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Potential of non-commercial parts of *Arracacia xanthorrhiza* Bancroft: Biscuit production

Potencial de partes não convencionais de Arracacia xanthorrhiza Bancroft: Produção de biscoitos

Luan Ramos da Silva[1]; *Rosimeire Pereira Gassi Jorge*[2]; *Elissandra Pacito Torales*[3]; *Maria do Carmo Vieira*[4]; *Néstor Antonio Heredia-Zárate*[5]; *Eliana Janet Sanjinez-Argandoña*[6]

[1]Mestre em Ciência e Tecnologia de Alimentos, Faculdade de Engenharia de Alimentos, Universidade Estadual de Campinas; Departamento de Engenharia Agrícola e Solos, Universidade Federal do Amazonas; luanramosea@gmail.com. [2]Doutora em Agronomia; Faculdade de Ciências Agrárias, Universidade Federal da Grande Dourados. [3]Doutora em Agronomia, Faculdade de Ciências Agrárias, Universidade Federal da Grande Dourados. [4]Doutora em Fitotecnia, Faculdade de Ciências Agrárias, Universidade Federal da Grande Dourados. [5]Doutor em Fitotecnia, Faculdade de Ciências Agrárias, Universidade Federal da Grande Dourados. [6]Doutora em Engenharia de Alimentos, Faculdade de Engenharia, Universidade Federal da Grande Dourados.

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A B S T R A C T

Some vegetables, such as *Arracacia xanthorrhiza*, present parts that are not commercialized. However, it still has a great composition that make it interesting to food industry. The flours production from vegetable waste are a great way to guarantee its use as a whole and decrease of waste of food in the World. Also, it can contribute on food products by adding nutrients and compounds important for human health. This study aimed to develop semi-sweet biscuits with crown and non-commercial roots of *A. xanthorrhiza* flour and the evaluation of its nutritional composition, physical characteristics and sensory profile. Biscuits were made in different concentration of cornmeal, flours of crowns and non-commercial roots of *A. xanthorrhiza*, according to centroid simplex experimental design, resulting in nine trials. The influence on nutritional, physical and sensory characteristics of the substitution of flours on the biscuits were analyzed. Results of the proximal composition of different formulations of biscuit were significantly different, except for lipids. Formulations with high percentage of flour of crown have presented darker color and has been liked by assessors on the sensory analyze, which could be associated with chocolate biscuits, due to the dark brown color. Semi-sweet biscuits with flour of crown and non-commercial roots of *A. xanthorrhiza* were satisfactory developed and showed a great nutritional composition, mainly on the minerals, fiber and carbohydrate content.

Palavras-chave:
Vegetais não convencionais
Subproduto
Produtos de panificação
Análise sensorial

R E S U M O

Algumas hortaliças, como a *Arracacia xanthorrhiza*, apresentam partes não comercializadas. Porém, ainda tem uma ótima composição que o torna interessante para a indústria alimentícia. A produção de farinhas a partir de resíduos vegetais é uma ótima forma de garantir seu uso como um todo e diminuir o desperdício de alimentos no mundo. Também, pode contribuir em produtos alimentícios ao adicionar nutrientes e compostos importantes para a saúde humana. Este estudo teve como objetivo o desenvolvimento de biscoitos semidoces com coroa e raízes não comerciais da farinha de *A. xanthorrhiza* e a avaliação de sua composição nutricional, características físicas e perfil sensorial. Os biscoitos foram confeccionados em diferentes concentrações de fubá, farinhas de coroas e raízes não comerciais de *A. xanthorrhiza*, segundo delineamento experimental centróide simplex, resultando em nove ensaios. Foi analisada a influência nas características nutricionais, físicas e sensoriais da substituição das farinhas nos biscoitos. Os resultados da composição proximal das diferentes formulações de biscoito foram significativamente diferentes, exceto para lipídios. Formulações com alto percentual de farinha de coroa apresentaram cor mais escura e têm sido apreciadas pelos avaliadores na análise sensorial, o que pode estar associado aos biscoitos de chocolate, devido à cor marrom escura. Biscoitos semidoces com farinha de coroa e raízes não comerciais de *A. xanthorrhiza* desenvolveram-se satisfatoriamente e apresentaram ótima composição nutricional, principalmente quanto ao teor de minerais, fibras e carboidratos.

INTRODUCTION

Perruvian carrot (*Arracacia xanthorrhiza* Bancroft) is an unconventional vegetable, native from the Andes region, also known as white carrot or arracacha. It consume in Mato Grosso do Sul (Brazil) is not common among the population, due to the lack of information about its nutritional properties and the expensive price, limiting its insertion on the diet of low income people (HEREDIA-ZÁRATE et al., 2008; HEREDIA-ZÁRATE et al., 2019; VITAMVAS et al., 2019; CHAALI et al., 2020; MONTAÑA et al., 2020). Consumers usually look for the commercial roots, due to its attractive appearance and the high content of minerals and vitamins. However, other morphological parts of this vegetable, such as non-commercial roots (roots with physical damage and/or mass less than 25.0 grams) or crown (transport and storage organ in the plants), have high content of essential nutrients for human diet and they are wasted by producers (TORALES et al., 2015).

