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Groundnut Shells as a Potential Feed Supplement for Ruminants on Pastures: A Review

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ABSTRACT

Communal grazing does not offer adequate forage for ruminants throughout the year. This problem is exacerbated during the dry season when grazing is scarce and of poor nutritional quality. Mineral shortages are common in communal grazing environments and yet they are nutritional requirements for optimal development, physiologic functioning and productivity in animals, as well as for cattle growth, reproduction and health. However, the use of groundnut (*Arachis hypogea* L.) shell (GNS) that are readily available but have no direct nutritional benefit in humans, have not been extensively investigated as a potential source of animal feed. This paper investigates the potential of GNS as feed supplement for ruminants on pasture and its use in other industries. After extracting the seed, the groundnut shell, accounts for roughly 21-29 per cent of the total weight of the nut. Despite the high lignin content of the shell that necessitates adequate processing before use in animal feed, groundnut shell includes 0.50 per cent crude protein, 59.0 per cent crude fiber, 2.50 per cent ash and 4.43 per cent carbs. Sodium (42.00 mg/100 g), potassium (705.11 mg/100 g), magnesium (3.98.00 mg/100 g), calcium (2.28 mg/100 g), iron (6.97 mg/100 g), zinc (3.20 mg/100 g) and phosphorus (10.55 mg/100 g) are all abundant in groundnut shells. In view of this, GNS, a by-product of industrial processing of groundnuts is a rich source of nutrients and can be used to supplement ruminants on pastures during times when pastures are in short supply and of poor quality. Studies are needed to investigate their use to supplement cattle on pasture grazing during times of feed shortage. However, its use as animal feed supplement is likely to face challenges from other industries such as biofuel production.

Key words: Grazing animals, Groundnut shells, Minerals, Pasture.

Cattle grazing on pastures can meet some of their mineral requirement by drinking water and eating dirt. However, forages are the primary source of minerals (McDowell, 1996). Natural pastures, on the other hand, are typically mineral deficient since some soils' are deficient in certain minerals especially with regard to phosphorus (P) and therefore insufficient to support appropriate Phosphorus content in pastures (Chardon and Koopmans, 2005).

According to Solomon and Mlambo (2017), in South Africa, animals, particularly cattle and goats, play a vital economical role. However, the adequacy and availability of important mineral elements from pastures and soil impact the performance and health of grazing ruminants (Islam *et al*. 2003) and herbage minerals affect the performance of grazing cattle (Gao *et al*. 2016)

Mineral levels vary with species of pasture and mineral imbalances exist in different parts of the plant (Fardous *et al*. 2010). Deficiencies, of the major minerals such as calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na) and sulphur (S), as well as the trace elements cobalt (Co), copper (Cu), iodine (I), manganese (Mn), selenium (Se) and zinc (Zn) can affect the production of livestock that depend on pasture grazing in most parts of the world (Goswami *et al*. 2005). This compromises the health of animals and as a result, farmers' income (Dermauw *et al*. 2013).

Groundnut shells (GNS) are considered to be an agriculture waste in places where groundnuts are harvested and processed and if they are not used productively, they can become an environmental concern. According to Nwofor and Sule (2012), groundnut shells are considered a waste product during and after harvest and when gathered in significant amounts in one location, they pose an environmental threat. Furthermore, groundnut shells make up around 20% of the weight of a dried peanut pod, implying that there is a substantial quantity of shell residue after groundnut processing (Pratha and Prabakar 2020). The use of groundnut shell as a cattle feed source would help to reduce the number of shells accumulated in huge amounts (Mokolopi *et al*., 2021). As a result, adopting the use of GNS as animal feed would not only solve waste disposal issues but also provide low-cost cattle feed, especially for community farmers.

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Ground nut shells are effective and inexpensive feed supplement for improving the performance of communally grazed animals and they are inexpensive and widely available for both commercial and communal farmers in South Africa and other countries. Therefore, the aim of this review is to emphasise the relevance of groundnut shells as a feed supplement ruminant on pasture and its use in other industries.

Groundnut shells as a feed supplement

Groundnut shells could be used by some farmers to feed some of their animals (Ikumapayi *et al*. 2021). Furthermore, according to the study conducted by Abdulrazak *et al*., (2014), the relatively high value of crude protein and carbohydrates found on GNS during their experiment, indicated the need for use of them as agricultural feed for herbivores. GNS are also source of roughages for ruminants (Varma *et al*. 2020).

According to Akinfemi *et al*., (2012), the tropical agricultural waste and by-products (including GNS) showed a great variation in chemical composition and mineral content during their experiment. According to them the use of GNS in animal feeding is a common practice in tropical countries. GNS can also be used as animal feed due to its nutritional value and can well be tailored into advanced synthetic fibers (Jubu *et al*., 2018). Ruminants in such in areas where GNS are readily available, largely depend on such crop residues for maintenance and production (Millan *et al*., 2020). Aregheore (2000) considered crop residues, which includes GNS as suitable for feeding livestock.

