Study on the Effect of Incorporating Rumen Protected De-Oiled Rice Bran on Milk Production in the Ration of Crossbred Cows

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A study was undertaken to assess the effect of incorporating rumen protected de-oiled rice bran or rapeseed meal, in the ration of crossbred cows on milk production, for sixteen weeks period. Cows (n=22) yielding 9 to 12 kg milk per animal per day were divided into two groups (control vs experimental) of eleven each, based on milk yield, fat percentage and stage of lactation. The animals in both the groups were fed similar basal diet, comprising 10-12 kg green maize fodder and 5-6 kg paddy straw. Animals in control group were fed cattle feed (CP 20%) containing 40% untreated de-oiled rice bran (UDP 39.29% of CP) and animals in experimental group were fed cattle feed containing 40% formaldehyde treated de-oiled rice bran (UDP 72.85% of CP), depending upon their level of milk production, to meet the maintenance and milk production requirements. There was no significant difference in milk yield and milk quality on incorporating treated de-oiled rice bran in experimental group as compared to control group. After 10 weeks, animals in experimental group were fed cattle feed containing untreated de-oiled rice bran, similar to animals in control group. However, 1.0 kg cattle feed was replaced with 1.0 kg formaldehyde treated rapeseed meal (CP 37.45%; UDP 72.70% of CP). Average increase in daily milk yield (kg), fat and protein percent were 0.87 ($p<0.05$), 0.25 ($p<0.05$) and 0.14, respectively. Amino acid composition of de-oiled rice bran and rapeseed meal revealed that most limiting amino acids for milk production, methionine and lysine were lower in de-oiled rice bran as compared to rapeseed meal. Present study revealed that treated rapeseed meal can supply more essential amino acids at lower tract for improved milk production, as compared to treated de-oiled rice bran, on protein equivalent basis.

Keywords: Rumen protection, de-oiled rice bran, rapeseed meal, milk yield, amino acids, cows

INTRODUCTION

It is estimated that the demand for milk would rise to more than 180 MMT by 2021-22, in view of increasing human population and increasing buying capacity of consumers. Several organizations have documented the shortage of feed resources to produce milk in accordance with the projected demand. Amongst others, protein meals would also be in short supply to support targeted milk production. Through bypass protein technology efficiency of utilization of protein meals can be increased, to compensate the shortfall to some extent. De-oiled rice bran (DORB) is considered to be a moderate source of protein and is abundantly available in India for feeding dairy animals. A study was undertaken to assess the impact of protected protein from DORB for milk production, so that gap between the demand and supply could be further narrowed down. Results of this investigation are reported in this publication.

MATERIALS AND METHODS

Experimental Design

A feeding trial was conducted on 22 lactating crossbred cows (Holstein-Friesian X Jersey), yielding 9.0 to 12.0 kg milk per animal per day. The feeding trial was conducted at R M Patel Dairy farm, near Anand for sixteen weeks period. Cows (440 ± 10 kg body weight) were divided into two groups (control vs experimental) of eleven each, based on level of milk production, fat percentage and stage of lactation (mid lactation; numbers 2 & 3). Animals in both the groups were fed similar basal diet, comprising 10.0-12.0 kg green maize fodder (Zea mays) and 5.0-

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6.0 kg paddy straw (Oryza sativa). Animals in control group were fed cattle feed (CP 20%) containing 40% untreated DORB (CP 15%; UDP 39.29% of CP; ADIN 0.76%; NDIN 1.20%) and animals in experimental group were fed cattle feed containing 40% treated DORB (CP 15%; UDP 72.85% of CP; ADIN 0.82%; NDIN 1.45%), depending upon their level of milk production, to meet the maintenance and milk production requirements (NRC, 2001), for ten weeks period. After ten weeks, animals from experimental group were fed cattle feed containing untreated DORB, similar to animals in control group, however, 1.0 kg cattle feed was replaced with 1.0 kg treated solvent extracted rapeseed meal (Brassica spp.; CP 37.45%; UDP 72.70% of CP; ADIN 1.18%; NDIN 1.95%) for six weeks period, as per NRC, 2001. Feeding was done twice daily in the morning and evening and animals were offered *ad libitum* clean drinking water thrice a day.