Production of flour from waste of fruits and vegetables is an alternative form to utilize them as byproduct, due to the presence of important nutrients, as well as reduction of waste on the environment. Besides, it contributing with income to producers (FREITAS et al., 2015; KIRBAS et al., 2019; SANTOS; GONÇALVES, 2016; SILVA et al., 2018; SOQUETTA et al., 2016; SALLAM et al., 2021).

Flours could be inserted in the formulation of different types of food, like cereal bars, yogurt, bakery products and others (COSTA et al., 2014; CRISTO et al., 2015; DIAZ et al., 2019; FARINELLI et al., 2014; GARMUS et al., 2016; GASSI et al., 2016; HUERTA et al., 2016; SILVA et al., 2018; SILVA et al., 2016). The partial substitution may increase the nutritional characteristics without to cause injuries to the final quality of products (COSTA et al., 2014; MONTES et al., 2015; KUMAR et al., 2019; PATEL et al., 2019; SINTHUSAMRAN et al., 2019).

Among the range of bakery products, biscuits are considered the most popular, due to its practicality of consumption and its shelf life relatively long, based on the low moisture content (ADHIKARI; ACHARYA, 2015; PATEL et al., 2019).

Lima et al. (2015) on the development of biscuit from a flour of watermelon rind have obtained a product with a great sensory acceptance and an expressive content of minerals and dietary fibers. This indicates that the use of this flour is a viable alternative to the industry. Similarly, Mariani et al. (2015) indicated rice bran, rice flour and soy flour as ingredients in the production of gluten free biscuits with high content of minerals and proteins.

This study aimed to develop semi-sweet biscuits with crown and non-commercial roots of Peruvian carrot flour and the evaluation of its nutritional composition, physical characteristics and sensory profile.

MATERIAL AND METHODS

Raw Materials

Fresh samples of crowns (morphological component of the plant used as seedling) and non-commercial roots (roots with physical damage and/or mass less than 25.0 grams) were fractionated separately into pieces and dried for 72 hours at 60 ± 5°C in an oven with circulating air (1.0 m s^{-1} speed). The dried product was ground in a circular rotor macro mill with fixed and mobile knives, "CROTON" type (Marconi - MA-580), and sieved through mesh with holes of 1 mm diameter, to obtain a flour with homogeneous particle size. Flours of crowns and non-commercial roots were placed separately on flexible polyethylene bags and stored at 25°C, protected from light until use.

Basic formulation and manufacturing process of biscuits

The semi-sweet biscuit manufacturing used several ingredients: cornmeal and flours of crowns and non-commercial roots of Peruvian carrot, sugar, butter, eggs, cassava starch and water. The biscuits were semi-sweet, not fermented and round in shape (GASSI et al., 2016).

The standard formulation of semi-sweet biscuit is shown in Table 1. Biscuits made with substitution of cornmeal (CM) were prepared using flour of crowns (FC) or non-commercial roots (FNCR) of Peruvian carrot. The process of preparing biscuits originally consisted of mixing the butter with sugar and eggs until smooth. Subsequently, CM, FC or FNCR, cassava starch and water were added. Next, the dough was divided into small portions (13 g) and molded. The biscuits were baked in an oven at 180°C for 35 minutes. After baking, the biscuits were cooled to room temperature (25°C) and immediately packaged in polyethylene bags. The vials were sealed, stored in glass containers and stored from light at 25°C until further analyses.

Table 1. Standard formulation of semi-sweet biscuit.

Ingredients	Quantity (%)
Cornmeal	27.60
Sugar	13.60
Butter	13.60
Eggs	9.00
Cassava starch	30.10
Water	sq*

*sq: Sufficient quantity.

Experimental Design

To study the effect of cornmeal substitution for flours of crowns and non-commercial roots on biscuits formulation, a simplex centroid experimental design was performed (Table 2), with nine trials.

Physical and chemical properties of biscuits

The proximal composition of biscuits was determined by analyzing for moisture, mineral, proteins, lipids and fiber (AOAC, 2000). Moisture was determined by gravimetric method, heating 105ºC to constant weight. Mineral was obtained by sample calcination in muffle furnace at 550°C. Protein content was determined by the Kjeldahl method. The Soxhlet method was used for lipids. The fiber content was determined by material digestion with a solution of NaOH (1.25%) and H_2SO_4 (1.25%). Carbohydrate was quantified by acid hydrolysis method (CARVALHO et al., 2006). All analyses were carried out in triplicate.

Table 2. Centroid Simplex Experimental Design for formulating semi-sweet biscuits with cornmeal (CM) and flours of crowns (FC) and non-commercial roots (FNCR) of Peruvian carrot 'Amarela de Carandaí' (*Arracacia xanthorrhiza* Bancroft).

