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EFFECTS OF STORAGE TIME AND ADDITION OF BAOBAB POWDER ON THE TEXTURAL SENSORY CHARACTERISTICS OF YOGURT

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ABSTRACT: In addition to taste and aroma, texture and appearance play an important role in the market's acceptance of yogurt. To improve these characteristics, baobab powder was added to the yogurt and the sensory analysis of the samples was performed using a score scale from 1 to 5. In this research, the effect on the textural and appearance sensory attributes of yogurt with different concentrations of baobab powder (2% and 4%) was investigated by comparing them with a sample of classic yogurt. The samples were prepared in the laboratory under similar conditions and stored at refrigeration temperature for 27 days. The sensory evaluation of the samples was performed in 4 different days from the mentioned storage period.
KEY WORDS: baobab powder, yogurt with baobab, textural attributes, appearance attributes

1. INTRODUCTION

Yogurt is one of the most popular acidic dairy products. The quality and acceptance of consumers for this product depends largely on the sensory characteristics of this product. The taste and aroma are obtained from the fermentation of milk under the action of two microorganisms: Streptococcus thermophilus and Lactobacillus delbrueckii subsp. Bulgaricus.

Lactic acid is considered one of the products with an overwhelming role in the formation of yogurt flavors (Beshkova et al., 1998). To date, more than 90 aromatic compounds have been identified (Ott, 2000).

The texture is another characteristic of yogurt that influences consumers' perception of yogurt. Acidification of milk and the formation of a coagulated gel is a complex process: the pH decreases and when it reaches the isoelectric point of caseins (pH 4.6), the latter precipitates and aggregates, generating a gel network, in which water and fats are incorporated. The firmness and viscosity of the curd ultimately depends on the final pH, as well as the bacterial proteolytic activity, which can lead to syneresis and can alter the structure or microstructure of the yogurt. (Francoise, 2017)

Classic yogurt contains only milk and the microorganisms needed for acidification, but over time it has been shown that adding various ingredients to improve flavor and texture has been successful in diversifying the product range and increasing the number of consumers, as well as increasing the quality of yogurt and preventing the appearance of defects.

Texture enhancers:

- Whole milk powder and skim milk powder

- Proteins and milk products

- Hydrocolloids (gums, pectin, starch, gelatin)

Baobab (Adansonia digitata) is a deciduous tree of the genus Adansonia, the Malvaceae family, whose branches are similar to the roots, hence the name "upside down tree". The indehiscent fruits are large, oviform capsules up to 25 cm long. Their core dries, hardens and breaks into pieces, resembling slices of dry bread. The seeds are hard and black, shaped like a kidney. The pulp of the fruit is edible, being known as "monkey bread". (Wikipedia, 2022) (National Research Council, 2008) (National Research Council, 2006)

In food industry, Baobab fruit flour is mainly used in the preparation of sweets, sauces, soft drinks, but also ice cream. Due to its carbohydrate and protein content, it is consumed mainly for the energy it can bring to the human body. (Osman, 2004) (Chadare, Linnemann, Hounhouigan, Nout, & Van Boekel, 2009)

In this study, baobab was used to make yogurt in order to improve the texture and overall acceptability of the yoghurt. In order to analyze the consumers' perception of the improved products, 3 yogurt samples were prepared (natural yogurt, yogurt with 2% baobab powder and yogurt with 4% baobab powder) and sensory determinations were performed by a group of 9 evaluators, for a storage period of 27 days, in 4 different days assigning grades from 1-5.

2. MATERIALS AND METHODS

2.1. Materials

The yogurt was obtained according to the classic technological scheme, using:

• whole cow's milk purchased from a local producer

• culture of your starter from CHN Hansen

• Baobab Powder from NIAVIS

2.1.1. Preparation of yogurt samples

Three yogurt samples were prepared, the description of the samples can be seen in the table 1.

For samples YB2 and YB4 baobab powder was added to raw milk, as a percentage according to the table above. The following technological operations are identical for all 3 samples. The samples were prepared separately.

The milk was pasteurized at 90-95°C for 20 minutes. The pasteurized samples are then cooled to an incubation temperature of 42-45°C, after which the inoculation with the starter culture is performed. The packaging was made in glass jars with a capacity of 250 ml. Thermostation was performed at 42-45 ° C for 2.5 hours. The fermentation is interrupted when the yogurt has a pH between 4.6-4.7 and an acidity between 80-90°T.

