

## USE OF “COCOA HONEY” (*Theobroma cacao* L) FOR DIET JELLY PREPARATION: AN ALTERNATIVE TECHNOLOGY<sup>1</sup>

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**ABSTRACT** - The “cocoa honey” is a local denomination to the clear liquid extracted from the cocoa mass, which cover the seeds, before the cocoa fermentation process. This material is attractive regarding its sensory and technological aspects; however, its use for consumption is still restricted. The purpose of this study was to produce diet jelly using the “cocoa honey” and to carry out the chemical and sensory characterization of the products. For the preparation of the jellies were used the following ingredients: slow metoxilation grade pectin, polidextrose, sorbitol, maltitol, tricalcium phosphate, potassium sorbate and cocoa powder. The diet jellies studied were: F1 (0.0015% thaumatin and 0.005% sucralose); F2 (0.0015% thaumatin and 0.002% acesulfame-k); F3 (0.005% sucralose and 0.002% acesulfame-k). It also was produced a control treatment (40.0% sucrose). The chemical and sensory data were analyzed by ANOVA, Tukey test and Internal Preference Map (MDPREF). The F3 treatment (sucralose and acesulfame-k) was the favorite diet jelly by the consumers, it differed significantly ( $p < 0.05$ ) of F1 (thaumatin and sucralose) and F2 (thaumatin and acesulfame-k) treatments related to color, chocolate odor, sweet taste, acid taste, chocolate flavor and consistency attributes; it also obtained higher purchase intention score. The use of the thaumatin sweetener showed unsuitable, it did not replace the sweetness in the jelly of “cocoa honey”. The results indicated the feasibility of technological profit of the “cocoa honey” as raw material in the preparation of diet jelly, which presented good sensory and nutritional characteristics.

**Index terms:** Cocoa pulp, diet jelly, sensory quality.

## APROVEITAMENTO TECNOLÓGICO DO “MEL DE CACAU” (*Theobroma cacao* L) NA PRODUÇÃO DE GELEIA SEM ADIÇÃO DE AÇÚCAR

**RESUMO** – O “mel de cacau” é uma denominação regional do líquido transparente extraído da polpa do cacau, que cobre as sementes, antes do processo de fermentação do cacau. Este material é atrativo do ponto de vista de seus aspectos sensorial e tecnológico; entretanto, seu uso para o consumo ainda é restrito. O propósito deste estudo foi produzir geleia dietética usando o “mel de cacau” e realizar a caracterização química e sensorial dos produtos. Para a preparação das geleias, foram usados os seguintes ingredientes: pectina de baixo grau de metoxilação, polidextrose, sorbitol, maltitol, fosfato tricálcico, sorbato de potássio e cacau em pó. As geleias dietéticas estudadas foram: F1 (0,0015% taumatina e 0,005% sucralose); F2 (0,0015% taumatina e 0,002% acessulfame-k); F3 (0,005% sucralose e 0,002% acessulfame-k). Foi produzido, também, um tratamento-controle (com 40,0% de sacarose). Os dados químicos e sensoriais foram analisados por ANOVA, teste de Tukey e Mapa de Preferência Interno (MDPREF). O tratamento F3 (sucralose e acessulfame-k) foi a geleia dietética preferida dos consumidores. Esta diferiu significativamente ( $p < 0.05$ ) dos tratamentos F1 (taumatina e sucralose) e F2 (taumatina e acessulfame-k) em relação aos atributos cor, aroma de chocolate, gosto doce, gosto ácido, sabor de chocolate e consistência; obteve, também, maior nota para intenção de compra. O uso do adoçante taumatina mostrou-se inadequado por não prover doçura à geleia de “mel de cacau”. Os resultados indicaram a viabilidade do aproveitamento tecnológico do “mel de cacau” como matéria-prima na preparação de geleia dietética, que apresentou boas características sensoriais e nutricionais.

**Termos para indexação:** Polpa de cacau, geleia dietética, qualidade sensorial.

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## INTRODUCTION

The cocoa tree is a plant belonging to the Malvaceae family, *Theobroma* genus. It is a plant cultivated in the tropics by small farmers, in the developing countries. According to the International Cocoa Organization (ICCO, 2012), the largest cocoa producers of the world are Ivory Coast and Ghana. Brazil takes the sixth position and it reached, at 2011, the larger production around 248.165 t. The Bahia State is still the major cocoa producer in Brazil, it contributed with 62% of the total national production, followed by the States of Pará (25%), Rondonia (7%) and Espírito Santo (3%) (CEPLAC, 2013).

The principal profit of this fruit is in the chocolate production. The processing creates significant amount of waste products, mainly during the fruits breakage and in the extraction of liquid from the pulp, which cover the seeds, before the fermentation process. The main waste products are cocoa peel, the pulp and the “cocoa honey”. The “cocoa honey” is a local denomination to the clear liquid extracted from the cocoa mass, which cover the seeds, before the cocoa fermentation process. This material is compound by water (moisture=74.94%), fermentable sugars (10-19%), acidity no volatile (0.77-1.52% expressed in citric acid) and pectin (0.9-2.5%). The pectin plus the soluble and insoluble fibers (about 0.7%) can confer high viscosity to the products (SANTOS, 2012).

