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EFFECT OF PARITY ON MILK PROXIMATE AND MINERAL COMPOSITIONS AMONG THREE BREEDS OF CATTLE UNDER EXTENSIVE MANAGEMENT IN NIGERIA.

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ABSTRACT

A total of 270 cows comprising 90 each of Sokoto Gudali, White Fulani, and Red Bororo were used for the study. Each breed was replicated into three parities of 30 cows each. 5ml of milk samples were collected from each cow. The parameters analyzed were milk protein, fat, ash, moisture, calcium, iron, phosphorus, and sodium. The data were subjected to analysis of variance and mean were separated by Duncan multiple range test. Results in Sokoto Gudali revealed that Parity 3 was significantly ($p<0.05$) higher in milk ash 0.43%, moisture 82.08%, Fe 1.23 mg/L and Na 75.36 mg/L. Parities 1 and 2 were not significantly ($p>0.05$) different in milk ash, moisture, Fe as 0.36% and 0.37%, 81.72% and 81.21% and 1.02 mg/L and 1.15 mg/L respectively, however they were significantly ($p<0.05$) lower than the values (0.43 %, 82.08 % and 1.23 mg/L) obtained in parity 3. In Red Bororo, Parity 1 was significantly ($p<0.05$) higher in milk protein 3.97% whereas parity 3 was significantly ($p<0.05$) low in milk protein 3.01%. Parity 1 was significantly ($p<0.05$) higher in Fe, P and Na as 1.01mg/L, 375.62mg/L and 71.22mg/L respectively whereas parity 2 and 3 were same and significantly ($p<0.05$) low in Na as 62.68mg/L and 64.62mg/L respectively. In White Fulani Parity 1 was significantly ($p<0.05$) higher in milk protein 4.52% whereas parity 2 was significantly ($p<0.05$) low in milk protein 3.93%. Parity 3 was significantly ($p<0.05$) higher in milk ash, moisture, Ca, Fe and Na as 0.46%, 85.25%, 611.48mg/L, 1.23mg/L and 75.33mg/L respectively. The milk parameters increased with increased in parity which might be influenced by development of animal mammary glands.

Keywords: Parity, Breed, Milk, Mineral, Cattle

INTRODUCTION

Dairy products are derived from milk; the secretion of the mammary glands of animals, usually cow (Bovine), sheep, goat, buffalo, mare, camel or yak (Alade *et al*., 2013). Most dairy products originated mainly from bovine, and to a lesser extent, sheep and goat milk (Sciascia *et al*., 2012; Sudhir and Agastian, 2013). Milk is an important source of dietary energy, fat, protein and lactose. One kilogram of cow milk is approximately composed of 878g of water, 33g of total protein, 33g of total fat, 47g of lactose, and 7g of Ash and provides 620Kcal as dietary energy (USDA, 2009). Milk also contains directly assimilated major salts, many trace elements in the form of complexes with proteins, vitamins and several enzymes (Clinquart, 2010). Milk is also an important source of lipids, proteins, vitamins, and minerals in many human diets. The mammary gland is the specialized secretory organ that provides essential nourishment to mammalian young in the form of milk. Milk is composed of water, fat, protein, lactose and minerals (Ash). The variation in milks and milk yield within species depends on so many factors (Ozrenk and Selcuk, 2008; Matei *et al*., 2010). Some of these factors are genotype, stage of lactation, daily variations, parity, diet, age, udder health and season (Haenlein, 2003). Genetic factors can influence milk composition, and its genetic variation has been reported in previous studies (Soyeurt *et al*., 2006; Schennink *et al*., 2007). In dairy cow, parity can influence the pattern changes in metabolic, hormones and metabolites following calving. However, in most dairy research there is paucity of information on effect of parity on milk proximate compositions of cattle (Dauda *et al*., 2023). This study aimed to investigate parity differences on milk proximate and mineral compositions among three breeds of cattle under Extensive Management in Nigeria.

