

INFLUENCE OF HEDONIC EXPECTATION ON SENSORIAL SHELF-LIFE PERCEPTION OF A GRAPE POMACE FLOUR-BASED BREAD

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ABSTRACT

The present work aimed to evaluate whether consumers' hedonic expectations affect the perception of sensory shelf life (SSL) of a bread added grape marc flour using two SSL approaches. A chemical-free vegan bread added dried grape pomace was stored at room temperature for up to 7 days. One hundred individuals were asked about their hedonic expectation to experience and evaluate the softness of the breads, their taste and overall acceptance. The participants were also asked whether or not each sample was sensory acceptable. SSL were statistically estimated by limit of acceptability (using linear regression methodologies) and survival analysis (using non-linear regression methodology to fits the Weibull model data). Consumers with the lowest expectations were more sensitive to sensory changes in relation to storage. Participants with higher expectations rated the softness of the breads to be hedonically acceptable up to 4 days, flavor up to 5 days, and overall up to 7 days. Those with the lowest expectations liked the tenderness and taste of the product up to 1 day, while overall acceptance was good for 2 days of storage. Consumers with low positive expectation were sensitive to changes in texture and flavor compared to those with high expectation, but overall acceptance was similar. The SSL estimate based on the survival analysis was close to 7 days, and the expectation did not affect the likelihood that consumers would reject the product. Thus, people with different hedonic expectations have different SSL-based perceptions of the acceptability of grape marc-based breads, but this did not affect the likelihood of consumers rejecting the product.

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KEYWORDS: FOOD BY-PRODUCTS; SURVIVAL ANALYSIS; SENSORIAL ANALYSIS; ACCEPTABILITY LIMIT.

INFLUÊNCIA DA EXPECTATIVA HEDÔNICA NA VIDA-DE-PRATELEIRA SENSORIAL DE PÃO A BASE DE FARINHA DE BAGAÇO DE UVA

RESUMO

O presente trabalho teve como objetivo avaliar se as expectativas hedônicas dos consumidores afetam a percepção da vida-de-prateleira sensorial (VPS) de um pão adicionado de farinha de bagaço de uva usando duas variedades de VPS. Um pão vegano sem conservantes químicos adicionado de bagaço de uva seco foi armazenado em temperatura ambiente por até 7 dias. Cem indivíduos foram questionados sobre sua expectativa hedônica de experimentar o produto e avaliaram a maciez dos pães, sabor e aceitação global. Os participantes também foram questionados se cada amostra era ou não sensorialmente aceitável. As VPS foram estimadas estatisticamente por limite de aceitabilidade (utilizando metodologias de regressão linear) e análise de sobrevivência (utilizando metodologia de regressão não linear que se ajusta aos dados do modelo Weibull). Os consumidores com as expectativas mais altas foram mais sensíveis às alterações sensoriais em relação ao armazenamento. Os participantes com maiores expectativas classificaram a maciez dos pães como sensorialmente aceitável até 4 dias, sabor até 5 dias e, em geral, até 7 dias. Aqueles com as expectativas mais baixas gostaram da maciez e sabor do produto até 4 dias, enquanto a aceitação geral foi boa por 2 dias de armazenamento. Os consumidores com baixa expectativa positiva foram sensíveis às mudanças de textura e sabor em comparação com aqueles com alta expectativa, mas a aceitação geral foi semelhante. A estimativa de VPS com base na análise de sobrevivência foi próxima de 7 dias, e a expectativa não afetou a probabilidade de os consumidores rejeitarem o produto. Assim, pessoas com diferentes expectativas hedônicas têm diferentes percepções baseadas em VPS sobre a aceitabilidade de pães à base de bagaço de uva, mas isso não afetou a probabilidade de os consumidores rejeitarem o produto.

