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Sodium, Potassium and Magnesium in milk of West African Dwarf Does as influenced by Lactation Stages

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Abstract

This study centers on the concentration of sodium (Na), magnesium (Mg) and potassium (K) in colostrum and mature milk of West African Dwarf (WAD) goats as influenced by stages of lactation. Six (6) WAD does aged 18 months and weighing 19-22 kg body weights were brought to heat by synchronization and served by two WAD bucks. After parturition, milk samples were collected at days 2, 3, 4, 5 and once a week from weeks 2 to 14. The results revealed that Na and K in colostrum were higher than that of matured milk. The Mg content of mature milk (19.8mg/100ml) was however higher than that of colostrum (18.2mg/100ml). Stages of lactation greatly influenced the contents of Na, Mg, & K in colostrum and mature milk of WAD does. Sodium and K in colostrum and mature milk decreased significantly ($p<0.05$) as lactation advanced. Magnesium in mature milk however depicted an increasing trend with advancing lactation while that of colostrum decreased significantly ($p<0.05$). Conclusively, the result showed that goat milk was richer in its content of Na, K and Mg than milk from cow and human. It is therefore recommended that the studied minerals be further jealously preserved in goat milk for its effective human consumption.

Keywords: Milk, WAD Does, Lactation, Colostrum

I. Introduction

Livestock has traditionally being an important component of agricultural industry and they play vital roles in agricultural development and food production.

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Livestock production uses resources more efficiently and adds value to the production industry; it secures sustainability of crop production [1]. The livestock production industry has been of great importance in sustainability of humans. This it does in recycling of nutrients, provision of energy, accumulation of wealth and reduction in unemployment level. However there are notable challenges: low capital input, use of native, unimproved animals, uncertainties caused by seasonality of feed availability among others.

The West African Dwarf (WAD) goat is the predominant breed in southern Nigeria. It has been reported that about 85% of the smallholder farmers in Nigeria sub-humid zone keep West African Dwarf goats [2]. In earlier findings of [3] this breed of goat appears to be the most prolific with more twins, triplets and occasionally quadruplets. The average litter size and prolificacy increased with age [3],[4]. Being poly oestrus, the WAD goats produce kids and come into milk at any time of the year. Milk production tends to be of secondary importance as they are known of meat type.

Goats are however valued for their milk. Goat milk is sweet, nourishing, and medicinal and found highly beneficial in consumptive cases [5]. The essential amino acids of goat milk are slightly in excess of infant requirements however it is adequate in essential fatty acids [16]. Goat milk is not apt to curdle in the stomach like cow milk [2]. It was said by [17] that goat milk is sweet, medicinal and highly beneficial in consumptive cases. His report also showed that goat milk is finer than cow milk; the fat and protein contents are easily digestible; and that goat milk is is known for its high buffering qualities and higher phosphate content. Thus goat milk can prevent ulcer, indigestion and constipation. In view of this, goat milk can substitute cow milk for human consumption.

A finding [6] revealed that the percentage of fat, protein and lactose in WAD goat milk tended to rise with advancing lactation. Reference [7] found that goat milk is similar to that of human being; and that it contained more of calcium, magnesium, phosphorus, iron, copper and manganese. Reference [8] revealed that colostrums of WAD does contained higher percentages of all minerals (except calcium) than milk secreted later. Due to the size of WAD goats, their milk yield does not correspond to the daily production rates of the temperate goat breeds [19]. It was found by [8] that colostrum of WAD goats was lower in its content of lactose but higher in butterfat and protein content than milk secreted later in lactation.

It was reported by [7] that protein fractions of WAD goat milk (non casein nitrogen, casein nitrogen and protein nitrogen) is on the high side.

In order to prevail against under nourishment and malnutrition which are acompanied by low intake of some minerals and vitamins among the populace especially the pregnant, lactating mothers and infants, goat milk is so reliable. Thus there is the need to contribute to existing knowledge on goat milk.

This research work focuses on appraisal of Sodium (Na), Potassium (K), and Magnesium (Mg) contents of WAD goat milk as influenced by stages of lactation with the aim of improving the nutritional contributions of milk to mankind.

