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Research article

Supplementation with Concentrate in Private Ranches Improves the Milk Production of Lactating Cows in Sub Humid Zone of Nigeria

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Abstract
This study examines the nutritive value of concentrate supplements fed to dairy cattle in private ranches within the sub humid zone (Adamawa) of Nigeria. Data was collected using Thirty five (35) well-structured questionnaires administered to the respondents. The questionnaire comprised of questions on the history, production system and the nutritive value of concentrate supplements fed to the lactating cows on the ranches. The result showed that amongst the breeds found the proportion of those in lactation were Sokoto Gudali (23.4%), followed by White Fulani (22.6%). The production system practiced was extensive or semi-intensive 71.4% each, the basal diets fed were from grazing of sown pasture or silage (71.4%), hay or haylage (57.1%), the time frame the ranches offer concentrate diet to the dairy cows was evening (40%) and morning & evening (40%). Majority of the farms (71.4%) practiced hand milking while milking was done once or twice (50%). The production constraints recorded include high cost of concentrate feed (66.6%), low milk yield and low milk market price (16.6%). The measures suggested to improve milk production were supplementing with concentrate (85.7%), control of health issues (57.1%), good hygiene practice and up-grading breeds (42.9%). The supplemented group was higher in milk yield than the un-supplemented group. It can be concluded that Sokoto Gudali and White Fulani are the main indigenous breeds of cows kept by the private ranches and the basal diet fed was grazing and silage. The increase in milk yield was 318% for dry season and 358% for wet season higher than the un-supplemented cows which revealed that the un-supplemented cows were in poor plane of nutrition since supplementation resulted in increase in milk production. It is recommended that the private ranches should practice intensive system, establish improved pasture, and continue with silage and supplement morning and evening to get better results.

Introduction

Livestock satisfy a variety of human needs (Chauhan & Gosh, 2014). According to FAO (2019), the livestock sector is an essential part of agriculture and crucial to the socio-economic development of Nigeria though its productivity is very low; it contributes 1.7% to the national GDP and 9% to the agriculture value added. Nigeria plays an important role in the livestock economy of Africa (Oni, 2006).

The basal feed resources available for ruminants in most developing countries are crop residues, native and sown pasture, browse plants and/or agro-industrial by-products which are low in protein and digestibility (Leng, 2011). Olaloku and Debre (2011) reported that inadequate feed supply is still a major constraint to sustainable cattle production in general, and milk production in particular. Concentrate is given as supplements in addition to the roughage in the cow's diet to provide the essential energy and protein that dairy cows need to meet the maintenance and production requirements (Peyraud, 2001), and profitability (Bargo, Muller, Delahoy & Cassidy, 2002).

Generating and meeting the national needs in dairy products in Nigeria will take future decades because Food and Agriculture Organization (FAO, 2010) stated that Nigerian dairy sector is primarily conditioned by demand situation. Instead of taking advantage to invest in dairy farming, the gap is usually bridged by mass importation of dairy products into the country. Nutritional challenges facing ruminant livestock is due to fluctuating nature of feed between wet and dry seasons which interferes with the production potential of livestock in the seasonally dry tropics (Muhammad, 2008). The deficit is to

be met by supplementation. Unfortunately, conscious effort to supplement for increasing milk production is not a common practice. Supplementing forage-based diets with concentrates can improve rumen fermentation, fibre digestibility and forage intake (Peyraud, 2001).

Reports on incremental level of supplementation with either protein or energy concentrates to increase milk production is paucity, hence the need to bridge the gap. This study therefore, examines the nutritive value of concentrate supplements fed to dairy cattle in private ranches within the sub humid zone.

Materials and Methods

Description of the study area

The study was conducted in the sub humid zone (Adamawa State) of Nigeria. The zone covers 455,000 km^2 and lies within longitude 3^o 00' to 12^o 31'E and latitude 7^o 00' to 11^o 31'N. The area is characterized by tropical wet and dry climate. The wet season has an annual rainfall ranging between 1000 to 1500mm with growing season from 180 to 300 days per year (Mohamed-Salem, 2014). Mean daily temperature and relative humidity during the wet season are 25°C and 72% and ranges from 14 to 36°C and 20 to 37% respectively during the dry season (Denton & Ogunkunle, 2014). Much of the zone is transitional between unimodal and bimodal rainfall distribution (Mohamed-Salem, 2014; Denton & Ogunkunle, 2014).

