Journal of Food and Nutrition Research, 2016, Vol. 4, No. 2, 82-87
Available online at http://pubs.sciepub.com/jfnr/4/2/3
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DOI:10.12691/jfnr-4-2-3

Preparation of Gluten-free Noodles Incorporated of Jabuticaba Peel Flour

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Abstract The objective of this study was to determine the technological and nutritional viability of the use of jabuticaba peel, an agroindustrial residue, in the development of gluten-free noodles. We evaluated the physical, chemical and technological characteristics of gluten-free noodles substituting 15% and 30% of rice flour and pre-gelatinized rice flour by jabuticaba peel flour. The product with highest proportion of the residue-derived flour increased considerably its nutritional value, and its energy value practically unchanged when compared with noodles prepared only with rice flour. Thus, the pasta added of jabuticaba peel flour is a more beneficial food not only for the gluten intolerant individuals, but for anyone concerned about a healthy diet.

Keywords: *co-products, bioactive compound, intolerant to gluten, Myrciaria jabuticaba (Vell) Berg, pasta*

Cite This Article: Lismaíra Gonçalves Caixeta Garcia, Anna Hiria Souza e Silva, Paola de Castro Cunha, and Clarissa Damiani, "Preparation of Gluten-free Noodles Incorporated of Jabuticaba Peel Flour." *Journal of Food and Nutrition Research*, vol. 4, no. 2 (2016): 82-87. doi: 10.12691/jfnr-4-2-3.

1. Introduction

Several kinds of pasta are present in Brazilian cuisine are served as a main dish or additional in the main meals. They have high acceptability, due to its great convenience, fast preparation, as well as the satiety they provide. However, the traditional pasta prepared with wheat flour, cannot be consumed by the entire population, because some individuals are intolerant to gluten present in this flour.

Gluten intolerance is an autoimmune disease that can potentially affect any organ, not merely the gastrointestinal tract, as previously assumed [1]. The only satisfactory treatment for gluten intolerance is a complete avoidance of wheat, rye, barley, oatmeal and their derivatives in the diet [2]. The substitution of these cereals can be done with soy, rice, corn, potatoes, cassava and yams, and among these, rice is the least allergenic [3,4,5,6].

Rice, due to its nutritional properties, hypoallergenicity, pleasant taste and not interference in color of the final product has been used industrially in the production of rice flour which is subsequently used as an additive in puddings, ice cream and similar products [7,8,9,10].

The development of gluten-free noodles should encourage the manufacture of products originated from mixed flours, attending a special portion of consumers, because the amount of special industrial products without gluten in the Brazilian market is still restricted. Moreover, the mixed flours can be prepared by the use of by-products from the food industry, such as fruit peels, and these comprise the main source of nutrients of the fruits, as in the case of jabuticaba peel, which constitutes about 50% of the fruit and has great amounts of bioactive compounds such as antioxidants, phenol compounds, tannins and anthocyanins.

The objective of this work was to prepare pasta added of rice flour, pre-gelatinized rice flour and jabuticaba peel flour and evaluate its technological and nutritional viability.

2. Material and Methods

2.1. Raw Material

Fruits from the species *Myrciaria jabuticaba* (Vell) Berg (jabuticaba sabará) were harvested with similar maturity, in the Farm and Winery Jabuticabal in Nova Fatima district, Hidrolândia, State of Goiás. The common rice flour and albumin powder were purchased in the local market. Pre-gelatinized rice flour was donated by Cerealle-Inovação and Segurança de Alimentos.

The fruits were washed and sanitized in 100 µL L^{-1} of sodium hypochlorite solution for 20 min. The peels were removed using an electric pulper equipment (Itametal, Bonina 0.25dF-A8). This machine separated pulp, peel and seeds. After, the peels were dried in forced air oven (Marconi, MA-035) at 60 °C for 48 h, ground in knife mill, packed in low density polyethylene bags and stored in freezer (Dako) at -18 ± 2 °C.