PALAVRAS-CHAVE: RESÍDUO DE ALIMENTOS; ANÁLISE DE SOBREVIVÊNCIA; ANÁLISE SENSORIAL; LIMITE DE ACEITAÇÃO

1. INTRODUCTION

Eco-innovation is based on life cycle products, services, processes and/or market approach that incorporate sustainability as the business model of leading companies to improve performance and competitiveness (UNEP, 2017). The development and application of grape pomace flour and products added from this ingredient can be considered eco-innovations, since they feature the concept of circular economy as the main business idea. Dried grape pomace presents compounds within its matrix with well-documented beneficial effects on human health, showing it to be an interesting functional ingredient for novel foods (SAURACALIXTO, 1998; SANT'ANNA *et al.*, 2012). It has been incorporated into pasta, breads, cookies and even vegan cake formulations with important sensory and technological performance (SANT'ANNA *et al.*, 2014; AMOHVALOVA *et al.*, 2016; CARLINI *et al.*, 2021). Vegan products are also a big trend for food industries, and the combination of grape pomace flour with the characteristics of veganism can be an interesting strategy to encourage food industries to launch products added to grape pomace flour in the market.

However, the implementation of food by-product recovery strategies requires great efforts including the development of well-defined processes for appropriate decision-making by companies regarding the processing and sale of by-product-based food products (GALANAKIS *et al.*, 2016). Sensory shelf-life (SSL) of foods is defined as the time when the first significant changes on foods are perceived by consumers, which imply on decreased on acceptance or completely rejection of them (HOUGH *et al.*, 2003). Shelf life of foods is an important characteristic for each product and has a major impact on product costs and market decisions. The shelf life of bakery products is usually limited by sensory changes (GÁMBARO *et al.*, 2004a,b; SALVADOR *et al.*, 2006; GIMÉNEZ *et al.*, 2007), which can be defined by two methods: acceptability limit and survival analysis. The first approach uses hedonic testing to assess the liking or disliking for a product or its overall acceptance (GIMÉNEZ; ARES, 2019). The other approaches address whether the samples are still suitable for consumption or not (HOUGH *et al.*, 2003).

Food consumption behavior is a complex process, which, among other factors, expectation plays important role on consumers' willingness to try and accept new foods (ARES *et al.*, 2010a; MANOHAR *et al.*, 2021). Expectation is defined as a pre-defined concept, belief, or idea that people have. It has been shown to impact the sensory perception of foods such as beer (COPORALE; MONTELEONE, 2004), olive oil (CAPORALE *et al.*, 2006), beef (MORALES *et al.*, 2013), among others (PIQUERAS-FISZMAN; SPENCE, 2014). Considering that it affects sensory results, it would be also expected that influences the acceptance limit of a food during the shelf-life. However, this approach is widely found in the current literature, which is an important step towards valorizing new ingredients for large scale use, such as grape pomace flour.

Efforts should be made to evaluate the eating quality after processing, and there is little information about the sensory shelf-life of products added of this by-product in the current literature, which is needed for the development of new foods and their proper insertion in the market. Thus, the present work aims i) to estimate the sensory shelf life of a bread added grape pomace flour; ii) evaluate the effect of consumers' expectation on sensory shelf life perceived of the bakery product; and iii) study acceptability limit and survival analysis approaches.

2. MATERIAL AND METHODS

2.1 VOLUNTEERS

The study was conducted with 100 individuals, who were recruited in city of Guaporé (latitude 29°5'22" south and longitude 51°32'01" west) in Rio Grande do Sul, the southernmost Brazilian state. The sample was composed of 61% (n=62) women and 38% (n=38) men, with a mean age of 38 years, of which 4% (n=4) had a monthly family wage below 1 Brazilian minimum income; 80% (n=80) between 1 and 3 Brazilian minimum wages; 13% (n=13) between 3 and 5 Brazilian minimum wages; and 3% (n=3) between 6 and 8 Brazilian minimum wages.