The pulp and the “cocoa honey” exhibit a chemical composition which makes possible the development of products like: juices, liquor, jellies, vinegar and others products. According to the Technical Standards Relating to Food and Beverage (Resolution n°. 12, July 1978), jellies are products obtained from whole or pieces of fruits, pulp or juice of fruits with addition, if necessary, of acids, sugars and pectin with the propose to obtain a product of jelly consistency (BRASIL, 1978). Others additives can be added, like the sweetener, gelling and preserving. The sweeteners exhibit the function of substitute the sugar, assigning similar sweetness.

The products without addition of sucrose, called also diet products, are those indicated to persons that present restrictions to some substances, in this case the restriction is the sucrose. Moreover products containing sweetener have increased in the market, due to the demand by products with low caloric value. According to the Brazilian Association of the Industry of Diet Foods and Special Purpose-ABIAD, about 35% of Brazilian homes consume some kind of product with sweetener (ABIAD, 2013). The main sweeteners used in Brazil are:

sucralose, acesulfame-k, stevioside, aspartame, thaumatin and others.

The available methods to determine the quality of manufacture products involve chemical, physical and sensory evaluations. Among the available sensory tests to measure consumer preference and acceptability of one or more products, the most used are the hedonic scale and the attitude scale. The results of affective tests are usually assessed using univariate analysis of variance and test of averages. With the purpose of analyzing the affective data, taken into account individual response of each consumer and not the average response of the consumer group, was developed the Preference Map methodology (REIS et al., 2010).

This study aimed the development of diet jelly using the “cocoa honey” and associations of different sweeteners to obtain products with good sensory acceptance, and the chemical and physicochemical characterization of the jellies, in order to put forward an alternative technology to the use of food waste.

## MATERIAL AND METHODS

### Preparation, physicochemical and chemical characterization of the “cocoa honey”

The “cocoa honey” was obtained to a farm located in South of Bahia State, Brazil, in the period March-June 2012; the material was packed, identified and frozen at -18°C until appropriate use. Thus it was transported to the laboratory of Food Science in the Pharmacy Faculty, Federal University of Bahia.

Samples of “cocoa honey” were thawed and evaluated to the physicochemical and chemical characteristics, such as: soluble solids content (SSC), expressed in °Brix, was measured with refractometer (Atago, model N-1 $\alpha$ , Jencons Scientific Ltd., Tokyo, Japan); titratable acidity (TA), expressed as g of citric acid in 100 g<sup>-1</sup> sample, was determined by titrating 10 g of the material with 0.01N NaOH to an endpoint of pH 8.1 and pH was determined through direct read using a titrator (Micronal Titrator, model B274, São Paulo, Brazil). Chemical composition: moisture, total protein, lipids, ash, reducing and no-reducing sugar, pectin and total fiber were evaluated according to methods described by AOAC (2002). All analyses were carried out in triplicate. The total caloric value of the “cocoa honey” and jellies were calculated from the centesimal composition data according to the Brazilian legislation (RDC n°360 from the National Agency for Sanitary Surveillance-ANVISA), using the conversion Atwater factors: 9 kcal.g<sup>-1</sup> lipid, 4 kcal.g<sup>-1</sup> protein, 4 kcal.g<sup>-1</sup> carbohydrate (BRASIL,

2003).

#### **Elaboration of the jellies**

The jellies were prepared according to Guilherme et al. (2012), replacing sucrose by sweetener and high-metoxyl pectin by low-metoxyl pectin. The following treatments were studied for the diet jellies: F1 - 0.0015% thaumatin and 0.005% sucralose; F2 - 0.0015% thaumatin and 0.002% acesulfame-k; F3 - 0.005% sucralose and 0.002% acesulfame-k. The samples of the three treatments were prepared to same way using 2.0 kg "cocoa honey" and were added the following ingredients: 0.8% slow metoxilation grade pectin (CPKELCO S/A, São Paulo, Brazil), 0.4% polidextrose (Nutramax S/A, São Paulo, Brazil), 0.125% sorbitol (Vogler S/A, São Paulo, Brazil), 0.125% maltitol (Vogler S/A, São Paulo, Brazil), 0.0003% tricalcium phosphate (Synth Company, São Paulo, Brazil), 0.025% potassium sorbate (Biotec Company, São Paulo, Brazil), 2.0% cocoa powder (Nestlé Company, São Paulo, Brazil); each formulation was taken to simmer, and the solid sweetener (sucralose, acesulfame-k, thaumatin – Nutramax S/A, São Paulo, Brazil) were added to obtain the respective diet jellies. When the product reached to the point of jelly (45° Brix) was withdrawn from the fire, the jellies were immediately transferred to glass jars and closed with metal caps, following the cooling in water. Control treatment was prepared using a rate 60:40 (w/w) of "cocoa honey" and sucrose (União Company, São Paulo, Brazil). The mixture of "cocoa honey" and 75% total sucrose was taken to simmer; when the product reached to the concentration of 65° Brix was withdrew from the fire, then was added 1.0% high metoxilation grade pectin (CPKELCO S/A, São Paulo, Brazil) with the remaining 25% sucrose and 2.0% cocoa powder under vigorous agitation. The product was transferred to glass jars, closed with metal caps and cooled in water. The jellies pots were identified with labels and kept under room temperature for further evaluation.

