The use of “kaun” (Local Potash) as a mineral source in the diet of West African Dwarf sheep

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Abstract

The study was conducted for 48 days to assess the use of kaun as a source of mineral for West African Dwarf sheep. The study was in two parts. Experiment I involved the use of milled kaun mixed with formulated concentrate consisting of wheat offal (50%), palm kernel cake (25%) and dried brewer's grains (25%). Experiment II was the use of dissolved kaun administered to the animals in form of drenching. Each group of animals in experiment I was allocated to experimental diet containing milled kaun (0.00, 0.14, 0.28, 0.45 and 0.56g/kg body weight/ram/day) and to kaun solution (0, 2, 4, 6 and 8g/10ml of water/ram/day) in experiment II. In Experiment I, significant ($P < 0.05$) effects of the diets were observed on average daily gain, dry matter intake and water consumption. The rams on D3 significantly ($P < 0.05$) performed better in daily gain, dry matter intake and feed efficiency than those on other dietary treatments. Water consumption increased with increasing level of kaun in the diets. Animals on D5 had the highest water consumption. No significant ($P > 0.05$) effects of the diets were observed on faecal and urinary mineral outputs of the rams fed kaun supplemented diet. The concentration of these minerals was higher at the end of the experiment than at the beginning thereby giving positive balance. Significant ($P < 0.05$) negative mineral balance was noticed between serum mineral before and after the experiment. This could suggest that mineral utilization was encouraged by kaun inclusion in the concentrate feed. In Experiment II, there were significant ($P < 0.05$) effects of the test diets on average daily gain, dry matter intake and water consumption. Diet 4 (6g/10ml of water/ram/day) and D5 (8g/10ml of water/ram/day) performed better with an average daily gain of 100g/d and 92.9g/d; dry matter intake, 70g $W^{0.75}$ kg and 66g $W^{0.75}$ kg; feed efficiency 0.700 and 0.710, respectively. Water consumption also increased with increase in the concentration of kaun solution but water consumption in treatment groups was lower than in the control (0.10L/kg body weight). The results of this study suggest that 0.28g kaun/kg body weight/ram/d promoted better performance in experiment I while 6g kaun/10ml of water, or 8g kaun 10ml of water/ram/d promoted better performance in experiment II. These levels of kaun as a source of mineral in sheep production are therefore recommended for optimum performance.

Keywords: Kaun, serum mineral, daily gain, West African dwarf sheep

Introduction

The advantage of mineral supplementation in enhancing the performance of grazing animals has been established (Ivery, *et al.*, 1986; Van Hourter and Leng, 1991). However, in the

traditional ruminant production systems, mineral premix is not normally included in the diets of the animals. This could be due to ignorance on the part of livestock owners who may not be aware of the importance of such mineral source.

or unavailability and high cost of mineral premix (Okagbare and Akinsoyinu, 1998). Grazing livestock from the tropical countries often depend almost exclusively on forages, which are low in minerals for their requirements (French, 1957; McDowell *et al.*, 1984). The problem is further compounded by the ever-increasing demographic growth which, over the years has reduced the available land for extensive grazing (Aina, 2002). Consequently, the need to search for a cheaper and readily available mineral sources is imperative. Mineral premix for ruminant (40% egg shell, 40% bone meal and 20% common salt; Payne, 1990). Is scarce and expensive and require expertise in compounding it.

However, *kaun*, popularly called 'local potash' and also known as 'Trona' in the geological sector (Gbodi and Ikwuegbu, 1982, RMRDC, 1996) is a common household item and readily available in open markets in all rural communities in Nigeria. OH is traditionally added to vegetable as a tenderizer and enhancer of green colouration. It is also used to energize horse for effective transportation of goods over a considerable distance and used locally by rearers to fatten up rams toward festive period (Gbodi and Ikwuegbu, 1982). Chemical analysis of *kaun* has shown that it is a repository of various essential mineral elements required by grazing animals (Ranjhan, 1980; Zogara *et al.*, 1988; Idowu, 1994). *Kaun* unlike mineral premix, does not require expertise in preparation before feeding it to animals. It could be fed directly to ruminants without milling or part of concentrate. *Kaun* is a dried lake salt, largely hydrated sodium bicarbonate (Davidson *et al.*, 1974), occasionally encountered as a saline lake deposit or evaporation product, and as an efflorescent on arid soil. It is a product of the salt industry in many parts of Nigeria and North Africa (RMRDC, 1996). This study was conducted to assess the nutritional implications of *Kaun* on the performance characteristics of the West African dwarf sheep.

