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USE OF PASSION FRUIT PEEL FLOUR IN THE MANUFACTURING OF BREAD

UTILIZAÇÃO DA FARINHA DE CASCA DE MARACUJÁ NA FABRICAÇÃO DE PÃO DE FORMA

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panificação; Passiflora edulis; alimento funcional.

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Abstract

Brazil is the largest worldwide Passiflora fruit producer producing peel waste with a large potential for use. The objective of this work was to evaluate the effect of different Passiflora peel flour (PPF) concentrations in addition to loaf bread. The experiment was carried out in the Agro Industry Sector of IF Goiano Ceres from August to November of 2019. The experimental design was completely randomized with four treatments with different concentrations of Passiflora peel flour (0%, 5%, 10% and 15%) and three repetitions. Physicochemical (pH, titratable acidity, humidity, ash) and microbiological analyses (total coliforms and thermotolerant coliforms) were carried out at Instrumental and Microbiologic laboratories. Sensory evaluations were performed with 50 untrained panelists to verify acceptance and purchase intention. A decrease in pH level (varying from 6.06 to 5.39) and humidity level (from 30.65% to 27.66%) was observed with the addition of PPF. For ash and titratable acidity levels, there was an increase in the observed values with the addition of PPF, varying from 1.04% to 1.36% and from 2.23% to 4.76%, respectively. A higher acceptance was observed for the 0% (80.31%) and 5% (78.16%) PPF treatments. In this way, we conclude that the use of PPF to enrich loaf bread is an alternative to the partial substitution of wheat flour for the addition of nutrients and fibers. The microbiological analysis results indicated that all treatments were in accordance with Brazilian legislation. Therefore, Passiflora peel flour has the potential to be used in loaf bread manufacturing and could be used to replace wheat flour up to 5%.

Resumo

O Brasil é o maior produtor mundial de maracujá, produzindo um resíduo de casca com grande potencial de aproveitamento. O objetivo deste trabalho foi avaliar o efeito de diferentes concentrações de farinha de casca de maracujá (FCM) na fabricação de pão de forma. O experimento foi realizado no Setor de Agroindústria do IF Goiano Ceres no período de agosto a novembro de 2019. O delineamento experimental foi totalmente casualizado com quatro tratamentos com diferentes concentrações de farinha de casca de maracujá (0%, 5%, 10% e 15%) e três repetições. Análises físico-químicas (pH, acidez titulável, umidade, cinzas), microbiológicas (coliformes totais e coliformes termotolerantes) foram realizadas nos laboratórios Instrumental e Microbiológico. Avaliações sensoriais foram realizadas com 50 provadores não treinados para verificar aceitação e intenção de compra. Observou-se diminuição do nível de pH (variando de 6,06 para 5,39) e do nível de umidade (de 30,65% para 27,66%) com a adição de FCM. Para os níveis de cinzas e acidez titulável, houve aumento nos valores observados com a adição de FCM, variando de 1,04% a 1,36% e de 2,23% a 4,76%, respectivamente. Observou-se maior aceitação aos tratamentos com 0% (80,31%) e 5% (78,16%) de FCM. Dessa forma, concluímos que a utilização da FCM para enriquecimento do pão de forma é uma alternativa à substituição parcial da farinha de trigo pela adição de nutrientes e fibras. Os resultados das análises microbiológicas indicaram que todos os tratamentos estão de acordo com a legislação brasileira. Portanto, a farinha de casca de maracujá tem potencial para ser utilizada na fabricação de pão de forma, podendo ser utilizada em substituição à farinha de trigo em até 5%.

INTRODUCTION

Brazil is the world's largest producer of passion fruit, producing approximately seven hundred thousand tons of the fruit per year with an average productivity of 15 tons/ha/year (Brazil, 2022). The region with the highest production comprises the

Brazilian Northeast, with the states of Bahia and Ceará being the largest producers (Embrapa, 2021). In addition to high production, Brazilians are the world's largest consumer of passion fruit, which absorbs all production on the domestic market, where 40% of the fruits are destined for pulp extraction and 60% for the fresh fruit market (Cavichioli, 2018).

Passion fruit is mainly used in the preparation of juices but also in sweets, jellies and mousses (Costa, 2016). Its processing produces some byproducts, such as the peel, which corresponds to 60% of the fruit's weight and is generally discarded into the environment, thus being a source of pollution (Damasceno et al., 2018).

