PROXIMATE ANALYSIS OF 'ERI': BY-PRODUCT OF SOYAMILK PROCESSING

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ABSTRACT

In this work, the proximate analysis of *'eri'* (by-product of soyamilk processing) was carried out with the view of ascertaining its edibility and suitability in various processes and applications. Whole soya beans were separated from foreign materials and then soaked for 24 hours. Thereafter, wet milling was done followed by filtration, the residue obtained after the filtration process has been completed is known as *'eri'*. Under approved standard laboratory conditions and using standard methods and instruments, experiments were conducted to determine the proximate compositions of *'eri'*. The results showed that *'eri'* has 9.4% moisture, 5% ash, 7.33% crude fibre, 13.00% lipids, 36.23% crude protein, 38.28% nitrogen-free extracts, and 33.28% carbohydrates. These values were compared with the typical proximate composition of *'kuli kuli'* (groundnut cake), a snack, rich in protein content and readily available in the country; its values were: 8-10% moisture content, 0.7-6% oil, 45-60% crude protein, 22-30% carbohydrate, 4-5.7% mineral matter, 3.8-7.5% crude fibre; it was observed that the proximate compositions of *'eri'* compared favourably with that of *'kuli kuli'*.

Key words: 'Eri', Soyamilk, By-product, Protein, Filtration

1. INTRODUCTION

Soyabean (*Glycine max*) is a major oilseed crop in the world. It is a legume native to China that has become a major source of vegetable protein and oil for human and animal consumption and for industrial usage. It provides approximately 60% of vegetable protein and 30% of oil in the world [1]

The first written record of soyabeans is dated 2838 BC by Emperor Shengnung and the Chinese have been cultivating it for thousands of years. So important are soyabeans to the Chinese that they are considered one of the five sacred grains ("*WuKu*") along with rice, wheat, barley and millet. Soyabean pods, which are covered with a fine tawny to gray fuzz, range in colour from tan to black. The beans themselves come in various combinations of red, yellow, green, brown and black. Dried soyabeans are mature beans that have been shelled and dried, while green soyabeans are those picked when they are fully grown but before they are completely mature [2]. Table 1[3] indicates that soya is grown in many areas of the world: in North and South America and in Europe, agricultural production is mechanized, in Asia production is small scale and largely done by hand. Soya has only recently been introduced in Africa, while it has been grown and processed for many centuries throughout Asia. In Bolivia, in South America, soya is grown for oil that is processed industrially [4].

Table 1. Worldwide cultivation of soya by region in 1996

Region (country)	Hectares (1000 ha)	Yield (kg/ hectare)
Worldwide	57778	1920
Africa (Nigeria)	401	1270
Asia (China, India)	15439	1340
Europe (Italy)	547	2840
North America	23837	2170
South America	16787	2140

Source: Meneses et al., (1996)

Soyabean (*Glycine max*) is an annual plant that may vary in growth and height. It may grow prostate, not growing higher than 20cm or even up to 2 metres in height. The pods, stems, and leaves are covered with fine brown or gray hairs. The leaves are trifolivate, having 3 to 4 leaflets per leaf, and leaflets are 6-15 cm long and 2-7 cm broad. The leaves fall before the seeds are matured. The big, inconspicuous, self-fertile flowers are borne in the axial of the leaf and are white, pink or purple. The fruit is a hairy pod that grows in clusters of 3-5, with each pod 3-8 cm long and usually contains 2-4 seeds of 5-11 mm in diameter [1].

The soyabean occupies a premier position as a world crop because of its high and virtually unrivaled protein content and also because it is a rich source of edible vegetable oil. Whole soyabeans have a good balance of the essential amino acids and are excellent dietary source of calories, minerals and vitamins. They are not only nutritious but inexpensive in areas where they are produced. Soyabean contains no poisonous substances. However, the crop contains some anti-nutritional components such as trypsin inhibitors, hemagglutinins, goitrogen and urease. The nutritional compositions of soyabean and seed parts are shown in Table 2 [5].

