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EFFECTS OF DIETARY LEVELS OF ROASTED FLAMBOYANT (*Delonix regia*) SEED MEAL ON MILK QUALITY AND YIELD FORM SAVANNA BROWN DOES

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ABSTRACT

A study was conducted to observe the effects of diets containing varying levels of roasted *Delonix regia* seed meal on the milk quality and milk yield from Savanna brown does using fifteen nulliparous does. The animals were allotted to five treatment groups of three replicates each in a completely randomized design and fed isocaloric and isonitrogenous treatment diets designated T_1, T_2, T_3, T_4 and T_5 which had the groundnut cake component substituted with *Delonix regia* seed meal at 0 %, 25 %, 50 %, 75 % and 100 % respectively. Data on milk quality and yield were collected and subjected to analysis of variance (ANOVA) and the differences between the means were separated using the Duncan's Multiple Range Test. The results obtained showed that animals fed diets with 50 % of groundnut cake replaced with roasted *Delonix regia* seed meal performed better with respect to all the milk parameters evaluated, with a decline in these parameters at dietary levels above 50 %. It was concluded that feeding diets having 50 % replacement level of groundnut cake with roasted *Delonix regia* seed meal is a nutritionally effective means of improving the performance of does in terms of the performance parameters so evaluated.

Key words: *Delonix regia*, savanna brown does, milk quality

INTRODUCTION

Animal protein sources available to man include eggs, meat and milk. Of all these, milk and other dairy products have retained a clean image in the face of adverse food safety issues associated with a number of food products in recent years (McDonagh, *et.al*, 2003). There is almost complete unanimity of opinion on the fact that of all foods, milk and milk products seem bound to play a leading role of meeting the nutritional requirements of people, especially in areas where protein malnutrition is most prevalent (Olalokun, 1995). A lot of health benefits has been attributed to goat milk over cow milk among which are reduced chances of occurrence of diabetes and other health problems (Eliott, *et al*, 1999), natural homogenization of the fat content thereby preventing arteriosclerosis (Jensen, 1994), higher amounts of short chain fatty acids and greater alkalinity that prevents growth of bacteria, viruses and fungi (Prosser, *et al*, 2003). A number of health promoting ingredients have equally been discovered in milk. They include compounds as bioactive peptides most notably caseinophosphopeptides to promote mineral absorption and prevent osteoporosis and conjugated linoleic acids with anti carcinogenic properties (McDonagh, *et al*, 2003). Tapping the nutritional benefits of milk and milk products would be impossible without the production of high quality and high producing dairy animals. This can only be achieved by ensuring that the nutritional, genetic and managemental status of the dairy animals is often of a very high standard. While Ademosun (1992) has noted that the development of dairy goats in Nigeria has suffered a lot of setbacks due to a number of constraints, with inadequate nutrition being of major concern, Bawala *et al* (2003) noted that feed costs account for the largest portion of production-related expenses. An increase in the energy and protein density of feed consumed by ruminants has been advocated by Harris (2003) due to the limitation of the rumen in volume and capacity to cover nutritional needs for high

production. This has necessitated the search for alternative feed resources that are more economical and efficient for incorporation into ruminant diets with a view to reducing feeding costs and achieving increased performance.

Grant *et al* (1991) emphasized the need to reassess the agricultural and nutritional potentials of many seeds which were traditionally used in human and animal diets but are no longer used due to increased availability of commercial food products as they are native to and grow well in regions where food shortages and famine are endemic. One of such seeds is the flamboyant tree seed. The flamboyant tree botanically known as *Delonix regia*, has commonly served ornamental purposes due to its attractive flowers (Lars and Jens, 1991).

