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Potential of defatted Delonix regia seed cake as alternative feed for ruminant animals

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ABSTRACT

The most widely available low-cost feed for ruminants in major developing countries is usually native pastures but there is a limitation in their availability as they kept reducing in quantities and qualities all year round while the high cost associated with convectional cereals and legumes made them be discouraged. The aim of this article is to investigate the potential of defatted Delonix regia seed cake as ruminant animals alternative feed. The properties of D. regia seeds were determined using the method (Idowu et al., 2012). The oil available in the seeds was extracted using cold maceration method. The proximate composition of the defatted seed cake was determined using (AOAC, 2016) methods while its elemental mineral component was analysed using Atomic Absorption Spectrophotometer (AAS) following (AOAC, 2016) methods. Its anti-nutrient content was determined following the method of (Akaninwor and Okechukwu, 2004). The average for the length, width and thickness of D. regia seeds obtained in this study are 17mm, 5mm and 3.8mm respectively. The proximate composition showed that the seed cake has high protein content with the value of 39.57%while the concentration for the mineral composition goes in the following order: (Fe>Zn>K>Mg>Mn>Cu>Co>Na>Ca). The anti-nutrient content showed that oxalate (0.85mg/100g) has the highest value while phytate (0.34mg/100g) has the least value. This study has demonstrated that defatted Delonix regia seed cake usually known to be waste could be useful in compounding animal feed.

Keywords— *Ruminants, Forage, Defatted, Delonix regia seed cake, Legumes, Feed*

1. INTRODUCTION

The most widely available low-cost feed for ruminants in major developing countries is usually native pastures (www.fao.org). But, there is a limitation in their availability as they kept reducing in quantities and qualities all year round due to climatic changes, overgrazing and increased land use by man (www.unaab.edu.ng). Also, the use of convectional resources such as cereals and legumes grains have been discouraged due to the high cost associated with them as they also serve as food to man. Therefore, there is need to search for alternative feed resources which are cheap, not competitive and readily available at the same time ensuring the preservation of animal health, production yield and product quality (www.unaab.edu.ng).

Oilseeds cakes and meals are the residues remaining after removal of the greater part of the oil from oilseeds. The residues are rich in protein and could serve as valuable feeds for farm animals (www.unaab.edu.ng). They often serve as protein supplements. Most oilseed cake that has high protein content include groundnut cake, cottonseed cake, soybeans cake, palm kernel cake and so on (www.unaab.edu.ng).

One of these oilseeds is *Delonix regia* known as Royal Poinciana or flamboyant tree, it belongs to the family Fabaceae/Leguminosae. It is native to Madagascar. The pods are flat, woody, dark brown, 61 cm long and about 5.1 cm wide (Abulude *et al*., 2017). The fruits are green and flaccid when young and later turn dark brown and hard when matured. On ripening, the mature fruit splits open into two halves revealing the elongated hard seeds (Adje *et al.*, 2008; Arora *et al.*, 2010; Rani *et al.*, 2011). D. *regia* is widely cultivated and may be seen in parks and estates in tropical cities throughout the world (Abulude *et al*., 2017). D. *regia* seed cake after extracting the oil for industrial use has always been a waste which when left unutilized, often causes environmental pollution and hazard. Reviewed literature (Abulude *et al*., 2017 and Oyedeji *et al*., 2017) on *Delonix regia*

reported the nutritional and anti-nutritional properties of the seed flour. The potential of the seed cake after extracting the oil has not been fully harnessed. This study is aimed at harnessing the potential of defatted D. *regia* seed cake for ruminant feed. This will be achieved by the determination of the physical properties of the seeds, proximate, mineral and anti-nutrient composition of the seed cake.

2. MATERIALS AND METHODS

Delonix regia pods were collected from the parent trees at Ogbomosho, Oyo State Nigeria. The D. *regia* seeds were obtained by cracking the pod and sorted to remove foreign materials. The physical properties of the seeds were determined before they were washed, dried, and milled for easy oil extraction. The seed cake was stored in an airtight container and kept at room temperature after removing the oil.

2.1 Physical Properties of D. *regia* Seeds (DRS)

About 100pcs of the seeds were taken at random and the physical properties such as length, width and thickness were determined while the geometric mean and surface area of the seeds were calculated using appropriate formulas following the method of (Idowu *et al*., 2012).

2.2 Proximate composition of defatted D. *regia* seed cake (DRSC)

The proximate composition of defatted **D.** *regia* seed cake, such as dry matter, crude protein, crude fibre, ash content, ether extract and energy content were all determined using (AOAC, 2016) methods. The carbohydrate content was calculated by difference.

