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Effects of Different Processing Methods on the Chemical Composition and Antinutritional Factors of Soybean [*Glycine max* (L.) Merrill]

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Abstract: An experiment was conducted to assess four different processing methods which include raw, sprouting, salt treating, cooking and roasting on proximate composition and antinutritional factors of differently processed soybean. Results showed that there was an increase in crude protein (40.13-56.66%), crude fibre (15.26-22.34%) and crude fat (12.27-18.94%) of differently processed soybean. There was a decrease in Nitrogen free extract (0.01-21.88%), calcium (0.33-0.43%) and phosphorus (0.12-0.18%) of differently processed soybean. Results of antinutritional factor revealed a decrease in trypsin inhibitor (3.51-24.54 mg/100 g), oxalate (15.00-25.00 mg/100 g), phytic acid (29.70-45.10 mg/100 g) and tannins (4.57-8.07 mg/100 g) of differently processed soybean. All the local processing methods were effective in enhancing proximate composition and reducing antinutritional factors.

Key words: Proximate composition, antinutritional factors, sprouting, salt treatment, cooking, roasting

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is a principal vegetable protein source in animal feed industry in Nigeria. The use of soybeans without oil extraction that is full fat soybean has great nutritional properties. It is high in protein with unique biological value, its fat content contribute to the energy required for protein synthesis. Full fat soybean has between 38-40% CP, 18% fat and 5% crude fibre (Smith, 2001). Soybean can be used as a source of sole source of protein in poultry and swine diets. The quality of protein of soybean can be comparable to that of animal protein sources such as meat and milk (Fabiyi and Hamidu, 2011). Metabolizable energy of 2800-3200 k/cal/kg was reported in soybean wound eliminate the cost of oil extraction in monogastric diets (Lesson *et al*., 1987). Soybean is limiting in sulphur containing amino acids such as methionine and cysteic but contain sufficient lysine to overcome the lysine deficiency of cereal (Potter and Hotchkiss, 1995). Full fat soybean contain anti nutritional factors that reduce the digestibility, bio availability of nutrients and utilization of amino acids in monogastric and immature ruminants (Anderson Heffernan, 1992; Maidala *et al.,* 2011). Increasing the nutritional quality of soybean and other legumes can be accomplished by several processing methods such as toasting, cooking, extruding, salt treatment, fermentation, germination pressure cooking, cooking, soaking, urea treatment (Akande and Fabiyi, 2010). The methods of processing the seeds to eliminate antinutritional factors have been a major challenge to most farmers (Okagbare and Akpodiete, 2006).It is against this background this research work attempt to evaluate local processing methods of soybean seeds on proximate composition and antinutritional factors of Nigerian soybean.

MATERIALS AND METHODS

Experimental site: SAn Experiment was conducted at Teaching and Research Poultry Unit of School of Undergraduate Studies College of education Azare. Azare is located in Katagum Local Government Area of Bauchi State. It is located between latitudes 11°30"N and 11°45°N and longitude 10°10'E and 10°10'E. It is 250 km north of the capital. It covers an area of 915,045 km with a population of 293,970.00 people (NPC, 2006). The mean monthly temperatures ranges from 20.10-22.50°C in December and January to 30.0-32.5°C in April and May. The temperature of the rainy season remains steady 25-27°C for the month of June to October. The area is characterized by 5 months of rainy season (April-September,) and seven months of dry season (October to March) (Bura, 2000).

Sources and processing of ingredients: The soybean was purchased in Azare Central Market. The collected seeds were cleaned by winnowing and hand picking of stones and debris.

Methods of processing of feed ingredients: Toasting soybean was sand roasted by making a bed of alluvial sand in half drum and heating the sand to about 100°C. Sufficient quantities of the ingredients to cover two third of the area of sand will be placed on the sand. Stirring of the ingredients will be done constantly until

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they are roasted for the duration of twenty to thirty minutes (20-30). Roasted soybean seeds are produced. Cooking (boiling) of soybean seeds was done by bringing water in a half drum to boiling point and poured the ingredients in the boiling water for 30 min to produced full fat cooked soybean bean seeds they are then sun dried for 3-4 days.

Salt treatment was prepared by solution of salt was prepared by adding 3% salt of total weight of sample, dissolved in water and soaked the protein sources for twenty four hours (24 h) they are then sun dried for 3-4 days and stored in bags. Salt treated Soybean will be produced.

Sprouting of soybean seeds was prepared by soaking the seeds in water for 24 h. The seeds are removed and germinated by spreading the seeds on jute bags and covered them with the same material and apply water on jute bags twice daily until the seeds begin to sprout. The sprouts were sun dried for 3-4 days. The different processed soybean seeds were analyzed according to procedures of AOAC (1990) in the biochemistry laboratory of National Veterinary Research institute VOM. Antinutritional factors were determined in the biochemistry laboratory of National Veterinary Research institute VOM. Tannin, oxalate, phytic acid were determine according to procedures of A.O.A.C. (1990). Trypsin inhibitor was determined according to Kakade (1969).