MATERIALS AND METHODS

The experiment was carried out at the ruminant animal production unit of the Teaching and Research farm of the Federal University of Technology, Minna, Niger State. Fifteen (15) healthy Savanna brown does with a mean initial body weight of 13.02 kg and aged between 6 – 8 months were used for the study. They were randomly assigned to five treatment groups each having three animals in a completely randomized design. Prior to their arrival, the pens were washed, disinfected and allowed to dry. On arrival, the animals were dewormed using albendazole and ivermectin, bathed with diazintol solution and vaccinated against Pest-de-Pestes Ruminantus (PPR) using tissue culture rinderpest vaccine. The female animals were allowed a pre-treatment period of two (2) weeks to enable them acclimatize. Thereafter, the animals were all synchronized for estrus using mesoprostol^{R} tablets which was administered intra-vaginally and were allowed to graze with a buck. The feed ingredients used for the study were obtained in Minna. The *Delonix regia* seeds were also harvested from trees around Minna. Harvesting was carried out between mid-November and early February. The pods were manually cracked to get the seeds which were already dried. The empty pods were thrown away while the seeds were further sundried and roasted using open flame for up to fifteen minutes in a large frying pan with little amounts of sandy soil to avoid friction and burning. They were then sieved and crushed to *Delonix regia* seed meal with the aid of a hammer mill for inclusion in the feed. Five different feeds were compounded for the five treatments designated T_1, T_2, T_3, T_4 and T_5. The feeds were formulated to be isocaloric and isonitrogenous. The diets T_1, T_2, T_3, T_4 and T_5 had the groundnut cake component substituted for *Delonix regia* seed meal at 0 %, 25 %, 50 %, 75 % and 100 % respectively. The animals were managed semi-intensively. They were allowed to graze in the morning beginning from 10:00 a.m and returned to their pens in the evening at 4:30 p.m during which period they were given the experimental diets. They were also supplied ample amounts of fresh water and salt licks. Feed intake and refusals were recorded daily.

Following parturition, milk yield was recorded thrice weekly for four (4) weeks. The animals were walked into a clean pen that served as a milking parlour where the udder and hind quarters were properly cleaned. This was followed by the milk collection which was carried out by hand milking. A measuring cylinder was used for the collection after which they were transferred into properly labeled sterile plastic bottles. The milk samples were stored immediately in an ice-packed cooler before transferring to the freezer until required for analysis. The raw and roasted *Delonix regia* seed meal were analyzed for their proximate composition, energy values and anti-nutritional factors. The treatment diets were also analyzed for their proximate composition and energy values while the milk samples were analyzed for their proximate composition, energy, calcium, phosphorus, potassium and sodium. The anti-nutritional factors were determined using

methods outlined by Onwuka (2005) while all other chemical analyses were carried out ording to AOAC methods (AOAC, 1995). Data from the experiment were subjected to lysis of variance (ANOVA), and the variations in means were separated using the Duncan's ltiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The results of the proximate composition and anti-nutritive factors of the raw and roasted *onix regia* seed meal and the experimental diets are presented in tables 1 and 2. The results w that the nutritional value was enhanced while the anti-nutritive factors of the *Delonix regia* e greatly reduced by roasting.

Table 1 Proximate composition and energy values of raw and roasted flamboyant tree seeds and experimental diets

Nutrients (%)	Raw *Delonix regia*	Roasted *Delonix regia*	Experimental diets				
	Seeds	Seeds	T_1	T_2	T_3	T_4	T_5
Dry matter	87.80	89.40	91.00	92.00	91.00	93.00	90.00
Moisture	12.20	10.60	9.00	7.99	9.00	7.00	10.00
Crude protein	18.10	18.92	12.05	12.03	12.06	12.10	12.12
Crude fiber	7.50	11.00	12.25	18.30	22.82	24.66	29.35
Ether extract	7.50	9.00	13.36	17.37	10.73	18.12	13.96
Ash	3.60	3.40	5.03	7.00	7.00	9.01	11.00
Nitrogen free extract	51.10	47.08	48.31	37.30	38.39	29.11	23.57
Energy (Kcal/kg)	3443.00	3450.00	3616.80	3536.50	2984.50	3279.20	2684.00

T_1 0 % replacement level of groundnut cake with *Delonix regia* seed meal

T_2 25 % replacement level of groundnut cake with *Delonix regia* seed meal

T_3 50 % replacement level of groundnut cake with *Delonix regia* seed meal

T_4 75 % replacement level of groundnut cake with *Delonix regia* seed meal

T_5 100 % replacement level of groundnut cake with *Delonix regia* seed meal

Table 2 Anti-nutritional composition of raw and roasted flamboyant tree seeds

Factors	Raw *Delonix regia* Seeds	Roasted *Delonix regia* Seeds
Tannin (mg/100 g)	93.10	11.20
Phytate (mg/100 g)	2.13	0.58
Saponin (%)	12.23	2.22
Trypsin Inhibitors (Tui/mg)	273.00	62.00

The results of the milk quality and yield from does fed varying levels of roasted flamboyant (*Delonix regia*) seed meal are presented in table 3.0. The results showed that most of the milk parameters measured increased with increase in dietary levels of roasted *Delonix regia* seed meal up to 50 % after which they declined. The results obtained in this study could be attributed to a variety of factors such as the high dietary concentrate in T_2 (25 % replacement level of groundnut cake with *Delonix regia* seed meal) diet which led to depressed fiber digestion and acetic acid production and consequently lower milk fat percentage, protein and non-fat-solids percentage when compared with milk from does fed T_3 (50 % replacement level of groundnut cake with *Delonix regia* seed meal). This is in line with the findings of Heinrichs *et al*, (2006) that high concentrate diets tend to depress fiber digestion and acetic acid production and consequently lower milk contents. The unsaturated fatty acid level could equally be implicated as regards the result obtained in this study. Heinrichs *et al* (2006) had stated that grain concentrates tend to contain a higher amount of unsaturated fatty acid and their inclusion in diets results in an increase in the unsaturated fatty acid content of such diets.

