Effect of Formulated Concentrate Feeding Level on Milk Yield and Quality among Lactating Friesian Cows

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Abstract

Dairy cattle hold enormous significance to humans as they convert energy stored in indigestible plant mass into milk and meat which are digestible and consumed by man. The dairy sub-sector contributes substantially to the 25% of the GDP from Agricultural sector in Kenya. The most important feature of the sub-sector is its change from large to small scale production features, which constitutes two thirds of total dairy herd. Feeding is an important component of keeping milk production at optimum level. The objective of the current study was to evaluate the effect of allocating different supplementary levels of formulated diet on milk production and composition among five lactating Holstein Friesians. The cows were fed on chopped Napier grass as a basal diet and supplemented with 0, 0.5, 0.75, 1.0, and 1.25 kg/litre of milk produced/cow/day of the formulated diet as treatment 1, 2, 3, 4 and 5 respectively. The formulated diet contained the following ingredients, Male maize line grains, molasses, sunflower husk, soya bean meal, rejected beans, milling maize chaff, cotton seed cake, limestone, di-calcium Phosphate (DCP) and dairy Premix. A sub-sample of the formulated diet was collected and analyzed for, DM, CP, NDF, ADF and Ash. The cows under experiment received a mineral supplement of 100g/day, and clean water provided adlib. Milk yields were taken daily and analyzed for Composition. The milk yields were 4.40, 5.1, 5.70, 6.54, and 7.30L/day for treatment 1, 2, 3, 4 and 5 respectively. There were highly significant ($p<0.001$) differences in milk yields on supplementation levels where 66% increase in milk yield was found at 1.25 kg of supplementation. There was no significant difference in milk composition for all treatment levels of the formulated diet. From this study, it was concluded that formulated ration can be used to improve milk production of dairy animals.

Key words: Formulated ration, Milk quantity, Milk composition, Lactating cows.

INTRODUCTION

The agricultural sector contributes about 25% of the Gross Domestic Product (GDP) and 75% of industrial raw materials (GOK, 2015) and is therefore important for economic growth and development in Kenya. Agriculture accounts for 65% of Kenya's total exports, 18% and 60% of the formal and total employment, respectively.

Animal production is a major economic and social activity for communities living in both high rainfall and arid and semi-arid lands (ASALs). Within the ASALs, it accounts for nearly 90% of the employment opportunities and 95% of family incomes. Animal production contributes about 5.5% of GDP, which accounts for about 22% of the agricultural GDP and over 40%t of farm gate value of agricultural commodities (Agnus *et al*., 2009).

The value of livestock and its products increased from Kshs.38, 895.90 million in 2008 to Kshs. 88,305.3million in 2012 (KNBS 2013). The livestock sub sector has potential to provide adequate supply of all animal products and by-products to meet domestic needs and generate surplus for export.

About 77% of the total dairy cattle population is kept by small scale farmers and account for 80% of the milk produced in Kenya, most of which comes from the highlands (Biwott *et al.*, 1998). In these highlands, feeding of dairy cattle is often based on crop residues and low quality pasture in both protein and energy raising the need for supplementary feeding. Commercial concentrates are limited and expensive, therefore economic alternative has to be found so as to maintain milk production.

The feeding practice of small holder dairy farmers is to give their dairy cows a constant amount of dairy concentrates at 2kg throughout lactation (Biwott *et al.*, 1998). This curtails cows from achieving potential peak milk yield and therefore do not attain maximum milk returns from their inputs. This leads to total lactation yields being significantly lower.

