EFFECT OF SOAKING PERIOD ON YIELD AND PROXIMATE COMPOSITION OF A NIGERIAN FRIED SOYBEAN SNACK- BESKE

By

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Abstract

Beske, a non-fermented fried soybean snack is consumed in South-West, Nigeria owing to its high protein quality and content. The study investigated the effect of soaking period on soy-curd yield and proximate composition (moisture, protein, fat, ash and carbohydrate contents) of beske. Soybeans were soaked for 6h, 12h, 24h and 72 h (labelled as sample A, B, C and D) at room temperature (32±2°C) in water, washed and wet-milled. The slurry was sieved and the milk was boiled, curdled and used for beske preparation. The results obtained in this study shows that, the period of soaking improves the proximate composition of the product. Soaking of soybeans for 6h to72h produced beske with varied yield and compositions ranging from; 25.42%-10.71% (yield), 18.21%- 23.88% (protein), 9.25% -12.20% (moisture), 22.15%-38.83% (fat), 1.00%-2.27% (ash) and 27.09%-49.39% (carbohydrate) respectively. There was significant (p<0.05) difference in soy-curd yield. Soaking of soybeans for 6h (sample A) produced the highest soy-curd yield (25.42%) while samples soaked for 72h (sample D) had the least soy-curd yield (10.71%). Furthermore, there was also significant (p<0.05) difference in the product composition as the soaking period increased from 6h to 72h. Soybeans soaked for 6h produced beske with the least compositions, while 72h soaking period resulted to products with the highest compositions. In conclusion, soaking of soybeans appeared to be a promising processing method for enhancing the soy-curd yield and proximate composition of beske.

Keywords- Soybeans, beske, soaking period, proximate composition, yield

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Introduction

Soybean (*Glycine max,* [L] Merrill) is a versatile legume that constitutes staple food to the livelihood of millions of people in west, central Africa and in many parts of the globe. It is the richest, cheapest and best source of vegetable protein available to mankind. Soybean is the most widely grown and utilized legume in the world and one of the most well researched, health-promoting foods available today (Hansen *et al*., 1989). The development of food products from soybean increases its utility and versatility. Soy protein is increasingly becoming important as food and feed sources, especially in developing countries where majority of the populace cannot afford protein from animal source. The profound utilization of dry whole soybeans is limited due the prolonged cooking period and limited varieties of soybeans-based products, among others.

There are several preliminary treatments available for processing soybeans, such as washing, cleaning, dehulling, soaking, germination, fermentation, wet and dry milling (Makuru, 1992). Several studies have shown that, soaking and germination improves the nutritive value of cereals and legumes (Marero *et al*., 1989a, Marero *et al*., 1989b).

Preparation of many indigenous foods from grains involves soaking in water, which is ultimately an household art (Hotz and Gibson, 2001). Soaking is a unit operation that involves the immersion of materials (seeds, leaves and nuts) in water for the purpose of sprouting, fermentation and softening of seeds. Soaking is a common local processing method in Africa that has been reported to influence the properties of legume seeds. It is one of the processing methods used to improve the nutritional value of seeds for the manufacturing of food products. During soaking, seeds absorb water, thereby making the food material to become soft, extensible, flowable, loss of crispness, hardness or toughness and fermentation of starch components occurs simultaneously (Ohenhen and Ikenbomeh, 2007). It also leads to the breakdown of several components into simpler compounds with alteration in texture, flavour, aroma and taste (Parveen, 2003).

Germination is also a processing method that improves the nutritional value of seeds, as it reduces the starch component, induces hydrolytic enzymes synthesis such as phytate reduction and some flavonoid components. Sprouted seeds contain high protein, low unsaturated fatty acids, low carbohydrate and vitamin compared with ungerminated seeds. Mineral content such as phosphorus, calcium, zinc and copper were higher in sprouts since the hydrolysis of phytic acid by the phytic enzyme were activated during germination.

Fermentation causes biochemical and nutritional changes in seeds, thus resulting in breakdown of certain constituents, reduction in anti nutritional factors and the synthesis of B- vitamins. It has also been found to increase protein digestibility of millet protein, decrease the concentration of phytic acid and polyphenols (Mahajan and Chauhan, 1987) with improvement in minerals availability (Khetarpaul and Chauhan, 1989).

The major drawback in the use of soybeans as food are as follows; not easily hydrated, difficult to cook, seed coats are difficult to remove and prolong cooking time is required. A number of technologies have been utilized to render the seeds for easy milling, and this include soaking of the seeds for a period of time proceeded by cooking. There is paucity of information on the effect of soaking of soybeans on the proximate composition and sensory qualities of a Nigerian fried soybeans snacks-beske.

