Application of pulp and peels of ariá (Calathea allouia) in dehydrated soups formulations

Accepted 30th April, 2019

Abstract

The ariá (Calathea allouia), also called Indian potato, from the Marantaceae family, is an Amazon region's tuber (potato). Its functional, sensorial, nutritional (essential amino acids such as methionine and cysteine) characteristics and high energy reserves, can play an important role in diets. This study aimed to elaborate dehydrated soups in different compositions from dehydrated ariá flour and do some centesimal and physicochemical analysis between others. The results showed that ariá presented an important content of carbohydrates and a very low content in fat. It was further noted that dehydrated soups made with ariá flour contained most of the nutrients necessary for good nutrition, had characteristics of light colors close to pure white, with tendencies for red and yellow intensities. Soup D (50% ariá flour + peel and 50% corn starch) had the highest water absorption index, and soup B (50% ariá flour and 50% corn starch) had the highest water solubility index. The soup C (soup with 60% ariá flour and 40% corn starch) obtained better results in the acceptability test and in the buying intention and presented an important content of fiber and a low water activity. The soups did not show significant variation of pH and acidity during the storage time. The microbiological results were satisfactory. The ariá can then serve as raw material for dehydrated soups as well as its peel.

Key words: Amazon region's tuber, ariá, dehydrated soup.
preservation is drying, allowing changes in the sensory properties, such as texture, color, flavor and aroma, leading to new products such as soups, etc. (Vilela and Arthur, 2008). The processing of the ariá in the soup form is a simple technique that can be used by small agro industries; it consists of the grinding of dehydrated slices of ariá, constituting a way to add value to the raw material, reducing postharvest losses. Among the advantages of using ariá for the preparation of dehydrated soups are its nutritional, functional (Varejão, 1988) and sensory characteristics, as well as the high energy reserve, mainly for the starch content. According to Franco et al. (2001), ariá’s starch has a low main part formation temperature, allowing a creamy consistency sought in soups in a shorter cooking time of the product.

The frantic rhythm of modern life and the increase in the number of people who live alone have determined changes in food preparation and in the habits of consumption. Less time is available for a cook to prepare the dish. In this consequence, the rapid progress of the ready-oven food technology and its products has to be mentioned. Dried soups play an important role in the nutrition of people because they fulfill present and future social consumer requirements (Krejčová et al., 2007). Considering all the good nutritional composition of ariá, and all the practical advantages and nutritional characteristics offered by the dehydrated soups, this work aims to use the ariá flour (Culathea allouia) for the elaboration of dehydrated soups.

MATERIALS AND METHODS

The experiment was conducted at the Laboratory of Physicochemical of Food of the National Institute for Amazon Researches (LFQA / INPA). The flowchart of obtaining the soups is presented step by step in the Figure 1.

Raw material

The raw ariá was obtained from the experimental farms of INPA. The tubers were harvested after physiological maturation and stored undiluted until processing time.

Characterization of the raw material

The following evaluations were carried out in ariá in natura:

**Moisture**

The moisture was determined by gravimetric technique in an oven dryer at 105°C until constant weight and the results expressed in %, according to the Analytical Standards of the Instituto Adolfo Lutz (2008).

**Potential hydrogen ion (pH)**

The pH value was determined using a digital pH meter according to the Analytical Standards of the Instituto Adolfo Lutz (2008).

**Total soluble solids (TSS)**

A few drops of a sample were transferred to the prism of the refractometer and the results were read and expressed in °Brix.

**Titratable total acidity (ATT)**

Titratable total acidity was determined by titrating with NaOH (0.1 N) solution using phenolphthalein as indicator. The results were expressed in % citric acid.100g⁻¹ of main part according to the Analytical Standards of the Instituto Adolfo Lutz (2008).

**Protein**

The protein fraction was determined by total nitrogen using the Kjeldahl technique, according to AOAC (1990). The protein nitrogen in the sample, multiplied by the conversion factor 6.25, corresponded to the percentage of the samples, and the results were expressed in percentage of crude protein.

**Ashes**

The ashes content was obtained according to AOAC (1990), by incineration of the sample in the muffle (550°C), for a period sufficient for the burning of all organic matter. The results were expressed in percentage of ashes.