Passion fruit peel, despite being a product discarded during the industrial processing of the fruit, has great potential for use in the food industry, mainly in the form of flour. According to Moraes and Seravalli. 2017, passion fruit peel flour is rich in dietary fiber (40.2% dry basis "bs."), mainly pectin, with the ability to retain water forming viscous gels that delay gastric emptying and intestinal transit. Furthermore, it is also rich in sugars, which gives it a pleasant and characteristic passion fruit flavor and has a considerable protein content (10.6% dry basis "bs "). With this composition, flour has great potential to be used in the creation of new products in the bakery area, such as breads, cakes and cookies.

Passion fruit flour is one of the products that can be added to bread, a popular Brazilian food, consumed in morning meals and snacks at any time of day. Mixing it with other products aims to enrich it with nutrients and contribute to consumer health; in this case, the passion fruit peel has niacin (vitamin B3), which acts on growth and hormone production, prevents gastrointestinal problems and helps the health of diabetics, as it controls blood glucose and LDL cholesterol (*Low Density Liproprotein*) (Pita, 2012).

Given this context, the objective of this work was to evaluate the effect of adding different concentrations of passion fruit peel flour in the manufacture of sliced bread.

MATERIAL AND METHODS

The test was carried out in the agroindustry sector of the Instituto Federal Goiano – Campus Ceres and in the instrumental chemistry laboratory of the same institution from August to November 2019. The design used was completely randomized (DIC), with four treatments, including bread form with different concentrations of passion fruit peel flour (0, 5, 10 and 15%) and three repetitions.

To prepare the flour, the fruits were obtained from a market in the city of Ceres-GO. After acquisition, they were washed in running water with neutral detergent, and then the pulp was extracted, with the peels immersed in a sodium hypochlorite solution (150 mg L-1) for 15 minutes for disinfection. After this step, the peels were rinsed in running water, cut into smaller fractions and placed in an oven (model 404-3DE ETHIK) for drying at 65°C for two days. Once dry, they were crushed with the help of a domestic blender until flour was obtained, which was sieved, packed in plastic packaging and stored in a refrigerator until use. Figure 1 shows the flowchart of all processing steps.

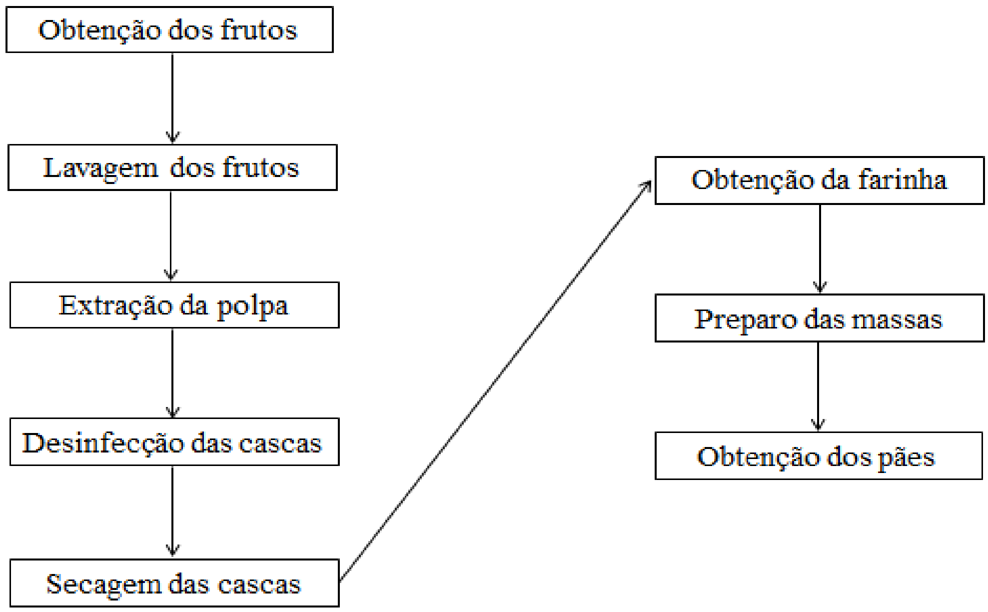

Figure 1: Flowchart of the steps for obtaining flour and making bread.

The breads were prepared based on the formulations presented in Table 1. After weighing, the ingredients were placed in a clean container and homogenized using a domestic mixer. Then, the masses of each formulation were worked by hand, molded into appropriate shapes and placed in oil-greased molds to rest for an hour and a half. Subsequently, the bread was baked in an oven at 180°C for 30 minutes.

Table 1: Formulation for the manufacture of different breads.

