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Sensory evaluation of gluten-free chicken pasty made with cassava (*Manihot esculenta* Crantz)

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Abstract

Celiac disease is a condition in which genetically predisposed people have an autoimmune reaction to gluten proteins found mainly in wheat. Celiac disease patients have few and expensive options of gluten-free food products. The aim of this study was to produce a gluten-free alternative to the wheat chicken pasty, a food largely consumed in South American countries. The main ingredient used for the elaboration of gluten-free pasty was cassava, a cheap and quite available raw ingredient, which after cooked results in a soft mass. This product was compared to the traditional wheat version by means of a sensory analysis, considering general aspects, consistency, flavor and aroma, and also a comparison of the production costs of the two products. General aspects, flavor and aroma did not differ significantly between the two products. Consistency was the only characteristic that differed significantly between them, the evaluation being more favorable to the cassava pasty. These results validate the gluten-free product regarding its

sensory acceptability. The cost of production of the gluten-free product was lower than that of the traditional one. This product can be a cheap and attractive alternative for celiac disease patients.
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Introduction

Adverse reactions to foods can be broadly divided into those with an immune basis – food allergies and celiac disease, or those without an immune basis – termed food intolerances (Turnbull et al., 2014). These diseases may impose the adoption of different eating habits by those who have these genetic predispositions. These habits generally include food restrictions that are difficult to adopt due to the scarcity of food products that are restrictive in one or more components and at the same time appetizing.

Celiac disease is a condition in which genetically predisposed people have an autoimmune reaction to gluten proteins found in all wheat types and closely related cereals such as barley and rye. This reaction causes the formation of autoantibodies and the destruction of the villi in the small intestine, which results in malabsorption of nutrients and other gluten-induced autoimmune diseases (Ciacci et al., 2007). Although considerable scientific progress has been made in understanding celiac disease and in preventing or curing its manifestations, a strict gluten-free diet is the only treatment for celiac disease to date (Niewinski, 2008). However, a lot of other vegetable and animal foods such as fish, poultry and meats, as well as fruits and vegetables, are permitted and rice, corn and potatoes have been widely used as substitutes for gluten-containing grains (Saturni et al., 2010).

In this study, a new gluten-free product has been created, using cassava (*Manihot esculenta* Crantz) in its composition as an alternative to wheat. The product, a chicken pasty, is a food created in Bolivia and typically consumed in all the countries of South America. Cassava is one of the most important sources of commercial production of starch in tropical and subtropical countries, with 73.7 to 84.9% of starch in its dry root weight (Sánchez et al., 2009). The sensory profile and production cost of the product was compared to that of its wheat counterpart.

Material and Methods

The main raw ingredient used for the making of gluten-free pasty was the flesh of yellow cassava. Whole cassava was purchased at the Porto Velho street market. The other ingredients were purchased in local supermarkets. The products were taken to the Laboratory of Dietary Practices of the University Center São Lucas - UniSL, where the pasties were made.

For the production of the doughs and filling, the dry ingredients were weighed on a scale (Tomate® SF400) with graduation 0.1 g and the liquid ingredients were measured in graduated beakers.
The filling used in the two kinds of pasty was the same (Table 1). To make the filling, chicken breast was cooked with garlic, salt, colorific (Kitano® - cornmeal, salt, seeds of *Bixa orellana* and vegetable oil), oil

and water in a pressure cooker for 30 minutes (Table 1). After the pressure cooker cooled completely, it was opened and the chicken breast was shredded. The broth was reserved. The shredded chicken was placed in a pan along with the broth, onions, bell peppers, potatoes, carrots, chives, dehydrated parsley, green olives, raisin and cumin powder cut into small pieces. This sauce was cooked for 20 minutes. Corn starch was added to give consistency to the sauce, which was cooked for more five minutes. The sauce was put in a glass container that was placed to cool in a domestic refrigerator at 12°C for two hours.