**Ethereal extract (Lipids)**

The method used to determine the ethereal extract was the Soxhlet intermittent, using organic solvent (ethyl ether), according to AOAC (1990). The results were expressed in percentage of ethereal extract.

**Carbohydrates**

For the determination of the carbohydrates contents the method used was the calculation by difference.
Atwater conversion factors were used: 4 kcal/g for protein, 4 kcal/g for carbohydrates and 9 kcal/g for lipids, according to the equation: VC = (% protein x 4.0) + (% ethereal extract x 9.0) + (% carbohydrate x 4.0), according to OSBORNE and VOOGT (1978). See Appendix figures

**Producing the dehydrated ariá’s flour**

The tubers of Ariá were washed in tap running water to remove the dirt, dipped in sodium hypochlorite solution at
### Table 1. Soup composition.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Starch + Ariás flour (or Ariás flour + Ariás’s peel flour)</td>
<td>55</td>
</tr>
<tr>
<td>Milk powder</td>
<td>20</td>
</tr>
<tr>
<td>Dehydrated condiments (coriander, onion, garlic, black pepper, basil and parsley)</td>
<td>10</td>
</tr>
<tr>
<td>Salt</td>
<td>15</td>
</tr>
</tbody>
</table>

The percentage of corn starch + ariás flour was varied for treatments: A (40% Ariás flour and 60% corn starch), B (50% Ariás flour and 50% corn starch), C (60% % Ariás flour and 40% corn starch) and soup D (25% ariás flour + 25% ariás’s peel flour and 50% of corn starch).

20 ppm for 30 min and then washed again in tap running water to remove excess of chlorine. The peeling was performed manually using a stainless steel knife. Then, the tubers were immersed in 200 ppm sodium bisulfite solution, to avoid enzymatic browning. The slicing of approximately 1.2 mm was made with the stainless steel knife. The slices were subjected to the bleaching process with sodium bisulfite solution 200 ppm for six minutes and then to the drying process at temperatures of 50 and 60°C and air velocity of 1.5 m.s⁻¹ to the final moisture of 8% bu, in oven dryer. The dehydrated material was then ground in a domestic blender and then sieved in order to standardize the particle size. The obtained flour was packed in plastic polyethylene packages and stored at room temperature until the analysis.

**Obtaining the dehydrated soups**

The dehydrated soups were initially produced by weighing all the ingredients according to their proportions (Table 1) and then homogenized in a domestic blender and packed in metallized polypropylene packaging and stored at room temperature. Approximately 150 g of sample was placed in each package. For the preparation of the soups, 17.50 g of the product were dissolved in 350 ml of cold water and then boiled on stove for 10 min.

**Physicochemical and functional analyzes of dehydrated soups**

The soups were characterized in terms of general appearance, physicochemical composition, color, solubility index (ISA) and water absorption index (IAA). The pH and titratable total acidity analyzes were performed at time zero, 30 and 60 days and the water activity was performed on the 30th and 60th days in order to check the shelf life. A package containing approximately 150g for each treatment was used to perform the analyses at each time, in each replicate.

**Water absorption index (WAI)**

It was determined by the method described by Linko et al (1980). A sample of soup (1 g) was suspended in 30ml of distilled water at room temperature in a pre-weighed 50ml centrifuge tube. The addition of the starch was made slowly and the mixture was stirred intermittently to prevent lump formation and then submitted to centrifugation at 3000 rpm for 10 min. The supernatant was then carefully separated and the weight of the remaining gel in the tube determined. The ratio between gel mass and dry sample mass represents the WAI, and the results are expressed as g/g dry matter.

**Water solubility index (WSI)**

It was also determined according to the method of Linko et al. (1980). A 10 mL aliquot of the supernatant obtained in the WSI test was transferred into a pre-weighed 150 mL becker and then subjected to evaporation in an oven at 105°C to constant weight (approximately 24 h). The ISA calculation was done by the following relationship, and the results are expressed as a percentage.

**Color**

The soups colors were evaluated in colorimeter, model ColorQuest XE. The results were expressed according to the CIELAB scale, using the parameters L*, a* and b*, where L* values (brightness) vary from white (100) to black (0); the a* values are defined as the transition from green (-a*) to red (+a*) and b* values represent the transition from blue (-b*) to yellow (+b*). Three readings will be taken in each sample, obtaining the average of these.