Cooling is carried out in two stages: pre-cooling to 20°C, for 3 hours in order to harden the curd and preventing the process of removing the whey, followed by cooling to a temperature of 2-4°C for 12h. The storage is done for 27 days (the whole analysis period) in the refrigerator.

Table 1. Samples description

Sample cod	Sample name	Raw materials used		
		Milk, %	Baobab Powder,%	Starter culture
Y0	Natural yogurt	100	-	According to the manufacturer's instructions
YB2	Yogurt with baobao powder 2%	98	2	According to the manufacturer's instructions
YB4	Yogurt with baobao powder 4%	96	4	According to the manufacturer's instructions

2.2. Methods of analysis

2.2.1. Sensory analysis of yogurt samples

In order to evaluate the texture and appearance of the yogurt samples and the impact that the baobab powder has on these characteristics and implicitly on the acceptability of the products, the sensory analysis of the yogurt samples was performed for a storage period of 27 days, in 4 different days day 1 , 9, 18 and 27.

The samples were served at refrigeration temperature and were coded differently so that they could not be identified.

To evaluate the two characteristics, texture and appearance, 9 main attributes described in the following table were chosen, taking into account the particularities of the study. The panelist committee, made up of 9 members, was instructed and tasted the yogurt samples giving a score from 1 (undetectable) to 5 (intense verry). (Desai, Shepard, & Drake, 2013) (Swi & Florowska, 2002) (ISO 8589:2007, 2014) (ISO 13299:2016, 2014)

Table 2. Selected attributes to evaluate the texture and appearance of yogurt

Attributes	Description
Whey presence	Syneresis, the existence of the removed whey
Consistency uniformity	Constant consistency throughout the sample: no particle agglomeration and no liquid removal
Maintenance of shape	Compactness of the cross section, absence of air perceived as the tongue is moved through the sample
Cohesiveness	Force required to move the spoon back and forth
Graininess	Granular particles felt in the mouth
Firmness	Force required to compress the product between tongue and palate
Creaminess	Soft feeling in the mouth
Meltaway	Rate at which the sample dissolves or melts.
Mouthcoating	Degree to which any sample residue remains on the mouth surface after swallowing.

2.2.2. Statistical Analysis

Minitab software was used to perform statistical data analysis. The Response Surface method (RSM) was used to determine the effect of independent variables on the textural properties of yogurt samples. The independent variables were storage time (4 levels: 0, 9, 18, 27 days) and sample concentration in baobab powder (3 levels: 0%, 2%, 4%).

Principal components Analysis (PCA) was used to reduce the number of dependent variables and to identify similarities and differences between the sensory profile of yogurt samples.

3. RESULTS AND DISCUSSION

3.1. Evolution of texture and appearance attributes depending on sample concentration and storage time

As can be seen from the figures, the greatest influence on the evaluation attributes has the baobab concentration, followed by the storage period. The dark green area shows the lowest values and the open area the highest values.

The whey presence, which represents the process of syneresis, is one of the most common defects. As can be seen from Figure 1, the addition of baobab powder reduces this phenomenon. The elimination of whey decreases with increasing baobab concentration and increases in small proportion for each sample during the storage period. During the storage time for the yogurt sample without addition, it can be seen that the presence of whey increases more than in the case of the other samples.

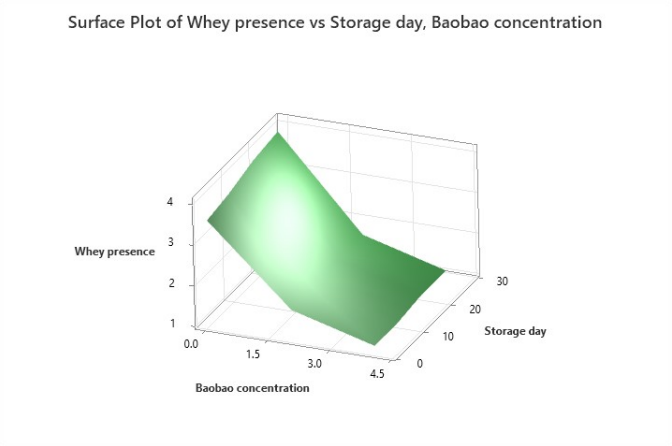

Figure 1. The evolution of Whey presence

The addition of baobab powder improves the consistency of the yogurt samples, figure 2. In the samples with the addition of baobab powder a better maintenance of consistency can be observed during the storage period.

