Rheological and nutritional characteristics of infant flours prepared from mixed flours of taro (*Colocasia esculenta* (*L.*)) *Schott*, soybean and baobab pulp


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Abstract

If, according to the UN, chronic hunger is declining, it still affects 795 million people worldwide. In sub-Saharan Africa, one in four people is undernourished. Malnutrition kills 3.1 million children under the age of five each year. This study aims to contribute to children’s food security by complementing feeding age through taro valorization in Benin. Rheological and nutrient qualities of two infant flours formulated (FT25, FT35) with a mixed flour of taro, soybean and baobab pulp were evaluated. These flours were analysed for their rheological, nutritional, microbiological and sensory profiles by standard methods. The result indicates that the rheological characteristic was 250.50, 345.50 and 353 cp respectively for FT25, FT35 and commercial infant flour “Beau bébé” (FBB). The infant flours FT25, FT35 and FBB had respectively 91.07±0.5; 91.65 ±0.04 and 93.68±0.007% for dry matter. The protein, fat and carbohydrate content were 14.97±0.01; 5.46±0.14 and 68.41±0.46% for FT25, 20.96±0.01; 7.31±1.06 and 60.30±1.73% for FT35 and 15.81±0.31; 7.34±0.05 and 67.31±0.32% for commercial infant flour FBB. The ash content and energy value were respectively 2.23±0.03% and 382.23±2.53Kcal for FT25; 2.58±0.08% and 390.85±2.67Kcal for FT35; 3.21±0.03% and 399.12±0.25Kcal for commercial infant flour FBB. It then becomes important to promote the product developed in order to valorize taro and to contribute to children’s food security in Benin. This goes through an industrial production and commercialization of taro based infant flours fortified with soybean.

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Introduction
Nutritionally adequate complementary foods are of high priority in developing countries. Adequate complementary feeding practices and appropriate quality and quantity of foods are essential components of optimal nutrition health and development for infants and young children from the age of 6 months, breast milk is no longer sufficient to meet infant nutritional needs according to WHO recommendations (WHO, 2003). Optimal nutrition in the first year of life is crucial in laying the foundation for good nutrition, health and development in later life (Mitchodigni et al., 2017). Globally, 159 millions of children under five years are still affected by stunting with more than a third living in Africa (WHO, 2014). Malnutrition among infants in low-income countries is an important public health problem and can be related to the composition and formulation of the complementary foods introduced after the breastfeeding period and inadequate complementary feeding practice (Issaka et al., 2015). Insufficient knowledge on infant feeding, poverty and cultural practices may affect the adequacy of the complementary feeding (Kulwa et al., 2015; Kouton et al., 2017). According to the UN, chronic hunger is declining but it still affects 795 million people worldwide. "Chronic hunger" means lack of sufficient food to lead a healthy and active life. The vast majority of hungry people live in developing countries, where 12.9% of the population is undernourished. In sub-Saharan Africa, one in four people suffer from malnutrition. Malnutrition kills 3.1 million children under the age of five a year. In francophone West African countries, malnutrition remains a pertinent problem and mothers are not well educated on how to provide the correct nutrition for their infant.

Indeed, complementary feeding period is the time when malnutrition starts in many infant and many factors contribute to the vulnerability of children during this period (Victora et al., 2016). The complementary foods are often characterised by low nutritional quality and given to infant in insufficient amounts. When given too early or too frequently, they are likely to displace breast milk (Dolan et al., 2015). It significantly contributes to the high prevalence of malnutrition in children under 5 years of age worldwide (WHO, 2012). Improved complementary feeding and breastfeeding practices with reduced morbidity are essential to achieving the Millennium Development Goals (MDGs) for child survival and prevention of malnutrition (Lutter, 2003). Complementary feeding improvement should be of highest priority for nutrition optimal of infant and young children because of it crucial role in preventing mortality and enhancing children development (Faber et al., 2014). Over 70% of dietary protein in developing countries is supplied by cereals that are relatively poor sources of protein (Mitchodigni et al., 2017). Formulation and development of nutritious complementary foods from local and readily available raw materials has received a lot of attention in many developing countries (Kouton et al., 2017; Mitchodigni et al., 2017).