Materials and Methods

Two experiments were conducted. The first experiment involved mixing milled *Kaun* with concentrate supplement at 5 levels of inclusion (0.0, 0.14, 0.28, 0.45, 0.56g/kg/body weight/ram/day). The second experiment involved dissolving *Kaun* in water at 5 levels of concentration (0.2, 4, 6, 8g/10ml of water/ram/day) and assigning the different concentrations to drench the animals in different groups.

Experiment Site

The study was carried out in the Small Ruminant Unit of the Teaching and Research Farm, University of Agriculture (7°15'N-3°25'E) between May and October, 2001 which coincided with period of wet season.

Experiment I- Experimental animal and management

Twenty growing West African Dwarf rams, weighing between 13 and 15kg were used for the experiment. The rams were purchased from the neighbouring villages. The rams were administered *Petits pestes* ruminants, broadspectrum antibiotics, dewormed with Barmint II and dipped in Asuntol powder solution^R to eliminate possible ectoparasites by Veterinarian. Clout^R was applied at 4 weeks intervals along the spine of the animals to curb mange infection. At the end of 3 weeks adaption period, the animals were grouped into 5 dietary treatments of 4 rams per treatment balanced for body weight. The rams were maintained on Guinea grass (*Panicum maximum*) concentrate supplement and water was *ad-libitum* for the 3 weeks of adjustment period in order to estimate their feed intake and water consumption before the commencement of the experiment.

Dietary treatment

The *Kaun* was milled into fine (about 0.2 to 0.02mm particle size) form while the concentrate supplement composed of palm kernel cake (25%), wheat offal (50%) and dry brewer's grains (25%) giving the calculated crude protein (18.8%), crude fibre (13.8%) and

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metabolizable energy (10.60MJ/kg). Each of the 5 groups was randomly assigned to a level of *Kaun* (0,2,4,6,8g/ram/day). In order to ensure total consumption of the daily allotted *Kaun*, about 50g of the concentrate supplement (to serve as carrier of the *Kaun*) was mixed with the *Kaun*. The mixture was first supplied to each group. After total consumption of the mixture, the remaining concentrate was then supplied to make 0.40kg/ram/d while *P.maximum* and water was offered *ad-libitum* once daily between 0080 and 0090hr. The animals were fed the experimental diet for 12 weeks.

Data collection

The body weight of each animal was taken before the experiment and fortnightly after 14-16 hours withdrawal of feed. Feed and grass refused were measured and recorded every morning to determine the feed intake. Water intake was estimated by subtracting the left-over from supply. Blood samples were collected via the jugular vein puncture (Frandsen, 1986) prior to the commencement (zero week) and at the end of the experiment (week 12) and serum was harvested (Heath and Olusanya, 1988) for mineral estimation. The faecal and urinary outputs from each animal were collected for 7 days in metabolic cages following the standard procedure (Aina and Akinsoyinu, 1996). About 10% of total faecal and urinary output were used for analysis. The faecal samples collected was oven-dried at 80°C to constant weight. The urinary was collected in a sample bottle with plastic covers, rinsed with 20% dilute sulphuric acid and then stored in a deep freezer at -20°C for subsequent analysis. The average temperature and relative humidity during this study were 34.7°C and 82% respectively.

Chemical analysis

Two grams (2g) oven-dried and milled faecal, 10ml urinary and 2ml serum samples were separately digested in separate 125ml-Erlenmeyer Flasks which have been previously washed with dilute H₂SO₄ and distilled water. Added to each sample were 4ml of perchloric acid, 25ml concentrated HNO₃ and 2ml

concentrated H₂SO₄. The content of each flask was mixed and gently heated at low-to-medium heat on a hot plate under perchloric acid fumehood. Heating was continued until dense white fumes appeared. The mixture is finally strongly heated (medium to high heat) for half a minute and then allowed to cool. Distilled water (50ml) was added and boiled for ½ minute on the same mate of medium heat. The solution was then cooled and filtered (with Whatman No. 42 filter paper) completely with a wash bottle into a 100ml Pyrex volumetric flask; then made up to mark with distilled water.

The Na, K, and Ca contents of each digested sample were estimated by Flame Photometry method while the P concentration was estimated using Vanadomolybdate Coloric method (IITA, 1978) while the concentration of Fe and Mg were determined using Perking Elmer Atomic Absorption Spectrophotometer (AAS).

Experiment II – Management of the experimental animals

The 20 rams that were used in Experiment I weighing between 16 and 17.5kg were allowed to rest for three weeks before the commencement of Experiment II. During the resting period, they were released to graze on paddock, supplemented with concentrate diet and water. At the end of the 3 weeks they were randomly divided into 5 dietary treatment groups of 4 rams per group balanced for body weight.