MATERIALS AND METHODS

The study was carried out in Maiduguri. Maiduguri, the capital of Borno State, is located in Northeastern Nigeria. It lies between latitude 11^0 32' and 11^0 4' North and longitude 13^0 32' and 13^0 25' East with mean annual rainfall between 200 – 250 mm (BMLS, 2016). The animals were managed under an extensive system. The animals are allowed to graze during the day on natural grassland pasture such as Northern gamba grass (*Andropogon gayanus)*, Stylo grass (*Stylosanthes gracilis*) and Leucaena grass (*Leucaena gracilis*) which are predominantly found in the study area. A total of 270 cows comprising 90 each of White Fulani, Sokoto Gudali and Red Bororo. Each 90 cows per breed were further subdivided based on parities which were made-up of 30 cows in first, second and third parity each. Milk samples were collected early in the before feeding in 5ml ETDA-free bottle and stored in ice for laboratory analysis of milk proximate and mineral compositions. The milk protein and fat were analyzed by Kjeldahl and Gerber methods respectively. The mineral compositions were determined by atomic absorption

spectrophotometer. The data obtained from the study were subjected to analysis of variance as described in procedure of SAS program (SAS, 2000), significant mean differences were separated by Duncan Multiple range test. The following model was used

$Y_{ij} = \mu + P_i + e_{ij}$

Where, Y_{ij} = Observed values of ij^{th} of the parities, μ = overall mean, P_i = fixed effect of i^{th} Parity (i= parity 1, 2 and 3), e_{ij} = random residual error

RESULTS AND DISCUSSION

The results of effect of parity on milk proximate and mineral compositions of Sokoto Gudali cows are presented in Table 1. The results showed a significant ($p<0.05$) difference in milk ash, moisture, Calcium (ca), Iron (Fe) and sodium (Na) between the three parities. Parity 3 was significantly ($p<0.05$) higher in milk ash 0.43%, moisture 82.08%, Fe 1.23 mg/L and Na 75.36 mg/L. Parity 2 was significantly ($p<0.05$) high in Ca 614.94 mg/L. Parity 1 and 2 were significantly ($p<0.05$) same and low in milk ash, moisture, Fe as 0.36% and 0.37%, 81.72% and 81.21% and 1.02 mg/L and 1.15 mg/L respectively. Parity 1 and parity 3 were significantly ($p<0.05$) same and low in Ca 549.33 mg/L and 560.26 mg/L respectively. Parity 1 was significantly ($p<0.05$) low in Na 51.96 mg/L. The ranged value of milk moisture 81.21 – 82.08% obtained from this study was lower than the recommended milk moisture standard requirement of 84.00 – 88.00% (Talukder *et al*., 2013). Moisture content of cow breeds observed in the present study is higher than 84.80 – 85.20% (Salau and Bolakale, 2012) for two local cow breed. The variations in milk moisture content could be attributed to differences in feed, seasons and environment. The variations of milk moisture that existed in this study were due to the parity, because parity 3 was superior in moistures content. This could be associated milk production since (Ramesh and Chandan, 2006), the major components of milk are water 87.40%. (Ramesh and Chandan, 2006). The ranged value of milk ash 0.36 – 0.43% obtained in this study was lower than 0.79 – 0.81% for Bokoloji and Bunaji (Oladapo *et al*., 2015). The ranged values of Cal were 549.33 – 614.94 mg/L obtained in this study. The Ca increased from parity 1 to parity 2 and then declined in parity. Fe and Na increased with increased in parity. The increased in Fe and Na due to increased in parity might be attributed to increase in lactation which, Fe and Na could be demand for milk production.

Table 1: Effect of parity on milk proximate and mineral composition of Sokoto Gudali Cows

Variables	First parity			Second parity			Third parity		
	Mean	SEM	COV	Mean	SEM	COV	Mean	SEM	COV
Protein	3.91	0.12	6.10	3.55	0.05	1.99	3.78	0.01	0.47
Fat	3.18	0.03	1.91	3.09	0.03	1.14	3.15	0.00	0.00
Ash	0.36 ^{b}	0.01	5.86	0.37 ^{b}	0.02	5.81	0.43^{a}	0.01	3.53
Moisture	81.72 ^{ab}	0.16	0.40	81.21 ^{b}	0.15	0.26	82.08 ^{a}	0.28	0.04
Ca	549.33 ^{b}	17.31	6.30	614.94 ^{a}	3.51	0.81	560.26 ^{b}	4.72	1.46
Fe	1.02 ^{b}	0.04	9.31	1.15 ^{ab}	0.00	0.00	1.23 ^{a}	0.03	2.15
P	326.86	6.98	4.27	314.25	1.60	0.72	323.21	1.08	0.58
Na	51.96 ^{c}	5.64	21.72	68.76 ^{b}	0.90	1.85	75.36 ^{a}	0.12	0.27

abc means in the same row with different superscripts are significantly different ($P<0.05$) SEM=standard error of mean. Ca=calcium, Fe=Iron, P=Phosphorus, Na=sodium, COV=coefficient of variation

