FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 7 No. 2, April, 2023, pp 172 - 175
DOI: https://doi.org/10.33003/fjs-2023-0702-1725

STUDIES ON THE MILK YIELD AND COMPOSITION OF LACTATING RED SOKOTO DOES FED GINGER (*Zingiber officinale*) AS FEED ADDITIVE

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ABSTRACT

A study was conducted to evaluate the effect of inclusion levels of ginger on milk yield and composition of Red Sokoto does. A total of twenty-eight (28) Red Sokoto does (RSD) weighing on the average 16.29 kg were used. The animals were randomly assigned to four diets, containing 0, 250, 500 and 750g/100kg diet levels of ginger respectively in a completely randomized design. Each of the animals were fed concentrate at 1.5% of body weight. Milk yield and composition were recorded. Udder and teats of each doe were washed with cotton wool soaked in disinfectant (Methylated spirit) and then they were hand-milked into sterilized containers and measured using calibrated cylinder. Milk samples were analyzed for total solids, fat and protein using infrared spectrophotometry. Ash content was determined after heating in a muffle furnace for 3 hours and the solids not fat content was calculated by difference. Results obtained showed that higher total milk yield of 360 liters was recorded in RSD fed diet containing 250 g ginger. All milk composition parameters (total solid, ash, fat, solid not fat and crude protein), were significantly affected ($P<0.05$) by ginger inclusion. Fat and crude protein contents were significantly affected ($P<0.05$) by lactation stages with their higher values ($P<0.05$) recorded in mid lactation stage (4.35% and 3.61%) respectively. Ash content recorded significantly higher value ($P<0.05$) in early lactation stage (1.05%). Ginger inclusion levels in the diets of RSD improved milk yield and milk composition.

Keywords: Red Sokoto does, ginger, milk yield and composition

INTRODUCTION

Total global goat milk production was estimated at 18.7 million tons in 2017 (FAO, 2019). It increased by 62% from 1993 to 2013 (Haenlein, 2017). From just 2007 to 2017, production increased by 16% (FAO, 2019). The dramatic increase in the 1990s corresponds to the growth of the dairy goat population. During the past decade (2007 to 2017), Asia has seen the largest increase in goat milk production (22%), followed by Africa (13%), and Oceania (9%), America (5%), and Europe (4%). Demand for dairy goat products is rising in both traditional and new markets. Goat milk and products increasingly are preferred for their health and nutritional benefits, including greater digestibility and lipid metabolism, in addition to their taste, compared to cow milk (Haenlein, 2004).

The domesticated milk producing livestock species are cattle, buffalo, Sheep and Goats. Globally, goat yields 60% of its value as milk, 35% as meat and 5% as skin (Malau-Aduli *et al*, 2001). Goats play an important role in increasing the low level of animal protein production and supply in many developing countries. Most of the goats in tropical countries are kept for meat production and are rarely milked despite their great potential as producers of good quality milk. Milk is extremely important in human nutrition especially among the rural communities where many cannot afford to buy milk and milk-products (Akpa *et al*., 2003). Goats contribute significantly to human nutrition in many developing countries (Devendra, 1999). Goat milk differs from cow or human milk in having better digestibility, alkalinity, buffering capacity and certain therapeutic values in medicine and human nutrition (Park, 1994). Density of goat milk is comparable to that of cow milk, while it has higher specific gravity, viscosity, but lower refractive index and freezing point than cow milk (Haenlein and Wendorff, 2006). The freezing point of goat milk is about -0.580^{0}C and viscosity is 13.4 mP at 27^{0}C (Roy and Vadodaria, 2006).

Various ailments are treated with ginger. These includes; skin diseases, respiratory infections, diarrhea, fever, eye infections, wound, external and internal parasites, poor milk secretion, poor weight gain, loss of appetite, fatigue among others (Hilow *et al.*, 2002). The various parts of the plant used for various treatments include the leaves, roots, herbs and the plant extracts. Hence, the main aim of this study was to investigate the effect of including ginger in the diets of RSD on milk yield and composition.

MATERIALS AND METHODS

Study Area

The experiment was conducted at the National Animal Production Research Institute (NAPRI), Ahmadu Bello University (ABU), Shika, Zaria, Nigeria. Shika is located at latitude 11º 12'N and longitude 7º 33'E at an altitude of 640 meters above sea level (GPS, 2018). The climate is relatively dry with annual rainfall range of 700 – 1400 mm. The rain starts between late April and early May to September. The dry season begins in October with cold weather that ends in January.