II. Materials and Method

A. Animals and Their Management

Six WAD does aged 18 months and weighing 19-22kg were used for the experiment. They were randomly divided into two groups. Each group was fed diet I or II (Table I and II) as supplement to grass (*Cynodon nlemfuensis*). Each animal was offered 4000g of supplement and 600g of freshly cut *Cynodon nlemfuensis*. Residues were weighed to estimate daily intake. Fresh water was provided *ad libitum* on daily basis. The does were brought to heat by synchronization. They were served by two herd WAD bucks and reared till parturition.

B. Collection of Milk Samples

The kids were allowed to run with the dam and milk samples were taken from each doe at days 2, 3, 4, 5 (6 x 4 samples) and once a week from weeks 2 to 14 (6 x 13 samples) after parturition. Hand milking method was used and samples were kept in a plastic bottle and stored in the freezing cabinet at -20^{o}C till required for chemical analysis. No preservative was added.

Table I: Composition of Concentrate Supplement fed to the Does

Feed ingredient	Diet I	Diet II	
Cassava flour	73.1		59.1
Urea	6.0		–
Groundnut cake	–		20.0
Wheat bran	20.0		20.0
Common salt	0.5	0.5	
Oyster shell	0.2		0.2
Mineral/vitamin premix	0.2		0.2
Total	100.0		100.0

Table II: Proximate Analyses of Feed given to WAD does (g/100g DM)

Proximate composition	Diet I	Diet II	*Cynodon nlemfuensis*
Crude protein	15.0	15.3	9.0
Crude fibre	24.9	24.0	22.1
Ether extract	7.2	9.1	5.4
Ash	6.9	6.3	6.0
Nitrogen free extract	46.0	40.4	59.5
Gross energy (Kcal/g/DM	4.8	4.9	3.3

C. Analytical Procedure and Statistical Analysis

Milk samples were thawed and warmed up to disperse the butterfat. Accurately weighed 2g of milk samples were transferred into kjeldahl's flask, digested in a fume cupboard with 20mls of concentrated HNO_3 and 5mls of perchloric acid. The digest was made up to the mark with deionised water in 100ml standard volumetric flask. The contents of sodium, magnesium and potassium, in the digest were determined with atomic absorption spectrophotometer model 490 Gallenkamp, London. The results were analyzed using [9].

III.Results and Discussion

A. Dry Matter Intake

The estimated values (kg/day) of the dry matter among the six animals ranged from 0.71-0.79kg/day (Table III). It was observed that stages of lactation had a significant effect ($p<0.05$) on total dry matter intake. The total dry matter intake of all the six does increased significantly as lactation advanced. Highest intakes were recorded at the 4th week of lactation. The average dry matter intake of these WAD does (0.75kg/day) is adequate for maintenance and production. This is within the range recommended by (10)-between 0.5- 0.8kg/day. Results from Table III revealed that the concentrate intake is about 60-62% of the total dry matter intake. This corresponds to the report of [11]; that showed that the dry matter intake depends on whether the forage alone is fed to the animal or with forages and that supplementation of low protein forage with high protein concentrates had appreciable effect on feed intake. The effect of the two test diets were not significant ($p<0.05$). Thus urea can substitute groundnut cake as a source of crude protein in cassava flour based diet for lactating does and is being readily made available in feed thereby increasing the production of microbial protein.

Table III: Mean dry Matter Intake (kg/day) of Lactating WAD does

Wks after parturition	A	B	C	D	E	F
1	0.720	0.710	0.756	0.729	0.736	0.750
2	0.725	0.715	0.736	0.739	0.735	0.755
3	0.730	0.730	0.740	0.740	0.745	0.745
4	0.740	0.720	0.760	0.741	0.740	0.765
5	0.735	0.740	0.755	0.744	0.741	0.760
6	0.745	0.739	0.755	0.749	0.745	0.770
7	0.765	0.755	0.785	0.739	0.746	0.765
8	0.759	0.749	0.779	0.740	0.746	0.771
9	0.760	0.751	0.780	0.742	0.746	0.766
10	0.759	0.749	0.779	0.740	0.745	0.771
11	0.764	0.754	0.7784	0.739	0.750	0.768
12	0.760	0.750	0.780	0.739	0.752	0.770
13	0.765	0.755	0.780	0.749	0.753	0.775
14	0.763	0.756	0.779	0.745	0.750	0.778
Total	10.490	10.373	10.727	10.375	10.429	10.724
Mean	0.749	0.741	0.766	0.741	0.745	0.766
S.D	0.016	0.015	0.018	0.005	0.005	0.007