Formulations	Flour (%)		
	CM	FC	FNCR
1	0	100	0
2	100	0	0
3	0	0	100
4	50	50	0
5	0	50	50
6	50	0	50
7	33	33	33
8	33	33	33
9	33	33	33

The energetic value of biscuits was calculated by multiplying the total percentages of lipids, proteins and carbohydrates in each sample, using the conversion factors of Atwater, namely: 9 kcal, 4 kcal and 4 kcal, respectively. Specific volume of biscuits was measured by millet seed method, and results showed as cm^3/g.

The texture of biscuits of each formulation was determined by measuring the shear strength (hardness) in texturometer TA - HDi (Stable Micro Systems, Godalming, UK) with TA 9/1000 rectangular steel blade HDP/LKB, operating under the following conditions: measure of strength at break, pre-test speed of 10.0 mm.s-1, 3 $mm.s^{-1}$ test and 10 $mm.s^{-1}$ post-test, 30 mm distance, depth penetration of 20 mm between the support base and the blade and 0.1 kg strength. The biscuit was placed horizontally on a support platform and sliced in half by the blade. Measurements were determined in six biscuits of each formulation.

The color of the biscuits was assessed in twelve random units of each sample unit in the digital colorimeter (Konica Minolta, Model CR400) at 25°C, adopting the CIELAB system. The values of L* lightness or brightness (black 0 / white 100), a* (green - / red +) and b* (blue - / yellow +) were measured. The parameters evaluated were Chromaticity (C*) obtained by Eq (1), shade (h*) representing the colors red (0°), yellow (90°), green (180°) and blue (270°) calculated by Equation (2), and color variation (ΔE), given by equation (3), where a_1^*, b_1^* and L_1^* refer to the values of the standard formulation, and a_2^*, b_2^* and L_2^* refer to other formulations.

$$C^* = \sqrt{a^{*2} + b^{*2}} \quad (1)$$

$$h^* = \arctan \frac{b^*}{a^*} \quad (2)$$

$$\Delta E = \sqrt{(a_2^* - a_1^*) + (b_2^* - b_1^*) + (L_2^* - L_1^*)} \quad (3)$$

Sensory analysis

Sensory analysis was carried out using a structured 9-point hedonic scale ranging from "disliked" to "liked" (color, texture, taste and overall acceptability). 120 untrained assessors were selected at random, all healthy adults (age between 18 and 50 years old) of any gender.

Samples were coded using 3-digit random numbers and served monadically in random order to assessors in individual booths. The test was carried out in two steps: In the first step, the assessors evaluated five formulations of biscuits (formulations F1, F3, F5, F7 and F8); In the second step, other four formulations were presented for evaluation (formulations F2, F4, F6 and F9).

Statistical analysis

Results were expressed by the mean value of triplicates and submitted to analysis of variance (ANOVA), and mean values compared by Tukey test ($p<0.05$), with STATISTICA 7.0.

RESULTS AND DISCUSSION

Results of the proximal composition of different formulations of biscuit were significantly different ($p<0.05$), except for lipids (Table 3). The biscuits have shown moisture content between 4.36% and 8.57%, which is into the Brazilian legislation, which recommend a maximum moisture content of 14% (BRAZIL, 1978).

Table 3. Proximal composition of semi-sweet biscuits with cornmeal (CM) and flours of crowns (FC) and non-commercial roots (FNCR) of Peruvian carrot 'Amarela de Carandaí' (*Arracacia xanthorrhiza* Bancroft).

Formulations	Moisture (mass %)	Minerals (mass %)	Proteins (mass %)	Lipids (mass %)	Carbohydrate (mass %)
100% FC	6.02±0.02^{c}	1.26±0.68^{b}	6.27±0.31^{ab}	15.56±0.18^{a}	73.41±2.00^{b}
100% CM	6.20±0.05^{c}	0.32±0.01^{c}	4.87±0.73^{bd}	13.03±0.78^{a}	79.48±1.48^{a}
100% FNCR	6.85±0.11^{b}	0.94±0.16^{bc}	3.52±0.38^{d}	13.19±1.68^{a}	77.21±1.31^{ab}
50% CM + 50% FC	5.65±0.07^{d}	0.35±0.04^{c}	6.44±0.72^{abc}	15.30±1.06^{a}	79.53±1.87^{a}
50% FC + 50% FNCR	6.02±0.09^{c}	2.11±0.08^{a}	4.50±0.65^{cd}	14.83±0.88^{a}	50.23±1.19^{d}
50% CM + 50% FNCR	4.36±0.05^{e}	1.07±0.13^{bc}	6.73±0.20^{a}	14.62±1.97^{a}	49.57±1.68^{d}
33% CM + 33% FC +33% FNCR	8.47±0.19^{a}	1.36±0.27^{ab}	3.46±0.24^{d}	15.06±2.14^{a}	55.03±0.68^{c}
33% CM + 33% FC + 33%FNCR	8.57±0.01^{a}	1.06±0.41^{bc}	3.44±0.38^{d}	11.39±0.66^{a}	53.11±1.68^{cd}
33% CM + 33% FC + 33%FNCR	8.44±0.05^{a}	1.00±0.08^{bc}	4.04±0.92^{cd}	11.61±2.48^{a}	55.83±1.18^{c}

Means followed by the same letter in the columns do not differ statistically by Tukey test, at 5% of probability. FC: Flour of crowns; CM: Cornmeal; FNCR: Flour of non-commercial roots.

