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THE PRODUCTION AND EVALUATION OF "ELUBO" (CASSAVA FLOUR) FORTIFIED WITH AFRICAN YAM BEAN FLOUR

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ABSTRACT

Cassava root and African yam bean was subjected to various processing method Viz: uprooting from the farmer, soaking in the water for 4days, for African yam bean (AYB) steeping in water for 12 hour and then boiling for 20 minute respectively. The moisture, ash protein carbohydrate fat, crude fibre some functional properties and bulk density of the flour were analyzed from the result, protein and carbohydrate content of sample A (ELUBO) are 1.70% and 80.09ml. Result showed that sample (D) gave the highest protein content (37.21%) which that 17 B really high in protein while the fortified sample (B) and (C) gave a mochate protein and carbohydrate content 2.04% and 40.00, 4.09% and 32.2% respectively. Moisture content of the sample ranges from 4.02%-1.96%. Ash ranges from 1.00%- 3.00% water absorption capacity ranged from 3.50g/ml-2.00g/ml. The bulk density ranged from 0.83g/ml- 0.58g/ml.

Keywords: Component, Formatting, Style, Styling, Insert.

1. INTRODUCTION

A. Background of Study

Manihot esculenta (commonly called cassava, Yaca, manioc, Mandioca" and Brazilian arrow root) is a woody shrub of native America of the spurge family, Euphorbiaceae (Mepha et a; 2008). It is extensively cultivated as an annual crop in tropical and subtropical regions for its edible starch tuberous root, a major source of carbohydrate. Though it is often called 'Yaca' in Spanish and in the United States, it differs from the 'Yaca' an unrelated fruit bearing shrub in the family Asparagaceae. Cassava when dried to a Powdery (or pearly) extreact is called tapoioca its fermented, flaky version named garri (Maepha et al; 2008) Cassva (Manihot Esculent Crantz) is the source of energy for more 500million people worldwide (celbalcos et al ; 2006). It has vast uses as food and industrial application (Nisa et al; 2007). African Yam bean (Sphenostylis stenocarpa) is a perennial climbing bush 1-3m high generally grown as an annual crop. Belonging to the family fabaceda and genus spenostylis (potter and Doyle, 1994). African yam bean is an under-utilized food legume crop in the tropics, not as popular as other major food legumes. It is a typical African plant grown in most parts of the hot humid tropical regions at middle and low altitude and more specifically, in Southern

Nigeria. It is called different names in different countries. The local names in different cultures in Nigeria includes: "Ceiregire" (Hausa), "Sese" (Yoruba), "Obudu and Azuma" (Igbo), "Nzumd" (Ibibio). (Ogbo, 2002). The protein content of African yam bean seeds ranges between

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21% and 29% and in the tubers of African yam bean, the protein content is about 2-3 times the amount of potatoes and higher than those in yams and cassavas. Moreover, the amino acid value in African yam bean seed is higher than those in pigeon peas, cowpeas and bambara groundnut. African yam bean is rich in minerals such as potassium, phosphorus, iron, magnesium, calcium and zinc but low in sodium and copper (Eke, 1997). The seed contains tannins, trypsin inhibitors, hydrogen, cyanide saponinis and phytic acid. Processing, such as heating, soaking and fermenting has been used to lower anti nutritional values. (Uebersax and zabis, 1986, Nzere Ogu, 1995).

B. Aim and Objective

The aim of this study is the production and evaluation of Elubo (cassava flour) fortified with yam bean flour. The other objectives include:

- To produce cassava flour
- To produce African bean flour
- To evaluate the nutritional composition of the flour blends
- To determine the functional properties of this blends.

C. Problem Statement

Cassava roots are highly perishable and a lot of post-harvest losses occur in this commodity during storage due to high physiological activities of micro-organisms that enter bruises received during harvesting; as well as inherent high moisture content of fresh root, which promotes both microbial deterio- ration and unfavourable biochemical changes in commodity. Some problems associated with African yam bean are the characteristic hardness of the seed coat which places a high demands on the energy cost as a result of the long cooking time and toxic substance from the seed.