Beske, a non-fermented fried soybean snack (a soft cheese-like food) is usually made by curdling of soymilk. Beske is widely consumed and sold as a fried product in south-west, Nigeria and is still receiving attention owing to its high protein quality and content and its usage as a meat substitute. It is generally prepared and sold on the same day because of its short shelf-life of 2-3 days. Soybeans is no doubt superior to other legumes with respect to some of its nutrients especially protein, minerals, vitamins and fat. However, the poor utilization of soybeans is attributed to the presence of various anti- nutrients inherent in the seed.

During the course of beske production, cleaned soybeans were soaked in warm water overnight in household utensils such as bowls, buckets and earthenware vessels. The soybeans were then thoroughly washed in clean water and wet milled with the aid of a grinding machine. The slurry was sieved with the aid of a cheese cloth and the chaffs were separated from the soymilk. The soy milk were heated for 30 mins at 70°C with continuous stirring to prevent burning, during which coagulants (pap steep-water) were added. The curdled mass were sieved and pressed manually to decant water. The curd were mixed with seasonings, pepper, onion and salt, repressed in cheese-cloth and the resulting solid mass were cut into desired shapes with the aid of a sharp knife. The solid pieces were then fried in hot vegetable oil for about 5 minutes, cooled and packaged as beske (self-developed). The objective of this study was therefore to investigate the effect of soaking period on soy-curd yield and the proximate composition of fried soybeans snack- beske.

Materials and methods

Materials

Soybeans (*glycine max*) (light brown colour), seasonings, pepper, salt and onions were obtained from Owena market in Osun-state, Nigeria. Pap steep-water (from maize) was prepared in the processing laboratory.

Soy-Milk Production

For soymilk production, 200g of raw soybeans were handpicked to remove stones and dirt and then soaked in two litres of water for 6h, 12h, 24h and 72h respectively at room temperature (32±2°C). The soaked soybeans were drained and wet-milled with the aid of a Phillip blender, sieved, using muslin cloth to separate chaff from the soymilk (Liu *et al*., 2004). Two litres of soymilk was introduced into four separate open kettles (labelled A, B, C, D) and boiled at 70°C for 30mins. The ratio of soybean to water used during wet-milling was 1:8.

$$\text{\% Soy-milk yield} = \frac{Mass\ of\ soymilk \times 100}{\text{Mass of slurry}}$$

Preparation Of Beske

To the boiled soymilk, pap steep-water (coagulant, 200ml) was added and stirred continuously to prevent burning. The curdled mass were sieved with the aid of cheese-cloth and pressed manually to decant water. The resulting curds were mixed with seasonings, pepper, onion and salt. The spiced soy-curds were then repressed in cheese-cloth and cut into desired shapes with the aid of a sharp knife. The solid pieces were then fried in hot vegetable oil for about 5mins., cooled and packaged as beske, prior to analysis.