Table 1. Ingredients of the filling of both pasties with and without gluten, for the preparation of 1,000 grams of chicken pasty.

Ingredient	**Weight (g)**	**Ingredient**	**Weight (g)**
Chicken breast	217.83	Dehydrated parsley	0.59
Water	23.78	Corn starch	2.97
Onion	30.91	Green olives	16.64
Potato	29.72	Raisin	9.51
Carrot	27.34	Salt	2.97
Bell pepper	17.24	Cumin powder	1.04
Garlic	7.43	Colorific	0.59
Chives	7.43	Oil	4.60

For the preparation of the cassava dough, the root was peeled, cut into cylindrical pieces of approximately 5 cm in diameter x 5 cm in length and cooked together with salt, garlic and saffron (Table 2) in an ordinary pan on a domestic stove for 30 minutes to obtain the texture to be kneaded. After cooling, xanthan gum was added. Oil and colorific were heated in a frying pan. This mixture was added to the cassava, which was kneaded until it did not stick to the hands. This dough was wrapped in PVC film and kept in a refrigerator at 12°C for two hours. Subsequently dough balls of 25 g were flattened by using a rolling pin into disks on which 10 g of filling were placed. Then the pastries were folded into a semi-circle and the edges were pressed together. The pasties were placed on greased baking sheets (floured with corn starch), brushed with egg yolk and baked in an electric combination oven by using dry (convection) heat at 160°C for 25 minutes.

For the preparation of the traditional dough, wheat flour, water, salt, sugar, margarine, colorific, eggs, garlic, saffron and biological yeast were mixed and kneaded until it did not stick to the hands (Table 2). This dough was wrapped in PVC film and kept in a refrigerator at 12°C for 30 minutes. Subsequently dough balls of 25 g were flattened by using a rolling pin into disks on which 10 g of filling were placed. Then the pastries were folded into a semi-circle and the edges were pressed together. The pasties were placed on greased baking sheets (floured with wheat flour), brushed with egg yolk and baked in an electric combination oven by using dry (convection) and moist (steam) heat at 160°C for 25 minutes.

Table 2. Ingredients of the dough of pasties with and without gluten, for the preparation of 1,000 grams of chicken pasty.

Ingredient	Traditional pasty (g)	Gluten-free pasty (g)
Cassava	-	921.32
Wheat flour	505.24	-
Margarine	188.88	-
Water	163.46	-
Eggs	29.72	-
Sugar	16.35	-
Salt	7.43	7.43
Oil	-	5.94
Biological yeast	2,97	-
Garlic	1.19	1.19
Colorific	1.19	1.19
Saffron	1.19	1.19
Xanthan	-	0.36

The gluten-free and traditional chicken pasties were evaluated sensorially in the Laboratory of Sensory Analysis of the Nutrition course of the University Center São Lucas (UniSL). The 78 participants in the study were students, teachers and employees of the institution. They were male and female, non-trained, non-celiac disease patients, aged 18 to 60 years old, who regularly consumed chicken pasties. The evaluation was in the afternoon, which is the usual time of consumption of this product. Prior to the test, the evaluators were given instructions about the general procedures.

Two samples weighing approximately 30 g were presented to each evaluator in disposable dishes identified with random numerals using the methodology described by Dutcosky (2013) and served at 47°C±1°C (IAL, 2008). Mineral water was offered to cleanse the palate. The evaluators attributed rates according to a hedonic scale of seven points, ranging from 1 - extremely disliked to 7 - extremely liked, regarding the attributes - general aspect, consistency, aroma and flavor (Minim, 2006). The results obtained in the sensory evaluation were submitted to analysis of variance and the averages compared by Tukey test (5%), by using the Assistat 7.5 statistical program. This research was approved by the Permanent Research Ethics Committee of the University Center São Lucas - UniSL (CAAE: 34041314.4.0000.0013). All participants in the study were informed about the procedures and voluntarily participated in the study, signing a Term of Free and Informed Consent.

