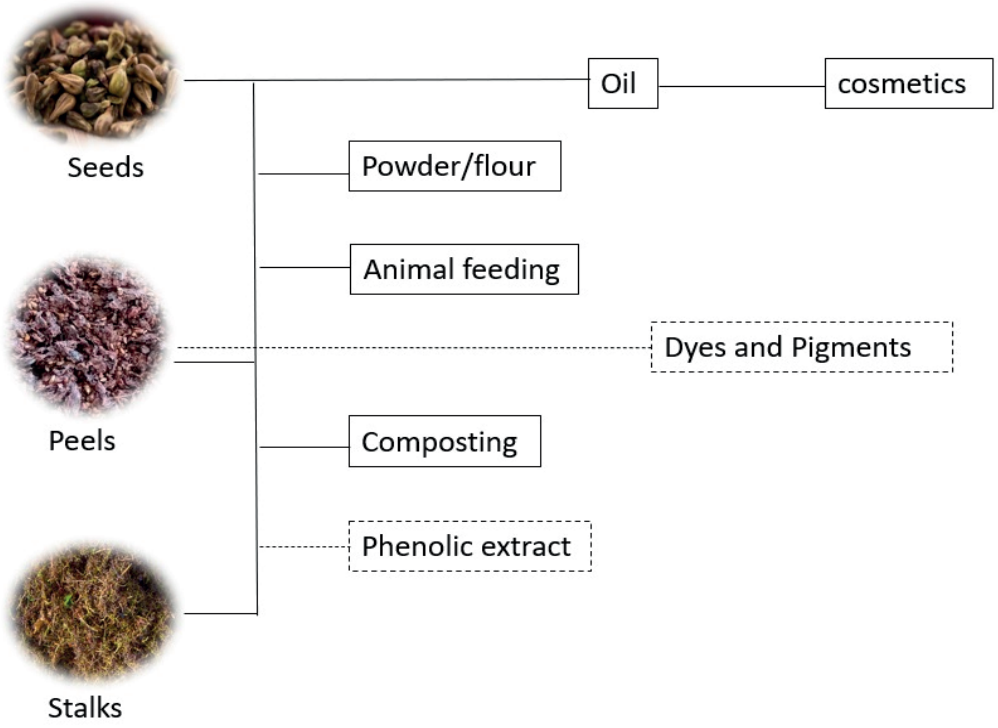

Figure 2. The destinations given to grape pomace by the evaluated companies (continuous lines) and the potential of the byproduct according to the literature (dotted lines).

The production of grape powders/flours and seed oil, composting, and animal feed are highlighted within the results. However, according to the literature, there is still potential for the production of phenolic extracts from seeds, peels, and stalks and for the extraction of dyes and pigments from peels, indicating alternative uses of grape byproducts with the potential to create an eco-innovative market.

The most cited uses of grape pomace were for fertilizer/compost production by companies A, B, F, H, and I and for animal feed by companies C and H. Other reported uses included: the production of distilled beverages (grappa and limoncello) by companies A, E, and H; donation to another company for the production of organic compost by company D; donation for the production of fertilizer and animal feed by company E; supply to other producers who extract the oil from the seeds and produce fertilizer by company G; and transformation of the grape byproduct into food for human consumption by companies F and I. The donation of grape pomace may be explained by the large volume of produced residues and the costs involved in their proper disposal, a scenario in which the donation to third parties helps grape producers to mitigate environmental impacts (Spigno et al., 2017).

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Considering its end use, the predominant destinations for grape pomace were the production of fertilizer/compost, animal feed, and distilled beverages. Regarding the use of grape residue for animal feed, an interviewee said:

Company C interviewee: "*it's a pity to be doing that; grape pomace is a waste full of many nutrients that could be much better used, but today we don't do it for 'n' reasons*".

The aforementioned destinations were also reported by Spigno et al. (2017), who observed that the large volume of material remaining from industries worldwide is mainly destined for fertilizers, animal feed, landfills, dyeing agents, distillation, tartaric acid, nutritional supplements, and seed oil production.

