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Physico-chemical and mineral characterizations of three local raw materials (millet, nutsedge, declassified cashew kernel) with a view to their use in the formulation of infant food in Côte d'Ivoire

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Abstract: Beyond 6 months after birth, breast milk no longer contains enough nutrients to meet the growing demand of the infant. In order to offer a solution to this situation, the combination of three local raw materials (millet, tiger nuts, downgraded cashew kernel) allowed us to formulate a flour of high nutritional value. For this, a characterization of the raw materials was made. The results indicated protein contents of 7.88 ± 0.10% for millet, 6.13 ± 0.05% for tiger nut and 18.38 ± 0.04% for downgraded cashew kernel. High ash levels were observed in downgraded cashew kernel and tiger nuts, which were 2.36 ± 0.53 mg/100g and 2.34 ± 0.04 mg/100g, respectively. Millet presented high contents of calcium (0.83 ± 0.56 mg/100g), potassium (0.389 ± 0.29 mg/100g), iron (4.17 ± 0.99 mg/100g) and in copper (2.52 ± 0.23 mg/100g). Cashew kernel gave the best contents of magnesium (0.428 ± 0.11 mg/100g), potassium (0.51 ± 0.05 mg/100g) and phosphorus (0.24 ± 0.09 mg/ 100g). Tigernut offers good levels of several minerals, notably zinc (2.320 ± 0.19 mg/100g) and calcium (0.949 ± 0.28 mg/100). The Bravais-Pearson matrix showed overall strong correlations between macronutrients (proteins, lipids, carbohydrates, etc.) and also between micronutrients (sodium, magnesium, iron, etc.), thus suggesting a possibility of formulating infant foods. from these three local raw materials.

Keywords: *Infant food; Millet; Tiger nut; Downgraded cashew kernel*

1. Introduction

Malnutrition is endemic in Côte d'Ivoire, especially for vulnerable populations such as infants. One of the many causes is that at the age of 6 months, breast milk alone is not sufficient to cover the child's energy needs (WHO, 2003). It is therefore recommended to include complementary foods. These are the first foods that the infant consumes when breast milk becomes insufficient to meet its needs. These foods must therefore be nutritionally rich because they are designed to cover the nutritional needs of the child (WHO, 2003) like commercial flours. Imported commercial flours provide solutions to meet the nutritional needs of infants, but their inaccessibility for most households due to their cost makes them a limiting factor. An alternative to this situation is the use of locally accessible raw materials (WHO, 2003).

In Côte d'Ivoire, several raw materials could be used for the formulation of complementary foods with regard to availability, nutrient composition and acceptability. Millet (Pennisetum glaucum) is one of the most cultivated cereals in southern country. This cereal has a relatively higher nutritional value than rice, wheat and corn and is often used to make complementary foods for children (Vital, 2018). But like most cereal products and tubers, millet does not have sufficient protein and micronutrient contents to cover the nutritional needs of the child (Fofana, 2018). An alternative to combat malnutrition is therefore the enrichment of these local products (WHO, 2005).

Legumes have often been used for the fortification of complementary foods. Among them, the cashew kernel. The cashew kernel is an important source of nutrients. This legume, due to its richness in nutrients (micro and macronutrients), could be used for the fortification of millet-based flours (Songré-Ouattara *et al*., 2016). It has good protein contents (Soro, 2012). Cashew nuts have good nutritional value due to their protein content (20-24 g/100g), carbohydrates (23-25 g/100g), lipids (40-57 g/100g) (Ogunwolu et al., 2009; Yang, 2009; Nasscimento et al., 2010) and minerals (Akinhanmi and Atasie, 2008).

However, the mineral content could also be reinforced by other local products such as tiger nut. Tiger nut presents itself as an alternative in the fortification of complementary foods due to its richness in fiber and minerals such as potassium, phosphorus, vitamins E and C (Umelo et al., 2014). The calcium levels observed in tiger nut are adequate for strengthening the bones and teeth of infants. Tiger nuts transformed into flour can be used to fortify complementary foods made from cereals. Tiger nut flour, due to its high calcium content, could be used as a supplement to cereals to increase the calcium content in foods (Oladele and Aina, 2007). Furthermore, tiger nut has a high ash content which indicates a significant presence of calcium, phosphorus, zinc, iron and magnesium (Fofana et al., 2017). This tuber is richer in minerals than the fruits, vegetables and cereals often consumed. Regular consumption of foods rich in minerals is a guarantee of providing the daily needs for these minerals (Ban-Koffi, 2005).