2.LITERATURE REVIEW

A. Cassava

Cassava (Manihot esculenta crantz) is a major food crop in Nigeria supplying about 70% of the daily calories of over 50 million people in Nigeria. It has also been estimated that cassava provides food for over 500 million people in the world (Celballos et al; 2006). It is essentially a carbohydrate food with low protein and fat. Edible part of fresh cassava contains 32-35% carbohydrate, 2-3% protein, 75-80% moisture, fat 1.0%fibre and 0.70-2.50% ash. Cassava roots are highly per- ishable and a lot of post-harvest losses occur to this commodity during storage, due to high physiological activities of micro- organisms that enter bruises received during harvesting as well as inherent high moisture content of fresh roots, which promote both microbial deterioration and unfavourable bio- chemical changes in commodity. These limits it's availability as raw material to the industries that need it (Ekwu and Ehirim, 2008).

B. Description

The cassava root is long and tapered with a firm homoge- neous flesh encased in a detachable rind, about 1mm thick, rough and brown on the outside. Commercial varieties can be 5-10cm (2.0 to 3.9) in diameter at the top and around 15 to 30cm (5.9 to 11.8m) long. A woody, cordon runs along the roots axis. The flesh can be chalked-water or yellowish. Cassava roots are very rich in starch and contains significant amount of calcium (50mg/100g), phosphorus (40mg/100g)

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and vitamin C (250mg/100g). However, they are poor in protein and other nutrients. In contrast, cassava leaves are good source of protein (rich in lysine) but deficient in the amino acid methionine and possibly tryptophan (Ravindann et al, 2007).

C. History of Cassava

Cassava is centered in West-Central Brazil, where it was likely first domesticated more than 10,000 BC. Forms of the modern domesticated more specie can be found growing in the wild in south of Brazil by 4,600 BC. Manioc pollen appeared in the Gulf of Mexico lowlands at the San-Andres archeo- logical site. The oldest direct evidence of cassava cultivation comes from a 1,400 year old. Cassava was introduced into Africa by Portuguese traders from Brazil in the 16th century. Maize and cassava are now important staple foods, replacing native African crops. Cassava is sometimes described as the "bread of the tropics" but should not be confused with the tropical and equatorial bread tree, Encephatartos, (Wikipedia 2005).

D. Industrial Uses of Cassava

• Animal feed: There is a rapidly growing market for cassava pellets for use as animal feed as it provides a lot of calories to animals. Pellets are easier to transport and pack and easier for animals to consume than whole cassava.

• Ethanol: Ethanol is produced by fermenting and distilling cassava. Ethanol has various industrial uses: it can be
mixed with petrol or used on it's own as a transport fuel. It can also be used as a base for alcoholic beverage. Lastly, ethanol can be utilized as industrial alcohol which is important in the pharmaceutical and cosmetic industry.

• Flour: Cassava flour offers several benefits. It is com- pletely gluten free and can be used as a substitute for wheat flour.

• Starch: Cassava starch can be extracted from cassava roots to form starch which are used by the food industry but is also used by the paper and textile industries, as well as an adhesive in glass, mineral, wool and clay (Wikipedia, 2005).

E. Processing of Cassava

Processing of agricultural production in Nigeria is an old farming itself. People have been storing and processing prod- ucts hundred of years ago. Cassava can be sold raw and eaten, this is popular in northern part of Nigeria where it is known as "Kogo", the species that are used are thin, long or have very low cyanogenic potential. The freshly sprouted cassava is cooked as soup. Processing is therefore necessary to reduce the moisture content, to improve storage characteristics and reduce the weight as well as to detoxify cassava by eliminating the HCN (Brown and Poon, 2005). Processing is also essential to impact the characteristics flavour in "Garri" and "Fufu" as desired by consumers. Another objective of processing cassava to raw material is for small-scale cassava-based industry. Cas- sava tubers are perishable, bulky and contain 70% moisture by weight. In addition, they contain cyanogenic glycosides which break down to form prussic acid (HCN, hydrogen-Cyanide) a toxic compound. The major processed

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forms of cassava root fall into four general categories: meal, flour, chips and starch. Meals form include: “garri” “fufu” “tapioca” and “abacha”. The meal and flour forms account for the bulk of cassava for human foods in the Tropics. The flour is popularly called “Lafun” in South Western Nigeria. Unfermented cassava flour, cassava chips and cassava starches are mainly for industrial uses. The chips are also used as livestock which can be milled into flour (lordbanjou, 2015).