**Microbiological analyzes**

The determination of total and fecal coliforms, molds and yeasts were performed according to the techniques described by Apha (1992), and Staphylococcus analyses.
were performed according to the method proposed by the International Commission on Microbiological Specifications for Foods (2000), right before the sensory analyses. For fecal coliforms, the most probable number technique (MPN) was used. Samples of dehydrated soups were diluted 1/10, homogenized for five minutes and then made at $10^{-1}$, $10^{-2}$ and $10^{-3}$ dilutions in peptone water. A 1 mL aliquot of each dilution will then be transferred into the test tubes containing 10 mL of bright green broth and Durhan tubes and incubated in an oven at 37°C for 48 h. For molds and yeasts, 1 mL aliquots of each dilution were plated on potato dextrose agar (PDA) acidified to pH 3.5 with 0.1% tartaric acid. Incubation was at 25°C for a period of 3 to 5 days. The results were compared to the microbiological standards for dehydrated soups established by Resolution-RDC No. 12 of January 2, 2001 of the National Health Surveillance Agency of the Brazilian Ministry of Health (BRASIL, 2001). For the staphylococcus analyses, egg yolk (50 mL/L) and 1.0% potassium tellurite (2 mL/200 mL) were added in melted and cooled base in a water bath (45°C), and then the contents was poured onto the sterilized petri plate and waited for complete solidification of the medium for use, incubated at 35°C for 48 h.

### Sensory analysis - Acceptance test

The evaluation of the acceptance of the soups in this study was approved by the Human Research Ethics Committee of Plataforma Brasil on a protocol number 68955617.2.0000.0006. The sensory analysis was carried out according to the norms of the Instituto Adolfo Lutz (2008), where it had a test in a group of 50 untrained judges, containing a hedonic scale between 1 and 9 in which 1 was "I disliked very much" and 9 was "I liked it very much" and the buying intention survey. The samples were presented to a team of 50 consumers in a completely randomized design in disposable plastic cups containing 20 mL of the soup ready at a temperature of approximately 70°C, duly cooled with three digits and served in individual booths under white light.

### Water activity (Aw) and crude fibers

After having the soup with the highest acceptance, its water activity and its crude fibers content were obtained. For the water activity, a sample was simply placed half full in a plastic flask that was placed in the chamber of the LAB START Water Activity Meter; the equipment was set up to express the result of Aw in 10 min. The determination of the crude fiber content was quantified by the enzymatic method for soluble and insoluble fiber methodology, described by the Instituto Adolfo Lutz Analytical Standards (2008), and the results were calculated and expressed in percentage.

### RESULTS AND DISCUSSION

The results obtained in the determinations of the centesimal composition of Ariá and its peel are shown in Table 2. Ariá main part presented a protein content lower than its peel. However, this protein content was higher than that of the baroa potato one (Chamaephyllum bulbosum), according to the Brazilian Table of Food Chemical Composition (TACO, 2011), and lower than that of potato (Solanum tuberosum L) studied by Stanley and Jewell in 1989. Although ariá is not a quantitatively important protein source, in nutritional terms, the quality of its protein is high because it contains essential amino acids such as methionine and cysteine (Bueno and Weigel, 1981). The lipid content in the ariá main part was almost the same in its peel, but much lower than the lipid content of the baroa potato (0.2%) (TACO, 2011); a similarly result was obtained by Garcia, (2013): the potatoes are poor in fat. The ariá main part presented slightly lower moisture content than the peel and both were almost equal to the moisture content of the Agate and Markies potatoes determined by Dos Santos (2009) and confirming the conclusion that the Brazilian varieties of potatoes have an average moisture content of 82% (TACO, 2011). The pH value from the main part was higher and was closer to the neutrality than the peel and both inversely proportional to the total titratable acidity values. Alfaro et al. (2011) concluded that the pH of potato (Solanum tuberosum) and yolulco (Ullucus tuberosus), all Amazonian tubers, was neutral.