Table 3 Milk quality and yield from savanna brown does fed varying level of roasted flamboyant (*Delonix regia*) seed meal

Parameters	T_1	T_2	T_3	T_4	T_5	Remark
Milk yield (ml)	160.45 ± 41.23^{a}	155.00 ± 33.67^{a}	86.18 ± 58.31^{b}	148.68 ± 41.25^{a}	NA	*
Protein (%)	5.66 ± 1.09^{b}	6.05 ± 0.89^{b}	9.34 ± 1.18^{a}	5.51 ± 1.09^{b}	NA	*
Total solids (%)	17.00 ± 2.19^{b}	16.46 ± 1.79^{b}	22.88 ± 2.31^{a}	16.21 ± 2.19^{b}	NA	*
Fats (%)	6.27 ± 0.95^{b}	4.93 ± 0.78^{c}	8.00 ± 1.15^{a}	5.87 ± 0.95^{b}	NA	*
Non-fat-solids (%)	10.73 ± 1.46^{b}	11.52 ± 1.19^{b}	14.87 ± 2.03^{a}	10.34 ± 1.45^{b}	NA	*
Moisture (%)	83.00 ± 2.19^{a}	83.55 ± 1.79^{a}	77.13 ± 2.81^{b}	83.88 ± 2.18^{a}	NA	*
Ash (%)	2.94 ± 0.22^{ab}	2.87 ± 0.18^{b}	3.09 ± 0.31^{a}	2.38 ± 0.22^{b}	NA	*
Energy (Kcal/kg)	4243.63 ± 9.31^{ab}	4133.04 ± 7.60^{c}	4282.68 ± 13.16^{a}	4180.29 ± 9.30^{b}	NA	*
Calcium (ppm)	6477.90 ± 483.61^{a}	5239.24 ± 394.87^{b}	6827.62 ± 541.91^{a}	6336.00 ± 483.60^{a}	NA	*
Phosphorus (ppm)	3610.60 ± 509.72^{b}	2695.50 ± 416.18^{c}	4227.70 ± 579.85^{a}	2450.00 ± 509.71^{c}	NA	*
Sodium (ppm)	73.95 ± 53.81^{b}	153.72 ± 43.93^{a}	156.36 ± 59.09^{a}	119.77 ± 53.82^{ab}	NA	*
Potassium (ppm)	244.20 ± 56.42^{ab}	246.21 ± 46.07^{ab}	263.35 ± 61.79^{a}	192.69 ± 56.42^{b}	NA	*

T_1 – 0 % replacement level of groundnut cake with *Delonix regia* seed meal, T_2 – 25 % replacement level of groundnut cake with *Delonix regia* seed meal, T_3 – 50 % replacement level of groundnut cake with *Delonix regia* seed meal, T_4 – 75 % replacement level of groundnut cake with *Delonix regia* seed meal, T_5 – 100 % replacement level of groundnut cake with *Delonix regia* seed meal, NA – not available as animals died before their expected kidding dates.