2.2 VEGAN BREAD PREPARATION AND STORAGE

Experiments were conducted during August of 2020. Commercial grape pomace flour, made of Bordô variety juice processing, was obtained from Eco Natura Company (Garibaldi, RS, Brazil). Other ingredients were purchased at local market (Guaporé, RS, Brazil). In the present work a chemical-free vegan baked product was used. Breads were prepared with of 444g of rice flour, 3g of brown sugar, 1g of salt, 70mL of **soybean oil**, 457mL of water, 24g of commercial yeast and 22g commercial grape pomace flour. The dry ingredients were mixed together and followed by the addition of water and soybean oil. The system was mixed in an industrial mixer (G.Paniz, Mod 90334, Caxias do Sul, RS, Brazil) for 10 minutes to obtain a homogeneous dough, which was divided into 200g portions and fermented for 1h at 25°C in an industrial baking chamber. Then, as were baked in an industrial oven (Cristal Steel; model Economy, Itajobi, SP, Brazil) for 20 minutes at 200°C. After cooling to room temperature, the loaves were packed in plastic containers and kept at room temperature for up to 7 days. There was any temperature control in order to evaluate products' SSL performance during an ordinary storage condition.

2.3 SENSORIAL SHELF LIFE

Samples were taken at 0, 2, 4 and 7 days of storage, which was chosen based on prior authors' test. For each time, samples were frozen at -18°C until sensorial analysis when they were thawed at 20°C for 6 h (SALVADOR *et al.*, 2006; GIMENÉZ *et al.*, 2007). Sensory analyses were performed in four steps: *i)* in the first part, volunteers fulfilled socio-economic questions and whether they knew the existence of grape pomace flour; *ii)* they were informed that they evaluate a grape pomace-based bread and asked what were their expectation to try it using a 9-point hedonic structured scale (being 1 "I will dislike very much" and 9 "I will like very much"); *iii)* then, samples were presented onto plastic dishes, coded with 3 random numbers with tap water for cleaning the paladar, in a completely randomized way; participants evaluated the breads' softness flavor and overall acceptance by a 9-point hedonic structured scale (being 1 "I disliked very much" and 9 "I liked very much"); additionally, to the hedonic rating, participants were asked whether each sample was sensorial accepted or not; *iv)* finally, they were asked to explain why they reject any of the samples tested in few words. This approach was based on previous work

successfully used to evaluate the impact of expectation and perception on sensory acceptance of yogurt with antioxidants (ARES *et al.*, 2010a).

The experimental procedures were approved by the Ethics Committee of the authors' University (protocol number 4.183.790) and all participants were in agreement to participate in the study.

2.4 DATA ANALYSIS

Hierarchical cluster analysis (HCA) was performed on participants' expectation rates for trying a grape pomace-based bread considering Euclidean distances (dissimilarity) and Ward's clustering criterion (agglomeration method) using XLSTAT (Addinsoft, Paris, France, version 2021.3.1). First an exploratory HCA was performed with automatic truncation and, after the analysis of the dendrogram, a truncation on 3 classes were performed to divide the group of clusters (ARES *et al.*, 2010b). First an exploratory HCA with automatic truncation was performed, and after the dendrogram analysis, a 3-class truncation was performed to divide the group into clusters (ARES *et al.*, 2010b). The chi-square per-cell test was used to assess the independence, at 5% and 10% significance, of the socio-demographic profile for the clusters.

The acceptability threshold was evaluated by the average rates of the one hundred participants over the entire storage period by linear regression using weighted least square analysis (SPOOG *et al.*, 2014). Equations 1, 2, 3, and 4 show the calculation of some variables used to estimate the slope (*a*-values), the intercept (*b*-values), and the standard errors (*S_a* and *S_b*).

$$S_{xx} = \sum x_i^2 - \frac{(\sum x_i)^2}{n} \quad \text{Equation 1}$$

$$S_{yy} = \sum y_i^2 - \frac{(\sum y_i)^2}{n} \quad \text{Equation 2}$$

$$S_{xy} = \sum x_i y_i - \frac{\sum x_i \sum y_i}{n} \quad \text{Equation 3}$$

The slopes of the curve (*a*-values) were calculated according to Equation 4.