Ingredients	Formulations			
	0%	5%	10%	15%
Wheat flour (g)	400	380	360	340
Passion fruit peel flour (g)	-	20	40	60
Biological yeast (g)	6	6	6	6
Egg (unit)	1	1	1	1
Milk (mL)	240	240	240	240
Butter (g)	30	30	30	30
Sugar (g)	25	25	25	25
Salt (g)	6	6	6	6

To evaluate the microbiological quality of the different breads, aiming to identify contamination by total coliforms during the manufacturing process, after preparing the doughs, they were subjected to microbiological analysis according to the methodology described by Silva et al. (1997), and values were expressed in MPN/g (Most Probable Number) (Brasil, 2022). In addition to this analysis, physical-chemical analyses were also carried out to determine the compositions (ash, humidity, total titratable acidity and pH) in accordance with the standards established by the Adolfo Lutz Institute (2008).

After preparation, the breads with different concentrations of passion fruit peel flour were subjected to sensory analysis, being evaluated at the Instituto Federal Goiano – Campus Ceres by 50 untrained tasters (students, teachers and staff). A 9-point structured hedonic scale was used to determine acceptability and preference according to the methodology proposed by Della Modesta (1994).

During the analysis, each taster received a consent form to be signed, and the samples were subsequently accompanied with water. After the tasting, they filled out an evaluation form containing the attributes to be evaluated, which were consistency, aroma, color, general appearance, flavor and preference. With the notes from the sensory analysis, the acceptability index for the different breads was also calculated as described by Santos and Almeida (2020).

The data from the physicochemical and sensory analyses were subjected to analysis of variance, and the means of the treatments were compared to the Tukey test at a 5% level of significance using Sisvar 5.6 software. The results of the microbiological analyses were expressed descriptively.

RESULTS AND DISCUSSION

According to microbiological analysis (Table 1), both passion fruit peel flour (FCM) and breads with different concentrations of FCM presented contamination <3.0 NMP/g and are, therefore, suitable for consumption. These results corroborate the studies by Andrade et al. (2018) and Santos and Almeida (2020), who obtained contamination < 3.0 MPN/g of Coliforms at 35 °C and Coliforms at 45 °C, molds and yeasts for sliced bread enriched with green banana flour.

According to Normative Instruction No. 161 of July 1, 2022, the acceptable limit established for flour, starch, cornmeal, bread, bagels and toast is 10^2 NMP/g (Brazil, 2022). The values found in this test were lower than the aforementioned values, thus demonstrating that the hygiene and sanitization procedures used, both in the flour and bread manufacturing process, were efficient.

Table 1. Results of microbiological analyses of FCM and bread with FCM.

Samples/Dilution	MPN/g
MHR 0%	<3.0
FCM 5%	<3.0
MHR 10%	<3.0
MHR 15%	<3.0
FCM	<3.0

FCM – Passion fruit peel flour - The Most Probable Number technique (MPN/g)

For pH (Table 2), it was noted that there was a significant difference between the treatments, with a decrease in pH with the increase in the FCM quantity. This result was probably caused by the organic acids present in the FCM. Santana et al. (2011) also observed a slight reduction in pH when working with biscuits, replacing 35% wheat flour with 17.5% passion fruit peel flour and 17.5% cassava starch. This result came from the fruit of passion fruit, which is a citrus fruit.

For total titratable acidity, a significant difference was observed between treatments (bread with 0% FCM; bread with 5% FCM; bread with 10% FCM; bread with 15% FCM), with a progressive increase in acidity of 2.28%, 3.83%, 4.23% and 4.76%, respectively, according to the respective treatments (bread with 0% FCM, bread with 5% FCM, 10% and 15%). These results are in line with those obtained by Santana et al. (2011), who, when working with passion fruit peel flour and cassava starch in the preparation of cookies, observed an increase in acidity caused by organic acids from the addition of passion fruit peel flour.

For humidity, there was no difference between treatments. The values for this attribute ranged from 26.48 to 30.65%, contrasting with the results obtained by Galeno and Rezende (2013), who observed a progressive increase in humidity according to the addition of passion fruit peel flour. This result was caused by pectin, which promotes greater interaction in the food with the water contained therein and, consequently, a retention of this constituent in the food. According to Resolution of the Collegiate Board (RDC) No. 90 of October 18, 2000, the humidity for breads prepared with wheat flour must be up to 38%; thus, the values found in this study are within the standard established by legislation current.

Table 2: Physicochemical analysis of breads enriched with different concentrations of passion fruit peel flour.

