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EFFECT OF SUPPLEMENTATION OF CASHEW NUT MEAL ON MILK YIELD AND MILK QUALITY (FAT AND SNF) IN CROSS BRED DAIRY CATTLE

J. Gayathri[1], R. Kavitha*[2] A. Natarajan[3] and N. Bharathy[4]
[1]Veterinary Assistant Surgeon
[2]Assistant Professor, Livestock Farm Complex,
Veterinary College and Research Institute, Orathanadu
[3]Professor and Head (Retd), Animal Feed Analytical and Quality Assurance Laboratory,
[4]Assistant Professor, Department of Anatomy,
Veterinary College and Research Institute, Thalaivasal.
Tamil Nadu Veterinary and Animal Sciences University
E-mail: vetkavi2004@gmail.com (**Corresponding author*)

Abstract: Cashew nut meal (CNM), a protein-rich byproduct available in Tuticorin, was tested as a partial concentrate replacement in dairy feed to evaluate its effect on milk yield and quality in crossbred cows. Eight cows were divided into two groups: T1 (control) received standard concentrate, while T2 (treatment) had 500 g/day CNM. Although milk yield showed no significant difference between groups, T2 had higher milk fat (3.79% vs. 3.44%) and solids-not-fat (SNF) (8.59% vs. 8.33%). A second trial with 1000 g/day CNM confirmed these quality improvements, with milk fat increasing to 3.91% and SNF to 8.63%. Milk production was slightly higher (0.5 L) at the 500 g level, with cost savings of Rs. 0.86 per liter. Profit per liter was highest in the 500 g CNM group at Rs. 9.76. The study recommends 500 g CNM as a cost-effective feed option for improving milk quality and profitability in crossbred dairy cows.
Keywords: Cashew nut meal, milk yield, fat, SNF and Economics.

The dairy sector is a crucial component of India's agricultural economy, where livestock farming serves as a primary source of income for rural households. India is the largest milk producer in the world and supporting livelihoods in rural communities. In Indian dairy farming, enhancing milk yield and quality is essential for improving productivity and profitability, especially for small and marginal farmers who rely on dairy income (Das *et al.,* 2017; Berhane and Singh, 2002). Rearing crossbred dairy cattle have gained popularity in India due to their adaptability to local environmental conditions and higher milk production (Doiphode *et al.,* 2008).

Feed quality plays a significant role in influencing milk yield and composition, particularly in terms of fat content and solids-not-fat (SNF) levels, both of which serve as important economic indicators of milk quality (Prajapati, 2022). In this context, this article

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explores the potential of supplementing dairy cattle feed with cashew nut meal, a by-product of the cashew processing industry, as a promising area of research.

India, being one of the largest producers of cashews, generates a significant amount of cashew nut meal, which is rich in proteins, fats, and other essential nutrients (Konda *et al.,* 2019). Cashew nut meal, due to its nutritional profile, has shown potential as an economical dietary supplement for dairy cattle, supporting lactation performance and enhancing milk quality. By utilizing locally available resources like cashew nut meal, Indian dairy farmers have the potential to enhance both milk yield and quality, while also lowering feeding costs (Thornton, 2010).

Hence, the present study aims to analyze the proximate composition, acid-insoluble ash, calcium, and phosphorus content of cashew nut meal from Tuticorin district, Tamil Nadu, and to evaluate the effects of its supplementation at varying levels on milk yield, milk fat, and SNF content in crossbred cows, as well as the cost-effectiveness.

Materials and Methods

The effect of supplementation of cashew nut meal on milk yield and milk quality (Fat and SNF) in cross breed dairy cattle was conducted during July 2022 at a private Dairy farm, Padukkapathu village, Tiruchendur division and located 60 km away from the Tuticorin, Tamil Nadu state. The average temperature maximum and minimum during the experimental period was 31.0^{o}C and 24.0^{o}C respectively. The relative humidity recorded was 85.0 per cent. The wind speed and rainfall recorded during the study period were 7 km/h, 173.2 mm. (IMD, 2022). All the animals available in the farm were weighed based on the Shaffer's formula (Sastry *et al.,* 1982) and among the animals, eight lactating cross bred cows (Holstein Friesian) with an average milk yield of 13.46 ± 0.95 kg/d and with a mean live weight of 337. 37 ± 16.02 kg were selected and randomly divided into two homogenous groups (each 4 animals in one group) on the basis of milk production and body weight. The total experiment consisted of 20 days, in which 15 days were allotted for adaptation and five days for data collection. Before starting the feeding trial each individual animal was treated for parasite infection with ivermectin injection and housed according to the procedure by Sastry *et al.,* (1982).