Also from figure 3 it is observed that yoghurts with addition of baobab powder keep their shape better. A higher increase can be seen for this indicator, from the sample without addition to the sample containing 2% baobab powder. From 2% to 4% baobab powder concentration, no such increase was noticed.

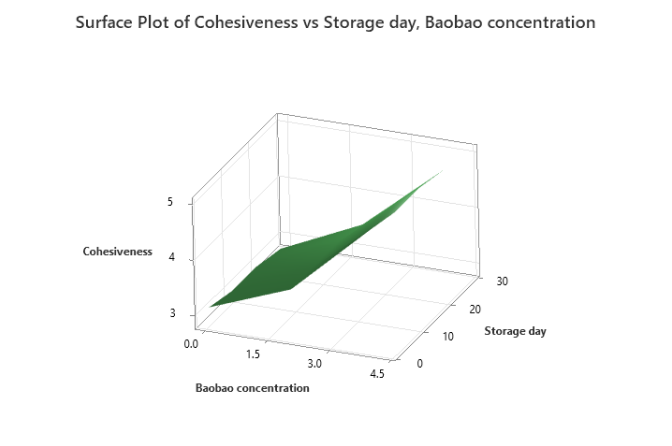

Figure 2. The evolution of consistency

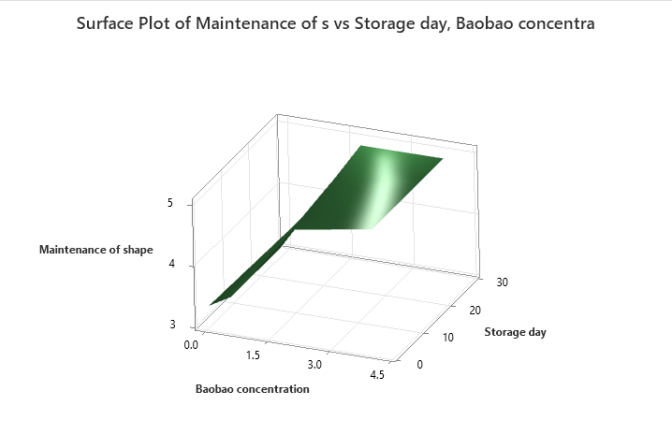

Figure 3. The evolution of Maintenance of shape

The cohesiveness of the samples increases due to the addition of baobab powder, as seen in figure 4. The highest increase was observed between the samples with 2% and 4% baobab powder.

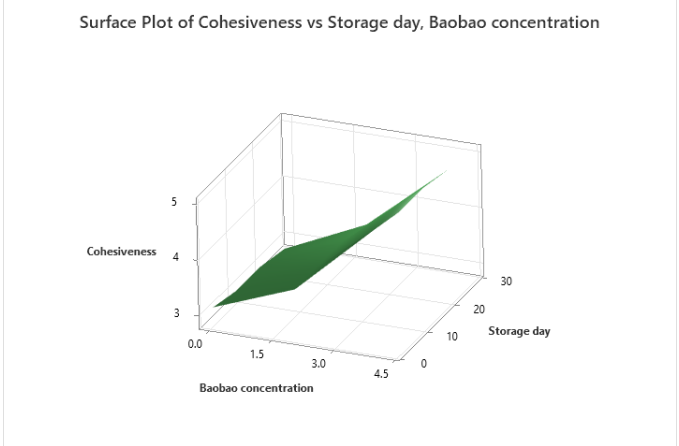

Figure 4. The evolution of Cohesiveness

The sensation of particles felt when chewed is an undesirable attribute of yogurts, especially characteristic of yogurts with a very high addition of dry matter (vegetable or milk: whey, protein, etc.), which have the role of improving the texture.

In this case, figure 5, a linear increase was obtained with the increase of the baobab powder concentration. A more intense feeling of graininess in the mouth was felt as expected for the YB4 sample, due to the high content of baobab powder. This sensation becoming more and more felt during the storage period, for all samples.