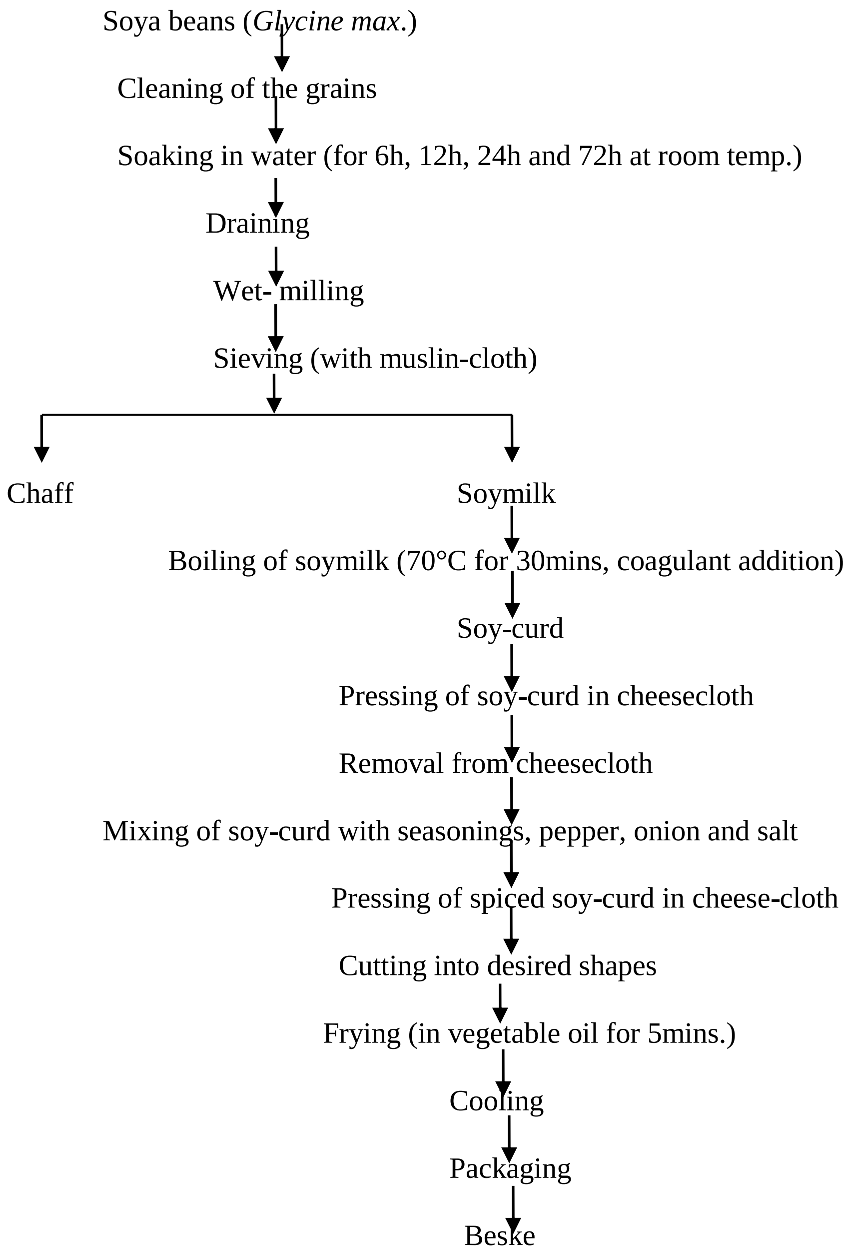

Fig.1: Flow chart for beske production
Source: - (Self-developed)

Proximate Composition Analysis
The moisture content of the samples was determined as described by AOAC (2005) until a constant weight was obtained. The ash content of the sample was determined using a muffle furnace set at 550°C for 18h (AOAC, 2005). The fat content was estimated with the aid of a Soxhlet extractor using n-hexane while the crude protein was determined using Kjeldahl apparatus, carbohydrate content was determined by difference.

Statistical Analysis
The data generated were subjected to Analysis of Variance (ANOVA) and Duncan Multiple Range Test at a level of $P<0.05$ to establish if significant differences exist among the samples using Statistical Package for Social Science (SPSS) version 16.0.

Results and discussion

Effect of soaking period on the soy- curd yields

The percent yield of freshly prepared soymilk and soy-curd yield on wet-basis were presented in figure 1. The soaking of soybeans for 6h with intermittent changing of the steep-water had a significantly reduced soymilk yield than soybeans soaked for 12, 24 and 72h respectively, which increased with other soaking periods. Reduced soy-milk yield at 6h soaking could be attributed to the fact that, most of the enzymes that breakdown and modify heavy macromolecules such as proteins and complex sugar molecules by *in vivo* hydrolyses into soluble proteins, peptides, amino-acids and sugars are usually generated during prolonged soaking period (Palmer *et al*., 1989) and this results in retention of much solids on the sieve.

However, with the addition of pap steep-water (medium with lactic acid as a coagulating agent) to soymilk, coagulation of the soy-curds decreased as the soaking period progressively increased from 6 to 72h respectively. This implies that a profound amount of soy-curd was obtained at 6h soaking period resulting from intact soluble components in the soy-milk. After this time, the hydrated shoots could have utilized much of the soluble nutrients for development, therefore resulting in reduced solids on the sieve. Increase in soluble proteins and sugars have been reported to occur during soybean soaking for soy-milk production.

Effect of Soaking Period on the Proximate Compositions of Soy-Bean Snack-Beske

The proximate compositions of soy-bean snack- beske were presented in table 1. The moisture, ash, crude protein, crude fat and carbohydrate contents of the samples were reported in percentage on dry basis. Results from this study revealed that soaking of soy-beans for varying periods increased the percentage moisture content from 9.25% (6h) to 12.20% (72h). There was significant difference ($p<0.05$) in the moisture content of all the samples with respect to soaking period. As soaking proceeds, seed absorbs water from the surrounding for metabolic activity to commence. Dry legumes absorb water rapidly as a result of the increasing number of cells within the seed becoming hydrated (Nonogaki *et al*., 2010). However, higher moisture in sample D (72h) could be attributed to the heat treatment which has led to partial coagulation of protein that restricts water expulsion from the product (Onuorah *et al*., 2007). Moisture content of any product predicts its shelf-life and determines the type of micro-organisms that could thrive there. It was observed that, the total moisture of beske samples on dry basis was below the range of water activity (0.6) that does not support microbial growth.