Groundnut shells as a by-product

Worldwide, roughly 45.6 million tons of peanuts are produced each year (Dahunsi *et al*., 2017). According to Sorita *et al*. (2020), from the Food and Agriculture Organization of the United Nations the global peanut output in September 2019 was over 46 million tons. Peanuts are the most important food legume crop, with recent increases in global output and are now farmed in China, India, Africa, Japan, South America and the United States, with over 300 varieties planted globally (Jayaprakash *et al*., 2019). According to Ge *et al*. (2020), groundnuts are a significant grain legume that is widely farmed and enjoyed across the world, with shell, skin and peanut meal as by-products of industrial processing. According to the same authors, about 230-300 g of shells is generated per kilogram of peanut, with an anticipated global production of 10.7-14 million tons of peanut shell trash in 2017 and 2018. Duc *et al*., (2019) regarded groundnut shells as a plentiful agro-industrial waste product that degrade extremely slowly under natural circumstances.

After the groundnut seeds have been extracted from their pods, GNS are the remnants and when the groundnut kernel is separated from its husk, they are considered as plentiful agricultural wastes (Duc *et al*., 2019). Furthermore, they are low-cost agricultural by products that are plentiful (up to 30 million tons per year) across the world (Sawe, 2018).

Groundnut shells are widely available and are so cheap that even the poorest can afford to buy. Furthermore, they account for around 20% of the weight of a dried peanut pod, showing that groundnut processing leaves a substantial quantity of shell residue. As a result of increasing groundnut productivity, groundnut shells are collected and are either burned or buried since they are not used. They are available plentiful throughout the world.

Characteristics of groundnut shells

Like other lignocellulosic wastes, GNS are complex substances made up of an interconnected net of cellulose, hemicelluloses and lignin. The functional groups of these components, namely carboxyl and phenolic hydroxyl groups, can act as physical and chemical bonding sites for biosorption in these materials (Rangabhashiyam *et al*., 2014).

The presence of significant amounts of lignin (41%), cellulose (37%) and hemicelluloses (9%) distinguishes this agricultural waste (Anike *et al*., 2016) and according to Ramrez-López *et al*., (2003), they also have a pH of about 6.8, a significant surface area of at least 260 m^2/m^3 and a high porosity of at least 115, 74 per cent.

Groundnut shells that have been thermally or chemically altered have mostly been evaluated in adsorption batch studies to remove organic (*e.g.*, dyes) pollutants, with findings indicating that 60 percent of nitrogen has been removed (Duc *et al*., 2019).

Groundnut shells make up about 20-30% of the weight of dried groundnut pods (Vyas *et al*., 2016). Proteins, lipids, sugars, minerals, lignin and carbohydrates with lignocellulosic compositions such as hemicellulose and cellulose may be found in peanut shells, according to Adhikari *et al*., (2018). According to them, they also contain numerous bioactive and useful chemicals that are safe for human ingestion (polyphenols, flavonoids, luteolin and carotene).

Importance of GNS

Ground nut shells can be utilised in a variety of sectors, including the food, feed and paper industries (Bharthare *et al*. 2014). GNS have been explored for a variety of purposes over the years, including, adding them to animal feed, particularly for cattle (Gary, 2002) and as dietary fiber for humans (Sorita *et al*., 2020). They are considered to be agro-waste that are common in nature and degrade slowly in natural conditions (Bharthare *et al*. 2014). According to Vyas *et al*. (2016), plastic manufacturing, charcoal production, wastewater treatment, metal casting, gasifiers, composting of wet materials and usage as manure to improve soil conditions are all viable applications for ground nut shells.

The GNS residue is a good feedstock for bioconversion into biofuel since it contains around 38% cellulose, 36% hemicelluloses and 16% lignin (Nyachaka *et al*., 2013). They further explained that GNS are potential substrate for commercial biofuel generation in industries like agricultural lignocellulosic wastes since they are renewable and

inexpensive. They have the highest biomass production potential among diverse agricultural wastes, according to Deeba *et al*., (2017) and are thus regarded as promising lignocellulosic biomass for the creation of biological energy. GNS may also be used to make biofuels (Duc *et al*., 2019). According to Malawade *et al*., (2021), GNS bio-residues are utilised to generate biofuel, as adsorbents and in other uses. They are also an excellent biosorbent for the adsorption of heavy metals from industrial effluents (Duc *et al*., 2019).

CONCLUSION

Groundnut shells are widely regarded as agro-industrial waste and millions of tons of them are dumped into the environment each year. These lignin-rich shells degrade slowly in the natural environment. To reach zero waste generation and given that they are rich in minerals, GNS can be turned into usable products such as animal feed sources, which is a more environmentally friendly way to dispose them off. In addition, GNS can be converted into a variety of bio-products with commercial uses, including biofuels, building materials, paper manufacture, heavy metal adsorption, dye degradation and so on, using simple biochemical treatments.

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