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Sundried Soybean Milk Residue can replace Expensive Soybean Meal in Monogastric Nutrition

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ABSTRACT

This study assesses the suitability of sundried soybean milk residue as a feedstuff in swine ration by determining their chemical properties via proximate analysis, anti-nutritional factors and fibre fractions. It was conducted at Central Laboratory Resaerch of Oyo State College of Agriculture and Technology, Igboora. The processing method was sundried for three weeks in T1, T2 and T3 respectively. Proximate composition, phytochemical analysis and characterization of fibre were determined using standard procedures. Data were subjected to descriptive statistics. The results of proximate analysis revealed crude protein (16.65±0.02), crude fibre (1.03±0.02), ether extract (2.45±0.03), ash (2.15±0.02), moisture content (11.86±0.03), nitrogen free extract (65.73±0.02), dry matter (88.11±0.05) and gross energy (3.63±0.00). The anti-nutritional factors include phytate (0.01±0.00), saponin (0.13±0.00), glycoside (0.10±0.00), phytosterol (0.01±0.00), trypsin inhibitor (2.66±0.03) and polysaccharide (0.11±0.00). Anti-nutrients composition showed sundried soybean milk residue had significant reduction in the levels of phytate, saponin, glycoside, phytosterol, trypsin inhibitor and polysaccharide. The non-starch polysaccharides were 11.52±0.01 for cellulose, 15.85±0.02 for hemicellulose, 29.63±0.04 for neutral detergent fibre, 13.86±0.03 for acid detergent fibre and 2.35±0.02 for lignin respectively. It concluded that sundried soybean milk residue could be used as non-conventional feedstuff for the feeding of livestock species. The nutritive contents of sundried soybean milk residue in terms of gross energy (3.63±0.00) is a potential energy source and therefore can be used as an alternative energy source in monogastric ration. The high content of crude protein and its attendant reduction in toxic substances placed it at a better level for consideration as replacement for the expensive soybean.

Keywords: *Anti-nutritional factors, fibre, nutrients, proximate, sundried, soybean milk residue*

INTRODUCTION

Given the ever-increasing cost and the negative environmental impacts of wastes generated yearly in Nigeria. The population of the world is increasing at an alarming rate but food production is inversely proportional to population growth. Hence, the greatest problem confronting mankind is the production of food for its teaming population. In an attempt to provide animal protein for their people, many developing countries face the problem of increasing cost of raw materials, inadequate and poor quality of feedstuffs to sustain animal production. In recent times, attention is drawing towards the utilization of industrial food waste and by products for the production of novel or functional ingredients. This is in line with the concept of sustainability. Nutrient analysis enables livestock producers to make optimum use of nutrient, help researchers relate feed to animals' performance and reduce production costs. The scarcity of orthodox raw materials for feed mill industry has led to a continuos increase in the cost of production, resulting to exorbitant increase in the unit cost of animal products such as eggs, milk and meat.

As a result, these conventional raw materials, especially maize and soybean which are the main energy and protein sources in livestock feed have become uneconomical to the livestock farmers. Therefore, the exploration of other potential feed resources for the industry has become very important research option in order to address the urgent need for alternative replacements that will arrest the high cost of feedstuff. One possible source of cheap and locally available feed materials is the sundried soybean milk residue (SSMR). SSMR is a by- product of milk and cheese produced from soybean (Iyeghe-Erakpotobor, Osuhor and Olugbemi, 2006).

Processing soybean into soymilk is increasingly becoming more popular as these products serve as good alternatives to lactose intolerant people and vegetarians, having the most essential amino acids compared to other legumes, with good digestibility. Moreover, soybean milk residue does not contain cholesterol which also makes this product good for people with hypercholesterolemia (Spring, 2005). Soymilk is a hot water extract of wet milled soybean seeds; it is off-white in colour and contains most of the soluble proteins and carbohydrates as well as the oil present in the soybean seeds (USDA, 2015a). Sundried soybean milk residue is one of the unexploited feed resources that have potential as a feed ingredient in pig feeding. It is a by-product obtained from the processing of soybean into soymilk. In Nigeria, the wet soybean milk residue is usually discarded as a waste. Its inclusion in livestock diets therefore could help to reduce feed cost drastically and eliminate the problem of waste disposal. This study is designed to determine the chemical composition of locally sundried soybean milk residue for dietary awareness of its nutritional status.

MATERIALS AND METHOD

Source and preparation of sundried soybean milk residue
The samples of the soybean milk residue investigated were collected at the selected soybean milk processors within Igboora metropolis of southwestern Nigeria. The wet soybean milk residue samples were properly sundried for two months until the moisture contents were low enough in the range of 8% to 10%.