Preparation of experimental diet

Kaun was dissolved in water at five levels of concentration (0,2,4,6,8g/10ml of water/ram/day). The concentrate offered was as presented in Experiment I.

Dietary treatment

Each group was randomly assigned to *Kaun* solution. The solution was administered by drenching it directly into the mouth of each ram using 10ml syringe by 0080hr. the concentrate supplement was offered at 4% body weight.

Grass and water were supplied *ad-libitum* while the treatment lasted for 12 weeks.

Data collection

The animals were weighed fortnightly before morning feed. The feed rejected and the left-over water were weighed and measured respectively on daily basis to estimate the dry matter and water intakes. Blood samples were collected via the jugular vein puncture (Frandsen, 1986) prior to the beginning and at the end of the experiment. Sera were harvested to estimate serum mineral concentration as described before.

Statistical analysis

The data collected (Experiment I and II) were subjected to analysis of variance (Wahua, 1991). Differences among treatment means were significant were separated using Duncan (1955) Multiple Range Test.

Results and Discussion

Table 1 shows the proximate component of *Kaun* as determined (%). The values contained in table are the average of 3 samples from the same source. It showed the potential of *Kaun* as

mineral source (Idowu, 1994) in the diet of ruminants. *Kaun* contains many of the minerals required by sheep as it is fairly high in P ($32.5 \pm 0.03\%$), Na ($20.19 \pm 0.30\%$), Cl⁻ ($16.25 \pm 0.11\text{mg/l}$), HCO₃⁻ ($13.55 \pm 2.10\text{mg/l}$), and CO₃ ($12.80 \pm 0.02\text{mg/l}$). It appears that the name local potash does not reflect the actual proportion of K present in *Kaun* as observed (Gbodi and Ikwuegbu, 1982; Idowu, 1994). It is fairly low in Mg ($0.63 \pm 0.03\%$), Fe ($0.89 \pm 0.01\%$), Cu ($0.73 \pm 0.11\%$) and Zn ($0.67 \pm 0.30\%$). NRC (1988) stated different dietary mineral requirements for mature rams to be Ca ($0.20 \pm 0.82\%$), P ($0.16 \pm 0.38\%$), Na ($0.09 \pm 0.18\%$), Mg ($0.12 \pm 0.18\%$), K ($0.50 \pm 0.80\%$) and Fe (30-50% mg/kg), Cu (7-11mg/kg) and Zn (20-33mg/kg). This suggests that inclusion of *Kaun* in the diet of sheep may meet the requirements for some of the minerals of sheep (Ranjhan, 1980). It appears that the inclusion of *Kaun* in the concentrate supplement of sheep could replace to a large extent the commercial ruminant mineral premix. However, the results of the chemical analysis. (Table 1) differ from that given by Idowu (1994). The reason for the variation could be attributed to the source of sample collection (RMRDC, 1996).

Table 1: Chemical composition of *Kaun* as determined (%)

Components	Mean $\pm$ SEM
Moisture content	7.96 ± 2.01
Dry matter	92.04 ± 3.63
Calcium (Ca)	3.47 ± 0.40
Phosphorus (P)	32.51 ± 0.03
Sodium (Na)	20.19 ± 0.03
Potassium (K)	6.08 ± 0.10
Magnesium (Mg)	0.63 ± 0.03
Iron (Fe)	0.89 ± 0.01
Copper (Cu)	0.73 ± 0.11
Zinc (Zn)	0.67 ± 0.30
Chloride (Cl) (mg/l)	16.25 ± 0.11
Carbonate (CO ₃) (mg/l)	12.80 ± 0.02
Hydrogen carbonate (HCO ₃) (mg/l)	13.55 ± 2.01

Table 2 indicates the average performance of the rams drenched with *Kaun* solution. The average daily body weight gain in the drenched groups

increased significantly ($P < 0.05$) than animals on control while water intake was significantly ($P < 0.05$) higher in animals on control than those

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in the drenched. The rams on D4 had the highest daily body weight gain (100g/d), followed by those on D2 (97.1g/d), D5 (92.9g/d), D3 (91.4g/d) respectively, while the control group had the least daily body weight gain (57.1g/d), although this is the higher in Experiment I (28.6g/d) and the poorest feed efficiency (1.053). It appeared that the control group had the poorest performance in terms of daily gain

and feed efficiency which might connote important economic indice in animal production. It could be inferred that when *Kaun* solution is supplied in form of drenching to sheep, an encouraging performance is obtained (Aina and Abegunde, 2000). Water intake of the rams drenched with *Kaun* solution was significantly lower ($P<0.05$) than those in the control group (Table 2).