2.2. Preparation of Noodle Formulations

Formulations containing two concentrations of jabuticaba peel flour (JPF) (15% and 30%) were prepared from a standard formulation of gluten-free pasta. The noodles were

prepared by cold drawing (Italvisa, Pastaia 6) and stored in high density polyethylene bags until analyzes. Table 1 shows the formulations used in the preparation of gluten-free pasta (standard) and gluten-free pasta added of JPF.

Table 1. Formulations of noodles with different concentrations of jabuticaba peel flour.

	Formulation		
Ingredient	Standard	15% of jabuticaba peel flour	30% of jabuticaba peel flour
Rice flour (g)	500	425	350
Pre-gelatinized rice flour (g)	165	140.25	115.5
Jabuticaba peel flour (g)	-	99.75	199.5
Water (mL)	275	275	275
Egg powder (g)	60	60	60

2.3. Physico-chemical Analysis, Bioactive Compounds and Cooking Tests

The determination of proximate composition (moisture, ash, proteins, lipids and carbohydrates), caloric value, pH, titratable acidity, soluble solids, anthocyanins, phenolic compounds, condensed and hydrolyzed tannins and antioxidant potential were carried out both in JPF and in the noodles. The cooking tests (cooking time, weight gain, volume increase and loss of soluble solids into the cooking water) were applied only on noodles. All analyzes were performed in triplicate.

The proximate composition was determined according to the Association of Official Analytical Chemists [11]. The moisture was evaluated by weight difference after sample drying, total nitrogen by micro-Kjeldahl method, total lipids using Soxhlet and ash by incineration in muffle furnace. The carbohydrate content was calculated by difference, subtracting from 100 the values of humidity, ashes, proteins and lipids. The energy value was estimated using the ATWATER factors (kcal carbohydrates = 4.0 kcal g^{-1}; lipid = 9.0 kcal g^{-1}; protein = 4.0 kcal g^{-1}) [12].

The determination of pH was performed in digital potentiometer (pH Meter HI-9224), total titratable acidity by titrating the sample with 0.1 N NaOH and the total soluble solids content was determined in digital refractometer (Atago N-1E) by reading the Brix of the sample at 20 °C [11].

Phenolic compounds in ethereal, ethanol and aqueous extracts was determined using the Folin-Ciocalteu reagent [13]. The condensed tannin content was estimated according to the method of Price et al. [14], with adjustments made by Barcia et al. [15]. The hydrolyzed tannins were determined by the method of Brune, et al. [16], with modifications of Barcia et al. [15]. The total anthocyanin content was evaluated according to Lee and Francis [17], adjusted by Barcia et al. [15]. The antioxidant activity was determined by the DPPH method (2,2-diphenyl-1-picrylhydrazyl), according to Brand-Williams et al. [18], with modifications of Borguini and Torres [19]. Readings for all the aforementioned analyzes of bioactive compounds were performed in spectrophotometer.

The L*, a* and b* (CIELAB) color parameters were determined by reading with a colorimeter (Hunterlab, ColorQuest II), wherein L* represents the lightness (L* = 0 black and L* = 100 white) and a* and b*, chromatic coordinates (+a* red and -a* green, +b* yellow and -b* blue). All of the pasta were subjected to cooking tests according to the AACC 16-50 [20] evaluating the cooking time, weight gain, volume increase and loss of soluble solids into the cooking water.

2.4. Statistical Analysis

The evaluations in the noodles were performed using analysis of variance (and when significant, applied the Tukey test or t test, according to the situation), at 5% significance level.

3. Results and Discussion

3.1. Physico-chemical Analysis and Bioactive Compounds of JPF

The JPF has considerable amounts of proteins, lipids and carbohydrates in its composition. Becker et al. [21], when preparing flour form the endocarp of buriti fruit, found higher values of humidity (9.93 g. 100 g^{-1}) and ash (4.59 g. 100 g^{-1}). The protein and lipid levels (Table 2), were lower and the carbohydrate content was higher than those found by other authors [22,23], when evaluating fruit-derived flours.

