PROXIMATE COMPOSITION AND MINERAL CONSTITUENTS OF ELEPHANT GRASS (*Pennisetum purpureum Schumach*.) LEAF PROTEIN CONCENTRATE AND SOYBEAN MEAL: A COMPARATIVE ANALYSIS

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ABSTRACT
Protein insufficiency remains one of the major nutritional problems across the globe especially in developing countries and in the quest to solve this lingering challenge researchers are sourcing alternative feed ingredients that can partially or wholly substitute this conventional protein source. The potential of Guinea grass leaf protein concentrate will therefore be assessed in this study. Freshly harvested Elephant grass (Pennisetum purpeurum) from the College environment in Iguoriakhi located between the tropical rain forest and the derived savanna were processed using the appropriate technology into Leaf protein concentrate. Samples of the sundried Leaf protein concentrate obtained from Elephant grass were subjected to proximate and some mineral elements analysis. All the parameters assayed for proximate composition was higher in Elephant Grass Leaf Protein Concentrate compared to Soybean *Meal except for ether extract which showed higher value in* Soybean *Meal compared to Elephant Grass Leaf Protein Concentrate. Mineral constituents showed higher value for Calcium, sodium, Magnesium and potassium in Elephant grass leaf protein concentrate compared to* Soybean *meal while Zinc, Magnesium and copper were higher in* Soybean*s than Elephant Grass Leaf Protein Concentrate. It is therefore concluded that Elephant grass (Pennisetum purpeurum) leaf protein concentrate can successfully be substituted wholly or partially as protein source for livestock feeding.*

Keyword: Proximate Composition, Nutrient Constituents, Elephant Grass, Leaf Protein Concentrate

INTRODUCTION

Protein deficiency remains one of the major nutritional problems worldwide, especially in developing nations (FAO et al. 2015). Leaf biomass is an abundant protein source with potential to supply essential amino acids and other beneficial nutrients to livestock (Domokos-Szabolcsy et al., 2023). However, plants are difficult to utilize as protein sources for most non-ruminant animals due to both non-digestible fibre fractions and anti-nutritional factors present in the leaf materials that held the protein bound in the leaf and are not available to be utilized by the animals. One strategy to increase utilization of leaf proteins is to isolate and purify high-quality leaf protein concentrate (LPC) (Balfani et al., 2023). While previous attempts to develop LPC for human nutrition have been limited, interest has increased recently in extracting LPC as a value-added co-product in biorefineries utilizing lignocellulosic feedstocks such as perennial grasses (Akaeze et al., 2015). Leafy crops such as grasses and legumes can produce high protein yields in humid climate in a sustainable way when compared with many traditional seed protein crops (Anders, 2021). Therefore, there is need to explore and utilize non-conventional feed sources that have the capacity toyield the same output as conventional feeds, probably at cheaper rate. Leaf protein concentrates have been proving to be a viable alternative protein source. Its crude protein value ranges between 20 and 50% (Olomu, 2011Akaeze, 2015; Sodamade et al., 2013; Aletor and Adebayo, 2012; Olomu, 2011). Method of processing leaf protein concentrate can be adopted locally and the leaf fractionation process can enhance crude protein and gross energy by 34.8% and 22%, respectively (Agbede et al., 2008). The major nutritional requirements of most livestocks especially non ruminants in small-scale tropical livestock production are protein and energy. Elephant grass (*Pennisetum purpureum* Schumach.), also known as Napiergrass, is a high-biomass, perennial grass native to Africa that has been cultivated and well- adopted in tropical areas in Asia, Oceania, and the Americas, as forage, fodder, andsilage. Napiergrass has more potential as an integrated biorefinery feedstock, possessing one of the highest protein contents among plants and lignocellulosic composition suitable for both high quality forage and cellulosic ethanol conversion (Urribarrí et al., 2005). The study therefore aimed to evaluate the proximate composition and mineral constituents of Elephant grass (*Pennisetum purpureum*) leaf protein concentrate and Soybean meal for possible partial replacement in animals' diet.

MATERIALS AND METHODS

Location and duration of the study

The experiment was carried out at the Teaching and Research Farm, Edo State College of Agriculture and Natural Resources, Iguoriakhi, Benin City located in ovia North East LGA of Edo State with the coordinate *6°39'N 5°37'E* of the equator and Samples were analysed at the College Central Laboratory.