Table 2: Average performance of the rams drenched with *kaun* solution (Experiment II)

Parameters	D1	D2	D3	D4	D5	SEM
Average daily gain(g/d)	57.1	97.1	91.4	100.0	92.9	13.13
Water intake(kg body weight)	0.100	0.056	0.058	0.063	0.057	0.067
Dry matter intake (g/W ^{0.75} kg)	60.00	70.00	65.00	70.00	66.00	0.03
Feed efficiency	1.053	0.722	0.714	0.700	0.710	0.713

The ratio of dry matter intake to water consumption in the drenched groups was fairly constant (1.11 to 1.25), this ratio was close to the observation (Akinsoyinu, 1985) who reported that male West African dwarf sheep and goats need approximately 1.11kg total water intake/kg dry matter for maintenance with ambient temperature between 27 and 29°C and relative humidity of 57 to 82%.

Table 3 contains the performance of the rams on the *Kaun*-based diet. There was an increasing daily body weight gain and water consumption as the level of *Kaun* increased in the diet, daily gain was optimal in D3 (74.3g/d) and then declined (35.7g/d) as the level increased to D5.

The maximum water consumption (0.052L/kg body weight) was probably induced by the diet containing the highest level of *Kaun* (0.56g/kg body weight). The feed efficiency appeared higher in the *Kaun* treated rams than the control with a better feed efficiency depicted in D3 (0.662) while the least feed efficiency (1.724) was noticed in the animals on the control diet. In general, the rams fed D3 exhibited significantly ($P<0.05$) higher growth rate (74.3g/d), least dry matter intake (49g/W^{0.75}kg) and better feed efficiency (0.662) than the rams on the other treatments. There was no significant difference ($P>0.05$) between the performance of the rams fed D2 and those fed D3 in growth rate, dry matter intake and feed efficiency (Table 3).

Table 3: Average performance of West African Dwarf ram fed *kaun* supplemented diets

Parameters	D1	D2	D3	D4	D5	SEM
Average daily gain(g/d)	28.6	71.4	74.3	52.9	35.7	11.37
Water intake(1kg body weight)	0.044	0.045	0.046	0.050	0.052	0.003
Dry matter intake (g/W ^{0.75} kg)	50.0	51.0	49.0	64.0	57.0	3.43
Feed efficiency	1.724	0.718	0.662	1.208	1.583	0.73

The animals on the control diet consistently performed poorer (28.6g/d) than those on *Kaun*-base diet in daily weight gain, water intake (0.044l/kg body weight) and feed efficiency (1.724). This observation supports submission (Ivery, *et al.*, 1986; Van Hourter and Leng, 1991 and Lufadeju and Lamidi, 1993) that mineral supplementation enhanced better performances in the treated animals than the control.

The balance between the initial and final faecal mineral output are contained in Table 4. the

table shows that Na, K, Ca, P, Mg and Fe are in positive balance. However, the balance was significantly ($P < 0.05$) higher in the control group (zero *Kaun* inclusion) than in the *Kaun*-treated groups. The reason for this observation was not understood. However, one could suggest that the *Kaun*-based diets encouraged more mineral utilization in the treated groups than the control, or that *Kaun* may contain some un-identified growth factors which probably promoted mineral utilization.

Table 4: Faecal mineral balance of the rams fed *kaun* supplemented diets before and after the experiment

Minerals (mg/kg)	D1	D2	D3	D4	D5	SEM
Na	12.70	7.40	5.93	10.10	6.73	5.01
K	17.50	11.27	8.57	14.33	12.80	3.03
Ca	64.00	39.13	30.97	43.95	44.20	7.10
P	470.20	318.50	229.67	367.80	325.17	12.13
Mg	65.00	40.00	15.00	48.33	38.33	3.11
Fe	89.17	54.67	33.33	59.63	48.33	6.17

Table 5 shows the balance between the initial and final urinary mineral outputs of the experimental animals. The balance between the control and *Kaun*-treated groups did not follow any regular trend as in faecal output. However, they were all in positive balance except Mg balance in the control which was negative (-0.77mg/100ml). The Mg balance had the least value of all the minerals. This could be an indication of higher utilization by the animals than what obtained for the other minerals. The utilization of mineral is dependent upon many factors including level of the element ingested, age of the animal, pH of the intestinal contents,

state of the animal with respect to deficiency or adequacy of the element and the presence of other antagonistic minerals or nutrient (Fontenot *et al.*, 1960, Hafez and Dyer, 1969, Fontenot, Webb and Wise, 1973; Kemp, 1983). The positive balance further suggested that the inclusion of *Kaun* in the diet increased the urinary and faecal outputs of the minerals. The results support the record of Bondi (1987), Church and Pond (1988) and Aina (1992) who observed that mineral absorbed in excess of body's requirement are excreted mainly through faecal and urine but the major route of excretion is through faeces.