Companies F and I have been processing grape pomace for human food for approximately 8 and 6 years, respectively. In these companies, the interest in this production chain was a result of the product marketing approach, as well as of the possible sustainability and health benefits of these products. According to the key informants from these companies, only a small portion of the byproduct was destined for fertilizer production for the following reasons:

Company F interviewee: "*a material very rich in nutrients and polyphenols*"

Company I interviewee: "*We are giving it a noble destination*"

According to Barcellos et al. (2015), the growing consumer demand for eco-innovative foods is increasing the demand for sustainably produced food and, consequently, the opportunity for companies to add value, through innovation, to food products. This point of view was noticed in the interviews of the participants from companies F and I, which use grape byproducts to produce food that can provide health benefits to consumers, while presenting, at the same time, a sustainable image to the market. However, recently, Baldissera et al. (2022) observed that the main drivers for the Brazilian consumers to purchase grape pomace-based products were consciousness, environmental concern, knowledge, and personal beliefs, not health-related issues.

According to the interviewees, the greatest concern of the properties/companies is giving grape pomace the ecologically correct destination (understood as licensed by the environmental agency). Even those that pass on this responsibility to other companies are careful to communicate the destination of the byproduct, complying with the Brazilian legislation that stipulates a joint responsibility for the generated waste (Brasil, 2010).

In this line, in a study carried out in Italy, Muscio et al. (2016) found that the adoption of cleaner production (CP) and end-of-line (EOL) technologies is related to the regulation of environmental policies and to demand-related and technology-boost factors, i.e., internal and external searches for business eco-innovation. The first technology includes the use of raw materials produced with CP methods, improvements in resource efficiency resulting from increases in raw material productivity, reductions in waste, and reductions in water and energy consumption. However, the indicators included in the EOL category are better in terms of waste management, reductions in gas emissions, and the use of antipollution devices. Despite this, both types of eco-innovation aim to reduce the environmental impact of dioxide carbon and other emissions of gases and waste, with the CP technology affecting the production process itself and the EOL technology limiting the impact of the company's activities on the environment, preventing the spread of pollution under regulatory measures. Therefore, for EOL technologies, the rigor of environmental policies is more important.

However, the adoption of technologies for grape pomace management is limited by the current structure of the evaluated companies, whose sector of product research and development (R&D), when present, is linked to the marketing department, whose focus is not thinking and developing innovations. Triguero et al. (2018) found that the R&D department is able to positively influence the creation of products, suggesting that it can contribute to the development of eco-innovations aimed at material efficiency, energy efficiency, and environmental responsibility. According to the same authors, eco-innovations in food companies involve investments in R&D and market-oriented

activities, with marketing being more associated with ecological products and innovations than with incremental processes and eco-innovations.

Another limiting factor for any interest in eco-innovation may be related to the roles of the key informants from each company. The interviewees from companies A, D, and E, for example, work in the sector or area responsible for the destination of production waste, being associated with operating licenses and not with the company's innovation sector. Furthermore, the interviews showed that some of the companies do not view bagasse as having a food-innovation potential but rather as a waste that must be properly disposed of.

Perceptions of entrepreneurs and technicians in the grape-processing sector about the transformation of grape pomace for human consumption

Among the companies that did not make products from grape pomace, companies C, G, and H were the only ones that intended to use this grape residue for human consumption in the future. The interviewees of the other companies, despite reporting knowledge of this potential use, were not confident that it would be implemented in the medium or long term.