	Treatments				
Variables	**0% FCM**	**5% FCM**	**10% FCM**	**15% FCM**	**CV (%)**
pH	6.06 to	5.72b	5.57c	5.39d	0.82
ATT (%)	2.28c	3.83b	4.23 ab	4.76 to	9.10
Moisture (%)	30.65 to	32.27 a	26.48 a	27.66 a	11.55
Ash(%)	1.04c	1.10 bc	1.17b	1.36 to	2.48

Tukey's test (p<0.05). FCM – passion fruit peel flour; CV – coefficient of variation.

For the ash content, it was noticed that there was a difference, with an increase in values with the addition of passion fruit peel flour. These results corroborate those obtained by Galeno and Rezende (2013), who also found an increase in ash content with the addition of passion fruit peel flour. The same authors also stated that this result can be explained because FCM is a whole food, which therefore has a higher mineral content and promotes a slight increase in ash content.

Table 3 presents the results of the sensory analysis for the different breads. It was found that for consistency, there was only a difference between bread with 0% FCM and bread with 15% FCM. It can be observed that the ratings given by consumers to the different treatments in this attribute decreased as the amount of passion fruit peel flour increased, and this result can be explained by the fiber content; large quantities make the consistency of the product firmer. This characteristic is not desired by bread consumers, who prefer a soft product.

Moraes and Seravalli (2017), studying the use of passion fruit peel flour in the manufacture of sliced bread, found that breads with 10% and 15% FMC had compact and hard crumbs, while the 5% concentration provided softer crumbs. These results are similar to those obtained in this work.

For aroma, no difference was found between treatments. According to Ishimoto et al. (2007), increased heating can degrade aromatic or bitter substances to the taste, called *off-flavors*, which is a factor that may have influenced the occurrence of this result. Damasceno et al. (2018) evaluated the effect of adding different concentrations of passion fruit peel flour (5%, 10% and 15%) on bread acceptability and did not observe a significant difference for this attribute. On the other hand, Ozores et al. (2015) found a difference in aroma for cakes enriched with 5%, 10% and 20% FCM, with the highest concentration treatment showing the lowest acceptance.

Table 3: Sensory analysis of breads enriched with different concentrations of passion fruit peel flour.

	Treatments				
Variables	**0% MHR**	**5% MHR**	**10% FCM**	**15% MHR**	**CV (%)**
Consistency	6.84 to	6.82 ab	6.47 ab	5.94b	27.73
Aroma	6.64 to	6.64 to	6.17 to	6.05 to	27.88
Color	7.28 to	7.12 to	6.07b	5.91b	25.54
Flavor	7.22 to	7.03 ab	6.15b	5.10c	31.04
General aspect	7.21 to	7.12 to	6.36b	6.07b	22.47
acceptance rate	80.31 a	78.16 ab	68.42b	56.72c	31.04

Means followed by different lowercase letters on the same line differ from each other using the Tukey test ($p<0.05$). FCM – passion fruit peel flour; CV – coefficient of variation.

In the color attribute, it was found that the 0% FCM treatment and the 5% FCM treatment did not differ statistically from each other and presented higher values than the treatments with 10% and 15%, and these did not differ from each other. This result can be explained by the fact that consumers prefer bread with a lighter color, a characteristic that was not provided by treatments with 10% and 15% FCM, which presented a darker color. Furthermore, according to Miranda et al. (2013), it is possible that some consumers associate color with the flavor of the product, for example, light color with passion fruit. The same author mentioned above tested the acceptability of cakes enriched with different concentrations of FCM (0%, 7%, 10% and 14%) and found greater consumer acceptability in terms of color for lighter cakes, which had a lower concentration of FCM. .

For the flavor attribute, it was observed that the treatment with 0% FCM did not differ statistically from the treatment with 5% FCM and presented a higher score than the other treatments, with the treatment with 15% presenting the lowest scores for this attribute. There was a significant reduction in scores for this attribute as the concentration of FCM increased. This result can be explained by the characteristics of passion fruit peel flour, which has a pronounced bitterness. This phenomenon was observed by Catarino and Seibel (2017), who studied the effect of adding different concentrations of passion fruit peel flour in the manufacture of biscuits, and Ozores et al. (2015), who evaluated the acceptability of cakes enriched with the same flour, found a reduction in flavor as the FCM concentration increased.