In this work, the aim was to determine the chemical and mineral composition of millet, declassified cashew kernel and tiger nuts in order to plan possible combinations for the formulation of infant foods of high nutritional value intended for children. at weaning age.

2. Methodology

2.1 Materials

Three local raw materials were used in the present study. These are millet (*Pennisetum glaucum*), downgraded cashew kernel (*Anacardium occidental L*.) and nutsedge (*Cyperus esculentus*). The millet (**Figure 1**) was purchased on the market in the town of Yamoussoukro in the center of Côte d'Ivoire from a women's cooperative. The cashew kernels (**Figure 2**) were supplied by the training factory of the National Polytechnic Institute (INP-HB) in Yamoussoukro (Côte d'Ivoire). The tiger nut (**Figure 3**) was obtained at the large market in the commune of Bouaké, a town located in the center of Côte d'Ivoire.

Figure 1. Millet grains

Figure 2. Downgraded cashew kernels

Figure 3. Tiger nut seeds

2.2 Methods

2.2.1 Production of millet flour

A quantity of 500 g of millet was sorted and washed with distilled water three times in order to remove all impurities. The millet grains were then dried in an electric rack dryer at 60 °C for 17 h. The dried millet is then crushed using a hammer mill with a mesh size of 200 µm. The flour obtained is stored in tightly closed plastic bags and kept at room temperature (30 to 37 °C) in a storage room.

2.2.2 Production of downgraded cashew almond flour

The production of downgraded cashew kernel flour was carried out according to the method described by (Sze-To and Sathe, 2000). The degraded cashew kernels obtained are crushed using a semi-artisanal grinder (YIBU TYPE 30 China). The crushed almonds were passed through an electric rack dryer at 70 °C for 17 hours. The dried almonds are ground using a 200 micron sieve grinder. The almond flour obtained is stored in plastic pots at room temperature (30 to 37 °C) protected from all physical and chemical contamination.

2.2.3 Tiger nut flour

The tiger nut grains purchased at the large Bouaké market were sorted to remove impurities and then washed three times with distilled water. The tiger nut grains were then dried at 70 °C for 17 hours in an electric rack dryer and roasted at 80 °C for 45 min in an open roaster. The grains are then removed and placed on a stainless steel tray for cooling and then crushed in a laboratory hammer mill (AR 108B). The tiger nut flour obtained is stored in plastic bags protected from all physical and chemical contamination.

2.2.4 Physico-chemical and mineral analyzes

The analyzes were carried out in triplicate in order to average them for the determination of the parameter considered.

2.2.4.1 Determination of physicochemical parameters

The physicochemical parameters of the samples were determined at the Laboratory of Industrial Processes, Syntheses, Environment and New Energies (LAPISEN) of the Institut National Polytechnique Félix Houphouët Boigny (INPHB) in Yamoussoukro in Côte d'Ivoire. The moisture content (MC) and dry matter content (DM) of the flours were determined after drying the samples in an oven following the AOAC method (AOAC, 1990). Five grams (5 g) of samples were dried in an oven (Memmert, Germany) at 105 °C for 24 h. The dried sample was then removed and cooled in a desiccator for 20 min. The difference in mass before and after drying made it possible to determine the humidity level. The humidity and dry matter levels were determined respectively from **equations (1)** and **(2)**:

$$MC\ (\%) = \frac{m_1 - m_2}{m_1 - m_0} \times 100 \qquad \textbf{Eqn. 1}$$

$$DM\ (\%) = 100\% - \%H \qquad \textbf{Eqn. 2}$$

With :

m_0 : mass of the empty crucible (g) ;
m_1 : mass of the empty crucible plus sample before drying in the oven (g) ;
m_2 : mass of the empty crucible plus sample after drying in the oven (g).

