



Sensory characteristics, brand and probiotic claim on the overall liking of commercial probiotic fermented milks: Which one is more relevant?

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ABSTRACT

The effect of brand and probiotic claim of four commercial probiotic fermented milks (A, B, C, and D) on the overall liking was evaluated, as well the influence of the intrinsic sensory characteristics of the products. The probiotic fermented milks were evaluated through a sequence of three acceptance tests (blind test, brand expectation test, probiotic claim test) using the nine-point structured hedonic scale, and through descriptive analysis. Information about brand and probiotic claim had little impact on the overall liking of the commercial probiotic fermented milks. The knowledge about the brand enhanced the overall liking only for one product, as well reduced the risk relative of two products of receiving scores under five at the nine-point hedonic scale. Information about probiotic claim only reduced the relative risk for one product. On the other hand, the sensory profile influenced the overall liking of the probiotic fermented milks. The product A, described by visual viscosity, oral viscosity and sweet taste, and the products B and C, described by cream color, acid odor and acid taste, had similar overall liking, while the product D had lower overall liking and it was not described by any attribute. Therefore, we conclude that brand and probiotic claim (non-sensory factors) are essential to study and understand the consumer behavior on food, but the intrinsic sensory characteristics are more relevant to commercial probiotic fermented milks in specific, and fundamental to overall liking of these products.

1. Introduction

It is a wide consensus that feeding has a great influence on diseases risk reduction and well-being promotion, and in this way, the functional foods are highlighted in the food area. The dairy products are the pioneers (Sánchez, Reyes-Gavilán, Margolles, & Gueimonde, 2009) and represent the most important and commercialized segment within the area of functional foods (Annunziata & Vecchio, 2013), attracting consumers for including functional foods in their diet (Santeramo et al., 2018). Among the functional dairy products, fermented milks present a high potential for development of new products, especially the probiotic foods, due to be associated with health, well-being, practicality, and convenience (Corbo, Bevilacqua, Petrucci, Casanova, & Sinigaglia, 2014; Granato, Branco, Cruz, Faria, & Shah, 2010). The lactic acid bacteria (LAB) stand out within the probiotics, and contribute to the odor and flavor of products through fermentation, acidifying the food that presents a tangy lactic acid taste, and producing aromatic compounds from amino acids upon further bioconversion (Leroy & Vuyst, 2004). Nowadays, there are a wide variety of commercialized fermented milks, with different brands, flavors, and focused on the diverse

age groups (children, adults, and elderly people), which labels express the contribution of a healthier life due to the presence of alive micro-organisms, and, in some cases, as having probiotics.

The consumer's choice, purchase, repurchase, acceptability, and preference form a process which involves the sensory characteristics of the product, that strongly influence consumer's acceptance (Sabbe, Verbeke, & Van Damme, 2009; Tuorila & Cardello, 2002). Appearance, through color, size, shape, and visual texture, is often used as an attribute for buying decision. The odor may help to consumption decision because of the volatile compounds that are perceived through the orthonasal olfaction, and through chemical sensations perceived by the trigeminal nerve, when a food is approximated to the nostrils and the air inspired. Inside the mouth, the perception of oral texture is complex, involving mechanical properties, geometric and other related to perception of the moisture and fat content. Still in the mouth, and as complex as, the flavor involves the combination of gustative perception of soluble and non-volatile compounds (basic tastes), volatile compounds perceived through retronasal olfaction (aroma), and chemical sensations through trigeminal nerve.

In addition, non-sensory factors also influence consumers' choices.

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Non-sensory factors include consumer-specific factors such as gender, age, household income, education level, health concerns, social factors, and cultural and religious beliefs, as well food-specific factors, such as practicality and convenience, price, package size, label claims, production technology, safety, nutritional value, and brand (Jaeger, 2006; Li, Jervis, & Drake, 2015). Several studies show the importance of and the need to understand both consumer behavior and the reasons guiding consumers' choices (Ares, Giménez, & Deliza, 2010; Asioli, Naes, Granli, & Almli, 2014; Laureati, Conte, Padalino, Del Nobile, & Pagliarini, 2016; Menis-Henrique, Janzanti, & Conti-Silva, 2017; Vidigal et al., 2015). Among the non-sensory factors, the brand is one of the most affecting the consumers' acceptance (Gadioli et al., 2013), as well health claims have important effects on the acceptance of functional foods (Ares et al., 2010; Behrens, Villanueva, & Da Silva, 2007; Oliveira, Ares, & Deliza, 2018; Santillo & Albenzio, 2015; Tuorila & Cardello, 2002).

