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Full Length Research Paper

Determination of proximate composition, amino acids, and some phytochemical properties of sesame seed capsule (*Sesamum indicum* L.) in semi-arid Zone of North-Eastern Nigeria

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The study was conducted to determine sesame seed capsules' proximate composition, amino acid, and phytochemical properties as a potential feed resource. Homogeneous triplicate representative samples were analyzed following scientific protocols. The results indicated that the sesame seed capsule contained 75.41% carbohydrate, 3.59% ether extract, 4.32% protein, 93.57% dry matter, 12.01% crude fiber, and 4.77% ash. The amino acids profile showed glutamic acid with the highest value of 1.71, while proline was not found. The phytochemical contents of the seed showed the presence of alkaloid (1209.88 mg/100 g, phytate (41.07 mg/100 g), saponin (31.94 mg/100 g), oxalate (3.33 mg/100 g), and trypsin inhibitor (9.92 Tiu/mg/g), respectively. The crude fiber and energy values indicated it was a good source of fiber and energy; however, the protein quality was poor, and the concentration of alkaloid, trypsin inhibitor, and oxalate were above the standard limits for safe feed. This may adversely influence digestibility and utilization. It is better to detoxified and supplemented with good quality protein sources before feeding to animals.

Key words: Sesame, capsule, proximate, amino acid, phytochemicals.

INTRODUCTION

Feed supply deficit, especially during the dry season, is an issue of concern to livestock farmers in the northeastern part of Nigeria. Lamidi and Ologbose (2014) reported that the situation becomes precarious during the long dry periods when animals hardly meet their protein and energy requirement. Post-harvest roughage forms a significant source of feed during such a period (Alhassan et al., 1992). These underutilized feedstuffs abound in the region and have the potentials to be used in livestock feeds. The sesame seed capsule is one of such, with large quantities of the capsule produced. This post-harvest waste can be utilized during the dry period when the available pasture is low in quantity and quality (Bogoro et al., 2006). Utilization of this locally available material may reduce the cost of feeding livestock. However, there is limited information on its nutrient

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composition. The need to evaluate its potentials as a feed ingredient is germane because the feed database serves as an essential decision support tool required for feed improvement (Tikabo and Shumuye, 2021). The current study was conducted to determine the proximate composition, amino acid, and phytochemical properties of sesame seed capsules locally available.

MATERIALS AND METHODS

Description of study area

Gashua is situated in Bade, Yobe State, Nigeria; its geographical coordinates are 12°C 52' 5" North, 11°C 2' 47" East. It lies within the Sudan-Sahel vegetation zone, characterized by a hot and dry climate. This community experienced an annual average rainfall of 500 to 1000 mm with a maximum summer temperature range of 38 to 40°C (March-April) and a minimum temperature of as low as 23-28°C (June to September) (Nwankwoala, 2012).

Collection and preparation of sample

Sesame seed capsules were obtained from farms in Gashua Yobe state, Nigeria. It was identified and authenticated by a crop scientist in the Department of Agronomy Federal University Gashua. Samples were sundried and ground into finer particles using an electric grinder and sieved through a 1 mm sieve. Before analyses, the grounded powder was stored in adequately labeled plastic containers and placed in a cool, dry place.

Laboratory analysis

Homogeneous representative samples were analyzed at T & D Laboratories Elim Vision Plaza, opposite the second Gate University of Ibadan. All determinations were done in triplicate.

Proximate analyses

Proximate analyses of sesame seed capsule were conducted according to AOAC (1990), total carbohydrate was determined by difference. All proximate analyses were conducted in triplicates.

Determination of crude protein

The crude protein of the samples was determined by the Kjeldahl method. The 2 g of homogenized triplicate samples were first digested in concentrated sulphuric acid, the digests were distilled into weak acids (boric acid), and later, the distillates were titrated with 0.1 M hydrochloric (HCl) acid using a mixed indicator (Methyl and Bromocresol green) as an indicator (AOAC, 1990). The nitrogen values recorded were converted to crude protein by multiplying with a factor of 6.25.

Crude fiber determination

Two grams of homogenized fat-free sample was boiled in 0.128 Mol of Sulphuric acid and 0.313 Mol of sodium hydroxide. The residue obtained was separated by filtration on a sintered glass fiber, washed, and oven-dried at 130°C for two hours. It was weighed and placed in Muffle furnace for ashing at 550°C for a period of two hours. The loss in weight resulting from ashing correspond to the crude fiber present in the feed (AOAC, 1990).

