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Proximate Composition, Anti-Nutritional Factors and Fibre Characterization of Sundried Soybean Milk Residue

Ogunbode Adesina Amao[1*], Abegunde Paul Taiwo[2], Olaniyan Olusanya Ajibade[3], and Aderoju Abiodun Aliu[3]

[1]Department of Animal Production Technology, University of Agriculture and Technology, Igboora, Nigeria

[2]Department of Animal Health Technology, University of Agriculture and Technology, Igboora, Nigeria

[3]Department of Animal Health and Production, University of Agriculture and Technology, Igboora, Nigeria

[*]**Corresponding author:** Ogunbode Adesina Amao, Department of Animal Production Technology, University of Agriculture and Technology, Igboora, Nigeria, E-mail: aaogunbode@gmail.com

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Abstract

In view of the ever increasing cost and the negative environmental impacts of wastes generated yearly in Nigeria, this study was undertaken to assess 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. The study was conducted at Central Laboratory Research of Oyo State College of Agriculture and Technology, Igboora. The processing method employed was sundried for three weeks in T1, T2 and T3 respectively. Proximate composition, phytochemical analysis and characterization of fibre were determined using standard procedures. Obtained data were subjected to descriptive statistics. The results of proximate analysis revealed that 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 revealed 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 that 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 can be concluded based on the findings in this study that sundried soybean milk residue could be used as non-conventional feedstuff for the feeding of livestock species. 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 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; Proximate; Sundried; Soybean milk residue

Introduction

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 continuous 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 [1]. 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 [2]. 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 [3]. 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 Methods

Source and preparation of sundried soybean milk residue

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

Chemical analysis

Determination of proximate composition: Samples of the sundried soybean milk residue were subjected to proximate analyses according to the methods of [4]. 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 determining by method described by glycoside by titrimetric and colorimetric methods as described by saponin and trypsin inhibitor by method of [5-8].

Characterization of fibre fraction: The carbohydrate fractions of the sundried soybean milk residue were analysed by methods outlined by [9].

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 [10]. The chemical composition of the sundried soybean milk residue is shown in **Table 1**.

Parameters	Values
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 1: Proximate composition of sundried soybean milk residue.

The crude protein was 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-nutrient composition of sundried soybean milk residue as shown in **Table 2**. 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 [11].

Parameters	Values
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 2: Quantitative anti-nutritional factors determination of sundried soybean milk residue.

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 are presented in **Table 3**. 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 and 29.11% and 23.77% [12,13]. The ether extract recorded was lower than 5.54% reported for sundried soybean milk residue.

Parameters	Values
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)	

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

The ash content was also lower than the value reported and this indicated that sundried soybean milk residue was a poor source of dietary mineral elements [14]. 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 [15]. The anti-nutritional factors are within the acceptance range reported by [16]. 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 [17]. Phytate is implicated in decreasing protein digestibility by forming complexes and also interacting with enzymes such as trypsin and pepsin [18]. 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/100 g [19]. High concentration of saponin cause cell damage by disrupting cell membranes and consequently arrest cell growth [20]. Saponin reduces the uptake of certain nutrients including glucose and cholesterol at the gut through intra-luminal physicochemical interaction and hence saponin had hypocholesterolemic effects [21]. Saponin is linked with reduction of palatability and intake of nutrients [22]. Saponins are active as clearing agent of defective erythrocytes from the body system [23]. They may also be very useful as sources of prophylactic and therapeutic drugs in cardiovascular, diabetic and peptic ulcer diseases [24]. 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 [25]. The trypsin inhibitor is also known to cause pancreatic hypertrophy which depresses energy availability in animals [26]. The value of glycoside content in sundried soybean milk residue 0.10 ± 0.00 was lower than 13.10 ± 0.05 reported 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 [27,28]. The sundried soybean milk residue had high content of non-starch polysaccharide compared with the values reported in earlier studies by [29]. 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 depending on the processing methods and varieties of soybean seeds used [30]. Other components of dietary fibre content of soybean include 12.1 ± 1.2% hemicellulose and 5.6 ± 0.9% cellulose [31]. 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 are 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 [32]. The differences observed in the study could be as a result of processing methods used, harvesting time, variety of soybean used and laboratory analysis.

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. The low values of anti-nutritional 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.

Conflict of Interest

The authors declare that there was no conflict of interests.

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