Within the study of non-sensory factors, the evaluation of consumer's expectation on the sensory acceptance is relevant and investigated over the years (Cardello, 1994; Saba et al., 2018; Sabbe et al., 2009). Moreover, the effects of the information given to the consumers, whatever information is, may complement the studies about food sensory properties. However, the consumer satisfaction may be dependent on the type of given information (Spreng, Mackenzie, & Olshavsky, 1996) and on the type of product considered, in this case, the probiotic fermented milks. In this paper, the effect of brand and of probiotic claim of commercial probiotic fermented milks on the overall liking was evaluated, as well the influence of the intrinsic sensory characteristics of the products on the acceptance. In this way, we are able to conclude about which factors (sensory or non-sensory) are more relevant to overall liking of this product in specific.

2. Material and methods

2.1. Material

Four commercial probiotic fermented milks, named as A to D, were purchased from a local market. Brands A, B and C were from multinational companies, while brand D had a regional market reach. All the products had traditional flavor, what means that no specific flavor characterized the product, as strawberry, passion fruit, fruit mix, grape, and so on. Moreover, all the products had no infant appeal, i.e., the commercial probiotic fermented milks that showed designs and pictures of characters and super heroes on the label were not considered in this work. Information on the label is described in Table 1.

2.2. Evaluation of the sensory acceptance of the probiotic fermented milks

This study was approved by the Research Ethics Committee at the Institute of Biosciences, Humanities and Exact Sciences, at Sao Paulo State University (Unesp) (Decision 656.892). The analysis was performed in individual booths under white light and at a temperature of

22 °C. Eighty-five consumers were recruited from students, staff and professors of the Institute, and individuals with any problem regarding to food ingestion were not recruited. Moreover, the trained panelists (Section 2.3) did not participate of tests with consumers, due to their differentiated knowledge about fermented milks in relation to the consumer public.

Initially, a questionnaire about gender and age of the individuals, degree of liking, frequency of consumption and favorite flavors of probiotic fermented milks, was applied to characterize the consumers. Among the consumers, 71% was female, between 18 and 30 years old (85%), who like fermented milks very much (80%) and little (20%). Their majority consume fermented milks daily (9%), from once to three times at week (45%) and fortnightly (24%). The most consumed flavor is the traditional, followed by strawberry, passion fruit, fruit mix and grape.

Then, the probiotic fermented milks were submitted to a sequence of three acceptance tests, following the methodology proposed by Deliza and Macfie (1996), with modifications. The tests were conducted in three sessions, with an interval of one day between each session. In the first session, called blind test, consumers evaluated the samples with no information about the product. In the second session, called brand expectation test, the product's brand was informed to consumer. The brand was informed in the evaluation form, not being presented the package or the label of the product, to guarantee that only the product's brand was influencing the evaluation of the consumer. And in the third session, called probiotic claim test, the consumer received together with the sample, the claim about probiotic printed in the evaluation form, as approved by ANVISA (Brazilian Health Regulatory Agency): "This product, called probiotic food, owns alive bacterias that contribute to the gut flora equilibrium. Its consumption must be associated to an equilibrated feeding and healthy life habits (ANVISA, 2015)".

In all the tests, the sensory acceptance of the commercial probiotic fermented milks was measured in terms of degree of liking, using the nine-point structured hedonic scale, with the extremes '9 - liked extremely' and '1 - disliked extremely' for appearance, odor, viscosity and flavor, as well as overall liking (Meilgaard, Civille, & Carr, 2007). The samples were presented in a monadic and balanced way and in complete block (MacFie, Bratchell, Greenhoff, & Vallis, 1989), and each consumer received 30 mL of samples at 10 °C, on a three-digit coded transparent disposable cup, and a glass with water at room temperature to drink between samples.