According to the interviews, the perceived limiting factors for the implementation of grape pomace processing in the evaluated companies were: priority in the production of beverages, few wineries carrying out this activity in the region, nonexistence of a specific physical structure, costly investments, availability/knowledge of a specific technology for this purpose, lack of market research, and lack of personpower in family-farming companies. These factors are confirmed by the following statements:

Company B interviewee: "*because the company's business is to produce wine and juice and its derivatives from grapes and wine, and we would need another company to process this waste and restructure to separate it (bagasse from the stalk).*"

Company E interviewee: "*I think it wasn't done because there's no tradition in the region to do this, and this potential line of business ends up going unnoticed*"

In relation to the notion of overcoming the product-centered focus, Dressler (2013) observed that the German wine industry is transitioning from only market production to the addition of new innovative activities. According to the results obtained for the studied Brazilian companies, this transition has the potential to happen in the future. Considering companies A, C, D, and E have a management team that defines business directions, it is important to raise their awareness of a potential new product line, such as the transformation of grape pomace into food for human consumption. Bossle et al. (2016) highlighted that the construct "managerial environmental concern" is perhaps the strongest determinant of the environmental innovation strategy.

The associations between sustainable development, innovation, and eco-innovation seem clear in theory, but it is not always possible to understand their real application due to the lack of tested and concise industrial protocols and equipment for processing byproducts (Barcellos et al., 2015). For example, although hot-air drying seems to be the most appropriate method for preserving grape byproducts, the difficulty in storing and processing a large part of the very moist residue obtained during the production of highly seasonal products, such as grape juice and wine, is a considerable challenge for the food industry. These perceptions can be verified in the following statements:

Company C interviewee: *"in a way, we don't have the technology for this, I wouldn't know how to do it. Second, we need a large industry, but it's a lot of waste in a short time, the waste is perishable, it doesn't last long, it can't stand it. We would need to have a large industry to process everything within two months. Third, we don't have a market for that; that is, it's a lot of product and we wouldn't know what to do with it. So, it's the sum of factors and not just one. We would also need investments, perhaps, in large and heavy equipment, technologies for a market that we don't know, that we don't explore yet, that we don't explore*"

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Company G interviewee: "*We have no physical structure for this. This part of food belongs to ANVISA* (Authors: Brazilian health surveillance agency), *we would have to build another pavilion, right, and today we don't have working capital for that, we even have a project for that, but now with this crisis*"

Regarding the Brazilian legislation on sanitation, the companies that produce beverages should follow different regulations than those that process products of plant origin, such as grape pomace (Brasil, 1997a, 1997b). Therefore, it is necessary to build a new infrastructure and purchase specific equipment different from those for the production of juices and wines, which entails a large initial investment for the processing of bagasse, resulting in capital costs. The interviewees were aware of the need for large investments in technologies for this type of eco-innovation, confirming the results of the research by Triguero et al. (2018), who observed that the acquisition of machines, software, hardware, and R&D enables an increase in the technological capabilities of industries, contributing to the process of eco-innovations.

The perception of one key informant was that the profitability would not be high enough to offset the investment that he would have to make. Moreover, this producer's excitement regarding this production chain was checked by fear in face of the large investments necessary and the proximity of a company that has been in this business for a longer time. This point of view is summarized in the following excerpt:

Company H interviewee: "*It's a large investment, then, and it's more viable to form a partnership than to produce, right*"

The interviewee from company I stated that the acquisition of the byproduct is not expensive, but, when combining this cost with other costs and expenses involved in the process, such as workforce and transportation costs, the operation becomes costly:

Company I interviewee: "*More freight, more people to load, more to unload*." "*That's why it's not viable.*", "*It's easier to produce fertilizer or silage"*, "*The product is cheap but the accessories to give it a destination are expensive*"