The water activity, pH and titratable acidity found in JPF (Table 2) do not favor the enzymatic activities or chemical reactions, once the flour has low water availability and can be considered an acid product according to the pH and acidity value. Ferreira et al. [24] when using of sorghum, rice, corn flours with potato starch for the preparation of gluten-free pasta found higher levels of pH to its different formulations with an average value of 5.5. Regarding the total soluble solids, the flour showed 8.814 ^{o}Brix, which is lower than that found by Aquino and Leão [25] in acerola flour (40 ^{o}Brix). The color analysis (Table 1) showed that JPF has intermediate color value, with a tendency to red.

The anthocyanin contents of JPF were similar to those found in Niagara grapes by Soares et al. [26] (47.65 mg of cyanidin-3-glycoside.100 g^{-1}) and can be used as an alternative source of natural pigments in pasta, as well as other products. The presence of anthocyanins, in addition to improving color attributes of foods, increases its antioxidant potential. The benefits of anthocyanins to human health are related to its antioxidant effect, preventing chronic diseases and various types of cancer.

The levels of condensed tannins were higher than those of hydrolyzed tannins in JPF, an expected result due to the astringency of jabuticaba peel. When comparing the different extracts used for the analysis of antioxidant activity, it was found that the aqueous extract had a higher

percentage of DPPH discoloration and consequently greater antioxidant potential.

Table 2. Physico-chemical composition of jabuticaba peel flour.

Determination	JPF*
Moisture (g.100 g^{-1})	7.856 ± 0.188
Ash (g.100 g^{-1})	1.401 ± 0.355
Proteins (g.100 g^{-1})	1.498 ± 0.050
Lipids (g.100 g^{-1})	1.433 ± 0.312
Carbohydrates (g.100 g^{-1})	87.895 ± 0.319
Water activity	0.292 ± 0.005
pH	3.533 ± 0.047
Titratable acidity (g.100 g^{-1})	0.871 ± 0.023
Soluble Solids (°Brix)	8.814 ± 0.178
L*	49.683 ± 0.50
a*	5.651 ± 0.27
b*	4.450 ± 0.44
Anthocyanins (mg cyanidin-3-glycoside.100 g^{-1})	41.302 ± 1.682
Condensed tannins (mg catechin.100 g^{-1})	200.617 ± 0.134
Hydrolysable tannins (mg gallic acid.100 g^{-1})	93.260 ± 2.655
Antioxidant potential – ether extract (% DPPH discoloration)	33.587 ± 4.274
Antioxidant potential – ethanol extract (% DPPH discoloration)	39.100 ± 9.887
Antioxidant potential – aqueous extract (% DPPH discoloration)	55.577 ± 11.53

* Values expressed as mean ± standard deviation.

3.2. Physico-chemical and Bioactive Evaluation of the Pasta

Analyzing the different prepared pasta, some variations were observed as a result from the addition of JPF (Table 3). Regarding the moisture content, the standard samples and those containing 15% of JPF did not differ by the Tukey test ($p>0.05$), whereas the sample with 30% of JPF was significantly different ($p<0.05$), with reduced moisture content due to the greater amount of JPF added in the formation and hence the preparation of the pasta. The values found in the moisture determination of all analyzed samples are within the maximum parameter allowed in fresh pasta, 35%, as predetermined by ANVISA in RDC No. 93 of October 31, 2000, which governs the standards of identity and quality of pasta [27].

The addition of JPF significantly increased ($p <0.05$) the protein content of noodles according to the amount added, whereas the ash and carbohydrate contents were higher in the standard formulation. Ash and lipid content showed no significant difference between them ($p> 0.05$). From the percentage of proteins, lipids and carbohydrates, it was possible to calculate energy values of 299.799 Kcal.100 g^{-1} for the standard sample, 298.064 Kcal.100 g^{-1} for the sample with 15%, and 307.329 Kcal.100 g^{-1} for the sample with 30% of JPF. Therefore, the energy values of noodles did not vary with the addition of jabuticaba flour, once this ingredient only substitutes certain amount of rice flour used in the preparation of the standard sample.