Experimental Feed Preparation

Feeds were compounded (Table 1) with inclusion levels of ginger at 0, 250, 500, and 750g/100kg. The formulation was done at the Feeds and Feeding Unit of NAPRI. They were compounded to contain 16% CP. Dry ginger was sourced from Samaru local market in Zaria and ground into powder using grinding machine before inclusion.

Milk sample collection

After parturition, individual does were manually drained of milk while 100 ml of each sample were immediately taken to the laboratory for analyses of milk composition. During milk collection, the udder and teats of each doe were washed with cotton wool soaked in disinfectant (Methylated spirit) and

then they were hand-milked into sterilized containers and measured using calibrated cylinder. The study was carried out at the beginning, middle and at the end of the lactation period (twelve weeks after kidding) and the milk yield recorded. Milk samples were analyzed for total solids, fat and protein using infrared spectrophotometry according to AOAC (2007), procedures. The ash content was determined after heating in a muffle furnace for 3 hours and the solids not fat content was calculated by difference.

Chemical Analysis

Milk samples were analyzed for total solids and protein using infrared spectrophotometry according to AOAC (2007) procedures. Fat was determined using Gerber test. The ash content was determined after heating in a muffle furnace for 3 hours at 550°C and the solids not fat content was calculated by difference.

Statistical Analysis

Data on milk yield was subjected to analysis of variance for repeated measure analysis using Proc Mixed Procedure of SAS (2005).

RESULTS

Chemical composition of the concentrate diets, *D. smutsii* hay and ginger fed to lactating RSD (%)

Results of chemical composition of the concentrate diets, *D smutsii* hay and ginger fed to lactating RSD is presented in Table 1. It indicated a higher DM and EE in the ginger while CP was higher in the concentrate diet. *D. smutsii* hay had higher CF value.

Effect of varying levels of ginger in diets fed to RSD on milk yield

Results of effect of varying levels of ginger in diets fed to Red Sokoto does on milk yield is presented in Figure 1. It indicated a higher total milk yield (360 liters) in the group fed diet containing ginger at 250 g/100 kg diet. Animals fed diet containing 0 g ginger recorded lower milk yield (135 liters) throughout the lactation period (90 days).

Effect of level of ginger in diets fed to Red Sokoto does on milk composition, lactation stage and their interactions

Results of effect of level of ginger in diets fed to Red Sokoto does on milk composition, lactation stage and their interactions is presented in Table 2. It indicated that all the parameters; total solids (TS), Ash, Fat, solid not fat (SNF) and crude protein (CP) measured were significantly ($P<0.05$) affected by the dietary treatments. TS, Ash and Fat recorded higher values (20.62, 1.31 and 4.18%) respectively in the group fed diet containing 0g/100 kg ginger. SNF and CP recorded higher values (16.83 and 3.36%) in the group fed diet containing 250g/100 kg ginger. Ash, fat and crude protein contents were the only significantly affected parameters ($P<0.05$) in stages of lactation. TS, Fat and CP contents recorded higher values in mid lactation stage while Ash content recorded higher value in early lactation stage. There was an interaction between ginger inclusion level and lactation stage for Ash.

Table 1: Chemical composition of the concentrate diets, *D smutsii* hay and ginger fed to lactating RSD

	Inclusion levels of ginger (g/100 kg diet)					
Nutrients (%)	**0**	**250**	**500**	**750**	***D. smutsii***	**Ginger**
Dry Matter	91.00	91.30	91.50	91.80	90.04	96.09
Organic Matter	83.64	83.92	84.10	84.38	87.39	88.72
Ash	7.36	7.38	7.40	7.42	2.65	7.37
Ether Extract	2.87	2.89	2.90	2.90	0.54	5.90
Crude Fiber	17.13	17.16	17.19	17.22	30.05	12.28
Crude Protein	15.90	15.90	16.00	16.00	5.36	11.36
Nitrogen Free Extract	56.74	56.67	56.51	56.46	61.40	63.09
Neutral Detergent Fiber	36.89	36.93	36.97	37.01	63.81	16.99
Acid Detergent Fiber	20.50	20.52	20.54	20.56	33.94	8.83

Table 2: Effect of level of ginger in diets fed to Red Sokoto does on milk composition, lactation stage and their interactions