Laboratory analysis
Triplicate homogenous representative samples of sundried soybean milk residue which was kept in properly labeled and tightly sealed clean plastic containers were analyzed. Analyses were conducted at Biochemistry and Nutrition laboratory of Institute of Agricultural and Research Training, Moor Plantation, Ibadan.

Determination of proximate composition
Samples of the sundried soybean milk residue were subjected to proximate analyses according to the methods of (AOAC, 2012). The parameters determined included moisture content (MC), crude protein (CP), crude fibre (CF), ether extract (EE), ash and gross energy. The nitrogen free extracts (NFE) was determined by difference. NFE % = 100 – (%CP+%CF+%ash+%EE)

Determination of anti-nutritional factors
Phytate was determine by method described by (Maga, 1983), glycoside by titrimetric and colorimetric methods as described by (Kirshman and Ranijhan, 1980), saponin by (Sim, 2011) and trypsin inhibitor by method of (Liener, 1979).

Characterization of fibre fraction
The carbohydrate fractions of the sundried soybean milk residue were analyzed by methods outlined by (Van Soest, Robertson and Lewis, 1991)

Statistical Analysis
All the results were expressed as mean of standard deviation of triplicate samples

RESULTS AND DISCUSSION

The nutritional importance of a given feed depends on the nutrient and anti-nutritional constituents (Aletor, Goodchild and Abd El Moneim, 1994). The chemical composition of the sundried soybean milk residue is shown in Table 1.0. The crude protein was 16.65 ± 0.02, crude fibre 1.03 ± 02, ether extract 2.45 ± 0.03, ash 2.15 ± 0.02, moisture content 11.86 ± 0.03, nitrogen free extract 65.73 ± 0.02, dry matter 88.11 ± 0.05 and gross energy 3.63 ± 0.00. Table 2.0 shows the anti-nutrient composition of sundried soybean milk residue. Anti-nutritional factors are biological compounds produced by plants and basically used as defensive arsenals. The phytochemicals have been reported to possess health promoting potential (Hennemen, 2016). Phytate was 0.01 ± 0.00, saponin 0.13 ± 0.00, glycoside 0.10 ± 0.00, phytosterol 0.01 ± 0.00, trypsin inhibitor 2.66 ± 0.03 and polysaccharide 0.11 ± 0.00. The fibre fractions of sundried soybean milk residue presented in Table 3 are Cellulose 11.50±0.01, hemicellulose 15.85±0.02, neutral detergent fibre 29.63±0.04, acid detergent fibre 13.86±0.03 and lignin 2.35±0.02 respectively.

The crude protein and crude fibre contents was lower than 27.29% and 9.14% reported by (Maidala and Doma 2016) and 29.11% and 23.77% reported by (Saleh, Baura, Hudu, Ibrahim and Abubakar, 2018). The ether extract recorded was lower than 5.54% reported for sundried soybean milk residue by (Maidala and Doma, 2016). The ash content was also lower than the value reported by (Odeyinka, Olosunde, and Oyedele, 2014) and this indicated that sundried soybean milk residue was a poor source of dietary mineral elements. The value obtained for the gross energy (3.63±0.00) showed that they can as well be used as energy feed stuff for livestock especially non-ruminant animals. The differences in values could be attributed to differences in processing methods, variety of soybean used, harvesting time, difference in geographical location, edaphic factors, drying methods employed and laboratory analysis (Ojewole, Okoye and Ukoha, 2015). The anti-nutritional factors are within the acceptance range reported by (Wafar Yakubu, and Lalabe, 2017).

However, the test ingredient was very rich in trypsin inhibitor. The level of phytate in sundried soybean milk residue (0.01±0.00) is less than (1.56%) reported for mucuna seed. Phytate also forms complexes with divergent minerals thereby decreasing the bioavailability of these elements for absorption (Oboh, Akindahunsin and Oshodi, 2002). Phytate is implicated in decreasing protein digestibility by forming complexes and also interacting with enzymes such as trypsin and pepsin (Rainbird and Low, 1986). The knowledge of the phytate level in feeds is necessary because high concentration can cause adverse effects on the digestibility. Saponin content of sundried soybean milk residue was found to be (0.13 ± 0.00) in the present study was at variance with the range of 0.23 – 0.57 mg/100g reported by (Abeke, Ogundipe, Dafwang, Sekoni, Abu and Adeyinka, 2008). High concentration of saponin cause cell damage by disrupting cell membranes and consequently arrest cell growth (Ologhobo, 2012). Saponins reduce the uptake of certain nutrients including glucose and cholesterol at the gut through intra-lumenal physicochemical interaction and hence saponin had hypocholesterolemic effects (Esenwah and Ikenebomaeh, 2008). Saponin is linked with reduction of palatability and intake of nutrients (Makkah and Becker, 1999). Saponins are active as clearing agent of defective erythrocytes from the body system (Waheed, Barker, Barton, Owen and Ahmed, 2012) They may also be very useful as sources of prophylactic and therapeutic drugs in cardiovascular, diabetic and peptic ulcer diseases (Airaodion, et al., 2019). The level of trypsin inhibitor obtained (2.66 ±0.03) was low compared to that reported for soybean varieties IT84E and 124. Trypsin inhibitor in high un-tolerable limit lowers the digestibility of legume proteins. Trypsin inhibitors disrupt protein digestion, which results in decreased released of free amino acids and their presence is characterized by compensatory hypertrophy of the pancreas due to stimulation of pancreatic secretions. Trypsin inhibitor binds irreversibly to proteolytic enzyme thereby making them unavailable for the breakdown of protein which has been inactivated completely (Ewa, 2015).