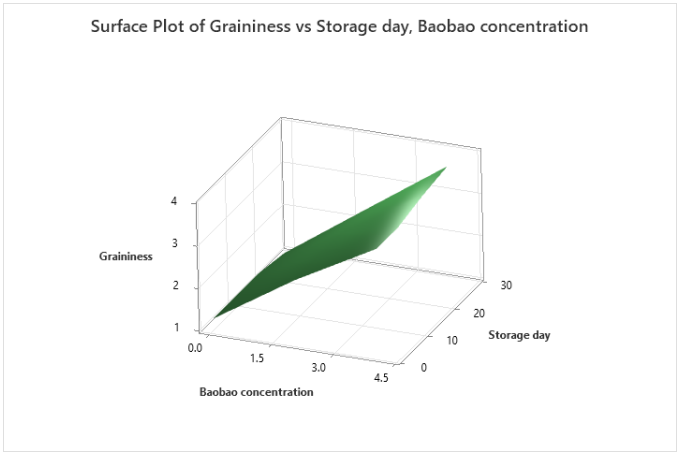

Figure 5. The evolution of Graininess

The yogurt with 4% baobab is firmer than the sample with 2% and the sample without addition, figure 6. Yogurt samples also increased their firmness during storage, especially in the last days of storage.

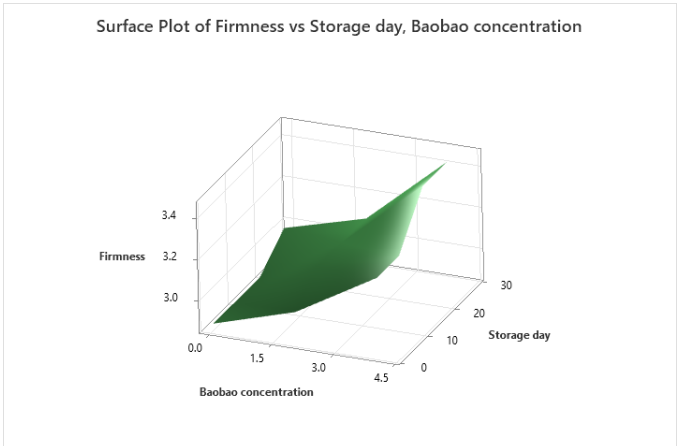

Figure 6. The evolution of Firmness

As seen in figure 7, a creamy, velvety sensation was felt for the 2% baobab yogurt sample which remains almost constant throughout the storage period. The sample without addition recorded the lowest values and a decrease can be seen during the storage period. The yogurt sample with 4% baobab obtained values between the other two samples, this may be due to the high concentration of baobab that gives the feeling of graininess.

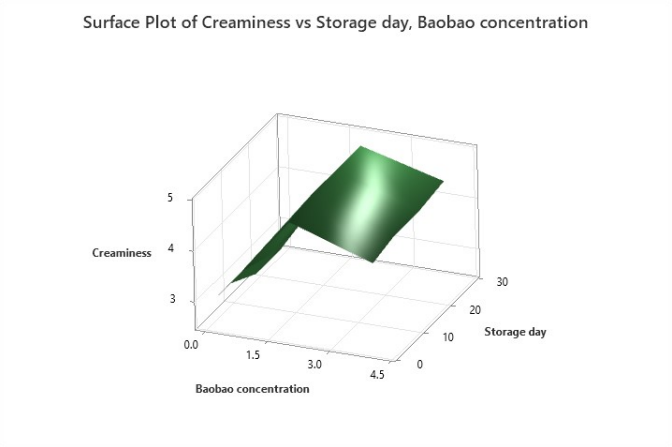

Figure 7. The evolution of Creaminess

The sample without addition melt most easily when chewed, figure 8. The degree of dissolution of the samples by chewing increases during storage and decreases with the addition of baobao powder.

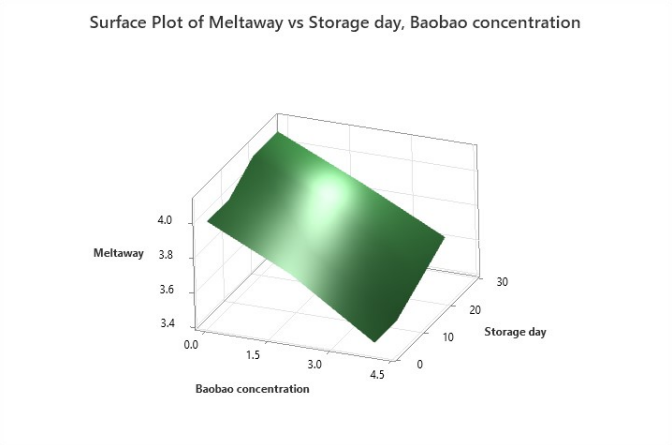

Figure 8. The evolution of Meltaway

Regarding the sensation that remains in the mouth after chewing, described in figure 9, a significant increase of the points obtained at the evaluation can be observed as the concentration of baobab increases. The storage period has little impact on increasing this attribute.