2.3. Descriptive analysis of the probiotic fermented milks

The probiotic fermented milks were evaluated regarding sensory profile using the descriptive analysis adapted from Stone and Sidel (2004). Panelists were recruited among undergraduate and post-graduate students from the Institute. The same questionnaire described in Section 2.2 was applied for characterization of the individuals, and individuals with any problem regarding to food ingestion were not recruited.

Table 1

Information on the labels of the commercial probiotic fermented milks.

| Product | Ingredients | Probiotic bacteria | Units by package | Wheight of the unit (g) | Flavor ^a | Company |
|---------|---|--|------------------|-------------------------|---------------------|---------------|
| A | Partially skimmed and/or partially skimmed milk reconstituted, liquid sugar, milk powder, dextrose, vitamin C and milk yeast. Gluten-free. | <i>Lactobacillus casei</i> | 6 | 100 | Traditional | Multinational |
| B | Skimmed milk and/or reconstituted skimmed milk, sugar, glucose, milk yeast and aroma. Gluten-free. | <i>Lactobacillus casei</i> | 6 | 80 | Traditional | Multinational |
| C | Skimmed reconstituted milk, sugar syrup, invert sugar, milk yeast, vitamins and minerals (A, D, calcium and zinc), stabilizer pectin, acidulant citric acid and flavoring. Gluten-free. | <i>Lactobacillus paracasei</i> | 7 | 75 | Traditional | Multinational |
| D | Skimmed milk or reconstituted skimmed milk powder, sugar syrup, dextrose and milk yeast. Gluten-free. | <i>Lactobacillus paracasei</i> , <i>acidophilus</i> , and <i>helveticus</i> | 6 | 80 | Traditional | Regional |

^a Traditional flavor means that no specific flavor characterized the product, as strawberry, passion fruit, fruit mix, grape, and so on.

Table 2
Definitions and references of the attributes of commercial probiotic fermented milks.

| Attributes | Definition | References |
|------------------|---|---|
| Appearance | | |
| Cream color | Characteristic cream color of fermented milk | Little: Honey yogurt (Vigor) Very: Diet <i>duche de leche</i> (Hué) mixed with whole milk, pasteurized, type A (Salute), at the proportion of 10:2 (w/w), respectively |
| Visual viscosity | Characteristic visual viscosity of fermented milk | Low: Skim milk, sterilized (Carrefour) High: Natural yogurt, sweetened, whipped (Vigor) |
| Odor | | |
| Acid odor | Characteristic acid odor of fermented milk | Little: Whole milk, pasteurized, type A (Salute) Very: Dry curd (Samira) |
| Viscosity | | |
| Oral viscosity | Characteristic oral viscosity of fermented milk and mouthfeel sensation | Low: Skim milk, sterilized (Carrefour) High: Natural yogurt, sweetened, whipped (Vigor) |
| Flavor | | |
| Sweet taste | Characteristic sweet taste of fermented milk | Little: Whole milk, pasteurized, type A (Salute) Very: Natural yogurt, sweetened, whipped (Vigor) mixed with sugar, at the proportion of 70:4 (w/w), respectively |
| Acid taste | Characteristic acid taste of fermented milk | Low: Whole milk, pasteurized, type A (Salute) High: Natural yogurt, sweetened, whipped (Vigor) mixed with citric acid, at the proportion of 100:1 (w/w), respectively |

Sixteen panelists, out of the eighteen recruited, were preselected through a basic taste recognition test, an odor recognition test and a difference-from-control test with a nine-point scale for the acid taste, due the importance of this attribute for fermented milks. The sensory attributes were generated by the sixteen panelists, using the Kelly Repertory Grid method (Moskowitz, 1983). After discussions to reach a consensus, the attributes that were most important for characterizing the appearance, odor, viscosity and flavor of the probiotic fermented milks were selected. The sensory panel also defined the attributes and the references for each one (Table 2).