In Benin, complementary feeding practices are not optimal. Complementary foods introduced by the mothers are mostly simple maize porridge and / or whether or not fermented sorghum porridge obtained from recycled maize dough. Porridge is slightly enriched with protein materials and daily distribution frequency is low (Atègbo, 1993; Kouton et al., 2017). Poor feeding practices and shortfall in food intake are the most important direct factors responsible of malnutrition and illness among children in Benin (Amoussa Hounkpatin, 2011). These practices, which are the use of poor quality complementary foods and inappropriate conduct of complementary feeding practices, partly explain the prevalence of 34% of stunting observed in Benin preschool children (INSAE, 2015).

It is then necessary to propose to mothers, the high energy and minerals dense foods which will cover nutritional and energy needs for infant and young children (Kouassi et al., 2015; Zannou-Tchoco et al., 2011). In order to reach these goals and to promote the forsaken agro-resources, poorly or little used, we chose to use taro tuber as a carbohydrate source to
improve the nutritional and organoleptic characteristics of complementary foods. Although, they are ample information on complementary foods from cereals, the potential of roots and tubers crops such as taro (*Colocasia esculenta* L.) to serve in the formulation of infant flours, has not yet explored by researchers in Benin. Le taro est l’un des tubercules délaissés, mal et/ou peu utilisés réservé seulement à la production et à la consommation domestique (FAO, 2009). Originally from Malaysia, taro (*Colocasia esculenta* L. SCHOTT) is a monocotyledonous plant belonging to the family of araceae and asian origin. This culture developed towards Polynesia from where it comes to it the name of Taro (Himeda et al., 2012). In Benin, the lack of diversified technologies for processing, especially in the producing or non-producing regions and the lack of valorisation efforts could explain the drop in taro production which went from 2475 tons in 2007 at 700 tons in 2011 (FAO, 2011).

Taro (*Colocasia esculenta* L.) is widely cultivated worldwide mainly for its edible roots rich in calories, dietary fiber (3.6 et 3.8%) and some biologically active phytochemicals such as essential amino acids, polyphenols, ascorbic acid (Himeda et al., 2012). Taro (*Colocasia esculenta* L.) is a food who containing 60 to 90% of carbohydrates, 0.4 to 0.7% of lipid and 1 to 4.5% of protein. The level of starch is 66 to 86% (Huang et al., 2007). Taro contains a high levels of minerals, so potassium is principal mineral of tuber of taro with a level of 1% (Contreras-Padilla et al., 2011). Taro flour has particles of very small sizes ranging from 1 to 4 µm which gives it a great digestibility to its starch (Himeda et al., 2012). But, this flour is of limited use for the industry. In west Africa, especially in Benin, tarr is almost exclusively consumed in boiled or fried form (Houngbo et al., 2015). In fact, it is a good basis in the preparation of infant complementary foods, which can be enriched with protein-rich foods such as soybean and pulp of baobab who contains high protein, minerals and vitamins (Contreras-Padilla et al., 2011). The objective of this study is to formulate new complementary infant flours, by combining a local product such as Taro flour with soybean flours and baobab pulp and to assess their nutritional, rheological, microbiological and sensory properties.

Materials and methods
The raw material is consisted of tuber such as: Taro (*Colocasia esculenta* L.), grains of soybean (Glycine max; yellow grains) and baobab pulp (*Adansonia digitata*). Raw material was obtained from local market at Ouando also located in southern Benin.

Infant flours preparation
The raw tubers of Taro were washed in tap water to remove dirt and soil peeled with a kitchen knife and sliced into pieces following Sanoussi et al. (2013). This method includes a boiling step which is among the most effective treatment that drastically reduced the anti-nutritional load of the tuber. Tuber peeled were cut small pieces about 0.5 cm thick and kept submerged in a water tank. The small pieces have been cooked during 5 minutes at 60°C and then dried in an incubator at 40°C during 72 hours. Then, the dried pieces of taro were crushed by the method of Elenga et al. (2012). Soybean seeds are sorted washed roasted and then crushed.

