Use of agroindustrial wastes (açai fiber and glycerol) in the preparation of cookies

Helena Lima · Nádia Cristina Fernandes Corrêa ·
Orquidea Santos · Lúcia de Fátima Henriques Lourenço

Revised: 25 June 2014 / Accepted: 18 July 2014 / Published online: 17 October 2014
© Association of Food Scientists & Technologists (India) 2014

Abstract The aim of this study was to assess the effect of adding industrial byproducts (açai fiber and glycerol) on the physical, physicochemical, and sensory properties of cookies. The statistical analysis showed that only the parameters of water content and water activity are significantly influenced by the amount of açai fiber added and by the fiber's particle size. Through sensory analysis of crispness and the flavor, it was found that the best percentage of açai fiber and the best particle size added to the cookie formulation were 10 % and + 28 mesh, respectively. From this result, another sensory analysis was performed to evaluate the effect of glycerol over the texture of the cookies. Acceptance indices for the crispness and flavor above 70 % were observed, indicating the possibility for industrial exploitation. Cookies with added industrial

byproducts may be considered a source of fiber, as they contain 6 g/100 g fiber.

Keywords *Euterpe oleracea* Mart · Dietary fiber · Biodiesel

Introduction

Açai palm (*Euterpe oleracea* Mart.) belongs to the Arecales order, the Palmae family, and the Euterpe genus. The fruit is the most important part of the açai palm, both for the ecosystem and for human populations in the Amazon. Açai has raised considerable interest as a result of its potential as a functional food, mainly due to its anthocyanins and phenolics (Rogez 2000; Galate et al. 2012).

The increasing concern with possible environmental impacts and the increase in byproducts generated by food industries have led researchers to search for viable alternatives in generating new products for human consumption (Santos et al. 2010, 2013). The high fiber content contained in food industry waste may be used in the preparation of cookies, increasing the offer of products with higher fiber content both for healthy consumers and for those who suffer from certain pathologies, e.g., intestinal constipation, high cholesterol levels, and obesity (Mauro et al. 2010; Han et al. 2010; Baiano et al. 2011).

The dietary fiber present in food possesses the following health benefits: the regulation of intestinal functions; increased sense of satiation; a decrease in the caloric content ingested, and a reduction in the risk of disorders such as coronary diseases and certain types of cancer (Giuntini et al. 2003; Han et al. 2010). Countless studies have been carried out that indicate the viability of using fructooligosaccharide (Handa et al. 2012), barley flour (Frost et al. 2011), cocoyam, fermented sorghum, and pigeon pea flour blends (Okpala and

H. Lima · N. C. F. Corrêa · L. de Fátima Henriques Lourenço (✉)
College of Food Engineering, Federal University of Pará, Rua
Augusto Corrêa, n. 1, Guamá, 66075-900 Belém, PA, Brazil
e-mail: luciah1@ufpa.br

H. Lima
e-mail: helenatlima@hotmail.com

N. C. F. Corrêa
e-mail: nadia@ufpa.br

O. Santos
Department of Agroindustrial Technology, State University of Pará,
Rua Enéas Pinheiro, n. 2626, Marco, 66095-100 Belém, PA, Brazil
e-mail: orquideavs@usp.br

H. Lima · N. C. F. Corrêa · L. de Fátima Henriques Lourenço
Programa de Pós-graduação em Ciência e Tecnologia de Alimentos;
Instituto de Tecnologia (ITEC), Universidade Federal do Pará, Rua
Augusto Corrêa, no. 1, Guamá, 66075-900 Belém, PA, Brazil

O. Santos
Departamento de Tecnologia Agroindustrial, Universidade do Estado
do Pará, Rua Enéas Pinheiro, n. 2626, Marco, 66095-100 Belém, PA,
Brazil

Okoli 2012) with the purpose of adding functional ingredients to the elaboration of cookies.

Many projects have been conducted to increase the amount of insoluble fibers in bread products, cookies, and cereal bars by adding fibers to cereals, fruits, vegetables, and powdered cellulose (Perez and Germani 2007; Baiano et al. 2011; Gomaa and Boye 2013; Alvarez and Barbut 2013).