The ash content (AC) is determined by incineration of 10 g of sample in a muffle furnace (Nabertherm, Germany) at 550 °C for 8 h (AOAC, 1990). The sample is removed from the oven and cooled in a desiccator for 20 min then weighed on an electronic balance (Chimadzu, Japan). The center rate is determined using **equation 3**:

$$AC\ (\%) = 100 - \%MS \qquad \textbf{Eqn. 3}$$

The protein content (PC) is determined by the Kjeldhal method after determining the total azote (AOAC, 1990). The concentration of azote (%N) is determined to be used to calculate the protein content part of the **equation 4** (AOAC, 1990) :

$$PC\ (\%) = 6,25 \times \%N \qquad \textbf{Eqn. 4}$$

The lipid (%Lip) content is determined by the Soxhlet method. so, a socket (Unit Tecator, System HT2 1045, Suède) a permis l'extraction des lipides à partir de l'hexane. The hexane (the solvent) is used to evaporate the surface of the lipids (AOAC, 1990). For this reason, a quantity of 10 g of foam (me) is introduced into the cellulose cartouche that has been put into the cotton aide to get the fragrance of the lamp at night extraction. A mass ballon (m0) containing 300 mL of hexane is placed on a calorie chauffant (Em 200/CE, Electrothermal, Paris, France) used to place a flux and reflux system for 6 hours. A rotating vaporizer (R-100, Buchi, Paris, France) will be used to remove hexane. The ballon is placed at 80 °C for 24 hours to eliminate all traces of solvent. The ballon can be replaced and placed in a pendant device 5 meters wide (1 m). The content of the lipids is determined by the **equation 5**. The content in the capsule is placed on a stove (Membert 854 Schwabach, Allemagne) at 105 °C for 1 hour before removing any traces of the solvent. The difference in weight obtained has permitted to assess the rate of lipid of sample (AOAC, 1990) :

$$\%Lip = \frac{(m_2 - m_1)}{M_e} \times 100 \qquad \textbf{Eqn. 5}$$

With :

m_1 : mass of the ball (g) ;
m_2 : mass of the balloon and the oil (g) ;
M_e : mass of the sample analyzed (g);

The tooth glucides (%GT) content is determined using the mathematical formula proposed by the United Nations Organization for Alimentation and Agriculture (Food and Agriculture Organization) donated by the **equation 6** (FAO, 2002):

$$\%GT\ (g/100g\ MS) = 100 - (\%Prot + \%Lip + \%H + \%Cd) \qquad \textbf{Eqn. 6}$$

2.2.4.2. Mineral dosage

The flours obtained from the raw materials were measured in the Pedology laboratory of the Institut National Polytechnique Félix Houphouët Boigny (INPHB) in Yamoussoukro. The determination of P, K, Na, Ca, Cu, Fe, Mg and Zn was carried out using an air-acetylene flame atomic adsorption spectrophotometer (Varian SpectrAA 20). A quantity of 0.4 g of flour sample is weighed into a porcelain crucible and placed in the oven (PROLABO) at 650 °C for 5 h for calcination. After cooling, 5 mL of nitric acid (1 M) are added to the ash obtained then brought to complete evaporation on a sand bath. After that, 5 mL of hydrochloric acid (0.1 M) is added to the residue and the whole is then put back in the oven at 400 °C for 30 min. The final residue is recovered with 10 mL of hydrochloric acid (1 M) then poured into a 50 mL volumetric flask. The crucible is rinsed twice with 10 mL of the hydrochloric acid and inverted into the flask. The vial is then made up to 50 mL with hydrochloric acid. Under the same conditions, a mock test is carried out (AOAC, 1990; Kouassi et al., 2013).

2.2.5 Statistical analyzes

Statistical analyzes were carried out with Statistica 7.1 software. Results are expressed as means of ± standard deviation of triplicate measurement. An analysis of variance (ANOVA) was carried out and the significance of the differences between the flour samples was determined at a risk of error of 5% ($P < 0.05$) according to the Duncan test. The software made it possible to carry out the correlation test in order to identify possible relationships between the physicochemical parameters and between the minerals (Sanou *et al*., 2021). The Bravais-Pearson correlation coefficient r varies from -1 to +1. The value -1 indicates a perfect inverse relationship between the parameters while the value +1 shows a perfect positive relationship. The value 0 shows that there is no correlation between the parameters studied. However, the more the correlation coefficient r is closed to -1 and +1, the stronger the linear relationship is. The more the value of r is closed to 0, the weaker the linear relationship is (Kouyaté *et al*., 2021).

