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Full Length Article

Effect of By-Pass Fat Supplementation on the Performance of Sahiwal Dairy Cows

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Abstract

Present study was conducted to evaluate the effect of by-pass fat supplementation on milk production, composition and weight gain in Sahiwal cows. Twelve dairy cows of same parity, stage of lactation, milk production level and body weight (285-360 kg) were randomly allotted to four treatments (T^0, T^1, T^2 and T^3) in such a way that each group had 03 animals under Completely Randomized Design. The animals received 250 g, 350 g and 450 g of bypass fat supplementation in T^1, T^2 and T^3 whilst animals in T^0 served as control group. All animals were maintained under similar managemental conditions. The data of milk production (daily/individually), milk composition and body weight were weekly recorded. The data recorded was statistically analyzed and results revealed that milk production and composition differed significantly ($p<0.05$) in all groups. The highest milk yield was found in T2 (10.45±0.53 Kg) and the lowest (6.93±0.53 Kg) in control group that was without by-pass fat supplementation. The T2 and T3 differed non-significantly ($p<0.05$) for milk yield and composition. Almost all the milk constituents showed the similar trend. The bypass fat did not affect the body weight gain significantly ($p<0.05$) in all groups. The milk cost showed significant differences in all treatments. The lowest cost (Rs. 32.20±2.37) was shown in T2 and the highest (Rs.46.14±2.37) in T3 group. It was concluded that 250 g was the optimum amount of bypass fat supplementation to produce milk economically with high fat percentage. © 2016 Friends Science Publishers

Keywords: Bypass fat; Milk production; Milk composition; Body weight; Dairy animal

Introduction

Livestock farming is an integral part of the prevailing agricultural system in Pakistan. A deficiency gap of 4.16 and 21.3 million tons of crude protein (CP) and total digestible nutrients (TDN), respectively has been reported by Sarwar (2006). During early lactation, the energy necessary to replenish body reserves and maintain high milk production is higher than the available energy from daily feeding (Goff and Horst, 1997) which may lead to mobilization of body fat to coop the deficiency. High milk producing animals during early production face negative energy balance leading to metabolic pressure and sub-optimal yield of milk (Drackley, 1999). By-pass fat increases fat corrected milk (FCM) and its proportion in milk composition (Rodriguez *et al*., 1997). The FCM and milk fat proportion is enhanced without disturbing the digestibility of other supplements; and it avoids the degradation of supplements and bio-hydrogenation in rumen leading to increase energy density of the ration (Elliott *et al*., 1996). The higher milk yield and fat content is direct benefit to farmers (Parnerkar *et al*., 2010). The rumen fermentation process is not affected by bypass fat but it provides additional energy to the animals for more milk production after being absorbed in the small intestine (Bobe *et al*., 2007). It also supports production of unsaturated fatty acid in the milk which is easily digestible for patients with heart disease (Garg *et al*., 2008). Calcium (Ca) salts of long chain fatty acids (LCFAs) and prilled saturated fatty acids (FAs) are more effective as bypass fat for lactating animals as extra energy source (Palmquist, 1991). The previous work was done in exotic animals under different managemental situations (Relling and Reynolds, 2007; Naik, 2013) but no work has been reported in indigenous dairy animals with different levels of supplementation. Therefore, this study was planned to investigate the effect of supplementation of different levels bypass fat on the production of milk, composition and weight gain.

Material and Methods

Experimental Design and Arrangement of Animals

The trial was conducted at the Livestock Experiment Station of Directorate of Farms, University of Agriculture Faisalabad. Twelve Sahiwal dairy cows of same parity, lactation stage and milk production level were randomly allotted to four treatments (T^0, T^1, T^2 and T^3) in such a way

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that each group had 03 animals. All the precautionary measures were taken to control the seasonal diseases and parasitic infestation by using the vaccination for FMD and HS as per schedule of the farm. The experimental animals were managed in individual stalls under uniform climatic conditions.

Feeding Management and Treatments

Green fodder was offered *ad libitum* (at least 10% refusal) twice a day. Fresh water was available round the clock. Compound feed was offered @ 3kg twice a day including the fat supplement. An energy supplement with calcium salt of long chain fatty acids for dairy animals was used as bypass fat. The bypass fat was supplemented in group T^1 @ 250 g day^{-1} animal^{-1}, group T^2 @ 350 g day^{-1} animal^{-1} and in group T^3 @ 450 g day^{-1} animal^{-1}. Animals of group T^0 will be taken as control (without bypass fat). The composition of different treatment ration is given in Table 1.

