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Original article

Development of smoothies from dehydrated products of strawberry and banana pulps obtained through foam-mat drying

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Summary Dehydrated products from strawberry and banana pulps were obtained through foam-mat drying and subsequently used for production and evaluation of smoothies. For that, six smoothies were prepared, with different proportions of dehydrated strawberry and banana products (40–60%, 50–50% and 60–40%, respectively), each reconstituted in whole milk or cold water (w/v). Smoothies with 50–50% and 60–40% of dehydrated strawberry and banana products, respectively, reconstituted in whole milk, stood out for their degree of liking of appearance and colour because of the lighter colour and instrumentally measured viscosity. The smoothie with 40% strawberry and 60% banana reconstituted in milk stood out by the degree of liking of its odour, viscosity and flavour, its overall acceptance, ideal intensity of sweetness and fruit flavour, as well by its colour hue. Our study shows the feasibility of using dehydrated products of strawberry and banana pulps through foam-mat drying in smoothies, highlighting smoothies reconstituted in milk.

Keywords Colour, hedonic scale, JAR scale, viscosity.

Introduction

Smoothies fit in the demand new products with high fruit and vegetable content, and they have become increasingly popular among fruit consumers (Keenan *et al*., 2010; Park *et al*., 2016). Smoothies can be prepared with fresh and/or frozen fruits and vegetables or acquired ready-to-drink in the supermarket (Keenan *et al*., 2011), through different combinations of fruits and vegetables with an aqueous base, dairy (ice cream, milk, yogurt), lemonade or tea (Barba *et al*., 2012; Zulueta *et al*., 2013; Castillejo *et al*., 2016). In this way, the product has a smooth semi-liquid consistency, similar to a milk shake, it may be sweetened or not, and, normally, it is free of dyes and flavourings (Keenan *et al*., 2010; Teleszko & Wojdyło, 2014).

Aiming a product with healthy appeal, that attracts consumers and has greater shelf life and consumption practicity, the foam-mat drying emerged as a promising technique. This technology implies in mixing a pulp or juice of fruits and vegetables with stabilising agent and/or foaming agent to produce stable foam, which is submitted to drying temperatures ranging from 50 to 80 °C, resulting in flakes or powder products (Tavares *et al*., 2017). In this procedure, the drying rates are quicker than during conventional drying with heated air circulation, because of the greater exposed surface area, decreasing the energy consumption (Auisakchaiyoung & Rojanakorn, 2015; Abbasi & Azizpour, 2016). In comparison to freeze-drying and spray-drying, the foam-mat drying can further degrade the present compounds in pulps and, that consequently, the smoothie prepared with the powder will have lower nutritive value than that made with a powder obtained through lyophilisation, per example. Another disadvantage of this technique is the need of adding additives to the pulp in order to obtain a stable foam, as well less hygroscopic and non-gummy products. However, foam-mat drying has the advantage of being a technique of simple execution and low cost, which makes it possible to offer products with more affordable price to consumers (Tavares *et al*., 2017).

Among the numerous fruits and combinations of fruits that may be used for smoothies, banana and strawberry is one option and their association with other fruits is also found (Keenan *et al*., 2010, 2011, 2012a,b,c; Hurtado *et al*., 2017). Indeed, strawberry is a much-liked fruit consumed across the world, *in natura* and also in derived products, such as jellies, yogurts, cookies, cakes and drinks (Hornedo-Ortega

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et al., 2016). On the other hand, banana is the fruit of national preference, widely available in the Brazilian market and several other countries throughout the year which contributes strongly to its high consumption. Currently it is the second most cultivated fruit consumed by Brazilians, losing out only to the orange (Treichel *et al*., 2016). However, no studies were found about smoothies produced with a strawberry and banana mix of dehydrated products produced through foam-mat drying.

The review of the literature shows the lack of studies on foam-mat drying for producing smoothies based on strawberry and banana. Therefore, we aimed to study the feasibility of producing smoothies from dehydrated products of strawberry and banana pulps obtained through foam-mat drying, in different proportions and reconstituted in different matrices (water or milk), with the subsequent characterisation of these smoothies.

