Original Article

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PERFORMANCE OF LACTATING BUFFALOES ON SOYBEAN HULLS BASED CONCENTRATE MIXTURE

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ABSTRACT

Eighteen lactating buffaloes were fed for 90 days to assess the effect of utilization of soybean hulls replacing maize grains in the concentrate mixture of lactating buffaloes. The buffaloes were divided into three groups of six buffalo each and fed as (CG) with maize based concentrate mixture, (25SH) concentrate mixture with 25% replacement of maize with soybean hulls and (50SH) fed on concentrate mixture with 50% replacement of maize with soybean hulls. The DMI and DMI percent BW showed nonsignificant differences. The NDF digestibility was significantly (P<0.05) better in soya hulls groups, all other nutrient digestibility did not vary significantly. The milk production and composition did not alter on soya hulls feeding, except milk protein. The rumen liquor profile did not alter due to supplementation of soybean hulls. The milk economics was better in 50SH group. It was concluded that soybean hulls can replace corn up to 50% as an energy source in the concentrate mixture of lactating buffaloes for economical milk production.

Keywords: *Bubalus bubalis*, buffaloes, soya hulls, lactating buffaloes

INTRODUCTION

Soybean hulls are readily fermentable in the rumen. It possesses a relatively high energy value due to its high digestible fibre. Feeding of soybean hulls has positive benefits on the growth rate and ADG and better digestibility of fibre fractions (Royes *et al*., 2001). Hintz *et al.* (1964) considered soybean hulls as highly digestible concentrate and because of rumen fermentation pattern, soybean hulls can be classified as rapidly fermentable fibre without lowering ruminal acetate concentrations or milk fat. Soybean hulls offer an alternative to high starch grains, as they contain significant level of digestible fibre and in many growing diets can be used as an energy source with similar value to grains. The ruminant diets are based on cereals with rapidly degradable starch. The fermentation of starch and soluble sugars enhance the lactate production, decreasing pH and thereby fibre digestion.

The feeding of soybean hulls in the diet increases the TVFA production (Cunningham *et al*., 1993) and increases total nitrogen flow to the duodenum linearly (Grigsby *et al*., 1992). Firkins and Eastridge (1992) reported improved milk production efficiency due to supplementation of

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soybean hulls in lactating dairy cows. Due to low lignin content and rapid fermentation of soybean hulls in the rumen, we have used in the concentrate mixture to replace maize grain at the level of 30 and 50% by (Rainchwar, 2012) and 75% maize by (Jadhav *et al*., 2016) in concentrate mixture of buffalo calves, hence present study was conducted to observe the effects of soybean hulls on milk production and composition in lactating buffaloes replacing 25% and 50% maize in the concentrate mixture.

Eighteen lactating buffaloes were fed for 90 days to assess the effect of utilization of soybean hulls replacing maize grains in the concentrate mixture of lactating buffaloes. The buffaloes were divided into three groups of six buffalo each and fed as (CG) with maize based concentrate mixture, (25SH) concentrate mixture with 25% replacement of maize with soybean hulls and (50SH) fed on concentrate mixture with 50% replacement of maize with soybean hulls. The concentrate mixtures were iso-nitrogenous and iso-caloric. The buffaloes were offered gram straw as dry roughage and para grass as green roughage apart from concentrate considering 3% DM requirement. The body weights of buffaloes were recorded fortnightly and dry matter intake was recorded daily. The rumen liquor profile was determined at every fortnight by collecting rumen liquor 2 h. post feeding from each buffalo under experiment. The rumen liquor was immediately brought to the laboratory in an insulated thermos and strained through double layer muslin cloth. The pH of strained rumen liquor (SRL) was determined using pH meter, total volatile fatty acids as per Barnett and Reid (1956) and ammonia nitrogen as per Conway (1957). The milk composition was analysed weekly in each animal. The economics of milk production was calculated from the records of daily feed consumption, milk production and procurement price of feeds and fodder used in the experiment. The samples collected during digestibility trial were analyzed as per AOAC (1995) for proximate composition and fibre fractions as per Van Soest (1967). The data were analyzed statistically as per Snedecor and Cochran (1994).