#### **Physicochemical and chemical characterization and caloric value of the jellies**

The physicochemical and chemical characterization of the jellies followed the same methodology presented to the "cocoa honey" characterization. The activity of water (AW) was determined in equipment Aqualab Lite (Decagon Braseq, São Paulo, Brazil), with  $\pm 0.015$  precision and 0.001 resolution.

#### **Sensory evaluation**

The sensory analysis was conducted with sixty consumers with varied ages (employees,

professors, researchers and students from the Pharmacy Faculty, Federal University of Bahia-UFBA), who were invited to participate based on availability, habit to consume fruit jellies and diet foods. Ethical clearance approval for this work was granted by the Research Ethics Committee, Faculty of Medical Science, UFBA (Process nº 2011/1652). In the sensory evaluation were used 5g of each treatment (F1, F2 and F3), placed in individual three-digit-coded plastic containers, served at room temperature (25 °C) and they were presented to assessors in a randomized design in order to eliminate any serving order effect. The tests were conducted on individual sensory booths of the Food Sensory Analysis Laboratory under daylight, the samples were presented using a complete block in the statistical design and the assessors used filtered water for a palate cleanser between samples. A nine-point structured hedonic scale (1= disliked extremely and 9= liked extremely) was used in the acceptance test (MEILGAARD et al., 2006) for each sample for the evaluation of the color, chocolate odor, sweet taste, acid taste, chocolate flavor and consistency; the purchase intention test of the products was evaluated using a five-point structured scale (1= certainly would not buy and 5= certainly would buy).

#### **Statistical analysis**

The data obtained on physicochemical and chemical characterization were submitted to variance analysis (ANOVA) and Tukey test (0.05% level of significance). The data of acceptance test were also performed to ANOVA, the sources of variance being the treatments and the assessors for each quality attribute, followed by Tukey test (MSD-minimum significant difference, at  $\alpha \leq 0.05$ ), using the SAS statistical software (SAS, 2008). The acceptance data were also analyzed by the Principal Component Analysis (PCA), a covariance matrix was prepared with the averages of the treatments (lines) and the assessors (column) in order to obtain the Internal Preference Map-MDPREF (REIS et al., 2010).

## **RESULTS AND DISCUSSION**

#### **Physicochemical and chemical characterization of the "cocoa honey" and the jellies**

The Table 1 shows the results of physicochemical and chemical characterization of the "cocoa honey" and of the jellies. The pH value (3.3) of the "cocoa honey" is near to the recommended pH (3.0) to preparation jelly (JACKIX, 1988). The SSC (11.53°Brix) of the "cocoa honey" is higher than

SSC of strawberry pulp (8.88°Brix), traditionally used to elaborate jelly (TACO, 2006). The “cocoa honey” presented a low amount of total fiber (0.23g 100g<sup>-1</sup>) and pectin (0.078g 100g<sup>-1</sup>), when compared to the values found to total fiber of cupuaçu (3.10g 100g<sup>-1</sup>) and cocoa pulp (2.20 g 100g<sup>-1</sup>); the content of protein (1.11g 100g<sup>-1</sup>), lipid (0.25g 100g<sup>-1</sup>) and ash (0.26g 100g<sup>-1</sup>) were similar to the values related to cocoa pulp and lower than values from cupuaçu pulp, respectively, 1.0 and 1.2g 100g<sup>-1</sup> to protein, 0.20 and 1.0g 100g<sup>-1</sup> to lipid, 0.30 and 1.2g 100g<sup>-1</sup> to ash (TACO, 2006). Similar results were found to the caloric value of the “cocoa honey” and cocoa pulp (70.75 kcal and 74.0 kcal, respectively) according to the TACO (2006), however, these values were higher when compared to values presented by cupuaçu pulp (49.0 kcal).

The diet jellies (F1, F2 and F3) and control treatment showed SSC in according to the previous established values, it was 45° Brix for the diet jellies and 65° Brix for the control at the end of the cooking. The levels of TA to the diet jellies (0.21-0.17 g citric acid 100g<sup>-1</sup>) are within the recommended range by Jackix (1988), which established an ideal acidity below 0.8g 100g<sup>-1</sup> to obtain suitable gelling. The pH values (3.91-4.15) are in according to recommend values to fruit jellies (2.5 - 4.5) to facilitate gelling process using low grade metoxilation pectin; and according to Lago (2006) which recommend pH above 3.0 to avoid syneresis process, due to dehydration and hydrolysis of pectin. The AW was lower to the control treatment (0.79) than the diet jellies (0.84-0.87), due to the hygroscopic properties of the sucrose added in the control jelly (FENNEMA, 2010). The same situation was observed to the moisture values, the control treatment presented lower value (41.9 g 100g<sup>-1</sup>) than the diet jellies (64.19-67.61 g 100g<sup>-1</sup>), due to higher time of cooking to obtain 65°Brix (higher concentration).

