

Acceptability of yoghurt with Marolo pulp (*Annona crassiflora* Mart.) in the traditional and diet/light formulations

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ABSTRACT: The aim of this study was to use marolo pulp in the confection of traditional (sucrose) and diet/light (sodium cyclamate/saccharine (2:1)) yoghurts, with variation in the concentrations of the pulp and sweeteners. The ripe fruit was harvested in Machado-MG and handled at UNIFAL-MG. Six test-formulations were made, resulting from the factorial combination of 3 levels of natural and artificial sweetener (1.4% and 1.9% of sodium cyclamate/saccharine and 14,4% sucrose) with 2 levels of pulp (20% and 30%). The acceptance test was performed using the hedonic scale (9 points) with 30 panelists. Every acceptance grade remained between 6 and 8. The interaction sweetener*pulp was significant, therefore, analysed. For the formulations with 20% pulp, the use of sucrose was more accepted, with average grade 0.68 point higher than the formulations containing artificial sweetener. Among the sweeteners, the dose containing 1.4% got significantly higher scores than the doses with 1.9%. The formulations with 30% pulp, didn't present significant difference among the different types of sweeteners. For the use of 1.9% artificial sweetener the concentration of 30% pulp was most accepted. In the internal preference mapping, there isn't difference in acceptance of formulations with 1.4% sodium cyclamate/saccharine with 20% and 30% of pulp and sucrose with 20% and 30% of pulp. There was superiority in the acceptability of the formulations with sucrose in relation to the artificial sweetener, and also, when comparing the 1.4% to the 1.9% artificial sweetener concentrations. It is concluded that yoghurt may be well accepted, mainly when sweetened with sucrose.

keywords: Marolo; yoghurt; acceptability; internal preference mapping.

1 INTRODUCTION

The Brazilian Savannah is a biome, with an approximate area of 1.8 million km², that supplies the market with its exotic native fruits, which have attracted attention from all over the world due to their unique flavor and nutritional value (BRANNSTROM et al., 2008). As an

example of these fruit crops we may cite the araticum or marolo (*Annona crassiflora* Mart.), as one among the 25 most frequent species in this biome (SOARES et al., 2009).

Belonging to the Annonaceae family, marolo is an arboreous species that produces fruit whose pulp coloring ranges from white to yellow (SOARES et al., 2009). According

to Silva Gomes and Martins (2009), the usual yielding of the fruits varies between 55% and 65%. Marolo pulp presents 106.83 kcal/100g as energetic value, constituting a good source of vitamin C (44.97 mg/100g). The fruit also contains expressive amounts of total carotenoids (2.822 µg/100g) and tannin (3.74 mg/100g), which are important for the sensory characteristics and functional value of the fruit. Besides, it is also a source of carbohydrates (14.77 g/100g), and mineral salts such as potassium (288.36 mg/100g), phosphorus (21.85 mg/100g), magnesium (20.21 mg/100g) and calcium (10.39 mg/100g) (DRAGANO et al., 2010).

Marolo is very appreciated in culinary due to its unique aroma and flavor, being used in juice, ice-cream, jelly, jam and liquor manufacturing (CORRÊA et al., 2011). Another possible alternative, still little exploited, would be the use of marolo pulp in the confection of yoghurt. This would be an innovation, because there is very scarce use the savannah's fruit in yoghurt production (OLIVEIRA et al., 2008). Besides, yoghurt has presented an increase in consumption within the Brazilian population over the last years, about 3 kg a year *per capita*. However, this value is still low when compared to countries such as Uruguay and Argentina with 7 kg/year, or France with 19 kg/year *per capita* (SANTANA et al., 2006).

Light/diet foods have contributed for the increase in yoghurt consumption. This change in the consumers' behavior is due to a greater concern for the ingestion of healthier products containing high nutritional value. Besides, the dissociation of the name *diet/light* from health problems or weight loss has contributed for this increase (RIBEIRO et al., 2010).

Understanding this new consumer's profile is very important for the food industry, mainly when there is interest in marketing a new product. In this context, market research techniques are great tools for providing the knowledge about the consumer's needs, their habits, besides evaluating product prototypes (POLIGNANO, 2001). Therefore, the aim of this study was to use marolo pulp in the confection of traditional and *diet/light* yoghurts, as well as checking their acceptability.