Glycerol, also known as glycerin or propane-1,2,3-triol, is an important by-product generated from the transesterification of vegetable oils for biodiesel production (Sotolani 2007). The production of 10 kg of biodiesel can yield approximately 1 kg of crude glycerol (10 %) (Chi et al. 2007). In the food industry, glycerol is used as a food additive due to its stabilizing, antioxidant, sequestrant, emulsifying, and humectant properties and has been used in the preparation of salad dressings, candy toppings, and frozen desserts.

Considering studies that report the use of wastes to obtain products with greater added value and consumer interest in products with high nutritional value and/or health benefits, the objective of this study was to evaluate the use of the industrial byproducts açai fiber and glycerol as ingredients in the preparation of cookies.

Materials and methods

Materials

The industrial waste (açai grains) resulting from açai processing was provided by a company that processes and sells açai pulp in the state of Pará, Brazil. Glycerol and the other ingredients used in the preparation of cookies (Table 1) were acquired in a commercial establishment in the city of Belém, Pará, Brazil.

Table 1 Percentage of the ingredients used in the standard formulation (SF)

Ingredients (g)	Standard formulation	%
Açai fiber	0	0
Wheat flour	100	35.20
Corn starch	40	14.08
Refined sugar	60	21.12
Margarine with salt	35	12.32
Distilled water	30	10.56
Powdered milk	15	5.28
Emulsifier	1.0	0.35
Baking soda	0.1	0.03
Ground cinnamon	0.5	0.18
Vanilla extract	2.5	0.88
Total	283.1	100.00

Methods

The experiments were performed on the premises of the College of Food Engineering of the Technological Institute of the Federal University of Pará (FEA/ITEC/UFPA).

Açai fiber

The açai grain was thawed in a refrigerator (brand GELOPAR, model GPTU 330) at 5 °C for 2 days. Around 1,000 g were dried in a stove with air circulation (FABBE Ltda. Brand, model 179) at 60 °C (12 h) until a final water content of around 5 % was reached. After drying, the açai grain was ground into 50 g portions using an HC21 mini food processor (Black & Decker) for about 20 s. Subsequently, a granulometric classification was performed using a Tyler series sieve (24, 28, 32, 42, 48, and bottom setting) and a sieve shaker (BERTEL Ltda., Brazil, model magnetic 0701). The açai grains retained in the 28 and 42 sieves were classified as açai fiber.

Microbiological analyses

The açai samples underwent microbiological analysis using the tolerance parameters required by Resolution RDC No. 12 of January 2nd, 2001 (Brasil 2001). All the analyses were performed in triplicate and followed the methodology described in the Compendium of Methods for the Microbiological Examination of Foods (Downes and Ito 2001).

Cookie preparation

The experimental procedure for the production of the cookies is presented in Fig. 1. All ingredients were weighed on an electronic digital scale (BEL ENGINEERING) and homogenized to light dough in an electric mixer (MB BRAESI, model BP-06) for 10 min. After the ingredients were mixed, the

Fig. 1 Experimental flow chart of the cookie processing

dough was molded (around 12 cm²) using a rolling pin and a PVC cutter. The cookies were placed in metal trays and subjected to a temperature of 150 °C in an electric oven (LAYR CRYSTAL 1–75) for 5 min, and were then cooled at room temperature for 4 h, as per trials performed by Ormenese et al. (2007). The cooled cookies were wrapped in foil, placed in vacuum-sealed polyethylene bags, and stored at room temperature for 24 h before laboratory analysis was performed.

The assays were performed in two stages: 1st—an evaluation of the effect of the amount and particle size of the açai fiber in the standard formulation; and 2nd—an evaluation of the effect of the açai fiber and glycerol in the standard formulation.

