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INFLUENCE OF SUBSTITUTING WHEAT STRAW WITH CORNCOBS IN FATTENING RATIONS FOR GROWTH RATE AND NUTRIENT DIGESTIBILITY IN BUFFALO CALVES

M. I. Anjum* and M. Afzal[1]

Animal Nutrition Program and [1]Livestock Research Station, Animal Sciences Institute, National Agricultural Research Centre, Islamabad, Pakistan.
*Corresponding Author E-mail: mianjum_narc@yahoo.com

ABSTRACT

Nine Nili-Ravi buffalo calves age between 10-12 months and average body weights 160±3.30 kg were randomly divided into three groups (3 animals in each). Three iso-nitrogenous (12% CP) and iso-caloric (68% TDN) total mixed diets were formulated as: Diet A contained 75% DM from concentrate +25% DM from wheat straw; diet B had 75% DM from concentrate +13% DM from wheat straw +12% DM from corncobs while, diet C consisted of 75% DM from concentrate +25% DM from corncobs. All calves were offered 7-8 kg/day of available green fodders (oats, maize and millet). The study lasted for 105 days (March to July). Growth trial was followed by a five days digestibility trial. Results revealed no-significant difference in the intake of dry matter (DM) among all groups, however, the total body weight gain or average daily weight gain and feed conversion ratio (FCR) were better ($P<0.05$) in calves of group C compared to group A, however group A and C were not different ($P>0.05$) from group B. Similar pattern was found in digestibility of DM, crude protein (CP) and crude fibre (CF) among the groups. However, digestibility of NDF and ADF was different ($P<0.05$) among all groups with maximum in group C and minimum in group A. Similarly, N retention was significantly ($P<0.05$) higher in group C followed by groups B and A. Feed cost per kg weight gain of group C was 31.32% and 25.00% less than calves in groups A and B, respectively. It may be concluded that corncobs can beneficially substitute with wheat straw for fattening of buffalo calves.

Key words: Buffalo calves, Growth rate, Digestibility, Wheat straw and Corncobs.

INTRODUCTION

Exploitation of alternative feedstuffs possibly will provide a means to reduce feed cost and cost of gain in animals. In Pakistan crop residues are extensively used as ruminants feed where grain feeding is not viable (Khan *et al*., 2006) except poultry. However, those are bulky feeds and have poor feeding value for ruminants because of high in fibre and low in energy and minerals contents (Hale and Olson 2001) but is widely used for feeding the animals along with concentrates, green fodders and others (Pandey and Bajpai, 2003). Fortunately ruminants have ability to partially utilize the fibrous material through anaerobic fermentation (Kibria *et al*., 1991) and convert poor quality dry roughages into quality food milk and meat. As dry roughages wheat straw, rice straw, dry grasses, stalks of corn, sorghum and millet etc., are used in ruminants. But wheat straw and rice straw are predominant dry roughages extensively used from 25-50% in animal feeding (Sarwar *et al*., 2002; Khan *et al*., 2006). For fattening of animals usually roughage consumption is limited to about one-fourth to one-third of the total concentrate mixed ration. When animals are fed with low quality roughages, supplemental concentrate containing protein or other energy sources is necessary to improve both roughages utilization and growth performance of animals (Sruamsiri *et al*., 2007).

In the recent past use of combined wheat harvester has increased which left the straw in field (Mirza *et al*., 2008) resultantly, the cost of wheat straw is rising high (>15 Rs/kg of ground wheat straw), so becoming difficult for common farmers particularly during winter to use it in ruminants' diet especially in urban areas of big cities. Factors affecting choice and form of dietary feedstuffs include cost, availability, feeding system and efficiency in achieving potentially higher production and good health (Marshal *et al*., 1992).

Now a day, hybrid corn cultivation trend is increasing for grains (3.5 million tons annually) supplied to poultry industry (GOP, 2011-12). Consequently, it's by product like corncobs (4.5 million tons) are produced abundantly whose cost is very low (<6 Rs/kg of ground corncobs) that is considered being waste and used for fuel purposes. Nutritionally corncobs and wheat straw have 2.42% and 2.21% CP and 7.67% and 9.82% lignin (Azim *et al*, 2000) and 48% and 45% TDN (Lardy and Anderson, 2003), respectively. Therefore, the best evaluation of feed quality is the animal response, in addition to its nutritional value of digestibility, consumption and feed efficiency (Montañez-Valdez *et al*., 2013). Corncobs may be proved as alternate dry

roughage instead of wheat straw. Feed accounts for about 65% (Anjum *et al*., 2012) to 70% (Khan and Sarwar, 2004) of total input costs for calf production, therefore, cost effective feeding program for buffalo calves is needed for profitable beef production. Little information regarding the use of corncobs versus wheat straw as dry roughages in animal feeding is available. The present study, therefore, is planned to compare the replacement effect of wheat straw with corncobs based concentrate along with green fodders on intake, nutrient utilization and growth rate in growing buffalo calves.