Ginger inclusion levels (g/100 kg diet)	**Milk composition (%)**				
	TS	**Ash**	**Fat**	**SNF**	**CP**
0	20.62^{a}	1.31^{a}	4.18^{a}	16.44^{a}	3.11^{b}
250	20.52^{a}	0.76^{b}	3.69^{b}	16.83^{a}	3.36^{a}
500	19.49^{a}	0.81^{b}	4.02^{ab}	15.47^{ab}	2.94^{bc}
750	17.77^{b}	0.89^{b}	3.07^{c}	14.70^{b}	2.86^{c}
SEM	0.74*	0.09*	0.19*	0.75*	0.12*
Lactation stages					
Early	19.69	1.05^{a}	3.38^{b}	16.31	2.88^{b}
Mid	19.85	0.84^{ab}	4.35^{a}	15.50	3.61^{a}
Late	19.05	0.78^{b}	3.15^{b}	16.35	2.82^{b}
SEM	0.99^{NS}	0.12^{*}	0.26^{*}	1.00^{NS}	0.16^{*}
Interactions					
G × L	NS	*	NS	NS	NS

^{abc}Means within the same column with different superscripts are significantly different ($P<0.05$) *significant at 0.05; SEM=Standard error of means; TS=total solid, SNF=solid not fat, CP=crude protein G=ginger level, L=lactation stage and NS= not significant

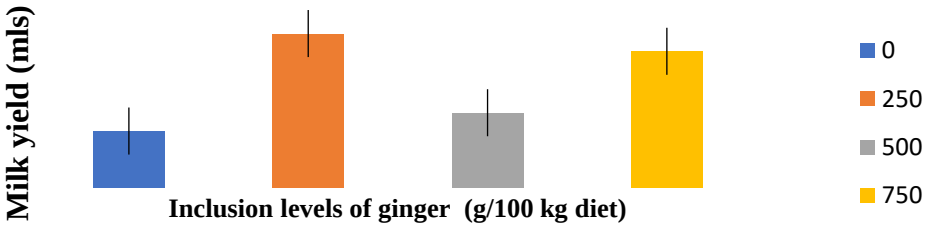

Figure 1: Milk yield of RSD fed varying inclusion levels of ginger

DISCUSSION

Chemical composition of the concentrate diet fed to lactating RSD (%)

The high DM content of the formulated diet might be as a result of high dry matter content of the ingredients used in the diet formulation which is the characteristics of most tropical crops as observed by Aduku (2004). The crude protein content of the diet was adequate to meet the minimum microbial need in the rumen as it is above the 7% crude protein required for microbial growth (Gatemby, 2002).

Milk yield of RSD fed diet containing varying levels of ginger

Hilow *et al.* (2002), reported that ginger is effective in treating poor milk secretion in animals. Eun and Sung (2015), reported that Phenols found in ginger are also known to improve milk yield. In this study, milk yield increased with an increase in ginger levels compared to the control. Zahraddeen *et al.* (2009), reported an increase in partial daily milk yield of indigenous goats from week one to week three and then a subsequent decline up to the fourteenth week. The increase in milk yield reported herein may be attributed to the reduction of methane production (Patra and Saxena, 2010). Decrease methane production is desirable in reducing gas emission which improved the efficiency of digested energy utilization (Sani *et al.*, 2023). Wilson *et al.* (1991), reported an increase in milk yield of lactating cows infused with acetic, propionic and butyric acids. The milk yield was higher in animals fed ginger at 250 g/100 kg feed. Supplementing 2 ml of ginger oil/ head/ day to the ration of Damascus goats significantly increased the daily milk yield (Khalof *et al.*, 2012).

Effect of levels of ginger in diets fed to RSD on milk composition, lactation stage and their interaction