A – F = goat numbers; S.D = standard deviation

A. Sodium in Milk

Stages of lactation had significant effect ($p<0.05$) on sodium content of colostrum and mature milk. Table IV revealed that sodium content in colostrum of WAD does decreased. The decline continued to week 7 of lactation and increased appreciably after 8th week (Figure 1). It also revealed that sodium content of colostrum is higher than that of mature milk. This observation agrees with the report of [12], as lactation advanced, sodium content of human milk decreased. This finding is similar to the report of [15] who said sodium content of WAD does decreased with the progression of lactation; highest values were recorded in week 5 and week 10.

An earlier report [12] had it that sodium in human milk was 15mg/100ml and that of cow was 47mg/100ml. This study however revealed that sodium in WAD goat is between 85 - 91mg/100ml. Thus milk form WAD goat is a good source of sodium most especially the colostrum.

Sodium is necessary for maintenance of water balance and pH. It functions in transmission of nerve impulses and in the absorption of amino acids and sugars. Its deficiency reduced utilisation of digested proteins and energy, poor growth and reduced feed intake [15], [18].

B. Magnesium in Milk

The stages of lactation had significant effects on magnesium in colostrum and mature milk of WAD does. Meanwhile the magnesium contents in colostrum decreased significantly ($p<0.05$) as lactation advanced but increased appreciably as lactation advanced in mature milk (Table IV and Figure 1&2). Mature milk had higher contents of magnesium than colostrums: 19.8mg/100ml being the highest in mature milk and 18.2mg/100ml being the highest in colostrum of WAD does. This finding is similar to that of (15) that magnesium content in WAD goat milk increased from week 4 at 0.5% till week 10 at 0.15%. Reference [13] reported the following values for magnesium: cow -18.66mg/100g , human -4.34mg/100g , sheep-25.94mg/100g and goat-20mg/100g. The result of this experiment (16 – 19.5mg/100ml) is similar to the earlier research works discussed above. However, it was observed by [7] that milk from WAD goats contained higher levels of magnesium.

Magnesium is vital to to enzyme activity; assists in uptake of potassium. Its deficiency interferes with the transmission of nerves, muscles, impulses causing irritability and nervousnress [15], [18].

C. Potassium in Milk

Stages of lactation had highly significant effect ($p<0.05$) on content of potassium in colostrum and mature milk of WAD does. The content of potassium in colostrum and mature milk of WAD does decreased significantly ($P<0.05$) as lactation advanced. (Table IV). It was reported by [15] that potassium in WAD goat milk decreased with progressing lactation before gradually rising to week 10.

Although, the potassium content of WAD goat milk (colostrum and mature milk) decreased as lactation advanced, it was observed from Figures 1 & 2 and Table IV that potassium content of colostrum was higher than that of mature milk. Reference [11] reported that potassium in goat is high. Reference (14) said that pygmy goat milk was 75% higher in potassium than milk from other dairy goats. The present study recorded potassium in milk to be 142-165.4mg/100ml. [12] recorded 55mg/100ml for human being; 155mg/100ml for cow. It was reported by [7] that potassium level of WAD goat milk is similar to that of cow. It is quite clear potassium content of WAD goat milk is fairly high. Meanwhile [7] found that goats generally have a higher content of potassium in their milk although this varies from breed to breed.

Potassium is important for a healthy nervous system and regular heart rhythm. It aids muscle contraction and works with sodium to control body's water balance [15], [18].