Materials and methods

Materials

Strawberries of the Oso Grande cultivar, at commercial maturation stage, and banana of the Nanica cultivar, at maturation stage grade six (all yellow peel), were bought from local producers in São José do Rio Preto (São Paulo, Brazil). The fruits that presented some kind of imperfection, like squashing or rotting, were discarded. The additives used to obtain the foams were albumin from dehydrated egg white, containing the antiwetting agent tricalcium phosphate (New Millen, Cajamar, Brazil) and ten DE maltodextrin (Ingredion, Mogi Guaçu, Brazil). The reagents used to prevent enzymatic browning of the bananas were L-ascorbic acid and citric acid (Synth, Diadema, Brazil), both with food grade.

Production of the dehydrated product from strawberry pulp

The fresh strawberries were washed, sanitised in a 50 mg/L active chlorine solution during 10 min, rinsed in potable water, placed in a stainless steel drainer for water drainage, packed in polypropylene plastic bags (30 cm × 40 cm), vacuum sealed in a 200B sealer (Selovac, São Paulo, Brazil) and frozen (−18 °C). The strawberries were thawed, homogenised in a JAA-66 vertical pulper (Incal, São Paulo, Brazil) and the pulp was packed in polypropylene plastic bags (30 cm × 40 cm) containing portions of approximately 1.3 kg, which were sealed in a Hermet 400 pedal sealer (Barbi, Itu, Brazil) and again frozen (−18 °C).

For the strawberry foam, a rotational central composite design was used to evaluate the effects of the additives albumin (0–0.25–0.75–1.25–1.5%) and maltodextrin (0–3–10–17–20%). Based on the experimental design, 0.75% of albumin, 10% of maltodextrin and 89.25% of strawberry pulp (relative to 100 g of formulation, w/w) were defined as ideal for obtaining a stable foam and a dehydrated product with good characteristics. Then, the strawberry pulp was thawed, the additives were mixed in and it was subjected to constant stirring with the aid of a Philips Walita RI7110 domestic mixer (Koninklijke Philips N.V., Amsterdam, Netherlands) at its maximum speed for 20 min.

The foams were then spread out into trays of aluminum of circular format (radius 150 mm and height 4 mm), filled with approximately 170 g of foam, and placed in a TE-394/2 oven with circulation and air renewal (Tecnal, Piracicaba, Brazil), at a temperature of 80 °C for 9 h. The dried material was removed from each tray using a stainless steel spatula, packed in bags with layers of polyester, aluminum and polyethylene (18 cm × 23.8 cm × 0.02 cm), sealed and stored under freezing. The strawberry dehydrated product contained 1.1% water content, 0.19 water activity at 25 °C, 99.2% solubility and 1.1% hygroscopicity.

Production of the dehydrated product from banana pulp

The bananas were washed in drinking water and dried naturally. Portions of 500 g of peeled bananas were sliced manually with a thickness of approximately 2 mm and placed for 2 min in 750 mL of solution containing 1% ascorbic acid and 4% citric acid to prevent enzymatic browning. Subsequently, the banana slices were drained with a sieve and steam blanched for 5 min, followed by heat shock for 1 min in water at 7 °C. The blanched banana slices were then homogenised in a Philips Walita RI1341 mixer (Koninklijke Philips N.V.) for 1 min for obtaining the pulp. The blanched pulp was stored in 500 mL plastic pots with caps under freezing (−18 °C).

The banana pulp was thawed and used for the preparation of a formulation composed of banana pulp and 1% albumin. The experimental design was not necessary for bananas because several papers in the literature have already used albumin as the foaming agent and obtained satisfactory results (Prakotmak *et al*., 2011, 2014; Thuwapanichayanan *et al*., 2012). The foam and dehydrated product from banana pulp were obtained using the same processing described for strawberry in Section Production of the dehydrated product from strawberry pulp, except for the drying period that lasted for 8 h. The banana dehydrated product had 1.0% water content, 0.15 water activity at 25 °C, 99.3% solubility and 1.0% hygroscopicity.