In the general aspect attribute, it was observed that the treatment with 0% FCM and treatment with 5% FCM did not differ statistically and presented the best results. The tasters themselves, during the sensory analysis, reported that the breads from these treatments were soft, with a lighter color and a pleasant flavor, thus justifying the occurrence of such a result. Damasceno et al. (2018) found similar results when evaluating the effect of adding passion fruit peel flour in the manufacture of sliced bread.

For the acceptance index (IC), it was found that the control treatment presented an acceptability among tasters similar to the treatment with 5% and higher than the treatments with 10 and 15% MHR, with the latter having the lowest scores. According to Teixeira et al.

(1987), for a product to be considered accepted in terms of sensory properties, an acceptability index of at least 70% must be obtained. Therefore, it can be observed that only treatments with 0% FCM and 5% FCM meet this parameter.

Figure 2 shows the order of preference of treatments by tasters. It was found that the 0% FCM treatment together with the 5% FCM treatment were the most preferred, presenting 41% and 35%, respectively. The 15% FCM treatment had a lower preference among tasters. These results demonstrate that passion fruit peel flour can be used in the manufacture of sliced bread, serving as a partial substitute for wheat flour.

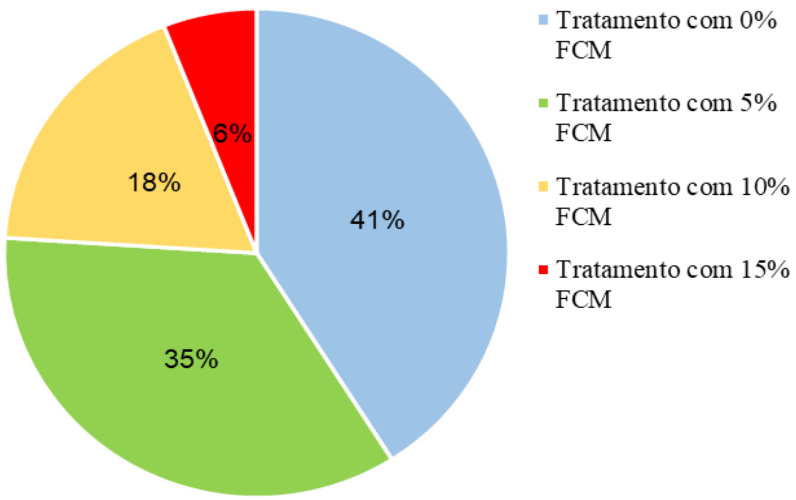

Figure 2. Order of preference of the tasters between the treatments sampled and breads with different concentrations of passion fruit peel flour.

CONCLUSIONS

The use of passion fruit peel flour as a partial replacement for wheat flour in the manufacture of sliced bread influenced the physicochemical properties and consumer acceptability, with the 0% FCM and 5% FCM treatments showing the highest levels of acceptance.

Microbiological analyses indicated that the treatments met the standards of Brazilian legislation.

Therefore, passion fruit peel flour has the potential to be used in the manufacture of sliced bread and can be used to replace wheat flour by up to 5%.

REFERENCES

Andrade BA, Perius DB, Mattos NV, Luvielmo MM, Mellado MS. Produção de farinha de banana verde (Musa spp.) para aplicação em pão de trigo integral. Braz. J. Food Technol, Campinas, 01 set 2017; 21. doi: org/10.1590/1981-6723.5516

Brasil. Ministério da Saúde. instrução normativa N°161, de 01° de julho de 2022. Estabelece os padrões microbiológicos dos alimentos e seus anexos"[internet]. Órgão emissor: ANVISA: Agência Nacional de Vigilância Sanitária. [acesso em 26 set 2023]. Disponível em: https://antigo.anvisa.gov.br/documents/10181/2718376/IN_161_2022_.pdf/b08d70cb-add6-47e3-a5d3-fa317c2d54b2

Brasil. Ministério da Saúde. Resolução - RDC N° 90, de 18 de outubro de 2000. Aprovar a "Fixação da identidade e as características mínimas de qualidade a que deve obedecer o pão"[internet]. Órgão emissor: ANVISA: Agência Nacional de Vigilância Sanitária. [acesso em 26 set 2023]. Disponível em: https://bvsms.saude.gov.br/bvs/saudelegis/anvisa/2000/rdc0090_18_10_2000.html.

Brasil. Instituto Brasileiro de Geografia e Estatística, Produção de Maracujá; 2022 [internet]. [acesso em 10 out 2023]. Disponível em: https://www.ibge.gov.br/explica/producao-agropecuaria/maracuja/br.