Biscuits made with 50% FC and 50% FNCR presented the highest percentage of minerals (2.11%), as shown in Table 3. It represents an increase greater than 500% from the standard formulation (100% CM). Formulations with partial substitution of cornmeal are significantly different ($p<0.05$) among them for this parameter. Formulations with 50% CM + 50% FC and 50% CM + 50% FCNR have shown protein content higher than the standard formulation (100% CM), indicating that mixing flours with cornmeal in the development of biscuits can improve the nutritional value of them.

Table 4. Fiber content, energetic value and specific volume of semi-sweet biscuits with cornmeal (CM) and flours of crowns (FC) and non-commercial roots (FNCR) of Peruvian carrot 'Amarela de Carandaí' (*Arracacia xanthorrhiza* Bancroft).

Formulations	Energetic Value (kcal/100g)	Fibers (mass %)	Specific Volume (cm^3/g)
100% FC	455.40±4.46[b]	2.27±0.55[a]	0.93±0.12[dc]
100% CM	453.13±1.42[b]	0.86±0.28[bc]	0.78±0.13[c]
100% FNCR	447.04±6.50[b]	0.07±0.01[d]	0.90±0.04[c]
50% CM + 50% FC	480.24±5.20[a]	0.88±0.12[bc]	1.29±0.06[a]
50% FC + 50% FNCR	337.04±3.75[e]	1.18±0.22[b]	1.05±0.06[bd]
50% CM + 50% FNCR	357.50±0.04[c]	0.37±0.01[cd]	1.15±0.08[ab]
33% CM + 33% FC + 33% FNCR	351.39±2.50[cd]	0.86±0.04[bc]	1.17±0.07[ab]
33% CM + 33% FC + 33% FNCR	347.06±1.51[cde]	1.09±0.46[bc]	1.20±0.05[ab]
33% CM + 33% FC + 33% FNCR	345.99±2.56[de]	0.95±0.07[bc]	1.18±0.04[ab]

Means followed by the same letter in the columns do not differ statistically by Tukey test, at 5% of probability. FC: Flour of crowns; CM: Cornmeal; FNCR: Flour of non-commercial roots.

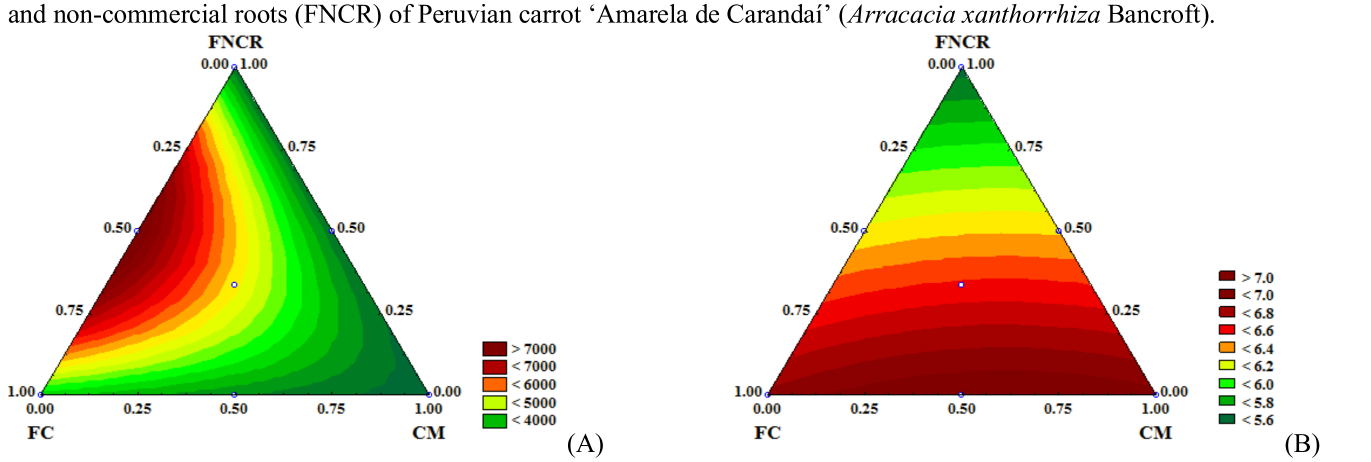
The development of biscuits from cornmeal or flour of non-commercial parts of Peruvian carrot results in a product with great content of carbohydrate, as shown in Table 3, for 100% FC, 100% CM and 100% FNCR, even though the formulation with 100% FC is significantly different of standard formulation. In contrast, a blend of flours decreased the percentage of carbohydrate, collaborating on the reduction of energetic value (Table 4). The total substitution of cornmeal to flour of crown and flour of non-commercial roots of Peruvian carrot have reduced the energetic value of biscuits from 453.13 kcal/100 g in the standard formulation to 337.04 kcal/100 g in that formulation (Table 4).

