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Milk yield and composition of crossbred cows in the hilly Wayanad district of Kerala, India

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Comprehensive research works on major constituents in cow milk and the factors affecting milk yield and composition is the need of the hour, as many farmers have complaints regarding low fat and SNF in their cow's milk. Wayanad district located 700 – 2100 m above mean sea level, on the north-east of Kerala, is the second largest milk producing district in the state, with a production of 40 025 322 litres in 2004–05 (Karshakasree 2005). Scientific studies regarding milk yield and composition of crossbred cows of Wayanad are seriously lacking due to its hilly terrain and geographic peculiarities. Hence the present study was undertaken to study the factors affecting milk yield and composition of crossbred cows in Wayanad district.

Cows (268) from 5 centres of Wayanad district namely - Ambalavayal, Sulthan Bathery, Meenangadi, Vythiri and Veterinary College Livestock Farm, Pookode, which calved from April to July 2007 were selected. Morning and evening milk recordings of these animals were taken using milk recording cards. First recording was taken at 20th day of lactation, followed by recordings at monthly intervals for consecutive 10 months or till date of drying whichever is earlier. Milk samples (929) from 244 cows were collected in morning and evening during early, middle and late lactation and were analyzed for fat, solids-not-fat and total solids. Milk fat was estimated using electronic milk fat tester and the equipment was calibrated with Gerber's method. SNF was estimated using lactometer with frequent calibration with gravimetric method for total solids estimation.

Season of calving was classified into rainy (June and July) and non-rainy seasons. The lactation period was divided into 3 stages – early, middle and late, for estimation of milk fat and SNF. Total lactation yield of individual cow was calculated, by taking the sum of product of each monthly recording and multiplying it by 30. The effects of centre, season and parity on peak yield, total lactation yield, fat, SNF and total solids percentage were estimated by least square analysis (Harvey 1960) using SPAB-2 package (Sethi 2002). The model used was,

$$Y_{ijkl} = \mu + C_i + S_j + P_k + e_{ijkl}$$

where, Y_{ijkl}, lth observation of kth parity of jth season of ith centre; μ, overall mean; C_i, effect of ith centre; S_j, effect of jth season; P_k, effect of kth parity, and e_{ijkl}, random error. Duncan's multiple range test as modified by Kramer (1957) was used to compare means.

Milk yield: The least square analysis of variance revealed that the effect of centre had significant effect (Table 1) on peak yield and lactation milk yield ($P<0.05$). Sulthan Bathery recorded the maximum lactation yield whereas Pookot Livestock farm recorded the maximum peak yield. But peak yields from farm and field were recorded invariably in the first month of lactation, deviating from the expectation that peak yield will be achieved around 45th day of lactation. This indicated that the cows are genetically capable of producing more, if proper management conditions are provided. Results agreed with the findings of Chacko *et al.* (1984) and Jadhav *et al*. (1991). Parity and season of calving had no significant effect on both these parameters. The nonsignificant effects of season maybe due to the fact that animals were raised on cultivated fodder throughout the year and seasons were not predominantly defined in Kerala. These findings are in agreement with those reported by Kuralkar *et al.* (1995). Contrary to this, significant effect of season of calving on milk yield and lactation length was reported by Bajwa *et al.* (2004) and Javed *et al.* (2004). Wayanad being a commercial hub for milk production, farmers mostly maintain cows in their peak lactation. Hence majority of cows recorded in the present study were in their first, second and third lactations which could be the reason for nonsignificance in parity.

Milk composition

Milk fat percentage: Centre had significant effect on milk

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Table 1. Least square means of peak yield, total yield, fat, solids not fat (SNF) and total solids (TS)