MATERIALS AND METHODS

Animals, Feed and Management: For experiment nine growing male buffalo calves of Nili-Ravi breed (age 10 to 12 months and average body weights 160±3.30 kg) were randomly divided into three groups with 3 animals in each group in completely randomized design after de-worming, vaccination and acclimatization to new feed for a period of 15 days. Three mixed diets were formulated as per NRC (2001) by adapting the large dairy breeds calves' nutrient requirements for growth rate of 0.6 kg/day (CP=12% and TDN=68%). Diet A contained 75% DM from concentrate +25% DM from wheat straw; diet B had 75% DM from concentrate +13% DM from wheat straw +12% DM from corncobs while, diet C consisted of 75% DM from concentrate +25% DM from corncobs fed as per NRC (2001) feed requirements (Table I). All calves were offered 7-8 kg/day of available green fodders (oats, maize and millet).

Whole corncobs were obtained from Rafhan Maize Products Co. Ltd. Faisalabad, Pakistan, cleaned them from grains and husks, and ground in a hammer mill of 3-4 inch pieces at Feed Technology Unit, Animal Sciences Institute, National Agricultural Research Center (NARC), Islamabad. Similarly, wheat straw was also ground of same size and mixed in concentrate feed by using paddle mixer.

The calves were housed in individual tie stall in well ventilated, concrete floor and asbestos sheet roof shed. Daily sweeping and cleaning of floors and bathing the calves with fresh ground water was practiced to provide good hygienic environment. Fresh water was offered 4-5 times per day. Growth performance trial on buffalo calves was conducted for 105 days (March to July). Actual amount of feed/fodders offered and refusal by individual animal was recorded daily to obtain net feed intake. Growth rate was examined by weighing calves fortnightly with floor scale with two consecutive days. Feed conversion ratio (FCR) was calculated as kilograms of feed intake per kilogram of gain. Feed cost incurred per unit weight gain was also calculated by using technique of Perrin *et al*., (1979).

Followed by feeding trial a five days total collection method was used to determine the digestibility coefficients and nitrogen balance trial during which calves were fed at 90% of their voluntary feed intake (Begum *et al*., 2010; Anjum, 2011). Feed, orts, faeces and urine (10% of total) samples were collected daily, composited by animal, dried at 60°C in air forced oven, grinded by Wiley mill (2 mm screen). The samples were analyzed for DM, CP and CF according to AOAC (1990) methods. Cell wall fractionation (NDF, ADF, ADL) were determined with the ANKOM fibre analyzer using reagents described by Van Soest *et al*. (1991).

$$\text{Dry matter digestibility (\%)} = \frac{\text{Dry matte intake} - \text{Dry matter out go}}{\text{Dry matter intake}} \times 100$$

Daily urine output was collected in plastic buckets which were acidified by daily addition of 30 ml 6 N HCl to avoid N losses due to ammonia volatilization and to prevent bacterial growth. A representative sample (10%) was taken of each animal for N determination (AOAC, 1990) and N retention estimation.

$$\text{\% N retention (as \% of N intake)} = \frac{\text{N intake} - (\text{Urinary + faecal N loss})}{\text{N intake}} \times 100$$

Statistical analysis: The data were given as means ±SE. The data were statistically analyzed with the standard procedure of analysis of variance according to completely randomized design as described by Steel *et al*., (1997) by using Minitab 15 software. Means were compared by least significant difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

The dry matter content of wheat straw and corncobs was almost similar, however, CP was little higher in wheat straw compared to corncobs. Cell wall fractionation (NDF, ADF, and ADL) values were higher in wheat straw compared to corncobs (Table 1). Three mixed diets i.e., A, B and C were iso-nitrogenous (12% CP) and iso-caloric (68% TDN).

Total dry matter (DM) intake and DM intake as percent body weight did not differ significantly ($P>0.05$) among the buffalo calves groups, however, the total body weight gain or average daily weight gain and feed conversion ratio (FCR) were better ($P<0.05$) in group C compared to group A, however group A and C were not different statistically ($P>0.05$) from group B (Table 2). Average daily weight gain was found to be 0.670, 0.696 and 0.778 kg/head in groups A, B and C, respectively.