Regarding the fiber content, biscuits made only with FNCR shown the lowest content (0.07%), and the highest value (2.27%) was found on those made only with FC (Table 4). The percentage of fibers on the flours (2.67% in FNCR and 4.71% in FC) have influenced significantly the results for this parameter on the final product.

Specific volume of biscuits was increased by the addition of flour of crown and flours of non-commercial roots of Peruvian carrot, as shown in Table 4. This property was influenced by any factors, such as quality of ingredients used on the dough, especially flours or conditions of the process (MOURA et al., 2010). Bick et al. (2014) and Lima et al. (2015) on the development of biscuits with quinoa flour and watermelon flour, respectively, obtained higher values of specific volume on their products, compared with those made in this work.

Texture was significantly influenced by the substitution of cornmeal for flour of crown and non-commercial roots of Peruvian carrot on biscuits, as presented in Figure 1. Hardness of biscuits increased proportionally with the percentage of FC and FNCR on the formulations (Figure 1A). This parameter resulted of the maximum force applied on the product to cause its deformation, and it can be influenced by the ingredients, time of baking, chemical composition or other processing conditions. As shown in Table 3 and 4, the biscuits had low moisture content and high content of fibers, particularly for formulations with FC. Hence, high percentage of flour of non-commercial parts of Peruvian carrot resulted in a harder product.

Figure 1. Contour curve of hardness (A), sensory texture (B) of semi-sweet biscuits with cornmeal (CM) and flours of crowns (FC) and non-commercial roots (FNCR) of Peruvian carrot 'Amarela de Carandaí' (*Arracacia xanthorrhiza* Bancroft).

