FUDMA Journal of Agriculture and Agricultural Technology
ISSN: 2504-9496
Vol. 9 No. 3, September 2023: Pp. 58-62
https://doi.org/10.33003/jaat.2023.0903.09

EFFECT OF GRADED LEVELS OF CONCENTRATE SUPPLEMENTION ON MILK YIELD AND COMPOSITION OF GRAZING WHITE FULANI COWS. IN MAYO-BELWA SUB-HUMID, NIGERIA

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ABSTRACT

A 98-day feeding trial was conducted at Sebore Farm along Mayo-Belwa-Ngurore road, Mayo-Belwa Local Government Area (LGA) of Adamawa State to determine the effect of graded levels of concentrate supplementation on milk yield, milk composition, body conformation and live weight changes of White Fulani cows. The objective of this study was to determine the extent to which supplementary feeding improves milk yield and quality of lactating White Fulani cows grazed on mixture of *Andropogon gayanus* (Gamba grass) and *Panicum maximum* (Guinea grass). Twelve White Fulani cows weighing average of 250±2.217kg with average age of 5±1.5 years between 2nd and 3rd lactations, were subjected to four dietary treatments: T_1 (control), T_2 (3kg concentrate), T_3 (4kg concentrate) and T_4 (5kg concentrate) per head per day. The treatments consisted of three replicates in a randomized complete block design (RCBD) experiment. Milk yield was measured with a cylinder which is graduated in litres. The chemical composition of milk was carried out to determine milk protein, fat, total solids, ash vitamins, minerals, pH and density. The live-weight changes were calculated by subtracting the initial weight from the final weight. The result indicated that milk yield was significantly ($P<0.05$) different among treatments with T_4 showing the highest milk yield of 1.89±0.059 litres per day while T_1 had low values of 0.78±0.013 litres per day. The live-weight changes showed a significant ($P<0.05$) increase with increasing level of supplementation up to 4kg at (T_3) but there was no significance ($P>0.05$) difference between treatments 3 and 4. T_2, T_3& T_4) had significantly ($P<0.05$) improved milk yield and live weight gain than the control. The study revealed that supplementary feeding of grazing White Fulani cows with concentrate was beneficial. Treatment 4 with 4kg supplementation is therefore recommended based better on milk yield and live-weight gain

Keywords: Supplementation; White Fulani; Concentrates; Milk yield; composition

INTRODUCTION

The basal feed resources available for ruminants in most developing countries are crop residues, pasture from infertile land, or agro-industrial by-products. These are low in protein and digestibility (Leng, 2011). Olaloku and Debre (2010) reported that inadequate feed supplies remain a major constraint to sustainable cattle production in general, and milk production in particular. Many tropical and subtropical countries are importing exotic breeds of dairy cattle or upgrading local types in an attempt to meet the local demand for milk and milk products. However, imported animals rarely achieve the levels of production that they show in their original habitats.

Nutrition seems to be the major factor limiting the productive and reproductive performance of such animals (El-Tayeb and Takia, 2010). Practical strategies for improving milk production of dairy animals depend on supplementation that optimizes both fermentative digestion in the rumen and the efficiency of metabolism of absorbed nutrients (Leng, 2011). Supplementing forage-based diets with concentrates can improve rumen fermentation, fibre digestibility and forage intake (Peyraud, 2001). Furthermore, supplementary feed in the form of cereal grain results in increased yield and quality of milk fat and milk protein (Bargo, Muller, Delahoy & Cassidy, 2003).

The objectives of this study are to determine the effect of graded levels of concentrate supplement on milk yield and composition of grazing White Fulani cows grazed on mixed pasture (Gamba and Guinea grass).

MATERIALS AND METHODS

Description of the study area

The study was conducted at Sebore Farms (latitude 8ºN to 11ºN and longitude 11.5ºE to 13.5ºE). The location has Northern Guinea savanna vegetation type of tropical climate with a mean temperature of 32ºC. The zone has distinct dry and wet seasons. The wet season has an average rainfall of 900 to 1000mm. The soil is generally sandy-loam with clay in Fadama areas. The common arable crops grown in the zone include maize, sorghum, millet, rice and groundnut and the common livestock species include cattle, sheep and goat (Weather Spark, 2023).