Analytical Methods

The chemical composition of feeds and fodder (Table 1) offered during the trial period was carried out as per AOAC (2005). Feeds and fodder were analyzed for neutral detergent fibre (NDF), neutral detergent insoluble nitrogen (NDIN), acid detergent fibre (ADF), acid detergent insoluble nitrogen (ADIN), cellulose, hemi-cellulose and acid detergent lignin (ADL) as per Goering and Van Soest (1970). The data were analyzed statistically according to Snedecor and Cochran (1968). The milk yield of individual cows was recorded in the morning and evening. Milk samples from each animal, pooled from each milking were collected weekly for analysis of milk fat and protein contents, using Milkoscan. Amino acid composition of DORB and rapeseed meal was determined as per the modified PICO-TAG method of Copyright Millipore Corporation (1987), using High Performance Liquid Chromatography (HPLC; Water Model 600).

Formaldehyde Treatment

De-oiled rice bran and rapeseed meal were treated with optimum level of formaldehyde (HCHO 37% w/v) in sealed chambers where they underwent formation of complexes, resisting degradation in the rumen (Ashes *et al.* 1995). This attributed to HCHO-binding to the proteins by the formation of methylene bridge, which makes them resistant to microbial attack. The treated materials were tested for degree of protection using in vitro rumen incubation procedure. Known quantity of test sample was incubated for 24 hours in strained rumen liquor (SRL), anaerobically at 38°C. The protein degradation was measured by analyzing ammonia nitrogen level in SRL, at the end of incubation period.

RESULTS AND DISCUSSION

Feeds and Fodder

The nitrogen fraction associated with fibre i.e. neutral detergent insoluble nitrogen (NDIN) and acid detergent insoluble nitrogen (ADIN) is a measure of the quality of protein in treated feeds. Analysis revealed that the level of NDIN and ADIN were very low in formaldehyde treated feed samples, indicating non-significant increase in the level of cell wall bound nitrogen contents (Table 1). It also revealed that there was no significant difference between treated and untreated materials particularly in NDF, NDIN,

Table 1: Chemical Composition (% on DM Basis) of Feeds and Fodder Fed During Trial Period

Parameter	Untreated DORB	Treated DORB	Treated rapeseed meal	Maize green	Paddy straw
Moisture	6.15 ± 0.11	6.19 ± 0.10	5.58 ± 0.08	81.28 ± 0.21	5.86 ± 0.05
Crude protein	15.46 ± 0.30	15.42 ± 0.28	37.45 ± 1.21	7.34 ± 0.16	3.62 ± 0.08
Ether extract	0.48 ± 0.00	0.50 ± 0.04	0.65 ± 0.03	1.62 ± 0.10	0.45 ± 0.07
Crude fibre	12.32 ± 0.12	12.30 ± 0.10	10.74 ± 0.06	25.36 ± 0.23	25.39 ± 0.20
Acid detergent fibre	32.48 ± 0.32	33.12 ± 0.28	18.54 ± 0.16	30.35 ± 0.26	56.12 ± 0.42
Acid detergent insoluble nitrogen	0.76 ± 0.00	0.82 ± 0.01	1.18 ± 0.03	0.86 ± 0.02	0.56 ± 0.00
Neutral detergent fibre	67.74 ± 0.36	67.25 ± 0.43	25.65 ± 0.22	56.65 ± 0.39	75.44 ± 0.44
Neutral detergent insoluble nitrogen	1.20 ± 0.10	1.45 ± 0.06	1.95 ± 0.12	1.58 ± 0.21	1.24 ± 0.08
Acid detergent lignin	4.22 ± 0.11	4.84 ± 0.08	5.26 ± 0.10	2.74 ± 0.03	3.45 ± 0.11
Cellulose	23.42 ± 0.34	23.48 ± 0.52	11.42 ± 0.33	25.44 ± 0.35	48.56 ± 0.41
Hemi cellulose	35.26 ± 0.35	34.13 ± 0.22	7.11 ± 0.12	26.30 ± 0.11	19.32 ± 0.10
Silica	4.84 ± 0.06	4.80 ± 0.10	1.86 ± 0.03	2.17 ± 0.07	4.11 ± 0.11

ADF and ADIN contents. Since animals were fed similar ration, there was no significant difference in the daily dry matter intake (12.39 vs 12.42 kg).