RESULTS AND DISCUSSION

The proximate composition of differently processed soybean was presented in Table 1 while the antinutritional factors of differently processed soybean were presented in Table 2. The decrease in dry matter content of differently processed soybean can be attributed to absorption of water by the different processing methods. Bau *et al.* (1997) has reported increase in moisture content of soybean during cooking, Mubarak (2005) has reported in mung bean while Blessing and Gregory (2010) reported increase in moisture content of mucuna seeds. The different processing methods (sprouting, salt treatment, cooking and roasting) enhanced crude protein (CP) content in this order (salt treated>sprouted>roasted>cooked). Iheukwumere *et al.* (2008) have reported increase in the crude protein of soybean as a result of roasting similarly Audu and Aremu (2011) reported the CP content of differently processed red kidney bean. The high increase in protein of salt treated and sprouted soybean can be attributed to complex biochemical changes that occur during hydration and sprouting lead the protein constituent being broken down by enzymes into simple compounds that are used to make new compounds. The increase in hydrolytic activities of the enzymes of sprouting resulted in improvement in the constituent of total protein due to disappearance of starch (Anonymous, 2008). The crude fibre (CF) value of raw of raw soybean (15.26) is lower than those obtained in differently processed soybean; these confirmed the earlier reports of (Peer and Lesson 1985; Ani, 2008; Ragab *et al.*, 2010; Audu and Aremu, 2011). Sprouting, salt treatment, cooking and roasting increase the CF values 3.51, 6.56, 7.08 and 4.60, respectively. The reason for the higher values in CF in differently processed soybean compared to the raw soybean is probably due to the loss of some valuable nutrients in the processing water during salt soaking, boiling and sprouting. The increase in crude fibre values can be useful in maintenance of health of gastrointestinal track of animals. The different processing methods increase the crude fat in this order (cooking>sprouting>roasting>and salt treatment). Legumes are low in fat content and the increase in fat content due to different processing methods is due to dissociation of lipid complexes as reported by Akpanum and Chinewlu (1985), Ragab *et al.* (2010). The processing methods reduced the ash content of soybean except in sprouted soybean which increases it (11.06). Chikwendu (2003) reported an increase in ash content of ground bean sprouted for 72 h due to endogenous enzymes hydrolysis of complex organic compounds to release more nutrients leaving antinutritional factors to leach in to germination medium. All the processing methods decrease the nitrogen free extract (NFE) in this order (cooking>salt treatment>roasting>sprouting). The reduction NFE were earlier reported by Ragab *et al.* (2010), the lowest NFE reported in sprouted soybean (0.01) can be attributed to the high amount of energy needed by seedlings during germination process. The calcium content decrease with different processing methods (Table 1). The phosphorus content followed the same trend and can be attributed to leaching and volatization of nutrients during processing (Akanji *et al.*, 2003; Abeke *et al.* 2011). The increase demand of nutrients particularly calcium and phosphorus by germination seeds could be a possible explanation for the reduced calcium and phosphorus in the sprouted seeds (Reddy *et al.*, 1982). The different processing methods have a profound effect on trypsin inhibitor activity. The reduction of trypsin inhibitor in the different process soybean is given the following order (cooked>roasted>sprouted>salt treated). Abeke *et al.* (2011), Maidala *et al.* (2011) have reported the superiority of cooking over other processing methods. The reduction in trypsin inhibitor in cooked soybean may be attributed probably to uniform heat given to soybean during cooking. The oxalate content of differently processed soybean is given in the following order (salt treated>roasting>cooking>sprouting). The cooking and sprouting methods have no effect on the oxalate content of soybean. Salt treated soybean has more pronounce effect in reduction of oxalate content of

Table 1: Proximate and mineral composition of differently processed soybean

Parameters	Raw	Sprouted	Salt treated	Cooked	Roasted
Dry matter (%)	93.70	83.80	84.80	94.00	95.96
Crude protein (%)	40.13	52.06	56.66	41.98	45.99
Crude fibre (%)	15.26	18.77	21.82	22.34	19.86
Crude fat (%)	12.27	18.10	17.92	18.94	18.03
Ash (%)	10.46	11.06	2.95	6.33	5.72
Nitrogen free extract (%)	21.88	0.01	0.65	10.41	5.72
Calcium (%)	0.43	0.33	0.35	0.40	0.35
Phosphorus (%)	0.18	0.12	0.15	0.12	0.09

Table 2: Antinutritional factors of differently processed soybean

Parameters	Raw	Sprouted	Salt	Cooked	Roasted
Trypsin inhibitor (mg/100 g)	24.54	20.12	21.51	3.51	3.92
Trypsin inhibitor reduction	0.00	18.01	10.64	85.70	84.03
Oxalate (mg/100 g)	25.00	25.00	15.00	25.00	20.00
Oxalate reduction (%)	0.00	0.00	40.00	0.00	20.00
Phytic acid (mg/100 g)	45.10	39.16	36.77	35.68	29.70
Phytic acid reduction (%)	0.00	13.17	41.40	20.87	34.15
Tannins (mg/100 g)	8.07	4.57	7.89	5.93	6.76
Tannin reduction (%)	0.00	43.37	2.23	26.52	16.23

soybean. The oxalate content reported in this study is within the range of (27.62 mg/100 mg) reported by Odumodu (2010) in dehulled soybean. The reduction in phytic acid of differently processed soybean in given the following order (roasted>cooked soybean>sprouted soybean>salt treated soybean). The salt treated soybean has an effect on phytic acid, it decreases the phytic acid by (41.40%) (Table 2). Roasting of soybean has more beneficial effect by reducing the phytate to 34.15% (Table 2). The phytic acid reported in this study is lower than those reported by Odumodu (2010), Ari *et al*. (2012) in fermented soybean. Mikic *et al*. (2009) reported phytic acid content in soybean seeds and products is about 1-1.5% of dry matter. Osman (2007) has reported reduction in phytic acid content in different processing methods (soaking, cooking and germination). The reduction of phytic acid is attributed to leaching in water. The reduction in tannin content of differently processed soybean is given in the following order (sprouted soybean>cooked soybean>roasted soybean>salt treated soybean). Sprouted soybean has more pronounced effect on total tannin content (43.37%) (Table 2). The tannin content reported in this study is much lower than those reported in by Odumodu (2010). All the different processing methods were effective in enhancing the proximate composition and reducing antinutritional factors of soybean.

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