Diagnostic survey

A diagnostic survey was conducted in private dairy cattle ranches within the sub humid zone of Nigeria. The study examined the types of concentrate supplements offered and milk production of the dairy cattle in the ranches. Purposive sampling technique was used in the selection of the farms in the study area based on the accessibility to the farms, availability of at least 5 lactating dairy cattle and supplementation of lactating cattle with concentrates. Thirty-five structured questionnaire were administered to 7 farms (5 to each farm). The questionnaire comprised of questions on the history, production system and the nutritive value of concentrate supplements fed to the lactating cows on the ranches.

Data collection

Data collected was on the breeds of cattle, type of concentrate, frequency, season and time of supplementation, yield of milk obtained and constraints of production.

Statistical analysis

Data generated was analyzed using Descriptive Statistics of SAS (2003). The data was compared for supplemented and non-supplemented groups using T-test.

Results

Breeds of cattle and number of lactating cows kept on the private ranches

Table 1 presents the breeds and number of lactating cows on the surveyed private ranches in the sub humid zone of Nigeria. The assorted crosses had higher percentage (71%) of breeds, followed by Sokoto Gudali (14.1%). Amongst the breeds found the proportion of those in lactation were Sokoto Gudali (23.4%), followed by White Fulani (22.6%) and crosses (12.9%) with an overall average of 14 cows.

Management activities on the private ranches

The management activities noted (Table 2) in all the ranches surveyed, the production system practiced was intensive or semi-intensive 71.4% each. The basal diets fed to the dairy cows on the farms were from grazing of sown pasture or silage (71.4%) and hay or haylage (57.1%). The time frame the ranches offer concentrate diet to the dairy cows was evening (40%) and morning & evening (40%). Majority of the farms (71.4%) practiced hand milking while milking was done once or twice (50%) daily.

Constraints and measures of improving milk production on the farms

Table 3 shows the constraints and measures of improving milk production on the private ranches in sub humid zone of Nigeria. The production constraints indicated high cost of concentrate feed (66.6%), low milk yield and low milk market price (16.6%). Supplementation with concentrate (85.7%), control of health issues (57.1%), good hygiene practice and up-grading breeds (42.9%) were the measures suggested to improve milk production.

Nutritive value of the concentrate diet offered to the lactating cows on the private ranches

Crude protein (CP) of the concentrate diet fed to lactating cows managed on selected ranches in sub humid zone of Nigeria is shown on Figure 1. Mean crude protein fed to the cows was 12.64%. The result showed that 71% of the farms' crude protein in the diets was above the mean while 29% was below the mean. The highest crude protein was 17.2% and the lowest was 5.7%.

Energy content (TDN%) of the concentrate diet fed to lactating cows managed on selected ranches in sub humid zone of Nigeria is shown on Figure 2. The mean of the energy content fed to the animals was 64.28%. The result showed that 57% of the surveyed ranches' energy content in the diets was above the mean while 43% was below the mean. The highest energy content was 75.59% and the lowest was 51.84%.

Milk yield from different indigenous cattle breeds and assorted crosses on the ranches

The crosses recorded highest mean milk yield (2.2 litres) than the indigenous breeds (0.7 for White Fulani and 0.8 for Sokoto Gudali) throughout the study period (Figure 3). Higher milk yield (0.9 litres) was recorded in the months of March, April and July for White Fulani. Sokoto Gudali had the highest milk yield (1.0 litre) in April and lowest (0.7) in February, March and May.

Effect of supplementation on milk yield

Table 4 shows the effect of concentrate supplementation on Milk yield (L) of Sokoto Gudali raised in private ranches in sub humid Adamawa. It shows the comparison between supplemented and non-supplemented groups. The supplemented group has the mean of 3.43 litres while the non-supplemented has 0.77 litres. The group was higher in milk yield than the un-supplemented group (Figure 4). The highest milk yield for the supplemented group was in August (3.7 litres) while the lowest is in February (3.1 litres). In the un-supplemented group the highest value (0.8 litres) was in February, March, April, July and August while the lowest value (0.7 litres) is in May and June.