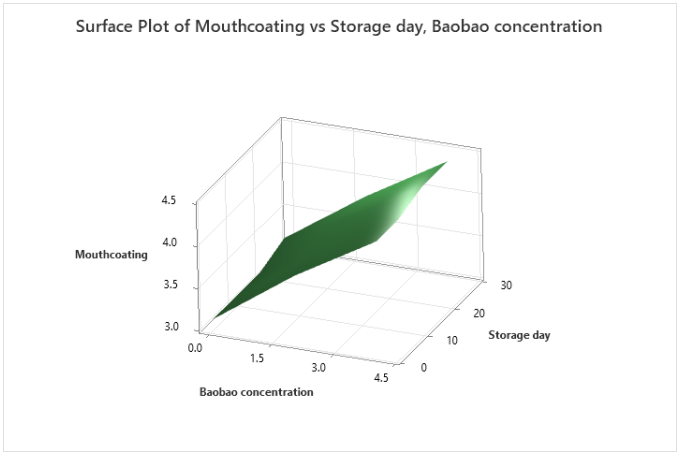

Figure 9. The evolution of Mouthcoating

3.2. Principal components analyses

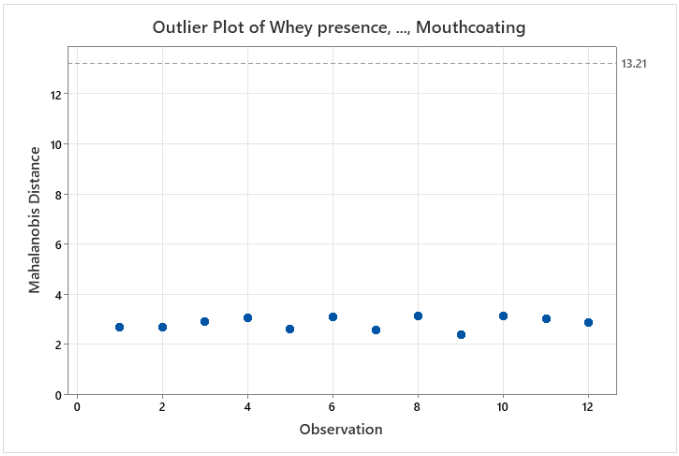

Figure 10. Outlier Plot

From the Outlier Plot Chart, fig.2 it can be seen that there are no aberrant values.

The first three principal components have eigenvalues greater than 1. These three components explain 99.7% of the variation in the data, as can be find in figure 11.

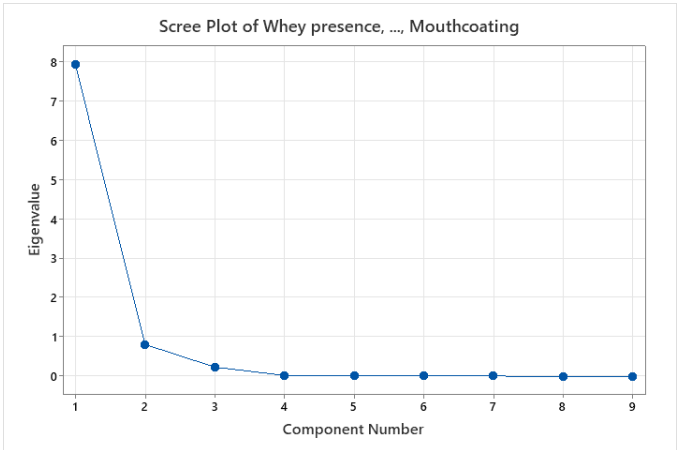

Figure 11. Scree Plot

The first principal component represents 88% of the total variation. From Loading Plot, figure 12, we notice that this component is most correlated with the variables: Consistency uniformity (0.335) Graininess 0.339), Mouthcoating (0.350) Maintenance of shape (0.342), Creaminess (0.299), Firmness (0.315). The first component is positively correlated with these variables and therefore the increase of these variables increases the value of the first component. The main component 1 is negatively correlated with Whey presence (-0.351) and

Meltaway (-0.326). The second variable is 9% of the total variation. This component correlates most positively with Cohesiveness (0.400), Firmness (0.332).