After the training stage, which took ten sessions and was performed with the four fermented milks of Table 1, the panelists evaluated the same four fermented milks in four repetitions, and were selected according to their capacity to discriminate samples ($p_{\text{sample}} \leq 0.50$), capacity to reproduce judgments ($p_{\text{repetition}} > 0.05$) and consensus with the panel (Damasio & Costell, 1991), and thirteen panelists were selected to analyze the sensory profile of the probiotic fermented milks. The sensory panel was composed by 75% female, between 23 and 33 years old, who like fermented milks very much (81%), and consume fermented milks at least once a week (43%) followed by three times at week (28%). The most consumed flavor is the traditional, followed by strawberry, fruit mix and passion fruit.

The final sensory analysis was performed in individual booths, under white light, at a temperature of 22 °C, and an unstructured linear intensity scale of 90 mm length was used for each attribute. The probiotic fermented milks (30 mL and at 10 °C) were presented on transparent disposable cup coded with three-digit random numbers and were evaluated in four repetitions by the thirteen panelists. For that, sixteen samples were considered (four samples x four repetitions), previously randomized and then presented in a monadic and balanced way and in complete block (MacFie et al., 1989). A glass with water at room temperature was served to panelists to drink between samples.

2.4. Statistical analyses

The data of sensory acceptance for all the attributes (appearance, odor, viscosity, and flavor) and overall liking, comparing the four samples within each test (blind test, brand expectation test and probiotic claim test), was submitted to two-way ANOVA, considering sample and consumer as factors, followed by Tukey test, at significance level of 0.05. Consumers were considered as a factor to ANOVA, because they may use all the nine-point structured hedonic scale for expressing their perceptions. Therefore, they must be considered as a

block, for yielding a more accurate estimate of experimental error and, consequently, allowing a more sensitive hypothesis test (Meilgaard et al., 2007). However, interpretation of the consumers' effect on the overall liking is not presented in this paper.

The results of overall liking were also compared to blind test and brand expectation test, and to blind test and probiotic claim test, through two statistical tests: Student's *t*-test for paired samples, and relative risk analysis, both to significant level of 0.05. The relative risk analysis, according to Della Lucia, Minim, Silva, Minim, and Cipriano (2014), compares the frequency of a sample of receiving scores equal or lower than 5 (in the nine-point structured hedonic scale) considering two situations in the case of this study: information about brand and information about probiotic claim against no information (blind test). Therefore, if the relative risk is equal to 1, it indicates that the probability of a sample in receiving scores equal or lower than 5 is the same for both situations. The hypotheses for the relative risk analysis are H_0 - there is no effect of the information, and H_1 - there is effect of the information, and the confidence interval is used for testing the significance of the relative risk. Thus, when the confidence interval does not include the value 1, H_0 must be rejected.

The internal preference mapping for overall liking of the probiotic fermented milks in all the three tests was constructed using the principal component analysis (PCA). The consumers (variables) were placed in the columns and the fermented milks with the three tests were placed in the rows. Factor extraction was based on a correlation matrix and without factor rotation. A joining cluster analysis taking Euclidean distances as the distance measurements and Ward's hierarchy as the amalgamation rule was also applied to the data, and the midpoint of the major increment was taken to separate the groups.

The data of sensory profile of the fermented probiotic milks were submitted to two-way ANOVA, considering sample and panelist as factors, as well the interaction between them, followed by Tukey test (significance level of 0.05). This analysis and the previous were performed using the Statistica 7.0 software (StatSoft, Inc.).

The PLS (partial least square) analysis was also applied to the data, considering the overall liking of the probiotic fermented milks at the blind test as dependent variable and the sensory attributes as the explanatory (independent) variables. The analysis was performed using the XLSTAT statistical software for Microsoft Excel.

3. Results

The probiotic fermented milks A, B and C had good degree of liking

Table 3

Scores of liking (mean \pm standard deviation, n = 85) of commercial probiotic fermented milks from blind test, brand expectation test and probiotic claim test.