Table 3. Physico-chemical composition of the standard noodles and incorporated of JPF

Determination	Samples*		
	Standard	15% of JPF	30% of JPF
Moisture (g.100 g^{-1})	26.972a ± 0.277	27.584a ± 0.277	25.629b ± 0.290
Ash (g.100 g^{-1})	0.642a ± 0.034	0.476b ± 0.428	0.364b ± 0.226
Proteins (g.100 g^{-1})	8.640c ± 0.100	9.516b ± 0.135	10.645a ± 0.319
Lipids (g.100 g^{-1})	2.047a ± 0.034	2.256a ± 0.302	2.325a ± 0.346
Carbohydrates (g.100 g^{-1})	61.699a ± 0.433	60.168b ± 0.575	61.038a.b ± 0.355
Water activity	0.762c ± 0.009	0.850a ± 0.006	0.817b ± 0.008
pH	6.177a ± 0.061	5.967b ± 0.004	5.813c ± 0.025
Titratable acidity (g.100 g^{-1})	2.577a ± 0.185	2.610a ± 0.026	2.837a ± 0.021

*Same letters in the same line do not differ at a significance level of 95% ($p \leq 0.05$), by Tukey test. Values expressed as mean ± standard deviation.

The water activity of the pasta was significantly different ($p<0.05$) among treatments, however, all samples were within pre-established standards, evidencing the stability of this product from a microbiological point of view, once the samples did not show the growth of yeasts, fungi and thermophilic bacteria. The pH and titratable acidity of the samples allow classify them as a low-acid product, a characteristic of pasta.

The color of the pasta is a factor of fundamental importance for marketing, being directly influenced by the raw materials that constitute the sample. The lightness of the standard sample showed significant differences ($p>0.05$) in relation to others (Table 4), and this difference

was explained by the use only of rice flour and pre-gelatinized rice flour. These values are close to that found by Depieri [28], in instant noodles, prepared with wheat flour (61.49). Formulations added of JPF had no significant difference (p>0.05) among them, tending to a darker color because of the natural color of jabuticaba peel. As well as the brightness, the chromaticity parameters a* and b* differed only in the standard sample, and the other formulations were influenced by the addition of jabuticaba flour.

Table 4. Color parameters of the standard noodle and noodles added of JPF

Parameters	Samples*		
	Standard	15%	30%
a*	2.482a ± 0.568	1.640b ± 0.263	1.034b ± 0.278
b*	12.168a ± 2.357	2.138b ± 0.395	0.832b ± 0.726
L*	67.490a ± 4.484	42.754b ± 3.590	39.082b ± 2.530

*Same letters in the same line do not differ at a significance level of 95% (p ≤0.05), by Tukey test. Values expressed as mean ± standard deviation.

Considering that the standard sample has no added JPF, the analysis of bioactive compounds were carried out only in samples with addition of 15% and 30% JPF, as shown in Table 5.

Anthocyanins are important alternatives for the gradual substitution of synthetic pigments because they are abundant in nature, have a broad spectrum of colors and also due to the beneficial effects to human health. The major limitation to the use of anthocyanins is the greater instability compared to synthetic dyes. The values found for anthocyanins showed significant differences (p <0.05), because of double the amount of JPF added to the sample of 30%.

Table 5. Levels of bioactive compounds in the formulations of gluten-free noodles with JPF.

Determination	Samples	
	15%	30%
Anthocyanins (mg of cyanidin-3-glycoside/100 g)	1.960b±0.375	3.080a±0.353
Condensed Tannins (catechin mg/100 g)	197.406b±0.485	197.418a±1.147
Hydrolysable Tannins (mg gallic acid/100 g)	71.863b±1.918	77.881a±1.461
Antioxidant Potential – ethereal extract (%DPPH discoloration)	32.937a±0.902	28.845a±0.657
Antioxidant Potential – ethanol extract (%DPPH discoloration)	30.891a±1.882	30.825a±0.173
Antioxidant Potential – aqueous extract (%DPPH discoloration)	31.287b±0.508	47.459a±0.826
Phenolic compounds – ethereal extract (mg gallic acid/100 g)	6.588b±1.272	17.550a±1.121
Phenolic compounds – ethanol extract (mg gallic acid/100 g)	29.330b±1.043	88.949a±0.791
Phenolic compounds – aqueous extract (mg gallic acid/100 g)	135.474a±0.470	135.449a±0.495

*Same letters in the same line do not differ at a significance level of 95% (p ≤0.05), by t. test values expressed as mean ± standard deviation.