	No. of observations	Peak yield	Total yield	Fat	SNF	TS
Overall mean	244	10.627±0.6120	2118.796±139.578	3.515±0.080	8.359±0.042	11.889±0.087
Centre		*	*	*	**	**
1	42	9.356^{a}±0.867	2132.343^{ab}±197.608	3.637^{a}±0.114	8.832^{a}±0.060	12.524^{a}±0.123
2	76	10.283^{a}±0.636	2472.04^{a}±144.965	3.353^{b}±0.084	8.324^{b}±0.044	11.685^{b}±0.090
3	88	11.512^{b}±0.593	2405.553^{ab}±135.183	3.481^{ab}±0.078	8.720^{a}±0.041	12.176^{c}±0.084
4	17	9.596^{a}±1.723	1646.284^{b}±392.911	3.470^{ab}±0.226	7.912^{c}±0.119	11.383^{b}±0.244
5	21	12.388^{b}±1.049	1937.759^{b}±239.293	3.633^{ab}±0.138	8.008^{c}±0.073	11.675^{b}±0.149
Parity						
1	57	9.908±0.654	1892.727±149.241	3.546±0.086	8.336±0.045	11.906±0.093
2	80	11.445±0.599	2269.323±136.654	3.599±0.079	8.333±0.041	11.980±0.085
3	78	10.980±0.605	2299.561±137.953	3.456±0.079	8.293±0.042	11.741±0.086
4	25	10.698±0.936	2277.368±213.491	3.449±0.123	8.422±0.065	11.872±0.133
5	4	10.105±2.197	1854.999±500.945	3.523±0.287	8.413±0.152	11.943±0.311
Season						
1	157	11.090±0.636	2163.743±144.976	3.538±0.084	8.374±0.044	11.918±0.090
2	87	10.164±0.738	2073.849±168.361	3.491±0.097	8.345±0.051	11.859±0.105

Means with different superscript within a column differed significantly from each other. (* $P < 0.05$, ** $P < 0.01$). Centre 1, Ambalavayal; 2, Sulthan Bathery; 3, Meenangadi; 4, Vythiri; 5 , Veterinary College Livestock Farm, Pookode.

fat percentage ($P<0.05$). Sulthan Bathery with maximum lactation milk yield recorded the minimum fat percentage and Ambalavayal recorded the maximum fat percentage. Iype *et al*. (1994) reported that location-wise difference in milk fat percentage was statistically significant. This report was in total concurrence with the present study in Wayanad, another northern district of Kerala. But parity and season of calving had no significant effect on milk fat % too. These findings are in agreement with those reported by Yadav *et al.* (1989). But Nareshkumar *et al.* (1988) reported significant effect of season on butter fat content of milk.

Milk solids not fat percentage and total solids: The overall average for SNF percentage was 8.359±0.042 and the least square analysis of variance revealed that centre had very significant effect on SNF and total solids percentage ($P< 0.01$) whereas parity and season of calving had no significant effect on these parameters. Among 5 different centres selected, Ambalavayal recorded the maximum SNF and total solids percentage, whereas Vythiri recorded the minimum SNF and total solids percentage. Topographical peculiarities and difference in feed ingredients must have resulted in such a significant difference between centers. Some of the farmers in Wayanad procure raw materials from nearby states at a cheaper rate and prepare concentrate feed of their own to feed their cows. A proximate analysis of these feeds will reveal imbalances if any, which should be corrected.

Incidence of low fat and solids not fat percentages: Morning milk fat below the PFA standards of 3.5 % was found in 47.3 % cows in early stage of lactation. In evening milk samples, 11.8 % cows in early lactation were below the standards. This may be attributed to the fact that crossbred cows of Kerala has more of Holstein Friesian inheritance and hence produce milk of low fat percentage. When all stages of lactation are considered, cows with milk fat percentage below the prescribed PFA standards are less in Wayanad compared to Thrissur (Radhika 1997) which may be due to the fact that more green fodder is available at Wayanad which increases the overall milk fat percentages.

During late lactation morning milk samples, 82.7 % cows had less than the minimum standards of 8.5% SNF and in evening milk samples 82.8 % cows in early lactation, 61.9% in middle lactation and 92.5 % in late lactation had less than the minimum standards of 8.5 % SNF. As the lactation advanced, fat percentage kept on increasing, while solids not fat kept on decreasing alarmingly and total solids remained almost constant. Overall average for SNF percentage was 8.359±0.042. Considering all stages of lactation together, 60.1 % in morning milk and 77.6 % cows in evening milk had solids not fat percentage below the prescribed PFA standards. This was much higher than the figures obtained in a similar study conducted in crossbred cows at Thrissur, where 47% of cows, irrespective of lactation stage and time of milking, recorded an SNF percentage below the legal standards of 8.5 (Radhika and Iype 1999). According to Sebastian and Geevarghese (1995) there is a possibility of obtaining milk with fat and SNF below minimum standards prescribed in PFA Act for many states in India. Malabar Regional Co-operative Milk Producer's Union Ltd., Kozhikode (MRCMPU) (1995) reported 73.8 % animals with milk SNF below legal standards.