Sample Collection and Analysis

Approximate analysis of the compound feed along with supplement was done using techniques described by AOAC 2005 (Table 1). The data of daily milk production of both milking (morning+evening) for individual animal was recorded. The weekly milk samples of individual animals were collected and used for milk analysis in Dairy Lab. of Inst. of Dairy Sciences. Milk fat and protein was determined by Gerber (Aggarrwala and Sharma, 1961), and Kjeldhal methods (Davide, 1977), respectively. Total solids (TS) and solid not fat (SNF) was calculated according to Fleischmann's formula. The experimental animals were weighed weekly basis to check change in weight.

Statistical Analysis

Data generated for milk production and milk composition for protein, fat, solid not fat (SNF) & total solid (TS) and body weight for seven weeks was analyzed statistically under completely Randomized Design using computer software MINITAB (2000, version 17.0) and the significance of means was compared using the Tuckey's test to draw the valid conclusion at certain significance level.

Results

Milk Production and Composition

Analysis of the data for milk production on by-pass fat supplementation revealed that milk production differed significantly ($p<0.05$). The highest milk production (10.45±0.53 Kg) was observed in T^2 and the lowest values (6.93±0.53) were found in treatment T^0 (Table 2). The milk production in T^2 where supplementation was given @ 350 g animal^{-1}, differed significantly with all other treatments except T2. The control group and T4 group differed non-significantly (Table 2). Animals in T^2 gave 3.52 Kg more milk than control and 1.49 and 2.82 Kg more milk than T^1 and T^3 respectively. The animals in T^2 on an average produced 50% more milk than control group.

The milk composition also differed significantly ($p<0.05$) in all treatments. The highest fat % was observed in T^3 (4.49±0.02) and the lowest (4.03±0.02) was found in control group. T^2 and T^3 group differed non-significantly ($p<0.05$). In group T^2 where animals showed the highest milk yield 4.26±0.02% fat was found and it was non-significant with highest fat producing group.

The solids not fat (SNF) percentage also showed the similar pattern. The T^2 and T^3 showed non-significant differences for SNF. Protein and Total solids % showed non-significant differences.

Milk Cost

There Cost per kg milk produced in differed groups varied significantly (Table 3). The highest cost (Rs. 46.14±2.37) was revealed in group T^3 whilst the lowest was found in animals on T^2 where 350 g supplement was offered. The highest cost feeding cost was observed in group 4 (Rs. 356.00) and lowest in control group (Rs. 280.00). The milk cost between T2 and T1 did not differed significantly.

Body Weight Gain

The data on body gain revealed that on an average body weight ranged from 45.03±2.19 to 48.28±2.19 (Kg) during the experimental period (Table 3) and did not differ significantly at $p<0.05$).

Discussion

Milk Production

Average milk production (kg) animal^{-1} day^{-1} with by-pass fat supplementation was significantly ($P<0.05$) increased in T^2 (10.45±0.53). It was observed that with the increase in fat supplementation milk production was enhanced in T^1 (250 g day^{-1}animal^{-1}) and group T^2 (350 g day^{-1}animal^{-1}) but there was no significant ($P>0.05$) change in group T^3 (450 g day^{-1} animal^{-1}). It might have improved their energy demand with supplementation of by-pass fat. The animals on T^0 showed significantly lower milk yield as compared to T^2 and T^1, it might be due to that animals were maintained only on basal ration. The animals maintained on T^3 (450 g day^{-1}animal^{-1}) also showed a non-significant difference in milk yield as compared to T^0 it may be concluded that milk yield on higher level of by-pass fat supplementation (> 350 g day^{-1} animal^{-1}) depressed the milk yield. A probable cause of this trend might be disturbed energy: protein ratio. The higher level of by-pass fat supplementation might have affected the nutrients intake with increased level of by-pass fat intake in T^3.