Elaboration of the smoothies

The smoothie formulations (Table 1) were determined through preliminary tests for standardisation of the quantities of each ingredient. Dehydrated strawberry

Table 1 Formulations of the smoothies with strawberry (S) and banana (B)

	Smoothie		
	50%S–50%B	60%S–40%B	40%S–60%B
Cold water or cold whole milk (mL)	500	500	500
Dehydrated product (total of 12% in relation to the liquid, w/v; g)			
Strawberry	30	36	24
Banana	30	24	36
Demerara sugar (2% in relation to the liquid, w/v; g)	10	10	10

and banana products were thawed and homogenised, separately, and mixed in the three defined proportions, with demerara sugar added. Demerara sugar is extracted from sugarcane, and is submitted to a slight refinement process, without chemical additive, having a slightly brown colour and large granulometry. The mixtures were packed in bags with layers of polyester, aluminum and polyethylene (18 cm × 23.8 cm × 0.02 cm), sealed, and stored under refrigeration (7 °C) until the smoothies were prepared for analysis.

At the time each analysis was done, the mixtures were reconstituted in two different matrices, cold potable water or cold milk (UHT integral milk, 3% fat), both at 7 °C. The ingredients were placed in different mixers, one for water (RI2034 model, Philips Walita - 600W, 3 speeds) and other for milk (RI2101 model, Philips Walita – 550W, 2 speeds), and beaten for 2 min at maximum speed. For the sensory analyses, the smoothies were kept under at 7 °C until the time of analysis and, whenever necessary, new smoothies were prepared. As of the sensory analysis dynamic, smoothies remained no more than 20 min under refrigeration and syneresis was not observed.

Analysis of the viscosity and colour of the smoothies

The viscosity of the smoothies was evaluated in ten replicates, using a TA.XT/Plus/50 Texture Analyser (Stable Micro Systems, Godalming, England) and the Texture Exponent 32 software (Stable Micro Systems), with the back extrusion probe of 45 mm in diameter. The test conditions were: smoothie at refrigeration temperature added inside the acrylic container in an amount sufficient to reach a height of 25 mm; compression of 50% of the sample height; pre-test velocity of 2 mm/s; test speed of 1 mm/s; post-test velocity of 10 mm/s. During the instrumental analysis, a typical graph of force type was plotted as a function of time, with two areas being obtained: one positive, relative to compression of the sample by the probe, and one negative, while the probe returned to the original position. Thus, the larger the plotted areas the greater the viscosities of the smoothies.

The colour was analysed using a Color Flex 45/0 colourimeter (Hunterlab, Reston, VA, USA) and the CM-S100W SpectraMagic Nx software v. 2.03.0006 (Konica Minolta, Tokyo, Japan), as well as with D65 illuminant and a 10° observer angle. The CIE-$L^*a^*b^*$ system was used and the chroma value (C^*) and hue (h) were also obtained. The smoothies were placed in a quartz capsule with an internal diameter of 58 mm, completely filling the bottom of the capsule. The analysis was performed in triplicate, and each replicate was rotated four times (0°, 90°, 180° and 270°), resulting in twelve replicates for each sample.

Analysis on the sensory acceptance of smoothies

Sensory analysis of smoothies was performed at the Laboratory of Sensory Analysis, Department of Food Engineering and Technology, Institute of Biosciences, Humanities and Exact Sciences, and the study was approved by the Research Ethics Committee of the same Institute. The acceptance analysis was performed in individual booths under white light and at 22 °C.