Experimental procedures

Ninety-eight day trial was conducted using twelve (12) White Fulani cows with an average weight of 250±2.217kg in their 2nd and 3rd parity. The animals were managed in a semi-intensive production system. Four dietary levels of concentrate inclusion were allotted in a Randomized Completely Block Design (RCBD). T_1 was 0kg (control), T_2 was 3kg; T_3 was 4kg and T_4 was 5kg per head per day. Each treatment had 3 replicates comprising of one animal per replicate.. The animals were offered the supplement individually at 6:00am in plastic container. Water and mineral licks were made available to the animals *ad libitum.* The animals were sent out for grazing at 8:00am after milking and returned to their pens at 6:00pm. The grasses grazed were mixtures of *Panicum maximum* (Guinea grass) and *Andropogon gayanus* (Gamba grass) at late vegetative to early bloom stages of maturity. The gross composition (%) of the experimental supplement was: 55% maize, 25%

cottonseed cake, 15% soybean meal, 2% di-calcium phosphate, 2% premix, 1% molasses.

Milk yield and composition

Partial milking was carried out in the morning when calves sucked briefly to induce milk let-down. Before milking, the cows were restrained and the udders washed with disinfectant. Thereafter, the milking was done manually (hand milking). The daily milk was collected in a cylinder which is graduated in litres where it was measured and recorded. Thereafter, 20mL sample was taken for determination of proximate composition. The fat content was analyzed by Gerber method. The fat was separated from other milk components by adding sulfuric acid. The separation is facilitated by using amyl alcohol and centrifugation. The fat content was read directly using a special calibrated butyrometer. Total solids (TS) was determined by first evaporating 4g of milk sample over a boiling water bath (100^0C) for 30 minutes and then oven dry to a constant weight. The total solids content of milk was the weight of dried milk expressed as a percentage of the original milk weight. Total nitrogen was obtained by the Kjeldahl method and the result multiplied by 6.25 to give milk protein. Total ash was estimated by heating 10g of at a temperature of 500^0C. The pH and density were determined using pH meter and hydrometer, respectively. Milk lactose was determined by colorimetric method. The water-soluble vitamins were determined by high performance liquid chromatography. The fat-soluble vitamins were determined by fluorescence at room temperature in an aqueous media of micellar solutions. Non-suppressed ion chromatographic determination was used for minerals determination (AOAC, 2005).

Proximate composition of experimental diet

Total nitrogen was obtained by the Kjeldahl method and the result multiplied by 6.25 to give crude protein, dry matter, ash, crude fibre, ether extract and nitrogen-free-extract (NFE) as described by AOAC (2002). Metabolizable energy of the feeds used was calculated as ME = 37 x %CP + 81 x %EE + 35.5 x %NFE (AOAC, 2002).

Statistical analysis

All record collected were subjected to statistical analysis using the General Linear Model of Completely Randomized Complete Block Design provided in SAS (2003). Difference between Means was compared using Least Significance Difference (LSD) at P = 0.05.

RESULTS AND DISCUSSION

Chemical composition of the forage grasses

The chemical composition of the forage grasses as sole and in mixed pasture and the fed concentrate are presented in Table 1.

Table 1. Chemical analysis of the experimental diet

Constituents (%)	Guinea grass	Gamba grass	Mixed pasture	Concentrate
Moisture	74.30	89.18	81.74	2.69
Dry matter (DM)	25.70	10.82	18.26	97.31
Crude protein (CP)	7.80	8.75	8.28	22.50
Crude fibre (CF)	33.40	29.13	31.27	13.13
Ether extract (EE)	1.40	10.36	5.88	10.06
Ash	12.40	5.99	9.20	16.50
Nitrogen-free-extract (NFE)	45.20	45.70	45.45	36.00
Calcium (Ca)	0.21	0.27	0.24	0.31
Phosphorus (P)	0.04	0.07	0.06	0.08
ME (Kcal/Kg)	2006.60	2785.26	2395.93	2954

Milk pH and density

Table 2 shows the milk pH and density of White Fulani cows razed on mixed pasture and fed varying levels of concentrates. Values of milk pH varied from 6.70 to 6.80, which is in accordance with the pH value of 6.6 to 6.7 as reported by Aduku and Olukosi (1991). The pH obtained were at the boarder of the upper limit recommended pH values. This reveals that freshly drawn milk is low in acidity which may be due to the presence of carbon dioxide, citrate and casein as reported by Banerjee (2009). Values for density were similar for all the treatments. The density was 1.03g/cm^{3}which agreed with the results of Puneet *et al.*, (2020) who reported milk density to be 1.025-1.035.g/cm^3 in Holstein-Friesian cows.