The result of total protein was higher to the F1 and F2 treatments (2.05 and 2.02 g 100g<sup>-1</sup>, respectively) that differed significantly to the control treatment (1.78 g 100g<sup>-1</sup>), probably, due higher time of cooking and presence of the sucrose added in the control treatment causing the Maillard reaction and, consequently, decreased the protein content. The F1 and F2 treatments also differed significantly to the F3 treatment, that presented lower protein content (1.84g 100g<sup>-1</sup>), and these treatments were prepared to same way, in this case can be deduced that there was some kind of error in the evaluation. Lower amounts of protein were found by Melo Neto et al. (2013), studying formulations of mixed jellies, obtained from açai pulp (A) and cocoa honey (CH), that

were prepared using different proportions: T1 (40% A:60% CH), T2 (50% A:50% CH), T3 (60% A: 40% CH) and T4 (100% A - control). The authors found total protein content of 0.44%, 0.47% and 0.51%, respectively to the treatments T1, T2 and T3. The control treatment (T4), prepared only with açai pulp was 0.54%. In relation to lipid content, these authors concluded that the addition of cocoa honey in the product decreased the lipid content in the jellies, thus the treatments T3, T2 and T1 presented, respectively 3.95%, 3.66% and 3.50%. When compared these values found by Melo Neto et al. (2013) with the values presented by diet jellies and control treatment of this study, respectively 1.02g 100g<sup>-1</sup> (F1 and F2), 1.10g 100g<sup>-1</sup> (F3) and 1.49g 100g<sup>-1</sup>(control), can be deduced that the cocoa honey present low lipid concentration, consequently the jellies prepared only with cocoa honey also present lower lipid content.

The result of ash was lower to the control treatment (0.45g 100g<sup>-1</sup>) than the diet jellies (0.91-0.98g 100g<sup>-1</sup>), probably due to the presence of the additives (as tricalcium phosphate and potassium sorbate) and sweeteners (as sucralose that contain Cl ions and acesulfame-k that contain potassium), that could cause increase of minerals content. Melo Neto et al. (2013) studied the mineral profile of mixed jellies with açai and cocoa honey. The authors revealed that among of mineral fractions present in the jellies, the Fe element showed levels ranging from 71.11 mg 100g<sup>-1</sup> (T1 treatment- 40% açai pulp: 60% cocoa honey pulp) to 32.70 mg 100g<sup>-1</sup> equivalent (T4 treatment- 100% açai pulp). The presence of cocoa honey in the jelly increased, on average, five times the recommended daily dietary allowances of Fe (14 mg/day) for an adult (BRASIL, 2005), considering a 100g portion of the product. The same way, the mineral element Mn exceeded by ten times the recommended daily value and the fractions of K, Ca, Mg, Zn and Cu also showed higher values than recommended daily values, for jellies with higher proportion of cocoa honey. The mineral element phosphorus also showed levels within the recommended daily value.

The results of reducing (27.57-24.44 g 100g<sup>-1</sup>) and no-reducing (2.15-1.08 g 100g<sup>-1</sup>) sugar of the diet jellies were lower than the control treatment (36.73 and 15.47g 100g<sup>-1</sup>), due to the absence of the sucrose. There were reduction in the reducing sugar values (F1: 24.94%; F2: 27.55% and F3: 33.46%) and in the no-reducing sugar values (F1: 93.02%; F2: 86.10% and F3: 86.36%) compared to control treatment. Study carried out by Granada et al. (2005) with light pineapple jellies elaborated with sucralose sweetener (substitute 50% sucrose) and addition of

hydrocolloid also presented reduction in the total sugar content, thus to F1 treatment (xanthan/locust bean gum) decrease of 33.80%, to F2 treatment (carrageenan/xanthan gum) was 35.64%, to F3 treatment (carrageen/locust bean gum) was 35.22% and to F4 treatment (carrageen/xanthan/locust bean gum) was 36.96%, due to the absence of the sucrose.

The result of total fiber was lower to the control treatment ( $0.26\text{g } 100\text{g}^{-1}$ ) than the diet jellies ( $3.15\text{-}3.84\text{g } 100\text{g}^{-1}$ ), probably due to the presence of the gelling agents added to these products. The diet jellies of this study can be classified as high dietary fiber food, according to the Brazilian legislation, the Ordinance n° 27 from the National Agency for Sanitary Surveillance-ANVISA (BRASIL, 1998a), that recommend at least  $3\text{g } 100\text{g}^{-1}$  of fiber to solid foods. Fibers are recommended in the prevention and treatment of constipation, diverticular disease of colon and colon cancer. It regulates blood glucose, blood cholesterol and triglycerides (KWAK & JUKES, 2007).

