

Impact of Propolis on Milk Yield, Composition and Somatic Cell Count of Cow Breeds at Dairy Farm of Banaras Hindu University, Varanasi, India

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ABSTRACT

Propolis has several pharmacological properties and safe alternatives to antibiotics. This study aims to address the impact of methanol extract of Indian propolis (MEIP) on milk yields and composition of six breeds and cross-breeds of cows. Bioactive compounds extracted from the raw propolis. 24 lactating cows were selected from six different types of breeds viz. Sahiwal, Haryana, Holstein Friesian × Sahiwal, Holstein Friesian × Haryana, Jersey × Sahiwal and Jersey × Haryana. They were randomly divided into four treatments with 6 replicates each and fed according to NRC (2001) with 0, 10, 20, 30ml MEIP/cow/day. The result showed that MEIP influenced the milk yield and composition of cows. The milk composition (%) was better ($P<0.05$) and the somatic cell count was lower in MEIP₂₀ and MEIP₃₀ compared to control and MEIP₁₀. The response was greater in Sahiwal cows. The lowest ($P<0.05$) somatic cell count was observed in the Holstein Friesian × Sahiwal crossbred cows. The study concluded that the supplementation with MEIP, improved milk yield, milk composition and somatic cells count in other breeds except Holstein Friesian.

Highlights

- The Methanol Extract of Indian Propolis influenced the milk yield and composition of cows. The somatic cell count was lower in MEIP₂₀ and MEIP₃₀ compared to control and MEIP₁₀. The response for propolis effective was greater in Sahiwal breed.

Keywords: Propolis, Cow Breeds, Milk Yield, Milk Composition, Somatic Cell Count

Livestock provided 16% to the input of small rural families, and contributes to two-thirds of their livelihood. About 8.8 % of the population in India gained employment opportunity and increased income by selling milk (Dash 2017). In spite of India having the largest dairy flock in the world, it still faces a production shortfall because of demand from the growing population as well as indigenous cows having low productivity. Dairy production in the country is still depending on traditional methods by subsistence farming where the milk is produced by small livestock farmers holding two or three lactating cows or buffaloes or both. Chronic deficiency in the feed resource; green fodder, dry fodder and concentrate supplements is one of the

continuing challenge for decades. Many strategies are followed for enhancing milk production in the past. Antibiotic supplements were tried successfully but, discontinued on the context of food safety to consumers due to presence of their residues in milk. Plant extracts such as saponins, tannins, and polyphenolics are considered to be safe natural alternatives those are having antimicrobial and enhance productivity properties (Wallace 2004). It improves rumen-microbial fermentation, based on their source and concentration in diets (Narvaez *et al.* 2013). One of the natural alternatives to antibiotics is Propolis (bee glue) which is produced by bees as they collect the resinous material from the buds of plants and mix it with salivary, enzymatic

secretions and beeswax (Castaldo and Capasso 2002). Propolis has antioxidant and antimicrobial properties (Marcucci *et al.* 2001; Shimizu *et al.* 2004). The present study aims to examine the effectiveness of the methanol extract of Indian propolis on cow milk yield and composition, and clarifies the role of breeding at the dairy farm of Banaras Hindu University, Varanasi, India.

MATERIALS AND METHODS

Geographical location

The raw propolis was collected manually from Bulandshahr district, Uttar Pradesh situated 28.4° south and 28.0° north latitudes and between 77.0° and 78.0° east longitudes. Propolis was collected during the period December 2016 to March 2017. The experiment was conducted at the dairy farm, Department of Animal Husbandry and Dairying, Institute of Agricultural Sciences, Banaras Hindu University, in Varanasi (23045' N to 28030' N and 80045' E to 84030' E, mean sea level 128.93 m, mean annual rainfall 110 cm).

Extraction of Bioactive compounds from Propolis

The crude propolis was kept dry at -30°C for 24 h followed by grinding into a fine powder. Bioactive compounds from the fine powder was soaked in 97% methanol in a tightly closed container at room temperature for 14 d, and shaken twice per day. At the end, methanol was filtered through Whatman filter paper no. 41 (Whatman no. 41). The methanol extract was kept at room temperature (20 °C) until use.