$$a = \frac{S_{xy}}{S_{xx}} \quad \text{Equation 4}$$

The intercepts of the tendency curve to y-axis (*b*-values) were calculated by Equation 5:

$$b = \bar{y} - a\bar{x} \quad \text{Equation 5}$$

For estimation of the standard error of *a*- and *b*-values (S_a and S_b , respectively), first the regression standard error was estimated:

$$S_r = \sqrt{\frac{S_{yy} - a^2 S_{xx}}{n-2}} \quad \text{Equation 6}$$

Then, Equation 7 and 8 were used:

$$S_a = \sqrt{\frac{S_r^2}{S_{xx}}} \quad \text{Equation 7}$$

$$S_b = S_r \sqrt{\frac{1}{N - (\sum x_i)^2 / \sum x_i^2}} \quad \text{Equation 8}$$

In the Equations *x* is the storage time; *y* is the average of the acceptance scores; and *n* is the number of storage times analyzed.

SSL was estimated when the hedonic rate was 6 for each hedonic parameter, calculated by Equation 9

$$\text{Hedonic rate} = a \cdot t + b$$

Complete rejection of sample acceptance was numerically assumed to be 0 and 1, respectively. Participants who rejected samples at time zero were excluded from the survival analysis, which was performed in XLSTAT using the standard Weibull distribution (Equation 10).

$$\%Acceptance = 1 - \Phi\left(\frac{\ln \ln(t) - \mu}{\sigma}\right) \quad \text{Equation 10}$$

where Φ is the standard normal cumulative distribution function, μ (location parameter) and σ (shape parameter).

Sensory acceptance of the samples was compared by two-way analysis of variance (ANOVA) followed by Tukey's honestly significant difference (HSD) test using the software XLSTAT, and differences were considered statistically significant when $p \leq 0.05$.

Comments in the end of the form were analyzed using a double translation approach as suggested by Rodrigues *et al.* (2017): *i*) correction of typing/spelling mistakes in Portuguese; *ii*) standardization the verbs and nouns; *iii*) translation from Portuguese to English; *iv*) translation from English to Portuguese; if there was a perfect match, the sentence was kept, otherwise, the it was changed and reanalyzed until an agreement was reached. The results are shown in English and Portuguese to ensure full understanding of the answers.

3. RESULTS AND DISCUSSION

Participants were divided into 3 groups according to their hedonic expectation to try a grape pomace-based bread by the ACP. The profile is shown in Table 1. Volunteers who gave scores between 6 and 9 were considered as presenting positive hedonic expectation, since they represent that they slightly would like the product to would like the product very much. Those who scored their expectation lower than 5 ("I will not neither like nor dislike") were considered with negative hedonic expectation (GIMENEZ *et al.*, 2007). Group 1 was composed of participants with average expectation (average rate of 6.42, which corresponds to "I'll like it a little bit"). In group 2, the participants had the lowest expectations for trying the product (mean rate of 4.34, corresponding to "I will like it a little"), while group 3 represents the people with the highest expectations (mean rate of 8.51, corresponding to "I will like it a lot"). Group 1 was composed mainly of women, people with monthly income between 1 and 3 Brazilian wages, with complete high school or college graduation, and who did not know about grape pomace flour. Group 2 was composed equally of men and women, people with monthly incomes between 1 and 3 Brazilian wages, with complete high school education, and who did not know grape-pomace flour. Group 3 presented in general women, with monthly income between 1 and 3 Brazilian wages, with complete high school or college graduation and that did not know grape-pomace flour.

Table 1. Socio-economic profile of the 3 consumers' group based on expectation of try a grape pomace-based bread. Data are shown as frequency of appearance (n) and the relative frequency among the expectation group (f%[†]).

	Group 1 (n ₁ =28)	Group 2 (n ₂ =28)	Group 3 (n ₃ =44)
Expectation^{††}	6.42	4.34	8.51
Gender			
Male	12 (42.85%)	14 (50.00%)	13 (29.54%)**
Female	16 (57.17%)	14 (50.00%)	31 (70.45%)**
Average age	33.33	36.62	39.27
Monthly income			
Less than 1 salary	2 (7.14%)	2 (7.14%)	1 (2.27%)
Between 1 and 3 salaries	21 (75%)	24 (85.71%)	35 (79.55%)
Between 3 and 6 salaries	4 (12.23%)	2 (7.14%)	7 (15.91%)
Between 6 and 8 salaries	1 (3.57%)	0 (0.00%)	1 (2.27%)
Education			
Incomplete high school	6 (21.43%)	9 (32%)	11 (25%)
Complete high school	12 (42.86%)	11 (50%)	20 (45%)
Graduated	9 (35.71%)	5 (18%)	13 (30/46%)
Knew grape pomace flour?			
Yes	4 (12.29%)	0 (0.00%)*	7 (15.91%)
No	24 (85.71%)	28 (100.00%)*	35 (79.55%)