Benchaar *et al*. (2007) and Tassoul and Shaver (2009), tested a commercial blend of EOs of some herbs (eugenol, vanillina and limonene) at dietary doses of 0.75, 1.2 and 2 g/d reported that milk fat was decreased for goats fed essential oil additives compared with the control animals. Milk fat in the present study decreased with increase in ginger levels compared to the control. The lower milk fat value (3.07%) was recorded in the RSD fed diet containing 750 g ginger. The reduction in milk fat can be attributed to the negative relationship with a higher milk yield. The milk yield in this study increased with increase in ginger levels compared to the control. The milk fat range values of 3.07 - 4.18% obtained in the present study were slightly lower than the values of 4.94 and 5.04% (Zahraddeen *et al*., 2007) and 5.7% (Alawa and Oji 2008), reported for the milk fat of Red Sokoto goats. The variation could be attributed to age, parity, nutrition and management systems. Milk protein initially increased with addition of ginger at 250 g and then significantly decreased in the last two groups fed diet containing (500 and 750 g ginger). The increase in milk protein in does fed diet containing 250 g ginger might be as a result of improvement of ruminal microbial protein synthesis. The values of milk protein in this study were slightly lower than the values reported by Khalof *et al.* (2012), when lactating goats were fed with garlic and ginger oil. Milk total solid decreased with increase in ginger supplementation from the group of RSD fed diet containing 250 g ginger to those fed diet containing 750 g ginger. The values of solids-not-fat recorded in this study were similar to the mean value reported by Midau (2012), where Milk Yield and Milk Composition of Red Sokoto Goats were analyzed during the wet season. According to Simos *et al*. (1991), milk fat; protein and solid not fat was negatively correlated to increase in milk yield. Several factors have been identified to influence the composition of milk in ruminant animals, which include age, breed, parity, nutrition, lactation stage and management practices, among others (Al-Saiady, 2011). Generally, the quality of milk produced by livestock is usually determined by the constituents that make up the milk, including fat, protein, lactose and solid-not-fat.

There was a significant difference in milk protein, fat and ash at different lactation stages while total solids and solid-not-fat were similar across the groups. The milk protein and fat in the present study were significantly higher during mid-lactation. Meanwhile, the least milk protein content was recorded (2.82%) during the late lactation stage but statistically similar with the early lactation stage (2.88%). However, this contradicts the findings of Zaharaddeen *et al.* (2007), where protein content showed a downward trend until mid-lactation before significant increase towards the end of lactation in Nigerian indigenous breeds of goat. The interaction between ginger inclusion level and lactation stage was significant in Ash. Ash was influenced by both ginger inclusion levels and stages of lactation where the values were higher in early lactation (1.05 %) than mid (0.84 %) and late (0.78 %) lactation stages. This corroborates the findings of Ahamefule *et al.* (2007), where he measured the lactation performance of WAD and RS goats raised in a hot-humid environment. Ash levels are indicators of mineral composition of milk.

CONCLUSION

Ginger inclusion levels in the diets of RSD improved milk yield and composition. Further studies should be conducted to investigate the comparative evaluation of ginger and garlic as feed additive on milk yield and composition of Red Sokoto does.

REFERENCES

Aduku, J. K. (2004). Mucuna: Herbaceous cover legume with potential multiple use. Resource and crop management. Research monograph. No 35. *International Institute of Tropical Agriculture, Ibadan, Nigeria.*

Ahamefule, F. O., Ibeawuchi, J. A. and Nwachinemere, G. C. (2007). Comparative evaluation of milk yield and compositions of West African Dwarf goats raised in the village and university environment. *Journal of Animal and Veterinary Advances*, 6(6):802 - 806.

Akpa, G. N., Osuhor, C. U., Olugbemi, T. S. and Nwani, P. I., (2003). Milk flow rate and Milking Frequency in Red Sokoto Goats. *Pakistan Journal of Nutrition*, 2(3):192-195.

Alawa, J. P. and Oji. U. I. (2008). Effect of Pendulous Udder Enlargement on Yield and Proximate Composition of Milk from Red Sokoto Goats. *Journal of Animal and Veterinary Advances*, 7: 870 – 872.

Al-Saiady, M. Y. (2011). Effect of restricted feeding, breed and diet on sheep milk yield. *Journal of Applied Animal Research*, 30(1): 85-88.

AOAC (Association of Official Analytical Chemists) (2007). *Official Methods of Analysis.* 19th Edition. Washington DC.

Benchaar, C., Petit, H. V., Berthiaume, R., Ouellet, D. R., Chiquette, J. and Chouinard, P. Y. (2007). Effects of essential oils on digestion, ruminal fermentation, rumen microbial populations, milk production and milk composition in dairy cows fed alfalfa silage or corn silage. *Journal of Dairy Science*, 90(2): 886–889.

Devendra C. (1999). Goats: challenges for increased productivity and improved livelihoods. *Outlook on Agriculture*, 28: 215 – 226.

Eun, T. K. and Sung, S. L. (2015). Effects of flavonoid rich plant extracts on *in vitro* ruminal methanogenesis microbial population and fermentation characteristics. *Asian-Australasian Journal of Animal Sciences*, 28 (4): 530-537.