3. Results and Discussion

3.1 Physico-chemical parameters of raw materials

Table 1 shows the physicochemical parameters of millet flour, downgraded cashew kernel flour and tiger nut flour. The results show that the humidity level varies from 5.02±0.24% to 5.51±0.28%. Allouh *et al*. (2021) had reported higher humidity levels (8.50%) than those observed in our study. Millet presents the highest water content of the three matrices, this could be explained by the hydrophilic properties of the starch observed in millet grains (Hamadou *et al*., 2017). This same observation was made by Béninga in 2011 during the characterization of 10 millet cultivars in Côte d'Ivoire where the humidity rate varied between 8.8% and 10.40% (Béninga, 2011). The ash contents are 1.58±0.01% for millet while those of tiger nut and cashew kernel are 2.34±0.04% and 2.36±0.53% respectively. This rate of ash in the nutsedge (2.34±0.04%) is close to that obtained by Pélégrin and al. or 2.23% (Pélégrin *et al*., 2022). A high ash content is illustrative of good mineral content (Fofana *et* *al*., 2017). Millet consumed in Côte d'Ivoire is characterized by its richness in mineral elements (Béninga, 2011). Oladele and Aina (Oladele and Aina, 2007) and Emelike et al. (Emelike *et al*., 2015) indicated high ash contents of 4.25% and 4.7±0.10% respectively in tiger nut and cashew kernel (Oladele and Aina, 2007 ; Emelike *et al*., 2015). Our values are lower than those found by these authors. This could be due to certain parameters such as soil type, temperature, water availability, type of soils where these raw materials grew and environmental conditions (Béninga, 2011). However, the levels observed remain high enough to allow fortification. The high ash content in tiger nut and cashew kernel indicates that they could be used as fortifiers in complementary foods. A study by Maduka and Ire (2018) indicated that tiger nut mixed in different proportions with other types of flour makes it possible to obtain fortified final products (Maduka and Ire, 2018).

Protein contents vary from 6.13±0.05% to 18.38±0.04%. The highest content was observed in the cashew kernel, i.e. 18.38±0.04%. High protein levels have been reported in cashew kernels (Emelike *et al*., 2015). The lowest protein content was observed in tigernut, this could be explained by drying because properly carried out drying would reduce the protein content of tigernut (Maduka and Ire, 2018). Almost similar protein levels in tiger nut were indicated by Adesakin et al. (Adesakin *et al*., 2020) which recorded a rate of 5.08% (Adesakin *et al*., 2020). The protein content of millet is approximately equal to that of wheat and corn (6.45% to 9.9%) (Béninga, 2011). Millet, although it has a higher protein content than tiger nuts in these studies, is not considered a reliable source of protein. Because the majority of millet proteins are poor quality. It is generally made up of prolamine which is a poor-quality protein (Béninga, 2011).

Lipid contents range between 1.89±0.75 and 30.42±1.67%. Millet is known to be low in fat. Among the three raw materials, it has the lowest fat content, i.e. 1.89±0.75%. This value is within the range of the values indicated by Hulse and colleagues (Hulse *et al*., 1980) who indicated that the fat contents of millet are between 1.8 and 7.58%. The cashew kernel has the highest lipid content. Several authors including Akinhanmi and Atasie (Akinhanmi and Atasie, 2008) have reported high fat contents in cashew kernels. Lipids play a major role in reinforcing the energy of flours. But high lipid contents in infant flour does not facilitate its conservation (Fofana *et al*., 2017). Regarding tigernut, the results obtained for fat content (24.60±0.06%) are lower than those of El-Anany and Ali (El-Anany and Ali, 2012) who determined a rate of 30.01%. lipids in tiger nut.

The carbohydrate contents range between 45.63±0.01 and 83.24±1.31% with a higher content in millet, followed by tiger nut and downgraded cashew kernel. Millet has the highest carbohydrate content because millet is mainly made up of starch (Béninga, 2011).