RESULTS AND DISCUSSIONS

Soybean hulls contain 603 g of NDF, 446 g of ADF, 118 g CP and 25 g lignin per kg DM (NRC, 2001). In the present study, soya hulls contained CP-10.82%, CF-35.98%, NDF-64.12%, Cellulose-38.66%, Hemicellulose-21.96% and Lignin-1.60%, which were consistent with Rainchwar (2012); Jadhav *et al.* (2016). However, Ipharraguerre and Clark (2003); Mohammadzadeh *et al.* (2013) reported higher CP 11.8% and lignin content in the range of 1.4% to 3.9% (Anderson *et al*., 1988).

The similar iso-nitrogenous and iso-caloric concentrate mixtures were used by Grigsby *et al.* (1993). Rainchwar (2012); Jadhav *et al.* (2016) also used similar concentrate mixtures when they have replaced maize with soybean hulls in the concentrate mixture of buffalo calves.

The initial and final body weights (Table 3) were non-significant, indicated that the replacement of maize with soybean hulls in the concentrate mixture has no adverse effect on body weight of lactating buffaloes. The BW increased in linear fashion at every fortnight in each group with significant variations ($P<0.01$), although the differences among first to fifth fortnights were comparable and it was significantly more during last fortnight in each group, due to pregnancy of two animals in each group. Similar results were obtained by Rainchwar (2012); Jadhav *et al.* (2016), who replaced corn by soybean hulls in the concentrate mixture at 30, 50 and 75% in the treatment groups, respectively. Anderson *et al.* (1988) found nonsignificant differences in weight gain when soyhulls was supplemented in grazing ruminants. Thomas *et al.* (2011) explored positive effect on ADG due to feeding soybean hulls in combination with wet brewer's grains than when soybean hulls fed alone.

The DMI and percent DMI did not vary significantly and corroborates with Nakamura and Owen (1989) reported when soya hulls constituted 0, 50 and 95% in the concentrate mixture replacing corn in the pelleted lactation ration of cows. Cunningham *et al.* (1993) also reported non-significant effect on DMI when soybean hulls replaced forages partially. Orr *et al.* (2008) reported non-significant difference in DMI on substitution of corn with soybean hulls in beef cattle. The observations reported by Shain *et al.* (1993) are also consistent with the present study, who obtained nonsignificant differences in average dry matter intake on addition of mixture of 85% soybean hulls, 12% soy lecithin and 3% soapstock in the ration of dairy cattle. Halachmi *et al.* (2004) also reported that average daily DMI of cow was similar in experimental and Control group (25.0 and 25.7 kg) when they observed effect of replacing roughage with soya hulls on feeding behaviour and milk production of dairy cow. Rainchwar (2012); Jadhav *et al.* (2016) reported non-significant difference in DMI when corn was replaced with soybean hulls at 30, 50 and 75%, respectively when it was 40% of the total concentrate mixture. However, Aikman *et al.* (2006) reported less DMI with increasing levels of soya hulls, when wheat was replaced by soya hulls in diets of lactating jersey cow. Similar findings were also reported by Mohammadzadeh *et al.* (2013).

The FCE was non-significant and consistent with Rainchwar (2012); Jadhav *et al.* (2016) also reported non significant feed conversion efficiency when utilized soybean hulls as an energy source in the concentrate mixture of buffalo calves and fed corn (40%) in the concentrate mixture of Control group, while part of corn was replaced at 30%, 50% and 75% by soybean hulls in treatment groups, respectively.

The NDF digestibility was significantly ($P<0.05$) better in soya hulls groups. It is also evident that the CF and hemicellulose digestibilities were comparatively better in groups where corn was replaced with soya hulls. The results are in accordance with Grigsby *et al.* (1992) observed on increasing level of soya hulls in diet of steers. Galloway *et al.* (1993) observed greater NDF digestibility in cattle. Aikman *et al.* (2006) also reported increased digestibility of NDF due to incremental level of soya hulls in lactating Jersey cows. Nguyen *et al.* (2008) also reported more NDF digestibility due to soya hulls feeding in cattle. The high content of fermentable NDF present in soybean hulls might allow more extensive ruminal fermentation. The concentration of lignin and phenolic monomers in soya hulls may be responsible for the greater digestibility of NDF in soya hulls (Garleb *et al.*, 1988). Moreover, the relatively large thickness and particle size of soybean hulls cell walls allow the rapid and extensive fermentation of the fibre fraction (Van Laar *et al.*, 1999), resulting apparently higher fibre digestibility in the present study. Ipharraguerre and Clerk (2003) opined that soybean hulls can replace corn to supply about 30% dry matter in high grain diets without negatively affecting either the fermentation or digestibility of nutrients or the performance of dairy cows.