Table 2. Nutritional Compositions of Soyabean and Seed Parts

Component	Yield	Protein	Oil	Ash	Carbohydrate
Whole soyabean	100.00	40.3	21.0	4.9	33.9
Cotyledon	90.30	42.8	22.8	5.0	29.4
Hull	7.30	8.8	1.0	4.3	85.9
Hypocotyl	2.40	40.8	11.4	4.4	43.4

Source: Adams et al. (1998)

Amino acids are the "building blocks" of proteins. Amino acids must be supplemented if the diet is insufficient or negative productivity or health consequences will develop. Eighteen amino acids found in soyabean are: Cystine, Methionine, Lysine, Threonine, Tryptophan, Arginine, Alanine, Isoleucine, Praline, Leucine, Glutamic Acid, Aspartic Acid, Valine, Serine, Glycine, Histidine, Phenylalanine, and Praline. Cystine, methionine, Lysine, threonine and tryptophan are usually considered the most critical in balancing a feed ration [6].

The oil and protein contents account for about 60% of dry soyabean by weight; protein at 40% and oil at 20%. The remainder consists of 35% carbohydrate and about 5% ash. Soyabean cultivars comprise approximately 8% seed coat or hull, 90% cotyledons and 2% hypocotyls axis or germ [1].

The soyabean is so versatile that it can be processed into a wide variety of food products. Advancements in processing and breeding technology plus human creativity have further increased diversity of soya foods are one of the fastest growing categories in the food industry, with products ranging from traditional soya foods to soya protein ingredients, and from diary and meat alternatives to various types of Western foods enriched with soya. More interest in this ancient bean that is becoming more popular, has reached an all-time high with the recent approval of a rule in 1999 by the US Food and Drug Administration for a health claim for soya protein reducing the risk of heart disease [7]. Soya utilization is of two types which are traditional and non-traditional soya foods. The traditional soya foods include: soyamilk, kecap, meat analogs, *miso, nato, okara,* soyabean oil, soya cheese, soya flour, soya ice cream, soya margarine, soya candle, soya mayonnaise, soya milk, soya nuts, soya sauce, soya sour cream, soya yogurt, *tamari; temper, tofu,* and *yuba.* Its by-products are used in making margarines; as emulsifiers in many processed foods and in non-food items such as soaps and plastics. The non-traditional soya protein foods include: soya flour, soya protein concentrate, and soya protein isolate, from which various types of granular, textured, structured, and fibrous products are formed [8].

Milk is defined as a fluid secreted by mammary glands of mammals for the nourishment of their young, for a period beginning immediately after birth. 'Soyamilk' is so called because of its milky appearance and comparable composition to milk from mammary glands.

The process of soyamilk production is in four stages namely soaking, grinding to slurry, filtration and simmering. The tradition Chinese method involves soaking overnight, grinding to slurry on local millstone and finally filtration. In Nigeria, the local processing of soyamilk is done using 2 methods, namely, wet and dry methods.

(i) Wet Processing of Soyamilk

The beans are separated from foreign materials and then soaked overnight (usually for 24 hours). Thereafter, wet milling is done followed by filtration and finally simmering. It is apparent that various combinations of the above procedure could lead to 'soymilk' with various qualities. For instance the viscosity will depend on the size of the filter material used.

(ii) Dry Processing of Soyamilk

The whole beans are first separated from foreign materials and thereafter boiled for several hours until they are well cooked. The beans are then cooled and the water drained. The coats are removed by flotation and the beans dried under atmosphere conditions. The dried beans are finally ground using a mill. The powder thus obtained is sieved through a suitable sieve to obtain a fine powder that can store for several months. The nutritional compositions of soyamilk are shown in Table 3[9].

Table 3. Nutritional Compositions of Soyamilk

Nutrient	Composition
Total fat	4.5g
Saturated fat	0.5g
Cholesterol	0mg
Sodium	29mg
Total carbohydrates	5g
Dietary fibre	2g
Sugars	1g
Protein	7

Source: www.q'tessence.com(2009)

A typical proximate composition of '*kuli kuli*' (groundnut cake) is shown in Table 4 [10].

