EFFECT OF WEEK OF LACTATION ON CHEMICAL COMPOSITION OF MILK AND COST BENEFIT ANALYSIS OF WEST AFRICAN DWARF GOATS REARED UNDER DIFFERENT MANAGEMENT SYSTEMS

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ABSTRACT
This study investigated the effect of management systems on weight of does and the chemical composition of West African dwarf goat milk. Animals were reared in three management systems - namely extensive, semi-intensive and intensive systems. Eighteen (18) West African dwarf does were divided into three treatment groups with six goats per treatment in a Completely Randomized Design. Concentrate diets were formulated as supplement for the goats in the intensive and semi-intensive systems while roughage was fed as a basal diet. The feeding trial lasted 56 days. Data were subjected to a one-way analysis of variance, and significant means were separated using Duncan Multiple Range Test. Week of lactation had significant ($p < 0.05$) effects on all chemical composition of goat milk and weights of dams. Doe weight ($p < 0.05$) of 13.98 kg was recorded in semi-intensive system and the lowest (11.00 kg) in extensive system. Cost per kg of feed consumed was highest ($p < 0.05$) (N191.18) in semi-intensive system and lowest (N208.52) in intensive system. Cost-benefit analysis among management systems was significantly influenced ($p < 0.05$). The least cost-benefit ratio of 1.125 was recorded for the extensive system while the best cost-benefit ratio of 1.99 was recorded for semi-intensive system. Cost-benefit analysis was better when goats were reared under semi-intensive system. The study concluded that semi-intensive management system improved the weight gain of does and the chemical composition of West African dwarf goat milk.
Keywords: West African dwarf goats, Goat milk, Chemical composition, Lactation, Cost-benefit analysis

INTRODUCTION

Goats are of the main sources of dietary livestock protein to many households, hence the need for improvement of this species. In Nigeria, goats are kept for meat, and rarely for milk. However, sometimes these lactating goats are milked periodically and fed to children, thereby improving the protein intake of these children consequently combating malnutrition status of infants in the community (Lebbie, 2004; Makun *et al.,* 2005). Goat production yields about 60 percent of its value as milk, 35 percent as meat and 5 percent as skin (Assan, 2020). Milk composition and quality are important attributes that determine the nutritive value and consumer acceptability. Malau-Aduli *et al.* (2001) reported goat milk yield and composition are affected by breed, age, stage of lactation, season and plane of nutrition.

Goat milk is one of the most complete foods for people, given the characteristics of its components, such as proteins that contain a large number of essential amino acids for food (Park *et al.*, 2007). However, the chemical composition of milk may vary according to individual characteristics such as race, food composition, time of lactation, management, climate and the region where the animals are found (Vega *et al.,* 2005). Farming for profit requires that farmers grow crops or livestock that can be sold on market. Farmer must understand market. He/she should know what leads to profit and what leads to loss. Cost-benefits analysis provides ways of analysing and comparing the profitability of livestock under different circumstances. Therefore, economic analysis is a valuable tool in the planning and management of animal production enterprise. Most of these economic benefits can be expressed in monetary terms (Babale *et al.*, 2018). It should be noted that many studies on milk chemical composition in goats have been carried out under different management system. The effect of different management systems on milk chemical composition, performance and cost benefit analysis of goat has not been extensively studied.

MATERIALS AND METHODS

Experimental Site

The study was carried out in three goat farms located at the Directorate of University Farms of the Federal University of Agriculture, Abeokuta. The climate of the site is humid; rainfall is well distributed during the rainy season with mean annual rainfall of 1037mm. The average temperature is 34.7°C. This area is located in the derived savannah vegetation zone of South Western Nigeria with latitude 7°13' 47.14" N, longitude 3°24'4.93" E, altitude 162m above sea level and relative humidity of 82% (Google Earth, 2022).

Experimental Animals and management

Eighteen West African dwarf goats (18 months old) with an average body weight of 11.78 ± 2.05 kg were used for the study and lasted for 56 days for each management system. The animals were quarantined for a period of two weeks in order to assess their health status before the commencement of experiment. In the first group, six intensively managed West African Dwarf goats were used. Thus, animals reared intensively were kept in permanent housing, with no access to pasture and were fed with roughage and concentrates. The second group of six WAD goats used for this study was reared under semi-intensive system; In semi-intensive systems, animals are not completely confined, were kept indoors during the night and in the evening and were moved to the pasture or simply to exhibit normal behaviour. Goats were fed with roughage and concentrates, in combination grazing. Goats in all farms, participating in this study were purebred animals. The composition of pasture consumed includes grasses like *Panicum maximum*, *Pennisetum purpureum* and animals are allowed to graze between 5 and 6 hours a day before supplementing with forage. The third group is also six WAD goats reared extensively. Animals were allowed to free grazing between the hours of 8hrs to 10hrs, water and salt lick were provided.