2 MATERIALS AND METHODS

The fruits were collected ripe at a rural property in Machado-MG and transported to the *laboratory of Dietetic Techniques* at the Nutrition Department from the Federal University of Alfenas – UNIFAL-MG, where they were sanitized after reaching the ideal ripening for consumption, then having their

rind removed manually. The granules that covered the carpels were eliminated with the use of a stainless steel knife, before washing them. The seeds were extracted from the carpels, which were conserved in plastic bags at -18°C until their utilization. Six test

formulations were elaborated, resulting from the factorial combination of 3 levels of natural and artificial sweetener (1.4% and 1.9% sodium cyclamate /saccharin, and 14.4% sucrose) and 2 levels of pulp (20% and 30%) (Table 1).

Table 1- Composition of the yoghurt formulations traditional and *diet/light* with marolo pulp.

Formulations	Sucrose (%)	Sodium Cyclamate/Saccharin (%)	Pulp (%)
A	-	1,9	20
B	14,4	-	20
C	14,4	-	30
D	-	1,9	30
E	-	1,4	20
F	-	1,4	30

For producing the yoghurt, 1 L of pasteurized milk type B, purchased at the local market, was heated up to 45 – 50°C. 100 mL was collected for diluting powdered milk, and then was added to the rest of the milk when this reached approximately 94 – 95°C (17 g/L). This mixture was keeping it under gentle heating for 5 minutes, and then immediately cooled down to 42°C. 1g of commercial lyophilized ferment (BIORICH® - *Lactobacillus acidophilus*, *Bifidobacterium* and *Streptococcus thermophilus*) was previously dissolved in 90 mL of cold milk; this mixture was divided into three equal parts. 30 mL of previously prepared lactic ferment was added to the mixture at 42°C, and incubated it in BOD (QUIMIS® Q-

315 M) at 42°C for 3 hours and 30 minutes. After this procedure, the yoghurt was chilled in an iced bath for 15 minutes and maintained at 7°C for 4 hours.

For the fruit basis preparation, the marolo pulp was heated in 750 mL of water during 20 minutes for the elimination of residual granules. The remaining water was poured out and the sucrose solution was added and gently heated for 20 minutes, and subsequently mashed in a multiprocessor for 5 minutes. In the *diet/light* version of the product, the sucrose was replaced by the sodium cyclamate/saccharin sweetener (2:1) (Tal e Qual®) with the concentrations established in a previous study. For the final

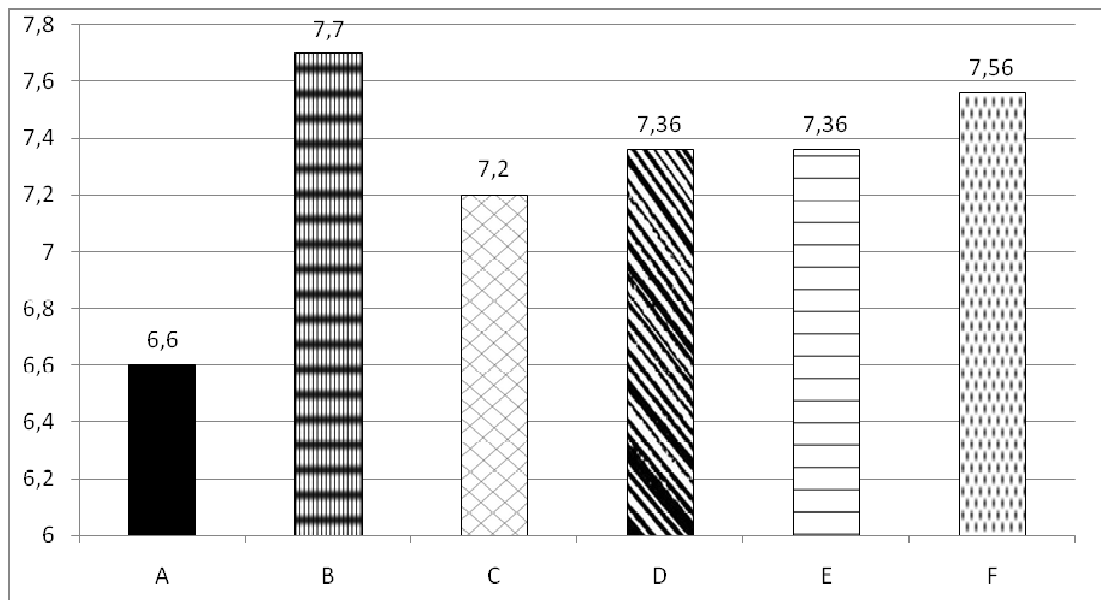
product, the yoghurt was liquefied with the pulp previously prepared, and kept refrigerated at 7°C.