The total caloric values of the diet jellies ( $132.46\text{ - }156.46\text{ kcal.}100\text{g}^{-1}$ ) were lower than the control treatment ( $229.78\text{kcal.}100\text{g}^{-1}$ ), demonstrating that there were reduction in the caloric value of the diet jellies (F1: 31.91%; F2: 39.93% and F3: 42.35%), %, due to the absence of the sucrose. The jellies F1, F2 and F3 obtained in this study can be characterized as diet, due to no addition of sugar, only sweetener can be incorporated in this class of foods to special purpose of consumptions with restriction of mono and disaccharides. They can get the denomination diet in their package label, based on Brazilian legislation, according the Ordinance n° 29 from ANVISA (BRASIL, 1998b). Granada et al. (2005) in their study, with light pineapple jellies elaborated with sucralose (substitute 50% sucrose) and addition of hydrocolloid, also reported a decrease in caloric values of the four treatments of light jellies ( $161\text{-}169\text{ kcal.}100\text{g}^{-1}$ ) when compared to conventional treatment ( $254\text{ kcal.}100\text{g}^{-1}$ ).

### Sensory evaluation

The variance analysis showed significant difference ( $p \leq 0.05$ ) in the acceptance of the samples in terms of color, chocolate odor, sweet taste, acid taste, chocolate flavor and consistency of the treatments F1, F2 and F3 (Table 2).

The F3 treatment stood out due higher scores reached to all studied attributes, differing significantly ( $p \leq 0.05$ ) to others two treatments (F1 e F2). The sucralose and acesulfame-k sweeteners showed better influence in the sensorial quality of the diet jelly of "cocoa honey". The means of the

sensory attributes for the F3 treatment were between 7 and 8 ("moderately liked" and "liked a lot") in the hedonic scale, demonstrating greater acceptance of this jelly. Both F1 and F2 treatments reached lower scores for all studied attributes, they did not differ significantly ( $p \geq 0.05$ ) to each other, except to the consistency attribute, that the F1 treatment (sucralose and thaumatin) reached higher score than F2 (acesulfame-k and thaumatin). In the case of diet jelly, the quality of gel depends on the concentration of pectin (LM) and Ca ions added in the product. A possible reason for lower score of F2 treatment could be due to error in the processing causing an inadequate gel structure. It was detected by the judges that commented in the ballot about the lower rigidity of the product. The means of the sensory attributes for the F1 and F2 treatments were between 5 and 6 ("no liked /no disliked" and "liked lightly"), indicating lower acceptance of these jellies.

Granada et al.(2005) studied four different formulations using sucralose in substitution to sucrose and addition of hydrocolloid to elaborate light pineapple jellies; although the light products had presented differences in the chemical composition, especially in the soluble solid, reducing, no-reducing and total sugar content, when they were compared to the control treatment, the sensory results showed that the consumers did not perceive difference among these treatments related to sweetness and flavor, indicating the good performance of the sucralose. By the other hand, Mendonça et al. (2005) studied different combinations of the sucralose and acesulfame-k sweetener to elaborate peach in syrup; the authors indicated that combined effect of these sweeteners in equivalent parts demonstrated higher sensory stability than it isolated use.

### Internal Preference Map

The data evaluated through multivariate analysis generated an internal preference mapping based on the acceptance scores for the attributes color (A), chocolate odor (B), sweet taste (C), acid taste (D), chocolate flavor (E) and consistency (F); the consumers were represented by points (Figure 1). In the present study, the two principal components (PCI and PCII) were used together and explained 99.9% of the total variability observed among the treatments (F1, F2 and F3).

In the Preference Map for the color attribute (Figure 1 - A) observed that many consumers are located in the central region of the graphic, they are not related to the two principal components, consequently they contributed little to discriminate the samples, all the samples presented the same

preference by consumers. In the others graphics (Figure 1- B to F), few consumers are located in the central region, indicating that most of them interfered to discriminate the samples. In general, the spatial separation of the samples plotted on the preference mapping showed that the F3 treatment was the favorite in terms of studied attributes, the consumers are located near to the favorite sample. The same way, it can be seen that the F1 and F2 treatments presented lower acceptance scores related to all attributes. These results are in agreement with the results showed in the Table 2, the means of sensory attributes, which indicated higher acceptance of the F3 treatment (sucralose and acesulfame-k), and lower acceptance of the F1 (sucralose and thaumatin) and F2 (acesulfame-k and thaumatin) treatments, both containing the thaumatin sweetener, possibly the thaumatin presented lower sweet taste (commentaries

of the consumers), in the proportions utilized in this study, and it did not get to balance the acid taste originated of the “cocoa honey”. It seems that there was not synergic effect between the thaumatin and sucralose sweetener, neither between thaumatin and acesulfame-k, in the proportions utilized in this study.

#### Purchase intention

The Figure 2 shows the purchase intent scores assigned by the consumers to the F1, F2 and F3 treatments. The F3 treatment presented the higher purchase intent score, since 92% of the consumers certainly or probably would buy this product, showing that this formulation was very well accepted and if it be available in the market it would be bought. The F2 treatment presented 43.33% of purchase intent followed by the F1 treatment with 31.66%, showing that these formulations were less accepted by the consumers.