Table IV: Sodium, Magnesium and Potassium (mg/100ml) in Milk of WAD does as Influenced by Stages of Lactation

After parturition	A Na	Mg	K	B Na	Mg	K	C Na	Mg	K	D Na	Mg	K	E Na	Mg	K	F Na	Mg	K
Day 2	100.1	18.1	160.1	101.2	18.0	160.2	103.0	18.2	158.1	104.2	17.5	165.4	100.4	17.6	161.0	100.0	18.2	164.0
Day 3	98.1	18.0	158.0	100.0	17.8	158.1	100.1	17.0	155.3	100.1	17.4	163.4	99.1	17.0	158.3	98.4	18.0	163.0
Day 4	96.0	17.5	153.0	95.1	17.0	156.2	96.0	17.4	152.0	96.0	17.6	161.2	99.0	17.1	156.0	96.0	17.0	160.4
Day 5	95.3	17.0	155.0	96.0	16.9	154.1	95.6	16.5	153.4	95.6	16.9	160.1	98.4	17.0	155.4	95.9	16.8	158.1
Mean	97.4	17.7	156.5	98.1	17.4	157.2	98.7	17.3	154.7	98.9	17.4	162.5	99.2	17.2	157.4	97.58	17.50	161.38
Standard deviation	2.17	0.51	3.15	2.98	0.56	2.61	3.53	0.72	2.64	4.03	0.31	2.36	0.84	0.29	2.12	1.99	0.70	2.66
Week 2	90.1	16.0	150.1	95.0	16.1	153.1	94.1	16.0	152.4	96.1	16.1	160.0	95.0	16.4	153.1	90.1	16.0	156.0
Week 3	87.0	16.1	150.2	90.1	16.3	151.3	90.0	16.5	150.1	91.1	16.3	158.1	90.0	16.5	153.0	87.1	16.1	155.4
Week 4	84.3	16.6	149.1	88.3	16.4	150.0	88.2	16.4	148.3	84.0	16.5	156.2	89.1	17.0	150.4	85.2	16.4	154.3
Week 5	82.4	16.8	148.5	84.0	17.0	148.4	86.1	17.8	147.4	86.2	17.0	154.5	89.0	17.1	149.8	83.1	17.0	152.0
Week 6	83.5	16.8	147.4	82.9	17.1	147.5	87.0	17.5	146.4	85.3	17.1	150.3	88.4	17.0	149.6	84.0	17.1	150.0
Week 7	86.9	17.0	146.3	85.0	17.2	146.3	87.0	17.1	145.5	85.2	17.3	148.0	88.1	17.4	148.4	84.1	17.4	149.4
Week 8	89.9	17.0	146.4	88.5	17.6	147.2	88.3	18.6	145.6	88.4	17.9	147.1	90.1	17.6	148.3	85.6	17.8	149.0
Week 9	90.5	17.1	145.5	91.0	18.4	145.1	90.0	18.4	144.3	90.0	18.0	147.0	91.0	18.0	147.0	87.3	18.3	148.2
Week 10	90.4	17.3	144.0	91.1	18.0	145.0	91.0	18.3	143.5	91.2	18.0	147.4	93.4	18.5	146.1	88.1	18.6	147.1
Week 11	90.5	17.6	143.1	92.0	18.5	144.4	93.4	18.0	142.9	92.4	18.3	146.8	94.2	18.6	145.2	89.4	19.0	146.3
Week 12	91.0	17.9	142.6	92.1	19.6	144.3	94.3	19.1	142.4	92.0	18.4	146.6	95.1	19.0	145.0	90.0	18.9	144.0
Week 13	91.1	18.0	142.8	94.0	18.4	144.1	94.9	19.5	143.0	95.1	18.7	147.1	96.0	19.2	144.0	92.1	19.4	144.8
Week 14	91.1	18.1	142.0	96.0	18.5	144.0	95.1	19.8	142.2	97.4	18.8	146.0	96.4	19.3	145.1	92.0	19.5	144.9
Mean	88.2	17.1	146.0	90.0	17.6	146.9	90.7	17.9	145.7	90.3	17.5	150.4	85.3	17.8	148.7	87.55	17.8	149.34
Standard deviation	3.18	0.67	2.93	4.12	1.05	2.98	3.30	1.20	3.16	4.35	0.91	4.97	2.31	1.02	3.01	3.04	1.20	4.06