The infant flour has been prepared by mixing, in varied proportions, the taro flour, soybeans flour and “baobab pulp”. The mixture was placed in polyethylene bag at room temperature to simulate the storage conditions in developing countries.

Infant flours formulation
Two complementary foods were elaborated. For the optimized and fortified formulation (FT25 and FT35), complementary foods (infant flours) were processed by mixing in varied proportions the taro and soybeans flours with baobab pulp as specified by FAO and WHO Commission (2006) recommendations for infant complementary food for older infants and young children (Table 1). Nutritional, microbiological, rheological analysis and sensory profiles of infant flours were assessed following multiple comparison test carried and infant flours in comparison to “Beau-Bébé” (FBB) commercial infant flour in Benin.
Physico-chemical and rheological analysis of the infant flours

The physico-chemical compositions and rheological of infant flours were determined using recommended methods (AOAC, 2000). The samples were analysed for Moisture, pH and titratable acidity. The viscosities of infant flours were determined by method of Analysse Rapid RVA modèle-super4.

Nutritional and microbiological analysis of the infant flours

Proximate composition of protein, fat, and ash contents of the samples were determined following AOAC (2000) and the process described by Soro et al. (2013). Total available carbohydrate was calculated as 100% minus the sum of moisture, protein, fat and ash contents obtained as described above. Energy Value (EV) was calculated according to equation of Atwater and Benedict (1902). EV = (9 x Fat (%) + 4 x Proteins (%) + 4 x Carbohydrates (%)) according to the method of Zannou-Tchoko et al. (2011).

Mineral element (Fe, Ca, Zn and Mg) concentrations were obtained using Atomic Absorption Spectrophotometer. Microbiological analysis was determined using the method described by Sanoussi et al. (2013). Micro-organisms research included total aerobics, yeasts and molds, faecal coliforms, Escherichia coli bacteria and staphylococcus. All the results were carried out in triplicates.

Sensory profiles assessment

Sensory profiles of porridges of infant flours formulated were assessed following multiple comparison test carried out in comparison. Color, aroma, taste, consistency, overall acceptability and preference were appreciated by 30 mothers of children at complementary feeding period (Amagloh et al., 2013). For evaluate overall acceptability, 5-point hedonic scale with 1 as least acceptable/dislike extremely and 5 as highly acceptable/like extremely were used. Samples were simultaneously presented to tasters in cup and tap water was provided for rinsing the mouth between samples.

Statistical analysis

The data obtained were subjected to analysis of variance (ANOVA) and the t test of Students, Newman Keuls procedures Statistica 7.1 were used to perform descriptive analysis and compare the means of triplicate measurements of physico-chemical, nutritional, and rheological parameters.

Let’s notify that the means were considered to be significantly different when p <0.05. The least significant difference test was used to separate the means when the difference was significant.

Results

Physico-chemical and rheological analysis of the infant flours

The physico-chemical and rheological characteristics for the infant flours (FT25, FT35 and commercial infant flour FBB) were showed in Table 2.

The moisture of infant flours FT25 (8.92%) and FT35 (8.84%) was higher than recommended value (6.31%) by FAO/OMS (2006).

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Table 1. Infant flours formulation.

<table>
<thead>
<tr>
<th>Infant flours</th>
<th>Material (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Taro flour</td>
</tr>
<tr>
<td>FT25</td>
<td>70</td>
</tr>
<tr>
<td>FT35</td>
<td>60</td>
</tr>
</tbody>
</table>

The viscosities of infant flours FT25 (345.50±0.71cp) and FBB (353.51±1.16cp) were significantly higher than those of infant flour FT35 (250.50±0.71cp) and the pH of commercial infant flour FBB was significantly higher than that of infant flours formulated. The titratable acidities values range from 0.80 ± 0.05 (FBB) to 1.06 ± 0.14 (FT35) %eq lactic acid and the pH values range from 5.05 ± 0.04 to 6.14 ± 0.01.
Table 2. Physico-chemical and rheological characteristics of infant flours.