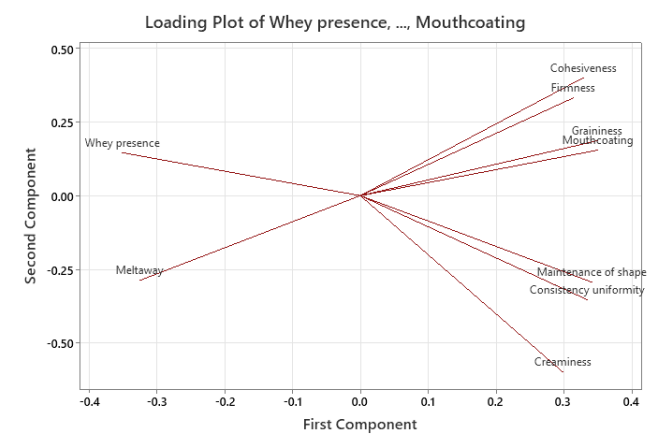

Figure 12. Loading Plot

The first two components account for most of the variance in the data.

Figures 13 and 14 show that the yogurt samples are divided into 3 distinct categories. The values obtained for the samples without the addition of Baobab powder are plotted on the negative side. These are characterized by whey removal and meltaway. The values obtained for the samples with the addition of 4% baobab obtained high values for maintaining shape and uniform consistency, but are also characterized by graininess, mouthcoating, are much more coehiveness and firmness. Yogurt samples with the addition of 2% baobao powder are characterized by features such as Maintenance of shape Consistescy unifromity and Creaminess.

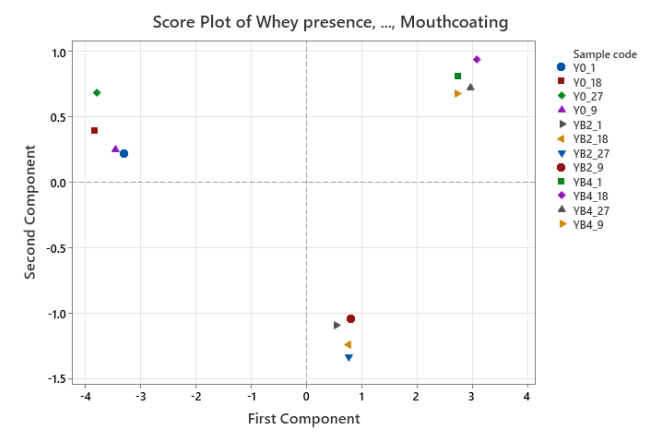

Figure 13. Score plot of Whey presence

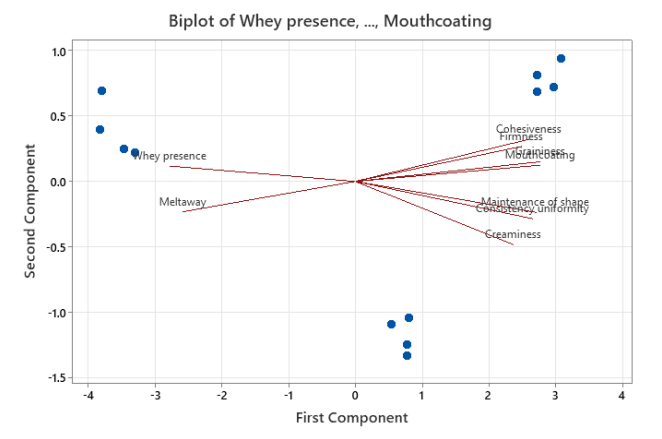

Figure 14. Biplot of Whey presence

4. CONCLUSIONS

The addition of baobab powder has positive effects on the evaluated texture and appearance attributes. Better scores can be seen for the 2% samples and

4% baobab compared to the classic yogurt sample without addition, for all evaluated attributes.

Yogurts with added baobab powder better maintain their characteristics in a storage period of 27 days.

Although the sample with 4% baobab powder obtained better values throughout the storage period for the presence of whey, consistency, cohesiveness compared to the sample with the addition of 2% baobab powder, but the high values obtained for Graininess, Meltaway and Mouthcoating can negatively influence consumer perception of this product.

The sample with the addition of 2% baobab powder has better values for Creaminess. A small variation between the samples with addition was obtained for Maintenance of shape.

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