**TABLE 1** – Means of chemical and physicochemical characteristics of the “cocoa honey” and “cocoa honey” jellies.

Constituents	“Cocoa honey”	F1	Treatments F2	F3	Control	SMD
Moisture (g 100g <sup>-1</sup> )	83.21*±0.94	64.19±0.99 c	64.76±0.96 b	65.61±0.98 a	41.90±0.99 d	0.02
Total Protein (g 100g <sup>-1</sup> )	1.11±0.04	2.05±0.02 a	2.02±0.02 a	1.84±0.01 b	1.78±0.01 b	0.06
Lipids (g 100g <sup>-1</sup> )	0.25±0.02	1.02±0.01 c	1.02±0.01 c	1.10±0.04 b	1.49±0.08 a	0.02
Ash (g 100g <sup>-1</sup> )	0.26±0.01	0.94±0.01 b	0.98±0.01 a	0.91±0.01 c	0.45±0.01 d	0.01
Reducing Sugar (g 100g <sup>-1</sup> )	8.63±0.04	27.57±0.04 b	25.61±0.06 c	24.44±0.05 d	36.73±0.99 a	0.03
No Reducing Sugar (g 100g <sup>-1</sup> )	11.30±0.24	1.08±0.01 d	2.15±0.03 b	2.11±0.01 c	15.47±0.07 a	0.03
Total Fiber (g 100g <sup>-1</sup> )	0.23±0.06	3.15±0.02 c	3.34±0.02 a	3.36±0.02 b	0.26±0.01 d	0.01
Pectin (g 100g <sup>-1</sup> )	0.078±0.003	1.46±0.01 a	1.31±0.01 c	1.41±0.01 b	0.21±0.01 d	0.01
Soluble Solids Content (°Brix)	11.53±0.98	45.0±0.50 b	45.0±0.60 b	45.0±0.50 b	65.0±0.90 a	0.10
Titratable Acidity (citric acid100g <sup>-1</sup> )	0.07±0.005	0.21±0.01 a	0.18±0.01 b	0.18±0.01 b	0.07±0.02 c	0.01
pH	3.30±0.10	3.91±0.10 c	4.15±0.10 a	4.00±0.10 b	4.12±0.10 a	0.04
Water Activity	nd	0.84±0.01 b	0.87±0.01 a	0.87±0.01 a	0.79±0.01 c	0.01
Total Caloric Value** (Kcal.100g <sup>-1</sup> )	70.75	156,46	138,02	132,46	229,78	-

F1: Thaumatin/Sucralose; F2: Thaumatin/Acesulfame-k; F3: Sucralose/Acesulfame-k; Control: sucrose.

\*Means(n=3)±Standard Deviation. nd = no determined.

SMD = Significant Minimum Difference by Tukey’s test (p≤0.05). Means in the same line accompanied by the same letter do not differ each other at 5% significance.

\*\*Calculated using the conversion factors: 9 kcal.g<sup>-1</sup> lipid, 4 kcal.g<sup>-1</sup> protein, 4 kcal.g<sup>-1</sup> carbohydrate.

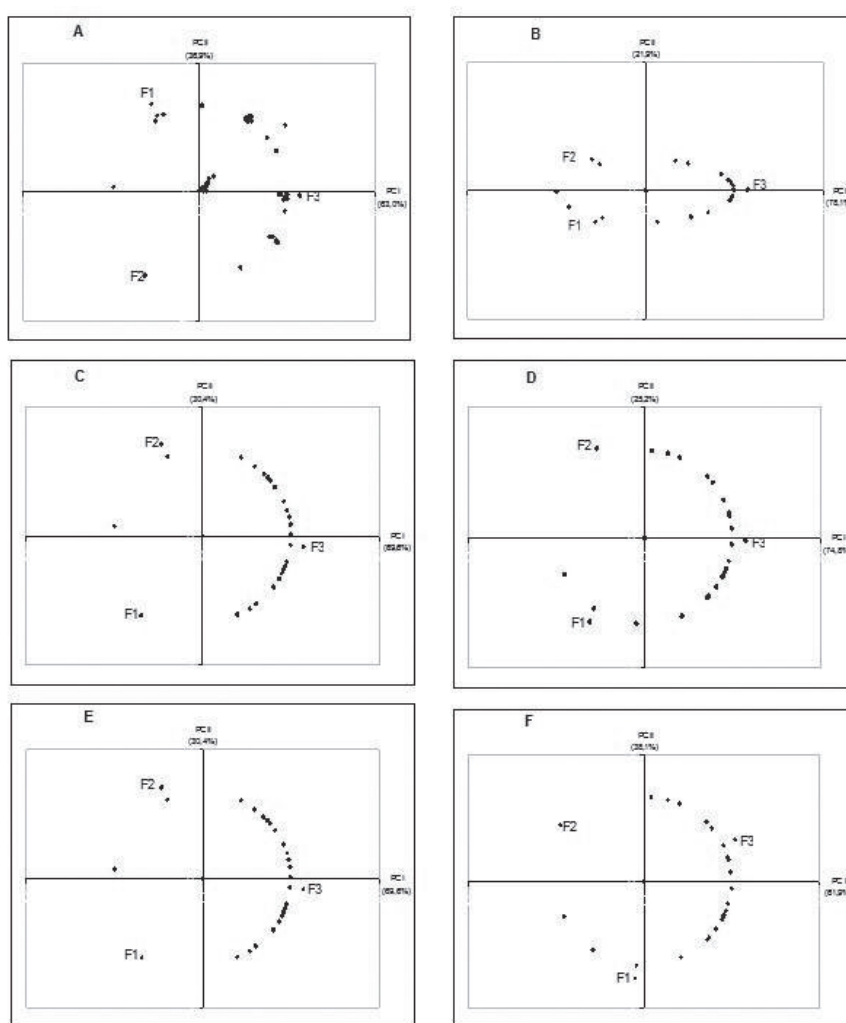
**TABLE 2** – Means of the sensory attributes of "cocoa honey" diet jellies.