Ariá's peel showed water absorption and water solubility indexes higher than the main part. At this point, the ariá peel can then be used to make foods that require dissolution in water such as dehydrated soups. The caloric values of the main part and ariá peel were respectively 58.52 kcal and 52.79 kcal. The ariá main part presented carbohydrate content and a caloric value higher than the peel, but both lower carbohydrate content and the caloric value of the 64 kcal potato (TACO, 2011).

Among the advantages of using ariá flour for the preparation of dehydrated soups are its nutritional, functional and sensorial characteristics, as well as the energy reserve, mainly for its starch content that, according to Franco et al. (2001), has a low main part formation temperature, allowing a creamy consistency sought in soups in a shorter product cooking time. Table 3 presents the results of the centesimal, physicochemical and minerals analyzes of dehydrated soups.

Data on the centesimal composition of the dehydrated soups were not found in the literature. This fact may explain the differences found among several works, since the flour goes through previous physical processes altering its physical and chemical properties. Table 3 reveals that the soups presented proteins, lipids, carbohydrates (all in a higher percentage than main part or peel), and minerals, all according to MAPA - Ministry of Agriculture and Food...
Table 2. Ariá centesimal composition and its main part.

<table>
<thead>
<tr>
<th>Components</th>
<th>Main part (%)</th>
<th>Peel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash</td>
<td>0.72</td>
<td>1.14</td>
</tr>
<tr>
<td>Moisture</td>
<td>84.78</td>
<td>85.81</td>
</tr>
<tr>
<td>Protein</td>
<td>1.02</td>
<td>1.22</td>
</tr>
<tr>
<td>Lipid</td>
<td>0.11</td>
<td>0.12</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>13.35</td>
<td>11.69</td>
</tr>
<tr>
<td>°Brix</td>
<td>3.20</td>
<td>5.60</td>
</tr>
<tr>
<td>Titratable Acidity</td>
<td>0.08</td>
<td>0.26</td>
</tr>
<tr>
<td>pH</td>
<td>6.72</td>
<td>5.59</td>
</tr>
<tr>
<td>WAI</td>
<td>2.51</td>
<td>4.14</td>
</tr>
<tr>
<td>WSI</td>
<td>7.81</td>
<td>21.13</td>
</tr>
</tbody>
</table>

A*: soup with 40% ariá flour and 60% corn starch.
B*: soup with 50% ariá flour and 50% corn starch.
C*: soup with 60% ariá flour and 40% corn starch.
D*: soup with 25% ariá flour + 25% ariá’s peel flour and 50% of corn starch.

Table 3. Centesimal, physicochemical and minerals results of dehydrated soups.

<table>
<thead>
<tr>
<th>Soups</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centesimal Composition (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ashes</td>
<td>17.21</td>
<td>17.06</td>
<td>17.14</td>
<td>18.57</td>
</tr>
<tr>
<td>Moisture</td>
<td>2.11</td>
<td>2.30</td>
<td>2.47</td>
<td>2.17</td>
</tr>
<tr>
<td>Protein</td>
<td>6.74</td>
<td>5.94</td>
<td>5.81</td>
<td>7.10</td>
</tr>
<tr>
<td>Lipid</td>
<td>2.29</td>
<td>1.66</td>
<td>2.05</td>
<td>2.25</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>71.66</td>
<td>73.42</td>
<td>71.53</td>
<td>69.91</td>
</tr>
<tr>
<td>Energy value</td>
<td>334.21</td>
<td>332.38</td>
<td>336.81</td>
<td>328.29</td>
</tr>
</tbody>
</table>

Physicochemical Evaluation

| °Brix | 23.15 | 31.30 | 27.81 | 30.47 |
| Titratable Acidity | 1.15  | 1.25  | 1.35  | 2.01  |
| pH | 6.15  | 6.14  | 6.14  | 5.98  |

Minerals (mg / 100g)