<table>
<thead>
<tr>
<th>Infant flours</th>
<th>Characteristics of infant flours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moisture (%)</td>
</tr>
<tr>
<td>FT25</td>
<td>8.92±0.57</td>
</tr>
<tr>
<td>FT35</td>
<td>8.44±0.67</td>
</tr>
<tr>
<td>FBB</td>
<td>6.31±0.01</td>
</tr>
</tbody>
</table>


*: not specify.

Values in the same row with different superscripts are significantly different (p <0.05).

Nutritional and microbiological analysis of the infant flours

These nutritional characteristics of infant flours, were summarized in Table 3. FT25 (containing taro flour, roasted soybean flour and baobab pulp in ratio 70/25/5) and FT35 (containing taro flour, roasted soybean flour and baobab pulp in ratio 60/35/5) infant flours revealed dry matter, carbohydrates, protein, fat, and ash which were statistically different (P<0.05) to the rates of each nutrient taken independently. FT25 has 91.07% dry matter, the protein ratio 14.98%, 5.46% of fat, 2.23% of ash and energy value was 382.23 kcal/100g. The protein content (14.98%) was conforming to recommended value (15%). Formulation FT35 present 91.65% of dry matter content, 20.96% of protein, 7.31% of fat, 2.58% of ash content and 390.85 kcal/100g for energy value. This formulation has a dry matter (91.07%), lipid content (5.46%) and ash content (2.23%).

Table 3. Nutritional characteristics of infant flours.

<table>
<thead>
<tr>
<th>Infant flours</th>
<th>Characteristics of infant flours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dry matter (%)</td>
</tr>
<tr>
<td>FT25</td>
<td>91.07±0.57</td>
</tr>
<tr>
<td>FT35</td>
<td>91.65±0.04</td>
</tr>
<tr>
<td>FBB</td>
<td>93.69±0.01</td>
</tr>
</tbody>
</table>


Values in the same row with different superscripts are significantly different (p <0.05).

The dry matter, fat, ash contents and energies values of formulation FT25 and FT35 were lower than recommended values (8% for fat, 2.9% for ash content and 400 kcal/100g for energy value). The dry matter, protein, Fats, ash content and energy value of the FT35 infant flour was higher than FT25 infant flour but still in accordance with the complementary food standard recommended by FAO/WHO (2006). So the carbohydrates content of FT35 (60.30%) was lower than that of FT25 (68.41%) infant flour. The nutritional characteristics of commercial infant flour FBB was conforms to recommended value of the FAO /WHO (2006) for infant flour using as a complementary food. Only FT25 flour containing 60% taro flour, 35% roasted soybean flour, 5% of baobab pulp allowed to prepare a complementary food having 382.23 kcal energy value. But the energy value of FT25 (382.23 kcal) infant flour was lower than energy value recommended (400 kcal) by FAO/WHO (2006). This is energy value don’t could cover the infant energy requirements (400 kcal).

Mineral contents of the infant flour FT25 were lower than recommended value by FAO and WHO (2006) (Table 4) for complementary infant flours. But the magnesium content (83.6541mg) of FT25 was higher than the recommended value (48.7mg). The mean counts of organisms were presented in Table 4 in the formulated complementary foods with significantly (p < 0.05). FT25 infant flour had significantly higher (p < 0.05) E. coli count, yeast and molds, faecal coliforms and staphylococcal than formulation FT35.
(Table 5). But the formulation FT25 has a lower mean count of total aerobics. According to Codex Stan 74-1981 of Codex alimentarius recommendations (1981) related to the microbiological qualities of infant flours intended for cooking, the total number of total aerobics, faecal coliforms, E. coli, yeasts and moulds and Staphylococcal should be less than $10^5, 10^2, 10^3$ and $10$ cfu/g respectively.