F. Nutritional Value of Cassava

The main component of cassava is starch. 100g of cassava flour contains about 87g of starch and gives 357kcal. Cassava is therefore a good source of energy. However, the roots are low in proteins, vitamins and most minerals and contains almost no fat. During processing, protein is lost. Fresh cassava contains vitamin but most of the vitamin C is probably destroyed by the long cooking time required to soften the leaves and remove residual cyanide. Therefore cassava should be eaten with foods which are high in protein, fat and minerals (Lordbanjou, 2015).

G. Local Uses of Cassava

Cassava can be consumed in different ways. The boiled roots taste similar to potatoes and are a great side for meat dishes or in soup. In many countries, cassava is handled similarly to potatoes, meaning they are eaten as mash, fried or boiled. In Africa cassava mash “Fufu”, is widely consumed by pounding and sieving cassava to make flour which is then put into hot water. This is particularly a popular food in Nigeria, Ghana and Democratic Republic of Congo (Celbullos 2007). Cassava is also used to make “garri”, a kind of cassava porridge, which is a white cassava flour made from fermented cassava tubers. The flour can be added to cold water and milk and to taste. In Latin America, cassava is mostly fried and offered as “Yucca Frita” as a side dish. In Panama, Yucca is used in scoco, a chicken soup (Wikipedia 2015). In the South Western part of Nigeria, cassava is widely used in the form of tapioca “Elubo” which is a flavourless starchy ingredient used as a thickening agent in food. It is gluten-free and therefore used in many gluten free foods. “Elubo” is also used to make tapioca pudding and used to make gluten free bread. “Elubo” (cassava flour) is also a main ingredient in the popular bubble tea, a Taiwanese drink that has a tea base and include Elubo pearls (Wikipedia 2015b).

H. Cassava Flour “Elubo”

Unlike wheat being ground and mashed to obtain it’s flour, cassava passes through other processes before it’s flour is gotten. A good cassava flour should be white in colour and have a good smell. It should not be contaminated by insect or undesirable micro-organisms. Drying, being a unit process for obtaining cassava flour (Elubo), should take place outdoors. This should be done on a sunny day. Sun-drying is to be used as the drying method, otherwise the chip may smell bad and eventually turn brown (Nweke et al:, 1994). It is best to use cassava cultivars which contain a low level of cyanogenic compounds, since these are potentially toxic. However, the cyanogenic content of fresh root is not a serious problem in cassava flour production since it is almost entirely eliminated during flour processing (Niba et al; 2007). Elubo (cassava flour) does not contain any gluten. If it is used to replace wheat flour 100%, the quality of the product will be different. A suitable ratio for replacing wheat flour that consumers find acceptable

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depends on the kind of food. For example, sponge- cakes and chiffon cake 50% in butter cakes and cookies, 75% in dough nuts and 20% in bread making. In production of Elubo (Cassava flour), first wash the roots again and again, the roots are then chopped into small pieces of about 5cm x 0.5cm x 0.2cm and sun dried for two or three days (or dried in a hot air oven at a temperature of about 55°C). After drying, the moisture content of the cassava should be less than 8%. The chips are then milled, and the flour sieved through an 80 mesh sieve. Finally, the flour is packaged in plastic bags. Packaged in this way, the flour can be stored for at least 8 months (Nweke et al; 1994).

The cassava flour has about 1550 calories in a pound of cassava flour (Nwosu, 2006). The number of calories in Elubo (tapioca Pearls) is higher because fibre has been removed.