Factors relevant for this are: nutrition, genetics, disease, stage of lactation and centre. When 4 increasing levels of

concentrate were fed, SNF increased from 8.3 to 8.6 % (Harris and Bachman 1988). Also, reducing the energy fed to high-producing cows below requirements may decrease SNF as much as 0.2–0.5 percentage units. Crossbred cows in Wayanad showing low level of SNF might be an indication towards insufficient energy intake. Edwards (1958) reported that the difference in SNF content between the normal and substandard groups of cows was due to a drop in lactose and protein, but with the latter playing the major part. Thus, although inadequate feeding was probably a major factor in lowering the SNF in this population, the fact that the lactose content was low gives an indication that mastitis was also important. A decline in SNF, protein, and lactose content is associated with sub clinical and clinical mastitis. According to Jones and Jones (1986) low milk fat and low milk protein were considered as possible predisposing factors to bovine *Escherichia coli* mastitis. Batavani *et al.* (2007) reported that protein fractions were significantly different in normal and subclinical mastitis milk. More studies have to be conducted in this side before a definite conclusion is drawn about the incidence of mastitis among crossbred cows of Wayanad.

Anemia is another reason for decline in SNF and since incidence of hemoparasites is quite high in Wayanad due to its proximity to forest areas**;** this could be a major reason. Hypoalbuminaemia is reported to be a major reason for low SNF in cow milk. Perry and Randolph (1999) reported great economic losses in productivity of dairy cattle due to parasitism.

SNF content of milk is highest at parturition, and reaches a minimum at the time of peak milk yield, after which it increases towards the end of lactation. In this study, SNF was low throughout the lactation, especially during later stages of lactation when fat percentage was quite high. Venkatachalapathy and Iype (1997) reported that fat and total solids showed an increasing trend as the lactation advanced, but SNF was not having any trend during lactation, which is in agreement with our results. Bhoite and Patekar (2002) reported that fat and SNF content in milk increased linearly with increase in stage of lactation. Jadhav and Patange (2009) studied a newly evolved genotype namely "Phule Triveni" and reported that the overall mean values of fat, total solids and SNF, were 4.26, 13.39 and 9.13 %, respectively, all of them being significantly ($P<0.05$) affected by the stage of lactation. But lactation order and its interaction with the stage of lactation did not significantly affect these parameters. Jadhav and Patange (2009) also noticed that the fat and SNF content were well above PFA limits as well as fulfilling the requirements laid down by the Maharashtra government.

Crossbred cattle of Wayanad are performing comparatively well in terms of milk production, especially due to the fact that impact of hot humid climate is not as severe in Wayanad, as in other districts of Kerala. But there is a reduction in the SNF content of milk due to many reasons mentioned above. Efforts should be taken to change nutrition and management aspects in such a manner that SNF content of milk is improved.

SUMMARY

Lactation milk yield and milk constituents like milk fat and solids-not-fat (SNF) decide the economics of dairy cattle rearing. Data from hilly districts like Wayanad are seriously lacking and hence the present study was undertaken, where 268 cows from 5 centres of Wayanad were selected for recording lactation milk yield. 929 milk samples from these cows were analyzed for fat, solids not fat (SNF) and total solids in different stages of lactation. The overall least squares mean for lactation milk yield, peak yield, milk fat and SNF percentages were 2118.796±139.578 kg, 10.627±0.6120 kg, 3.515±0.080 and 8.359±0.042 respectively. The least squares analysis of variance revealed that centre had significant effect on peak yield, lactation milk yield, milk fat, SNF and total solids percentages, whereas parity and season of calving had no significant effect.

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