

Effect of Supplementation Level of Leucaena Leaves and Wheat Bran to Grass Based Diet on Milk Yield and Cost of Production in Dairy Goats

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ARTICLE INFO

Article History:

Accepted : 08 Feb 2025

Published: 10 Feb 2025

Publication Issue :

Volume 12, Issue 1

January-February-2025

Page Number :

413-419

ABSTRACT

Leucaena (*Leucaena leucocephala*) is a forage of arid and semi-arid rangeland. It is a high protein forage that is drought tolerant and resistant to pests and diseases. Leucaena provided palatable, digestible and nutritious forage for ruminants thus helps to improve milk yield. Wheat bran is an excellent feed for goats due to its high palatability and laxative properties. The problem encountered was low milk production among dairy goat farms at the study area. Goat milk production has the potential to increase food security. An experiment was designed to study the effect of supplementing dried leucaena and wheat bran mixture on milk yield and the cost of its production in dairy goats at Mogotio Sub-County, Baringo County. This experiment was carried out on one farm where supplementations were carried out twice a day and milking done once daily. The study used Latin square design with five treatments of increasing levels of supplementation at control, 5, 10, 15, and 20% of the diet. The experiment was run for 35 days using 5 lactating dairy goats of body weights ranging between 35 and 53kg. The parameters observed included milk yield and cost of the feeds. The data was analysed using analysis of variance and significant means were separated using tukey's test. Results showed that dairy goats on supplementation produced more milk compared to the control. Supplementation treatment four had the highest milk production (476ml). Cost of dried leucaena leaves mixed with wheat bran was lower than commercial concentrates. In conclusion, linear increase in milk yield on all the treatments containing increasing levels of supplementation of dried leucaena leaves mixed with wheat bran at a fairly low cost was observed. The farmers should plant more leucaena and be trained to formulate treatment three diet for high milk production from lactating dairy goats.

Keywords: Commercial concentrates, Fodder, Goat products, Lactating goats, Milk production

I. INTRODUCTION

Livestock provide great benefits to farmers such as high nutritive value food, generating income and manure which is very important for maintaining soil fertility. They serve as financial assets so livestock offer an alternative for storing their savings or accumulated capital. Keeping livestock is considered as an alternative form of insurance; they also enhance family status because the value of livestock can be an indicator of social importance (Kounnavongsa, 2010).

Dairy animal rearing is an inseparable and integrated part of the smallholder subsistence farming system (Khan et al., 2009). Rearing of dairy goats improve farmers livelihoods through consumption and sale of their products. Dairy goat milk and its products (yoghurt, cheese, and powder) have high impact in human nutrition. The dairy goat enterprise is deemed profitable under smallholder production systems and the margins are influenced by the prevailing production factors (Ahuya et al., 2005). In Kenya, goats are an important component in the agriculture sector and account for about 58% of the total ruminants reared in the country (Mbae et al., 2020). Dairy production is faced by various constraints including; unclear market channels, diseases, poor breeds and breeding practices, low quality feed, and insecurity. The low productivity in small dairy farms is influenced by several factors, such as feed and livestock raising management. Feed is the major constraint, due to fluctuation of availability and price (Rusdy et al., 2020). There has been low milk production in dairy goats despite being different supplementary feeds in Mogotio sub-county. Mogotio sub-county was purposively selected for this study because of low performance of the dairy sub-sector (Joseah et al., 2023).

Dairy goats' maintenance is easier since they need less land, have higher prolificacy, and are hardier (Mutunga et al., 2023). Demand for dairy goat products in Kenya is increasing due to climate change and the fast-growing human population that has

resulted to increased land fragmentation and urbanization (Jerop et al., 2014). Alternative efforts to reduce costs of feed is by homegrown ration formulations. The feed supplement should be easily obtained with an economical price.

Fodder trees having high crude protein content and suitable for dairy goats include leucaena (*Leucaena leucocephala*) (Ahuya et al., 2009). *Leucaena* has the potential to be used as animal feed because it has nutritional content that is quite supportive for feed (Nurul Huda et al., 2024). *Leucaena* leaves are highly palatable, digestible (50 – 70%), and nutritious (22 – 40% of CP) (Katunga et al., 2014; Barwani et al., 2022). These good nutritional characteristics make the leaves suitable for supplementation in ruminant diets and have been shown to increase milk production, fat, and protein contents. The content of *Leucaena* includes crude protein 31.1%, crude fat 5.6%, dry matter 94.8%, crude fibre 13.2%, ash 4.5% (De Angelis et al., 2021). Amino acids composition in *Leucaena leucocephala* leaves is comparable with that in fish meal and soybean meal (Jayanegara & Sofyan, 2008). It is adapted to soils that are even barren for conventional crops. *Leucaena leucocephala* is one of the fastest growing plants. It is a persistent plant that thrives on the steep, rocky slopes where its roots penetrate deep into rock crevices, but does not thrive on highly acidic soils. It is a preferably accessible, good quality forage legume used to cut and carry roughage for fresh and single diets for goat in the tropics (Prasetianti et al., 2019).