Attributes	F1	Treatments		SMD
		F2	F3	
Color	7.72 b	7.52 b	8.22 a	0.31
Chocolate odor	5.33 b	5.38 b	7.45 a	0.60
Sweet taste	5.48 b	5.97 b	8.18 a	0.53
Acid taste	5.37 b	5.67 b	7.75 a	0.65
Chocolate flavor	4.80 b	4.85 b	8.17 a	0.67
Consistency	6.90 b	5.90 c	8.00 a	0.65

F1: Thaumatin/Sucralose; F2: Thaumatin/Acesulfame-k; F3: Sucralose/Acesulfame-k.

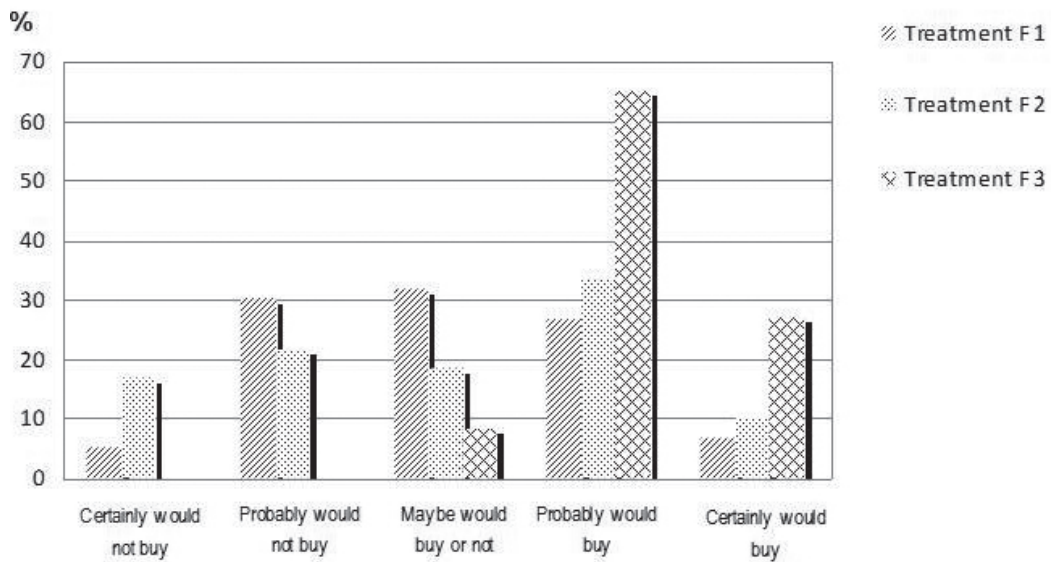
Means (n=60) in the same line accompanied by the same letter do not differ at 5% significance.

SMD = significative minimum difference by Tukey's test ( $p \leq 0.05$ ).



F1: Thaumatin/Sucralose; F2: Thaumatin/Acesulfame-k; F3: Sucralose/Acesulfame-k.

**FIGURE 1-** Internal Preference Map obtained on the acceptance means of the "cocoa honey" diet jelly (designed by letters A= color, B= chocolate odor, C= sweet taste, D= acid taste, E= chocolate flavor, F= consistency) plotted inside the sensory space; the consumers (n=60) are represented by points.



F1: Thaumatin/Sucralose; F2: Thaumatin/Acesulfame-k; F3: Sucralose/Acesulfame-k.

**FIGURE 2-** Purchase intent scores assigned by the consumers to the “cocoa honey” diet jellies.

## CONCLUSIONS

The results indicated the feasibility of technological profit of the “cocoa honey” as raw material in the preparation of diet jelly, which presented good sensory and nutritional characteristics.

The jellies of the treatments F1, F2 and F3 can be classified as high dietary fiber food and characterized as diet, due to no addition of sugar and reduction in the caloric value.

The F3 treatment contained sucralose and acesulfame-k sweetener was the favorite diet jelly by the consumers.

The use of the thaumatin sweetener showed unsuitable, it did not replace the sweetness in the jelly of “cocoa honey”.

## REFERÊNCIAS

ABIAD - Associação Brasileira de Indústria de Alimentos Dietéticos e para fins especiais. **Percentual de consumo de alimentos diet e light**. Disponível em: <<http://www.abiad.org.br/>>. Acesso em: 20 jan. 2013.

AOAC - Association of Official Analytical Chemists. **Official methods of analysis of AOAC International**. 17<sup>th</sup> ed. Arlington. 2002. v.2. 1141 p.

BRASIL. Leis, Decretos. Decreto n. 12.486 de 20 de outubro de 1978. Normas técnicas especiais relativas a alimentos e bebidas. **Diário Oficial do Estado de São Paulo**, São Paulo, SP, 21 out. 1978. p.3-25.