Table 4. Mineral content of infant flour FT25.

<table>
<thead>
<tr>
<th>Infant flour</th>
<th>Iron</th>
<th>Calcium</th>
<th>Zinc</th>
<th>Magnesium</th>
</tr>
</thead>
<tbody>
<tr>
<td>FT25</td>
<td>6.6139 ± 0.56b</td>
<td>207.2637 ± 1.16b</td>
<td>2.0890 ± 0.14b</td>
<td>83.6541 ± 0.95a</td>
</tr>
<tr>
<td>Suitable composition (mg/100g) FAO/OMS (2006)</td>
<td>8.5 ± 0.66a</td>
<td>341.2 ± 1.06a</td>
<td>3.7 ± 0.22a</td>
<td>48.7 ± 1.30a</td>
</tr>
</tbody>
</table>

Values in the same row with different superscripts are significantly different (p <0.05).

Sensory profiles assessment

The results of the sensory profiles evaluation by panel members for various attributes (acceptability, aroma, consistency, color and taste) of the porridges made with the different infant flours (Table 6) showed that all the developed taro tuber base flour porridges were more appreciated than the commercial infant flour “Beau bébé” used in Benin.

The formulation FT35 was more appreciated than FT25. However, FT25 infant flour has obtained higher levels (90%) of preference by mothers.

Table 5. Mean count of organisms (cfu/g) in infant flours FT25.

<table>
<thead>
<tr>
<th>Infant flours</th>
<th>Total aerobic</th>
<th>Faecal coliforms</th>
<th>Escherichia coli</th>
<th>Yeast and molds</th>
<th>Staphylococcal</th>
</tr>
</thead>
<tbody>
<tr>
<td>FT25</td>
<td>$2.51 \times 10^3 ± 0.21b$</td>
<td>$50 ± 0.00a$</td>
<td>$54 ± 0.00a$</td>
<td>$10 ± 0.14a$</td>
<td>$5 ± 0.25^a$</td>
</tr>
<tr>
<td>FT35</td>
<td>$10^4 ± 0.30^a$</td>
<td>$25 ± 0.00b$</td>
<td>$2 ± 0.00b$</td>
<td>$5 ± 0.16b$</td>
<td>$4 ± 0.12b$</td>
</tr>
<tr>
<td>Standards</td>
<td>$&lt;10^5$</td>
<td>$&lt;100$</td>
<td>$&lt;10$</td>
<td>$&lt;10^3$</td>
<td>$&lt;10$</td>
</tr>
</tbody>
</table>

Values in the same row with different superscripts are significantly different (p <0.05).

Discussion

Physicochemical characteristics of the produced flours

Lack of nutrient-dense complementary foods is one of the common factors accounting for decline in satisfactory growth pattern in children (Anigo et al., 2010). Kouton et al. (2017) reported that appropriate number of feeding by children depends on the energy density of the local foods and the usual amount consumed at each feedings. The physico-chemical characteristics of infant flours have revealed that formulation FT25 who contains taro flour (70%), roasted soybeans flour (25%) and “baobab pulp” (5%) has 91.07% of dry matter and moisture of 8.92%. Moisture of FT35 was 8.84%. These moistures of infant flours were higher than the recommended value (5%) by FAO/WHO (2006). The higher moisture of infant flours was due to insufficient dried conditions (temperature and times) of pieces of taro tubers. But the higher moisture can have developed the undesirable modifications of nutritional and organoleptic characteristics of infant flour during the storage. Dry matter, fat, ash and energy value levels are lower than 95% for dry matter, value recommended by the FAO/WHO for standard complementary infant flour. Our result was higher than Sanoussi et al. (2013) who indicated 5.20% as moisture of infant flours based on sweet potatoes (75%) and roasted soybeans flours (25%). The moisture of formulation FT25 of the formulated complementary foods was higher with 4.5% founded by Gnahé et al. (2009) in complementary food based taro (74%) and pigeon pea flours.