In the two analyzed formulations, the content of condensed tannins was superior to that of hydrolyzed tannins, and this difference influences positively in the sensory aspect, once the condensed tannins have a lower complexing capacity with proteins, resulting in low astringency [15].

Evaluating the contents of phenolic compounds, it was noted that its yield was higher for the aqueous extract. The difference among the extracts can be justified by the differential solubility of phenolic compounds in a given solvent. However, there is no it is not possible to infer the structure of the phenolic responsible for this characteristic, because it has no studies referring to the unique constituents of JPF.

The bioactive compounds are of great importance for the composition of pasta, because it originates color, astringency, aroma and oxidative stability of the final product, besides bringing several benefits to consumer health such as the antimicrobial, neuroprotective, anticance, anti-inflammatory and antioxidant actions.

For the non-conventional pasta prepared without gluten, it is sought the formation of a structure similar to that of gluten, through the use of technologies that exploit the functional properties of the starch present in the raw material or by adding flour rich in proteins or additives, as mentioned by Pagani [29].

According to Leitão et al. [30], the most interesting characteristics in the cooking test are the degree of cooking, the resistance to welding, water absorption capacity and volume increase. According to these authors, the nature and quality of raw materials, the shape of the final product, the processing system, drying and the cooking system itself can influence this test.

Table 6. Characterization of the quality of noodles from the cooking tests

Determination	Samples		
	Standard	15%	30%
Weight gain (g)	8.611a±0.948	8.804a±0.003	7.576a±0.401
Cooking time (min)	11.333a±1.528	6.667b±0.577	9.000a.b±0.000
Loss of soluble solids (%)	5.967b±0.252	7.200a.b±0.265	8.533a±0.850
Volume increase (%)	61.910a±0.956	51.200b±0.576	42.860c±1.321

*Same letters in the same line do not differ at a significance level of 95% (p ≤0.05), by Tukey test. Values expressed as mean ± standard deviation.

In Table 6 are the results of the characterization of the noodles after the cooking tests which include cooking time, weight gain, volume increase and loss of soluble solids in water, important parameters for assessing the overall quality.

The values of weight gain of the noodles showed significant differences (p> 0.05). Thus, considering that weight gain is a parameter of quality that is directly related to the yield of the pasta after cooking, it is considered as appropriate the value of approximately 2 times the original weight (200%) [31]. These data, therefore, indicate that the studied pasta has medium-low quality, even the standard sample, probably because of the processing method used and the removal of the flour which contains gluten. The volume increase of the pasta, differentiated among treatments at 5% (p <0.05), and the standard sample showed the largest volume. This difference is explained by Menegassi, and Leonel [32], who mentioned that the volume increase depends on the cooking time and the format of the noodles, as well as the content and quality of proteins, which hydrate and absorb water during the mixing of the dough.

The sample with addition of 15% of jabuticaba flour showed the shortest cooking time, and this result is of great importance nowadays, when consumers have sought foods of faster preparation. Ferreita et al. [24] found times higher when evaluating the cooking time macarrrões prepared with the mixed flour sorghum, rice and potatoes. Noodles containing JPF had lost from 7.2% (15%) to 8.533% (30%) of soluble solids in water and the standard sample, which contains only rice flour and pre-gelatinized rice flour, had lost only 5.967. The greatest solid loss was due to the residual JPF incorporated in the first two samples. Garib [33] studied pasta made with 75% of wheat flour, 15% of pre-gelatinized corn flour, 10% soy flour, and reported loss of soluble solids of 9.33%.