* significant relation of socio-economic profile to hedonic expectation group by chi-squared at 5% of significancy.

** significant relation of socio-economic profile to hedonic expectation group by chi-squared at 10% of significancy.

[†]f(%) = n/n_i

^{††} Expectation based on hedonic scale anchored on 1 "will dislike very much" and 9 "will like very much"

Expectation is based on the hedonic, sensory, and perception characteristics of the product, which are further compared to the real ones (ARES et al., 2010a) and can affect the willingness to try a new product. It may impact directly on sensory acceptance of foods (ARES et al., 2010a; TUORILA; HARTMANN, 2020; MANOHAR

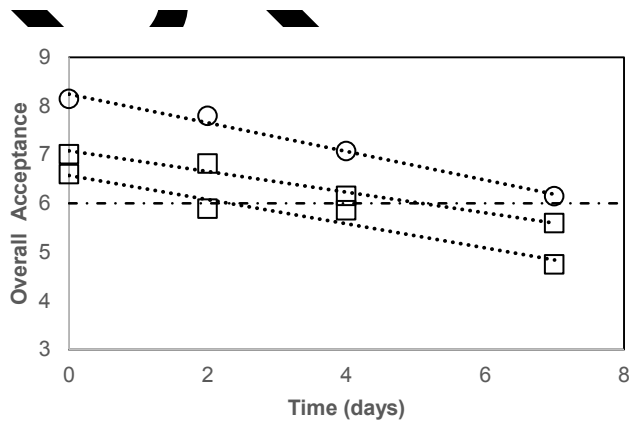
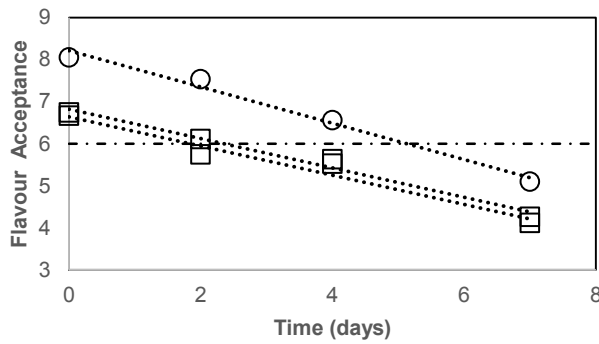
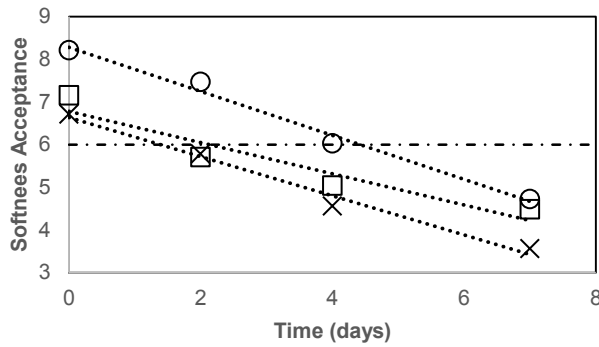
et al., 2021). Baldissera *et al.* (2022) recently observed that informing consumers of the presence of grape pomace powder in food formulation positively impacted the acceptance of the product. In the present work, income and education were independent of expectation ($p>0.05$). Gender was dependent only on the highest expectation group ($p<0.10$). Although the data did not relate people's socio-demographic profile to new/healthy food attitudes, the literature shows that women are more likely to be interested in new foods, especially healthy foods, than men (ARES; GÁMBARO, 2008; PALUDO *et al.*, 2017). In addition, men have stronger intuition that unhealthy foods are tastier than women, although they may choose healthy foods that set high taste expectations (MANOHARAN *et al.*, 2020). In addition, people with higher incomes tend to be a more positive group willing to try new foods, as they are able to commit a larger portion of their monthly income to new experiences (MEISELMAN *et al.*, 2010; D'ANTUONO; BRANAMI, 2012; PADULO *et al.*, 2017). Focusing on education, individuals with low educational level tend to have significantly higher levels of food neophobia (version: fear, disgust of eating unfamiliar foods) (TUORILA *et al.*, 2001; BUCHNER *et al.*, 2003; MEISELMAN *et al.*, 2010; SANJÚAN-LÓPEZ *et al.*, 2011).

