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Effect of Uromalt Inclusion Level on Reproductive Traits of West African Dwarf Buck-kids

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ABSTRACT

An experiment was conducted with the aim of evaluating the effect of uromalt inclusion level on reproductive traits of West African Dwarf (WAD) buck kids. A total of 45 West African three months old dwarf buck-kids with an average body weight of 6.25 kg (5.5-7 kg) were randomly assigned to five dietary treatments designated as E_1 (0%), E_2 (25%), E_3 (50%), E_4 (75%) and E_5 (100%) of uromalt inclusion levels with three replications, each having three goats. Thus, the study was a completely randomized design. The experiment was conducted for a period of three months and the animals were fed the experimental diets at 3% of their body weight at 8.00 h. *Echinochloa stagnina* (hay) was offered as basal diet at 16.00 hours. The experimental traits studies include body weight, scrotal circumference and semen sample. Buck-kids offered diet E_2 having 25% uromalt and 75% maize inclusion levels had a higher significant ($p<0.05$) scrotal circumference than those offered diets E_1, E_3, E_4 and E_5, respectively. Similarly, the highest semen volume (2.46 mL) was obtained from buck-kids fed diet E_2 having 25% uromalt and 75% maize inclusion levels while the lowest semen volume (0.5 mL) was obtained from buck-kids fed diet E_5 having an inclusion level of 100% uromalt diet. Additionally, the slowest semen mass activity was obtained from buck-kids fed diet E_5 having 100% uromalt inclusion level. This may indicate less improvement in semen traits of buck-kids with increase in the inclusion level of uromalt to 100% in the diet. It is, therefore, concluded that feeding uromalt at 100% inclusion level is not desirable mainly because of its detrimental effects on the animal's reproductive traits.

Key words: Urea, ruminant nutrition, spermatozoa, semen quality, scrotal circumference

INTRODUCTION

The use of non-protein nitrogenous compounds of which urea is the most prominent in ruminant nutrition serves as a ready source of protein for the ruminant animal. Often, when urea is fed together with low-quality roughages, the intake of dry matter is stimulated and the low-quality roughages are therefore better utilized. Thus, the wider use of and utilization of urea in the feeding of intensively managed ruminant animals is being explored. In beef cattle's, studies

have nonetheless demonstrated improved productivity when urea provided 25% of the nitrogen in the ration (Looski and McDonald, 1999). However, the palatability of the ration was found to decrease at higher levels causing intake problems. Also, these authors further added that in the total ration, the amount of urea should not exceed 55% in the mixed ration for Nigerian goats because this has the advantage not only of reducing the cost of protein but also of ensuring that dietary protein supply is readily available to the animal. Furthermore, it has been found that fermented maize when heated with a non-protein nitrogen (urea) increased crude protein content of maize from 9-20.13% and hence improving the quality and nutritive value of maize in the diet of ruminant animal (ARC, 2000). Keeping in view of these, uromalt is a compound word obtained from the combination of two words, "Uro" from Urea and "malt" from fermentation of maize grain. Thus, it is expected that the use of these compound in the diet of West African Dwarf (WAD) buck kids will help to improve their reproductive productivity. However, information regarding the utilization and use of uromalt is limited especially on its effect on the reproductive traits of (WAD) buck kids. Therefore, the objectivity of this study was to determine the effect of uromalt on reproductive traits of WAD buck-kids.

MATERIALS AND METHODS

Uromalt: Fifty kilogram of yellow maize harvested in the Teaching and Research Farm of the Federal College of Wildlife Management, was soaked in 60 L of water inside a plastic container and covered for 5 days and then allowed to germinate so as to develop a complete enzyme system for hydrolysing starch to dextrin and maltose, according to McDonald *et al.* (1997). The sprouted fermented grains were filtered and sun-dried for 4 days. After sun drying, it was coarsely grounded. Urea solution was prepared by dissolving 2 kg of urea in 12.5 L of distilled water. This was thoroughly mixed with the coarsely ground maize. The mixture was then toasted on fire for 10 min in an open aluminium pan and continuously stirred to avoid charring of the concentrate. The resulting uromalt produced was sun-dried for 2 days and used for this study.