Animals and experimental details

The study was carried for 12 months from March 2017. The breed and cross-bred cows of six different breed, i.e., Sahiwal (S), Haryana (H), Holstein Frisian × Sahiwal (HFS), Holstein Frisian × Haryana (HFH), Jersey × Sahiwal (JS) and Jersey × Haryana (JH) were randomly divided into 4 groups of 6 in each, based on milk production, lactation stage and body weight.

The cows were housed in well ventilated individual pen having facility for feeding, and cleaned twice a day. Cows were fed according to NRC (2001) for maintenance and milk production.

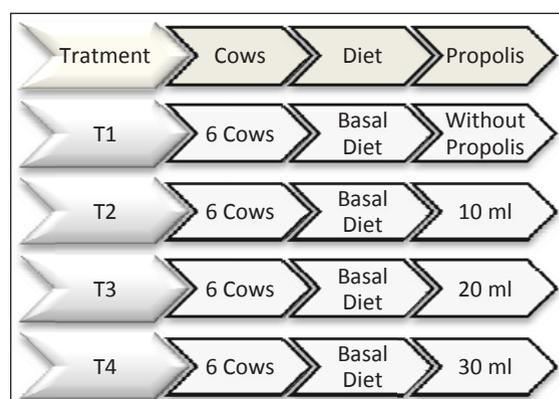


Fig. 1: Experimental design (grouping of experimental animals)

Ingredient composition of the concentrate supplements fed during the period in accordance to season is presented in table 1. Milk samples of 100 ml was collected from each cow once per two weeks in clean and dry PP bottle and analyzed for total fat, protein, lactose, total solids, solid not fat (SNF), pH and somatic cell count by electronic Eckomilk machine. Data was analyzed using tow factorial CRD model of analysis of variance (ANOVA) and the significant difference between individual means was identified by Duncan multiple range test at the probability level of $P < 0.05$, by using the SAS software package (2002).

Table 1: Ingredients of the concentrate feeding during the different seasons

Ingredients	Summer	Rainy	Autumn	Winter
Barley	10%	10%	10%	—
Maize	20%	10%	10%	—
Arhar Chuni	14%	18%	18%	12%
Wheat barn	16%	12%	12%	10%
Mustard Cake	15%	40%	40%	20%
Cottonseed Cake	25%	—	—	20%
Sorghum	—	10%	10%	20%
Pearl millet	—	—	—	10%
Gram Chuni	—	—	—	8%
Total	100	100	100	100

RESULTS AND DISCUSSION

Effect of propolis on milk yield, composition and somatic cell count

Significant differences ($P < 0.05$) were observed in milk yield, composition and somatic cell count but no significant effect ($P > 0.05$) was found in total solids% and pH in treatment groups MEIP₁₀

Table 2: Milk yield, composition and somatic cells counts of indigenous and lactating cross-breed cows supplemented with MEIP

Variable	Dietary treatment			
	Control	MEIP ₁₀	MEIP ₂₀	MEIP ₃₀
Milk yield kg/d	8.07 ^b	8.59 ^b	9.79 ^a	10.22 ^a
Fat%	2.48 ^b	2.68 ^b	3.27 ^a	3.43 ^a
Protein%	2.58 ^b	2.61 ^b	3.08 ^a	3.00 ^a
Lactose%	3.42 ^b	3.66 ^b	4.13 ^a	3.98 ^a
Total Solids%	10.54 ^a	11.13 ^a	11.59 ^a	11.87 ^a
Solids not fat%	6.23 ^c	6.89 ^b	7.76 ^a	7.63 ^a
pH	6.64	6.65	6.63	6.65
Somatic cells count 10 ⁴ cell/ml	12.17 ^a	12.33 ^a	11.68 ^b	8.28 ^b

^{a,b,c} Different letters in the same line are statistically different ($P < 0.05$).