Determination of ether extract

Ether extract contents were extracted by using a Soxhlet extractor. Two grams of homogenized dried ground samples were extracted with petroleum ether. The ether was later evaporated from the fast solution. The resulting residue was weighed and referred to as either extract or crude fat.

Ash content

Two grams of homogenized grounded sesame seed pod were added to an already weighed crucible and placed in a muffle furnace set at 550°C for 5 h, cooled in desiccators, and reweighed. The ash content was calculated with the following equation:

$$\text{Ash (\%)} = \frac{\text{Weight of ash} \times 100}{\text{Weight of sample}}$$

Total carbohydrates

Total carbohydrates (%) were determined by difference: 100 − (% Crude protein +% Crude fat + % Crude fiber +%Total ash).

Energy values

The metabolizable energy (ME) was calculated by Pauzenga (1985) formula as follows: ME (kcal/kg DM) = (37 × % CP) + (81 × % fat) + (35.5 × % NFE).

Amino acid determination

The amino acid content in sesame seed capsules was determined using the AOAC (1990) method. The results were then analyzed using the Technicon Sequential multi-sample amino acid analyzer.

Phytochemical determination

Quantitative determination of phytochemicals was carried out using a procedure described in Aliyu et al. (2016), which involved using a conical flask and deionized water. The extract was then filtered through a water bath at a temperature of over 45°C. Phytochemical screening was carried out using standard procedures of Harbone (1973).

Computed protein efficiency ratio

The C-PER was calculated using the equation described by Alsmeyer et al. (1974.)
C-PER = - 0.684 + 0.456 (LEU) - 0.047 (PRO).
-0.684 + 0.456(0.13) - 0.047(0.00)
-0.684+ 0.05928 – 0.047=0.69

Statistical analysis

Data recorded were analyzed using descriptive statistics (Olawuyi, 1996). Results were expressed as mean value ± standard deviation of three different determinations.

Table 1. Proximate composition of sesame seed capsule (%).

Nutrients	Mean	SD
Dry matter (%)	93.57	0.00
Crude protein (%)	4.32	0.00
Crude fiber (%)	12.01	0.47
Ether extract (%)	3.59	0.00
Ash (%)	4.77	0.00
NFE (%)	75.41	0.01
ME(Kcal/kg)	3, 127	0.01

Values are mean± standard deviation.

Table 2. Amino acid profile of Sesame seed capsule.

Amino acid (%)	Mean	SD
Arginine	0.48	0.00
Alanine	0.57	0.00
Aspartic acid	0.66	0.00
Cysteine	0.34	0.00
Glutamic acid	1.71	0.00
Glycine	0.48	0.00
Histidine	0.21	0.00
Isoleucine	0.11	0.00
Leucine	0.13	0.00
Lysine	0.20	0.00
Methionine	0.13	0.00
Ornithine	0.02	0.00
Phenylalanine	0.49	0.00
Pyrolyse	0.68	0.00
Proline	0.00	0.00
Serine	0.52	0.00
Threonine	0.07	0.00
Tyrosine	0.14	0.00
Tryptophan	0.04	0.00
Valine	0.38	0.00

Values are mean± standard deviation.

RESULTS AND DISCUSSION

The proximate composition of the sesame seed capsule is presented in Table 1. The results indicated that the sesame seed capsule contained 75.41% carbohydrate, 3.59% ether extract, 4.32% protein, 93.57% dry matter, 12.01% crude fibre, and 4.77% ash. The dry matter value recorded in this study is higher than 90.6% reported by Teferi et al. (2013). The high content of dry matter in the seed capsule suggests that it can be kept for a long time. The crude protein value of 4.77% recorded in this study was slightly lower than the 5.44% reported by Teferi et al. (2013). The slight difference observed might be attributed to varietal and geographic differences. The high crude fiber and NFE contents suggest that sesame capsules can serve as a good source of fiber and energy. Dietary fibers have been reported to be beneficial in stimulating gut health, increasing satiety, affecting behavior, and overall animal well-being (Bach et al., 2012; Wenk, 2001, de Leeuw et al., 2008, de Lange et al., 2010).