In order to evaluate the effect of the quantity and particle size of the açai fiber in the standard formulation, a 2² statistical fractional factorial design was followed with one repetition. The independent variables were the particle size (PS) and the açai fiber (AF) corresponding to the amount of fiber replaced a portion of the flour. The order of the trials was random to avoid statistical distortion in the results, i.e., to avoid atypical deviations from being associated with the combinations of the levels.

The dependent variables obtained were the water activity (*Wa*), the water content (*WC*), the acceptance index of crispness (*AIC*), and the acceptance index of the flavor (*AIF*). The established levels for the independent variables are presented in Table 2 with the coded and uncoded levels of the variables for the trials in the factorial design.

After the dependent variables were analyzed (Table 2), only one condition was selected for the appropriate açai content and particle size that served as the basis for the trials to evaluate the inclusion of glycerol and açai fiber in the cookie formulation.

In order to evaluate the effect of açai fiber and glycerol in the standard formulation on cookie acceptance (*AIC* and *AIF*), four trials were performed under the conditions shown in Table 3: standard cookie (SC), glycerol-added standard

(GAS), açai-fiber-added standard (AAS), and açai-fiber- and glycerol-added standard (GAAS). Glycerol was added according to the norms of the ABIA (1990) and of resolution no. 4 from 1988 of the National Health Council, which allows a maximum limit of 5.0 g/100 g or 5.0 g/100 mL in food.

Physical and physicochemical characterization of the cookies

The physical analysis of the cookies was based on procedures described in the method 10-50D of the AACC (1995) for the determination of weight, diameter, and thickness of the cookies before and after thermal treatment, in addition to the expansion factor.

The weight of each cookie was obtained using an electronic digital scale (BEL ENGINEERING). The thickness and the diameter of the cookies were measured with a caliper ruler. In this analysis, 10 cookies that were taken out of the oven and cooled for 4 h at room temperature were randomly chosen from the same experimental batch.

The expansion factor was determined from the ratio between the width and thickness values of the cookies, before and after the thermal treatment. The color was determined with a portable colorimeter (Minolta Model CR 310, Osaka, Japan) in the CIE (*Commission Internationale de L'Éclairage*) space using three readings: *L**, *a**, and *b**, where *L** is luminosity, *a** is the intensity of the color red, and *b** is the intensity of the color yellow.

The physicochemical analyses of the cookies were performed in triplicate, according to the methodology proposed by the AOAC (1997): water content in an oven at 105 °C; ash after incineration at 550 °C; and lipids (Soxhlet method). Total nitrogen was determined through the Kjeldahl method and converted into raw protein by a factor of 5.83. Total fiber was

Table 2 Coded and uncoded levels of the variables for the trials of the 2² factorial design

Trials	Variables				Dependent variables			
	Coded		Uncoded					
	X1	X2	AF (%)	PS (mesh)	Wa	WC (%)	AIC	AIF
1	−1	−1	5	28	Wa ₁	WC ₁	AIC ₁	AIF ₁
2	+1	−1	10	28	Wa ₂	WC ₂	AIC ₂	AIF ₂
3	−1	+1	5	42	Wa ₃	WC ₃	AIC ₃	AIF ₃
4	+1	+1	10	42	Wa ₄	WC ₄	AIC ₄	AIF ₄
5	−1	−1	5	28	Wa ₅	WC ₅	AIC ₅	AIF ₅
6	+1	−1	10	28	Wa ₆	WC ₆	AIC ₆	AIF ₆
7	−1	+1	5	42	Wa ₇	WC ₇	AIC ₇	AIF ₇
8	+1	+1	10	42	Wa ₈	WC ₈	AIC ₈	AIF ₈

AF açai fiber, *PS* particle size, *Wa* water activity, *WC* water content, *AIC* acceptance index of crispness, *AIF* acceptance index of flavor

calculated through the 985.29 enzymatic-gravimetric method (AOAC 1997). Water activity (Wa) was determined through a direct measurement in a Decagon AquaLab hygrometer (3TE, Decagon Devices Inc., Washington), at 25 °C. The carbohydrate content was obtained by difference, i.e., by subtracting the protein, ash, lipids, and water contents. The caloric values (kcal. 100 g⁻¹) were obtained considering conversion factors (Brazil 2003).