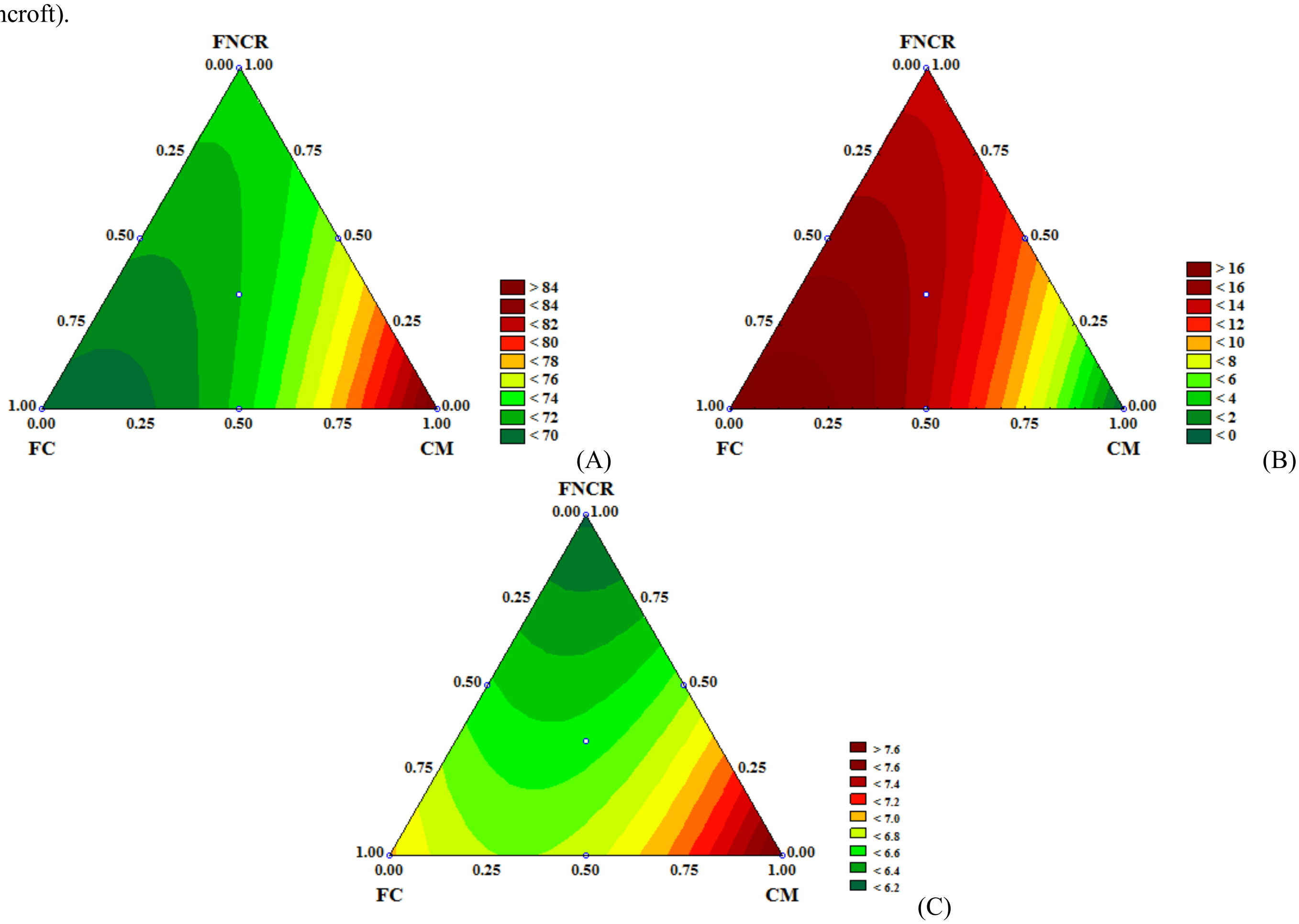


Assessors observed on the sensory analyses the difference in the texture of biscuits, and they preferred the softer formulations (Figure 1B). However, the central point formulations (33% CM + 33% FC + 33% FNCR) presented values around 6 in the sensory analysis, which means “I liked slightly” on the hedonic scale. Silva et al. (2015) on the sensory analyses of cookies replacing hydrogen fat by avocado fat obtained greater results for softer biscuits by assessors, corroborating with this work.

In addition, color parameters of semi-sweet biscuits have been influenced by the use of flours (Figure 2). Replacement of cornmeal to flour of crown reduce the lightness (L*) of biscuits (Figure 2A), resulting in darker products. It is shown in Figure 2B the color variation (ΔE) of all formulations, and the high variation was observed specially with the addition of FC, due to the high initial content of fibers of this flour, which is not observed in FNCR and CM. A color variation was also observed on biscuits with FNCR in the formulation, comparing with standard formulation, but it was lower than biscuits with FC.

Assessors on the sensory analyses (Figure 2C) preferred biscuits made with high percentage of cornmeal. In contrast, they also liked the darker formulations (with FC), giving values of 6 (I liked slightly) and up on the hedonic scale. Assessors could associate the darker color of biscuits with chocolate, as the formulations with high content of FC were dark brown. Biscuits formulated with 8% of amaranth flour, 17% of Jerusalem artichoke flour and 75% of wheat flour exhibited the higher rate of acceptance between the tested formulations, and it may be considered a healthier alternative, with lower energy content than traditional wheat flour-based biscuits (DÍAZ et al., 2019).

Figure 2. Contour curve of lightness (A), color variation (B) and sensory color (C) of semi-sweet biscuits with cornmeal (CM) and flours of crowns (FC) and non-commercial roots (FNCR) of Peruvian carrot ‘Amarela de Carandaí’ (*Arracacia xanthorrhiza* Bancroft).



CONCLUSION

Semi-sweet biscuits with flour of crown and non-commercial roots of Peruvian carrot were satisfactory developed and showed a great nutritional composition, mainly on the minerals, fiber and carbohydrate content. The increase on flour of crown resulted in harder and darker biscuits, due to its fibers content. Based on parameters of color and texture resulted from sensory analyses, the formulation with 33% cornmeal + 33% flour of crown + 33% flour of non-commercial roots is recommended.

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REFERENCES

ADHIKARI, N.; ACHARYA, D. R. Effect of incorporation of malted sorghum flour on quality of biscuit. Sunsari Technical College Journal, 2: 33-37, 2015. 10.3126/stcj.v2i1.14796

AOAC, ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS. Official methods of analysis of International (AOAC). 12th. ed. Washington, DC. (2000).

BICK, M. A.; FOGAÇA A. O.; STORCK C. R. Biscoitos com diferentes concentrações de farinha de quinoa em substituição parcial à farinha de trigo. Brazilian Journal of Food Technology, 17: 121-129, 2014. 10.1590/bjft.2014.015

BRAZIL. Ministério da Saúde. Agência Nacional de Vigilância Sanitária. RDC n. 12, de 1978. Comissão Nacional de Normas e Padrões de Alimentos – CNNPA/ANVISA – Agência Nacional de Vigilância Sanitária. Normas técnicas especiais. (1978). Retrieved from: http://www.anvisa.gov.br/legis/resol/12_78.pdf. Accessed in 12/02/2021.

CARVALHO, G. G.; FERNANDES, F. E. P.; AURELIANO, J. V.; PIRES, A. J. V. Métodos de determinação de amido e pectina em alimentos para animais. Revista Electrónica de Veterinaria, 7: 1-12, 2006.