Trail 1: The control (T_1) group fed with Roughage + 100 % commercial concentrate diet (Average milk yield 13 litres / day, 3.6 Kg of concentrate was fed) and the T_2 - Treatment group fed with roughage plus partial replacement of concentrate diet with CNM at the rate of

500 g / day / animal (Average milk yield 13 litres / day, 3.1 Kg of concentrate feed + 500 g of CNM was fed).

Trail 2: The biological trial 2 was carried out by extension of feeding trial with the same group of animals used in the part 2 with enhancement of quantity of CNM to 1000 g from 500 g replacing commercial concentrate feed on pro rata basis duly following the adaptation period of 15 days and collection period of 5 days as similar to biological trial 1. The control (T_1) fed with roughage + 100 % commercial concentrate diet (Average milk yield 13 litres / day, 3.6 Kg of concentrate was fed) and the T_2 group fed with roughage + partial replacement of concentrate diet with CNM at 500 g / day / animal) (Average milk yield 13 litres / day, 2.6 Kg of concentrate feed + 1000 g of CNM was fed). The ingredients came from the same lot used in Trial 1.

The concentrate feed offered was calculated (up to 5 litre of milk production no concentrate was fed and after 5 litre for every one litre of milk production 450 g of concentrate was fed) and divided in to two equal doses and offered at 8.00 am and 4.00 pm separately. The animals were earlier fed for reaching the optimum milk production. The regularly used commercial concentrate mixture is used for the control animals. A part of the concentrate mixture on pro rata basis was replaced by CNM in treatment group. A quantity of 500 g of CNM was offered replacing 500 g concentrate feed. The quantity of 500 g of was arrived at the previous usage level followed by cattle growers in that tract, for easy and adoptable basis. Paddy straw was fed *ad-libidum* as a dry fodder to the experimental animals throughout the period. As there was scarcity of green fodder and the animals are confined to the stall, the practice is to feed them only dry fodder, mostly, paddy straw throughout the year. Data for feed intake and refusals were recorded on daily basis. Machine milking was done for the individual cow two times per day. Daily milk yield of individual cows were recorded immediately after milking both in the morning and evening,

The collected samples (concentrate feed, paddy straw and cashew nut meal) were examined for their moisture (AOAC 2019), crude protein (AOAC 2019), crude fiber (AOAC 2019), crude fat (AOAC 2019) total ash (IS 14827), acid insoluble ash (IS 14826), calcium (AOAC 2019) and phosphorous (AOAC, 2019) content. The collected milk samples were analysed for milk fat, solids not fat content as per AOAC (2019) by automatic milk analyzer (Milkoscreen- Indifoss). Finaly, the cost of feeding, paddy straw, concentrate feed, cashew nut meal and labour were calculated per litre of milk production for control and treatment groups as per the current market price.

Results and Discussion

The (Mean ± SE) proximate composition, acid insoluble ash, phosphorous and calcium content of six CNM samples (Plate 1) collected from different manufactures in Tuticorin district are (in percentage) moisture 9.96 ± 0.28, crude protein 22.86 ± 0.11, crude fibre 3.33 ± 0.04, crude fat 12.66 ± 0.15, total ash 5.84 ± 0.08, acid insoluble ash 0.57 ± 0.05, calcium 0.44 ± 0.02, phophorous 0.54 ± 0.02 and the gross energy 4435 ± 8.24 Kcal/Kg. However, the values obtained were slightly higher than the values reported by Blomhoff *et al*. (2006) for crude protein and lower for crude fat. The variations could be mostly due to mode of production, maturity status of the nuts, collection, drying, storage practices and method of oil extraction (Adeigbe *et al.,* 2015).

Based on the Shaffers formula, the body weight of the animals was arrived at and the animals were grouped into two for the biological trial I.

The body weight (Kg) of the (1 to 4) control (T_1) group animals were 381.02, 356.09, 361.77, 255.11 with an average mean value of 338.49 and the T_2 group were 372.81, 230.58, 386.37, 355.19 and 338.49 with an average mean value of 336.24 respectively. The nutrient composition of CNM, concentrate feed and paddy straw used in the biological trail I is presented in Table 1 and the daily milk yield, milk fat, solid not fat (SNF) content and Total DM intake of Paddy straw (Kg) experimental cows maintained on two dietary treatments presented in Table 2.