Sensory analysis

To evaluate the acceptance of the cookie formulations, a nine-point structured hedonic scale was used, which varied from “I liked it very much” to “I disliked it very much,” according to Dutcosky (2011). The evaluator team was composed of 30 untrained testers, consisting of students and staff of the Federal University of Pará, aged 20 to 40 years.

Statistical analysis

The results obtained in the physical, physicochemical, and sensory analyses of the cookies were analyzed using the software Statistica version 5.0 (StatSoft Inc., USA) through analysis of variance (ANOVA) and Tukey's test at a 5 % significance level.

Results and discussion

The results of the microbiological analyses for coliforms at 45 °C, *Salmonella*, and coagulase-positive staphylococcus carried out on the açai fiber were within the standards defined by the legislation (Brasil 2001).

The values of total coliforms found in the samples analyzed were below the critical level of 10² UFC/g. This value indicated that the açai and its byproduct were manipulated in hygienic conditions and are appropriate for technological processing.

Table 3 Formulations of cookies containing glycerol and “açai fiber”

Trials	Glycerol (g)	“Açai fiber”
SC	Zero	Zero
GAS	14	Zero
AAS	Zero	Best Formulation
GAAS	14	Best Formulation

SC with added glycerol GAS with added açai fiber AAS and with added glycerol and açai fiber (GAAS)

Table 4 The results of the trials according to a 2² fractional factorial design

Trials	Dependent variables			
	Wa	WC (%)	AIC (%)	AIF (%)
1	0.483	6.258	90.83	95.42
2	0.468	6.155	90.42	97.50
3	0.491	6.395	91.67	98.33
4	0.434	6.126	89.58	98.75
5	0.481	6.255	99.58	90.37
6	0.466	6.151	92.86	95.42
7	0.488	6.390	97.50	89.26
8	0.436	6.129	97.92	99.17

Effect of açai fiber content and particle size in the standard formulation

The experimental results of water activity (Wa), water content (WC), acceptance index of crispness (AIC), and the acceptance index of the flavor (AIF) obtained in the trials were performed according to the conditions in Table 2, and are presented in Table 4.

The results of the statistical analysis demonstrated that the evaluated parameters (açai fiber content and particle size) had a significant effect only on the dependent variables of Wa ($p < 0.0004$) and WC ($p < 0.000009$), with a non-significant effect for the rest of the variables. Considering that the maximum acceptable limit for replacing wheat is 10 %, as confirmed by Silva et al. (2001), the conditions selected for the cookie preparation were a particle size corresponding to a + 28 mesh sieve and 10 % açai fiber (best formulation).

In the cookies prepared according to the design in Table 3, acceptance tests were performed for the attributes of AIC and AIF, whose results are presented in Table 5.

For the attribute of AIC, a difference ($p \leq 0.05$) was observed among trials SC, GAS and GAAS, meaning that adding glycerol and glycerol plus açai fiber reduced the acceptance of the cookie. This probably occurred

Table 5 Results of the acceptance test from the trials with cookies containing açai fiber and glycerol

Trials	Acceptance test	
	AIC (%)	AIF (%)
SC	91.25 ac	95.42abcd
GAS	62.92bd	86.25bc
AAS	90.37c	87.78 cd
GAAS	74.07d	74.07d

In the same column, averages with a common letter indicate no significant difference among the results ($p < 0.05$)

Table 6 Physical parameters of the trials of the standard formulations and those with the addition of açai fiber and of glycerol