| | A | B | C | D |
|------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Blind test | | | | |
| Appearance | 7.4 ^b \pm 1.6 | 7.5 ^b \pm 1.4 | 7.9 ^a \pm 1.0 | 7.7 ^{ab} \pm 1.1 |
| Odor | 6.7 ^b \pm 1.7 | 7.5 ^a \pm 1.4 | 7.2 ^{ab} \pm 1.5 | 7.0 ^{ab} \pm 1.6 |
| Viscosity | 7.0 ^c \pm 1.6 | 7.5 ^{ab} \pm 1.3 | 7.7 ^a \pm 1.1 | 7.2 ^{bc} \pm 1.3 |
| Flavor | 6.9 ^a \pm 1.8 | 7.5 ^a \pm 1.8 | 7.4 ^a \pm 1.8 | 5.3 ^b \pm 2.3 |
| Overall liking | 6.9 ^b \pm 1.6 | 7.5 ^{ab} \pm 1.5 | 7.5 ^a \pm 1.5 | 5.9 ^c \pm 1.9 |
| Brand expectation test | | | | |
| Appearance | 7.4 ^b \pm 1.4 | 7.7 ^{ab} \pm 1.4 | 7.9 ^a \pm 1.1 | 7.5 ^{ab} \pm 1.4 |
| Odor | 6.9 ^c \pm 1.6 | 7.8 ^a \pm 1.3 | 7.6 ^{ab} \pm 1.3 | 7.3 ^{bc} \pm 1.4 |
| Viscosity | 7.4 ^{bc} \pm 1.4 | 7.8 ^a \pm 1.0 | 7.6 ^{ab} \pm 1.1 | 7.1 ^c \pm 1.3 |
| Flavor | 7.0 ^b \pm 1.8 | 7.9 ^a \pm 1.4 | 7.7 ^{ab} \pm 1.4 | 5.7 ^c \pm 2.1 |
| Overall liking | 7.1 ^b \pm 1.7 | 7.8 ^a \pm 1.3 | 7.7 ^{ab} \pm 1.3 | 6.2 ^c \pm 1.8 |
| Probiotic claim test | | | | |
| Appearance | 7.2 ^b \pm 1.6 | 7.6 ^{ab} \pm 1.4 | 7.9 ^a \pm 1.1 | 7.7 ^a \pm 1.1 |
| Odor | 6.7 ^b \pm 1.9 | 7.7 ^a \pm 1.3 | 7.6 ^a \pm 1.4 | 7.2 ^{ab} \pm 1.6 |
| Viscosity | 7.2 ^{ns} \pm 1.5 | 7.6 ^{ns} \pm 1.2 | 7.6 ^{ns} \pm 1.0 | 7.2 ^{ns} \pm 1.3 |
| Flavor | 6.7 ^b \pm 2.0 | 7.4 ^{ab} \pm 1.9 | 7.6 ^a \pm 1.4 | 5.5 ^c \pm 2.3 |
| Overall liking | 6.9 ^b \pm 1.9 | 7.4 ^{ab} \pm 1.6 | 7.6 ^a \pm 1.4 | 6.0 ^c \pm 2.1 |

Different letters in the same line indicate statistically different means by the Tukey test ($p \leq 0.05$).

n.s. means not significant.

in all the three tests for all attributes and overall liking, varying from 6.7 to 7.9 in the nine-point hedonic scale, that it corresponds from 'I slightly liked' to 'I liked very much' (Table 3). The product D also had good degree of liking, however, it received scores lower to flavor and overall liking in relation to the other products, varying from 5.3 to 6.2, corresponding from 'neither liked nor disliked' to 'I liked moderately', in all the three tests.

Evaluating the effect of the brand expectation on the overall liking of the probiotic fermented milks, the knowledge about the brand enhanced, significantly, the degree of liking by the product B (Table 4) and reduced the relative risk (positive influence) of the products A and D in receiving scores lower than five in the nine-point hedonic scale (Table 5). However, the knowledge about the probiotic claim only reduced the relative risk of the product D in receiving scores lower than five in the nine-point hedonic scale (Table 5).

The internal preference mapping obtained through PCA explained 53.5% of the data variation (Fig. 1A). Although an explanation higher than 70% is desirable for considering the PCA an appropriate multivariate analysis to be applied to the data (Mardia, Kent, & Bibby, 1979), internal preference mappings in general show lower percentage of explanation. This is explained because of the high number of variables (consumers), which may enhance the data variability, reducing the percentage of explanation. The internal preference mapping for the overall liking (Fig. 1A) of the products show the discriminance of products A and D from the products B and C, as well the non discrimination of products in function of the applied test, corroborating the previous results that showed little effect of the information about the

Table 4

Values of p from Student t test to brand expectation test (session 2) and probiotic claim test (session 3) in relation to the blind test (session 1), considering the overall liking.

| Product | p-Value ^a (two-sided) | |
|---------|----------------------------------|-----------------------|
| | Session 2 – session 1 | Session 3 – session 1 |
| A | 0.085 | 0.851 |
| B | 0.018 | 0.946 |
| C | 0.255 | 0.489 |
| D | 0.137 | 0.628 |

^a Significance level of 5%.