Table 1. Breeds and number of lactating cows as of 2022 on some private ranches in sub humid zone of Nigeria**

Variables	Frequency	Percentage
Number of lactating cows		
Simmental	6 (18)	4.8 (1.6)
Friesian	12 (27)	9.7 (2.4)
Jersey	2 (9)	1.6 (0.8)
Simbrah	15 (24)	12.1 (2.2)
White Fulani	28 (59)	22.6 (5.3)
Sokoto Gudali	29 (156)	23.4 (14.1)
Crosses	16 (783)	12.9 (70.9)

*Figures in parentheses are for total number of cows in the ranches
**Records from 7 dairy farms

Table 2. Management activities in some selected private ranches in sub humid zone of Nigeria

Variables	Frequency	Percentage
Production system practiced*		
Intensive	5	71.4
Semi-intensive	5	71.4
Extensive	2	28.6
Basal diet fed to dairy cows*		
Silage	5	71.4
Hay	3	57.1
Grazing	5	71.4
Haylage	4	57.1
Treated crop residues	1	14.3
Untreated crop residues	1	14.3
Time of offering concentrate diet		
Evening	2	40
Morning & Evening	2	40
Adlibitum	1	20
Method of milking		
Hand milking	4	71.4
Hand & machine milking	2	28.6
Frequency of milking		
Once	3	50
Twice	3	50

*Multiple responses

Table 3. Constraints and measures of improving milk production on some selected dairy farms in sub humid zone of Nigeria

Variables	Frequency	Percentage
Constraints of milk production		
High cost of concentrate feed	4	66.6
Low milk market price	1	16.6
Calves stay with dams throughout	1	16.6
Measures to improve milk production*		
Control of health issues	4	57.1
Good hygiene practice	3	42.9
Supplementing with concentrate	6	85.7
Up-grading breeds	3	42.9

*Multiple responses

Table 4. Effect of concentrate supplementation on Milk yield (L) of Sokoto Gudali raised in private ranches in sub humid Adamawa

Treatments	Mean ± SE
Supplemented	$3.43^{a} \pm 0.11$
Non-supplemented	$0.77^{b} \pm 0.02$
LSD	0.246

Means in the same column with different superscripts are significantly different ($P<0.05$).