Physical parameters	Trials			
	SC	GAS	AAS	GAAS
Average pre-cooking unit weight (g)	7.57 ^{abcd}	6.38 ^{bc}	5.52 ^c	8.39 ^d
Average post-cooking unit weight (g)	6.77 ^{abcd}	5.67 ^{bc}	4.51 ^c	7.22 ^d
Average pre-cooking width (cm)	3.54 ^a	3.43 ^a	3.59 ^a	3.60 ^a
Average post-cooking width (cm)	3.57 ^a	3.58 ^a	3.46 ^a	3.67 ^a
Average pre-cooking thickness (cm)	0.14 ^{abd}	0.12 ^{bd}	0.29 ^c	0.15 ^d
Average post-cooking thickness (cm)	0.35 ^{ab}	0.34 ^{bc}	0.30 ^c	0.41 ^d
Average expansion index	18.02 ^a	19.85 ^a	12.01 ^a	16.18 ^a
Specific volume (cm ³ .g ⁻¹)	2.03 ^{abc}	1.95 ^{bcd}	2.39 ^{cd}	1.01 ^d
L*	76.86 ^{ab}	75.78 ^b	67.77 ^{cd}	69.19 ^d
Color a*	3.17 ^a	4.36 ^{bd}	4.05 ^c	4.35 ^d
b*	26.59 ^a	25.27 ^b	21.46 ^{cd}	21.22 ^d

Means followed by different letters in the same row differ significantly among themselves ($p < 0.05$). L* luminosity; a* the red-green component; b* the yellow-blue component

as a result of glycerol's moist characteristic, which decreases the cookie's crispness.

Trial AAS did not have a significant difference in relation to the standard formulation. For flavor, there was no significant difference ($p \leq 0.05$) between the standard formulation and the other formulations. However, in the trials with the addition of glycerol, the acceptance of the cookie flavor increased from 74.07 to 86.25 %. Glycerol did not affect the product's flavor and could be used with no rejection by consumers.

Fig. 2 Cookies prepared with the standard formulation (SC); with added glycerol (GAS); with added açai fiber (AAS); and with added glycerol and açai fiber (GAAS)

According to Sotolani (2007), glycerol does not increase blood sugar levels and is not used as a substrate by cavity-causing bacteria.

The sensory analysis demonstrated that cookies with açai fiber and with açai fiber and glycerol may be commercially viable, as they have AIC and AIF values above 70 %. Studies performed with different types of cookies have demonstrated a strong trend among industries and researchers of promoting the enrichment of cookies, especially since these are low cost products that can be easily consumed by the underprivileged social classes (Silva et al. 2001; Santucci et al. 2003; Borges et al. 2006; Ormenese et al. 2007).

Physical characteristics of the cookies

Table 6 presents the results of the physical parameters in the formulations of trials SC, GAS, AAS and GAAS where it was observed that all of the trials after cooking had a reduction in cookie weight. However, a significant difference ($p < 0.05$) was shown among the cookies of trial GAAS and those of trials GAS and AAS. That is, the presence of glycerol and of açai fiber increased cookie weight.

The trials with glycerol yielded a lower specific volume. The index of expansion (IE) is statistically the same ($p < 0.05$) among the trials, although the highest IE values (19.85) were found for the cookies containing glycerol. This result is explained by the water content, as expansion power is favored by an increase in the water content present in the cookie formulation according to Silva et al. (1998).

In Fig. 2, it can be seen that the cookie with açai fiber (AAS), which had a light color, had a difference in relation to the other trials. The addition of glycerol to the formulations made the color lighter for the GAS and GAAS trials, an

observation that is verified by the luminosity (L^*) values of 75.78 and 69.19, respectively. Adding glycerol to the dough decreased its consistency, making molding difficult.

Physicochemical characteristics of the cookies

The results of the physicochemical analysis are presented in Table 7. The cookies' caloric value showed high nutritional content when compared to a standard complete meal averaging 2,000 kcal. Since formulation AAS contained the highest lipid content, it had the highest caloric value, which can be explained by the greater amount of açai fiber and its oil in this particular formulation.

All of the trials had water and ash contents within the legal values of 14 % for water content and 3 % for ash for cookies (Brazil 1978). It was observed that the water content is the same between trials SC and GAAS, indicating that adding açai fiber minimizes glycerol's moist characteristic.

The maximum total fiber content found is within the guidelines by Anvisa (Brazil 1998) for high-fiber-content foods of 3 g/100 g. Adding glycerol and açai fiber did not lead to an increase in water activity and the caloric value is below 3 %, which shows that the stability is not significantly altered.