Table 5

Relative risk and influence of the information on the overall liking of probiotic fermented milks.

| Relative risk ^a | | Confidence interval (95%) | Conclusion |
|-----------------------------|------------|---------------------------|--------------------|
| Product | Estimative | | |
| A | | | |
| Blind and brand expectation | 1.286 | 0.280 < CI < 0.988 | Positive influence |
| Blind and probiotic claim | 1.000 | 0.295 < CI < 0.940 | No influence |
| B | | | |
| Blind and brand expectation | 1.800 | 0.184 < CI < 1.506 | n.s. |
| Blind and probiotic claim | 1.000 | 0.220 < CI < 1.261 | n.s. |
| C | | | |
| Blind and brand expectation | 1.000 | 0.193 < CI < 1.436 | n.s. |
| Blind and probiotic claim | 1.750 | 0.160 < CI < 1.732 | n.s. |
| D | | | |
| Blind and brand expectation | 1.478 | 0.341 < CI < 0.813 | Positive influence |
| Blind and probiotic claim | 1.133 | 0.357 < CI < 0.776 | Positive influence |

n.s. means not significant.

^a Scores of liking from 1 to 5.

brand and the probiotic claim on the overall liking of the products. The dendrogram (Fig. 1B) from cluster analysis also shows the same formation of groups. Moreover, the internal preference mapping (Fig. 1A) shows preference for the products B and C, regarding the overall liking.

All the attributes from the sensory profiles discriminated the probiotic fermented milks (Table 6), especially samples A and B. The sample A may be described by visual viscosity, oral viscosity and sweet taste, while the sample B may be described by cream color, acid odor and acid taste. Samples C and D may be considered as having intermediate intensities of sensory attributes in relation to A and B.

The PLS analysis (Fig. 2) resulted in a cumulated R^2 of 72.5% for two components, and it shows the effects of the sensory attributes of the probiotic fermented milks on the overall liking. Samples A, B and C stood out by the overall liking, even with different sensory profiles. Sample A had the overall liking influenced by the visual viscosity, oral viscosity and sweet taste, while samples B and C had the overall liking influenced by the cream color, acid odor and acid taste. Sample D did not show good overall liking, as well observed in Table 3, and it had no influence of any sensory attribute. Indeed, the sample D had intermediate intensities of sensory attributes, as seen in Table 6.

4. Discussion

The knowledge about the brand enhanced the mean of overall liking to product B (Table 4), and reduced the relative risk to products A and D in receiving scores under five at the nine-point hedonic scale (Table 5). Therefore, the brand had a positive impact on the overall liking of the commercial probiotic fermented milks. Indeed, the brand has a recognized importance as one of the factors that most affecting the consumers' acceptance (Gadioli et al., 2013). Regarding the probiotic claim, the knowledge about it reduced the relative risk for one product, without changes to the other products (Table 5), i.e., the effect of the claim was less expressive than the brand. According to Spreng et al. (1996), the consumer satisfaction may be dependent on the type of given information, and probably these results suggest that the information approved by ANVISA may be not attractive, or even, not well-explanatory about the benefit effects of probiotic products on the gut microbiota. Moreover, considering that 80% of the recruited