I. Nutritional Composition of Cassava Flour "Elubo"

The cassava flour has about 1550 calories in a pound of cassava flour (Nwosu, 2006). The number of calories in Elubo (tapioca Pearls) is higher because fibre has been removed. **The Composition of Cassava Flour (Elubo) is approximately**

Component		Percentage
Carbohydrate	-	80.4%
Protein	-	1.7%
Fat	-	1.6%
Fiber	-	0.1%
Water	-	4.2%

J. African Yam Bean (Ayb)

African yam bean (Sphenostylis Stenocarpa) belongs to the family Fabaceae, sub-family Papilionoideae tribe Phase- oleae, sub-tribe Phaseolinae, and genus Sphenostylis. The vine twines clockwise around the stake or climb other support to a height of about 3m or more. The level are compound trifoliate (Berezie; 1999). It is grain legumes and cultivated in tropical Africa as far as Zimbabwe, throughout west Africa from guinea of South Easthern Nigeria for its edible seeds (Okigbo, 1993) being especially common. In the lather and into and the Ivory Coast, and in East Africa from Northern Ethiopia (Eritrea) to Mozoambique, including Tanzamia a Zanzibar. Nigeria has the highest production of African yam bean (Potters 1992, Abbey and Berezi, 1999).

1) **History/origin Of African Yam Bean (Ayb):** The origins of Africa yam bean as indicated by GRIN, (2009) include the following countries within the tropical region of Africa Chad and Ethiopia (North East tropical Africa); Kenya, Tanzania and Ujander (East tropical Africa) Burudi, Central Africa Republic and Democratic Republic of Congo (West-central-tropical Africa) Angola Malawi, Zambia and Zimbabwe(south tropical Africa). The center of diversity of AYB is only within Africa. Nigeria is very significant for AYB production where extensive Cultivation had beejn reported in the eastern, western and southern areas of Nigeria. In different

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yield trails in Nigeria (IITA, Ibadan and Nsukka), the most productive accession in each gave 160Kg and 2000kg of seeds/hestare (Adewale and Dominique, 2009).

2) **Uses of African Yam Bean (Ayb):** Following a research carried out by Klu et al; (2001) in the volta region of Ghana, the African yam bean is grown primarily for its dry seed, which are a nutritious pulse. Some of the indigenes of the Nkwanta district mill that seeds into flour is processes into a paste with waer and some condiments. This is then wrapped into plantain leaves, boiled and eaten as turbani. The flour is also sometimes mixed with cassava flour and cooked into a paste eaten with soups or sauces. Another ethnic group here boils the dry seed for about 3 hours replacing the water intermittently and makes it into sauce eaten with "garri", a roasted cassava product.

K. Effect of Heat Processing on Africa Yam Bean Seed Flour (Ayb)

The Africa yam bean (sphenostylis stenocarpa) is a repre- sentative of the family Legumninosae and has many variations in seed size and colour. The grey, black and brown varieties are very common (Onyeike et al:, 1995, Ikhajiagbe and Mensah, 2012). The seed usually cooked without soaking, or soaked in water or salt solution prior to cooking to reduce cooking time and save cost of fuel. When this legume is eaten raw or under-cooked i.e improperly cooked seeds, it can lead to growth failure, poor food utilization, pancreatic hypertrophy and hyperplasia as well as reduced enzyme(leuicine amino peptidase) activity in various animal models. This is very the notable limitations include: common with the member of the legume family (Onyeike et al;1995). From the research carried out by Onyeike et al; (1995) using rats, they discovered and concluded that feeding of rats with treated-African yam bean caused a higher increase in their body weight than those fed with raw one. This was attributed to the fact that increased period of heating increase the inactivation of the anti-nutritional factors especially trypsin- inhibitors. It can also be suggested that the animals were able to properly utilize the nutrient in the AYB because of the heat treatment given to it. This bought about the conclusion that heats processing of this legume improves the utilization food conversion and increase the digestible nutrients (Onyeike et al; 1995, Emiola, 2011).