Rheological characteristics of the flours produced

The viscosities of infant flours FT25 (345.50±0.71cP) was significantly higher than those of infant flour FT35 (250.50±0.71cP). The result showed that higher incorporation of roasted soybeans flour in formulation infant flour increase the viscosities of complementary infant flours. These results were close to those found by Soro et al. (2013), which showed
that, with the exception of 10% of soybean flour fortified, the viscosity of infant flour based yam and soybean flours decrease with the rate of the incorporation of soybeans. Kouton et al. (2017) revealed that the viscosities (mm/30sec) of infant flours decreased from traditional to fortified formulations based on soybeans flour (from 0; 26 to 31%).

### Table 6. Sensory profiles of infant flours.

<table>
<thead>
<tr>
<th>Infant flours</th>
<th>Colour</th>
<th>Aroma</th>
<th>Taste</th>
<th>Consistency</th>
<th>Acceptability</th>
<th>Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>FT25</td>
<td>83.3± 0.4³</td>
<td>53.3± 0.5³</td>
<td>96.66± 0.5³</td>
<td>86.66± 0.25⁴</td>
<td>36.67± 0.10⁴</td>
<td>90± 0.54⁴</td>
</tr>
<tr>
<td>FT35</td>
<td>83.9± 0.38³</td>
<td>54.3± 0.25³</td>
<td>93.33± 0.33³</td>
<td>96.66± 0.32³</td>
<td>46.67± 0.35³</td>
<td>85± 0.52³</td>
</tr>
<tr>
<td>FBB</td>
<td>76.66± 0.3³</td>
<td>43.33± 0.1³</td>
<td>96.66± 0.5³</td>
<td>16.66± 0.4³</td>
<td>36.37± 0.11³</td>
<td>90± 0.4³</td>
</tr>
</tbody>
</table>

Values in the same row with different superscripts are significantly different (p <0.05).