Table 2: Milk pH and density of White fulani cows fed concentrate levels

Parameters	T_1	T_2	T_3	T_4
pH	6.70	6.75	6.80	6.78
Density (g/cm^3)	1.03	1.03	1.03	1.03

T_1 = Treatment 1, T_2 = Treatment 2, T_3 = Treatment 3 and T_4 = Treatment 4

Milk yield and composition

Table 3 presents the results of milk yield and chemical constituents of milk from White Fulani cows grazed on mixed pasture supplemented with varying levels of concentrate. Milk yield differed significantly (P<0.05) increasing from 0.78±0.013 in T1 to 1.89±0.059 litres in T4 treatments. The increase in T_2 was 59%, T_3 was 142% and T_4 was 69% higher than the nonsupplemented cows. The improvement of milk yield was due to supplementation with graded levels of concentrates which could be attributed to improved plane of nutrition of the grazing dams. This revealed that the animals were in poor plane of nutrition since increase in supplement resulted in increases in milk production and live weight gain of the dam. Furthermore, lactation is the highest nutrient demanding activity and as such, increase in the 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. Similarly, Akinlade *et al.* (2005) obtained more milk from cowpea cultivars supplementation of lactating Bunaji cows. Milk yield obtained from this study was in agreement with the report by Muhammad *et al.* (2006) who obtained increased in milk yield from Bunaji grazed on *Sorghum almum*. Evidently, results obtained by previous researches reported increase in milk with increase in supplementation.

Total solids, fat, protein, ash and lactose did not manifest any significant effect as a result of increase in level of concentrate supplementa9tion. As shown in table 3, values for total solids ranged from 9.0±0.153 to 9.2±0.85

0% which is below the range reported by (Ahamefule *et al*., 2003) for the same breed. The value was also below the range of values reported by Ndubueze *et al*. (2006). The Total Solids recorded in this study is also below the values recorded by Akinlade *et al.* (2005). This might be due to differences in nutrition and management.

The values for fat was higher in T_3 (4.3±0.404%) and least in T_1 (3.7±0.987%) with a mean of 3.9%. The milk fat recorded in this work was similar with the results of Taylor & Field (2004), Damron (2009) and Banerjee (2009). The result showed animals in good nutrition give better milk quality.

Milk protein was higher in T_2 & T_3 (3.9%) and significantly different (P<0.5)) among treatments. The value of the protein obtained in this study was higher than that reported by Alemede and Sadiq (2008) but in agreement with the repor for White Fulani cows by Ndubueze *et al.* (2006). The milk protein obtained in the present study is in agreement with the recommended range (3.1-3.9%) in cow.

Highest value for lactose was 6.3%±0.333 in T_4 and the least was 4.5%±0.100 in T_1 and are higher than the value reported by Ezekwe and Machebe (2005) who studied milk yield and composition of Muturu cattle under the semi-intensive system of management. For ash, T_3 and T_4 had the same values (4.6%) while that of T_1 and T_2 was 4.5%. These values do not agree with the values reported by Aminu (2006) who studied milk yield and composition of different indigenous breeds of cattle under traditional management system.

Vitamins (water soluble) were not influenced by the treatments applied (P>0.05). Fat soluble vitamins (E and K) showed significant variation (P<0.05) but the pattern was not consistent with increase in concentrate level. Macro nutrients (Ca, P, K, Mg and Na) were influenced by the treatments evaluated but no defined trend was noted due to linear increases in concentrate supplementation. The variations in mineral composition of milk were 131.4±0.458 to 141.7±0.400mg/100g for calcium, 45.4±0.61 to 52.3±0.529mg/100g for sodium, 142.5±0.603 to 184.0±0.498mg/100g for potassium, and 12.8±0.208 to 14.0±0.289mg/100g for magnesium. Values obtained in the present study are in the same range with the values reported by Zamberlin *et al.* (2012) for cow milk. The mineral concentrations in the milk obtained met the recommended daily allowances for calcium (200-1300mg/100g), magnesium (30-420mg/100g), phosphorus (100-1250mg/100g), potassium (400-5100mg/100g) and sodium (120-1500mg/100g) according to the Institute of Medicine (2011) as cited by Zamberlin *et al*, (2012).

Table 3: Milk yield and chemical composition of White Fulani cows fed varying concentrate levels