1) Potential of African Yam Bean: According to an article by Adewale and Dumet (2009) African Yam Bean has got immense economic potentials. Apart from the production of two major food substance, the value of the protein in both tuber and seeds is comparatively higher than what could be obtained from most tuberous and leguminous crops. The protein in the tuber of Africa yam bean is than twice that is in sweet or irish potatoes and very much higher than those in yam and cassava (Amoatey et al; 2000, Adewale et al; 2012). As a legumes crop, the African yam bean has the ability to fix atmosphere nitrogen into the soil (Amoatey et al; 2000, Klu et al; 2001, Stricker, 2011). The crop also has the po- tential of with standing pest and disease which are commonly encountered with cawpea and groundnut (Amoatey et al; 2000, Adewale 2010, Adewale and Dumet, 2009), this quality could be undoubtedly due to the inherent lectin in the seed of the crop. (Adewale and Dumet 2009)(Adewale, 2010). It also has a potential role in contributing to national food security when developed to such an extent that it becomes accepted nation wide as a component of some popular meals (Amoatey et al; 2000, Adewale et al; 2013, Klu et al 2001). Despite all those potential in AYB, the crop still stands a risk of extinction and is still underutilized. For instance, most people in Nigeria do not know this crop and so many do not utilize it, others who are conversant with it do not accepts it as a major part

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of their meals due to some of its constraints or limitation. Some of these constraints have negatively influenced the productivity and acceptability of the crop among cultivar, consumer and research scientist. According to Adewale and Dumet (2009),

2**) Potential of African Yam Bean: Nutritionally,**
cooked seeds of AYB have higher fiber content, high efficiency of protein digestibility, higher amino acid availability, high gross and profile. It proportion of essential amino acids in protein is over 32% with lysine and leucine being predominant. Crude protein in the grain ranged between 25.4-28.6% and in the tuber about 19% (Adewale et al, 2012). Again, the African yam bean is rich in minerals such as potassium magnesium, zinc and calcium (Suclinery, 2013; Adwale and Dumet, 2009, Adewale et al; 2013) but the level of sodium and cooper was low. According to Nwodo and Nwinyi, (2012) who carried out a proximate analysis of the sphenostylis stenocarpa, the percentage total of proximate composition is a follows:

Moisture	Protein	Fat	Carbohydrate	Total (%)
1.96	37.21	9.49	44.4	93.06

Furthermore, Adewale et al; (2013) stated that the result of researchers on the proximate analysis of AYB seeds were inconsistent. The observed variation they state could be at- tributed to cultivar type, cultural practices and differences in the methodologies of estimation. In an online publication by Culiney, (2013), this legume was stated to have a low pyretic index and high dietary fiber content and is therefore becoming increasingly important in the management of chromic diabetes, hypertension and cardiovascular disease.

3. METHODOLOGY

A. Material and Method

The raw material cassava was purchased from farmers in Agbaja Ehime Mbano L.G.A Imo State, while the other raw material like African yam bean was purchased from retailers in Eke-Okigwe market Imo state.

B. Reagents

The materials used in the analysis are: cassava and African yam bean: The equipment used are weighing balance, mea- suring cylinder beaker, Petridish sieve bowl.

C. Sample Preparation

The cassava root were sorted and cleaned to remove dirt and sort. The following steps were adopted in the production of Elubo (cassava flour). Manual peeling of cassava root, washing, grading, steeping in writer for four days (4days) cut into small thins, sun drying or oven drying at 400c, cassava flour. The African yam bean flour was prepared according to the method described by (Enwere, 1998). During preparation, two kilogram of African yam bean which where free from foreign particles such as stone, leaves and sticks as well as damaged and contaminated seeds were weighed, cleaned and soaked in tap water contain 4% sodium Hydroxide (NasoH3) for 12 hours. Thereafter the soaked seeds were manually dehulled, drained and boiled (1000C, 20 min) the dehuled and boiled seed were spread on the trays and dried in the dried seed tray