4. Conclusion

The preparation of gluten-free pasta with JPF is a viable and nutritious option for use of this agroindustrial residue. Moreover, it can be used both by healthy individuals who seek for products rich in antioxidants and essential nutrients for maintaining a healthy diet. In addition, this product can also be consumed by gluten intolerant people, which have few options of pasta with high energy value and good protein quality in the Brazilian market.

Acknowledgements

We thank Cerealle-Inovação e Segurança de Alimentos, for donating pre-gelatinized rice flour, and Fazenda & Vinícola Jabuticabal for donating the jabuticabas.

Statement of Competing Interests

The authors have no competing interests.

Abreviation

JPF = Jabuticaba peel flour

References

[1] Mearim, M.L., Ivarsson, A., Dickey, W. "Coeliac disease: is it time for mass screening?" *Best Practice & Research Clinical Gastroenterology*, 19 (3), 441-52. 2005.

[2] Raymond, N., Heap, J., Case, S. "The gluten-free diet: An update for health professional." *Practical Gastroenterology*, *30* (9), 67. 2006.

[3] Acelbra. Celiac Association of Brazil. http://www.acelbra.org.br. Accessed 10 August 2013.

[4] Amussen, H.W., Sharp, R.N., Sharp, C.K. (1990). "The feasibility of making soups from rice flour and hydrolized rice". *Journal of the American Dietetic Association*. 90 (7). 991-993. July 1990.

[5] Lorenz, K. Cereals and schizophrenia. In: POMERANZ Y "Advances in cereal science and technology". St. Paul: American Association of Cereal Chemists. 1990, 435-466.

[6] Mota, J.A.C., Penna, F.J. Tabus alimentares. In: WEHBA, J et al. "Child nutrition". edn. Fundo editorial BYK, Rio de Janeiro, 1991, 257-268.

[7] Brasil. Decreto nº 12.486, de 20 de outubro de 1978. Normas técnicas especiais relativas a alimentos e bebidas. Diário Oficial do Estado de São Paulo, São Paulo, p. 20, 21 out. 1978.

[8] Chrastil, J. "Correlations between the physicochemical and functional properties of rice". *Journal of Agricultural and Food Chemistry*, 40 (9), 1683-1689. 1992.

[9] Ju, Z.Y., Hettiarachchy, N.S., Rath, N. "Extraction, denaturation and hydrophobic properties of rice flour proteins". *Journal of Food Science-Chicago*, 66 (2), 229-232. 2001.

[10] Shih, F.F., Daigle, K.W. "Preparation and characterization of rice protein isolates". *Journal of the American Oil Chemists' Society*, 77 (8), 885-889. 2000.

[11] Association of Official Analytical Chemists. Official Methods of Analysis. 18th edition, 3th Review, Washington: AOAC International, 2010.

[12] Merrill, A.L., Watt, B.K. "Energy value of foods: basis and derivation". Washington, DC: United States Department of Agriculture. 1973.

[13] Waterhouse, A. L. Wine phenolics. Ann New York academy of Sciences. University of California, USA. 2002.

[14] Price, M.L., Scoyoc, S.V., Butler, L.G. "A Critical Evaluation of the Vanillin Reaction as an Assay for Tannin in Sorghum Grain". *Journal of Agricultural and Food Chemistry*, 26 (5), 1214-1218. 1978.

[15] Barcia, M.T., Pertuzatti, P.B., Jacques, A.C., Godoy, H.T., Zambiazi, R. "Bioactive compounds, antioxidant activity and percent composition of jambolão fruits (Syzygium cumini)". *The Natural Products Journal*, 2 (2), 129-138. 2012.

[16] Brune, M., Hallberg, L., Skanberg, A.. "Determination of Iron-binding Phenolic groups in Foods". *Journal of Food Science*, 56 (1), 128-131. 1991.

[17] Lee, D.H., Francis, F.J. "Standardization of Pigment Analyses in Cranberries". *HortScience*, 7:83-84. 1972.