Similarly, in a study conducted by Rajesh et al. (2019), the authors reported that dietary fiber stimulates the growth of health-promoting gut bacteria. The ash content of sesame seed capsules was 4.77%, lower than the value of 9.68 reported by Teferi et al. (2013). This may be attributed to varietal differences.

The result of the amino acid analysis of the Sesame seed capsule is presented in Table 2. Glutamic acid had the highest value of 1.71, while proline was not found. The essential amino acids content of the seed capsule

Table 3. Phytochemical properties of the sesame seed capsule.

Phytochemicals	Mean	SD
Alkaloids (mg/100 g)	1209.88	0.47
Phytate (mg/100 g)	41.07	0.47
Saponin (mg/100 g)	31.94	0.47
Oxalate (mg/100 g)	3.33	0.00
Trypsin inhibitor (Tiu/mg/g)	9.92	0.82

Values are mean± standard deviation.
T & D Laboratories Elim Vision Plaza, opposite the second Gate University of Ibadan.

was low; this corroborates with the earlier report of Iwe et al. (2001) that most plant proteins are low in total sulfur-containing amino acid. The amino acids profile recorded in this study were all below the reference values reported by FAO/WHO/UNU (1991). Plant protein quality is usually evaluated by comparing its essential amino acid content with reference standards for ideal protein quality set by the World Health Organisation, which is based on the amino acids requirement for children aged 2- 5 years (FAO/WHO/UN, 1991).

The phytochemical contents of the seed showed the presence of alkaloid (1209.88 mg/100 g), phytate (41.07 mg/100 g), saponin (31.94 mg/100 g), oxalate (3.33 mg/100 g), and trypsin inhibitor (9.92 Tiu/mg/g), respectively (Table 3). The alkaloid and saponin contents recorded in this study were above the values of 825 and 320 mg/100 g reported by Fasola and Ogunsola (2014) for sesame seed and above the upper limit of 60 mg/100 g recommended for a safe feed (McDonald et al., 1995). Some plant alkaloids cause infertility and gastrointestinal and neurological disorders (Olayemi, 2010; Aletor, 1993). The oxalate concentration of 3.33 mg/100 g recorded in this study is similar to the value of 3.40 mg/100 g for locust bean pulp reported by Alabi et al. (2005). The recommended safe limit for oxalates in ruminants is <2% (Sidhu et al., 2014). The oxalate values obtained for this study was slightly above the recommended safe limit of 2%, however, within tolerable levels that would not adversely influence digestibility and utilization. Saponins are steroidal glycosides in many plants, including oilseeds such as kidney bean, lentil, pea, chickpea, alfalfa, soybean, groundnut, and sunflower (Jenkins and Atwal, 1994). Oxalate-rich plants can be supplemented with other plants as forage for domestic animals, which may help to reduce the overall intake of oxalate-rich plants (Rahman et al., 2012). If a ruminant is slowly exposed to a high oxalate diet, the bacterial population in the rumen will increase to prevent poisoning (Rahman et al., 2012). In non-ruminants, <0.5% soluble oxalate may be acceptable (Rahman et al., 2012). The concentration of trypsin inhibitor activity value of 9.92 Tiu/mg/g recorded in sesame seed capsule was higher than the values of 1.08, 1.09, 1.04 and 1.06 TIU/mg for blended apple fruits, watermelon fruits, pawpaw fruits and pineapple fruit reported by Ekpa and Sani (2018). This suggests that the feeding of sesame seed capsules may interfere with protein digestion. Current upper limits tolerable for TIA in soybean products fed to monogastric livestock are considered to be ≤ 4 mg/g for broiler chickens and ≤ 4.7 mg/g for pigs (Batterham et al., 1993; Clarke and Wiseman, 2005).

Conclusion

The results from this study revealed that the Sesame seed capsule contains high levels of NFE (75.41%), crude fiber (12.01%), and caloric value of 3127 kcal/kg; hence it can serve as a source of fiber and energy. However, its major limitations include a high level of alkaloid, trypsin inhibitor, oxalate, and protein efficiency ratio value of 0.711 below the minimum threshold index level of 1.5 for good quality protein. It is better to detoxified and supplemented with good quality protein sources before feeding to animals

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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