Concentrates are supplemented to cows grazing on pasture to meet nutrient requirement, increase the stocking rate, milk production, maintain body condition and improve the profitability of dairy business (Bargo *et al*., 2003). The level of concentrates fed and the associated response in milk production have a major effect on the profitability of pasture based dairy farming. It is therefore important to determine the optimum level of concentrate supplementation. The milk yield response to concentrates fed to cows on a pasture based system is affected by pasture quality; pasture allowance, nutritional value of the concentrate, and level of concentrate feeding and the genetics potential of the cow (Bargo *et al*., 2003). The milk response per kg to concentrates fed tended to decline as pasture allowance is increased (Grainer & Mathews, 1989) and the level of concentrate feeding is increased (Robaina *et al*., 1998). A high pasture allowance results in poor pasture utilization, lower stocking rates and reduced profit per hectare. The substitution rate by which concentrate replaces pasture is greater at a high pasture allowance and therefore the response to concentrate feeding will be lower (Bargo *et al*., 2003).

Western Seed Company, situated in the Western region of Kenya, in Kitale Town processes and packages grain seed for farmers. They formulated a dairy ration

concentrate using the by-products from their company and others. The objective of the current study was to determine the milk yield and quality from lactating Friesian cows fed on Napier grass and supplemented at varying levels of formulated concentrate diet.

MATERIALS AND METHODS

The current study took place at Kenya Agricultural and Livestock Research Organization (KALRO) Centre, Kitale in Trans Nzoia County. The research Centre is located on the outskirts of Kitale town with an altitude of 1800-1900 m above sea level, temperatures range from 8 to 27 °C and experiences an annual bi-modal rainfall pattern of 1100 to 1200 mm per year. The long rainy season starts from March/April to July/August and the peak is in May, the short rains begin in October and ends in November. December to February is relatively dry months, characterized by scarcity of fodder for cattle (Jaetzold *et al.*, 1983).

The formulation and mixing of the experimental diet was carried out at Western Seed Company where weighing and mixing machines are available. Ration formulation was done using trial and error method with the support of Excel computer application programme. The formulated ration was mixed packed in 50kg bags and labeled Feed Y. The feed ingredients and their quantities were as shown in Table 1. A sample was taken from each bag, mixed and a sub-sampled for laboratory analysis for the amounts of Dry Matter (DM), Crude Protein (CP), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Ash according to methods described by AOAC (2000). Five multiparous lactating Holstein Friesian cows at the same stage of lactation with similar range of milk yield were selected and moved to the experimental pens in a 5 x 5 Latin square arrangement. The five cows were randomly assigned to the four supplementary levels 0.5, 0.75, 1.0, and 1.25Kg/litre of milk produced/day. The fifth treatment received 0 Kg of concentrate supplementation. The experimental animals were preconditioned for seven days both to the diet and the pen conditions. Cows were allowed free access to the basal diet of chopped Napier grass but fed on the formulated concentrate diet during milking. Each cow was given 100gms of Mineral supplement daily, while water was provided *ad libitum.* Each period run for seven days and allowed three days for change-over.

Milk yields were recorded twice daily (Kg) during milking. Milk samples were collected weekly before change-over for determination of Butter- Fat (BF), Protein, Solid Not Fat (SNF) and Density.

The data was subjected to Analysis of Variance (ANOVA) and significant means were separated using Tukeys test.

Table 1: Ingredients of the formulated diet Y

Ingredients	Amount(Kg)
Maize on corn (male lines)	41.6
Mollases	10.0
Sunflower husks	6.0
Soya meal	1.03
Rejected soya beans	6.0
Cotton seed meal	4.0
Dicalcium phosphate	0.8
Limestone	0.5
Dairy Premix	0.07
Total	70.0

RESULTS AND DISCUSSIONS

The nutrient content of formulated diet (FD) and the basal diet (BD) showed that the two feeds were different as shown in Table 2.

Table 2: The nutrient content of the formulated diet (FD) and the basal diet (BD)

Type of Diet	Dry Matter (%)	Crude Protein (%)	Neutral detergent Fiber (%)	Acid detergent Fiber (%)	Ash (%)
FD	90.85	17.82	28.94	11.55	6.83
BD	19.48	5.40	67.45	37.90	0.40

There was highly significant ($p \leq 0.01$) effect of the supplement on milk production among the lactating Friesian cows. Milk increased gradually with increasing level of the diet as shown in Figure 1. The highest increase of 66.03% was recorded when the cows were fed on 1.25 kg of concentrate per litre of milk produced compared to the Control treatment. According to Dutta (2011), dairy cows require special nutritional care and must be given optimum nutrients to realize optimum milk production. This author emphasized the importance of energy, protein, mineral elements and vitamins for milk production.