Wheat bran used as a supplement to goats has a number of benefits including high protein, high phosphorous (1.27%), high energy (1.5 Mcal/lb) but low calcium.

The objectives of the study were to determine the effect of supplementing dried leucaena leaves mixed with wheat bran to lactating dairy goats on milk yield and cost of production.

II. METHODS AND MATERIAL

Study area

Mogotio Sub-County is located at the southern end of Baringo County and borders Rongai Sub-County in Nakuru County. The main economic activities are livestock and large-scale sisal cultivation for export. It is a semi-arid area situated at an altitude of 1067 metres above sea level and lies within longitude 35° 30' East and 36° 30' West and latitude 0°10' South and 1° 40' North. The area has a mean temperature of about 30.8°C ± 1.6°C, with an annual average rainfall of 512 mm occurring in two seasons: March to August and November to December (Ezenwa et al., 2018).

Experimental set-up

Procedures followed during the study included pre-testing by marking geographical area. One farm was purposively selected based on the availability of lactating dairy goats. The main objective of a purposive sample is to produce a sample that can be logically assumed to represent the population (Chakraborty & Biswal, 2023). Five dairy goats weighing 35, 40, 45, 48 and 53 Kgs were selected for the experiment. Leucaena leaves were harvested and dried for 6 hours, then weighed and half the wheat bran was added, then mixed based on percent supplementation (Treatment 1- 5%, Treatment 2- 10%, Treatment 3- 15%, and Treatment 4- 20%). The control was fed on pasture alone for 1 week, and then the four treatments were provided for a period of 1 week each. They were hand-milked once in the morning, and data on milk yield in varying conditions was recorded daily. The experiment was run for 35 days.

Housing and management of dairy goats

Dairy goats were housed in an over-ground, slatted floor facility. Five dairy goats were randomly allocated into five stalls (2m x 2m x 1m). Each stall was randomly assigned to a treatment. Stalls were equipped with water and feed troughs. Cleaning of the stalls was done weekly. Dairy goats were sprayed

with acaricides for external parasite control on a weekly basis.

Experimental design and model equation

A Latin square design was used where there were five treatments (control and supplementations: 5, 10, 15, and 20%), and the five dairy goats were the replicates.

Linear model equation for Latin square is;

$$Y_{ijkl} = \mu + \beta_i + \alpha_j + \tau_k + \phi_{ijkl}$$

Where:

Y_{ijkl} = Total observation

μ = Overall mean

β_i = i th effect of row

α_j = j th effect of column

τ_k = k th effect of treatment

ϕ_{ijkl} = Error term

Data analysis

Data on milk production and feed costs of each treatment per week was subjected to Analysis of Variance (ANOVA) in Genstat 14th Edition. The means of treatments that differed were ranked using Tukey's test at $p < 0.001$.

III. RESULTS AND DISCUSSION

Milk yield in dairy goats supplemented leucaena leaves and wheat bran compared to grass-based diet

The initial average milk production for the control from all treatments was 310 millilitres per day, while the average weekly milk production was 341, 375, 420 and 475 millilitres for treatments 1, 2, 3 and 4 respectively. Average milk production per week increased by 31, 34, 45 and 56 millilitres for treatment 1, 2, 3 and 4 respectively (Table 1).

Table 1 shows the dairy goats' average weekly growth as per treatments. Treatment one and two have an average weekly growth in milk of around 10% while treatment four had the highest growth performance in the average weekly milk yield of 13.3% followed by treatment three at 12.0%.