Animals and their management: Forty five West African three months old dwarf buck-kids, with an average weight of 6.25 kg (5.5-7 kg), were used for this study and were randomly assigned to five treatments with three replications each having three goats. The ingredients used for the dietary treatment were uromalt and maize. Diet (E_1) which served as the control, contained only maize at 100%. Diet (E_2) contained uromalt at 25% and 75% maize. Diet (E_3) contained uromalt at 50% and maize at 50%. Diets (E_4) was made up of 75% and 25% maize, while Diet (E_5) had only uromalt at 100% level of inclusion (Table 2). Thus, a complete randomized design (SAS, 2008) was used. The animals were fed the experimental diets at 3% of their body weight at 8.00 hours. *Echinochloa stagnina* (fresh bloom) was offered as basal diet at 16.00 hours. The animals had free access to clean water and salt lick daily and were allowed two weeks to adjust to treatments, confinement and the diets offered.

The animals were dipped against ectoparasites and dewormed of endoparasites as routine treatments. The reproductive organs of the animals were confirmed to be free from any obvious reproductive disorder and abnormalities in their reconditioning on palpation.

Data collection: Body weight and scrotal circumference were measured on weekly basis for all the buck-kids for a period of three months. Body weight was measured using a spring balance while the scrotal circumference was measured by grasping the neck of the scrotum and using the fingers to push the testicles ventrally to eliminate any wrinkles as result of cold weather. A measuring tape

was passed around the scrotum and tightened at the greatest width of the two testicles and measured in centimetres (Adedeji and Gbadmosi, 1999; Ahmed *et al*., 2005).

Semen samples were collected fortnightly from the bucks with the aid of an ejaculator over a period of three months. The animals were stimulated by inserting the probe which was lubricated with petroleum jelly, gently into the rectum. Current was then applied at the rate of one volt every seven seconds (Cameron, 1997), until stimulation of the buck was achieved which was followed by ejaculation at five volts. The ejaculate was collected into a rubber funnel attached to a graduated tube, directly from the gland penis. The volume of each ejaculate was read immediately from the graduated tube and recorded (Nwoko and Ibe, 2005). After examination the semen collected was stored in the refrigerator at 4-5°C. The materials used for semen collection were properly sanitized, rinsed with distilled water and allowed to dry.

Semen analysis: The semen samples collected were analysed in the laboratory for sperm mass activity and motility, sperm morphology, sperm concentration/count, total sperm in the ejaculate, sperm abnormalities and percentage live and dead sperm cells were also determined. Other semen characteristics such as odour, colour, viscosity, volume and pH were also determined as described by Salisbory *et al*. (1998).

Mass activities of semen were determined immediately after collection by placing a drop of concentrated semen on a glass slide without a cover slip under low magnification (10x) power. The microscopic wave pattern of the sperm cells was assessed and ranged from slow (0) to very rapid motion (+++), depending on the quality of semen.

Semen mass motility was determined with a drop of semen in a drop of buffer solution (Sodium citrate) under a cover slip at a magnification of (40x). Mass motility was measured as the percentage of sperm cells moving straight forward over the field in the microscope. The buffer solution was prepared by dissolving 2.9 g of hydrated trisodium citrate ($C_6H_5NaO_7.2H_2O$) in 100 mL of distilled water and shaking thoroughly. Then a cover slip was used to provide a uniform film to restrict the floating of the sperm cells and to delay the drying of the smear.

The morphology of the spermatozoa was determined by staining a drop of semen with Nigrosin-Rosin stain on a glass slide. A thin smear was made with a cover slip and observed under a binocular microscope at high magnification (40x) for live and dead spermatozoa and for spermatozoa abnormalities located in the head, mid-piece and tail.

Sperm concentration or count was determined using the improved Neubauer haemocytometer designed for counting blood cells. The numbers of sperms per mL were calculated using the formula:

$$\text{No. of spermatozoa (mL)} = \text{No. of spermatozoa in 0.1 mm}^3 \times 10 \text{ dilution rate}$$

Total spermatozoa in the ejaculate were also determined by multiplying concentration (spermatozoa per mL) by the ejaculate volume:

$$\text{Total sperm in ejaculate (mL)} = \text{Semen volume} \times \text{Concentration (mL)}$$

Samples of the experimental diets were analysed to determine the dry matter, moisture content, crude protein, crude fibre, ether extract, total ash and Nitrogen Free Extract (NFE), using the method as described by AOAC (2000).