According to Bossle et al. (2016), companies seek to assess the costs, benefits, and risks involved in the adoption of eco-innovations, with the reduction in costs being considered the most relevant factor. Dressler (2013), when analyzing the innovation of German wineries, concluded that the price of products and services was a factor of great relevance, while others, such as the creation of new services, changes in supply, new sources of capital or new alliances, were considered less important. The results of the present study show that price is the dominating factor because the focus of wineries, given the lower volume produced for the market, is to maintain high margin levels; therefore, this is an important issue to be evaluated in future works on the Brazilian market. Furthermore, given the lower production volume as a result of fewer grapes and the implicit risk of financial disadvantages, it would be expected that this new product line would require innovative financing, but this reaction was not observed according to the methodology used in the present work. Interviewees from companies A, B, and C stated that the company's aim is to expand the beverage portfolio instead of investing in new products from bagasse. In addition, interviewees from companies C, E, G, and H highlighted uncertainties in relation to the consumer market despite being aware of the potential of grape pomace as a new product in their portfolio, suggesting a preference for stability with well-consolidated products. This behavior was also observed in the work of Dressler (2013), in which the level of innovation decreased in German wineries when comparing the activities currently carried out and those planned, an indication of their inclination for more stability and fewer changes.

As to consumers, Barcellos et al. (2015) found that the have strong collectivist values and very positive attitudes towards the environment, which positively influence the purchase of eco-innovative foods. Perhaps this grape byproduct market in the region studied in the present research has not yet attracted a sufficient number of consumers to cause a high demand, which could awaken an expansion of this innovative market. According to the obtained results, some of the participants

showed interest in innovative food products from grape pomace, with the companies that already process this byproduct still finding motivation to continue with this line of business and those that do not doubting the possibility of developing such a market in the future. The latter companies might wait for this business model to become more consolidated and for them to have more financial and/or human resources in order to implement it, alone or through partnerships with other companies that already produce these foods, as shown by the following statement of an interviewee:

Company B interviewee: "*Not at the moment, maybe one day, if there's a demand that could be profitable for the company*."

However, the respondents from companies C, G, and H showed a clear interest in the production and/or commercialization of functional food from grape pomace. These companies are even prospecting markets, eliciting requirements and standardization needs, and analyzing the necessary mobilization of other sectors of the production chain to achieve an adequate flow of technology and services.

According to Bebber et al. (2016), among the factors that contribute to innovations and the maintenance of competitive advantage are the search for external sources of knowledge through close contact with customers and a broad view of the company's management in seeking to know its target audience, providing differentiated products. This concern was perceived in the statement given by the interviewee of company F, who reported participating in national events to publicize products and to gauge consumer interest about possible new products. The perception that changing the name of flour to powder products will engage more consumers was highlighted. When a participant was asked about the possibility of innovation in the pharmaceutical area as well, his answer showed that he had already analyzed this alternative:

Company F interviewee: "*The issue is, for the pharmaceutical company, what ends up hindering some uses is that the product, it's not standardized, and we can't always have an identical formula, so, I think that, for the pharmaceutical industry, the greatest obstacle is that they need to have a more standardized dosage*"

According to the interviewees, two companies are studying and carrying out strategic planning to implement the transformation of grape pomace into food products. Company G had already obtained a cost estimate and prepared a technical project with the physical structure required by law. In company C, the issue was already part of its strategic planning, as observed in the interviewee's response:

Company C interviewee: "*This is a subject that has been on our radar for a long time, okay, so it was part of our strategic planning for a long time, but ... so far, we haven't taken it forward, right, in making investments in technology, but we're interested, everything to gain from it, right, for several reasons, including to maximize or capitalize even more*"

Worldwide, the large amounts of byproducts generated by wineries have led companies to develop applications to add value to these underexploited organic materials. The trend is to extract some phenolic compounds from the remaining materials and explore their potential use in the cosmetic and nutraceutical fields (Figure 1). The European Commission plans to apply a circular economic approach to eco-innovation with a "zero waste" principle, where waste is used as a raw material for the production of new products (Gouvinhas et al., 2019).

Approximately 50 companies around the world recover valuable compounds from food waste and sell them as ingredients for processed food products or for use as natural preservatives or functional compounds (Galanakis, 2020). Currently, many wineries are seeking for innovations that increase the value of their waste, choosing the most available and appropriate techniques (Oliveira & Duarte, 2014; Daou et al., 2020). The growing concern of consumers about environmental issues, such as climate change, environmental pollution and the use of natural resources, also encourages

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the growth of the sustainable food market (Daou et al., 2020). However, in the Brazilian market, this topic needs to be better explored in regard to the grape production chain.