Food and Agriculture Organization of the United Nations (2019). *Food and Agriculture Organization of the United Nations statistical databases.* [cited 2019 Feb 16]. Available from: http://faostat.fao.org/

Gatemby, R. M. (2002). *Sheep revised edition. Tropical Agricultural Series.* Macmillan Publishers Ltd.

GPS (Global Positioning System) (2018).

Haenlein G. F. W. (2017). Why does goat milk matter? A review. *Nutrition and Food Science International Journal*, 2: 555594. doi: 10.19080/NFSIJ.2017.02.555594.

Haenlein G. F. W. and Wendorff W. L. (2006). Sheep milk production and utilization of sheep milk. In: Park, Y.W., Haenlein, G. F. W. (Eds), Handbook of milk of Non-Bovine Mammals. Blackwell publishing professional, Oxford, UK, and Ames, Iowa, USA, pp137 – 194.

Haenlein G. F. W. (2004). Goat milk in human nutrition. *Small Ruminant Research*, 51:155–63. doi: 10.1016/j.smallrumres.2003.08.010 [Google Scholar]

Hilow, S. A., Abidi, S. B., Jeremiah, E. and Abdullahi, H. Y. (2002). *Ethnoveterinary medicine.* In: Mathias E. and Mundy (Editors). *Workshop on ethnoveterinary medicine* held in Kenya.

Khalof, M., Morsay, T., Abdo, M. O., Matloup, B. and Abu EL-Ella, A. (2012). Effect of supplementing lactating goats rations with garlic, cinnamon or ginger oils on milk yield, milk composition and milk fatty acids profile. *Journal of Life Science*, l4(1): 27-34.

Malau-Aduli, B. S., Eduvie, L.O., Lakpini, C. A. M. and MaulauAduli, A. E. O., (2001). Effects of supplementation on the milk yield of Red Sokoto does. *Proceedings of the 26 Annual conference of Nigerian Society for Animal Production*, March, ABU, Zaria Nigeria pp353-355.

Midau, A. (2012). Goat Milk a Possible Alternative Source of Protein and Minerals to the Rural Poor populace in Nigeria. *International Journal of Dairy Science*, 7: 29 – 33.

Ohiokpehai, O., (2003). Processed Food Products and Nutrient Composition of Goat Milk. *Pakistan Journal of Nutrition*, 2 (2):68-71.

Park Y. W. (1994). Hypo-allergenic and therapeutic siginifance of goat milk. *Small Ruminant Resrach*, 14: 151 – 161.

Patra, A. K. and Saxena, J. (2010). A new perspective on the use of plant secondary metabolites to inhibit methanogenesis in the rumen. *Phytochemistry*, 71: 1198–1222.

Roy S. K. and Vadodaria V. P. (2006). Goat milk and its importance, *Indian Dairyman*, 58 (3): 65 – 69.

Sani, R. T., Lamidi, O. S., Achi, N. P., Idowu, W. U., Ishiyaku, Y. M., Ahmed, S. A. and Lawal H. B. (2023). Effect of feeding diet containing raw or parboiled rice offal on rumen metabolite of Bunaji bulls. *FUDMA Journal of Sciences*, (7): 84 – 90.

SAS (2005). *Institute Incorporated SAS/STAT user's guide*. 6.03 Edition, Gray NC U.S.A

Simos, E., Voutsinas, L. P. and Pappas, C. P. (1991). Composition of milk of native Greek goats in the region of Metsovo. *Small Ruminant Research*, 4: 67-74.

Tassoul, M. D. and Shaver, R. D. (2009). Effect of a mixture of supplemental dietary plant essential oils on performance of periparturient and early lactation dairy cows. *Journal of Dairy Science*, 92(4): 1734 – 1740.

Wilson, J. R., Deinum, B. and Engles, F. M. (1991). Temperature effects on anatomy and digestibility of leaf and stem of tropical and temperate forage species. *Netherland Journal of Agricultural Science*, 39(1): 31 – 48.

Zahraddeen, D., Butswat, I. S. R. and Mbap, S. T. (2007). Evaluation of some factors affecting milk composition of indigenous goats in Nigeria. *Livestock Research for Rural Development*, (11): 19-20.

Zahraddeen, D., Butswat, I. S. R. and Mbap, S. T. (2009). A note on factors influencing milk yield of local goats under semi-intensive system in Sudan Savannah ecological zone of Nigeria. *Livestock Research for Rural Development*, (3): 21-22.