Table 1. Dairy goats milk production average increment on weekly basis

Goats	Treatment One		Treatment Two		Treatment Three		Treatment Four	
	ml	%	ml	%	ml	%	ml	%
1	30	10.0	30	9.09	40	11.1	50	12.5
2	15	7.50	25	11.6	30	12.5	40	14.8
3	60	12.0	60	10.7	70	11.3	90	13.0
4	40	10.0	40	9.09	60	12.5	70	13.0
5	10	6.67	15	9.38	25	14.3	30	15.0
Average	31	10.0	34	9.97	45	12.0	56	13.3

ml = millilitres

Differences in average milk production was observed due to treatment regimens administered to dairy goats. The analysis in Table 2 showed significant differences in milk yield and milk production among treatments in ANOVA hence the treatment means was separated and ranked by Tukey's. The ANOVA analysis, $F = 166$ shows that there was highly $p < 0.001$ in the average milk production according to the treatment regimes. Treatment four made of 20% Leucaena – wheat bran supplementation had the highest average milk production of 476ml/day-1, with 15% Leucaena – wheat bran supplementation having the second average milk production at 420ml/day-1, while control feed had the average milk at 310ml/day-1.

Table 2 highlights the differences in milk yields per treatments. The ANOVA analysis, $F = 10.9$, shows that there was highly $p < 0.001$ milk yield in treatments with treatment 3 giving the best, followed by treatment 1 and 4. Treatment three made of 15% Leucaena – wheat bran supplementation had the highest average milk yield increase of 9.14ml/day-1, followed by treatment 1 of 5% Leucaena – wheat bran supplementation having with 6.83ml/day-1. The control treatment had the average milk yield increase of 1.40ml/day-1.

Table 2. Milk yield and milk production in treatments Tukey's Comparison for difference in preference

Treatment	Milk yield	Subset for Species, $\alpha = 0.05$	
		Treatment	Milk production
Control	1.40a	Control	310a
2	3.29a	1	341b
4	6.74ab	2	375c
1	6.83b	3	420d
3	9.14c	4	476e

^{abc} Means in the same column without common letter are different at $p < 0.001$

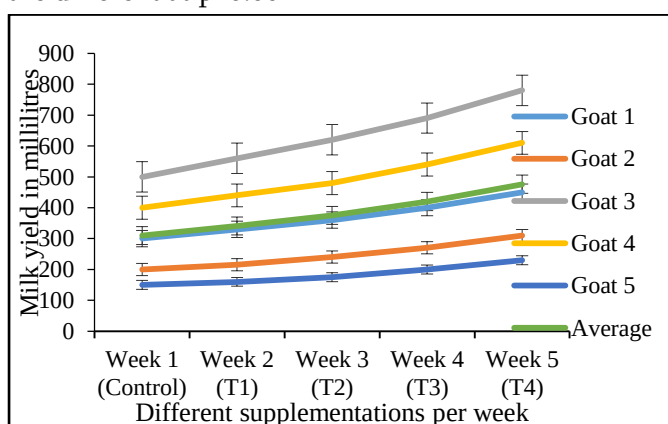
**Figure 1.** Graphical representation of trends in milk production over time

Figure 1 shows average weekly milk production across treatments during the study period. Though the goats had differing milk production at the start of the experiment, the mean production increases show a progressive growth in the yield.

Cost of production

Cost of supplementing dried leucaena leaves mixed with wheat bran compared to commercial concentrate known as dairy meal is shown in Table 3 below.

A. Parameters		B. Experimental Treatments			
		C. 5%	D. 10 %	E. 15 %	F. 20 %
G. Total feed intake in 5 weeks (Kg)		H. 2.32 _a	I. 4.64 _b	J. 6.89 _c	K. 9.28 _d
L. Total feed cost of supplementation (KSh)		M. 58 ^a	N. 116 _b	O. 172 _c	P. 232 _d
Q. Total feed cost of commercial concentrate (Ksh)		R. 93 ^a	S. 186 _b	T. 276 _c	U. 371 _d

Table 3. Calculating costs of feed supplements to dairy goats per kilogram

Dairy goat farmers incurred lower feed costs by supplementing dried leucaena leaves mixed with wheat bran compared to the commercial concentrate across all experimental treatments.

IV. CONCLUSION

Dairy goat farming generates income, creates employment opportunities, and provides food security. Feeding 15% dried leucaena leaves mixed with wheat bran increased milk production and was more cost-effective than other levels of supplementation. Dairy goat farmers in the semi-arid lands should plant drought-tolerant fodder crops including leucaena which can be used as supplement to dairy goats in times of low rainfall.

V. ACKNOWLEDGEMENT

The authors gratefully acknowledge the farmer for her valuable help during the field study of the project.

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