In trial 1, the moisture (9.71 %) and phosphorous (1.05 %) contents were higher in commercial concentrate feed. However, the crude protein (22.03 %), crude fat (12.63 %) and calculated gross energy (4427 Kcal/Kg) values were higher in CNM compared to concentrate feed (19.15 %, 2.75 %and 3729 Kcal/Kg respectively). Expectedly, paddy straw had higher crude fibre (27.47 %), total ash (17.62 %), acid insoluble ash (15.85 %) and calcium (0.77 %) content was higher when compared with CNM and commercial concentrate feed.

Highly significant ($P<0.01$) variation was observed in the milk fat content (3.79 Vs. 3.44; 10.17 % increase) and solids not fat content (8.33 vs. 8.59; 3.12 % increase) between treatment and control group. This could be due to high fat content of CNM (Preston and Leng, 1987). A 500 g of CNM contained a fat content of 63.3 g which, in absolute terms, after replacing concentrate feed supplied a net 49.8 g crude fat over and above. This could be one of the reasons for the extra milk fat content of the milk in the treatment group (Table 2). Similarly, higher protein content of CNM over the commercial concentrate feed might have associated in better digestibility of other nutrients also, which could have resulted in increase

in milk yield and possibly SNF also. In line with our results, earlier, Remond (1991) concluded that CNM usage had a linear increase in protein content of the milk with increase in energy supply of the diet.

Table 1. Nutrient composition of Cashew Nut Meal (CNM), commercial concentrate feed and paddy straw*

S. No	Parameter	Cashew Deoiled Cake	Commercial concentrate feed	Paddy Straw
1	Moisture (%)	9.25 ± 0.20	9.71 ± 0.01	7.53 ± 0.01
2	Crude protein (%)	22.23 ± 0.44	19.15 ± 0.01	6.13 ± 0.17
3	Crude fibre (%)	4.78 ± 0.07	9.93 ± 0.01	27.47 ± 0.02
4	Crude fat (%)	12.63 ± 0.32	2.75 ± 0.01	2.25 ± 0.02
5	Total ash (%)	6.46 ± 0.07	8.60 ± 0.06	17.62 ± 0.01
6	Gross energy (Kcal/kg)	4427 ± 7.84	3729 ± 0.58	3124 ± 1.52
7	Acid insoluble ash (%)	0.91 ± 0.07	2.20 ± 0.06	15.85 ± 0.01
8	Calcium (%)	0.40 ± 0.05	0.53 ± 0.23	0.77 ±0.07
9	Phophorous (%)	0.52 ± 0.07	1.05 ± 0.01	0.06 ± 0.01

Mean of three observations

Table 2. Daily milk yield, milk fat, solid not fat (SNF) content and Total DM intake of Paddy straw (Kg) experimental cows maintained on two dietary treatments

Treatment	Milk Yield (litre) / day	Milk Fat (%)	SNF (%)	Total DM intake of Paddy straw (Kg)
Control	12.99 ± 0.138	3.44^{a} ± 0.004	8.33^{a} ± 0.006	130.69 ± 0.07
Treatment	13.84 ± 0.110	3.79^{b} ± 0.005	8.59^{b} ± 0.002	124.04 ± 0.06
P value	0.14	<0.00001	<0.00001	0.26

*Mean of 20 observations

Means with different superscript within the same column differ significantly (P<0.01)

This corresponds well with our results on increase in SNF in treatment group animals. Better composition of CNM over concentrate feed in terms of high fat and protein, less fibre and more gross energy content could have resulted in high fat SNF content of milk. However, the results obtained in the study were contraindicated with the results reported by Pimetal *et al*. (2012 and 2017) and Brasil (2003). There are no significant differences observed in the total intake of paddy straw between treatment group and control group with treatment groups showing a small non-significant decrease in the average daily paddy straw intake of /day/animal.

As the trial 2 was continued as such without any feed and management changes in both the groups, only the quantum of CNM was increased to 1000 g/day/animal replacing 1000 g of concentrate feed and rest of the management, practices remained the same.