[18] Brand-Williams, W., Cuvelier, M.E., Berset, C. "Use of a free radical method to evaluate antioxidant activity". *LWT-Food Science and Technology*, 28 (1), 25-30. 1995

[19] Borguini, R.G., Torres, E.F.S. "Tomatoes and tomato products as dietary sources of antioxidants". *Food Reviews International*, 25 (4), 313-325. 2009.

[20] American Association of Cereal Chemists. International approved methods of analysis, 11th edn. AACC, St Paul, 2010.

[21] Becker, F.S., Damiani, C., Melo, A.A.M., Borges, P.R.S., Vilas Boas, E.V.B. "Incorporation of Buriti Endocarp Flour in Gluten-free Whole Cookies as Potential Source of Dietary Fiber". *Plant Foods for Human Nutrition*, 69 (4), 344-350. 2014.

[22] Fasolin, L.H., Almeida, G.C., Castanho, P.S., Netto-Oliveira, E.R.. "Cookies produced with banana meal: chemical, physical and sensory ratings". *Ciência e Tecnologia de Alimentos*, 27 (3), 524-529. 2007.

[23] Silva, M.R., Silva, M.A.A.P., Chang, Y.K. "Use of jatoba flour (Hymenaea stigonocarpa mart.) In drawing up standard cookie biscuits and evaluation of acceptance by univariate and multivariate affective sensory tests." Ciência e Tecnologia de Alimentos, 18 (1), 25-34. 1998.

[24] Ferreira, S.M.R., Mello, A.P., ANJOS, M.C.R., Kruger, C.C.H., Azoubel, P.M., ALVES, M.A.O. "Utilization of sorghum, rice, corn flours with potato starch for the preparation of gluten-free pasta". Food Chemistry, 191, 147-151. 2016.

[25] Aquino, A.C.M.S., Leão, K.M.M. Obtaining and physicochemical characterization of the flour waste of acerola pulp processing. Anais do XVI Encontro Nacional e II Congresso Latino-americano de Analistas de Alimentos. Belo Horizonte. 2009.

[26] Soares, M., Welter, L., Kuskoski, E.M., Gonzaga, L., Fett, R. "Phenolic compounds and antioxidant activity of grape peel

Niagara and Isabe"l. *Revista Brasileira de Fruticultura*, 30 (1), 59-64. 2008.

[27] Brasil. AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA (ANVISA). Resolução RDC Nº 93 de 31 de Outubro de 2000. Dispõe sobre o regulamento técnico para fixação de identidade e qualidade de massas alimentícias. Diário Oficial da União, Poder Executivo, Brasília, DF. http://www.anvisa.gov.br/alimentos/legis/especifica/htm. Accessed 10 August 2013.

[28] Depieri, M. "Development instant Alimenticias folders by thermoplastic extrusion process: influence of the type of wheat, emulsifying content of the process parameters and product quality". Dissertation, Campinas State University. 2004.

[29] Pagani, M. A. Pasta products from non conventional raw materials. In: Mercier, C., Cantarelli, C. "Pasta and extrusion cooked foods: some technological and nutricional aspects." Elsevier Applied Science Publishers, London, 1986, 52-68.

[30] Leitão, R.F.F., Gonçalves, J.R., Eiroa, M.N.U., Garcia, E.E.C. "Noodle technology", Campinas:ITAL.1990, 71 p.

[31] Casagrandi, D.A., Canniatti-Brazaca, S.G., Salgado, J.M., Pizzinato, A., Novaes, N.J. "Technological, nutritional and sensory analysis of pasta prepared with added flour of pigeon pea flour". *Revista de Nutrição*, 12 (2), 137-143. 1999.

[32] Menegassi, B., Leonel, M. "Quality analysis of a mixed pasta of arracacha". *Revista Raízes e Amidos Tropicais*, 2, 27-36. 2006.

[33] Garib, C.C. "Balanced diet: an alternative proposal for school meals". Thesis, Universidade Federal de Santa Catarina. 2002.