Recruited from students, staff and professors, one hundred and seventeen consumers answered a questionnaire for characterisation of the sensory panel. Among them, the age ranged from 17 to 50 years, and 69% were women. It was found that 93% of these consumers are very fond of fruit-based drinks and 91% consume at least once a week. The questionnaire also asked whether consumers knew the fruit-based drink called a smoothie, and 65% of the panel said yes, 67.1% said they liked smoothies a lot, but most consumers (53.9%) consume them only once a month. This low smoothie consumption is probably because the drink is still new to the market and, its price is not yet accessible to all the different socioeconomic levels.

The smoothies were presented in a monadic and balanced manner and in a complete block (Macfie & Bratchell, 1989), and each consumer received approximately 30 mL of each sample at 7 °C, in plastic cups coded with random numbers of three digits. Two scales were used to evaluate the sensory acceptance of the smoothies: (i) nine-point structured hedonic scale, with the extremes 'dislike extremely' and 'like extremely' for appearance, colour, odour, viscosity and flavour, as well as overall acceptance; and (ii) just-about-right (JAR) scales for ideal intensity of sweetness and fruit flavour, which ranged from 'extremely less intense than ideal' to 'extremely more intense than ideal' (Meilgaard *et al.*, 1999).

Statistical analyses

All statistical analyses were performed using the Statistica 10.0 software (StatSoft, Inc., Tulsa, OK, USA). The means for viscosity, colour and sensory acceptance were compared using analysis of variance followed by the Tukey test, at a significance level of 0.05.

An external preference mapping was constructed, for correlating the sensory acceptance with viscosity and colour, using principal component analysis. On the JAR scale, the centre of the scale indicates 'ideal intensity' and the farther from the centre, the intensity of the measured characteristic is less ideal (whether for more or for less). Therefore, this scale had to be adjusted for establishing correlations through principal component analysis, so that the higher values indicated 'closer to the ideal', as proposed by Bower & Boyd (2003). The means of the variables were placed in the columns and the smoothie formulations were placed in the rows, and the data was standardised in the columns before the analysis. Factor extraction was performed from the correlation matrix and factor rotation was not used.

Results and discussion

Viscosity and colour of the smoothies

The positive and negative areas obtained in the viscosity analysis show that the smoothies made with milk have a higher viscosity ($P \leq 0.05$) than those with water (Table 2), which is due to the composition of milk, with the presence of fat content, proteins and total solids (Sodini *et al.*, 2004). Thus, the viscosity may be altered according to the reconstitution matrix used, such as skimmed milk instead of whole milk, yogurt or ice cream. In addition, considering only water-based smoothies, the one with the highest percentage of banana (40%S–60%B) also had one of the highest viscosities due to the presence of larger solid particles, insoluble materials such as pectin, hemicellulose and some cellulosic materials from the banana dehydrated products (Byaruagaba-Bazirake *et al.*, 2012). Therefore, fruits that generate purée, such as banana, can produce beverages with higher viscosity.

Comparing smoothies made with water, the different proportions between dehydrated strawberry and banana products resulted in differences in all the colour attributes ($P \leq 0.05$), except for C*, which was the same for all three smoothies ($P > 0.05$; Table 2). Reconstitution in milk caused little change in the colour of smoothies, even when they were prepared with different proportions of dehydrated products, except for hue, which was statistically different for all smoothies ($P \leq 0.05$), although the smoothies obtained after reconstitution in the same matrix may be classified as the same colour. Angles from 25 to 70° indicate orange colour, while angles from 70 to 100° indicate yellow (Ramos & Gomide, 2009), in other words, angles from 70 to 100° indicate that there is predominance of yellow chromaticity (b*) in relation to the red (a*). The smoothies with milk presented colours with angles that may be classified as yellow, and in fact, the colours of these smoothies showed values of yellow chromaticity higher than the red. The smoothies with water, whose colours may have angles classified as orange, presented less distant values between red and yellow chromaticity. This difference in the colour of the smoothies is mainly due to the reconstitution matrix. Water, being a colourless, insipid and scentless liquid, does not interfere in the colouration of the drink, it only reflects the colouration of the fruit powders. Milk, on the other hand, alters the colouration of the milk-based smoothies due to its own composition containing casein micelles and fat globules that, acting together, causes variations in the white-yellowish colour (Fox & Brodkorb, 2008).

