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EFFECTS OF GRADED LEVELS OF GMELINA ABOREA BARK SUPPLEMENTED WITH *AFZELIA AFRICANA* LEAVES ON NUTRIENT DIGESTIBILITY AND HAEMATOLOGICAL PARAMETERS OF GOATS

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Abstract: **The study was conducted to determine the effects of graded levels of *Gmelina arborea* bark supplementation with *Afzelia Africana* leaves on nutrient digestibility and haematological indices of bucks. Twenty five bucks with body weight of 14.75-17.00 kg, were used for the study. The bucks were weighed and divided into five groups. Each group of five bucks were randomly assigned to one of the five treatments in a completely randomized design (CRD). Fresh *Afzelia africana* leaves was fed as basal diet. The basal diet was fed *ad libitum*, while *Gmelina arborea* bark was fed as supplement at the levels of 0, 100, 150,200 and 250 g/head/day for T1 (control), T2, T3, T4 and T5, respectively. Clean drinking water and mineral salt lick were provided *ad libitum* throughout the experimental period. There were significant (P>0.05) differences between the treatments groups in all the parameters measured excepts dry matter (DM), ether extract (EE) and acid detergent fibre (ADF) which did not differ significantly (P<0.05) between the treatments groups. Bucks on T5 recorded the highest Cp digestibility, however it did not differ from other treatments groups significantly (P<0.05). Crude fibre (CF) digestibility was higher in T4 and T5 fed 200 and 250g inclusion of *Gmelina arborea* bark than other treatments. The neutral detergent fibre (NDF) digestibility was also higher in T4 and T5 diets but did not differ (p<0.05) significantly from that of T2 and T3 while T1 (control) recorded the highest ash digestibility. Haematological parameters indicated that there were significant (P>0.05) differences between the treatments for all the parameters measured except red blood count (RBC) and mean corpuscular haemoglobin which did not differ significantly (P<0.05) among the treatments groups. Bucks fed diet T_5 recorded higher value of packed cell volume (PCV) while T2 recorded the least. Red blood count (RBC) was higher in T1 while T3 recorded the least. Treatments 2, 3, 4 and 5 recorded highest white blood count (WBC) when compared to T1. Mean corpuscular volume (MCV) was higher in T4 but did not differ significantly (P>0.05) from that of T5 and also mean corpuscular haemoglobin concentration (MCHC) also followed the same trend between T2 and T3. In conclusion Gmelina bark can be included at 250 g in *Afzelia Africana* leaves without adverse effect on nutrient digestibility and heamatological parameters in goats.**

Keywords: **Goats, Digestibility, Heamatology, *Afzelia africana* leave, Gmelina bark.**

1. INTRODUCTION

Small ruminants form an integral part of the cultural life and farming system of Nigeria peasantry. Goat production in Nigeria is essentially a traditionally activity in which household units feature prominently (Ajala, 1998). Despite the high small ruminant population in developing countries particularly in Africa, their prolificacy, cheap production cost and the

indiscriminate demand for their product, goat production potential remain poorly exploited, due largely to neglect, disease, lack of motivation on the part of decision makers and the conservative traditional management system (Ajala , 1998).

Ruminant animals have been the major source of meat in Nigeria. Relative to other ruminants, goat is easier to keep and requires smaller capital investment (Momoh *et al.*, 1998). Goats are important domestic animals in the tropical livestock production system. In subsistence sector, pastoralist and agriculturist often depend on them for much of their livelihood (Devendra *et al.*, 1982). Goats in Nigeria are raised principally for meat production, while their potential for milk production is being harnessed by majority of owners' domiciles in Nigeria rural communities (Devendra *et al.*, 1983). Fodder (browse) is an agricultural term for animal feed, and fodder trees and shrubs are those plants (shoots or sprouts, especially tender twigs and stems of woody plants with their leaves, flowers, fruits, pods or bark) that are raised, used and managed to feed livestock.