Table 3: Interaction between MEIP and breed effect on milk composition and somatic cell count of indigenous and lactating cross-breed cows supplemented with MEIP

Variable	Fat	Protein	Lactose	Total Solids	Solid not fat	pH	Somatic cell count
Sahiwal							
Control	2.89 ^d	2.44 ^c	3.14 ^c	8.76 ^c	5.87 ^d	6.61 ^a	10.80 ^a
MEIP ₁₀	3.24 ^c	2.62 ^{bc}	3.50 ^{bc}	9.39 ^b	6.68 ^c	6.66 ^a	9.53 ^{ab}
MEIP ₂₀	3.76 ^b	3.26 ^a	4.41 ^a	11.43 ^a	8.32 ^b	6.66 ^a	9.20 ^b
MEIP ₃₀	4.57 ^a	3.49 ^a	4.65 ^a	11.48 ^a	9.01 ^a	6.65 ^a	7.70 ^c
Haryana							
Control	2.88 ^c	2.56 ^b	3.46 ^b	9.95 ^b	6.63 ^c	6.67 ^a	14.20 ^a
MEIP ₁₀	3.03 ^{bc}	2.59 ^b	3.54 ^b	9.67 ^b	6.49 ^c	6.65 ^a	13.60 ^{ab}
MEIP ₂₀	4.08 ^a	3.26 ^a	4.20 ^a	10.38 ^a	7.53 ^b	6.63 ^a	12.65 ^b
MEIP ₃₀	4.14 ^a	3.51 ^a	4.68 ^a	11.96 ^a	8.38 ^a	6.67 ^a	9.05 ^c
H. Friesian × Sahiwal							
Control	2.97 ^b	2.55 ^b	3.45 ^b	9.12 ^b	6.21 ^b	6.67 ^a	13.78 ^a
MEIP ₁₀	2.72 ^b	2.42 ^b	3.46 ^b	9.47 ^b	6.42 ^b	6.66 ^a	13.73 ^a
MEIP ₂₀	2.96 ^b	3.31 ^a	4.64 ^a	11.35 ^a	8.77 ^a	6.64 ^a	13.28 ^a
MEIP ₃₀	3.38 ^a	3.35 ^a	4.72 ^a	11.21 ^a	8.63 ^a	6.63 ^a	10.73 ^b
H. Friesian							
Control	2.32 ^b	2.46 ^a	3.52 ^a	9.42 ^a	6.37 ^a	6.66 ^a	12.70 ^a
MEIP ₁₀	2.37 ^b	2.51 ^a	3.29 ^a	9.47 ^a	6.48 ^a	6.66 ^a	9.98 ^b
MEIP ₂₀	2.67 ^a	2.78 ^a	3.46 ^a	9.86 ^a	6.48 ^a	6.64 ^a	9.75 ^b
MEIP ₃₀	2.73 ^a	2.59 ^a	3.39 ^a	9.21 ^a	6.80 ^a	6.64 ^a	7.43 ^c
Jersey × Sahiwal							
Control	1.96 ^c	2.76 ^a	3.72 ^a	9.97 ^a	6.28 ^b	6.65 ^a	13.60 ^a
MEIP ₁₀	2.13 ^b	2.45 ^a	3.53 ^a	9.38 ^a	6.49 ^b	6.65 ^a	11.45 ^b
MEIP ₂₀	2.13 ^b	2.57 ^a	3.69 ^a	10.19 ^a	7.34 ^a	6.63 ^a	11.45 ^b
MEIP ₃₀	2.95 ^a	2.79 ^a	3.52 ^a	9.32 ^a	6.98 ^a	6.67 ^a	9.48 ^c
Jersey × Haryana							
Control	2.43 ^b	2.89 ^b	3.65 ^b	9.53 ^a	6.25 ^c	6.64 ^a	13.80 ^a
MEIP ₁₀	3.20 ^a	2.49 ^b	3.59 ^b	10.06 ^a	6.96 ^b	6.64 ^a	11.38 ^b
MEIP ₂₀	3.14 ^a	2.58 ^b	3.49 ^b	10.53 ^a	7.16 ^b	6.65 ^a	12.83 ^{ab}
MEIP ₃₀	3.26 ^a	3.41 ^a	4.35 ^a	11.34 ^a	8.68 ^a	6.63 ^a	10.80 ^c

^{a,b,c} Different letters in the same column are statistically different ($P < 0.05$).