The results of effect of parity on milk proximate and mineral compositions of Red Bororo cows are presented in Table 2. The results showed a significant ($p<0.05$) difference in milk protein, fat, ash, moisture, Ca, Fe, phosphorus (P) and Na. Parity 1 was significantly ($p<0.05$) higher in milk protein 3.97% whereas parity 3 was significantly ($p<0.05$) low in milk protein 3.01%. The ranged value of protein 3.01 – 3.97% obtained from this study was lower than 4.08% for Red Bororo reported by Yusha'u *et al*. (2018). The increased in milk protein with decreased in parity observed in this study could be attributed to increased in milk production as the parity increased. Generally, in cow milk yield tend to be lower in parity 1 which will lead to an increased in percent milk protein. This implies that milk protein and milk yield might be controlled by different gene or inherited independently. The decreased in milk protein with decrease in parity could be attributed to accumulation mammary alveoli at first parity. Parity 3 was significantly ($p<0.05$) higher in milk fat, ash and moisture as 3.75%, 0.40% and 84.00% respectively, where parity 1 was significantly ($p<0.05$) lower in milk fat, ash and moisture as 2.89%, 0.35% and 81.13% respectively. The milk fat, ash and moisture increased with increased in parity observed in this study is in line with the report of Zahradeen *et al*. (2017) who reported that fat content of milk increased with increased in parity which might have been influenced by the fact that animal mammary gland need to be fully developed according to genetic limit before milk secretion. Egbowon (2004) opined that at first stage of lactation, the milk removed from udder is low in fat percent whereas milk removed at last stage of lactation was higher in

milk fat percent. The increased in milk moisture and ash with increased in parity might be associated with increased in milk yield since major component of milk is water. Parity 3 was significantly ($p<0.05$) higher in Ca (626.99 mg/L) and was significantly ($p<0.05$) low in parity 2 (555.42 mg/L). The result of milk Ca obtained from this study was lower than 1301 mg/L for Red Bororo as reported by Adesina (2012). The variations of milk Ca might be attributed to management system and parity. Parity 1 was significantly ($p<0.05$) higher in Fe, P and Na as 1.01mg/L, 375.62mg/L and 71.22mg/L respectively whereas parity 2 and parity 3 were same and significantly ($p<0.05$) low in Na as 62.68mg/L and 64.62mg/L respectively. Parity 1 was superior in Fe, P and Na, this could be associated with accumulation of mammary aveoli and low milk yield that is usually occur in first parity in ruminant animals. The ranged values of Fe, P and Na obtained in this study were 0.84 – 1.01mg/L, 310.01 – 375.62mg/L and 62.68 – 71.22mg/L respectively. The Milk Fe in this study was higher than 0.38±0.5mg/L for Red Bororo reported by Adesina (2012). The P and Na obtained in this study were lower than 884±117mg/L and 491±80mg/L for P and Na for Red Bororo milk respectively Adesina (2012). The variation in milk mineral compositions could be attributed to feeds, seasons and geographical location

Table 2: Effect of parity on milk proximate and mineral composition of Red Bororo Cows

Variables	First parity			Second parity			Third parity		
	Mean	SEM	COV	Mean	SEM	COV	Mean	SEM	COV
Protein	3.97[a]	0.03	1.45	3.64[b]	0.01	0.31	3.01[c]	0.01	0.84
Fat	2.89[c]	0.03	2.01	3.23[b]	0.01	0.64	3.75[a]	0.00	0.00
Ash	0.35[b]	0.01	2.86	0.35[b]	0.01	4.95	0.40[a]	0.00	0.00
Moisture	81.13[c]	0.05	0.11	83.43[b]	0.08	0.17	84.00[a]	0.10	0.20
Ca	585.05[b]	5.41	1.60	555.42[c]	11.4	3.56	626.99[a]	5.75	1.59
Fe	1.01[a]	0.02	4.01	0.99[a]	0.01	1.21	0.84[b]	0.02	4.46
P	375.62[a]	10.2	4.70	310.01[c]	5.10	2.85	350.92[b]	6.02	2.64
Na	71.22[a]	0.52	1.27	62.68[b]	1.50	4.15	64.62[b]	1/24	3.33

abc means in the same row with different superscripts are significantly different ($P<0.05$) SEM=standard error of mean. Ca=calcium, Fe=Iron, P=Phosphorus, Na=sodium. SEM=standard error of mean, COV=coefficient of variation