There was significant difference ($p<0.05$) in the protein content of all the samples with respect to soaking period. The crude protein content of sample A, B, C, D were 18.21%, 21.19%, 21.64%, 21.88% respectively. Nsofor and Osuji (1997) reported an increase in soluble proteins during soybean sprouting for soymilk production. Sample D (72h) had the highest protein value (21.88%) while sample A (6h) had the least protein value (21.19%) with respect to soaking period. The increase in protein content observed could be due to the fact that during soaking, heavy molecules such as proteins and complex sugars molecules are hydrolyzed by enzymes into soluble proteins, peptides amino acids (Palmer *et al*., 1989) which were latter coagulated during boiling with the aid of a coagulating agent (e.g pap steep-water or alum). This led to increased protein content at 72h of soaking. Furthermore, the presence of other protein-rich ingredients, such as pepper may also increase the product's protein content. The increase in protein content might also be due to the fact that, some amino acids are produced in excess of the requirement during protein synthesis which tend to accumulate as free amino acid pool (Marero *et al*., 1989a).

Camacho *et al.* (1992) made a similar observation (increase in protein content) during the germination of lentils, beans, chick pea and pea’s seeds. Furthermore, a previous study carried out by Ohtsubo *et al.* (2005) showed that soaking /germination also increased the protein content of brown rice. Obizoba (1991) also reported that, total nitrogen, total non-protein nitrogen, protein nitrogen and true protein nitrogen also increased with sprouting period. An increase in protein content could be attributed to synthesis of protein enzymes (for example, proteases) by sprouting seeds or a compositional change following the degradation of other constituents (Khatoon and Prakash, 2006, Parameswaran and Sadasivan, 1994, Ghavidel and Prakash, 2007, Kaushik *et al.,* 2010 and Urbano *et al.,* 2005). The protein of beske was higher than some of the commonly consumed tropical plant foods, such as yam (4-10%), cassava products (4-12%) and some commonly available green leafy vegetables in Nigeria (Akindahunsi and Oboh, 1998, Akindahunsi and Oboh, 1999, Akindahunsi *et al.*, 1999, Oboh *et al.*, 2002, Oboh and Akindahunsi, 2003).

Results from this study revealed that percentage fat content was highest in sample soaked for 72h (38.83%) and least in sample soaked for 6h (22.15%). There was significant ($p<0.05$) difference in the fat content of all the samples. This result contradict the report of Badshah *et al.* (1991) and Chung *et al.* (1998) who observed significant decrease in lipid content during canola sprouting.

Furthermore, the result conforms to the report of Obozoba and Atii (1991), who observed increase in fat content after 12hours of soaking sorghum. The report was attributed to the synthesis of fatty acid. El-Adawy, (2002) and Wang *et al.,* (1997) also reported that, decrease in fat content of seeds could be attributed to the utilization of fat as energy source during sprouting period or the hydrolysis of fat to glycerol and fatty acids in the presence of lipolytic enzymes. The vegetable oil used in frying the product also contributes profoundly to fat increment in the product.

Percentage ash content of beske samples was highest in sample soaked for 72h (2.27%) and least in sample soaked for 6hours (1.00%). Generally, there was significant ($p<0.05$) increase in the ash content of all the samples throughout the soaking period. Ash content refers to the inorganic substance which translates into high mineral contents in the product. El Adawy *et al.* (2003) reported significant increase in the ash content of mung bean, pea and lentil seeds during sprouting. An increase in ash level of the beske samples could be attributed to the addition of pepper, onion and salt to the products.

Generally, the percentage carbohydrate content of the samples varied throughout the soaking period. Soybean soaked for 6hours had the highest content (49.39%), while sample soaked for 72h had the least value (27.09%). This could be attributed to the fact that, most of the soluble sugars are present in the whey compared to the soy-curd. The decrease in carbohydrate might be due to increase in alpha-amylase activity (Lasekan, 1996). The alpha-amylase breaks down complex carbohydrates to simple and more absorbable sugars, which are utilized by the growing seedlings during the early stages of soaking, thereby resulting to loss in dry matter and volatiles.