The perception of ordinary consumers about these by-products is a topic that is currently on the rise in the field of science (CATTANEO *et al.*, 2018; PERITO *et al.*, 2020). Table 1 shows that previously knowledge of grape pomace flour was related to group 2 (the lowest expectation) ($p<0.05$), who were not aware of the grape by-product flour before the tests. Cattaneo *et al.* (2018) noted that informing consumers about the benefits and concerns of grape skins can result in a more positive attitude toward the use of food by-products. Perito *et al.* (2020) observed that the willingness to accept products with olive by-products is positively associated with the degree of sustainability awareness and the perceived benefits of sustainable products. Baldissera *et al.* (2022) observed that attitude, environmental concern, knowledge, and personal beliefs are key drivers of grape pomace powder consumption and health concerns did not impact on the intention of purchasing this product. In the present work, consumer perception of grape pomace was not studied in depth, but De Barcellos *et al.* (2012) observed that Brazilian society seems to be open to innovation and at the same time concerned about environmental sustainability, and thus communication accompanying by-products as ingredients and waste-based

products among consumers can result in better knowledge and consequently reach consumers and resonate with sustainable thoughts (CATTANEO *et al.*, 2018).

Evaluating the hypothesis that expectation influences the SSL of a grape pomace-based bread, the results of the acceptability threshold approach for bread softness, flavor and overall acceptability are shown in Figure 1.

Figure 1. Average hedonic scores (N=100) of softness (A), flavor (B) and overall acceptance (C) for group 1(□), group 2 (x) and group 3 (o) of veg bread added of grape pomace flour through storage time. tendency curves, ——— acceptability cut-off.



ACCEPTED MANUSCRIPT

B

C

Hedonic scores of the participants (N=100) for the samples decayed linearly as the bread was stored. Results showed good fit of the experimental data to the linear model ($r^2 > 0.90$; $p < 0.05$). Acceptability of softness flavor and global acceptance regression models for the 3 groups of expectations are presented in Table 2.

Table 2. Tendency curve parameters for the regression of average acceptance scores through storage time for the 3 different clusters.

	Group 1		Group 2		Group 3	
	a	b	a	b	a	b
Softness	-0.4±0.1	6.8±0.4	-0.5±0.1	6.7±0.2	-0.5±0.1	8.3±0.2
Flavor	-0.4±0.1	6.8±0.1	-0.4±0.1	6.6±0.1	-0.4±0.1	8.2±0.2
Overall acceptance	-0.2±0.0	7.1±0.1	-0.3±0.1	6.9±0.2	-0.3±0.0	8.2±0.1

a-values are the slope of the line; *b*-values are the intercept of the line. Linear regression is expressed as $Acceptance = a.t + b$

Considering the hedonic scale used, rates of less than 6 can be considered as the sensory acceptance margin, since rates of 5 indicate that people "neither liked nor disliked" the sample. Softness acceptance of Group 1 and 2, who presented slight positive and low expectations respectively, were 2 and 1 days, which did not differ ($p > 0.05$) between them. The soft acceptance of Groups 1 and 2, which had slightly positive and low expectations respectively, were 2 and 1 days, which did not differ ($p > 0.05$) between them. People on Group 3, with highest expectation, presented the highest SSL of 4 days ($p < 0.05$). A similar pattern was observed for the taste acceptance of the breads: people in groups 1, 2, and 3 had an acceptance threshold of up to 2, 2, and 5 days. However, the SSL of the bakeries based on overall acceptance showed that the groups with positive expectations did not differ ($p > 0.05$) and those with low expectations had the lowest SSL ($p < 0.05$).