Fodder plants are plants which are grown in order to provide the nutritional needs of animals. Babayemi and Bamikole, (2006) opined that fodder and shrubs are important components of ruminant diet and they have been found to play an important roles in the nutrition of grazing animals in areas where few or no alternatives are available (Van *et al.*, 2005). In a study conducted by Osemeobo (1996) it was observed that fodder is consumed in the livestock industry and the savannah areas account for about 10-15% fodder as livestock food in the dry seasons. These parts of the country have less rainfall and low biomass production but support over 90% of livestock. Fodder trees and shrubs were noted to support livestock such as-cattle, sheep, goats, donkey and camel - in the dry season. The study aim at determine the effects of Gmelina bark and *Afzelia africana* leaves on nutrients digestibility and haematological indices of goats.

2. MATERIALS AND METHODS

Site and Location of the Study Area

The study was conducted at the Livestock Teaching and Research Farm of the Department of Animal Health and Production, Federal Polytechnic Bali, Taraba State. Bali covers a total land area of about 5,500 KM and extends between latitude 8^0 and 35^1 00^{11} North of the equator and 10^0 46^1 00^{11} East of the Greenwich meridian (Taraba State Government, 2015). It lies within the guinea savanna zone. The climatic condition is characterized by dry and rainy season. Rainfall varies from 1000 mm-1500 mm/annum, and the temperature ranges from 30 to 38^0C depending on the season. (Taraba State Government, 2015). Rainy season starts in April and ends in October, while the dry season begins in November and ends in March. (Taraba State Government, 2015). The dry season reaches its peak in January and February when the dusty north east trade wind blows across the local government. The climate, soil and hydrology of the local government area provide ideal atmosphere for the growth of browse trees such as *Ficus spp, Gmelina arborea, Daniella africana, Afzelia africana, Tamarindus indica, Parkia clappertoniana, and Prosopis africana*. The area is suitable for the cultivation of crops such as Groundnut, Soya beans, Rice, Maize, Sorghum and Cowpea, and the vegetation is marked by tall grasses such as West African baful grass and Gamba grass.

Experimental Animals and their Management

Prior to the commencement of the experiment the pens were thoroughly swept, washed and disinfected to eliminate any disease-causing organism. The pens were allowed to dry for 5 days before introducing the bucks. The bucks were kept in individual pens measuring 1.5m X 1.5m X 4m (width x length x height). The bucks were vaccinated against PPR and pasteurellosis and treated against internal and external parasites with ivemectin injection based on individual body weight. Proper sanitation was maintained during the experimental period. The bucks were fed for adaptation period of fourteen (14) days to enable them adjust to the diets and confinement before data collection.

Experimental Design

Twenty five (25) bucks with average body weight of 18.25-19.00 kg were used for the study. The bucks were purchased from Graba Chede cattle market in Bali Local Government Area, of Taraba State. The bucks were balanced for weight and divided into five (5) groups and each group of five (5) bucks was randomly assigned to one of the treatments in a completely randomized design (CRD). The study lasted for a period of 12 weeks (84 days).

Collection and Preparation of Feed

Fresh *Gmelina arborea* bark and *Afzelia Africana* leaves were harvested within Federal Polytechnic Bali campus and the leaves were allowed to wilt before feeding to the bucks daily.

Treatments /Experimental diets

Five (5) treatments consisting of fresh *Afzelia Africana* leaves and Gmelina bark were used. *Afzelia africana* leaves were given *ad libitum* as the basal diet, while Gmelina bark was fed at the rate 0, 100, 150, 200 and 250 g/head/day in treatments 1, 2, 3, 4 and 5, respectively.

T_1- *Afzelia Africana leaves* only (control)

T_2- *Afzelia Africana* leaves + 100 g *Gmelina arborea* bark /head/day

T_3- *Afzelia Africana* leaves + 150 g of *Gmelina arborea* bark/head/day

T_4- *Afzelia Africana* leaves + 200 g of *Gmelina arborea* bark /head/day

T_5- *Afzelia Africana* leaves + 250 g of *Gmelina arborea* bark/head/day

Feeding and Management

The basal diets was fed *ad libitum* twice daily at 7:00 am and 4:00 pm, while Gmelina bark were fed at the rate of 0, 100, 150,200 and 250 g/head/ day in treatment 1, 2, 3,4 and 5, respectively. Clean drinking water and mineral salt lick were provided *ad libitum* throughout the experimental period.