The proposed sensory analysis was performed by 30 panelists, composed by students and staff of both genders from UNIFAL-MG with ages ranging between 18 and 50. All the panelists were elucidated about the research protocol (Ethics Committee in Research - n° 23087.001220/2008-17). The hedonic scale of nine points was used (extremely liked/ extremely disliked) in lab conditions. The samples were served at refrigerated temperature in monadic form, serving about 30 mL each, in disposable glasses, previously codified with three digits. Two samples per session were presented, totalizing three sessions. The presentation order of the samples was randomized in every session.

The experiment was performed in randomized block design (DBC) and factorial 2x3. Orthogonal contrasts were made and Tukey's test was carried out at 5% significance. In addition, the internal preference mapping was done (SCHLICH, 1995).

3 RESULTS AND DISCUSSION

All acceptability means were located between 6 (slightly liked) and 8 (liked very much) (Figure 1). The interaction sweetener*pulp was significant in the variance analysis, therefore, unfolded. For the formulations with 20% pulp, the use of sucrose was more accepted, with average grade 0.68 point higher than the formulations containing artificial sweetener. Among the sweeteners, the dose containing 1.4% got significantly higher scores than the doses with 1.9%. For the formulations containing 30% pulp, there was no significant difference between the means of the different kinds of sweeteners. In another unfolding, for the dose containing 1.9% artificial sweetener, the concentration with 30% pulp was better accepted. Regarding the other ways of sweetening, both pulp concentrations were statistically equivalent. The highest average grade was for the yoghurt formulation containing 14.4% sucrose and 20% pulp, and the lowest grade was for the formulation containing 1.9% sodium cyclamate/saccharin and 20% pulp.

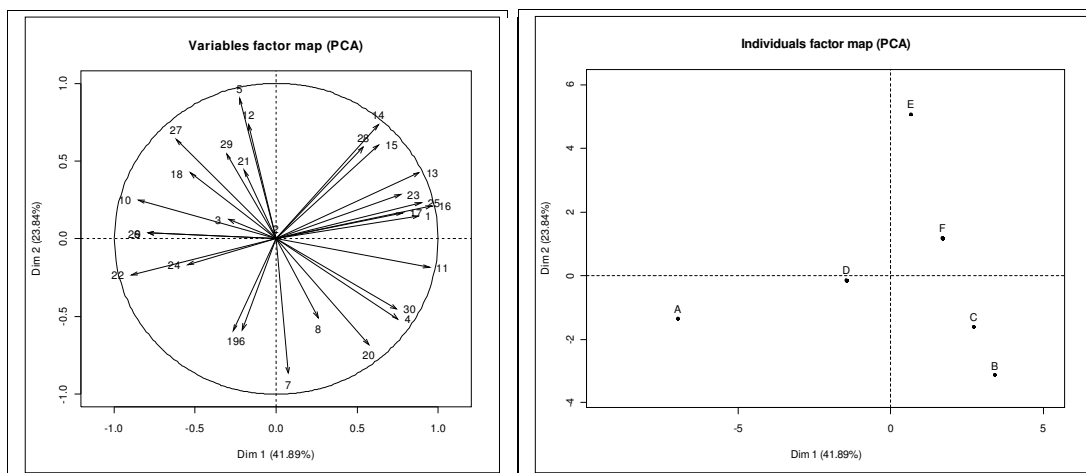


*A – 1.9% sodium cyclamate/saccharin + 20% pulp; B – 14.4% sucrose + 20% pulp; C – 14.4% sucrose + 30% pulp; D – 1.9% sodium cyclamate/saccharin + 30% pulp; E – 1.4% sodium cyclamate/saccharin + 20% pulp; F – 1.4% sodium cyclamate/saccharin + 30% pulp.