As per Table 3, there is no significant variation in the milk yield between treatment and control group even with 1000 g of replacement of concentrate. A significant ($P<0.01$) variation was observed in milk fat content (3.91 vs; 3.33 10.17 % increase) and SNF (8.63 vs 8.31; 3.12 % increase) between the groups. Enhanced CNM supplementation increased the fat from the level observed in the 500 g supplementation (from 3.79 to 3.91%) but not in SNF (from 8.59 to 8.63 %). Once again, the high fat content of the CNM could be the reason for further increase in the fat content of CNM which was reported by earlier study also (Preston and Leng, 1987). A 1000 g of CNM contained a fat of 126.6 g which, in absolute terms, after replacing concentrate feed, supplied a net 99.6 g crude fat over and above. This could be one of the reasons for the extra milk fat content of the milk in the treatment group.

Further increase in protein quantity from CNM by replacing concentrate feed did not result in further increase in SNF, as found in. Similarly, high protein content of CNM over concentrate feed might have associated in better digestibility of other nutrients also, which could have resulted in increase in milk yield and possibly SNF also. Remond (1991) found that there was a linear increase in protein content of the milk with increase in energy supply of the diet. Better composition of CNM over concentrate feed in terms of high fat and protein, less fibre and more gross energy content could have resulted in high fat SNF content of milk. A few results, however, contraindicated the present finding (Pimetal *et al*., 2012; and 2017 and Brasil, 2003).

Table 3. Daily milk yield, milk fat, SNF content and Total DM intake of Paddy straw (Kg) experimental cows maintained on two dietary treatments

Treatment	Milk Yield (litre)	Milk Fat (%)	SNF (%)	Total DM intake of Paddy straw (Kg)
Control	12.91 ± 0.14	3.33^{a} ± 0.003	8.31^{a} ± 0.004	131.46 ± 0.05
Treatment	13.81 ± 0.11	3.91^{b} ± 0.041	8.63^{b} ± 0.004	126.12 ± 0.08
P value	0.13	0.00157	<0.00001	0.26

Mean of 20 observations ± SE
Means with different superscript within the same column differ significantly ($P<0.01$)

The total milk produced in 5 days by the experimental cows fed on three dietary treatments such as control, 500 g replacement of concentrate with CNM and 1000 g replacement of concentrate with CNM was 259.70, 276.70 and 276.20 litres (Table 4). The excess milk production in the CNM supplemented group was 17.0 and 16.50 litres in 500g and 1000 g replacement respectively over the control. Differences between two CNM supplemented groups were only 0.5 litre which indicates that further increase in the supplementation of CNM did not yield further increase in milk quantity.

Table 4. Effect of supplementation of CNM (both 500 g and 1000 g replacement of concentrate feed) on cost effectiveness in cross bred dairy cattle (4 % fat Corrected Milk)

Parameters	Control	500 g replacement of concentrate feed	1000 g replacement of concentrate feed
Expenditure on cost of paddy intake (at the rate of Rs. 11/Kg)	1774.85	1793	1798.5
Expenditure on cost of concentrate feed (at the rate of Rs. 27.5/Kg)	3245	2970	2695
Expenditure on cost of CNM (at the rate of Rs. 36/Kg)	-	360	720
Total litres of milk produced for five days	259.7	276.7	276.2
Income through sale of total milk (in Rs)	7531.30	8024.30	8009.80
Miscellaneous expenditure (Labour + Medicines +Trace mineral mix	200	200	200
Total expenditure (Rs)	5219.85	5323.00	5413.50
Net profit / Total milk production	2311.45	2701.30	2596.30
Cost of one litre of milk production (Rs)	20.10	19.24	19.60
Total cost of production (Roughage + Concentrate + CNM + labour charges)	12736.15	13692.30	14128.30
Profit for one litre of milk production	8.90	9.76	9.40
Profit over control group (Rs)	-	0.86 (9.66%)	0.50 (5.61%)

Cost of paddy straw –Rs 220/20 Kg, Cost of concentrate feed – Rs 27.50/Kg, cost of CNM – Rs 36/kg, Labour cost – Rs 10000/labour (3 labours are working for 40 animals)

Conclusion

Crossbred cows supplemented with 500 g and 1000 g of CNM, replacing concentrate feed, produced higher milk yields and improved quality compared to the control. Based on two trials, supplementing 500 g of CNM significantly enhanced milk quantity and quality, yielding a substantial profit of Rs 9.76 per liter. It is recommended to add 500 g of CNM as a replacement for concentrate feed in crossbred cattle.

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