Sensory acceptance of the smoothies

The degree of liking of appearance and colour was lower ($P \leq 0.05$) for the smoothies with water than with milk (Table 3). This could have happened because consumers associated the smoothie with milk-based drinks, such as milk shakes, and in this way, smoothies with milk were more 'characteristic' of these

Table 2 Viscosity ($n = 10$) and colour ($n = 12$) of the strawberry (S) and banana (B) smoothies

Smoothies	Viscosity						
	Positive area (N.s)	Negative area (N.s)	*L**	*a**	*b**	*C**	*h* (°)
50%S–50%B–Water	3.3 ± 0.31^{ab}	0.6 ± 0.04^{a}	43.0 ± 0.12^{b}	9.6 ± 0.09^{c}	17.2 ± 0.12^{c}	19.7 ± 0.15^{c}	60.8 ± 0.14^{b}
50%S–50%B–Milk	$6,0 \pm 0.25^{c}$	1.2 ± 0.02^{d}	69.4 ± 0.42^{e}	5.5 ± 0.17^{a}	15.9 ± 0.46^{b}	16.9 ± 0.49^{b}	70.8 ± 0.09^{e}
60%S–40%B–Water	3.0 ± 0.14^{a}	0.6 ± 0.03^{a}	40.4 ± 0.20^{a}	10.1 ± 0.04^{d}	16.4 ± 0.12^{b}	19.2 ± 0.11^{c}	58.5 ± 0.20^{a}
60%S–40%B–Milk	5.9 ± 0.22^{c}	1.2 ± 0.04^{d}	69.6 ± 0.09^{e}	5.5 ± 0.03^{a}	15.1 ± 0.04^{a}	16.0 ± 0.05^{a}	70.1 ± 0.09^{d}
40%S–60%B–Water	3.8 ± 0.25^{b}	0.7 ± 0.04^{b}	43.9 ± 0.34^{c}	8.6 ± 0.17^{b}	17.7 ± 0.33^{d}	19.7 ± 0.37^{c}	64.1 ± 0.15^{c}
40%S–60%B–Milk	5.3 ± 1.06^{c}	1.0 ± 0.09^{c}	68.4 ± 0.82^{d}	5.5 ± 0.35^{a}	16.2 ± 0.67^{b}	17.1 ± 0.75^{b}	71.3 ± 0.40^{f}

Results presented as means ± standard deviation. Different letters in the same column indicate significant differences among the samples by the Tukey test ($P \leq 0.05$).

products. Viscosity liking was equal among all of them ($P > 0.05$). It is interesting to note that even the instrumental analysis showed differences in the viscosities of the smoothies as a function of the matrix used for reconstitution and the different proportions among the fruits (Table 2), the degree of liking of the viscosity was not influenced by these variables.

The smoothies 60%S–40%B–Water and 40%S–60%B–Milk were different ($P \leq 0.05$) in relation to the degree of liking of the aroma, flavour and global acceptance, the latter being more accepted (Table 3), probably due to the greater proportion of dehydrated banana product and reconstitution with milk, leading to a pronounced banana odour and sweeter taste. As

Table 3 Degree of liking (n = 117) of the strawberry (S) and banana (B) smoothies