ADA (American Dietetic Association 2008) recommends the intake of 20 to 35 g/day of dietary fibers, 5 to 10 g of those being soluble fibers. The total dietary fiber content found in formulation GAAS was 6.15 ± 0.28 g, which means the cookie is a high-fiber product. The insoluble fiber contents in the present research (5.34 ± 0.73) were higher than the soluble fiber content (0.81 ± 0.55). Dietary fibers can be categorized according to their water solubility: insoluble (structural polysaccharides such as cellulose, lignin, and hemicellulose) and insoluble (or non-structural), which have shown very distinct physiological effects. The effects attributed to fibers as a whole are related to the prevention of several gastrointestinal tract pathologies, which are the primary benefits mostly related to insoluble fibers (Ohr 2004).

The metabolic effects of insoluble fibers on the human body, found at a lower proportion (0.81 ± 0.55) in the present study, are mainly related to a reduction in the absorption rate and effectiveness of nutrients such as glucose, lipids, and cholesterol and associated to their respective hypolipidemia and hypocholesterolemia levels (Ohr 2004). The açai fiber cookie is, according to the Brazilian legislation, a high-fiber product (Brazil 1998) and helps reduce the incidence of rectal cancer associated to the consumption of vegetables, fruits, whole grains, and fibers.

Silva et al. (2001), when preparing cookies with 10 % *Hymenaea stigonocarpa* Mart. and *Hymenaea stilbocarpa* Mart., found total dietary fiber contents of 6.05 ± 0.09 and 6.77 ± 0.53 g/100 g, respectively, which are very close to the results found in the present research. Santos et al. (2011) produced cookies with manioc starch with 2.96 % crude fiber and with sour starch with 3.08 % crude fiber.

Other authors also used several raw materials to prepare cookies. Mauro et al. (2010) prepared cookies with kale stalk flour and spinach stalk flour and found values of 3.37 % and 4.25 % total dietary fiber, respectively. Handa et al. (2012) prepared cookies with fructooligosaccharide and obtained 12.1 % fibers. In all those studies, the cookies were classified as good sources of fibers according to guideline 27/98 (Brazil 1998; Brazil 2003), which sets a minimum of 3 g/100 g fibers for solid foods.

Conclusion

The results obtained in the sensory analysis show that the cookies formulated with açai fiber (AAS) and with açai fiber and glycerol (GAAS) may be commercially viable, as they exhibited good acceptability among the testers.

Table 7 Physicochemical characteristics of the cookies prepared with açai fiber and glycerol

Composition	SC	GAS	AAS	GAAS
Caloric value (kcal)	419.24	426.32	444.09	431.59
Water activity	0.50 ± 0.00^{ab}	0.494 ± 0.00^b	0.478 ± 0.00^c	0.426 ± 0.00^d
Moisture	6.97 ± 0.06^{ad}	8.45 ± 0.08^b	6.26 ± 0.06^c	7.10 ± 0.11^d
Lipid	10.32 ± 0.01^a	12.88 ± 1.18^{bd}	14.65 ± 0.17^c	12.83 ± 0.24^d
Protein	6.50 ± 0.14^{abc}	6.12 ± 0.12^{bcd}	5.98 ± 0.04^{cd}	5.69 ± 0.21^d
Ash	1.12 ± 0.013^a	1.07 ± 0.029^a	1.03 ± 0.023^a	1.04 ± 0.03^a
Carbohydrate	75.09 ± 0.24^a	71.48 ± 0.71^{bc}	72.08 ± 0.17^{cd}	73.34 ± 0.38^d
Total fiber	—	—	—	6.15 ± 0.28
Insoluble fiber	—	—	—	5.34 ± 0.73
Soluble fiber	—	—	—	0.81 ± 0.55

Means followed by different letters in the same row differ significantly among themselves ($p < 0.05$). Dry basis

Adding glycerol and açai fiber to the cookie formulations did not alter the physical parameters when compared to those of the standard formulation.