Giménez et al. (2007) observed that Spanish brown pan bread was accepted up to 8 days of storage, while Uruguayan bakery products were accepted up to 10 days. Gambaro et al. (2004a) observed that alfajores have a shelf life of 74 days when storage at 20°C and physicochemical protocols were not good predictors to define the period of time, in which acceptable food quality is maintained.

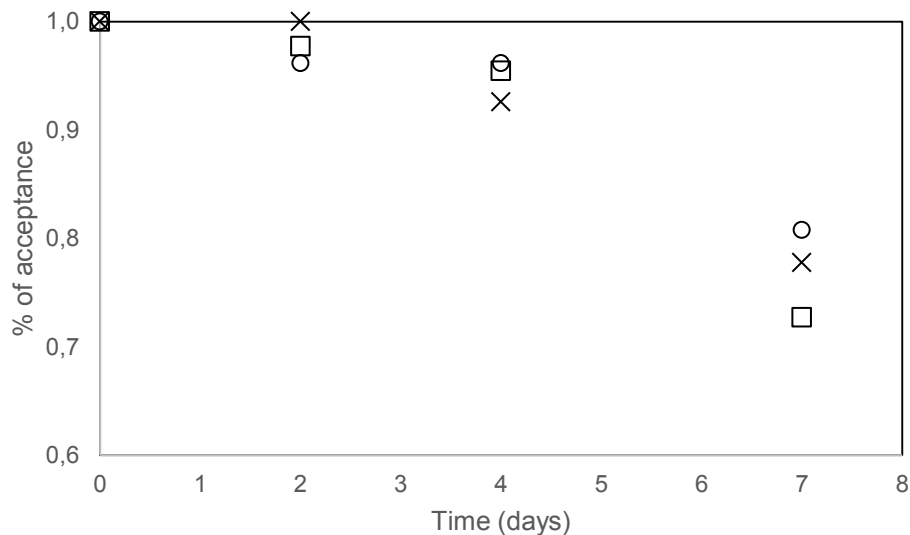
The results of the present study clearly show the rejection of the breads, although their storage is impacted by consumer expectation. In general, if expectations are met, the actual acceptance of the product is improved. However, if they go against what people feel in the sensory evaluation, the result can be quite negative for the product when rating it or a softening of rejection. The assimilation theory proposes that any discrepancy between product expectation and performance is minimized by the consumer by shifting his perception of the product to his expectation (positive or negative). In other words, the consumer tends to make his evaluation more according to what he expects from the product (ANDERSON, 1973). This behavior seems to fit to the positive hedonic expectation groups (group 1 and 3). Meanwhile, the contrast theory is because consumers maximize the disparity between the tasted product and what they initially expected when the expectation is not met by the current performance of the product, the consumer will have a less favorable evaluation compared to no previous expectation (CARDELLO; SAWYER, 1992), which may explain the behavior of consumers in group 2.

By the acceptability limit approach, softness was the limiting failure criteria for all participants. Texture, including softness, of bakery products changes through storage mainly due to moisture loss and starch retrogradation. The loss of moisture in the bread during its shelf life implies an increase in the crumb's rigidity, resulting in significant changes in the product (DAVIMOU *et al.*, 1996). For Galić *et al.* (2009), the main problem affecting softness in bread goods is staling since it processes takes place so rapidly and bakeries are located close to the point of consumption and produce daily. Retrogradation is the phenomenon in which disaggregated amylose and amylopectin chains in a gelatinized starch paste reassemble to form more ordered structures, implying significant changes in the texture of bakery products over time (WANG *et al.*, 2015).