MEIP₂₀ and MEIP₃₀ compared to control. Milk yield was increased significantly ($P<0.05$) in MEIP₂₀ and MEIP₃₀ compared to control and MEIP₁₀. Similar trend was found with fat, lactose, solids not fat and somatic cell count ($P<0.05$).

Effect of propolis and breed on milk composition and somatic cell count

The effect of propolis supplementation had significant ($P<0.05$) effect on milk composition and somatic cell count. However, the milk composition was higher ($P<0.05$) and the somatic cell count was lower ($P<0.05$) in MEIP₂₀ and MEIP₃₀ than control and MEIP₁₀. Affect on milk composition was significant ($P<0.05$) higher in Sahiwal breed while comparable among other breeds. Somatic cell count was least ($P<0.05$) in Holstein Friesian × Sahiwal cross-bred cow of treatment group MEIP₃₀. On other hand the impact of MEIP on the Holstein Friesian cows breed was not been noticed ($P>0.05$) for milk composition except milk fat.

In Sahiwal, Haryana and Holstein Friesian × Sahiwal breeds the fat, protein, lactose, total solids and solid not fat was higher ($P<0.05$) in MEIP₂₀ and MEIP₃₀ than control and MEIP₁₀. Lowest ($P<0.05$) somatic cell count was found in MEIP₃₀ compared to control, MEIP₁₀ and MEIP₂₀.

In Holstein Friesian breed the fat % was higher ($P<0.05$) in MEIP₃₀ and MEIP₂₀ over control and MEIP₁₀. Protein, lactose, total solids and solid not fat was no different significantly ($P<0.05$). Lowest ($P<0.05$) somatic cell count was found in MEIP₃₀ compared to control, MEIP₁₀ and MEIP₂₀. In Jersey × Sahiwal cross-breed the fat was higher ($P<0.05$) and the somatic cell count was lower ($P<0.05$) in MEIP₃₀ than control, MEIP₁₀ and MEIP₂₀. Solid not fat was higher ($P<0.05$) in MEIP₃₀ and MEIP₂₀ than control and MEIP₁₀. Protein, Lactose and total solids was no different significantly ($P>0.05$). In Jersey × Haryana cross-breed the fat % was higher ($P<0.05$) in MEIP₃₀, MEIP₂₀ and MEIP₁₀ than control. Protein and lactose was higher ($P<0.05$) in MEIP₃₀ than control, MEIP₁₀ and MEIP₂₀. Solid not fat was higher ($P<0.05$) in MEIP₃₀ than control, MEIP₁₀ and MEIP₂₀. Total solids was no different significantly ($P>0.05$). The somatic cell count was lower ($P<0.05$) MEIP₃₀ compared to control, MEIP₁₀ and MEIP₂₀.

Current research appears to show that the higher milk yield and milk composition ($P<0.05$) was

observed in MEIP₂₀ and MEIP₃₀ over control and MEIP₁₀. This result is similar to Morsy *et al.* (2016) who observed that the oral administration of Brazilian red propolis extract to Santa Inês ewes (3 g /ewe/day) increased ($P<0.05$) milk yield, fat, protein, and lactose. In contrast the impact of MEIP on the Holstein Friesian breed was not observed, this result is in agreement with Aguiar *et al.* (2014) who reported that adding propolis 15 g to the Holstein cow's diets had no effects on milk production, and milk solid concentrations. Similarly, Stelzer *et al.* (2009) reported that propolis ethanolic extract in the diet at 30% w/v while feeding Holstein cows has not affected milk yield and milk composition.

CONCLUSION

The methanol extract of Indian Propolis which has been collected in Bulandshahr district, influenced the milk yield, milk composition and somatic cell count of cows breed and cross-bred viz. Sahiwal, Haryana, Holstein Frisian X Sahiwal, Holstein Frisian X Haryana, Jersey X Sahiwal and Jersey X Haryana.

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