2.3 Mineral composition of defatted D. *regia* seed cake

D. *regia* seed cake was analysed for its mineral content using Atomic Absorption Spectrophotometer, (Model 215 VGP BUCK Scientific). The sample analysis was based on standard methods of (AOAC, 2016). Metals such as Magnesium, Iron, Zinc, Calcium, Manganese, Copper and Cobalt were determined. Sodium and Potassium were determined using flame photometer.

Accurately weighed (2.0g) of the seed cake was transferred into a silica crucible and kept in a muffle furnace for ashing at 550°C for 3 hours and then 5mL of 6M HCl was added to the crucible. Then, the crucible containing the acid solution was kept on a hot plate and digested to obtain a clear solution. The final residue was dissolved in 0.1M HNO_3 solution and made up to 50mL with distilled water. The digested sample was transferred to the Atomic Absorption Spectrophotometer (AAS). Working standard solutions were prepared by diluting the stock solution.

2.4 Determination of the defatted D. *regia* seed cake anti-nutrient content

The tannin and phytate content was determined according to the method of (Akaninwor and Okechukwu, 2004) with some modifications. Oxalate content was determined according to the method described by (Aina et al., 2012).

3. RESULTS AND DISCUSSION

3.1 Physical properties of the seeds

For small scale production, the seeds are pretreated (dehulled) manually, but for commercial production, there is a need for designing a machine to dehulled and separate **D**. *regia* seeds. These external morphological features are used to identify the seed. Therefore, to achieve this, the physical properties of the seeds are necessary. The average for the length, width and thickness of **D**. *regia* seeds obtained in this study are 17mm, 5mm and 3.8mm respectively, these values are in close range to the values obtained by (Alan *et al*., 2016). Values are the mean ± standard deviation of triplicate determinations.

Table 1: Physical properties of D. *regia* seeds

Physical Properties	Quantity
Length (mm)	17.0±0.02
Width (mm)	5.0±0.01
Thickness (mm)	3.8±0.12
Geometric mean (mm)	132.64±0.05
Surface area (mm^2)	55,279.78±0.01

Values are mean ± standard deviation of triplicate determinations

3.2 Proximate composition of the defatted D. *regia* seed cake

The dry matter for **D**. *regia* seed cake was 95 % DM. The dry matter is somehow low when compared with the mean value of some legumes which ranged between 87-97 g/ 100g DM as reported by (Aletor *et al*., 2007). This is an indication of good shelf life characteristic, i.e. more stable during storage than those with high values. The value of protein content 39.57% is comparable with those reported for some conventional seeds (Esuoso and Bayer, 1998) but higher than the value (8.75%) obtained by (Oyedeji *et al*., 2017) for the undefatted seed flour, the huge difference may be due to the fact that the seed flour is still containing fat. The value falls within the range for important legumes such as soybeans, cowpeas, pigeon peas, melon, pumpkin and gourd seeds ranging between 23.1-33.0% (Olaofe *et al*., 1994); chick beans 19.4% and lima bean, 19.8% (FAO,1991) and Jack bean, 30.8%. Crude protein content is very important in ruminants and animal generally as protein contribute energy and provides essential amino acids for rumen microbes as well as the animal itself. This seed cake due to its high protein content could act as a protein supplement for ruminant feed. The crude fibre for **D**. *regia* seed cake was 10.78%. The crude fibre is within the range of the values reported by (Abulude *et al*., 2017) and (Oyedeji *et al*., 2017). The role of crude fibre in both human and animal body is to maintain the internal distention for normal peristaltic movement of the intestinal tract. (Okon, 1983) reported that a diet low in fibre is undesirable as it could cause constipation and associated diseases like piles and appendicitis. The ash content of **D**. *regia* seed cake was 1.58%. It has been recommended by (Pomeranz and Clifton, 1981) that ash contents of nuts, seed and tubers should

fall in the range 1.5-2.5% in order to be suitable for animal feeds. The energy content for **D**. *regia* seed cake was 341.45kcal/100g. This value is low when compared with the report of (Aletor *et al*., 2007) for the commonly utilized seed cake for animal feed. However, it is still within the range of some legumes used for compounding animal feed (Abighor *et al*., 1997). This result thus gave an indication that **D**. *regia* seed cake is moderately rich in energy and can supply animals required an amount of energy.