Sourcing and Processing for Elephant grass Leaf Protein Concentrate (EGLPC) and SBM

The Elephant grass leaves were freshly harvested early in the morning in the Teaching and Research Farm environment of the College and was thoroughly rinsed with water. The leaves were chopped into finer particle size and pulped using a milling machine and the resultant paste was sieved with a sieve cloth and hand pressed to properly extract the juice and then separate the fibrous chaff (bagasse). The extracted juice was heated to about 80–95^{0}C until the coagulated protein extract are fully formed. The curd formed was sieved, pressed and sun dried as the formed leaf protein concentrate. About 2kg of crushed Soybean meal was purchased from a reputable feed store in Benin Metropolis and about 100g sample was collected and kept in a tight container. The dried Elephant grass leaf protein concentrate and Soybean sample were then taken to the laboratory for analysis (Akaeze et al., 2014).

Proximate composition of EGLPC and SBM

The proximate composition of Elephant grass leaf protein concentrate and Soybean meal were determined as described by AOAC (2016).

Mineral Constituents of EGLPC and SBM

The mineral content of Elephant grass leaf protein concentrate and Soybean meal were analysed using atomic Absorption spectrophotometer (AAS) for the following metals: Ca, Na, Mg, K, Zn, Mn, Cu, Fe, K, Cu, Zn, Mg and Mn while the Flame Photometer was used in the analyses of K and Na as described by (Ahmed et al. 2015).

RESULTS AND DISCUSSION

Proximate composition of Elephant grass leaf protein concentrate and SBM

The proximate composition of Elephant grass leaf protein concentrate (EGLPC) and Soybean meal (SBM) is shown in Table 1. The values obtained revealed that the dry matter content value of 94.26% was higher than that (88.05%) obtained from soya bean meal. The higher moisture content recorded in EGLPC compared to SBM could be due to the fact that the leaf protein concentrate of elephant grass was subjected to sun drying that reduces its moisture content compared to SBM. Sasu et al., (2023) who reported variation in moisture content of three species of Bamboo leaves compared to soya bean which he reported could be due to the prevailing dry condition during the study period, which likely reduced the moisture content of the leaves.

Table 1: Proximate composition of Elephant grass leaf protein concentrate as compared to Soybean meal

Parameters(%)	Dry Matter	Crude Protein	Crude Ash	Crude Fibre	Ether Extract	NFE
EGLPC	94.06	48.06	12.07	5.42	2.03	30.11
SBM	88.05	43.73	7.92	4.83	6.60	28.07

EGLPC: Elephant grass leaf protein concentrate, NFE: Nitrogen free extract

The value (48.06%) obtained for crude protein in EGLPC was higher than those recorded in SBM with the percentage value of 43.73% respectively. The higher crude protein content recorded in Elephant Grass Leaf Protein Concentrate compare to SBM could be due to the effective extraction process of the technology used in extracting leaf protein from elephant grass that tend to release the protein fraction in the elephant grass. This finding lend its support from the report of Akaeze et al., (2015); Nwokoro et al., (2022) who reported higher crude protein value in Rubber LPC and Barbados LPC compare to Soybean. Crude ash value of 12.07% was also higher in Elephant grass leaf protein concentrate and lower value of 7.92% was recorded for Soya bean meal (SBM). The higher crude ash recorded for EGPLC compared to SBM is traceable to the highest crude fibre level recorded for Elephant grass LPC. Ash on food determine largely the extent of mineral matters likely to be found on food substance. The mean value observed was higher than those reported for vegetable species (Saidu and Adunbarin, 1998) that is *Talium triangulare* (0.62%). *Rosselle* (0.46%), *Cochorus Olitorius* (0.32%) *Telfaira Oceidentalis* (0.68%) and *Amaranthus hybridus* (0.41%) the reported value of ash indicated that they were good source of mineral element. The value obtained for crude fibre was higher (5.42%) than that recorded in soya bean meal (4.83%) obtained from soya bean meal. The crude fibre value of EGLPC recorded was higher than those reported by (Aletor and Fasuyi 1999) for *Amaranthus hybridus* which was 1.7%. Although it was lower than the value 9.25% reported by (Ibok et al., 2008). Fibre in a diet helps in the cleansing of the digestive tract by removing potential harmful substances from the body system and hence prevents the absorption of excess cholesterol. Fibre also adds bulk to feed and reduces the intake of excess starchy food and feed. The high fibre content of the Pride of Barbados bagasse makes it a potential livestock feed ingredient, particularly for ruminant and pseudo ruminant animals. Ether extract was higher with a percentage value of 6.60% in SBM than (2.03%) recorded in EGLPC. There was obvious higher value recorded in the ether extract values of the Soybean meal compared to Elephant grass LPC is a pointer to the fact SBM is an oily seed which tend to contain higher fat content compared to extracted LPC from elephant grass. The higher ether extract recorded for EGLPC compared to SBM could be traceable to the high protein and energy content of the material. This finding also agrees with the report of (Mustafa and Baurhoo, 2017). The NFE value (30.11%) obtained from EGLPC was higher than (28.07%) recorded in Soybean meal. NFE value reported in this study was lower than the value reported by Akaeze et al., (2014) for NFE value of Pride of Barbados leaf protein concentrate.