Similarly, the FCR (kilograms of feed consumed per kg weight gain) was calculated to be 7.34, 7.49 and 6.92 in groups A, B and C, respectively. The present findings are in line with those of Azim *et al.* (2000) who reported non-significant difference (P>0.05) in dry matter intake but found better (P<0.05) in weight gain and FCR in buffalo heifers when 30% coroncobs was substituted with wheat straw in total mixed rations. Similar results were previously documented by Kerley *et al*. (1985) and Urio and Katogile (1987) who reported that diets containing 30% corncobs and maize stover had no negative effects on growth performance and milk yield, respectively. Rehman *et al.* (2003) reported non-significant differences in dry matter intake between the groups of Sahiwal cows when they were fed whole crop maize or maize stover silage along with commercial concentrates.

Water intake as percent of body weight was not affected (P>0.05) in all calves groups. In the current study, buffalo calves consumed 3.30 to 3.56 litres of water for every one kg of dry matter intake. Generally buffaloes consumed water 4-5 times of DM intake (Banerjee, 1998) but it depends on DM intake, sodium intake, milk yield and environmental temperature (Khan, 2009).

Average nutrient intake of DM, crude protein (CP), crude fiber (CF), neutral detergent fibre (NDF) and acid detergent fibre (ADF) and their digestibility are presented in Table-3. Intake of DM, CP, CF, NDF and ADF by calves of groups A, B and C were non-significantly (P>0.05) difference among the groups. Digestibility of DM, CP and CF was significantly (P<0.05) higher in calves fed diet C compared to calves fed diet A, however, group A and C did not differ from calves fed diet B. Digestibility of cell wall constituents NDF and ADF was significantly (P<0.05) different among the groups. Maximum digestibility of NDF and ADF was found to be in group C and minimum in group A. This might be due to higher lignin content in wheat straw compared to corncobs (11.90 vs 8.65%, respectively). These results matched with findings of Azim *et al*. (2000) who reported higher lignin contents in wheat straw (9.82%) compared to corncobs (7.67%).

Table 1. Ingredient and chemical composition of experimental diets containing two dry roughages sources

Ingredients, %	Mixed Diets*			Roughages		
	A	B	C	Green fodder**	Wheat straw	Corn cobs
Maize grains	15	15	15	-	-	-
Rice polishings	10	10	10	-	-	-
Wheat bran	15	15	15	-	-	-
Maize gluten feed	10	10	10	-	-	-
Cottonseed cake	15	15	15	-	-	-
Molasses	8	8	8	-	-	-
Di-calcium phosphate	1	1	1	-	-	-
Limestone	0.5	0.5	0.5	-	-	-
Salt	0.5	0.5	0.5	-	-	-
Wheat straw	25	13	-	-	-	-
Corn cobs	-	12	25	-	-	-
Total	100	100	100	-	-	-
Chemical composition (% DM)						
Dry matter	89.59	88.94	89.22	32.63	90.97	91.29
Crude protein	11.87	11.69	11.57	6.38	2.21	1.75
Crude fibre	17.63	17.04	16.41	27.48	41.01	36.46
Neutral detergent fibre	33.59	33.95	34.57	-	76.00	79.91
Acid detergent fibre	20.87	20.46	19.88	-	50.15	46.45
Acid detergent lignin	9.325	8.93	8.52	1.50	11.90	8.67
Total Digestible Nutrients***	67.49	67.90	68.45	54.30	43.45	48.80

*Mixed diet A contained 75% DM from concentrate +25% DM from wheat straw; diet B had 75% DM from concentrate +13% DM from wheat straw +12% DM from corncobs while, diet C consisted of 75% DM from concentrate +25% DM from corncobs. During feeding trial, all calves were offered mixed diets on ad-*libitum* along with 7-8 kg green fodders daily.
** Green fodders (oats, maize and millet); ***Calculated values;

Our results of nitrogen (N) intake and losses (faeces and urine) and its retention are presented in Table 3. Nitrogen balance was positive in all calves; however, N retention whether expressed as grams per day or as a percentage of N intake difference was significant (P<0.05) among all groups. Maximum N retention was

observed in calves fed diet C followed by calves fed diets B and A which may be associated with higher faecal and urinary N losses by calves fed diet A, followed by group B and C. Higher lignin in wheat straw reduced digestibility possibly by binding to digestive enzyme and dietary protein (Sniffen *et al*., 1992), consequentially increases N losses through faeces and urine and finally impede N absorption. Other possibility of higher nutrient digestibility in corncobs fed group versus wheat straw fed group may be due to slow fermentation rate of corncobs that might have positive effect on fibre digestation.