BRASIL. Ministério da Saúde. Agência Nacional de Vigilância Sanitária-ANVISA. Portaria n. 27, de 13 de janeiro de 1998. Regulamento técnico referente à informação nutricional complementar. **Diário Oficial da União. Diário Oficial da República Federativa do Brasil**, Brasília, DF, 13 jan. 1998a.

BRASIL. Ministério da Saúde. Agência Nacional de Vigilância Sanitária-ANVISA. Portaria nº 29, de 13 de janeiro de 1998. Regulamento técnico referente a alimentos para fins especiais. **Diário Oficial da República Federativa do Brasil**, Brasília, DF, 30 mar. 1998b.

BRASIL. Ministério da Saúde. Agência Nacional de Vigilância Sanitária-ANVISA. Resolução n. 360, de 23 de dezembro de 2003. Regulamento técnico sobre rotulagem nutricional de alimentos embalados. **Diário Oficial da República Federativa do Brasil**, Brasília, DF, 26 dez. 2003.



- BRASIL. Ministério da Saúde. Agência Nacional de Vigilância Sanitária-ANVISA. Resolução n. 269, de 22 de setembro de 2005. Regulamento técnico sobre a ingestão diária recomendada (IDR) de proteína, vitaminas e minerais. **Diário Oficial da República Federativa do Brasil**, Brasília, DF, 22 set. 2005.
- CEPLAC - Comissão Executiva do Plano da Lavoura Cacaueira. **O Estado do Pará e a produção brasileira de cacau**. Disponível em: <<http://www.ceplacpa.gov.br>>. Acesso em: 12 fev. 2013.
- FENNEMA, O.R. **Química de alimentos**. 4.ed. Porto Alegre: Editora Artmed, 2010. 1258p.
- GRANADA, G.G.; ZAMBIAZI, R.C.; MENDONÇA, C.R.B.; SILVA, E. Caracterização física, química, microbiológica e sensorial de geleias *light* de abacaxi. **Ciência e Tecnologia de Alimentos**, Campinas, v.25, n.4, p. 629-635, 2005.
- GUILHERME, P.R.; PESSATTO, C.C.; ZAIKA, W.R.; QUAST, E.; QUAST, L.B.; ORMENESE, R.C.S.C.; RAUPP, D.S. Desenvolvimento de geleia de tamarillo contendo polpa integral. **Brazilian Journal of Food Technology**, Campinas, v.15, n.2, p. 141-149, 2012.
- ICCO - International Cocoa Organization. **Produtores de cacau no mundo**. Disponível em: <<http://www.icco.org/>>. Acesso em: 25 jun. 2012.
- JACKIX, M.H. **Doces, geleias e fruta em calda: teórico e prático**. 2. ed. São Paulo: Editora da Unicamp, 1988. 98 p.
- KWAK, N.S.; JUKES, D.J. Functional foods. **Food Control**, Guildford, v. 12, n. 2, p.109-117, 2007.
- LAGO, E.; GOMES, E.; SILVA, R. Produção de geleia de jambolão (*Syzygium cumini* Lamarck): processamento, parâmetros físico-químicos e avaliação sensorial. **Ciência e Tecnologia de Alimentos**, Campinas, v.26, n.4, p. 847-852, 2006.
- MEILGAARD, M.; CIVILLE, G. V.; CARR, B. T. **Sensory evaluation techniques**. 4<sup>th</sup> ed. Boca Raton: CRC Press, 2006. 448 p.
- MELO NETO, B.A.; CARVALHO, E.A.; PONTES, K.V.; BARRETTO, W.S.; SACRAMENTO, C.K. Chemical, physico-chemical and sensory characterization of mixed açai (*Euterpe oleracea* L) and cocoa's honey (*Theobroma cacao* L) jellies. **Revista Brasileira de Fruticultura**, Jaboticabal, v.35, n.2, p.587-593, 2013.
- MENDONÇA, C.R.B.; ZAMBIAZI, R.C.; GULARTE, M.A.; GRANADA, G.G. Características sensoriais de compotas de pêssago *light* elaboradas com sucralose e acesulfame-k. **Ciência e Tecnologia de Alimentos**, Campinas, v.25, n.3, p. 401-407, 2005.
- REIS, R. C.; REGAZZI, A. J.; CARNEIRO, J. C. S.; MINIM, V. P. R. Mapa de Preferência. In: MINIM, V. P. R. **Análise sensorial: estudo com consumidores**. Viçosa: UFV, 2010.
- SANTOS, C.O. **Aproveitamento industrial de mel de cacau (*Theobroma cacao* L) na produção de geleia sem adição de açúcar**. 2012. 75 f. Dissertação (Mestrado em Ciência de Alimentos) - Universidade Federal da Bahia, Salvador, 2012.
- SAS - Statistical Analysis System for Windows. **User's procedures guide**. Version 6. Cary, 2008. 2 v.
- TACO - Tabela Brasileira de Composição de Alimentos. **NEPA-UNICAMP, versão II**. 2.ed. Campinas, 2006. 113p.