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Table 5: *Urinary mineral balance of rams fed kaun supplemented diets before and after the experiment*

Minerals (mg/100ml)	D1	D2	D3	D4	D5	SEM
Na	21.48	21.96	13.37	15.30	13.04	4.06
K	31.05	30.90	39.63	10.20	11.40	5.10
Ca	102.13	124.20	87.43	89.10	61.03	21.66
P	86.72	80.53	69.04	34.51	41.09	11.33
Mg	-0.77	0.13	0.10	0.90	0.60	0.07
Fe	1.33	1.44	0.80	0.94	0.83	0.33

In Table 6, almost all the animals exhibited negative serum mineral concentration except Na indicating higher pre-experimental mineral concentration in the serum of each animal than post-experimental one. This could suggest utilization of the minerals for physiological activities including osteogenesis and osmotic phenomena since the animals were still in the growing stage. Other likely reasons for the

negative serum mineral balance include breed, age, climatic condition and/or the composition of the experimental diet (Bondi, 1987, Church and Pond, 1988). However, the rams treated with D3 consistently remained in the positive mineral balance except in Fe. This could mean that the optimum level of inclusion for maximum performance is contained in D3.

Table 6: *Serum mineral balance of the rams fed kaun supplemented diets, before and after the experiment*

Minerals (mg/100ml)	D1	D2	D3	D4	D5	SEM
Na	14.22	17.23	37.50	2.72	17.03	7.11
K	-8.88	-2.82	0.25	-8.36	-10.00	-2.66
Ca	-20.70	-37.70	12.98	-49.17	-19.77	-13.13
P	-1.97	-1.63	7.32	-2.48	-1.91	-1.97
Mg	-13.17	-40.30	16.00	-30.83	-12.50	-5.66
Fe	-60.87	-76.16	-42.00	-84.57	-54.91	-20.33

Table 7 contains the packed cell volume (PCV), red blood cells (RBC), and white blood cells (WBC) of the rams prior to the commencement of the experiment. This was to ascertain the health status of the rams before the experiment. The values were in agreement with the record of

Schalm *et al.*, (1975) and Heath and Ohusanya (1988) for healthy sheep. This suggests that the rams were in good health condition as at the start of the experiment. Thus, any responses obtained could be attributed to treatment effects.

Table 7: *Haematological parameters of the experimental animals before the commencement of the experiment*

Parameters	Range	Mean $\pm$ SEM
Packed cell volume (PCV%)	25.00-31.00	27.33 $\pm$ 3.07
Red Blood Cells (RBC) (mm $\times 10^6$)	12.33-13.73	12.53 $\pm$ 2.01
White Blood Cells (WBC) (mm $\times 10^3$)	8.35-10.6	9.15 $\pm$ 1.96

The results of the two experiments indicated that the inclusion of *Kaun* in the diet of sheep either mixed with concentrate diet or as drench solution would encourage better performance by the animals. The serum mineral concentration in all the treatment groups including the control was higher before than after the experiment, thus giving significant ($P < 0.01$) negative balances in all mineral considered except Na. The reason for significant negative serum mineral balances could not be understood. However, it could be suggested that the animals utilized much of the serum minerals for some physiological developments such as osteogenesis of other tissue formation and osmotic activities. Mahan (1990) observed that mineral requirements in ruminants increases with age and physiological status of the animals. However, the negative balances noticed in this study did not reflect in the weight gain of the animals as *Kaun*-treated groups (dietary or drenched) significantly ($P < 0.05$) gained more weight than the control. This suggest that administering *Kaun* to WAD rams either in the diet or by drenching as a source of mineral salts has beneficial effects on the animals. The better performance of the rams on *Kaun* solution than those on mixed diet suggests that the milled *Kaun* would have to undergo longer digestive processes before it could be utilized while the drenched ones undergo a shorter period of digestion before utilization. It is therefore recommended that up to 4g of *Kaun*/ram/day (0.28g/kg body weight/day) in the diet or 8g/10ml of water/ram/day) by drenching may be administered.

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