The milk production did not vary significantly and corroborated with Cunningham *et al.* (1993) reported in Holstein cows; however, Weinder and Grant (1994) reported no significant change in milk production on replacement of forage by soyhulls at 25 or 42%. The results are also supported by Aikman *et al.* (2006) who observed no change in milk production on replacement of wheat with soya hulls in diets of jersey cow and Mohammadzadeh *et al.* (2013) in multiparous dairy cows when fed graded amount of soya bean hulls. However, Firkins and Eastridge (1992) observed increased milk production, when soybean hulls was supplemented in lactating dairy cows; Shain *et al.* (1993) reported increased milk yield fed mixture of 85% soybean hulls, 12% soy lecithin and 3% soapstock in dairy cattle; Halachmi *et al.* (2004) found higher milk yield due to replacement of roughage with soy hulls in dairy cows under hot weather conditions.

The milk fat did not vary significantly but comparatively better in soya hulls group and consistent with Cunningham *et al.* (1993) who did not observe significant effect of soya hulls on milk fat in Holstein cows; Weinder and Grant (1994) when forages were replaced by soya hulls at 25 or 42%; Aikman *et al.* (2006) reported on replacement of wheat with soya hulls in diets of jersey cow; Araujo *et al.* (2008) reported on feeding of soybean hulls in ewes and Halachmi *et al.* (2009) reported no negative effect on milk fat due to the influence of soyhulls in high yielding dairy cows. However, Firkins and Eastridge (1992) observed increased milk fat, due to soybean hulls in lactating dairy cows. Halachmi *et al.* (2004) also found significantly higher milk fat due to replacement of roughage with soy hulls in dairy cows under hot weather conditions. Soybean hulls may enhance milk fat percentage because of the replacement of starch also confirms that non forage fibre source can participate in milk fat synthesis as supported by Mohammadzadeh *et al.* (2013). More milk fat on soya hulls fed group may also be attributed to the enhanced digestibility of NDF polysaccharides, which usually results in increased production of acetate by rumen cellulolytic bacteria, and this can serve as precursor for milk fat synthesis in the mammary gland (Halachmi *et al.*, 2004).

The milk protein of 50SH group was more where maize was replaced by soybean hulls at 50% level in the concentrate mixture and it was comparable to the Control group. The findings corroborate with Mohammadzadeh *et al.* (2013), who concluded that inclusion of soya hulls in cattle diet produces milk with greater protein concentration. The milk SNF did not show significant variations, however the values were comparatively better in groups fed soybean hulls replacing maize at 50% in concentrate mixture than other groups. The observations on milk SNF corroborates with Araujo *et al.* (2008); Halachmi *et al.* (2009) reporting nonsignificant effect on milk SNF due to soya hulls supplementation in ewes and influence of soya hulls on high yielding dairy cows, respectively. The milk composition i.e. fat, protein and SNF obtained in the present study were in the normal range as reported by Sukumar De (2010). The rumen liquor pH did not vary significantly, and it was in the normal range for all buffaloes indicating beneficial effects of supplementation of soybean hulls on rumen pH. The findings are in agreement with Cunningham *et al.* (1993); Galloway *et al.* (1993); Richards *et al.* (2006); Rainchwar (2012); Jadhav *et al.* (2016) who have not observed significant difference in ruminal pH when fed soybean hulls in the diet. The overall average of rumen ammonia nitrogen was

Table 1. Ingredients of concentrate mixture (%).

Ingredients	**CG**	**25SH**	**50SH**
Maize	40	30	20
Soybean Hulls	-	10	20
Cotton Seed Cake	24	24	24
Ground nut cake	10	9	8
Rice polish	10	10	10
Tur chunni	13	14	15
Mineral mixture	2	2	2
Salt	1	1	1

Table 2. Composition of concentrate mixtures (% DM).