Digestibility

The digestibility trial was conducted at the end of the trial. One (1) buck was randomly selected from each treatment for the digestibility trial. The bucks were placed in individual metabolism cages and were fed for seven (7) days as adaptation period, followed by seven (7) days collection period. Each of the animals was assigned to one of the five experimental diets in a 4 X 4 Latin square design and subsequently housed individually in previously disinfected metabolism cages. The quantity of faeces voided daily was collected to determine the faecal output. Faecal samples were collected and were oven-dried at 105^0 C for 24 hours to determine the dry matter content. Dried faecal samples were collected and bulked, ground and stored in air-tight containers for the determination of nutrient digestibility. Samples of the feeds were collected and bulked for chemical analysis using AOAC (2000) method. Dry matter digestibility was determined using the formula:

$$\text{DMD\%} = \frac{DMI - DMFO}{DMI} \text{X } 100$$

Where DMD = Dry Matter digestibility

DMI = Dry matter intake

DMFO = Dry matter faecal output

$$Apparent\,digestibility = \frac{(nutrientin\ feed \times FI) - (nutrientin\ faeces \times FO)}{nutrientin\ feed \times FI} \times 100\,\%$$

Where F1 = feed intake

FO = Faecal output

Haematological Parameters

At the end of the 12^{th} week of the experiment, blood samples were collected from three (3) bucks in each treatment for haematological analysis. Blood samples were collected through the jugular vein of the bucks. Disposable syringes and needles of 21mm gauge were used. The bucks were fasted overnight (12 h) and bled in the morning to collect blood. Fasting was done to avoid temporary elevation of blood metabolites as a result of feeding (Bush, 1975). Sterilization of collection site was done with alcohol, while zylene was applied to dilate the veins. Blood samples collected were emptied into bottles containing dipotassium salt of ethylene tetracetic acid (DETA) as anti-coagulant.

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The blood samples were analyzed according to standard methods (Bush, 1975). The haematological parameters determined include packed cell volume (PCV), haemoglobin (Hb) concentration, red blood cells (RBC) count and white blood cells (WBC) count. Mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were calculated using standard formulae (Schalm *et al.*, 1975; Jain, 1986).

$$\text{MCV} = \frac{PCV(\%)}{RBC\,count\left(10^6/mm^3\right)} \times \frac{10}{1}$$

$$\text{MCH} = \frac{Hb/g/100ml}{PCV(\%)} \times \frac{10}{1}$$

$$\text{MCHC (\%)} = \frac{Hb\left(g/100ml\right)}{PCV(\%)} \times \frac{100}{1}$$

Table 1: Proximate composition of Gmelina arborea bark and Afzelia africana leaves on dry matter basis (%)

Parameters	***Gmelina arborea* bark**	***Afzelia Africana* leaves**
Dry matter	93.80	88.57
Crude protein	3.93	19.84
Crude fibre	25.0	17.11
Ash	4.0	5.77
Ether extract	2.0	4.53
Nitrogen free extract	65.07	53.75
Neutral detergent fibre	57.26	52.11
Acid detergent fibre	44.11	31.39
Hemicellulose	23.15	20.72
ME (Mcal/kg DM)	3177.49	2003.69

ME = Metabolizable Energy: Calculated according to the formula of pauzenga (1985)

Table 2: Nutrient Digestibility (%) of goats fed *Afzelia africana leaves* and graded levels of *Gmelina arborea* bark

	Inclusion levels of Gmelina arborea bark					
Parameters	T_1(0g)	T_2 (100g)	T_3 (150g)	T_4 (200g)	T_5 (250g)	SEM
DM	84.68	85.38	84.47	86.51	86.43	1.25^{NS}
CP	91.63^{b}	91.97^{ab}	92.12^{ab}	93.56^{ab}	93.84^{a}	0.69^{*}
CF	50.48^{c}	52.60^{bc}	54.78^{bc}	61.27^{a}	57.57^{ab}	2.48^{*}
EE	1.60	1.54	1.46	1.47	1.92	0.19^{NS}
NDF	68.89^{b}	70.31^{ab}	71.45^{ab}	72.38^{a}	72.91^{a}	0.24^{*}
ADF	61.81	61.82	60.83	65.02	65.03	1.49^{NS}

SEM- Standard Error of Mean, *- Significant (P<0.05), a,b,c,d- means on the same row with different superscript differ significantly (P<0.05), NS-Not significant (P>0.05), DM-dry matter, Cp-Crude protein, CF-Crude fibre, EE-Ether extract, NDF-Neutral detergent fibre, ACD-Acid detergent fibre.