Table 4. Proximate compositions of *kuli kuli* (groundnut cake)

Type of nutrient	%composition
Moisture content	8-10
Oil	0.7-6
Crude Protein	45-60
Carbohydrates	22-30
Mineral matter	4-5.7
Crude fibre	3.8-7.5

Source: www.appropidea.com (Reddy, 2003)

In Nigeria, the by-product of soyamilk processing (*Hausa 'dusa', and Yoruba 'Eri')* is commonly used as animal feed while some people throw it away, compared to groundnut cake (*'kuli kuli')* which is commonly used for human and animal consumption. Most Nigerians do not know its importance to human health and dietary, hence the need for this research. Also, there is little or no information on the proximate compositions of *'eri'* and its uses, therefore this study serves as a compendium of relevant information on the proximate compositions of 'eri'.

The nutritional contents to be determined are moisture content, ash, crude fibre, crude protein, ether extract (lipids), nitrogen free extracts and carbohydrates.

2. MATERIAL AND METHODS

Soya beans used for this study were purchased from Minna Central Market, Niger State, Nigeria. The whole soya beans were separated from foreign materials and then soaked for 24 hours. Thereafter, wet milling was done followed by filtration, the residue (by- product) obtained after the filtration process has been completed is known as *'eri'*; the determination of its proximate compositions was then carried out. The laboratory analyses were carried out in Food Science Department Laboratory, Federal University of Technology, Minna, Niger State, Nigeria.

Material: *'Eri'* (By-product of soyamilk processing)

Apparatuses: Oven (Gallenkamp Oven 300 Plus Series, APP NO: 2062P 19N, CAT No. OVE 200 210G), Electronic weighing balance (Mettler weighing balance, sensitivity = 0.01g, Serial No. H52764), Heating devices (Gerhardt Kjeldatherm Digestion Block, App No. 44098; 449046 (Heating block), Furnace (Lenton Furnace (England), Serial No. 439).

Experimental Procedures

Samples were analysed chemically according to the official methods of analysis described by Association of Official Analytical Chemists, AOAC [11], while crude protein was analysed chemically according to Laboratory Manual on Basic Methods in Plant Analysis [12]. The following parameters were determined using the above protocols: moisture content, crude fibre, lipids, nitrogen/crude protein, ash content, carbohydrate content and nitrogen-free extracts. All determinations were carried out in duplicates and results reported as mean ± SD.

3. RESULTS AND DISCUSSION

Presentation of Results

The results of the analyses carried out on *'eri'* (by-product of soyamilk processing) are presented in Table 5.

4. DISCUSSION

The proximate compositions of *'eri'* (Table 5) were compared to proximate compositions of *kuli kuli* (Table 4) [10]. There are slight differences in the moisture contents, similarity in crude fibre but high differences in their crude proteins. The very low moisture content of *'eri'* suggests that it lost a considerable amount of water during storage, which will result to a longer shelf-life. The moisture content of *'eri'* on a dry weight basis is 9.40% which is little lower than the recommendation for non-oil bearing grains (14-15%). However, the ideal moisture content for long-term storage of soyabean is about 12%.

Table 5. Proximate Compositions of 'eri' (Mean ± SD)

Nutrient	% Composition
Moisture	9.40 ± 1.17
Ash	5.00 ± 0.14
Crude fibre	7.33 ± 0.95
Crude protein	36.23 ± 0.23
Ether extract (Lipids)	13.00 ± 0.057
Nitrogen-Free Extracts	29.04 ± 0.26
Carbohydrates	36.37 ± 0.79

The ash content of *'eri'* is 5% which gives an idea of the amount of mineral elements present and the content of organic matter in the sample. The ash content of a biological material like *'eri'* is an analytical term for the inorganic residue that remains after the organic matter has been burnt off. The organic component of food is burnt in air. The residue is ash which consists of the inorganic components in form of their oxides. The ash is not usually the same as the inorganic matter present in the original food since there may be losses due to volatilization or chemical interaction between the constituents. The ash may however contain material of organic origin such as sulphur and phosphorus from proteins and some loss of volatile material in the form of sodium, chloride, potassium, phosphorus and sulphur will take place during ignition. The value is useful in assessing the quality or grading certain edible materials.