Smoothie	Appearance	Colour	Odour	Viscosity	Flavour	Overall acceptance
50%S–50%B–Water	5.1 ± 1.8^{a}	5.0 ± 1.9^{a}	5.7 ± 1.7^{ab}	6.0 ± 1.7^{ns}	5.2 ± 2.0^{ab}	5.3 ± 1.6^{ab}
50%S–50%B–Milk	6.3 ± 1.7^{b}	6.2 ± 1.8^{b}	6.0 ± 1.5^{ab}	5.8 ± 2.2^{ns}	5.9 ± 2.1^{bc}	5.9 ± 1.8^{bc}
60%S–40%B–Water	5.1 ± 1.8^{a}	5.0 ± 1.8^{a}	5.5 ± 1.9^{a}	5.7 ± 2.1^{ns}	5.1 ± 2.1^{a}	5.2 ± 1.8^{a}
60%S–40%B–Milk	6.3 ± 1.8^{b}	6.2 ± 1.9^{b}	5.8 ± 1.7^{ab}	5.9 ± 2.2^{ns}	5.9 ± 2.1^{bc}	5.9 ± 1.9^{bc}
40%S–60%B–Water	5.1 ± 1.7^{a}	5.1 ± 1.9^{a}	5.8 ± 1.9^{ab}	6.0 ± 1.9^{ns}	5.2 ± 2.2^{ab}	5.4 ± 1.8^{ab}
40%S–60%B–Milk	6.3 ± 1.8^{b}	6.2 ± 1.9^{b}	6.3 ± 1.6^{b}	6.0 ± 2.1^{ns}	6.2 ± 2.0^{c}	6.2 ± 1.9^{c}

Results presented as means ± standard deviation. Different letters in the same column indicate significant differences among the samples by the Tukey test ($P \leq 0.05$).
ns, not significant.

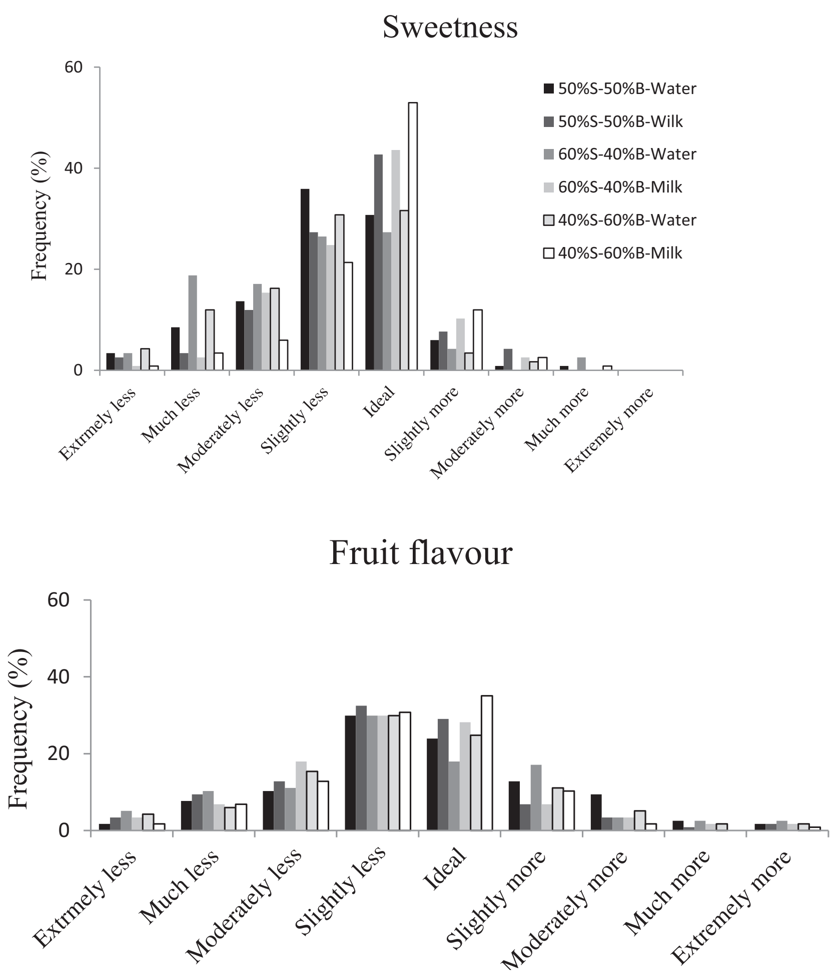

Figure 1 Frequency distribution of the consumer responses to the just-about-right scale of intensity of sweetness and fruit flavour of the strawberry (S) and banana (B) smoothies.