Additionally, the final production costs of each product were estimated, by a price survey of each ingredient at the local markets and supermarkets.

Results and Discussion

In Table 3 are presented the average rates obtained at the sensorial analysis of the traditional wheat pasty and the cassava gluten-free product. General aspect, flavor and aroma did not differ significantly between the two products. Consistency was the only characteristic that differed significantly between them, being more favorable to the cassava pasty. These results validate the gluten-free product regarding its sensory acceptability.

Table 3. Sensory evaluation of traditional wheat pasty and gluten-free cassava pasty.

Sensory characteristics	Traditional	Gluten-free
General aspect	5.44 a	5.09 a
Consistency	4.23 b	5.03 a
Flavor	5.36 a	5.33 a
Aroma	5.19 a	5.27 a

*Averages followed by the same letter in the rows do not differ significantly at 5% probability by Tukey's test.

The consistency of the gluten-free product had a higher rate than that of the traditional one. It is important to note that the dough of pasties function as an envelope and does not need to be so aerated as in a bread, for example. This can explain the good acceptability of the consistency of the cassava product. This is in agreement with the study of Fiorda et al. (2013), who achieved a pasta with good texture, adequate firmness and not very sticky, by using a pre-gelatinized flour made from cassava starch and dehydrated cassava bagasse (70:30), cassava starch and amaranth flour (10:60:30). Opposite results have been found by researchers working with bread, for instance, in which the aeration of the dough is essential. Pasqualone et al. (2010) compared wheat bread to cassava bread and found that the inability of cassava dough to retain CO_2 and consequent lack of an alveolate structure leads to an unappealingly stiff consistency. Defloor et al. (1991) enhanced the air uptake in cassava bread supplementing the batter by incorporating extruded starch and glyceryl monostearate in the formula.

The flavor and aroma of the cassava pasty was well evaluated, in agreement with the study of Pasqualone et al. (2010), who found a sensory perception of the typical cassava odor in cassava bread tending to be more sweet than bitter and pungent. The authors mentioned that the addition of olive oil or egg in the mixture can reduce the distinctive cassava odor. In general, the aroma of cassava has good acceptability in food preparations, except when it is fermented and can confer an objectionable odor to the mass, as mentioned by Ohochuku & Ballantine (1983).

In the present study, the gluten-free product was less expensive than the traditional one - the cost of the gluten-free pasty is US$2.00/kg, and that of the traditional pasty is US$2.46/kg. This is of great significance, for in general gluten-free products are much more expensive than their traditional counterparts. Stevens (2008) made a comparison between costs of 56 gluten-free products and their reciprocal regular foods, and found that all the labelled gluten-free were significantly more expensive (on average 242%) than the regular ones. This may impact on compliance to a gluten-free diet, with potential

nutritional and clinical consequences, together with an increased risk of complications (Singh & Whelan, 2011).

Another relevant aspect is the availability of raw material for gluten-free products. As mentioned by Alvarez-Jubete et al. (2010), several gluten-free sources exist, such as the pseudocereals amaranth, quinoa and buckwheat, but they are difficult to obtain, limiting the options for celiac disease patients. On the contrary, cassava is the main source of carbohydrates in developing countries (Alves et al., 2008) and, in Brazil, it is cultivated in all states, is the ninth product of the country in terms of cultivated area and the sixth in terms of value of production (Ceni et al., 2009). Besides, according to Montagnac et al. (2009), because cassava is drought-tolerant and its mature roots can maintain their nutritional value for a long time without water, it may represent the future of food security in some developing countries.

Conclusion

A new gluten-free food product was produced and validated regarding its sensory acceptability in comparison to its counterpart – a wheat chicken pasty largely consumed in South American countries. The basis of the new product is cassava, an inexpensive and quite available ingredient. This product can be a frugal and attractive alternative for celiac disease patients.

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