### Nutritional value of the produced flours

The nutritional value of infant flours have revealed that formulation FT25 who contains taro flour (70%), roasted soybeans flour (25%) and “baobab pulp” (5%) has 68.41% of carbohydrate, 14.98% of protein ratio, 5.46% of fat, 2.23% of ash and energy value was 382.23 kcal/100g. In the two formulations FT25 and FT35, only FT25 was the best formulation of infant flour that the formulation respected the recommended value (15% and 68%) respectively of protein and carbohydrate values by the FAO/WHO. However, these dry matter, fat, ash and energy value levels are lower than 95% for dry matter, 8% for fat, 2.9% for ash and 400 kcal for recommended energy value by the FAO/WHO for standard complementary infant flour. FT25 was the best formulation of infant flour that the formulation respected the recommended value (15% and 68%) respectively of protein and carbohydrate values by the FAO/WHO. It would be necessary to incorporate in this formulation of infant flour other lipid raw material such as palm oil, roasted groundnut, pigeon pea flour, fruits and legumes to improve the fat and ash contents. The carbohydrate level (68.41%) of formulation FT25 was in lined with Soro et al. (2013) in Côte d’Ivoire who founded 68.90% of carbohydrate in infant flour based of fermented yam flour incorporated with 30% of soybean flour. Fat content (5.46%), protein level (14.98%) and ash (2.23%) of infant flour FT25 were comparable respectively to 5.42%, 14% and 2.28% with those reported by Kayodé et al. (2012) in Benin, Zannou-Tchoco et al. (2011) in Côte d’Ivoire and Anigo et al. (2010) in Nigeria. Energy value (382.23 kcal) of FT25 was lower than recommended energy value (400 kcal) by FAO/WHO (2006). It was necessary to incorporate in this infant flour a malted cereals flours to improve the dry matter and energy value concomitantly. The result of Kouton et al. (2017) in Benin and Kouassi et al. (2015) in Côte d’Ivoire also showed that the use of malted maize and sorghum flours improved the dry matter and energy value of composite infant flour. Traoré et al. (2004) in Burkina-Faso reported that in order to enhance energy value of infant flours in order to meet nutritional requirements of young children, malted cereal flour should be added to infant flour in rate depending on raw material. These observations were in lined with those found by Kayodé et al. (2006) in Benin who reported that the malted maize flour is a good base in the preparation of infant gruel with good energy value. Formulation FT35 present 91.55% of dry matter content, 20.96% of protein, 7.31% of fat, 2.58% of ash content and 390.85 kcal/100g for energy value. The dry matter, protein, fats, ash content and energy value of the FT35 infant flour was higher than FT25 infant flour. The result revealed that the incorporation of 35% of roasted soybean flour in infant flour improved the nutritional characteristics such as dry matter, protein, fat, ash content, energy value and viscosity of the infant flour. These results are in lined with Oniludé (2009) who showed that the protein content of the combined cereals and legumes combined was better than that produced from cereals alone. Iron, calcium and zinc
levels of formulation FT25 were lower than recommended values by FAO/WHO (2006). But the magnesium content of FT25 (83.65) was higher than recommended value (48.7). Also, this low mineral content could be explained by infant flour processes and used raw materials (Taro tuber, soybean and baobab pulp). They might be fortified with mineral sources, in this case legumes and fruits, to cover the nutritional requirements of infant and young children. The calcium and magnesium contents (207.26 mg and 83.65 mg) of infant flour FT25 was higher than 13 mg and 70 mg respectively found by Gnahé et al. (2009) in infant flour based on Taro flour, pigeon pea, malted maize flour and sucrose. The iron content (6.61 mg) of FT25 was higher than 5.59 mg obtained by Soro et al. (2013) in complementary infant flour based on fermented yam and soybean flours. This is value was lower than 10 mg obtained by Gnahé et al. (2009) in infant flour based on Taro flour, pigeon pea, malted maize flour and sucrose. Soro et al. (2013) were founded 2.83 mg of zinc in complementary infant flour based on fermented yam and soybean flours and 2.08 mg have been found in formulation FT25. Gnahé et al. (2009) have founded 10 mg of zinc content in infant flour based on Taro flour, pigeon pea, malted maize flour and sucrose. The microbiological analysis obtained, showed that all the infants flours produced were conformed to microbiological standard Codex Stan 74-1981 of Codex alimentarius recommendations (1981). It was observed that the infant flours have been produced to adequate conditions. The sensory profiles evaluation by panel members for various attributes (acceptability, aroma, consistency, color and taste) of the porridges made with the different flours showed that all the developed taro tuber base flour porridges were more appreciated than the commercial infant flour “Beau bébé” used in Benin. The infant flour FT25 have been more preference than infant flour FT35. This preference is explained by nutritional value of infant flour FT25. As reported by Gnahé et al. (2009), Amagloh (2013) and Sanoussi et al. (2013) the results indicated that root and tuber can serve as basis for nutritious infant flours. In terms of taste, tasters reported that porridge of taro tuber flour were sweeter that the commercial infant flour “Beau bébé”. The formulation FT25 and FT35 presents the high organoleptic characteristics and could be using as complementary food for cover the requirement nutritional needs of children in the age of complementary feeding.

**Conclusion**

This study showed that taro flour is a local available raw material, which present a good nutritional quality and not toxic for human consumption. When enriched with soybean flour in specific ratios. it can be used as complementary infant flour and a potential complementary food of high nutritional, microbiological and organoleptic qualities. Only the infant flours FT25 have presented good nutritional characteristics conforms to FAO/WHO recommendations. But, fat and mineral contents are lower than recommended value by the FAO/WHO for standard complementary infant flour. It would be necessary to incorporate in this formulation other lipid raw material, fruits and legumes to improve the fat and mineral contents of this formulation, while increasing the potential to overcome protein-energy malnutrition and mineral deficiencies within infants and young children.

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