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Table 3: Haematological Parameters of Bucks Fed Gmelina arborea bark and Afzelia Africana Leaves

	Inclusion Levels of *Gmelina arborea* bark					
Parameters	T1(0g)	T2(100g)	T3 (150g)	T4(200g)	T5(250g)	SEM
PCV	36.63^{c}	21.50^{d}	23.13^{d}	34.18^{b}	39.46^{a}	2.05*
Hb	10.33	9.16	9.57	8.61	10.90	0.47^{NS}
RBC	12.76^{a}	8.76^{b}	5.92^{c}	6.13^{b}	7.66^{b}	0.84^{*}
WBC	6.85^{b}	12.93^{a}	10.53^{a}	10.23^{a}	11.46^{a}	0.82^{*}
MCH	3.41	4.14	4.13	3.04	2.27	0.24^{NS}
MCV	24.52^{d}	26.56^{c}	41.60^{b}	56.00^{a}	54.70^{ab}	4.24
MCHC	34.17^{a}	44.60^{a}	41.40^{ab}	30.43^{c}	27.66^{d}	2.37

SEM- Standard Error of Mean, *- Significant (P<0.05), a,b,c,d- means on the same row with different superscript differ significantly (P<0.05), NS-Not significant (P>0.05), PCV- Packed cell volume, Hb- Haemoglobin, RBC- Red blood count, WBC- White blood count, MCH- Mean corpuscular haemoglobin, MCV- Mean corpuscular volume, MCHC- Mean corpuscular haemoglobin concentration

3. RESULT AND DISCUSSION

The proximate composition of Gmelina bark and *Afzelia African* leaves is presented in table 1. The dry matter (DM) obtained in the present study for *Afzelia african* and Gmelina bark were 88.57 and 93.80% respectively. The DM content of *Afzelia africana* leaves was higher than 30.50 and 86.42% respectively reported by Ikhimioya *et al*., (2007) and Gidado *et al*., (2013) while that of Gmelina bark was also higher than reported by Omokanye *et al*., (2014). The difference in DM content might be due to variation in sample preparation (fresh basis) vegetational zones and the period at which the sample were collected (Gidado *et al*., 2014). The crude protein (CP) content OF *Afzelia Africana* leaves was lower than 21.00% reported by Gidado *et al*., (2014) while that of Gmelina bark was slightly lower than 4.60% reported by Omokanye *et al*., (2014). The CP content of *Afzelia Africana* leaves in the present study was within the range of 12 to 30 % reported by Norton (1998) for tropical leaves legumes. Le Houerou (1980) reported a mean value of 12.5 % for West African browse. *Afzelia africana* leaves meet the minimum CP of 8 % requirement for ruminant production, while that of Gmelina bark fell below the suggested nutrition requirement for various classes of goats (11-14%) reported by NRC (2007). Such plant may only be supplemented by proteins feeds. The Ether extract (EE) recorded in the present study were lower than 6.83 and 26.2 % for *Afzelia africana* and Gmelina bark respectively reported by Gidado *et al*., (2013) and Omokanye *et al*., (2014). The variation in EE might be due to the study area, harvesting time and probably drying method employed (Gworgwor *et al*., 2006).

The crude fibre (CF) contents of *Afzelia africana* leaves and *Gmelina arborea* bark were 17.11 and 25. 0 % respectively. The CF recorded for *Afzelia afriana* leaves in the present study was higher than 7.08 % reported by (Fadiyimu *et al*., 2011) while that of Gmelina bark was lower than 44.9 % reported by Omokanye *et al*., (2014). The CF content recorded in the present study, meet the CF requirement level (17 %) for ruminants such level were describe as being important in the maintenance of optimal ruminal activities. GU (2002) reported that CF function in maintaining micro ecological balances of the gut, promoting digestive system development and raising reproductive performance.