Table 2: Proximate composition of D. *regia* seed cake (DM basis)

Parameters	Quantity
Dry matter (%)	87.0±0.25
Ash content (%)	6.41±0.20
Crude protein (%)	39.57±0.13
Crude fibre (%)	10.78±0.1
Ether extract (%)	6.04±0.12
Energy content (Kcal/100g)	341.45±0.08

Values are mean ± standard deviation of triplicate determinations

3.3 Mineral composition of D. *regia* seed cake

The mineral composition of **D**. *regia* seed cake showed a high concentration of potassium, iron, zinc and magnesium. The values for iron, zinc calcium, manganese and copper are within the range of those reported by (Oyedeji *et al*., 2017). Iron has long been recognized as an essential constituent of haemoglobin, the red colouring matter of blood. Deficiency of iron results in nutritional anaemia, a condition in which the blood is deficient in red colouring matter (Hang, 1951). It has been shown that animals cannot utilize the iron in their rations properly unless a trace of copper also is present. Deficiency in copper usually have a serious effect on ruminant animals, symptoms include anaemia, scouring, a faded appearance of the hair coat or of dark coloured wool, and brittle bones (Hang, 1951).A large percentage of the calcium and phosphorus stored in the body is deposited in the bones in the rather constant ratio of about twice as much calcium as phosphorus. The animal body can use calcium and phosphorus independently of each other to only a limited extent. The utilization of both calcium and phosphorus is connected closely with Vitamin D. A significant supply of Vitamin D (or its equivalent in sunshine) is necessary for the proper utilization of the calcium and phosphorus contained in the ration (Hang, 1951). Deficiency in calcium and phosphorus nutrition in farm animals is shown in a variety of ways such as rickets, retarded growth, decreased milk production, reproductive disturbances, and depraved appetite and so on. The exact calcium and phosphorus requirements of farm animals are not known (Hang, 1951). Cobalt is known to be an essential element. The requirements for cobalt are most striking for cattle and sheep. Symptoms of cobalt deficiency are difficult to distinguish from those resulting from underfeeding and consequent malnutrition (Hang, 1951).

Table 3: Mineral composition of D. *regia* seed cake

Minerals	Quantity (ppm)
Magnesium	296.702±0.05
Iron	1096.0±0.02
Zinc	859.0±0.03
Potassium	569.198±0.01
Sodium	9.062±0.1
Calcium	3.45±0.06
Manganese	245.0±0.1
Copper	89.50±0.04
Cobalt	67.12±0.02

Values are mean ± standard deviation of triplicate determinations

3.4 Anti-nutrient composition of defatted D. *regia* seed cake

The tannin, oxalate and phytate content of **D**. *regia* seed cake are 0.58mg/100g, 0.85mg/100g and 0.34mg/100g respectively. These values are lower than those reported by (Oyedeji *et al*., 2017). Tannins are known to be responsible for decreased feed intake, growth rate, feed efficiency and protein digestibility in human and animals. If tannin concentration in the diet becomes too high, microbial enzyme activities including cellulose and intestinal digestion may be depressed (Aletor *et al*., 2005). Tannins also form insoluble complexes with proteins and the tannin-protein complexes may be responsible for the anti-nutritional effects of tannin containing foods (Panhwar, 2005; Kyriazakis and Whittenmore, 2006). Phytate is usually present in plant, seeds and grains, comprising 0.5 to 5 percent (w/w) (Loewus, 2002). The phosphorus bound to phytate is not typically bio-available to any animal that is non-ruminant. Ruminant animals, such as cows and sheep, chew, swallow, and then regurgitate their food. This regurgitated food is known as cud and is chewed a second time. Due to an enzyme located in their first stomach chamber (rumen), these animals are able to separate and process the phosphorus in phytates. Humans and other non-ruminant animals are unable to do so (Harold, 2004). Oxalate is an anti-nutrient which under normal conditions is confined to separate compartments. However, when it is processed and/or digested, it comes into contact with the nutrients in the gastrointestinal tract (Noonan and Savage, 1999). In ruminants, oxalic acid is of only minor significance as an anti-nutritive factor since ruminant stomach can readily metabolize soluble oxalates, and to a lesser extent even insoluble calcium oxalate.

Table 4: Anti-nutrient content of defatted D. *regia* seed cake

Anti-nutrient	Quantity(mg/100g)
Tanin	0.58±0.21
Oxalate	0.85±0.35
Phytate	0.34±0.23

Values are mean ± standard deviation of triplicate determinations

4. CONCLUSION

Based on the rich protein content, adequate essential minerals and low anti-nutrient contents of defatted *Delonix regia* seed cake, this study shows that defatted *Delonix regia* seed cake could be of good economic importance in ruminant feed.

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