The trypsin inhibitor is also known to cause pancreatic hypertrophy which depresses energy availability in animals (Akanji, 2003). The values of glycoside content in sundried soybean milk residue (0.10±0.00) were lower than (13.10±0.05) reported by (Arogbodo, 2021) for sundried fruit peel of unripe plantain. Glycosides and phytosterol have been reported to possess anti-ulcer, antimicrobial and anti-proliferation properties against cancer cells (Chen *et al*, 2014). The sundried soybean milk residue had high content of non-starch polysaccharide compared with the values reported in earlier studies by (Ogundeji, 2018). The total carbohydrates in soybean milk residue are made up of 3.9 -6.6% soluble sugars, 0.5 -1.8% starch and 31.8 – 54.3% total dietary fibre (Mateos-aparicio *et al.,* 2010) depending on the processing methods and varieties of soybean seeds used. Other components of dietary fibre content of soybean include 12.1±1.2% hemicellulose and 5.6±0.9% cellulose (Guermani *et al*, 1992). The values reported for cellulose, hemicellulose, neutral detergent fibre and acid detergent fibre 11.52 ± 0.01, 15.85±0.02, 29.63±0.04 and 13.86±0.03 respectively was higher compared with the values reported by (Akinfala et al., 2019) 6.81, 11.36,22.32 and 10.96 for cassava plant meal. Lignin value 2.35±0.02 obtained for sundried soybean milk residue was however lower than the value 4.15 reported for cassava plant meal by (Akinfala et al., 2019). The differences observed in the study could be as a result of processing methods used, harvesting time, variety of soybean used and laboratory analysis.

Table 1: Proximate composition of sundried soybean milk residue

Parameters	**Means**
% Crude Protein	16.65± 0.02
% Crude Fibre	1.03±0.02
% Ether Extract	2.45±0.03
% Ash	2.15±0.02
% Moisture Content	11.86±0.03
% Dry Matter	88.11±0.05
Nitrogen Free Extract	65.73±0.02
Gross Energy	3.63±0.00

Values are means of triplicate determinations ± Standard Deviation (SD)

Table 2: Quantitative antinutritional factors determination of sundried soybean milk residue

Parameters	**Means**
Phytate	0.01±0.00
Saponin	0.13±0.00
Glycoside	0.10±0.00
Phytosterol	0.01±0.00
Trypsin Inhibitor	2.66±0.03
Polysaccharide	0.11±0.00

Values are means of triplicate determinations ± Standard Deviation (SD)

Table 3: Quantitative fibre fraction determination of sundried soybean milk residue

Parameters	**Means**
Cellulose	11.50±0.01
Hemicellulose	15.85±0.02
Neutral Detergent Fibre	29.63±0.04
Acid Detergent Fibre	13.86±0.03
Lignin	2.35±0.02

Values are means of triplicate determinations ± Standard Deviation (SD)

CONCLUSION

It can be concluded based on the findings in this study that sundried soybean milk residue have low moisture content, low ash content, low fat and high protein content. From present investigation, phytate, saponin, glycoside, phytosterol, polysaccharide and trypsin inhibitor were present below the standard level of recommended dietary allowance. *Anti-nutrients composition showed that sundried soybean milk residue had significant reduction in the levels of phytate, saponin, glycoside, phytosterol, trypsin inhibitor and polysaccharide. The study also revealed that sundried soybean milk residue was higher in soluble non starch polysaccharide.* The low values of antinutritional factors indicated the suitability of sundried soybean milk residue for consumption. Fibre characterization investigated revealed that the sundried soybean milk residue was low in starch and higher in soluble non starch polysaccharide.

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