Catarino RPF, Seibel NF. Elaboração e caracterização de farinha de casca de maracujá para aplicação em biscoitos, Tópicos em Ciências e Tecnologia de Alimentos: Resultados de Pesquisas Acadêmicas - Vol. 3, , Volume , 2017, Pages 113 -140, ISSN , http://dx.doi.org/10.1016/9788580392722 -04

Cavichioli JC. Panorama da cultura do maracujá do Brasil. Informe Técnico; 2018.[acesso em 10 nov 2019]. Disponível em: https://www.cpac.embrapa.br/publico/usuarios/uploads/minicursomaracuja/informemaracuja.pdf

Costa AM. Maracujá: 500 perguntas 500 repostas. Embrapa Brasília, DF. 2016.

Damasceno CSB, Silva DN, Damasceno ER, Oliveira LF, Porto KRA, Candil RFM. Efeito da adição de farinha da casca de maracujá (Passiflora edulis) na aceitabilidade de pão. Visão Acadêmica, Curitiba, v.19, n.3, 2018. doi:10.5380/acd.v19i3.62298

Della Modesta RC. Manual de análise sensorial de alimentos e bebidas. EMBRAPA/CTAA, Rio de Janeiro, 1994.

Embrapa. Produção brasileira de maracujá. 2021 [acesso em 08 ago 2023]. Disponível em: http://www.cnpmf.embrapa.br/Base_de_Dados/index_pdf/dados/brasil/maracuja/b1_maracuja.pdf

Galeno GN, Rezende AJ. Avaliação Físico-Química de Bolos Produzidos com Diferentes Níveis de Farinha da Casca de Maracujá. Revista de Divulgação Científica Sena Aires, 2013; 2, n. 2, p. 25-29.

Ial – Instituto Adolfo Lutz. Métodos físico-químicos para análise de alimentos./coordenadores Odair Zenebon, Neus Sadocco Pascuet e Paulo Tiglea – São Paulo: Instituto Adolfo Lutz, 2008; p. 1020.

Ishimoto FY, Harada AI, Branco IG, Conceição WAS, Coutinho MR. Aproveitamento alternativo da casca do maracujá-amarelo (Passiflora edulis) para a produção de biscoitos. Revista Ciências Exatas e Naturais, 2007; 29, n° 2, p. 280-292..

Miranda AA, Caixeita ACA, Flávio EF, Pinho L. Desenvolvimento e análise de bolos enriquecidos com farinha da casca do maracujá (Passiflora edulis) como fonte de fibras. Alimentos e Nutrição = Brazilian Journal of Food and Nutrition, Araraquara, 2013; 24, n. 2, p. 225-232.

Moraes FF, Seravalli EAG. Utilização da farinha de casca de maracujá *(Passiflora edulis F. Flapicarpa*) na fabricação de pão de forma. Brazilian Journal of Food Technology. Campinas, (2017). V 18, n 4.

Ozores B, Storck CR, Fogaça AO. Aceitabilidade e características tecnológicas de bolo enriquecido com farinha de casca de maracujá. Ciência da Saúde, Santa Maria, 2015; 16, n. 1, p. 61-69.

Pita JSL. Caracterização Físico-Química e Nutricional da Polpa e Farinha da Casca de Maracujazeiros do Mato e Amarelo. 2012. Dissertação (Mestrado em Engenharia de Alimentos) – Universidade Estadual do Sudoeste da Bahia, Vitória da Conquista.

Santana FC, Silva JV, Santos AJAO, Alves AR, Wartha ERSA, Marcellini PS, Silva MAAP. Desenvolvimento de biscoito rico em fibras elaborado por substituição parcial da farinha de trigo por farinha de casca do maracujá amarelo (Passiflora edulis Flavicarpa) e fécula de mandioca (Manihot Esculenta Crantz. Alimentos e Nutrição = Brazilian Journal of Food and Nutrition, Araraquara, 2011; 22, n. 3, p. 391-399.

Santos MRLS, Almeida TM. Avaliação físico-química, microbiológica e sensorial de pães enriquecidos com farinha de banana verde com e sem casca.Científic@ Multidisciplinary Journal. 2020. v8, n.2, pg.1-11, ISSN: 2358-260X,. DOI: 10.29247/2358-260x.2020v7i2.4781.

Silva N, Junqueira VCA, Silveira NFA. Manual de métodos de análise microbiológica de alimentos. São Paulo: Varela, 1

997; p. 259.

Teixeira E, Meinert EM, Barbetta PA. Análise sensorial de alimentos. Florianópolis: Ed UFSC. 1987; p. 180.