It can be concluded that this product may be considered a source of fibers as it contains 6 g/100 g of fiber for solid foods.

Acknowledgments This study received financial support from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and Pró-Reitoria de Pesquisa e Pós-Graduação (PROPESP/UFPA)

References

- Alvarez D, Barbut S (2013) Effect of Inulin, β -Glucan and their mixtures on emulsion stability, color and textural parameters of cooked meat batters. *Meat Sci*. doi:10.1016/j.meatsci.2013.02.011
- AMERICAN ASSOCIATION OF CEREAL CHEMISTS (1995) - AACC. Approved methods of the American Association of Cereal Chemists. 9th ed. St. Paul
- AMERICAN DIETETIC ASSOCIATION (2008) ADA. Position of the American dietetic: health implication of dietary fiber. *J Am Diet Assoc* 108:1716–1731
- ASSOCIAÇÃO BRASILEIRA DAS INDÚSTRIAS DE ALIMENTAÇÃO—ABIA (1990) cap. 3, revisão n° 4. Available at: <<http://www.abia.org.br>>. Accessed 25 Jan 2012
- ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS (1997)—A.O.A.C. Official Methods of Analysis. 16 ed., Washington
- Baiano A, Lamacchia C, Fares C, Terracone C, La Notte E (2011) Cooking behaviour and acceptability of composite pasta made of semolina and toasted or partially defatted soy flour. *LWT-Food Sci Tech* 44:1226–1232. doi:10.1016/j.lwt.2010.11.029
- Borges SV, Bonilha CC, Mancini MC (2006) Sementes de jaca (*Artocarpus integrifolia*) e de abóbora (*Cucurbita moschata*) desidratadas em diferentes temperaturas e utilizadas como ingredientes em biscoitos tipo cookie. *Alim Nutr* 17:317–321
- Brasil, Ministério da Saúde. Agência Nacional de Vigilância Sanitária—ANVISA (2003) Resolução RDC n° 360. Aprova o regulamento técnico sobre rotulagem nutricional de alimentos embalados. *Diário Oficial*. Brasília, DF. Dezembro de 2003
- Brasil, Ministério da Saúde. Comissão Nacional de Normas e Padrões para Alimentos—C.N.N.P.A. Resolução n°12 de 24 de julho de 1978. Aprova normas especiais relativas a alimentos (e bebidas), para efeito em todo território brasileiro. *Diário Oficial*. Brasília, DF de 24/07/1978
- Brasil, Ministério da Saúde, Agência Nacional de Vigilância Sanitária—ANVISA (2001) Resolução RDC n° 12 de 2 de janeiro de 2001.Regulamento técnico sobre os padrões microbiológicos para alimentos. *Diário Oficial*. Brasília, DF
- Brasil. Ministério da Saúde, Agência Nacional de Vigilância Sanitária—ANVISA (1998) Portaria n° 27, de 13 de janeiro de 1998. Regulamento técnico referente à informação nutricional complementar. *Diário Oficial da União*, de 16 de janeiro de 1998. Available at: <<http://e-legis.bvs.br/leisref/public/showAct.php>>. Accessed 29 May 2014
- Chi Z, Pyle D, Wen Z, Frea C, Chen S (2007) A laboratory study of producing docosahexaenoic acid from biodiesel-waste glycerol by microalgal fermentation. *Process Biochem* 42:1537–1545
- Downes FP, Ito K (eds) (2001) Compendium of methods for the microbiological. *Examinations of foods*, 4th edn. APHA, Washington, DC
- Dutcosky SD (2011) Análise Sensorial de Alimentos. Editora Universitária Champagnat, Curitiba, 426p
- Frost DJ, Adhikari K, Lewis DS (2011) Effect of barley flour on the physical and sensory characteristics of chocolate chip cookies. *J Food Sci Technol* 48:569–576. doi:10.1007/s13197-010-0179-x