Table 1. Physico-chemical compositions of raw materials (millet, tiger nut, declassified cashew kernel)

	Moisture (%)	**Dry matter (%)**	**Ash (%)**	**Protein (%)**	**Lipid (%)**	**Carbohydrates (%)**
Millet	5.51±0.28	94.49±0.28	1.58±0.01	7.88±0.10	1.89±0.75	83.24±1.31
Tiger nut	5.02±0.24	94.97±0.24	2.34±0.04	6.13±0.05	24.6±0.1	62.28±1.28
Kernel	3.21±0.02	96.78±0.02	2.36±0.53	18.38±0.04	30.42±1.67	45.63±0.01

3.2 Mineral contents of raw materials

The mineral values found in the present study are shown in **Table 2**. Analysis of the results indicates phosphorus contents of 0.10±0.05 to 0.24±0.09 mg/100g; potassium from 0.389±0.29 to 0.510±0.05 mg/100g; calcium from 0.83±0.56 to 0.949±0.28 mg/100g; magnesium from 0.187±0.37

to 0.428±0.11mg/100g; iron from 4.17±0.99 to 7.630±0.67 mg/100g; sodium from 25.013±0.38 to 82.477±0.66 mg/100g; zinc from 0.59±0.44 to 2.490±0.55 mg/100 and copper from 2.120±0.03 to 2.520±0.23 mg/100g.

These values vary from one raw material to another. The highest levels of phosphorus, potassium, magnesium and zinc are observed in the degraded cashew kernel. All these minerals play an essential role in the body. Appreciable potassium levels can cause hyperpolarization of endothelial cells which participate in the control of the tone of vascular smooth muscle cells through the release of several relaxants (Haddy *et al*., 2006).

Magnesium is responsible for activating over 300 enzymes. It controls and regulates the entry of calcium into cells and intracellular fluids. It is very important for the central nervous system. It acts as a nicotinic acetlycholine receptor, G protein-coupled acetylcholine receptor, N-methyl-D-asparate type glutamate receptor (Marret and Ancel, 2017). Magnesium supplementation would reduce motor and visual after-effects in premature children (Durlach, 2000). Zinc deficiency has quite serious repercussions on the health of children. These include weak cognitive functions, memory impairment and nerve atrophy (Tripathi *et al*., 2012).

Zinc is involved in child growth (Aguayo, 2002). However, 48% of children in developing countries are at risk of zinc deficiency (Hotz and Brown, 2004). Zinc deficiency is linked to growth retardation, reduced physical development of children, immune deficiency and high morbidity. Furthermore, zinc deficiency is responsible for the loss of taste perception, the appearance of edema, lack of appetite, and disorders in the development of cognitive functions (Ezzati *et al*., 2002). Additionally, zinc deficiency is associated with iron, iodine and vitamin A deficiencies (Ezzati *et al*., 2002). The presence of this trace of element in the raw materials studied could be an asset for their valorization in the formulation of infant foods.

High levels of calcium and copper were observed in tiger nuts and millet, respectively. Calcium is an important mineral for children. It participates in the stability of nerves and muscles and plays an essential role in the strength of bones and teeth, it is therefore essential for the child during the first months of their growth (Pravina *et al*., 2013). Copper actively participates in the reconstitution of hemoglobin and red blood cells. It is not abundant in the blood and is stored as a reserve in organs such as the child's liver and spleen. This reserve decreases with age. Food resources are essential sources of copper. Copper deficiencies can cause anemia. There are two important sources of copper, breast milk and food (Ptudip and Farlane, 1936).

Millet has relatively higher levels of iron and sodium (Table 2), which makes this cereal an asset in infant nutrition. Some studies have shown that 80% of cases of anemia in children are attributed to iron deficiency (Anonyma 1, 2015). Millet is often used as a staple food in the formulation of infant flour because in most regions where millet is grown it is the main source of energy, mineral salts and vitamins. Millet is rich in calories so it is recommended for children, the elderly and pregnant women and its richness in iron makes it an essential food for people suffering from anemia (Béninga, 2011). The mineral values found in millet in the present study (Table 2) are different from those obtained by Béninga (2011) which are 30 to 40 mg/100g for calcium, 90 to 1180 mg/100g for phosphorus, from 330 to 370 mg/100 for potassium, from 10 to 30 mg/100g for sodium, from 1.2 to 1.4 mg/kg for magnesium and from 62 to 105 mg/kg for iron. This difference in mineral compositions could be explained by the ecological conditions of the growing regions which would have an impact on the mineral salt content (Béninga, 2011).