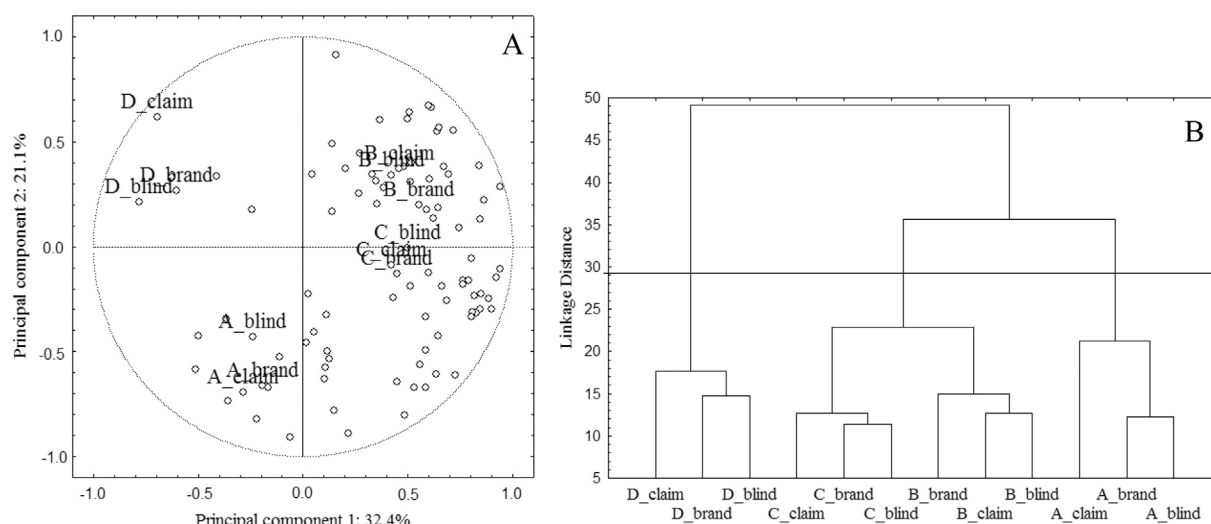


Fig. 1. Internal preference mapping for overall liking of commercial probiotic fermented milks (A, B, C and D) at blind test, brand expectation test and probiotic claim test (A) and dendrogram from the cluster analysis (B).

Table 6

Intensity of attributes (means \pm standard deviation, $n = 208$) of commercial probiotic fermented milks.

| Attributes | A | B | C | D |
|------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|
| Cream color | 1.9 ^c \pm 0.5 | 5.1 ^a \pm 0.9 | 2.5 ^b \pm 0.5 | 2.2 ^{bc} \pm 0.6 |
| Visual viscosity | 2.2 ^a \pm 0.8 | 1.4 ^b \pm 0.6 | 2.0 ^a \pm 0.9 | 1.5 ^b \pm 0.8 |
| Acid odor | 3.2 ^c \pm 1.2 | 5.3 ^{ab} \pm 1.4 | 5.5 ^a \pm 1.3 | 4.5 ^b \pm 1.4 |
| Oral viscosity | 2.9 ^a \pm 1.1 | 1.5 ^c \pm 0.7 | 1.9 ^b \pm 0.9 | 1.8 ^{bc} \pm 1.0 |
| Sweet taste | 5.6 ^a \pm 1.1 | 2.7 ^d \pm 1.8 | 3.7 ^c \pm 1.8 | 4.4 ^b \pm 1.4 |
| Acid taste | 2.2 ^d \pm 1.2 | 6.7 ^a \pm 1.1 | 5.7 ^b \pm 1.7 | 4.2 ^c \pm 1.4 |

Different letters in the same line indicate statistically different means by the Tukey test ($p \leq 0.05$).

consumers like fermented milks very much (Section 2.2), probably the positive effects of probiotic products on the gut microbiota were already known, and therefore little influenced the overall liking of the products.

Differences in the sensory profile of the products are related not only to the ingredient list (Table 1), but also are due to the fermentation processing during the production of fermented milk products. As it may be seen at Table 1, different strains of *Lactobacillus* were used in the

product formulations. The proteolytic system of lactic acid bacteria (LAB), as *Lactobacillus*, is essential for their growth in milk and contributes significantly to flavor and texture development in fermented milk products (Savijoki, Ingmer, & Varmanen, 2006; Turbay, LeBlanc, Perdigon, Giori, & Hebert, 2012). In the same way, the free fatty acid concentration, derived from the lipolytic activity, is strictly related to the flavor formation in fermented milks (Masuda, Hidaka, Kondo, & Itoh, 2005). Moreover, these effects may be also related to the type of bacteria strain used. For example, two types of lactic acid, l(+) and d(−), are produced by LAB: *Lactobacillus casei* produces only l(+) lactic acid, while *Lactobacillus helveticus* and *Lactobacillus acidophilus* produce both types of lactic acid - l(+) and d(−) (Chandan & Kilara, 2013), which may result in differences on the acidity of fermented milks (Penna et al., 2015).