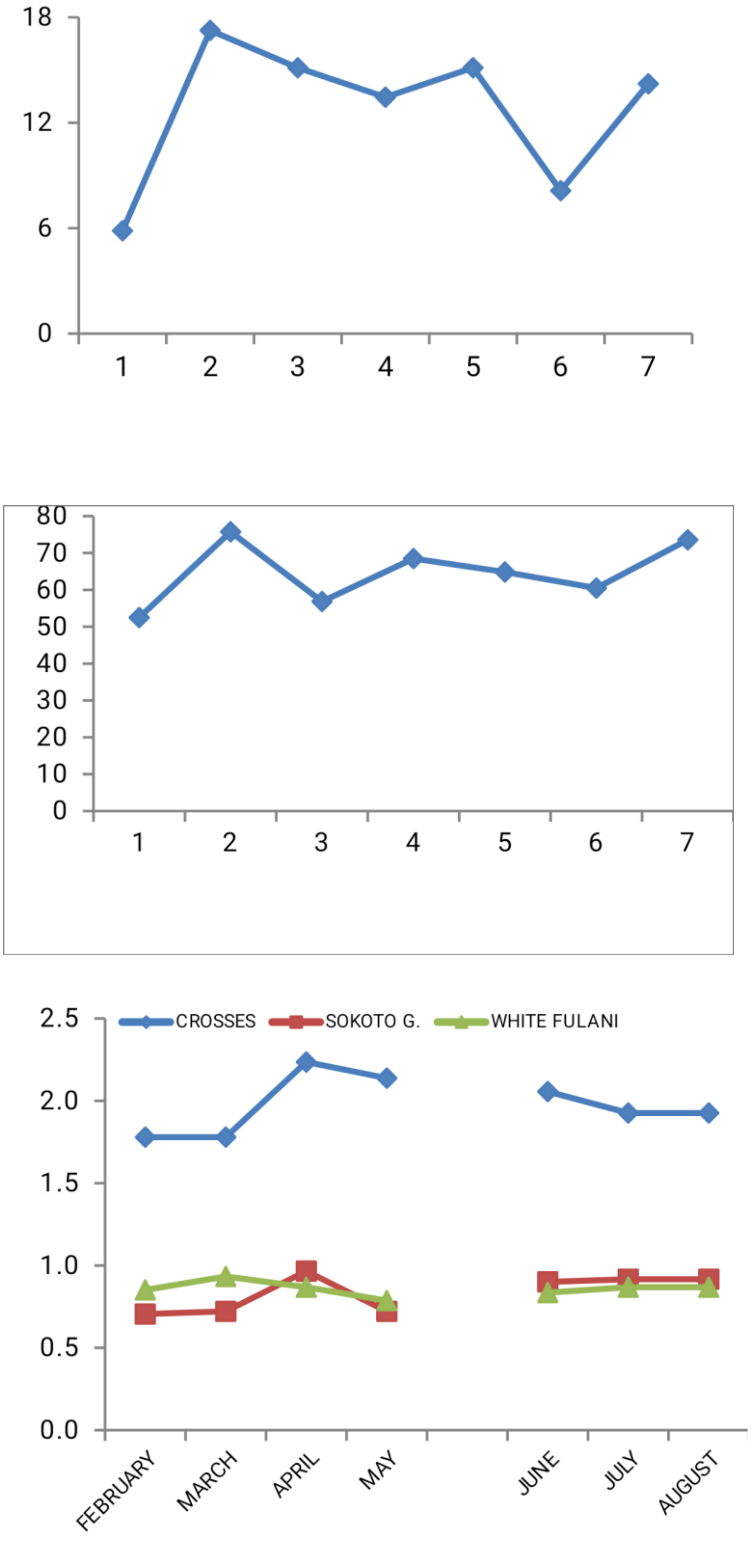

Figure 3. Milk yield of Sokoto Gudali, White Fulani and crosses bred cows raised in private ranches during dry and early wet season in sub humid zone of Nigeria

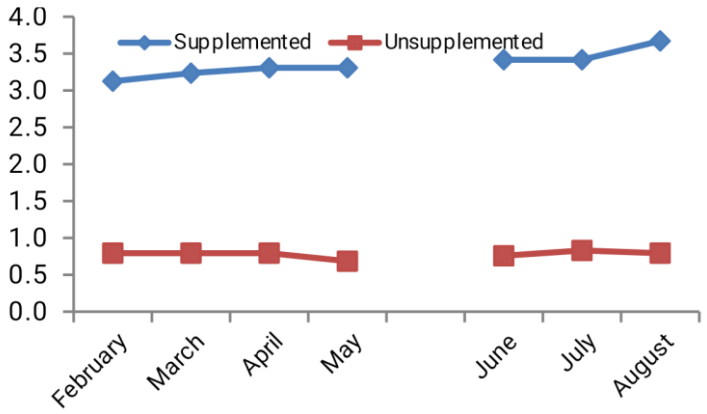

Figure 2. Effect of supplementation on Milk yield from Sokoto Gudali raised under farm condition during the late dry and early wet sesaons in the sub humid zone of Nigeria

Discussion

Breeds of cattle and number of lactating cows kept on the private ranches. The general assertion is that exotic breeds are better than indigenous even when raised out of their areas of origin provided they are managed under a mimicked production system. However, contrary report indicated that exotic breeds are less adapted to African conditions and are more susceptible to endemic diseases and environmental stress, additional labour and capital requirements (Bebe *et al.*, 2003; Bayer and Wanyama, 2005). Data obtained from the present study revealed the assorted crosses were higher in preponderance followed by Sokoto Gudali, Ngaundere and White Fulani while the proportions of those in lactation were higher in Sokoto Gudali followed by White Fulani then the crosses. This result agrees with that of Hanga (2017) who reported highest percentage of crosses in ranches in Kano; but it differs from that of Hassan & Mohammed (2001); Shittu *et al*. (2008) & Nasiru (2006) where Sokoto Gudali was the breed with highest percentage.

Management activities on the private ranches. The production system practiced in the present study was the semi-intensive system which tally with the result of Hassan & Mohammed (2001), Shittu *et al*. (2008), & Hanga (2017) & Shamsuddeen *et al*. (2021). This may be attributed to the expensive nature of the intensive type of management practices. The basal diet fed to the animals by most of the farms in this study was grazing and silage followed by hay and haylage. This agrees with the result of Milligo *et al*. (2008), Moges (2015) & Belew (2009). Hand milking was the method of milking practiced by most of the ranches in this study which is similar to that of Hassan & Mohammed (2001) & Shittu *et al*. (2008). The frequency of milking was once in most farms in the study and this goes the same in the study by Hassan & Mohammed (2001) & Nasiru (2006).