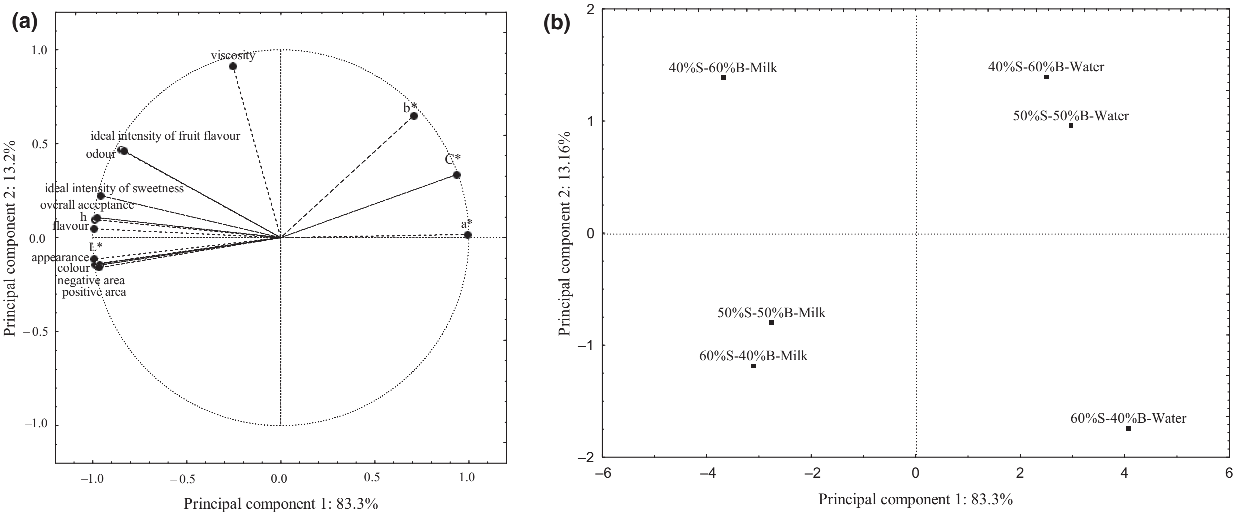

Figure 2 External preference mapping between sensorial acceptance and physical properties (viscosity and colour) of the strawberry (S) and banana (B) smoothies (a - projection of the variables; b - projection of the smoothies).

for the sample 60%S–40%B–Water, the presence of a greater amount of the strawberry dehydrated product and reconstituted with water emphasised the greater perception of the odour and acid taste of the strawberry and also less sweet, generating rejection of the sample. According to Teleszko & Wojdyło (2014), the proportion of sweet and acid taste plays a significant role in the sensory evaluation of smoothies, which may improve or hinder acceptance.

The averages for the degree of liking were between 5.0 ('neither liked nor disliked') and 6.3 (from 'slightly liked' to 'moderately liked'; Table 3). The low acceptance for all smoothies caught the attention of the authors and this probably occurred due to two factors: development of a product that (i) close to natural, because after reconstitution of the hydrated products, all smoothies showed more than 70% of fruit pulps, and (ii) low in sugar. The authors chose not to add dyes or thickeners, which could improve the colour and viscosity of the smoothies, respectively. Furthermore, it was the intention of the authors to work with little added sugar, given the global and national guidelines to combat chronic noncommunicable diseases such as obesity, diabetes and dyslipidemias. Larger amounts of banana could be used in the smoothies for avoiding the sugar addition, however, preliminary tests showed that smoothies prepared with higher amounts of banana (higher than 60%) presented a very pronounced banana flavour, not evidencing the strawberry flavour, and the purpose was to obtain a smoothie with a combination of the two dehydrated pulps. Moreover, the smoothie made with higher amounts of banana and reconstituted in milk became very viscous (data not shown) and was not able to be drink, having to use a spoon to consume the product. In this way, it was necessary to add a small amount of sugar to improve the sweetness of the beverage.