Where:

$$\text{NFE} = (100\% - \%\text{CP} + \%\text{EE} + \%\text{Ash})$$

Statistical analysis: All data obtained were subjected to one-way analysis of variance using the general linear model (SAS, 2008). Where, there was a significant F-test ($p<0.05$), the Duncan test for multiple comparisons was used to test the significance of differences between treatment means (SAS, 2008).

RESULTS

The result of the nutrient composition of uromalt and maize used in the experimental diets and *Echinochloa stagnina* (hay) offered as basal diet is presented in Table 1. The highest value of dry matter was from maize (91.73%), followed by and the hay. Uromalt had the highest crude protein (20.13%) and ether extracts (4.23%), while hay had the highest value of crude fibre, total ash and NFE. Table 2 shows the nutrient composition of the percentage inclusion level of the experimental diets fed to WAD buck-kids. The dry matter and crude fibre and Nitrogen Free Extract NFE of the experimental diets decreased as the level of uromalt increased in the diets. However, the moisture content increased with increase in inclusion level of uromalt in the diet. Results of the effect of dietary treatment on average final body weight at three months of age, average initial body weight, average daily weight gain and scrotal circumference of WAD buck-kids are presented in Table 3. There were no significant differences ($p>0.05$) in the average final body weight of buck-kids fed diets E_1, E_2, E_3, E_4 and E_5 respectively. Similarly, buck-kids fed diets E_1, E_2, E_3, E_4 and E_5 had similar ($p>0.05$) average daily weight gain. However, buck-kids offered diet E_2 having 25% and 75% maize inclusion levels had a higher ($p<0.05$) scrotal circumference than those offered diets E_1, E_3, E_4 and E_5, respectively. Table 4 shows the effect of dietary treatment on semen traits of WAD buck-kids. The results

Table 1: The nutrient composition of uromalt, maize and *Echinochloa stagnina* (fresh bloom)

Nutrients	Uromalt	Maize	*Echinochloa stagnina* (fresh bloom)
Dry matter (g kg^{-1} DM)	86.20	91.73	80.70
Crude protein (g kg^{-1} DM)	201.3	82.3	113.0
Ether extract (g kg^{-1} DM)	4.23	2.80	2.20
Crude fibre (g kg^{-1} DM)	3.20	12.00	32.5
Total Ash (g kg^{-1} DM)	4.60	5.24	9.90
NFE (g kg^{-1} DM)	67.84	68.96	44.1

NFE: Nitrogen free extract

Table 2: Nutrient composition of the percentage inclusion level of the experimental diets fed to WAD buck-kids

	Treatment (uromalt:maize, %)				
Nutrients (%)	E_1 (0:100)	E_2 (25:75)	E_3 (50:50)	E_4 (75:25)	E_5 (100:0)
Dry matter (g kg^{-1} DM)	91.73	90.35	88.96	87.58	86.20
Moisture (g kg^{-1} DM)	8.27	9.65	11.04	12.42	13.80
Crude protein (g kg^{-1} DM)	82.3	132.8	155.7	178.5	201.3
Ether extract (g kg^{-1} DM)	2.80	3.16	3.50	3.87	4.23
Crude fibre (g kg^{-1} DM)	12.00	9.80	7.60	5.40	3.20
Total Ash (g kg^{-1} DM)	5.24	5.08	4.92	4.76	4.60
NFE (g kg^{-1} DM)	68.96	68.68	68.39	68.12	67.84
ME Mcal kg^{-1} DM	2.50	2.74	2.99	3.23	3.47

NFE: Nitrogen free extract, ME: Metabolizable energy

Table 3: Effect of dietary treatment on average final body weight at three months of age (kg/goat), average initial body weight (kg/goat), average daily weight gain (g/day) and Scrotal circumference (cm/goat) of WAD buck-kids

	Treatment (uromalt:maize, %)				
Variable	E_1 (0:100)	E_2 (25:75)	E_3 (50:50)	E_4 (75:25)	E_5 (100:0)
Ave. final body wt (kg)	11.00±0.65	12.50±1.160	10.8±0.860	11.00±1.27	9.66±0.66
Ave. initial body wt (kg)	7.00±0.20	7.00±0.200	5.50 ±0.50	6.00±0.40	5.50±0.50
Ave. daily wt gain (g/day)	44.44±5.00	61.11±10.65	58.89±4.00	55.56±9.67	46.22±6.00
Scrotal circumference (cm)	18.30±0.81^b	19.20±0.960^a	17.10±0.120^c	17.60±0.56^c	16.80±0.48^d