Table 1: Approximate analysis of the compound feed offered to animals in various treatments (%)

Nutrients	T^0	T^1	T^2	T^3
Dry matter	85.56	87.96	90.06	92.06
Crude protein	18.50	17.23	15.31	15.17
Crude fiber	05.20	04.70	04.40	04.10
Ether extract	03.40	04.30	05.10	05.70
Ash	05.17	06.12	07.43	08.25

Table 2: Effect of by-pass fat on milk yield and composition on Sahiwal cows

Parameter	Group 1	Group 2	Group 3	Group 4
Average Milk yield (kg day^{-1})	6.93±0.53^{b}	8.96±0.53^{ab}	10.45±0.53^{a}	7.63±0.53^{b}
Average Fat (%)	4.03±0.02^{c}	4.14±0.02^{bc}	4.26±0.02^{ab}	4.49±0.02^{a}
Average Protein (%)	3.56±0.32	3.70±0.32	3.75±0.32	3.61±0.32
Average SNF (%)	7.61±0.03^{b}	7.76±0.03^{b}	8.21±0.03^{a}	8.29±0.03^{a}
Average Total solids (%)	12.60±0.31	13.42±0.31	13.81±0.31	14.01±0.31
Average Weight gain (kg)	48.28±2.19	48.09±2.19	45.03±15.8	45.15±15.8

Mean ± standard deviation. Values in same rows, sharing same letters differ non-significantly (P>0.05)

Table 3: Effect of by-pass fat on milk cost at different levels of supplementation and weight gain

Parameter	Group 1	Group 2	Group 3	Group 4
Feed cost Rs./day	280.00	320.00	336.00	356.00
Milk yield (kg day^{-1})	6.03±0.53^{b}	8.96±0.053^{ab}	10.45±0.53^{a}	7.630.53^{b}
Milk Value (Rs.)	541±42.8^{b}	716±42.8^{ab}	836.±0.53^{a}	610±0.53^{b}
Milk cost (Rs./Kg)	41.53±2.37	36.7±2.37^{ab}	32.20±2.37^{b}	46.14±2.37^{a}
Average Wt. gain (Kg)	48.28±2.19	48.90±2.19	45.03±2.19	45.15±2.19

Mean ± standard deviation. Values in same rows, sharing same letters differ non-significantly (P>0.05)

The results of the present study are in line with Barley and Baghel (2009) who reported that the milk production and fat was increased in dairy animals by supplementation of bypass fat. Garg and Mehta (1998) also revealed that without disturbing the dry matter intake, the milk yield was significantly increased by the feeding of by-pass fat. Significant improvements in milk production was observed in lactating cows by the supplementation of by-pass fat (Purushothaman *et al*., 2008). Dhiman *et al*. (1995) reported that by-pass fat preserves the nutrients degradation and bio-hydrogenation in rumen with improved energy density of the ration supporting the animals to meet energy demand and fatty acid requirements to express their milk production potential.

Milk Composition

Milk fat % was improved significantly with the bypass fat supplementation in all the groups. The e group T^3 (4.49±0.02) showed most significant results than all other treatments. In group T^3 there was 10.24% increase in fat from T^0 but 5.90% and 5.12% increased from T^1 and T^2 respectively. All the results of increasing fat percentage in milk of dairy cows may be due to the supplementation of bypass fat in the ration of dairy animals. However the effect of bypass fat supplementation on milk fat percentage depends on the profile and level of calcium salt of long chain fatty acids (Chouinard *et al.*, 1998; Sklan *et al*., 1991). However, in some studies non-significant effect was also reported (Naik *et al.,* 2013). The Protein content had shown non-significant (P>0.05) results by the supplementation of bypass fat. It was decreased with the supplementation of by-pass fat, might be due to increase in milk quantity and fat percentage content. Loss in milk protein % had been associated to the dilution of milk protein, as higher milk volume produced might not be coordinated with uptake of amino acids by the mammary gland (DePeters and Cantt, 1992). Solids not fat (SNF) percentage had shown non-significant (P>0.05) results in all the treatments. It had already been reported that SNF content of milk is not altered (Naik *et al*., 2009; Tyagi *et al*., 2009; Thakur and Shelke, 2010; Sirohi *et al*., 2010) or improved (Wadhwa *et al*., 2012). The total SNF production is enhanced due to increase in milk yield (Naik *et al*., 2009). The study had shown non-significant weight gain among all groups. The present finding has been supported by work of (Purushothaman *et al*., 2008; Wadhwa *et al*., 2012).

Conclusion

The results of present study indicated that bypass fat can be used successfully in indigenous dairy animals with significant increase in milk and fat yield. The high amount of supplementation will not increase yield and fat% accordingly and will increase milk cost per unit.

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