As for the ideal sweetness intensity (Fig. 1), smoothie formulations with milk had the highest percentage for ideal of sweetness in the opinion of consumers (from 43% to 53%), with emphasis on the formulation with 40%S–60%B, probably because both the higher proportion of banana dehydrated product and the presence of milk favoured the sweetness in this sample. Thus, the use of sweeter and less acidic fruits, as well as the reconstitution matrix, influences the sweetness intensity of the smoothies. Indeed, other studies (Nowicka *et al.*, 2015, 2016) showed that sweeter products were characterised with higher ratings to the degree of liking by consumers while the more acidic ones were less accepted. The results found in the present work are quite interesting, because even with the low degree of liking obtained using a hedonic scale (Table 3), smoothies with milk presented appreciable percentages of ideal intensity of sweetness, showing that some consumers will accept lower sugar content, which is in line with the need to reduce Brazilian sugar consumption (Brasil, 2014). However, there were also consumers who pointed to the smoothies with less intense sweetness than the ideal, indicating that there is still resistance by some individuals to this reduction in sugar.

For the ideal fruit flavour intensity in the smoothies (Fig. 1), again the highest percentage (35%) of ideal intensity was for the sample 40%S–60%B–Milk, although there were high percentages for less intense than ideal for all samples. Probably, the greater addition of dehydrated products (higher than 12%) could increase the percentage for ideal intensity of fruit flavour in the smoothies, but along with that, maybe there was a need to add more sugar, mainly because of the strawberry acidity that is highlighted in formulations prepared with water. Despite the low acceptance, the product has potential considering the increasing demand for products with greater proportions of fruit in its composition.

External preference mapping

The first principal component explained 83.3% of the data variation and the second principal component explained 13.2% of the data variation, totalling 96.5% (Fig. 2). The first principal component was explained by two groups of variables (Fig. 2a): one formed by sensory acceptance (except viscosity), instrumental viscosity through positive and negative areas and colour parameters (luminosity and hue; variables with factorial charges ≤ -0.70 in the principal component 1); and a second group formed by red and yellow chromaticities and chroma (variables with factorial charges ≥ 0.70 in the principal component 1). Variables in the same group are positively correlated, while variables in different groups are negatively correlated. The second principal component was explained only by the degree of liking for viscosity (factorial charge ≥ 0.70 in the principal component 2; Fig. 2a).

The smoothies 50%S–50%B and 60%S–40%B with milk (Fig. 2b) stood out for the degree of liking of appearance and colour, instrumental viscosity, and this acceptance was due to high luminosity (clearer colour) and low intensities of red and yellow chromaticities and chroma. In addition, the characterisation of these samples by instrumental viscosity corroborates the results presented in Table 3, since these two samples presented one of the highest means for positive and negative areas. Samples 50%S–50%B and 40%S–60%B elaborated with water had low acceptance, exactly due to high red and yellow chromaticities and chroma.

The smoothie 40%S–60%B–Milk was distinguished by the degree of liking of its odour and flavour, overall acceptance, ideal intensities of sweetness and fruit flavour, colour hue, and also by the degree of liking for its viscosity (Fig. 2b), although no correlation exists between this latter variable with the other variables listed first. The high acceptance of this sample was due to the higher proportion of dehydrated banana product, associated with the presence of milk, giving a pronounced odour and flavour to the sample, besides a higher viscosity. In comparison, the smoothie 60%S-40%B-Water was highlighted by low viscosity acceptance.

Conclusion

The reconstitution of dehydrated products in milk favoured their sensory acceptance, characteristics that correlated with instrumental analyses of viscosity and colour. In addition, a higher proportion of banana contributed to overall acceptance and ideal intensities of sweetness and fruit flavour of the smoothies, although the low quantity of sugar added to the smoothies probably most limited their acceptance. However, these smoothies have potential, especially considering the market niches for this type of product, with a low amount of added sugar and with similar characteristic to natural fruit beverages.

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