Parameters	T1	T2	T3	T4
ADMY (L)	$0.78±0.013^{c}$	$1.24±0.016^{b}$	$1.89±0.059^{a}$	$1.32±0.024^{b}$
Total solids (%)	$9.0±0.153^{a}$	$9.1±0.850^{a}$	$9.2±1.004^{a}$	$9.0±1.015^{a}$
Fat (%)	3.7±0.987	4.0±0.153	4.3±0.404	3.8±0.448
Protein (%)	$3.5±0.173^{bc}$	$3.9±0.120^{ab}$	$3.90.033^{a}$	$3.4a±0.115^{c}$
Lactose (%)	$4.5±0.100^{b}$	$4.7±0.088^{b}$	$5.1±0.100^{b}$	$6.3±0.333^{a}$
Ash (%)	4.5±0.153	4.5±0.500	4.6±0.219	4.6±0.252
Vitamin A (IU)	1245.6±98.5	1322.7±13.313	1325.6±52.272	2507.8±1201.1
Vitamin B (mg/ what?)	9.27±0.584	9.6±0.467	8.83±0.120	10.06±0.233
Vitamin C (mg)	8.5±1.153	9.2±0.458	8.4±0.231	7.9±0.186
Vitamin D (mg)	41.5±0.404	38.6±2.200	40.2±0.635	39.6±0.208
Vitamin E (mg)	$0.25±0.006^{b}$	$0.3±0.012^{a}$	$0.2±0.005^{b}$	$0.3±0.025^{a}$
Vitamin K (mg)	$44.3±2.425^{b}$	$50.1±0.153^{a}$	$38.6±0.058^{c}$	$36.7±0.351^{c}$
Sodium (mg/100g)	$45.4±0.611^{a}$	$48.2±0.833^{b}$	$46.7±0.202^{bc}$	$52.3±0.529^{a}$
Potassium (mg/100g)	$151.2±0.300^{c}$	$154.2±0.300^{b}$	$142.5±0.603^{d}$	$184.5±0.498^{a}$
Phosphorus (mg/100g)	$96.2±0.252^{a}$	$91.2±1.462^{b}$	$97.5±0.577^{a}$	$90.8±1.473^{b}$
Calcium (mg/100g)	$131.4±0.458^{c}$	$134.8±1.976^{b}$	$121.3±0.208^{d}$	$141.7±0.400^{a}$
Magnesium (mg/100g)	$13.2±0.529^{ab}$	$13.5±0.351^{ab}$	$14.0±0.289^{a}$	12.8±0.208

Means with the same letters are not significantly different

T_1 = Treatment 1, T_2 = Treatment 2, T_3 = Treatment 3, T_4 = Treatment 4, ADMY = Average Daily Milk Yield

Live weight changes

Figure 1 presents the average daily live-weight gain of lactating White Fulani cows grazed on Gamba and Giunea grasses (mixed pasture) supplemented with concentrates at graded levels. Treatment 4 had the highest live-weight gain (5±1.667kg) followed by treatment 3 with 4±2.517kg (P>0.05). Treatment 1 had a significantly lower weight gain (3±0.577kg) compared to the supplemented cows. At the end of the experiment, the average daily live weight of cows on T_3 and T_4 were similar and were higher than that of cows on T_1 and T_2. El-Tayeb *et al.* (2011) found that live weight increased as the rate of concentrate supplementation increased. The improved performance of the animals on the supplemented diets also agrees with the assertion of Vazquez *et al.* (2000) that energy-protein balance of a ration enhances live weight gain. From the present study, it was found that for every one (1) unit of supplement taken, there was a correspond 0.09 unit of weight gain.

Dams constantly increased in live weight as the levels of concentrate increased. The result depicted that the nutrient needs of the grazing animals was deficit. This implied the nutrient needs for maintenance, compensatory weight gain and milk synthesis were perhaps being provided by the supplement fed thus, the responses noted in live-weight gain.

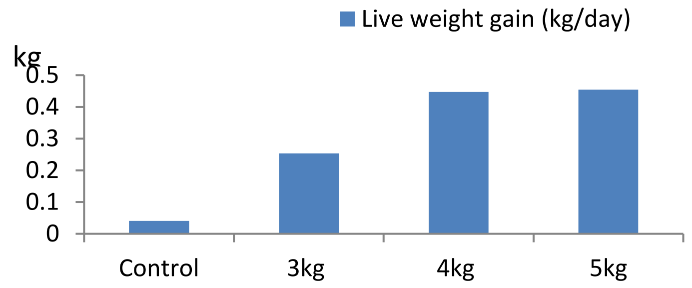

Figure 1. Average Daily Liveweight Gain of Lactating White Fulani Cows grazed on Gamba and Guinea mixed pasture Supplemented

CONCLUSION AND RECOMMENDATION

From the present study, it could be concluded that supplementary feeding of grazing White Fulani cows with concentrate was beneficial. Milk yield and daily live weight gain of the cows increased with an increasing level of supplementation. Treatment 4 with 4kg supplementation is therefore recommended based better on milk yield and live-weight gain

ACKNOWLEDGEMENT

I wish to express my appreciation to my late supervisors, Prof. A. A. Kibon and Prof. A. A. Mubi for their guidance and effort during this study period.

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