Mineral constituents of Elephant grass leaf protein concentrate (EGLPC) and SBM

The mineral constituents of Elephant grass leaf protein concentrate (EGLPC) and Soybean meal is depicted in Table 2. The values obtained revealed that the calcium content values of 124.80% was higher than that (0.43%) obtained from soya bean meal. Calcium content was found to be higher in Elephant grass LPC compare to those obtained from Soybean. Calcium is necessary for the strong bones and teeth. It is relatively high in cereals, nuts and vegetables (Thomas, 2006). The value (10.23%) obtained for sodium in EGLPC was higher than those recorded in SBM with the percentage value of 0.08% respectively. Sodium and potassium are important sources of electrolytes within the body. Magnesium value of 22.35% was also higher in Elephant grass leaf protein concentrate and lower value of 0.42 was recorded for Soya bean meal (SBM). Magnesium is essential for enzyme reaction in the metabolism of ingested carbohydrate, example of such enzymes are α-amylases, maltase, sucrase and lactase. It is essential in electrical breakdown of nutrient and other materials within the cells (Bolt, 2008).

Table 2: Mineral Constituents of Elephant grass leaf protein concentrate (Mg/100g) as compared to Soybean

Parameters	Ca	Na	Mg	K	Zn	Mn	Cu	Fe	N	P
EGLPC	124.08	10.23	22.35	62.53	1.86	1.73	0.42	114.3	2.45	0.14
SBM	0.43	0.08	0.42	1.23	49.60	53.82	17.30	117.25	8.75	12.26

Ca- Calcium, Na- Sodium, Mg- Magnesium, K-Potassium, Zn- Zinc, Mn- Manganese, Cu- Copper, Fe- Iron, N- Nitrogen, P-Phosphorus

The value obtained for potassium was higher (62.53%) in EGLPC than that (1.23%) recorded in SBM. The high level of potassium in the EGLPC compare to SBM is a good indication that its consumption will enhance the maintenance of the osmotic pressure and acid-base equilibrium of the body (Odoemenam and Ekeyem, 2008). Zinc was higher with a percentage value of 49.60% in Soybean meal than (1.86%) those recorded in EGLPC. Zinc value obtained from this study in EGLPC was found to be low compared to Soybean. Zinc is essential in the activation of certain enzymes, these include dehydrogenase, alkaline phosphatise and carboxypeptidase. Zinc containing organic compounds is employed as astringent and anti- fugal agents. Zinc aids wound healing and metabolism of nucleic acid and insulin (Takeri, 2004). The manganese value (53.82%) obtained from Soybean meal was higher than (1.73%) recorded in EGLPC. Manganese concentration reported in this study for EGLPC is lower compared to the value reported for *Thaumatococcus danielli* leaf protein concentrates by Sodamade (2014). Manganese assist in the regulation of blood sugar level, it is involving in the cell production, energy and reinforce the immune system (Deborah 2008). The value obtained for copper was higher (17.30%) SMB than the mean percentage (0.42%) recorded in EGLPC. The copper content reported in this study negetes the findings of Sodamade et al., (2019) who reported that *Daucus Carota* leaf protein concentrate contain copper concentration of 4.40mg/100g the concentration is higher than 3mg per day recommended for adult and 2mg per day recommended as daily allowance for children. Copper plays vital role in the biological transfer of electron and production of enzymes in the body. The value obtained for iron was higher (117.25%) in Soybean meal than the percentage value of 114.30 recorded from soya bean meal. Iron is a fundamental element as its required for the formation of haemoglobin and its deficiency leads to anaemia (Turan *et al* 2003) the value was higher than 28.97 ± 0.04mg/100g reported for astragalina leaves (Gafar *et al,* 2011). Nitrogen value of (8.75%) seems to be higher in SBM than (2.45%) recorded in EGLPC. The value obtained for phosphorus was higher (12.26%) in SBM than that (0.14%) recorded in EGLPC. Nitrogen and Phosphorus was higher in SBM compared to EGLPC is a good indication that its consumption will enhance the maintenance of the osmotic pressure and acid-base equilibrium of the body. They are essential elements that support growth and development of muscles, tissues and bones of the animals its reduction could be as a result of the heat that could have denatured the element during processing.

CONCLUSION

Given the relatively high nutrient contents of Elephant grass (*Pennisetum purpeurum*) leaf protein concentrate comparable to Soybean meal, it is suggested that it has the potential of being used as protein supplement in animal feeding. The bagasse of the Elephant grass can be used in ruminant and pseudo-ruminant feeding because of its high fibre content. Therefore, research should be carried out on their utilization by livestock.

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