Milk Production and Quality

On feeding cattle feed containing 40% treated de-oiled rice bran in experimental group, there was non-significant effect on milk yield and composition of milk. When animals in experimental group were fed 1.0 kg treated rapeseed meal in place of 1.0 kg cattle feed, daily average milk yield (9.85 vs 10.72* kg) and fat per cent (4.31 vs 4.56*) increased significantly ($p<0.05$). However, there was no significant increase in protein per cent (3.10 vs 3.24). Weekly milk production as depicted by regression equations on scatter plot is shown in Figure 1, indicating that when the experimental animals were fed treated rapeseed meal in place of treated DORB through cattle feed, milk yield improved significantly ($p<0.05$). Effect of incorporating treated meals in the ration for improved milk production has also been reported by other workers (Garg, 2009; Walli, 2010).

Amino Acid Composition of DORB and Rapeseed Meal

Amino acid composition (Table 2) revealed that 100g crude protein of DORB provided lower amount of essential amino acids, as compared to rapeseed meal. Methionine and lysine are reported to be the most limiting amino acids for milk production (Lapierre *et al.* 2002). Methionine and lysine were lower in DORB (Met 0.97 & Lys 3.31% of CP) as compared to rapeseed meal (Met 1.93 & Lys 6.49% of CP). Level of other EAAs (% of CP) like phenylalanine, threonine and valine were also comparatively lower in DORB (3.83, 6.82 and 3.84), as compared to rapeseed meal (5.21, 8.09 and 5.04), respectively.

Table 2: Amino Acid Composition (% of CP)

Amino acids	De-oiled rice bran	Rapeseed meal
Aspartic acid	7.51	8.05
Glutamic acid	12.15	23.87
Serine	4.20	6.05
Glycine	4.07	6.43
Histidine	1.45	1.93
Arginine	4.50	7.46
Threonine	6.82	8.09
Alanine + Proline	6.54	10.23
Tyrosine	2.09	2.69
Valine	3.84	5.04
Methionine	0.97	1.93
Cystine + Isoleucine	4.60	6.63
Leucine	34.11	
Phenylalanine	3.83	5.21
Lysine	3.31	6.49

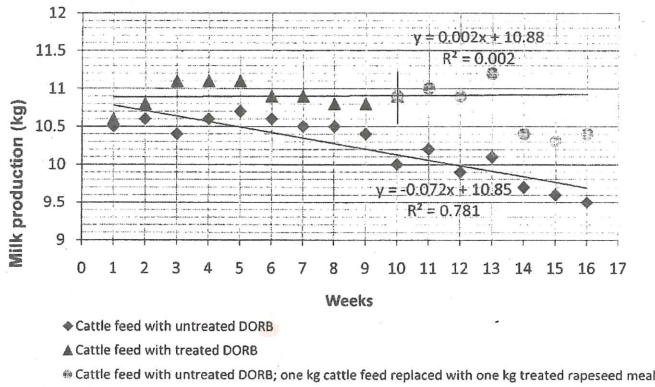

Figure 1 : Weekly milk production as depicted by regression on scatter plot

There are several reports that supplementation of rumen protected methionine and lysine increased milk yield, milk fat and protein contents (Socha *et al.* 2005; Watanabe *et al.* 2006). Bernard *et al.* (2004) reported that supplementation of L-lysine-HCL along with steam flakes corn rations increased microbial protein synthesis and flow of amino acid to the duodenum.

CONCLUSION

Present study indicated that there was non-significant effect of incorporating rumen protected de-oiled rice bran on milk production in the ration of crossbred cows. However when treated DORB was replaced with treated rapeseed meal, there was significant improvement in milk yield, as the latter was able to supply higher amount of essential amino acids for milk synthesis.

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