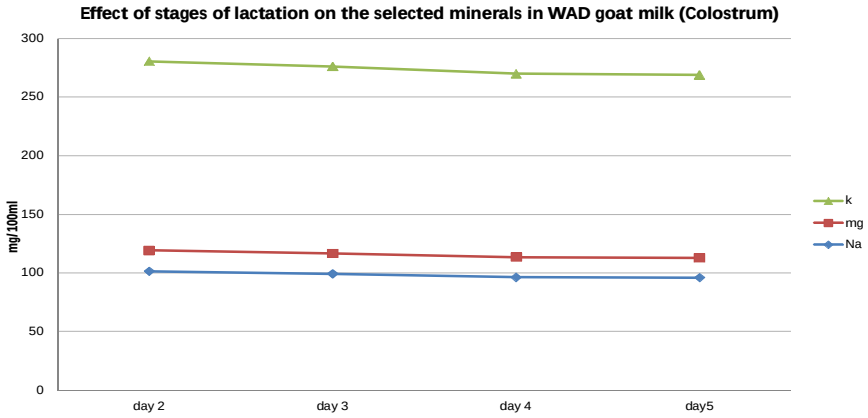

Figure I: Effect of stages of lactation on the selected minerals in WAD goat milk (Colostrum)

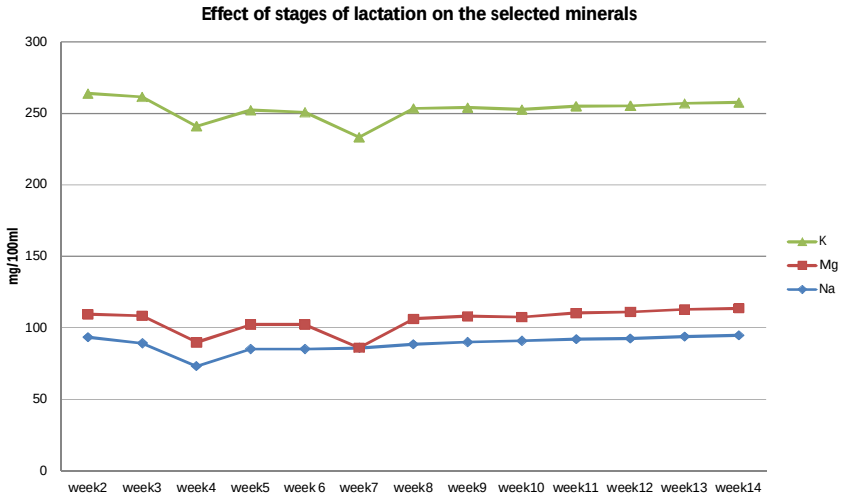

Figure 2: Effect of stages of lactation on the selected minerals

IV. Conclusion

This study revealed that the concentrate supplement and the basal grass *Cynodon nlemfuensis* contributed greatly to the voluntary intake of the WAD does. This influenced the mineral composition of the milk from WAD does. The concentrate supplement with either urea or groundnut cake as source of crude protein could be fed to the does since dietary effect was not significant.

In addition, the stages of lactation had significant effect ($p<0.05$) on sodium, magnesium and potassium in colostrum and mature milk. As lactation advanced, sodium and potassium in colostrum and mature milk decreased significantly ($p<0.05$). In case of magnesium, it's content in colostrum decreased while that of mature milk increased significantly. Again, colostrum from WAD does had higher contents of sodium and potassium.

Based on this, it can be recommended that milk from WAD goats is suitable for human consumption. It is highly nutritive most especially to the infants. Milk from goat is to be preferred to that of cow due to higher content of these minerals.

Hence goat milk can complement human milk in young children. Appraisal of nutritonal value of goat milk could promote its complementary effect in human diet, mostly if used for pregnant mothers and children.

Further research work would be necessary so as to increase the rate of milk production of WAD does since they are of the meat type.

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