In Brazil, according to the statements obtained in the present study, environmental compliance was a strong motivator for the destination given by the companies to the grape pomace generated, supporting the hypothesis of Triguero et al. (2018), who concluded that the existing regulatory structure, as well as public support for a company's innovations, is a positive motivator for all types of eco-innovation in the food industry. Bossle et al. (2016) also found that regulatory pressures appear to be a predominant factor for the adoption of eco-innovations by different companies, as an "action to comply with the law and other regulations". Additionally, according to the same study, public funding, in terms of training or subsidies, is positively associated with a greater willingness to adopt eco-innovations.

Dressler (2013) realized that the intensity of innovation was not related the size, strategic orientation, or management tools of German wineries but to the competition in this industry. Muscio et al. (2013) found that business characteristics are key elements for the adoption of eco-innovations, observing that agricultural wineries are less likely to introduce eco-innovations than nonagricultural ones. Bossle et al. (2016) added that large companies tend to develop and adopt more eco-innovations. However, in the present work, not only the large companies, but also the small and micro ones, showed interest in eco-innovations and/or a tendency to eco-innovate through the transformation of grape byproducts into food for human consumption.

Eco-innovations create new market opportunities for companies, increasing their competitiveness and that of countries that innovate ecologically (Arundel & Kemp, 2009 cited by Muscio et al., 2013). According to Muscio et al. (2016), several countries are promoting policies focused on the environmental aspects of production and sustainability throughout the supply chain. In this context, the study of public policies aimed at the environmental aspects of grape processing, the impact of the interest of wineries in implementing new eco-friendly actions, and consumer acceptance of these practices are important for future works.

FINAL CONSIDERATIONS

The present study analyzed the perception of the representatives (key informants) of companies that work with grape processing, focusing on the Southern region of Brazil, recognized nationally as a reference in the production of wines. The participants were from companies of various sizes, all that work with the processing of grapes, but that sell different products. Most of them focus on the production of beverages (wines, juices, sparkling wines, coolers, sweet filtrates, and brandy), while others, in addition to beverages, also produce jams and cosmetics from grapes, and one does not produce drinks but processes grape pomace from other companies.

The most common destination for the bagasse generated from grape processing is the production of compost/fertilizer, although a few of the companies produce flour/powders and grape seed oil from the byproduct. According to the interviewees, the main obstacles for the companies that do not use bagasse as raw material for the production of new foods for human consumption were: focus on beverage production, a lack of knowledge of specific technologies for this type of production, large investments in this new production chain, reduced labor in family-farming companies, and/or market uncertainties, which are factors that can be considered limiting for the adoption of this eco-innovation.

Since the use of plant residues as ingredients by the Brazilian food and beverage industry is still rare, this work contains important data on how organic residues from the industrialization of grapes are currently managed and on their (potential) use in the production of food for human consumption. This may support the formulation of public policies to encourage the reduction of waste and mitigate the sector's impacts on the environment through visionary strategies to boost this eco-innovation, generating income for producers in the region and contributing to sustainability.

Within this context, to overcome the barriers to a more noble destination for grape pomace, multidisciplinary efforts on the part of the scientific community, rural/university extension, and industrial research should be done to evaluate marketing potential and the perception and attitudes of consumers and industries in relation to grape by-products, whose potential nutritional and environmental benefits to society should also be disseminated. Moreover, promoting the interest of companies through public policies, related to both financial and legal aspects, is an important action to encourage a wider use of grape pomace for human consumption.

Since, in the present work, sampling was carried out through a qualitative methodology, it does not represent the wineries in the Vale dos Vinhedos, which may introduce bias in the data. Therefore, in future works, quantitative methodologies with a rigorous sampling methodology are essential to better identify a company's perception and behavior towards the destination of grape pomace from fruit processing, not disregarding, however, the intrinsic value of the present study for the field of food by-products, which has been of great concern worldwide.

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