- Galate RS, Mota MGC, Gaia JMD, Costa MSS (2012) Caracterização morfoagronômica de germoplasma de açaizeiro no nordeste paraense Rer Bras Frutic doi://dx.doi.org/10.1590/S0100-29452012000200028
- Giuntini EB, Lajolo FM, DE Menezes EW (2003) Dietary fiber potential in iberian-american countries: food, products and residues. *Arch Latinoam Nutr* 53:14–20
- Gomaa A, Boye JI (2013) Impact of thermal processing time and cookie size on the detection of casein, egg, gluten and soy allergens in food. *Food Res Int*. doi:10.1016/j.foodres.2013.01.019
- Han J, Janz JAM, Gerlat M (2010) Development of gluten-free cracker snacks using pulse flours and fractions. *Food Res Int* 43:627–633
- Handa C, Goomer S, Siddhu A (2012) Physicochemical properties and sensory evaluation of fructoligosaccharide enriched cookies. *J Food Sci Technol* 49:192–199
- Mauro AK, Silva VLM, Freitas MCJ (2010) Physical, chemical, and sensorial characterization of cookies made with Kale Stalk Flour (KSF) and Spinach Stalk Flour (SSF) rich in nourishing fiber. *Cienc Tecnol Aliment* 30:719–728
- Ohr LM (2004) Fortifying with fiber. *Food Technol* 58:71–75
- Okpala LC, Okoli EC (2012) Development of cookies made with cocoyam, fermented sorghum and germinated pigeon pea flour blends using response surface methodology. *J Food Sci Technol*. doi:10.1007/s13197-012-0749-1
- Ormenese RCSC, Marchese DA, Lage ME. (2007) Perfil sensorial e teste de consumidor de biscoito recheado sabor chocolate. B. CEPPA, Curitiba, v. 19, n. 2, p. 277–300, jul./dez. 2001. Available at: <http://calvados.c3sl.ufpr.br/ojs2/index.php/alimentos/article/view/1239/1039>. Accessed 15 Nov 2012
- Perez PMP, Germani R (2007) Elaboração de biscoitos tipo salgado, com alto teor de fibra alimentar, utilizando farinha de berinjela (*Solanum melongena*, L.). *Cienc Tecnol Aliment* 27:186–192
- Rogez H (2000) Açai: preparo, composição e melhoramento da conservação. 1 ed. Belém, PA: Ed. Universidade Federal do Pará—EDUFA, 2000. 313 p
- Santos OV, Lopes AS, Azevedo GO, Santos AG (2010) Processing of Brazil-nut flour: characterization, thermal and morphological analysis. *Cienc Tecnol Aliment* 30:264–269
- Santos AAO, Santos AJAO, Alves AR, Santana Silva JV, Marcellini PS (2011) Elaboração de biscoitos a partir da incorporação de produtos da mandioca e casca de maracujá (*Passiflora edulis* Flavicarpa) na farinha de trigo. *Sci Plena* 7:1–7
- Santos OV, Corrêa NCF, Carvalho JRRN, Costa CEF, França LF, Lannes SCS (2013) Comparative parameters of the nutritional contribution and functional claims of Brazil nut kernels, oil and defatted cake. *Food Res Int* 51:841–847
- Santucci MCC et al (2003) Efeito do enriquecimento de biscoitos tipo água e sal com extrato de levedura (*Saccharomyces* sp.). *Cienc Tecnol Aliment* 23:441–446
- Silva CEM, Façanha SHF, Silva MGG (1998) Efeito do teor de água, amilose, amilopectina e grau de gelatinização no crescimento do biscoito de amido de mandioca obtido por fermentação natural. *Cienc Tecnol Aliment*. doi:10.1590/S0101-20611998000100013
- Silva MR, Martins KA, Borges S (2001) Avaliação química, física e sensorial de biscoitos enriquecidos com farinha de jatobá-do-cerrado e de jatobá-da-mata como fonte de fibra alimentar. *Braz J Food Technol* 4:163–170
- Sotolani AS Glicerol (2007) Serviço Brasileiro de Respostas Técnicas—SBRT, 2007. Available at:<<http://www.sbrt.ibict.br>> Accessed 10 Oct 2012