The ash content recorded in *Afzelia africana* leaves was slightly lower than 6.66 % reported by (Ikhimioya *et al*., 2007) while that of Gmelina bark was also lower than 7.81 % reported by (Omokanye *et al*., 2014). Le Houerou (1980) and Gworgwor *et al*., (2006) reported that difference in ash content might be attributed to difference in soil species and the season. The nitrogen free extract (NFE) recorded (53.75) for Afzelia Africana leaves,---------- while that of Gmelina bark was higher than 13.7 % reported by Omokanye *et al*., (2014). The variation in NFE might be attributed to soil type, stage of maturity of the leaf or bark, season at which the plant were harvested the NDF and ADF content report for *Afzelia africana* leaves in the present study were lower than 53.97 and 42.69 % respectively reported by Ikehimioya *et al*., (2007) while that of Gmelina bark was also lower than 77.4 and 58.0 % respectively reported by Omokanye *et al*., (2014).

The NDF content in *Afzelia africana* leaves and Gmelina bark were generally lower than the safe upper of 60 % thought to guarantee appreciable intake of forages (Meissner *et al*, 1991). The study by Wyamangara and Ndlovu (1995) with goats on natural vegetation with NDE content of between 59 % and 79 %, indicate that this cell wall component in the forages should be adequately degraded. The *Afzelia africana* leaves and Gmelina bark recorded appicirable fibre content. This is the positive attribute of the browse forage and Gmelina bark since the voluntary DM intake and digestibility are dependent in the cell wall constituents (fibre) especially the NDF and lignin (Bakshi and Iwadhiwa, 2004).

The hemicellulose content recorded in the present study for *Afzelia africana* leaves was higher than 11.28 % reported by Ikhimioya *et al*., (2007) while that of Gmelina bark was higher than 19.4 % reported by Omokanya *et al*., (2014). The ME Kcal/g 3.17 was similar to ME Kcal/g 3.25 reported by Ikhimioya *et al*., (2007) while that of *Gmelina arborea* bark was slightly higher than ME Kcal/g 1.07 reported by Omokanya *et al*., (2014). The value of feeds to goat depends on the amount of energy they supply (Saurant and Morandfehr 1991). Thus, when compare to the recommendation of NRC (1981), only Gmelina bark (3.17 Kcal/g) meet the minimum energy requirement level of 3.26 Kcal/g for goats in the present study.

Table 2 shows the result of nutrient digestibility by the bucks. There were significant (P>0.05) differences between the treatments groups in all the parameters measured excepts dry matter (DM), ether extract (EE) and acid detergent fibre (ADF) which did not differ significantly (P<0.05) between the treatments groups. Bucks on T5 recorded the highest Cp digestibility, however it did not differ from other treatments groups significantly (P<0.05), crude fibre (CF) digestibility was higher in T4 and T5 fed 200 and 250g inclusion of *Gmelina arborea* bark than other treatments. The neutral detergent fibre (NDF) digestibility was also higher in T4 and T5 diets but did not differ (p<0.05) significantly from that of T2 and T3 while T1 (control) recorded the highest ash digestibility.

The result of the nutrient digestibility revealed that, bucks fed 200 and 250 g *Gmelina arborea* bark however recorded the highest nutrient digestibility of DM, CP, CF, NDF and ADF. The values were higher in all the treatments except CF and NDF which are low in T1 (control). The higher values of DM, CP, CF, NDF and ADF digestibility observed for bucks fed 200 and 250 g *Gmelina arborea* bark was due to palatability of the diet with its attendant supplementary or associative effects with the basal diet. Small ruminants (goats) are choosy in their eating habit and abhor bitter tasting or unpalatable diets but tend to consume more of sweet and palatable type (Kruegue *et al*., 1974). The higher dry matter digestibility (DMD) observed in all the treatments could be attributed to the lower NDF content of the browse leaves and the bark as reported in table 1. The NDF and ADF digestibility followed a similar trend as the levels of *Gmelina arborea* bark increases between the treatments. This implied that bucks fed 200 and 250 g *Gmelina arborea* bark were better in NDF and ADF digestibility which invariably improved microbial activity in the rumen. Generally low CF and fibre fraction digestibility of bucks on T1 (control) diet might be attributed to insufficient energy in the rumen to support microbial activities. This agrees with the report of (Oddoye *et al*., 2005) who observed that for the rumen microbial flora to perform at an optimum level, the presences of nitrogen and soluble carbohydrate had to be synchronized. The comparatively higher nutrients digestibility of bucks fed 200 and 250 g *Gmelina arborea* bark could be attributed to the gradual solubility of the diet, which makes nitrogen available over a long period of time there by enhancing rumen microbial activity.