Nutrients	**CG**	**25SH**	**50SH**
DM	91.12	91.56	91.56
CP	19.92	19.86	19.86
EE	4.70	3.50	3.50
CF	6.85	10.27	10.27
TA	5.68	5.89	5.89
NFE	63.52	60.48	60.48
ADF	13.71	12.26	12.48
NDF	28.66	29.02	29.16
Cellulose	12.88	11.26	11.02
Hemicellulose	14.95	16.76	16.68
Lignin	0.56	0.60	0.60

DM: Dry matter; CP: Crude protein; EE: Ether extract; CF: Crude fibre; TA: Total ash; NFE: Nitrogen free extract; ADF: Acid detergent fibre; NDF: Neutral detergent fibre.

Table 3. Performance of lactating buffaloes on soybean hulls-based concentrate mixtures.

Parameters	Treatments			SEM
	CG	25SH	50SH	
Body weights, kg				
Initial body weights 0th day	368.00	363.50	368.75	21.32
Final body weights 90th day	454.75	458.75	464.75	23.54
Dry matter intake, kg				
DMI	11.97	12.07	12.10	0.17
DMI % BW	3.05	3.12	3.18	0.11
Digestibility of nutrients, %				
DM	69.11	66.22	66.29	2.75
CP	80.99	79.65	80.90	2.79
CF	58.04	59.31	62.96	4.57
NFE	77.58	73.98	76.17	2.07
EE	85.12	86.67	82.44	1.73
ADF	33.93	35.90	34.53	1.69
NDF*	40.82[a]	41.71[b]	44.55[c]	1.58
Cellulose	61.89	60.47	60.33	1.24
Hemicellulose	39.37	46.02	42.31	2.10
Milk attributes				
Avg. daily milk production, kg	3.31	3.26	3.52	0.19
Avg. milk fat	6.89	7.21	7.55	0.33
Avg. milk protein**	3.54[ab]	3.38[a]	3.84[b]	0.13
Avg. milk SNF	9.70	9.29	9.88	0.31
Rumen liquor profile				
pH	6.64	6.63	6.63	0.01
NH_3-N, mg/100 ml SRL	27.67	26.64	26.71	0.31
TVFA, mEq./lt.	84.03	84.71	84.05	0.55
Economics				
Feed cost/kg milk, Rs.	32.94	32.33	29.26	

abc within the respective row differs significantly.

DM: Dry matter; CP: Crude protein; EE: Ether extract; CF: Crude fibre; TA: Total ash; NFE: Nitrogen free extract; ADF: Acid detergent fibre; NDF: Neutral detergent fibre; DMI: Dry matter intake; NH_3-N_2: Ammonia nitrogen; TVFA: Total volatile fatty acids.

found to be comparatively lower in soybean hulls fed groups, however the differences amongst the group were non-significant. The values of rumen ammonia nitrogen between the groups were within normal range. The findings in the present study are in accordance with Galloway *et al.* (1993); Cunningham *et al.* (1993); Grigsby *et al.* (1993) who did not observe significant difference in the concentration of rumen ammonia nitrogen when fed soybean hulls in the diet. Similarly, Jadhav *et al.* (2016) found nonsignificant difference in rumen ammonia concentration among the groups when maize was replaced with soybean hulls in concentrate mixture of buffalo calves. The total volatile fatty acid concentration was found to be nonsignificant and corroborates with Grigsby *et al.* (1993); Richards *et al.* (2006); Nguyen *et al.* (2008) who reported nonsignificant differences in the concentration of total volatile fatty acids when soybean hulls were supplemented in the diet. The reports are also consistent with Rainchwar (2012); Jadhav *et al.* (2016) who utilized soybean hulls as an energy source in the concentrate mixture of buffalo calves, replaced at 30, 50 and 75%, respectively. All the ruminal parameters were in the normal range indicating beneficial effects of feeding soybean hulls on ruminal microflora.

The feed cost per kg milk was lowest in 50SH group, where corn was replaced by soya hulls at 50% level in the concentrate mixture, may be attributed to lower cost of soybean hulls. Hence it is confirmed that soybean hulls can be substituted corn up to 50% in concentrate mixture of lactating buffaloes for economical milk production. The economical benefits of feeding soybean hulls are also supported by Thomas *et al.* (2011); Rainchwar (2012); Jadhav *et al.* (2016). Thus, the feeding of soybean hulls in the concentrate mixture of lactating buffaloes has no adverse effect on performance, milk yield, milk composition and rumen fermentation of buffaloes. Hence it is concluded that soybean hulls can replace corn up to 50% as an energy source in the concentrate mixture of lactating buffaloes for economical milk production.

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