Value are Mean±SD in the same row not sharing a common superscript are significantly different at $p<0.05$

Table 4: Effect of dietary treatment on semen traits of WAD buck-kids

	Treatment (uromalt:maize, %)				
Variable	E_1 (0:100)	E_2 (25:75)	E_3 (50:50)	E_4 (75:25)	E_5 (100:0)
Semen volume (mL)	1.74± 0.04^b	2.46±0.07^a	1.55 ±0.03^c	1.30 ±0.10^c	0.50 ±0.08^d
Mass activity (mL)	+++	+++	+++	++	+
Ave. sperm motility (mL)	83±2.74^b	92 ±2.74^a	80±5.48^b	60±7.90^c	50±3.54^d
Ave. sperm conc/count ($\times10^{10}$ mL)	0.22±0.01^b	0.36±0.0^a	0.35±0.08^b	0.34±0.07^a	0.12±0.04^d
Ave. total sperm cell ($\times10^{10}$ mL)	0.38±0.03^c	0.88±0.56^a	0.54±0.02^b	0.44±0.07^b	0.06 ±0.01
Ave. dead spermatozoa (mL)	9.0±4.18^c	7±2.74^c	16±2.24^a	7.20±2.59^b	20±20.1^a
Ave. morphology (mL)	88±2.12^b	94±2.24^a	90±4.78^{ab}	82±4.74^c	81.0±6.52^e
Ave. sperm abnormalities (mL)	12±2.12^b	6±2.24^c	10±4.18^b	18±4.74^a	19±6.52^a
pH	7.6± 0.1	7.4±0.2	6.8±0.0	6.6±0.2	6.4±0.1
Colour	Creamy yellow	Creamy yellow	Milk white	Milk white	Opaque
Viscosity	Non-viscous	Non-viscous	Non-viscous	Non-viscous	Non-viscous
Odour	Faint odour	Faint odour	Faint odour	Faint odour	Faintodour

Values are Mean±SD in the same row not sharing a common superscript are significantly different at $p<0.05$

obtained revealed significant differences ($p<0.05$) in semen volume as a result of increase in the amount of uromalt inclusion level in the diet. The lowest semen volume (0.5 mL) was obtained from buck-kids fed diet E_5 having an inclusion level of 100% uromalt diet while the highest semen volume (2.46 mL) was obtained from buck-kids fed diet E_2 having 25% uromalt and 75% maize inclusion levels. However, the slowest semen mass activity was obtained from buck-kids fed diet E_5 having 100% uromalt inclusion level. The average sperm motility were significantly higher ($p<0.05$) in buck-kids offered diet E_2 having 25% uromalt and 75% maize inclusion levels than those offered diets E_1, E_3, E_4 and E_5, respectively. The average sperm concentration/count significantly reduced ($p<0.05$) concurrently as the level of uromalt inclusion level increased to 100%. The highest percentage of dead spermatozoa (20%) was recorded for the 100% uromalt inclusion level and was significantly higher ($p<0.05$) compared to other supplemental diets. Similarly, the average percentage sperm abnormality tended to increase significantly ($p<0.05$) as the uromalt level increased along the trend. All the diets showed similar pH values which implies no significant differences ($p<0.05$). However, the pH values decreased with increase in the amount of the uromalt inclusion level in the diets.

DISCUSSION

The animal performance results indicated that dietary treatment had no effect on average final body weight, average initial weight and average daily weight gain of WAD buck-kids. This may

indicate that there was no advantage of supplementing uromalt with 20.13% CP alone or with maize over feeding a hundred percent complete maize ration to three months old WAD buck kids during a 90 day growing period. Thus, in agreement with our findings, previous studies on the response of slow-release form of NPN have been variable but trials in which performance was not improved predominate (Virk *et al*., 1989; Loest *et al*., 2001). The physiological explanation for this effect is not clear and thus merits further investigation. However, it is known that fermented maize heated with a non-protein nitrogen such as urea increases crude protein of maize from 9%-20.13% (ARC, 2000) and hence the improvement in the quality and nutritive value of maize in the animal diet. Though, in the present study, such improvement in the quality and nutritive value of maize do not appear to alter body weight composition when fed to WAD buck-kids. As such, body weight composition in the present study may have been similar irrespective of treatment. Contrary to the present findings, Berwal *et al*. (1992) reported an increase in average daily gain when uromalt (40% CP) was supplemented alone or with groundnut cake to 10-month-old buffalo calves during a 90-day growing period.