CHAALI, N.; OUAZAA, S.; JARAMILLO-BARRIOS, C. I.; CARRILLO, G. A. A.; PEDRAZA, E. Á. Á. Edaphoclimatic characterization and crop water requirement of Arracacha (*Arracacia xanthorrhiza* Bancroft) roots in upland production áreas. Scientia Horticulturae, 272: 109533, 2020. 10.1016/j.scienta.2020.109533

COSTA, J. D.; OLIVEIRA, M. A. O.; MEDEIROS K. C.; ARAÚJO, A. S. Elaboração e caracterização de cookie com adição de farinha do mesocarpo do fruto do marizeiro (*Geoffroea spinosa*). Revista Verde de Agroecologia e Desenvolvimento Sustentável, 9: 36-39, 2014.

CRISTO, T. W.; RODRIGUES B. M.; SANTOS, N. M.; CANDIDO, C. J.; SANTOS, E. F.; NOVELO, D. Barras de cereais com adição de farinha de casca de chuchu: caracterização físico-química e sensorial entre crianças. Semina. Ciências Biológias e da Saúde, 36: 85-96, 2015. 10.5433/1679-0367.2015v36n2p85

DÍAZ, A.; BOMBEN, R.; DINI, C.; VIÑA, S. Z., GARCÍA, M. A., PONZI, M., COMELLI, N. Jerusalem artichoke tuber flour as a wheat flour substitute for biscuit elaboration. LWT-Food Science and Technology, 108: 361-369, 2019. 10.1016/j.lwt.2019.03.082

FARINELLI, B. C. F.; HONORATO C. A.; AGOSTINI, J. S.; BIN, M. C. Elaboração, análise sensorial e características físico-químicas do biscoito doce de casca de banana. Ensaios e Ciências: Ciências Biológicas, Agrárias e da Saúde, 18: 77-82, 2014. 10.17921/1415-6938.2014v18n2p%25p

FREITAS, E. C.; BARRETO, E. S.; BARROS, H. E. A.; SILVA, A. C. M.; SILVA, M. V. Processamento e caracterização físico-química de farinhas de resíduos de polpas de frutas congeladas da *Theobroma grandiflorum* e *Fragaria vesca*. Revista Brasileira de Produtos Agroindustriais, 17: 425-432 2015.

GARMUS, T. T.; BEZERRA, J. R. M. V.; RIGO, M.; CÓRDOVA, K. R. V. Avaliação sensorial e físico-química de iogurte enriquecido com farinha de linhaça. Ambiência, 12: 251-258, 2016. 10.5935/ambiencia.2016.01.15

GASSI, R. P.; SILVA, L. R.; HEREDIA-ZÁRATE, N. A.; SANJINEZ-ARGANDOÑA, E. J.; TORALES, E. P.; VIEIRA, M. C. Substitution of cornmeal for flour of shoots and non-commercial roots of arracacha (*Arracaria xanthorrhiza* Bancroft.) in the processing of semisweet biscuits. Boletim do Centro de Pesquisa e Processamento de Alimentos, 34: 111-122, 2016. 10.5380/cep.v34i1.48990

HEREDIA-ZÁRATE, N. A.; SCHWAN-ESTRADA, K. R. F.; VIEIRA, M. C.; VIEIRA, S. C. H.; TORALES, E. P.; GRACIANO, J. D. Desinfecção de mudas e do solo com óleo de eucalipto na produção de mandioquinha-salsa. Revista de la Facultad de Agronomía, 118(1): 19-23, 2019. 10.24215/16699513e002

HEREDIA-ZÁRATE, N. A.; VIEIRA, M. C.; RECH, J.; QUAST, A.; PONTIM, B. C. A.; GASSI, R. P. Yield and gross income of arracacha in monocrop and intercropping with the Japanese bunching onion and parsley. Horticultura Brasileira, 26: 277-281, 2008.

HUERTA, K. M.; ALVES, J. S.; SILVA, A. F. C.; KUBOTA, E. H.; ROSA, C. S. Sensory response and physical characteristics of gluten-free and gum-free bread with chia flour. Food Science and Technology, 36: 15-18, 2016. 10.1590/1678-457X.0032

KIRBAS, Z.; KUMCUOGLU, S.; TAVMAN, S. Effect of apple, orange and carrot pomace powders on gluten-free batter rheology and cake properties. Journal of Food Science and Technology, 56(2): 914-926, 2019. 10.1007/s13197-018-03554-z

KUMAR, A.; ELAVARASAN, K.; HANJABAM, M. D.; BINSI, P. K.; MOHAN, C. O.; ZYNUDHEEN, A. A.; KUMAR, A. Marine collagen peptide as a fortificant for biscuit: Effects on biscuit attributes. LWT: Food Science and Technology, 109: 450-456, 2019. 10.1016/j.lwt.2019.04.052

LIMA, J. P.; PORTELA, J. V. F.; MARQUES, L.; ALCÂNTARA, A. M.; EL-AOUAR, Â. A. Farinha de entrecasca de melancia em biscoitos sem glúten. Ciência Rural, 45: 1688-1694, 2015. 10.1590/0103-8478cr20130209