The results of effect of parity on milk proximate and mineral compositions of White Fulani cows are presented in Table 3. The results showed a significant ($p<0.05$) difference in milk protein, fat, ash, moisture, Ca, Fe, P and Na. Parity 1 was significantly ($p<0.05$) higher in milk protein 4.52% whereas parity 2 was significantly ($p<0.05$) low in milk protein 3.93%. The ranged value of protein 3.93 – 4.52% obtained from this study was higher than 3.12% for White Fulani Yushu'a *et al*. (2018). The result of milk protein obtained from this study was lower than 5.08% for White Fulani (Falola, 2012). The milk protein in this study was high in parity 1 and thereafter declined in parity 2 then increased again in parity 3. Parity 2 and 3 were same and significantly ($p<0.05$) higher in milk fat as 3.07% and 2.96% whereas parity 1 was significantly ($p>0.05$) lower in milk fat 2.76%. Milk fat increased from parity 1 to parity 2 and became static in parity 3. The ranged value of milk fat obtained in this study 2.76 – 3.07% was low than 4.45% for White Fulani (Adesina, 2012). The milk fat obtained in this study was also lower than 4.60 – 4.70% for Bunaji and Bokoloji cow breeds (Oladapo *et al*., 2015). The proportion of fat and protein in milk are determined primarily by the genetic make-up of the lactating animals, though they can be changed by nutrition and methods that adjust digestive and metabolic process (Adewumi and Olorunisomo, 2009). Parity 3 was significantly ($p<0.05$) higher in milk ash, moisture, Ca, Fe and Na as 0.46%, 85.25%, 611.48mg/L, 1.23mg/L and 75.33mg/L respectively. Parity1 and parity 2 were same and significantly ($p<0.05$) low in ash and Fe as 0.35% and 0.37% and 1.03mg/L and 1.08mg/L respectively. Parity 2 was significantly ($p<0.05$) in moisture and Ca as 83.75% and 560.50mg/L respectively. Parity 1 was significantly ($p<0.05$) low in P and Na as 282.52mg/L and 49.62mg/L respectively. Parity 2 was superior in P (361.54mg/L). Ash, moisture, Ca, Fe and Na attained maximum value in parity 3 except P and protein. The superiority of the aforementioned milk parameters might be connected with full development of mammary gland. The attainment of Ash, moisture, Ca, Fe and Na maximum value in parity 3 could also be due to secretory cells used in milk synthesis (Carnicela *et al*., 2008).

Table 3: Effect of parity on milk proximate and mineral composition of White Fulani Cows

Variables	First parity			Second parity			Third parity		
	Mean	SEM	COV	Mean	SEM	COV	Mean	SEM	COV
Protein	4.52[a]	0.04	1.42	3.93[c]	0.02	0.69	4.16[b]	0.02	0.97
Fat	2.76[b]	0.09	5.63	3.07[a]	0.02	1.36	2.96[a]	0.01	0.40
Ash	0.35[b]	4.41	2.86	0.37[b]	0.12	3.15	0.46[a]	0.12	2.53
Moisture	84.56[b]	0.05	0.10	83.75[c]	0.01	0.02	85.25[a]	0.01	0.02
Ca	571.06[b]	2.13	0.65	560.50[c]	3.59	1.11	611.48[a]	2.03	0.57
Fe	1.03[b]	0.06	5.58	1.08[b]	0.06	5.30	1.23[a]	0.03	2.15
P	282.52[c]	7.24	4.44	361.54[a]	0.32	0.15	325.76[b]	3.67	1.95
Na	49.62[c]	0.53	1.86	61.25[b]	0.56	1.59	75.33[a]	1/24	0.38

abc means in the same row with different superscripts are significantly different (P<0.05) SEM=standard error of mean. Ca=calcium, Fe=Iron, P=Phosphorus, Na=sodium. SEM=standard error of mean, COV=coefficient of variation

CONCLUSION

Parity had influence on milk proximate and mineral compositions of the three breeds of cattle (Sokoto Gudali, White Fulani and Red Bororo). Parity 1 was superior in milk protein in the entire three breeds. Parity 3 was superior in almost all the milk parameters except for protein. The milk parameters increased with increased in parity. This might be influenced by development of animal mammary gland. This study is recommending that animal should be allowed to attain genetic limit before milk secretion.

REFERENCES

Adesina, K. (2012). Effect of Breed on the Composition of Cow Milk under Traditional Management Practices in Ado-Ekiti, Nigeria. *Journal of Applied Science Environmental Management*, 16 (1) 55 – 59

Adewumi, O. O. & Olorunisomo, O. A. (2009). Milk yield and milk composition of West African Dwarf Yankasa and crossbred sheep in Southwest of Nigeria. *Livestock Research for Rural Development*, 21 (3): 45-53

Alade, N.K., Abbaya, H.Y. & Raji, A.O. (2013). Influence of season, species and interaction on milk composition of ruminant animals in Maiduguri, Borno State, Nigeria. *Advances in Agriculture, Sciences and Engineering Research*, 3 (10): 1195 –1204

Carnicella, D., Dario, M., Ayres, M. C. C., Laudadio L. and Dario C. (2008). The effect of diet, parity, year and number of kids on milk yield and milk composition in Maltese goat. *Small Ruminant Research* **77**(1):71-74.