<table>
<thead>
<tr>
<th>Iron</th>
<th>Traces</th>
<th>Traces</th>
<th>Traces</th>
<th>Traces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manganese</td>
<td>Traces</td>
<td>Traces</td>
<td>Traces</td>
<td>Traces</td>
</tr>
<tr>
<td>Zinc</td>
<td>2.18</td>
<td>0.33</td>
<td>0.69</td>
<td>1.97</td>
</tr>
<tr>
<td>Calcium</td>
<td>28.75</td>
<td>40.43</td>
<td>36.7</td>
<td>7.03</td>
</tr>
<tr>
<td>Sodium</td>
<td>2135.00</td>
<td>2326.10</td>
<td>2410.60</td>
<td>2135.00</td>
</tr>
<tr>
<td>Potassium</td>
<td>903.10</td>
<td>958.57</td>
<td>1039.00</td>
<td>586.00</td>
</tr>
<tr>
<td>Magnesium</td>
<td>66.60</td>
<td>61.30</td>
<td>64.95</td>
<td>102.50</td>
</tr>
</tbody>
</table>

A*: soup with 40% ariá flour and 60% corn starch.
B*: soup with 50% ariá flour and 50% corn starch.
C*: soup with 60% ariá flour and 40% corn starch.
D*: soup with 25% ariá flour + 25% ariá’s peel flour and 50% of corn starch.

Supplies (1997), essential elements for a good diet and with important and differentiated functions for a good metabolism. The lipid content of the soups was relatively low, ranging from 1.66 for soup B to 3.05 for soup C. Soups could thus be considered a low-fat food according to Brazilian legislation (BRASIL, 1998).

In the determination of protein content, the soups had a value ranging from 5.81 for soup C to 7.10 for soup D. Since this protein content is greater than 5% of the daily protein intake for an adult, these soups are considered as food source group of proteins, according to Brazilian legislation (BRASIL, 2004; BRAZIL, 1998). The soups presented a
carbohydrate content ranging from 69.91 for soup D to 73.42 for soup B. This amount of carbohydrate is mainly due to the fact that ariá is rich in starch and is combined with corn starch, which has the important function of reducing main part temperature (64.8°C) and tendency to retrograde (Franco et al., 2001; Zobel and Stephen, 1995; Freitas et al., 2003). The carbohydrate content of the soups led to an energy value of 334.21 kcal for soup A, 332.38 kcal for B, 336.81 kcal for C and 328.29 kcal for D. Soup D, then, contains the lower caloric value and B the greater. The moisture content of the soups varied between 2.11 and 2.47% and, concomitantly, the highest dry matter obtained was 98.34% while the lowest was 96.95% in 100 g of the product. That provides a reduced water activity which provides unfavorable conditions for microorganisms’ activities and consequent alteration of its characteristics of the soup, resulting then to a longer shelf life for the product. The ashes of a food are the inorganic residues that remain after the organic matter is burned and transformed into CO₂, H₂O and NO₂ (Cecchi, 2003). The results for ash content ranged from 17.06% to 18.57%, being the latter from D. This may be justified by the low moisture content found in the same soup.

All minerals analyzed were present in the soups; manganese and iron were found in traces and the remainder in quantities within the recommended daily intake (FIB, 2008; WHO, 2006) for a soup (17.5 g for 350 mL of water). Although they are small in number, minerals are essential and vital because they help the metabolism of proteins, hormones and vitamins in the body, as well as several other functions (WHO, 2006). All the results obtained in this work regarding the soups’ nutritional quality are similar to those obtained by Abdel-Haleem and Omran (2014) for dried vegetarian soup.

**Microbiological analyses**

The microbiological results showed that all the treatments were with no contamination, evidencing the use of good hygienic practices during the soups processing and thus obeying the sanitary standards established by RDC N 12 of January 2, 2001 from the Brazilian Ministry of Health (MS) (BRAZIL, 2001). These results can be explained by the fact that the raw material was submitted to a drying process at 105°C for 2 days. Based on Valeschi (2006), the thermophilic microorganisms’ growth is inhibited between 55 and 75°C. It was shown by Oliveira (1994) that with 25 min of a heat treatment application at 70°C, it’s possible to reduce the microorganisms’ population to 99%. Then it can be concluded that for a 48 hours at 105°C, there was no microorganism left. The non-existence of water can be another explanation. The Aw represents the availability of water for the biochemical reactions for the development of the microorganisms, then a low value of water turns out the environment (product) unusable to the microorganisms’ activity (Ahlem et al., 2012).