Table 2. Mineral compositions of raw materials (millet, tiger nut, declassified cashew kernel)

	P (mg/100g)	K (mg/100g)	Ca (mg/100g)	Mg (mg/100g)	Fe (mg/100g)	Na (mg/100g)	Zn (mg/100g)	Cu (mg/100g)
Millet	0.10±0.05	0.389±0.29	0.83±0.56	0187±0.37	4.17±0.99	25.013±0.38	0.59±0.44	2.52±0.23
Tiger nut	0.10±0.21	0.418±0.81	0.949±0.28	0.240±0.28	5.25±0.04	82.477±0.66	2.320±0.19	2.170±0.72
Kernel	0.24±0.09	0.51±0.05	0.837±0.34	0.428±0.11	7.630±0.67	34.590±0.88	2.490±0.55	2.120±0.03

3.3 Correlation between physicochemical parameters and raw material minerals

The Bravais-Pearson correlation matrix of the physicochemical parameters (**Table 3**) indicated the existence of positive and significant correlation between all parameters. These strong positive and significant correlations observed between these parameters could reflect a mutual dependence of these parameters if the raw materials were mixed for the formulation of infant foods (Sanou *et al*., 2021).

Table 3. Bravais-Pearson linear correlation coefficients r between the physicochemical parameters

	Moisture	Dry Matter	Ash	Protein	Lipid	Glucide
Moisture	1					
Dry Matter	1	1				
Ash	1	1	1			
Protein	0.79	0.79	0.79	1		
Lipid	1	1	1	0.79	1	
Glucide	1	1	1	0.79	**1**	1

As for minerals, the Brallais-Pearson correlation matrix (**Table 4**) indicates the existence of positive and significant correlations between phosphorus and potassium (r = 0.97), between phosphorus and magnesium (r = 0.98), between potassium and magnesium (r = 1), between calcium and sodium (r = 0.99), between calcium and copper (r = 0.99), between iron and sodium (r = 0.90). These positive and significant correlations indicate a mutual dependence between these minerals (Sanou *et al*., 2021; Kouakou *et al*., 2022). Furthermore, negative and significant correlations were found between zinc and copper (r = - 0.96), calcium and zinc (r = - 0.91) and between sodium and zinc (r = - 0.86). These results show an inverse dependence between these minerals, thus suggesting a decrease in one of the minerals with the increase in the other and vice versa (Kouyaté *et al*., 2021).

Table 4. Bravais-Pearson linear correlation coefficients r between the minerals of the three raw materials

	P	K	Ca	Mg	Fe	Na	Zn	Cu
P	1							
K	**0.97**	1						
Ca	-0.45	-0.24	1					
Mg	**0.98**	**1**	-0.26	1				
Fe	0.07	0.30	**0.86**	0.28	1			
Na	-0.36	-0.14	**0.99**	-0.16	**0.90**	1		
Zn	0.79	0.63	**-0.91**	0.64	-0.56	**-0.86**	1	
Cu	-0.60	-0.40	**0.99**	-0.41	0.76	**0.96**	**-0.96**	1

Additionally, non-significant (r < 0.5) negative correlations between phosphorus and calcium (r = - 0.45), potassium and sodium (r = -0.14), calcium and magnesium (r = - 0.26), magnesium and sodium (r = - 0.16) and positive between potassium and iron (r = 0.30), magnesium and iron (r = 0.28) have been observed between certain minerals. These weak correlations indicate that the absence or presence of one of the minerals has little effect on the content of the other (Sanou *et al.*, 2022).

Conclusion

Millet is often used as a staple food for children of weaning age. However, although having quite appreciable nutritional values in certain minerals such as iron, calcium and sodium and many other minerals, this cereal does not contain the necessary nutritional elements requested in infant flours. To be used as a staple food for children of weaning age, millet must be combined with other local raw materials such as cashew kernel and tiger nut. These foods can thus play the role of fortifiers due to their richness in proteins and mineral salts. With a protein content of 18.38±0.04 mg/100g and an ash content of 2.36±0.53 mg/100g, cashew kernel appears to be a good fortifier for the formulation of infant foods. The choice of tiger nut as a fortifier is justified by its good ash content which is 2.34±0.04%. The Bravez Person correlation matrix highlighted the effects of the physico-chemical parameters between them and also those of the minerals between them. In short, the correlation matrix made it possible to make a prediction on the effect of physicochemical and mineral elements on each other. It appears from this work that a mixture of these products would generate strong impacts of nutrients between them, which remains an advantage in the formulation of composite infant flour.

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