RESULTS AND DISCUSSION

Table 1 showed the effect of week of lactation on chemical composition of West African dwarf goat milk. All parameters of milk chemical composition such as fat, protein, ash, lactose, total solid and solid-non-fat evaluated had significant effect ($p < 0.05$) on week of lactation. Weight of does was influenced ($p < 0.05$) by week of lactation, highest value was recorded at 4th week of lactation, followed by animals at 5 th week of lactation and the lowest weight was recorded at 8th week. The values for fat is higher than the values of protein. Protein had a higher significant value at 8th week and the lowest value was recorded at 5th week. Fat had a higher significant value at 6th week and having lowest value at 7th week and lactose having the lowest value at 3rd week. Ash had a higher significant value at 8th week and the lowest value at 4th week. According to Tovar-Luna *et al.*, (2010) efficiency of use of dietary metabolizable energy for lactation differed among stages of lactation and was greater for the higher concentrate diets. However, the recovered energy in tissue gain was similar among stages of lactation and between diets. Early lactation is a critical time for does because they need to be challenged but dry matter intake lags behind the milk demand. However, mid lactation should coincide with peak dry matter, which is approximately equal to nutrient requirements for milk production (Lawal *et al.,* 2021). In late lactation, however, grain feeding should be equal to milk production when fed along with *ad libitum* good quality hay or forage.

Table 2 showed the cost benefit analysis of WAD goats reared under management systems. Result of total feed consumed indicated no significant ($p > 0.05$) effect among management systems. Goats in intensive system showed a higher value while goats reared under extensive system showed a lesser value. Cost of feed consumed was significantly ($p < 0.05$) highest in intensive system because more feed was consumed and the cost per kg feed was significantly ($p < 0.05$) higher. Benefit per kg live weight showed significant ($p < 0.05$) effect among management systems. The highest benefit recorded though gave the cost per kg feed as the does in semi-intensive system also recorded best ($p < 0.05$) total weight. The cost-benefit ratio (CBR) shows significant ($P<0.05$) difference among the management systems reported by growing WAD goats managed under semi-intensive system could be more beneficial. In this study, the cost of producing feed for the experimental goats decreased from intensive to extensive system. This significant ($p<0.05$) decrease in the cost of producing feed for the animals may be attributed to the inclusion of alternative feedstuff in the diets (Tona *et al.*, 2015). The economic analysis of the research showed a gross farm income of #9,789.67 from intensively managed, #8,534.60 from semi-intensively managed and extensively managed which implies that the animal managed under semi-intensive system was a profitable venture. The highest turnover was obtained with semi-intensive system.

Table 1: Effect of week of lactation on chemical composition of West African dwarf goat milk

	Week									
Parameter	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**SEM**	**p-value**
Doe weight (kg)	11.84^{cd}	11.90^{cd}	12.90^{bc}	15.80^{a}	13.51^{b}	11.67^{cd}	13.08^{bc}	11.30^{cd}	0.35	0.003
Protein **(%)**	3.16^{ab}	3.06^{ab}	3.63^{ab}	2.93^{ab}	2.79^{b}	3.10^{ab}	3.42^{ab}	3.73^{a}	0.41	0.021
Fat **(%)**	4.95^{ab}	5.15^{ab}	5.46^{ab}	4.68^{b}	4.72^{b}	5.47^{ab}	4.63^{b}	5.09^{ab}	0.35	0.014
Lactose **(%)**	6.19^{ab}	5.94^{ab}	5.11^{b}	5.65^{ab}	6.81^{ab}	7.48^{a}	6.36^{ab}	6.41^{ab}	0.41	0.001
Ash **(%)**	0.76^{a}	0.64^{a}	0.68^{a}	0.60^{a}	0.63^{a}	0.67^{a}	0.66^{a}	0.84^{a}	0.33	0.000
Total solid **(%)**	14.62^{ab}	14.34^{ab}	14.43^{ab}	13.66^{b}	14.70^{ab}	16.17^{a}	14.51^{ab}	15.18^{ab}	0.47	0.001
SNF **(%)**	10.27^{a}	10.32^{a}	9.80^{a}	8.70^{a}	9.73^{a}	10.70^{a}	9.88^{a}	10.10^{a}	0.46	0.000

ab Means on the same row having different superscripts are significantly ($p< 0.05$) different
SEM - Standard error of the mean,
SNF - Solid-non-fat

Table 2: Effect of management systems on cost benefit analysis of WAD goats reared under intensive, semi-intensive and extensive management systems.

	Management system				
Parameter	Intensive	Semi intensive	Extensive	SEM	p-value
Total feed consumed (kg)	43.21	41.73	22.00	0.37	0.13
Cost of feed consumed (#)	9010.15[a]	7977.94[b]	3100.00[c]	867.5	0.03
Cost/ kg feed (#)	208.52[a]	191.18[b]	140.91[c]	15.58	0.01
Benefit/kg live weight gain (#)	9789.67[a]	8534.60[b]	2768.77[c]	266.5	0.02
Cost-benefit ratio	1.92[b]	1.99[a]	1.12[c]	0.04	0.01

[ab] Means on the same row having different superscripts are significantly ($p< 0.05$) different
SEM - Standard error of the mean

CONCLUSION

Following from this study,

- It showed that farm animals can benefit from adequate semi-intensive management system.
- Week of lactation showed the highest significant effect on Ash and solid-non-fat.
- Cost benefit analysis recorded the least cost-benefit ratio in extensive system and the Cost benefit analysis was better when goats were reared under semi-intensive system.

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