**Water absorption index (WAI)**

The soup A presented the lowest water absorption index of 1.61, followed by soups B with 1.73 and C with 1.83 and soup D presented the highest IAA with 1.93. The WAI depends on the availability of hydrophilic groups to bind to water molecules and the gel-forming capacity of macromolecules (Faubion et al., 1984). The soup having the highest availability of hydrophilic groups and consequently absorbing more water even at room temperature is soup D, followed by C and B and finally soup A.

**Water solubility index (WSI)**

Soup B presented a highest solubility index in water with 40.83%, followed by C soups with 38.67% and D with 38.67%, and the lowest index was Soup A with 35.68%. The WSI is related to the amount of soluble solids present in the dehydrated soups and allows to verify the degree of the heat treatment due to gelatinization, deextrinization and consequent solubilization of the starch among other components (Moura, 2011), which explains the total soluble solids content proportional in the soups, with the largest in soup B and the smallest in soup A.

**Color**

The color evaluation results of the soups are shown in Table 4. The brightness (L* ) was higher in soup C, followed by soups A and B, and lower in soup D. The brightness (L*) of all soups was greater than chroma (a*) and chroma (b*), which characterizes lighter colors because they are close to pure white. The low and positive values obtained for (a*) , a color component that varies from green when below zero (-) to red when above zero (+), indicate that, in most varieties, colors tended to a red intensity. The high and positive values of chroma (b*) indicate that, in most varieties, colors tended to a yellow intensity.

**Sensory analysis**

The sensory attribute analysis results of each soup were inserted into the Excel program and the whole generated the graph shown in Graph 1. Regarding the attribute of appearance, the soup C had the best preference, followed by soups D and A, and finally soup B. Regarding the attribute of color, the soup C had a better preference, followed by soups D, C and finally, the soup A. Regarding the attribute of texture, the soup C had a better preference, followed by soups D and B, and finally the soup A. Regarding the
Table 4. Soup color indicators.

<table>
<thead>
<tr>
<th>ID</th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soup A</td>
<td>82.92</td>
<td>0.09</td>
<td>13.52</td>
</tr>
<tr>
<td>Soup B</td>
<td>82.45</td>
<td>0.17</td>
<td>13.70</td>
</tr>
<tr>
<td>Soup C</td>
<td>83.11</td>
<td>0.41</td>
<td>13.15</td>
</tr>
<tr>
<td>Soup D</td>
<td>75.63</td>
<td>2.94</td>
<td>17.27</td>
</tr>
</tbody>
</table>

A*: soup with 40% ariá flour and 60% corn starch.
B*: soup with 50% ariá flour and 50% corn starch.
C*: soup with 60% ariá flour and 40% corn starch.
D*: soup with 25% ariá flour + 25% ariá’s peel flour and 50% of corn starch.

Graph 1: sensory attributes analysis of ariá soups (*Calathea allouia*).

attribute of taste, the soup D was tastier, followed by soups C and B, and the soup A was the least tasty. It was observed, then, that the soup C was the most preferred in relation to the sensorial attributes analyzed, followed by soups D and A and, finally, soup B.

**Buying intention**

The buying intention analysis result of each soup was inserted into the Excel program and generated the graph shown in Graph 2. The results confirmed the preference for the soup C; it would be the most bought by 38.46%, followed by soup D by 25.64% and soups A and B, by 17.94% of the 39 evaluators who affirmed they would buy a soup.

**Shelf life**

The results of pH, acidity measurements and acid titration for the 1st, 30th and 60th day are given in Table 5. For all the soups, the pH and acidity did not present significant variations during the storage time. The same characteristics were found in the work made by Bolzan and Da Silva, (2012), and his interpretation was the same done in this present work, that there was no microbial activity or development. The soups can then be stored and consumed in the range of, at least, two months.

Advantages of the dehydrated foods, particularly, dry soup mixes could be as a protection from spoilage and flavour stability at room temperature over long periods of time (Abdel-Haleem and Omran, 2014).

**Water activity (Aw) and crude fiber**

After having the soup C as a best soup, its water activity was measured and the result was 0.34. The Aw represents the availability of water for the biochemical reactions for the development of the microorganisms. The low value of water turns out the environment (product) unusable to the microorganisms’ activity; it was then unfavourable for their...
Table 5. Measurement of pH and acidity.

