EFFECT OF SOAKING PERIOD ON THE PROXIMATE COMPOSITION OF SOYBEAN USED IN FORMULATING MILK REPLACER FOR CALVES

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ABSTRACT

The study investigated the effect of soaking period on the proximate composition (dry matter, organic matter, crude protein, fibre, fat, ash, carbohydrate, acid detergent fibre, neutral detergent fibre and energy) and (moisture, pH, titratable acidity, solid non fat, protein, total solid, fat and ash contents) of soybeans both on dry and wet matter basis respectively. Raw seeds of soybean (*Glycine max* (L.) Merril) were sun-dried and milled which serves as the control (sample A); soaked for 12h at room temperature (34±2°C) dehulled, sun-dried and milled (sample B); soaked for 24h, sun-dried and milled (sample C); soaked for 48h, sun-dried and milled (sample D) and soaked for 72h sun-dried and milled (sample E). Results from the proximate composition showed that dry matter content of the samples ranged from 95.53 (sample D) to 96.91% (sample A); crude protein content ranged from 40.28 (sample A) to 46.60% (sample C); crude fibre content ranged from 5.16 (sample C) to 9.50% (sample A); and crude fat content ranged from 14.11 (sample A) to 29.55% (sample E). The control (sample A) recorded the highest ash, carbohydrate, NDF, ADF and Hemicellulose contents of (8.47, 24.55, 60.19, 49.98, 10.21%) respectively, while sample D recorded the highest energy content (5631.61 MJ/kgDM). Total solid and solid non-fat were highest in sample D (7.01 and 6.85) respectively. On the other hand, length of soaking period decreases the pH of the samples, but there was an increase in titratable acidity across the samples. In conclusion, the study showed that period of soaking improves the proximate composition of the product.

Keywords: Soybeans, Soaking period, Proximate composition, Milk replacer, Calves

INTRODUCTION

Soybean (*Glycine max* (L.) Merrill) is a herbaceous annual legume with a bushy, erect and leafy plant structure. It originated from China around 1100 to 1700 BC (IITA, 2009). Soybeans were first introduced into Nigeria in 1908 (Fennel, 1966), but the first successful cultivation was in 1937 with the Malayan variety, which was found suitable for commercial production in Benue State in Central Nigeria. Nigeria has been the largest producer of soybeans for food/feed in Sub Saharan Africa (Pele *et al.*, 2016). Soybean is particularly a good source of quality protein (35 – 42%) and fat (16 – 27%), and is a rich source of vitamins and minerals. This makes it one of the most valuable and most commonly cultivated crops (Amusat and Ademola, 2013). Generally soybean seeds content 5.6 – 11.5% moisture, 32 – 43.6% crude protein, 15.5 – 24.7% crude fat, 31.7 – 31.85% carbohydrate, 4.5 – 6.4% ash, 10 – 14.9% neutral detergent fiber (NDF), and from 9 to 11.1% acid detergent fiber (ADF) on a dry matter basis (Goyal *et al.*, 2012). It also contains very little starch (4.66 – 7%) and quite a lot of hemicellulose and pectins. The beans can be utilized in the liquid, powdery and meal forms for animal consumption (Ogundele *et al.*, 2015). Soybean protein is equivalent in quality to animal protein and could serve as an alternative to cow milk. It contain up to 40% protein compared with 1.0 – 5.6% protein content of most animal milk (Goyal *et al.*, 2012). Soybean has the potential for use in calve milk replacer (Ghorbani *et al.*. 2007). Increasing the nutritional quality of soybean and other legumes can be accomplished by several processing methods such as soaking, toasting, cooking, extruding, fermentation, germination, pressure cooking, and urea treatment (Akande and Fabiyi, 2010).

MATERIALS AND METHODS

Source of soybeans and production into flour

Soybeans (*Glycine max* (L.) Merril) were purchased from Giwa market in Kaduna State, Nigeria. The beans were sorted, washed and divided into five different portions labelled as sample (A, B, C, D and E). The control (sample A) was sun-dried, milled, sieved and kept in airtight container for laboratory analysis. Sample B, soybeans were soaked in tap water at room temperature of (34±2°C) for 12 hours, dehulled, sun-dried and milled into flour and sieved. Sample C, were soaked for 24 hours, without dehulling, sun-dried, milled into flour and sieved, while sample D and E were soaked for 48 and 72 hours respectively, after which they were sun-dried, milled into flour and sieved.

Soybean seeds
↓
Screen/sort/wash
↓
Soak in tap water for (12, 24, 48 and 72 hrs)
↓
Drain/Dehull (as the case may be)
↓
Sun-dry the rinsed soybeans
↓
Grind
↓
Sieve with 0.04mm sieve
↓
Soybean flour

Figure 1: Flowchart for the processing of soybeans into flour
Source: (Pele *et al*., 2016).