Figure 1- Acceptability scores of yoghurt formulations with marolo pulp and sweetener*

The results of the internal preference mapping for acceptance are shown in Figure 2. The first main component explains approximately 41.89% of the total variance, while the second one explains 23.84%, totalizing 65.73% of variance of the acceptance data. The formulations E and F (1.4% sodium cyclamate/ saccharin with 20% and 30% of pulp) form the first group and are considered similar. The formulations B and C

(14.4% sucrose with 20% and 30% pulp) form the second group and formulation D (1.9% sodium cyclamate/ saccharin with 30% pulp) presents an intermediate position. Formulation A (1.9% sodium cyclamate/ saccharin with 20% pulp) appears in an opposed position in relation to the rest, therefore different.



*A – 1.9% sodium cyclamate/saccharin + 20% pulp; B – 14.4% sucrose + 20% pulp; C – 14.4% sucrose + 30% pulp; D – 1.9% sodium cyclamate/saccharin + 30% pulp; E – 1.4% sodium cyclamate/saccharin + 20% pulp; F – 1.4% sodium cyclamate/saccharin + 30% pulp.

Figure 2 – Internal preference mapping for yoghurt formulations made with marolo pulp and sweeteners*

There was no difference between the formulations containing 1.4% sodium cyclamate/saccharin with 20 - 30% pulp, and those with 14.4% sucrose with 20% and 30% pulp. The formulations 1.9% sodium cyclamate/saccharin present lower acceptability, mainly in the proportion of 20% marolo pulp. These results prove what has been observed in the contrast analysis, showing superiority of the formulations with sucrose in comparison to those with artificial sweetener, as well as the 1.4% in relation to 1.9% artificial sweetener concentration. Several studies show more acceptability to products elaborated with sucrose compared to those with artificial sweetener, because they are generally prominent in appearance and flavor. Besides

the sweet taste, sucrose increases the viscosity, giving suitable texture and stability (ALONSO & SETSER, 1994).

We have obtained success in replacing the sucrose by sodium cyclamate/saccharin, because there was not loss of flavor and physical characteristics when compared to the product sweetened with sucrose. However, when we increased the artificial sweetener concentration (1.9%), and adding to that, we decreased the pulp content, there was a decrease in acceptability. The results suggest that a higher concentration of pulp influenced positively the average acceptability, once the strong taste of marolo has probably masked the artificial sweetener residual taste, mainly because saccharin has a

bitter residual taste. Oliveira et al. (2008), while developing a marolo yoghurt formulation (0, 12.5, 25 and 50% pulp with 15% sucrose) verified that in the 12.5% and 25% pulp concentrations, the acceptance scores were 7 and 6.2 respectively. Using 50% concentration, the score decreased (5.6), which proves that the amount of pulp is important for the acceptance of the product, and must contain concentrations below 50%, as those used in the present study.

Upon analyzing the average of the judgments for the different samples (Figure 1), it is possible to infer that all samples, except formulation A, present satisfactory scores. Such fact is important, since it deals with a product with good acceptability with higher aggregated value for attending the soaring request for dietetic products.

There is preference for yoghurt sweetened with sucrose and a low concentration of marolo pulp, however, when sodium cyclamate/saccharin was used, there was preference for the yoghurt containing higher pulp concentration, which highlights the possibility of marolo masking the residual taste of the sweetener. Besides, the acceptability of the product was higher in the samples that contained lower sweetener concentrations independently from the amount of pulp.

4. CONCLUSION

According to the results of the sensory evaluation it is possible to infer that all the samples, except the formulation with 1.9% sodium cyclamate/saccharin and 20% pulp, constitute good market alternatives. Therefore, we conclude that it is necessary to expand and diversify the elaboration of products containing marolo pulp, suggesting that they will obtain high quality standards and competitiveness in the consumers' market.

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