Grant and Kubik (1990) also noted that a high dietary unsaturated fatty acid level can result in inhibition of rumen fermentation and fiber digestion. Thus, it could be that the unsaturated fatty acid level in the experimental diets decreased with decrease in dietary grain concentrate level and increase in *Delonix regia* seed meal inclusion. The lower grain concentrate and unsaturated fatty acids level in the T_3 (50 % replacement level of groundnut cake with *Delonix regia* seed meal) diets must have favoured higher rumen fermentation, fiber digestion and acetic acid production. This must have resulted in the higher crude protein content, fats and non-fat-solids percentages obtained in milk samples from animals fed T_3 (50 % replacement level of groundnut cake with *Delonix regia* seed meal) diets. In animals fed T_4 (75 % replacement level of groundnut cake with *Delonix regia* seed meal) diets, the low dietary concentrate level and subsequent low feed intake level occasioned by the dietary fiber which gave a rapid gut fill effect left the animals with little or no glucose to energize the rumen microbes to carry out rumen fermentation activities resulting in decreased availability of nutrients at the udder for milk synthesis and in the lower milk contents of fats, proteins, non-fat-solids and other milk components reported in this study. This is in line with the findings of Chase and Overton (2002) that feeding high levels of fermentable carbohydrates provides energy for use by the rumen microbes to synthesize microbial protein. The results of the milk composition obtained in this study could also be due to the nature of the dietary fiber. Sahlu *et al* (2004) noted that high grain concentrates diets tend to contain mostly soluble fiber and such diets with majority of its carbohydrate and fiber fraction being highly soluble tend to be insufficient physically to promote salivation, mastication and rumen function; they are rapidly fermented thereby leading to a high acetate:propionate ratio and subsequent milk fat depression. Applying this to the results obtained, this might have been the case in animals fed T_2 (25 % replacement level of groundnut cake with *Delonix regia* seed meal) diets as the concentrate content was on the high side indicating that the fiber content though equally on the high side as reported by the results of the laboratory analysis, was majorly soluble fiber. By virtue of the lower concentrate content, the soluble fiber content might have been lower in the T_3 (50 % replacement level of groundnut cake with *Delonix regia* seed meal) diets but the entire fiber content of this diet might have had a greater degree of physical sufficiency for salivation, mastication, rumen function and less rapid fermentation leading to a higher acetate:propionate ratio and higher milk fat content in line with the reports of Sahlu *et al* (2004). In the case of animals fed T_4 (75 % replacement level of groundnut cake with *Delonix regia* seed meal) diets, fiber intake was lower due to low feed intake when compared to the other treatments. Also, the fiber had a very low degradability and thus spent more time in the rumen before utilization. Such a situation as this is known to result in very poor or low microbial activity, and low rumen fermentation due to absence of enough energy for the microbes to function as reported by Chase and Overton (2002).

The results of this experiment could also be attributed to the anti-nutritional factors present in the test ingredient and by extension the experimental diets. Perhaps, the beneficial effects of these anti-nutritional factors such as anti-bloat and anti-helminthic effects of tannins (Khan and Diaz-Hernandez, 2000), lowering of cholesterol levels (Duranti, 2006) and lowered solubility of calcium and phosphorus (Erbas *et al*, 2005) could be responsible for the high nutrient utilization resulting in high milk constituents such as protein, fats, non-fat-solids and minerals. The effects of high tannin consumption such as gut irritation as reported by Makkar (2003), inflammation of the mucosa of the

alimentary canal, diarrhea and decreased rumen motility associated with saponins as reported by Hu *et al* (2005) and Jamroz and Kubizna (2007) and binding of nutrients to indigestible complexes that are unavailable for further absorption and utilization associated with phytates/phytic acids as reported by Singh and Krikorian (1982) and Jamroz and Kubizna (2007) must have all played roles resulting in the decline in milk constituents at above 50 % replacement level of groundnut cake with *Delonix regia* seed meal. In line with the reports by Makkar (2003), Erbas *et al* (2005), Hu *et al* (2005) and Jamroz and Kubzina (2007) that anti-nutritional factors in legume seeds are beneficial when consumed in little amounts and harmful when consumed in excess, it is believed that the animals fed diets containing more than 50 % replacement level of groundnut cake with *Delonix regia* seed meal exceeded the tolerance level for these anti-nutritional factors and manifested this by exhibition of the symptoms earlier stated. The does fed T_5 (100 % replacement level of groundnut cake with *Delonix regia* seed meal) diets had all died before their expected kidding dates. This might be attributed to the does exceeding tolerance level for anti-nutritional factors present in the treatment diets as they all manifested the symptoms earlier associated with these anti-nutritional factors.

The low milk yield in animals fed T_3 (50 % replacement level of groundnut cake with *Delonix regia* seed meal) diets when compared to that of other animals used for this experiment could be attributed to the milk fat content of the milk from these animals, in line with the findings of Caja and Bocquier (2005) that a negative correlation exists between milk fat and milk yield. Haenlein (1995) earlier noted that energy shortage or delay in energy supply can result in a low milk yield with high fat contents.

CONCLUSION AND RECOMMENDATION

This study showed that there were significant ($P < 0.05$) effects of dietary levels of roasted *Delonix regia* seed meal on milk quality and yield, with a general increase in the parameters evaluated with increase in replacement level of groundnut cake with *Delonix regia* seed meal up to 50 %, after which there was a decline at inclusion levels above this. It can therefore be concluded that the animals fed T_3 diet (containing 50 % replacement level of groundnut cake with *Delonix regia* seed meal) performed best in terms of all the milk parameters determined in this study.

It is recommended that feeding dietary levels of roasted *Delonix regia* seed meal at up to 50 % replacement level of groundnut cake is a nutritionally effective means of fine – tuning the performance of ruminants to get the best in terms of milk composition and yield.

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