Determination of Proximate Composition

All the samples were subjected to (AOAC, 2005) method of analysis for dry matter (DM), crude protein (CP), crude fibre (CF), crude fat and total ash (minerals) at the Central Laboratory of the National Animal Production Research Institute (NAPRI), Ahmadu Bello University (ABU), Shika-Zaria, Kaduna State, Nigeria. Total carbohydrate content was determined by subtraction. The formulated soymilk replacer were subjected to analysis to determine the the moisture content by using the oven drying method as described by AOAC (2005). The total ash was determined as described by Pele *et al.* (2016). Fat content was determined using the procedure of AOAC (2005). The crude protein content was determined using Macro Kjeldahl method as reported by Pele *et al.* (2016). The gram nitrogen obtained was multiplied by 6.25 to obtain the crude protein content calorimetrically. Energy values of the samples was determined using Bomb Calorimeter.

RESULTS AND DISCUSSION

Effect of soaking period on Proximate Composition of Soybeans on Dry matter basis

The proximate composition of the various soaking periods are shown in Table 1. The dry matter content ranged from 95.53 to 96.91%. The high DM content could be attributed to adequate drying of the soybean seeds after soaking which reduced the moisture content. The moisture content of any food is an index of its water activity and is used as a measure of stability and susceptibility to microbial contamination (Aruah *et al.*, 2012), indicating that *Glycine max* can be processed into flour after soaking and kept for sometime without microbial spoilage and deterioration in quality. The organic matter content ranged from 88.44 to 93.23%, crude protein content ranged from 40.28 to 46.60 and crude fat content ranged from 14.11 to 29.55%.

There was an increase in the organic matter, crude protein and crude fat contents of the soaked soybeans. This was probably as a result of mobilization of the organic compounds as the seed was preparing for germination. Similar results were reported by Pele *et al.*(2016) for increase in crude protein content which was attributed to sprouting which increased the bioavailability of the crude protein in the soybeans. However, processing method by soaking had decreased the crude fibre, total ash and carbohydrate contents of the soybeans. The control (sample A) recorded the highest ash, carbohydrate, NDF, ADF and Hemicellulose contents (8.47, 24.55, 60.19, 49.98, 10.21%) respectively. Legumes have been reported to be good sources of ash (Aruah *et al.*, 2012). The metabolizable energy for the samples ranged from 3459.50 to 5631.61MJ/kgDM. Sample A (control) recorded the lowest ME (3459.50MJ/kg DM) which might be due to the low fat content of the raw soybeans.

The results of the effect of soaking periods on the nutritional composition of soybeans on wet basis are presented in Table 2. The moisture content of the samples ranged between (92.11 to 92.93). There was an increase in total solid, protein, solid non-fat, titratable acidity and ash with increased length of soaking. While fat content and pH decreases with increase soaking period. This could be due to biochemical reaction and dissociation of lipid complexes as reported by Ragab *et al.* (2010).

CONCLUSION

The results of this study have shown that soaking soybeans in water can greatly improve the nutritional composition of the beans. Soaking is easy and cheap and is an environmentally friendly way of processing soybeans. This is important to the rural farmers because they can now improve the quality of the feed for their animals. This in turn can improve their health and income generation.

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Table 1: Effect of soaking period on the proximate composition of soybeans on dry matter basis

	Samples				
Parameters (%)	**A (raw)**	**B (12hr+dehulled)**	**C (24hr)**	**D (48hr)**	**E (72hr)**
Dry Matter	96.91	96.63	96.03	95.53	96.18
Organic Matter	88.44	92.92	92.25	92.24	93.23
Crude Protein	40.28	45.44	46.60	45.53	44.37
Crude Fibre	9.50	6.17	5.16	8.46	7.60
Crude Fat	14.11	18.48	24.78	29.26	29.55
Total Ash	8.47	3.71	3.78	3.29	2.95
Carbohydrate	24.55	22.83	15.71	11.01	11.71
NDF	60.19	10.80	9.69	11.54	12.61
ADF	49.98	5.54	4.64	7.62	5.88
Hemicellulose	10.21	5.26	5.05	3.92	6.73
ME (MJ/kg DM)	3459.50	5514.57	5333.04	5631.61	5459.87

Table 2: Effect of soaking period on nutritional composition of soybeans on wet basis

	Samples				
Parameters (%)	**A (Raw)**	**B (12 hr dehul)**	**C (24 hr)**	**D (48hr)**	**E (72 hr)**
Moisture	92.93	92.74	92.61	92.38	92.11
Total Solid	6.52	6.74	6.98	7.01	7.33
Protein	3.24	3.71	3.94	3.98	3.82
Fat	2.23	2.14	1.43	1.18	0.90
Solid-non-fat	4.29	4.60	5.55	6.85	6.63
Ash	0.24	0.27	0.29	0.43	0.45
pH	6.80	6.01	5.54	4.93	4.52
Titratable Acidity	0.37	0.81	1.31	1.58	1.84