'Eri' is rich in fibre (7.33%) which is within the range of crude fibre of *'kuli kuli'* (groundnut cake) has shown in Table 4[10], therefore *'eri'* is an excellent source of fibre. "A fibre rich diet is very important in reducing the risk of certain types of cancer and heart disease". When trying to enhance the proximate values in the dietary formulation of animals or humans, it is recommended to mix *'eri'* with other cereals, which would guarantee maximum nutritional benefits to the consumers.

Thus, *'eri'* has good potentials not only as survival food, but as a complement for standard diets. It is digested efficiently by human and other ruminant animals, and also available for monogastric animals notably pigs and poultry because of its high methionine content [13].

Lipid content in *'Eri'* (13.00%) is high compared to *kuli kuli* showed in Table 4[10], and it has oil composition comparable to other vegetable oils such as sunflower and groundnut. Soyabean oil has been reported to be highly digestible, high in polyunsaturated fatty acids and contains no cholesterol. It also contains high unsaturated fatty acids and includes concentrations of Omega-3 fatty acids which have the ability to lower the risk of heart disease and even cancer. In the addition, Omega-3 may be essential to brain development in infants. Soya pulp contains isoflavones which are plant chemicals that help to decrease low density (bad) cholesterol if taken as part of healthy eating plan. Isoflavones are considered by some nutritionists and physicians to be useful in the prevention of cancer and by others to be carcinogenic and endocrine disruptive [14].

Crude protein in 'eri' is 36.23% and is particularly valuable because its amino acid composition complements that of other cereals. It is limiting in the sulphur containing amino acids cysine and methionine, but contains sufficient lysine to overcome the lysine deficiency of cereals.. In any case, *'eri'* contains much higher protein content than other legumes which average about 20-30 percent protein. The cereals contain much lower protein contents in the range of 8-15 percent.

The carbohydrate content of *'eri'* is 36.37% which is high compared to that of *kuli kuli* showed in Table 4[10]. Carbohydrates are classified as monosaccharides, disaccharides and polysaccharides. Examples of monosaccharides are ribose, doxyribose, glucose, galactose, mannose, aldose, and fructose.

Glucose has an important function as fuel in the body and is of great importance in carbohydrate metabolism. Glucose occurs more frequently and to a greater extent in nature than any other carbohydrate. An animal can scarcely ingest a meal without consuming adequate dietary amounts of it; it is the sole monometirc component of starch and cellulose in plants and of glycogen in animals [14]. Maltose is an example of disaccharides and it is important as an intermediate stage in the breakdown of starch to glucose. Sucrose occurs in certain plants, such as sugarcane and as an important dietary carbohydrate.

5. CONCLUSION

In this study, it has been established that the proximate compositions of *'eri'* (by-product of soyamilk processing) is comparable with *kuli kuli* (groundnut cake). Thus, the properties should not be a limitation to its uses for animal feed, human food and as a raw material for several domestic and industrial purposes such as making of candle, margarine, bread and as an ingredient for soup. It also helps add fibre and bulk to food thereby creating a more chewy texture. *'Eri'* can be an excellent ingredient in human food such as bakery, sausage, burger, *tempeh*, breakfast cereal, and also mixed into animal feed. It is concluded that *'eri'* (by-product of soyamilk processing) is a functional ingredient that has high nutritional value as protein supplement.

A good consumption of *'eri'* is seen in medical sector as a dietary supplement for diabetic, coronary heart disease, cancer, and osteoporosis patients due to its protein quality, no cholesterol, high isofalvones, easily broken down starch as well as its high fibre content.

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