<table>
<thead>
<tr>
<th>Periods</th>
<th>1st day</th>
<th>30th day</th>
<th>60th day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pH</td>
<td>Acidity</td>
<td>pH</td>
</tr>
<tr>
<td>Soup A</td>
<td>6.15</td>
<td>1.16</td>
<td>6.15</td>
</tr>
<tr>
<td>Soup B</td>
<td>6.23</td>
<td>1.22</td>
<td>6.15</td>
</tr>
<tr>
<td>Soup C</td>
<td>6.15</td>
<td>1.35</td>
<td>6.14</td>
</tr>
<tr>
<td>Soup D</td>
<td>5.89</td>
<td>2.7</td>
<td>5.84</td>
</tr>
</tbody>
</table>

A*: soup with 40% ariá flour and 60% corn starch.
B*: soup with 50% ariá flour and 50% corn starch.
C*: soup with 60% ariá flour and 40% corn starch.
D*: soup with 25% ariá flour + 25% ariá’s peel flour and 50% of corn starch.

Graph 2: buying intentions of ariá soups (Cakathea allouia)

Development in the soup (Ahem et al, 2012). According to Bolzan (2013), there is no activity of molds, yeasts and many others microorganisms during that period. All this could explain why the soup has been conserved during two months at room temperature without pH and acidity variation. For the crude fiber, the results were 44.82%, where the insoluble fiber (40.28%) was much higher than the soluble fiber (4.54%). According to Ferguson et al., (2001), the high starch content can influence the level of fibers. The high level of fibers in the soup C could be a result of its composition in corn starch and the proper aria.

Dietary fibers are carbohydrates that are resistant to digestion and absorption in the human small intestine, with complete or partial fermentation in the large intestine. Dietary fibers promote beneficial physiological effects including laxation (AACC, 2001), decrease intestinal transit time and increase stool bulk; fermentable by colonic microflora; reduce blood total and/or LDL cholesterol levels; reduce post-prandial blood glucose and/or insulin levels (CAC, 2006). The soup C, through its crude fiber content, can provide all the benefits listed above.

Conclusion

It was verified in this work that the tubers of ariá have a considered content of moisture and carbohydrates and low content of fat, ashes and proteins; nevertheless they have a good raw material quality for the elaboration of dehydrated soups, considering other properties as water solubility or absorption index. It was also observed that dehydrated soups made with ariá flour contain most of the nutrients necessary for good nutrition, such as minerals. Dehydrated ariá soups can be stored at the room temperature and consumed for at least two months. All soups had light-colored characteristics close to pure white, tending to red and yellow intensities. Soup D (soup with 25% ariá flour + 25% ariá’s peel flour and 50% of corn starch) had the highest water absorption index, and soup B (50% ariá flour and 50% corn starch) presented the highest solubility index in water. Soup C (soup with 60% ariá flour and 40% corn starch) is the best composition to adopt, since it got better results in the acceptability test and the buying intention, and presented an important content of fiber and a low water
activity. The aria can then be used as a raw material to elaborate dehydrated soups and its peel cannot be neglected. The use of traditional raw materials such as aria for the development of dehydrated soups contributes to the diversification of aria use and can serve as an incentive for producing regions. Besides, dehydrated soups have a positive impact on consumer life, especially for people who have little time to prepare food, since their preparation only requires the addition of water and small application of heat.

**Conflict of interests**

The authors did not declare any conflict of interests.

**ACKNOWLEDGEMENT**

The authors are grateful for the Laboratory of Physicochemical of Food of the National Institute for Amazon Researches (LFOA / INPA) and the Laboratory of Food Microbiology of the Federal University of Amazonas. The authors also thank the Amazon Research Foundation (FAPEAM – Fundação de Amparo à Pesquisa do Estado do Amazonas) for financial support, process 062.01725/2014 – PAPAC and 062.00682/2015 Universal.**

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APPENDIX

1) Ariá in natura being sanitized

2) Peeled ariá

3) Ariá’s pells

4) Packed flours from dehydrated and ground ariá (white) and its peel (brown)

5) Titrating acidity

6) Measuring pH
7) Boiling the soup
8) Soup

9) Measuring °Brix
10) Analysis of soups’ colours

11) Fecal coliforms test
12) Molds and yeasts
13) Water activity meter