Estimating the shelf life of foods is complex, as it is affected by legislative criteria, physicochemical reactions, and consumer behavior. Salvador *et al.* (2006) observed 11 days as optimal SSL of *alfajores*, and titrable acidity and moisture loss (physicochemical approaches) did not represent good predictors for the product. Additionally, SSL does not depend only on how the sensory characteristics of the product change over time, but rather on how consumers react to these changes, as they are the ones who decide whether a product after a certain storage time is still acceptable or not (HOUGH *et al.*, 2003; GIMÉNEZ; ARES, 2019). Specific attributes

such as scores, or even overall hedonic ratings, may not provide what a consumer would do when confronting a food product that has been in storage for some time, whether they decide to eat it or discard it (GIMÉNEZ; ARES, 2019). Thus, a survival analysis was performed to analyze whether or not the products would be rejected by the participants. Figure 2 represents the results of the percentage of participant acceptance and shows a good fit of the data to the tested Weibull model.

Figure 2. Preference percent distribution as function of storage time by survival analysis for group 1(□), group 2 (x) and group 3 (o).



The estimated Weibull model parameters, and SSL based on the survival analysis are shown in Table 3. SSL were estimated based on the probability after this period 25% of the consumers may completely reject the product (GÁMBARO *et al.*, 2004ab). Results (Table 4) shows that expectation did not impact on SSL ($p > 0.05$). Group 1, 2 and 3 rejected the samples after 7, 6 and 7 days. The SSL based on acceptability limit and survival analysis approaches is usually different (HOUGH *et al.*, 2003; GIMÉNEZ *et al.*, 2007; GÁMBARO *et al.*, 2004a).

Table 3. Grape pomace flour bread's shelf-life estimation based on acceptance limit and survival analysis approaches according to the different expectations' group.

	Group 1		Group 2		Group 3	
	μ	σ	μ	σ	μ	σ
Model parameters	2.37±0.09	0.32±0.09	2.33±0.09	0.37±0.12	2.32±0.07	0.39±0.08
SSL	7±1 ^a		6±1 ^a		6±1 ^a	

^a equal superscript letters indicate no statistical differences ($p>0.05$)

μ is the location parameter and σ is the shape parameter of Weibull model (Equation 10) from survival analysis approach.

Consumers may be more tolerant of sensory defects because they do not want to discard the product for economic and environmental reasons (GIMÉNEZ et al., 2008; GIMÉNEZ; ARES, 2019), as they may consider consuming it after it is stored in their homes (GIMÉNEZ et al., 2006). The results of the current work indicate that the total rejection of porridge-based grape bread did not depend on consumer expectations.

The comments at the end of the evaluation form showed that 20 participants, regardless of grouping, stated that "*amostra de pão rejeitada não estava boa mas estava comestível*" - the rejected slice of bread was not good, but it was edible". Another 15 volunteers pointed out that "some samples are clearly less soft / *algumas amostras são claramente menos macias*".

Several published studies support that the survival analysis approach is more suitable for Shelf Life Estimation of foods by manufacturers (HOUGH et al., 2003; SALVADOR et al., 2006; GIMÉNEZ et al., 2007; GIMÉNEZ; ARES, 2019). Consumer behavior in deciding whether to accept or reject a food is different from their taste, and the acceptability of attribute failure criteria may underestimate the shelf life of the product. However, it is important to point out that the acceptance of some attributes by consumers can be highly affected at this point, which is a point to be cautious about.

4. CONCLUSION

In conclusion, hedonic expectations about trying a grape-pomace bread influenced SSL perception based on hedonic approaches. People with low expectation to like the product were more critical to bakery changes through storage time, mainly on softness features. Although the participants hedonically disliked the samples, however, the expectation did not affect their overall rejection of the product. Overall acceptance proved to be the main limiting factor for shelf life, as it estimated the self-life of the breads according to the survival analysis approach. Using softness and flavor as shelf-life limit become too conservative and reduce the commercial life of the product.

The SSL of the evaluated bakery is almost 7 days before consumers reject the product, but at this point people may not like the softness and taste of the breads, which should be taken into account when making decisions to launch the product on the market. Furthermore, segmenting consumers according to their perceptions, attitudes, and/or expectations can be a good way to find out how they react to the product and how characteristics should be modified to increase food acceptability.

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