Therefore, the sensory attributes of the probiotic fermented milks may not be underestimated, even when the non-sensory factors are being investigated. Fig. 1 shows that products may discriminate in relation to the overall liking, especially products A and D in relation to B and C, at the same time that the type of test applied (blind, brand expectation, and probiotic claim) did not differentiate them, which may be explained by the intrinsic characteristics of the products. Indeed, the

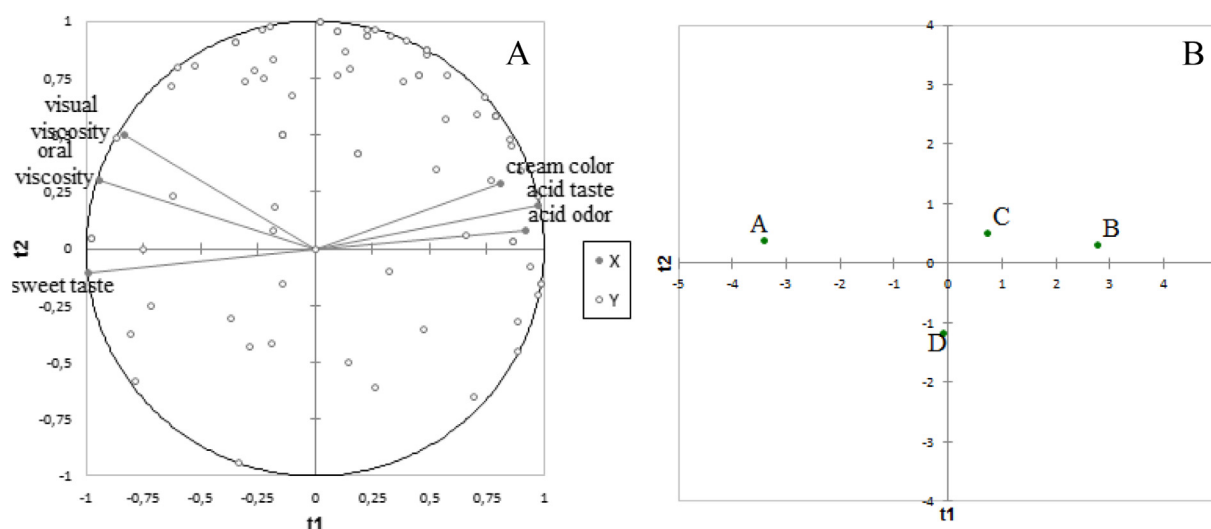


Fig. 2. Results from PLS analysis for commercial probiotic fermented milks. A - Projection of variables (X = explanatory variables - attributes; Y = dependent variables – consumers' overall liking at blind test). B - Projection of products.

Fig. 2 shows the influence of the sensory attributes on the overall liking of the products, again discriminating products A and D from B and C. Therefore, our results suggest that the intrinsic sensory characteristics of probiotic fermented milks are more relevant to the overall liking than the non-sensory factors.

5. Conclusions

Information about brand and probiotic claim had little impact on the overall liking of the commercial probiotic fermented milks. The knowledge about the brand enhanced the overall liking only for one product, as well reduced the risk relative of two products of receiving scores under five at the nine-point hedonic scale. Information about probiotic claim reduced the relative risk for only one product. However, the sensory profile influenced the overall liking of the probiotic fermented milks. The product A, described by visual viscosity, oral viscosity and sweet taste, and the products B and C, described by cream color, acid odor and acid taste, had a similar overall liking, while the product D had lower overall liking and it was not described by any attribute. Therefore, we conclude that brand and probiotic claim (non-sensory factors) are essential to study and understand the consumer behavior about food, but the intrinsic sensory characteristics are more relevant to probiotic fermented milks in specific, and fundamental to overall liking of these products.

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