The result of the haemotological parameters of the experimental bucks is presented in Table 3. There were significant (P<0.05) differences among the treatments groups for all the parameters measured except red blood count (RBC) and mean corpuscular haemoglobin which did not differ significantly (>P0.05) among the treatments groups. Bucks fed diet T_5 recorded higher value of packed cell volume (PCV) while T2 recorded the least. Red blood count (RBC) was higher in T1 while T3 recorded the least. Treatments 2, 3, 4 and 5 recorded highest white blood count (WBC) when compared to T1. Mean corpuscular volume (MCV) was higher in T4 but did not differ significantly (P>0.05) from that of T5 and also mean corpuscular haemoglobin concentration (MCHC) also followed the same trend between T2 and T3. The mean (29.78 %) PCV obtained in this study was similar to 29.4± 0.9 reported by (Daramola *et al*., 2005) for West African dwarf goats. The PCV values obtained in the present study were within the normal range (22.00-38.00 %) reported by (Feldman *et al*., 2002). The mean Hb\ recorded also in the present study was similar to 9.8± 0.3 and 9.97± 2.73 (g/dl) respectively reported by (Daramola *et al*., 2005) in WAD goats and Samari *et al*. (2016) in Barbari goats. Generally increase in the Hb concentration is associated with greater ability to resist disease infection and low level is an indication of disease infection and poor nutrition (Cheesbrong, 2004; Tambuwal *et al*., 2002).The Hb values recorded were also within the normal range of 8.00 – 12.00 (g/dl) for healthy goats reported by Feldman *et al*. (2002). The mean (8.25 $x10^6$ /mm^3) red blood count

(RBC) recorded in this study is within the normal range (8.25-18.00 x 10^6 /mm^3)reported by Feldman *et al*. (2002), however the RBC in T3, T4 and T5 were lower than the normal range. The lower values of RBC recorded in T3, T4 and T5 could be attributed to age, nutrition, degree of physical activities and high ambient temperature as reported by (Daramola *et al.*, 2005).

The mean (10.40 x 10^3 /mm^2) white blood count (WBC) recorded in this study is similar to 10.6 $\pm$ 2.8 x 10^3 /mm^3 reported by (Tambuwal *et al*., 2002) in Red Sokoto goats. The mean values of WBC is within the normal range (4.00-13.00 x 10^3 /mm^3) reported by Feldman *et al.* (2002), the higher WBC is an indication of immune responses to infections or toxic substances in the organism and a low count is an indication of pathogenic infection or presence of antigens in the organism (Bradbury *et al*., 1999). Mean corpuscular haemoglobin (MCH) is lower than the normal range of (5.2- 8.0 pg) reported by (Feldman et al., 2002), the lower values of MCH recorded in the present study might be attributed to fasting and physical stress when the blood sample were collected. The result of this study is in agreement with the findings of some authors (Carlson, 1996; Johnson and Morris, 1996) who reported that fasting, extreme climatic condition and stress might adversely affect blood values of farm animal. The values of mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) significantly increased and are very important in the diagnosis of anemia and also serve a useful index of the capacity of the bone marrow to produces red blood cells (Awodi *et al*., 2005). The increase in MCV and MCHC might be greatly influenced by age and sex (Egbe-Nwiyi, 2000).

4. CONCLUSION

The study has shown that, supplementation of *Gmelina arborea* bark with *Afzelia africana* leaves have no detrimental effects on nutrient digestibility and haematological parameters of the goats. Buck fed 200 and 250 g *Gmelina arborea* bark recorded the highest nutrient digestibility. However, all the animals had positive nutrient digestibility an indication that nutrients was well utilized. Gmelina bark can be included at 250 g in *Afzelia Africana* leaves without adverse effect on nutrient digestibility and heamatological parameters in goats.

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