Buck kids offered diet E_2 having 25% uromalt and 75% maize inclusion levels had a higher scrotal circumference than those offered diets E_1, E_3, E_4 and E_5, respectively. This result is unexpected since there were no differences in body weight because it is known that testicular development is associated with body weight and age (Ritar, 1991; Rekwot *et al*., 1988; Adedeji and Gbadmosi, 1999). Contrary to the present findings, Cortada *et al*. (2000) showed that increasing the amount of urea in the diet had no effect on scrotal circumference. Dietary treatment had effect on semen traits. Thus, the results obtained revealed differences in semen volume as a result of increase in the amount of uromalt in the diet. This result could be explained in terms of differences in average sperm motility, average sperm concentration/count and average total sperm cells among the treatments. Apparently, the average sperm motility, average sperm concentration/count and average total sperm cells reduced concurrently as the level of uromalt increased to 100% inclusion level. Additionally, the highest percentage of dead spermatozoa (20%) was recorded for the 100% uromalt supplemental diets. This may indicate decrease of the semen quality of buck-kids with increase in the inclusion level of uromalt to 100% in the diet. Thus, it is possible that this effect is stimulated by high concentration of intake controller (urea) in the diet as the inclusion level of uromalt increases to hundred percent. According to Detmann *et al*. (2007), urea is a good controller of supplement intake and hence these authors suggested that the mechanism of action of urea in controlling intake happens due to the relation of learning as a function of a sense of negative feelings by the animals. This effect is caused by ammonia (product of hydrolysis of urea) that, when reach levels above normal in the blood, affects primarily the central nervous system (Boin, 1984). Other factors that cause control of supplement intake when urea is present are the characteristics bitter taste of urea as suggested by Looski and McDonald (1999) and hence a possible decrease in palatability and dry matter intake as the inclusion level of uromalt increases in the diet since the dry matter values followed the same trend though not significantly like the average sperm motility, average sperm concentration/count and average total sperm cells in which diets containing 100% inclusion level of uromalt presented lower values than the rest of the treatment groups. These results evidenced that high levels of uromalt in relation to maize are not adequate for growing WAD buck-kids. However, it is suggested that adequate procedure should be followed for the correct utilization of urea associated with higher concentration of uromalt in the diet and avoid, as a consequence intoxication by its excessive intake. This excessive intake of urea were confirmed by considering the

differential of sperm colour obtained in the experiment as a function of differential of urea intake as the inclusion level of uromalt increases in the diet. Thus, it is possible that the differences in the supplemental levels of uromalt have allowed for less equilibrium in semen quality and then a greater response in toxicity level leading to differences in sperm colour among the treatments. Interestingly, the average sperm motility were higher in buck kids offered diet E_2 having 25% uromalt and 75% maize than those offered diets E_1, E_3, E_4 and E_5. This result supports the theory that satisfactory results were obtained when urea provided 25% of the nitrogen in the ration as suggested by Looski and McDonald (1999). Similar results have been reported elsewhere (Okere *et al.*, 1986; Ahmed *et al.*, 2005). Apparently, in spite of the variations observed in the sperm qualities, semen of WAD buck-kids fed uromalt diet was good, since the semen collected was optimum and could be used for natural mating or in artificial insemination programmes and can provide information to breeders for evaluating breeding soundness of (WAD) buck-kids.

CONCLUSION

At the feeding rate of uromalt used in these trials, our findings suggest that there is no improvement in average final body weight, average initial weight and average daily weight gain of WAD buck-kids. However, treatment containing 25% uromalt and 75% maize improved semen qualities of WAD buck kids compared to others. This result supports the theory that satisfactory results were obtained when urea provided 25% of the nitrogen in the ration. Thus, it is recommended that feeding of 25% inclusion level of uromalt diet will improve the semen quality of West Africa Dwarf buck-kids. However, Semen collected from WAD buck-kids fed uromalt diets should be tested through artificial insemination to determine its viability in reproduction. Finally, more studies on plasma and semen urea concentration on WAD buck-kids fed uromalt diets are highly encouraged.

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