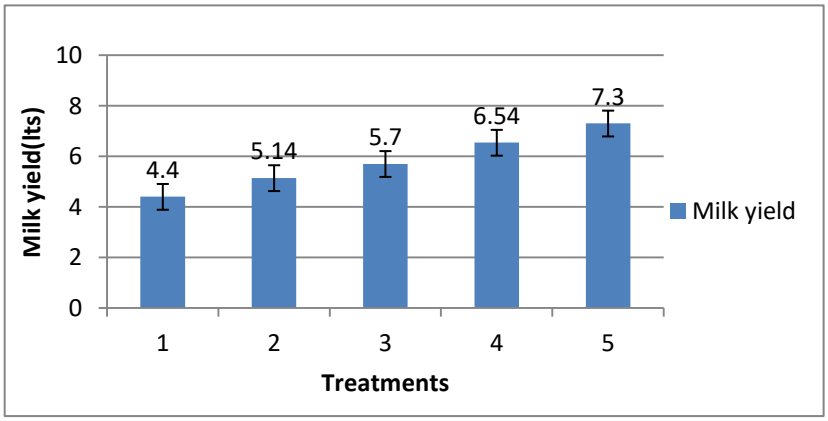

Figure 1: Milk yield at different supplementation levels (lts)

Milk yields in each treatment are shown in the Figure 1. Treatment 4 and 5 produced significantly ($p \leq 0.05$) high amount of milk compared to treatments 1 and 2. Treatment 5 performed ($p \leq 0.05$) better than treatments 1, 2 and 3. The contribution of the concentrate was important and its major component was energy. Energy as the major component has been has been reported to have a great impact on milk yield (Dutta 2011).

The findings presented in this study shows that milk production increased as the level of the formulated diet was increased. Supplementation level of 1.25 kg/l produced mean milk yield of 7.30L of milk per day. Increasing milk yield with increased concentrate feed was also observed by Meeske *et al*, (2006).

Milk quality

The quality of milk from the cows fed on the different supplementation levels is shown in Table 3.

Table 3: Means of Milk Quality from cows fed different levels of supplementation

Treatment	Butter-Fat	Protein	SNF	Density
1(control)	4.46	3.36	8.56	28.85
2	4.52	3.41	8.68	29.49
3	4.64	3.37	8.60	29.07
4	4.51	3.29	8.63	29.29
5	4.51	3.43	8.74	29.71
Mean	4.53	3.37	8.64	29.28
C.V. (%)	8.20	3.80	1.40	1.80
LSD (0.5)	Ns	ns	Ns	Ns

No significant difference ($p \geq 0.05$) in butter fat content in milk from animals fed the different supplementation levels was observed. The mean butter fat contents were 4.46, 4.52, 4.64, 4.51 and 4.51 for treatments 1, 2, 3, 4 and 5, respectively.

The levels of Protein, Solid Not Fat (SNF) and density in milk from the cows fed on the different supplementation level were not different as indicated in Table 3. There was no significant change in milk composition from cows fed on different supplementation level of the concentrate. Similar findings were also reported by Faverdin *et al.* (1991) who found no significant effect of concentrates on the butter-fat and protein content of the milk.

CONCLUSION AND RECOMMENDATION

The feeding of formulated diets resulted in increased milk yield from as low as 0.5 kg/l of supplementation. High supplementation level of 1.25 kg/l resulted in the highest increase of milk yield of 7.30 Litres on average. These results indicate that it is beneficial to supplement forage with concentrates to lactating cows. Supplementation at the current levels had no effect on milk quality. Further work should be done to compare

the performance of the formulated diet with other commercially available concentrate diets in the region.

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