Conclusion

Soaking of soybeans as a processing technique was found to improve the proximate composition of the product. Sample soaked for 6hours had the highest soy-curd yield with minimum nutrients while samples soaked for 12hour and above had maximum composition but with the least soy-curd yield. The chemical analysis result showed an adequate balance of the proximate composition in all the samples. In conclusion, soaking of soybeans could be an alternative processing method for enhancing the yield of soy-curd and proximate composition of the product (beske).

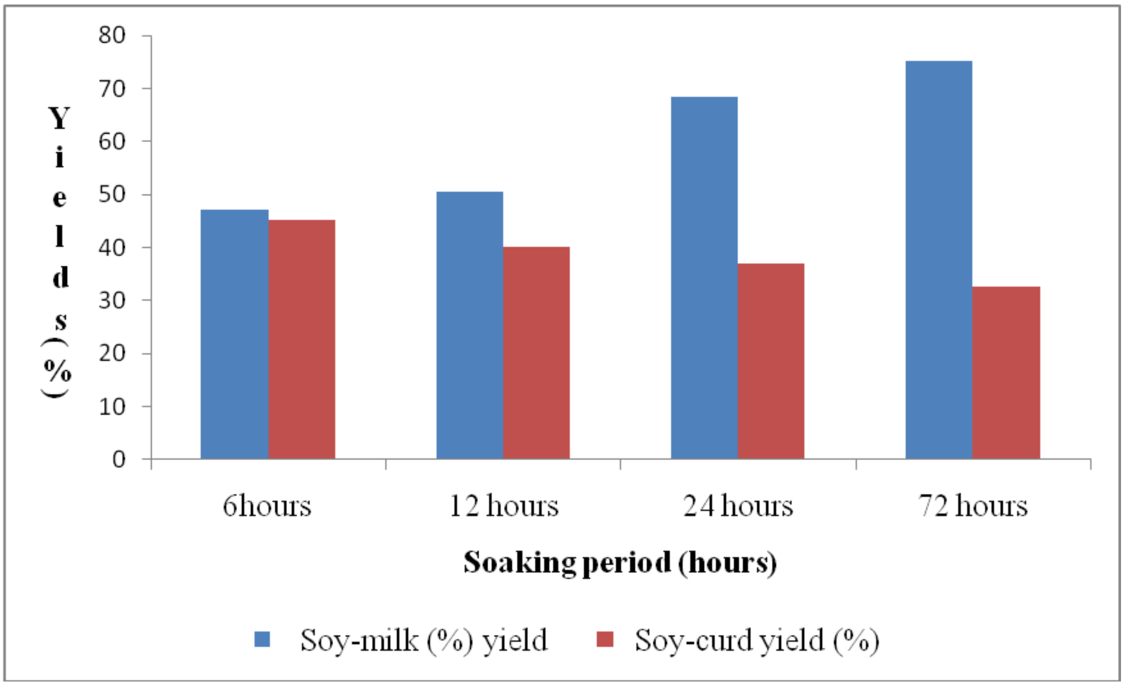

Fig. 1: Percent yields of fresh soy-milk and soy-curd at different soaking periods

Sample A- Soybeans soaked for 6h

Sample B- Soybeans soaked for 12h

Sample C- Soybeans soaked for 24h

Sample D- Soybeans soaked for 72h

Table 1: Proximate composition of fried soybean snack-beske produced at different soaking periods

Soaking period (hrs)/Samples	Proximate composition (%)				
	Moisture content (%)	Protein content (%)	Fat content (%)	Ash content (%)	Carbohydrate content (%)
Sample A/6hr	9.25± 0.01[d]	18.21± 0.12[d]	22.15± 0.21[d]	1.00 ± 0.02[d]	49.39± 0.11[a]
Sample B/12hr	10.20 ± 0.18[b]	21.19 ± 0.33[c]	24.50± 0.29[c]	1.03 ± 0.01[c]	42.08 ± 0.07[b]
Sample C/24hr	10.27 ± 0.12[c]	21.64 ± 0.06[b]	30.33± 0.60[b]	1.43 ± 0.00[b]	36.33 ± 0.31[c]
Sample D/72hr	12.20 ±0.12[a]	21.88 ± 0.06[a]	38.83± 1.17[a]	2.27 ± 0.01[a]	27.09 ± 0.04[d]

[abc] Means with the same superscript in the same column are not significantly P<0.05 different. Values are means ± SD of duplicate determinations.
Sample A- Soybeans soaked for 6h
Sample B- Soybeans soaked for 12h
Sample C- Soybeans soaked for 24h
Sample D- Soybeans soaked for 72h

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