MARIANI, M.; OLIVEIRA, V. R.; FACCIN, R.; RIOS, A. O.; VENZKE, J. G. Elaboração e avaliação de biscoitos sem glúten a partir de farelo de arroz e farinhas de arroz e de soja. Brazilian Journal of Food Technology, 18: 70-78, 2015. 10.1590/1981-6723.6514

MONTAÑA, J. P. G.; RODRÍGUEZ, O. J. R.; JARAMILLO-BARRIOS, C. I.; CABRERA, F. A. V. Diversidad morfológica y caracteres de selección del germoplasma de arracacha (*Arracacia xanthorrhiza* Bancr.) en Colombia. Ciencia y Agricultura. 17(3):49-62, 2020. 10.19053/01228420.v17.n3.2020.11150

MONTES, S. S.; RODRIGUES, L. M.; CARDOSO, R. C. V.; CAMILLOTO, G. P.; CRUZ, R. S. Tapioca and rice flour cookies: technological, nutritional and sensory properties. Ciência e Agrotecnologia, 39: 514-522, 2015. 10.1590/S1413-70542015000500010

MOURA, F. A.; SPIER, F.; ZAVAREZE, E. R.; DIAS, A. R. G.; ELIAS, M. C. Biscoitos tipo cookie elaborados com diferentes frações de semente de abóbora (*Curcubita maxima*). Alimentos e Nutrição, 21: 579-585, 2010.

PATEL, A. S.; KAR, A.; PRADHAN, R. C.; MOHAPATRA, D.; NAYAKE, B. Effect of baking temperatures on the proximate composition, amino acids and protein quality of de-oiled bottle gourd (*Lagenaria siceraria*) seed cake fortified biscuit. LWT - Food Science and Technology, 106: 247-253, 2019. 10.1016/j.lwt.2019.02.026

SALLAM, Y. I.; EL-SALAM, E. A., ABAZA, A. G. Green pea waste flour as a wheat flour partial replacer in pound cake: bater rheology behavior and cake quality properties. Acta Scientiarum Polonorum, Technologia Alimentaria. 20 (1): 67-78, 2021. 10.17306/J.AFS.2021.0838

SANTOS, M. C. P.; GONÇALVES, É. C. B. A. Effect of different extracting solvents on antioxidant activity and phenolic compounds of a fruit and vegetable residue flour. Scientia Agropecuaria, 7: 7-14, 2016. 10.17268/sci.agropecu.2016.01.01

SILVA, E. P.; SIQUEIRA, H. H.; DAMIANI, C.; VILLAS-BOAS, E. V. B. Effecting of adding flours from marolo fruit (*Annona crassiflora* Mart) and jerivá fruit (*Syagrus romanzoffiana* Cham Glassm) on the physicals and sensory characteristics of food bars. Food Science and Technology, 36: 140-144, 2016. 10.1590/1678-457X.0074

SILVA, L. R.; FERRAZ, M.; FAKHOURI, F. M. Vegetable waste as a raw material for flour: Nutritional values and its applications. In: Pérez, M. D. T. (Ed.), Flour: Production, varieties and nutrition. New York, USA: Nova Science Publishers, 2018, p. 315-331.

SILVA, M. F.; LOURENCETTU, R. E.; MARCHI, L. B.; MARQUES, D. R.; CHINELLATO, M. M.; SANTOS JUNIOR, O. O.; MONTEIRO, A. R. G. Desenvolvimento e caracterização de biscoito recheado de chocolate com substituição parcial da gordura hidrogenada por polpa de abacate. Revista Tecnológica – Edição especial 2014: 327-335, 2015.

SINTHUSAMRAN, S.; BENJAKUL, S.; KIJROONGROJANA, K.; PRODPRAN, T. Chemical, physical, rheological and sensory properties of biscuit fortified with protein hydrolysate from cephalothorax of Pacific white shrimp. Journal of Food Science and Technology, 56(3): 1145-1154, 2019. 10.1007/s13197-019-03575-2

SOQUETTA, M. B.; STEFANELLO, F. S.; HUERTA, K. M.; MONTEIRO, S. S.; ROSA, C. S.; TERRA, N. N. Characterization of physiochemical and microbiological properties, and bioactive compounds, of flour made from the skin and bagasse of kiwi fruit (*Actinidia deliciosa*). Food Chemistry, 199: 471-478, 2016. 10.1016/j.foodchem.2015.12.022

TORALES, E. P.; HEREDIA-ZÁRATE, N. A.; VIEIRA, M. C.; HEID, D. M.; MORENO, L. B.; GRANDO, V. R. Produtividade da mandioquinha-salsa em resposta aos espaçamentos entre plantas e peso de mudas. Bioscience Journal, 31: 433-444, 2015.

VITAMVAS, J.; VIEHMANNOVA, I.; CAPKOVA, P. H.; MRHALOVA, H.; ELIASOVA, K. Assessment of somaclonal variation in indirect morphogenesis-derived plants of *Arracacia xanthorrhiza*. Pesquisa Agropecuária Brasileira, 54: e00301, 2019. 10.1590/S1678-3921.pab2019.v54.00301