Constraints and measures of improving milk production on the private ranches. The major constraint of milk production in majority of the farms found in this study was high cost of concentrate feed which is similar to the study by Hassan & Mohammed (2001), Shittu *et al*. (2008) & Belew (2009). Crude protein and Energy content of the concentrate diet offered to the lactating cows on the private ranches Proper crude protein is essential in diets of livestock. When the percentage of crude protein is low, the bacteria responsible for degradation cannot sustain adequate levels to process forage. The results in this study agreed with the NRC recommendation which reported CP contents between 16.5 and 17.5% supply the protein requirements of early lactation dairy cows under most conditions; dietary CP should be equal or below 16.5% as cows advance into the 2nd half of the lactation.

The highest crude protein of the concentrate diet found in this study (17.2%) was higher than the 6.08 to 16.4% by Ndubueze, Ukachukwu, Ahamefule & Ibeawuchi (2006); Olafadehan & Adewumi (2010); Olafadehan, (2010); Olorunnisomo & Ibhaze (2013) and Olorunnisomo (2017). Furthermore, crude protein percentage in the diet has been implicated in milk production. Feeding energy diet improves the digestibility of the main nutrients of the diet and increases milk production and its quality (Sycheva, Yunusova, Pastukhov & Popov, 2021). The highest energy content of the concentrate diet found in this study (75.59%) was higher than the 57.7% by Kamal, Iqbal & Khaleduzzaman (2009) and lower than the 77% by Lehman, Meeske & Cruywagen (2007).

Milk yield from different indigenous cattle breeds and assorted crosses on the private ranches. Generally, the milk yield increased in the month

of April and decreased gradually throughout the wet season for the crosses. For Sokoto Gudali and White Fulani, the pattern increased slightly in the late dry season, decreased slightly in the early wet season and increased slightly in the late wet season. The milk yield for the crosses was higher and more than double the milk of White Fulani (133%) and Sokoto Gudali (149%) in the dry season. It was also more than double compared to milk from White Fulani (128%) and Sokoto Gudali (118%) in the wet season.

The highest average daily milk yield recorded in this study for the crosses and White Fulani cow was lower than the 6.5L/day and 2.37L/day reported by Shamsuddeen *et al*. (2021). Also the highest daily milk yield (1.0L) for Sokoto Gudali was lower than the 3.5L obtained by Coffie, Annor, Kagya-Agyeman & Bonsu (2015). The observed differences might be due to their genetic potential and environmental effects.

Effect of supplementation on milk yield. From this study, it could be seen that supplementation had improved milk production even though the milk yield was not up to optimum level. The increase in milk yield was 318% for dry season and 358% for wet season higher than the un-supplemented cows. This revealed that the un-supplemented cows were in poor plane of nutrition since supplementation resulted in increase in milk production. Furthermore, lactation is the highest nutrient demanding activity therefore; supplementation resulted in increase in milk production indicating the optimum is yet to be attained. This present finding agrees with that of Olafadehan (2010) who obtained higher milk yield due to feeding of supplements to cattle. Consumption of cowpea fodder by lactating White Fulani cows improved daily milk yield over the control by more than 30% (Akinlade *et al*., 2005).

Conclusion and Recommendation

From the results of this study, it can be concluded that Sokoto Gudali and White Fulani are the main lactating cows kept by the private ranches. The production system practiced was the semi-intensive and extensive; the basal diet fed was grazing and silage, time of feeding was morning or morning and evening, hand milking was practiced and the frequency of milking was once or twice. The major constraint of milk production was high cost of concentrate feed. The crude protein percentage and energy content in the farms' diets has been implicated in milk production. The increase in milk yield was 318% for dry season and 358% for wet season higher than the un-supplemented cows. Despite the constraints of milk production outlined by the respondents, concentrate supplementation has great potential in improving milk production. It is therefore recommended that the private ranches to: practice intensive system, establish improved pasture, continue with silage and supplement morning and evening to get better results.

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