Clinquart, A. (2010). Technologie du lait et des produits laitiers. CUD – UAC01 AbomeyCalavi, janv. 2010, 34p, 2010.

Dauda, A., Ahmadu, P. J. & Jibrin, D. N. (2023). Breed Differences on Milk Proximate and Mineral Compositions Across Parities in cattle under Extensive System. (*Manuscript under preparation*)

Egbowon, B. F. (2006). Comparative evaluation of milk secretion rate and milk composition in West African Dwarf and Red Sokoto goats. M.Sc. Thesis Department of Animal Breeding and Genetics, University of Agriculture, Abeokuta, Nigeria.pp:35-47

Falola, J. A. (2012). Atlas of Nigeria (pp 146-147).

Haenlein, G. (2003). Nutritional value of dairy production of ewe and goat milk, Retrieved January 28-2019.http://ag.edu/extension/information/goatmgt/gn-10.htm

Matei, S. T., Groza, I . Andrei, S. Bogdan, L. Ciupe, S. & Petrean, A. (2010). Serum metabolic parametersin Healthy and Sub chemical mastitis cows. Bulletin UASVM, *Veterinary Medicine* 67(1): 110-114.

Oladapo, A., Fasae, A. & Ogunekun, T. (2015). Quality Assessment of Fresh Milk from Traditionally Managed Nigerian Bunaji and Bokoloji Breeds of Cattle. *Pacific Journal of Science and Technology*, 16 (1):45-55

Ozrenk, E. & Selcuk, I. S. (2008). Effect of seasonal variation on the composition of cow milk in Van Province. *Pakistan. Journal of Nutrition. 7: 161-164.*

Ramesh, C. & Chandan, B. (2006). Manufacturing Yogurt and Fermented Milks, 6th ed., Blackwell Publishing Ltd, Oxford, U.K, pp. 7-40

Salau, A. & Bolakale, R. (2012). Nutritional Comparisons of milk from two Cow Specie and Local Preparations of Soya milk drinks. *Journal of Applied Chemistry*, 2(6), 41-44.

SAS (2000). Statistical analysis system, multiple incorporations. Users Guide Statistical version. Cary, NC, USA.

Schennink, A., Stoop, W. M., Visker, M. H. P. W., Heck, J. M. L., Bovenhuis, H., Van Der Poel, J-J., Van Valenberg, H. J. F. & Van Arendonk, J. A. M. (2007). DGAT1 underlies large genetic variation in milk-fat composition of dairy cows. *Animal Genetics*, 38:467–473.

Sciasciaa, Q., Pachecoa, D., SennaSalernob, M., Blairc, H.T. & McCoard, S. A. (2012).Milk somatic cells are not suitable biomarkers of lactating ruminant mammary gland function. *Proceedings of the New Zealand Society of Animal Production*, 72: 14-18.

Soyeurt, H., Dardenne, P., Dehareng, F., Lognay, G., Veselko, D., Marlier, M., Bertozzi, C., Mayeres, P. & Gengler, N. (2006) Estimating fatty acid content in cow milk using mid-infrared spectrometry. *Journal of Dairy Science*, 89:3690–3695

Sudhir, V & Agastian, P. (2013). Expression Profile of Important Milk Producing Genes in Cattle Breeds from India. *International Journal of Advanced Biotechnology and Research, 4 (1): 976-980.*

Talukder, M. A. I., Panandam, J. N., Halimatun, Y. & Idris, I. (2013). Milk composition and quality of Sahiwal-Friesian crossbred cow studied in Malaysia. *A scientific Journal of Krishi Foundation. The Agriculturist*, 11(2), 58-65.

USDA, (2009). United States Department of Agriculture national nutrient database for standard reference. Washington, DC, Agricultural Research Service, United States Department of Agriculture. Available at: http://ndb.nal.usda.gov/

Yusha'u, A. Z., Gimba, C. E., Omoniyi, K. I. & Ekwumemgbo, P. A. (2018). Effects of breeds on proximate composition of raw milk of local cow and sheep breeds. *Nigerian Research Journal of Chemical Sciences*, 4:8-16

Zahraddeen, D., Butswat, I. S. R. & Mbap, S. T. (2017). Evaluation of some factors affecting milk composition of indigenous goats in Nigeria. *Livestock Research for Rural Development*, 19:11.