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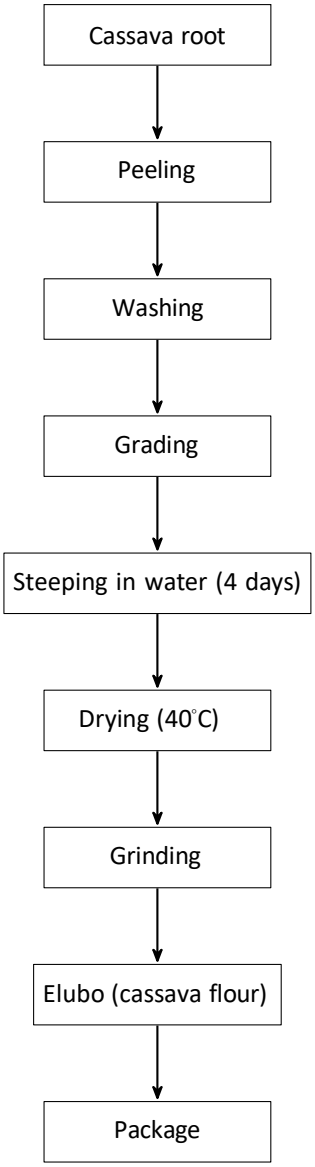
dryer (600C, 10 hours). After that the dried seed were immediately milled (attrition and sieved through a 500 µm mesh sieve. The grinned African yam bean flour. Produced was finally packaged in sealed polyethylene bags to be blended with Elubo (cassava flour) the flour of cassava and African yam Bean were divided into 4 (four) ratios of 100:00 80:20, 60:40, 50:00 respectively to obtain the blends that was used as the samples in this research work

Flow Chart For Production of Elubo (cassava flour)



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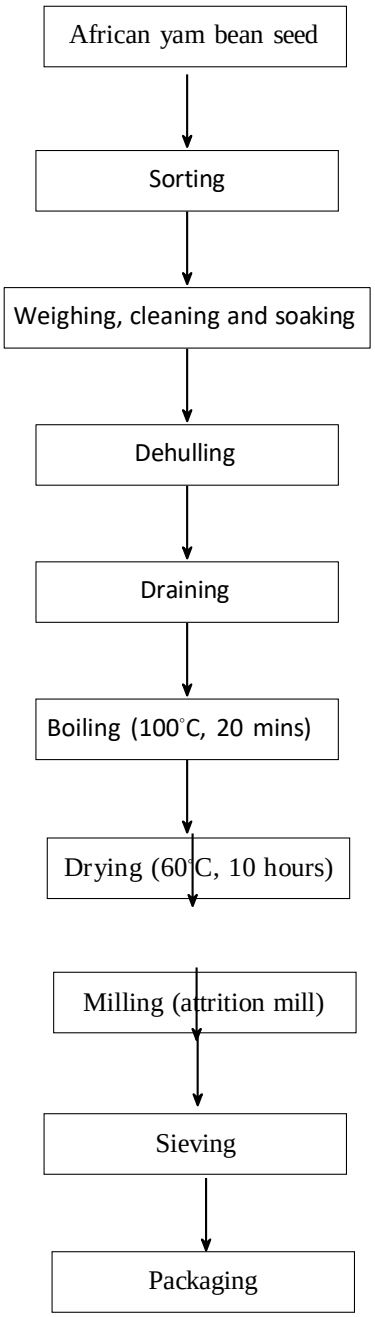
Flow Chart For African Yam Bean Flour



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4. RESULT

A. Proximate Analysis of Cassava Flour (Elubo) And African Yam Bean Flour

	SAMPLE		
Parameters (%)	**A**	**B**	**C**
MOISTURE	4.02 ± 0.01	3.01 ± 0.01	2.05 ± 0.10
PROTEIN	1.70 ± 0.10	2.04 ± 0.10	4.09 ± 0.01
FAT	1.60 ± 0.01	4.10 ± 0.01	3.00 ± 0.07
CRUDE FIBRE	0.20 ± 0.01	1.10 ± 0.03	1.00 ± 0.10
ASH	1.00 ± 0.10	1.90 ± 0.01	1.50 ± 0.01
CARBOHYDRATE	80.09	40.00 ± 0.01	32.20 ± 0.10

B. Discussion

As presented in Table I, the moisture content of Sample A was significantly higher than that of Samples B and C is the proximate analysis of the samples which comprises of moisture content, ash, protein, crude fibre and carbohydrate.

As presented in Table III, the bulk density and gelation temperature values showed significant differences between the unfortified and fortified samples.

B. Recommendation

Based on the findings of this work, it is recommended that Elubo and African yam bean are nutritional and balanced for human health, it is also recommended for infants and breast feeding mothers and helps to reduce cardiovascular diseases.

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