The feed cost of live weight gain is mainly relying on cost of feed and efficiency of feed utilization by the animals (Nair *et al*., 2004). In this experiment, cost per kilogram of mixed concentrate was Rs. 25.67; wheat straw Rs. 15.00, corncobs Rs. 6.00 and fodders (oats, maize and millet) Rs. 3.71. Feed cost per unit of weight gain of calves fed diet C was numerically 31.32% and 25.00% less than the calves fed diets A and B, respectively (Table 4). The highest feed cost incurred per unit of weight gain was observed in calves fed diet A (Rs. 129.83) followed by calves fed diet B (Rs. 123.58) and diet C (Rs. 98.86), indicating that the calves of group A and B treatments ate more to gain less weights. The results may be suggested that corncobs can beneficially substitute wheat straw in growing buffalo calves of one year age in terms of better growth rate, feed efficiency, nutrients digestibility and cost effective alternate for profitable calf farming.

Table 2. Growth performance of buffalo calves fed diets containing wheat straw and corn cobs as dry roughages

Description	Mixed diets*		
	A	B	C
Parameters			
Average initial body weight (kg)	158.33±2.36	161.00±4.64	159.67±4.67
Average final body weight (kg)	218.67^{b}±2.59	223.67^{ab}±3.81	229.67^{a}±5.03
Average body weight gain (kg/head)	188.5±2.28	192.33±4.67	194.67±4.49
Average daily DM intake (kg/head)	4.92^{b}±0.15	5.11^{b}±0.12	5.38^{a}±0.11
DM intake % body weight	2.61±0.53	2.66±0.53	2.76±0.62
Average daily weight gain (kg/head)	0.670^{b}±0.02	0.696^{b}±0.04	0.778^{a}±0.01
Feed conversion ratio (FCR)	7.34^{a}±0.03	7.49^{a}±0.20	6.92^{b}±0.03
Water intake % body weight	9.01±0.12	8.78±0.15	9.82±0.19
Water intake (lit) per kg DM intake	3.45±0.13	3.30±0.11	3.56±0.15

*Mixed diet A contained 75% DM from concentrate +25% DM from wheat straw; diet B had 75% DM from concentrate +13% DM from wheat straw +12% DM from corncobs while, diet C consisted of 75% DM from concentrate +25% DM from corncobs. During feeding trial, all calves were offered mixed diets on ad-*libitum* along with 7-8 kg green fodders daily.
±SE= standard error of means

Table 3. Nutrients intake, their digestibility and nitrogen balance in experimental buffalo calves.

Description	Mixed diets*		
	A	B	C
Average daily intake (kg/day)			
Dry matter	4.85±0.14	4.73±0.15	4.95±0.12
Crude protein	0.78±0.17	0.76±0.18	0.79±0.18
Crude fiber	0.85±0.20	0.83±0.10	0.81±0.09
Neutral detergent fibre	1.63±0.65	1.61±0.61	1.72±0.55
Acid detergent fibre	1.01±0.55	0.95±0.30	0.96±0.35
Nutrients digestibility (%)			
Dry matter	59.88^{b}±1.09	62.23^{ab}±1.25	64.48^{a}±0.59
Crude protein	58.81^{b}±3.15	63.13^{ab}±2.55	66.08^{a} ±2.10
Crude fiber	57.20^{b}±1.15	58.92^{ab} ±1.12	62.10^{a}±1.13
Neutral detergent fibre	60.55^{c}±1.05	62.66^{b}±0.56	65.97^{a}±0.44
Acid detergent fibre	57.12^{c}±1.25	60.55^{b}±1.05	63.66^{a}±1.25
Nitrogen retention (g/day)			
Nitrogen intake	120±2.22	120±1.74	126±2.10
Nitrogen outgo (feces+urine)	83.69^{a}±1.85	63.61^{b}±1.71	57.28^{c}±1.70
Nitrogen retention	36.31^{c}±2.10	56.39^{b}±2.00	68.72^{a}±2.00
Retention % of intake N	36.60^{c}±1.08	46.99^{b}±0.76	54.54^{a}±1.02

*Mixed diet A contained 75% DM from concentrate +25% DM from wheat straw; diet B had 75% DM from concentrate +13% DM from wheat straw +12% DM from corncobs while, diet C consisted of 75% DM from concentrate +25% DM from corncobs. During feeding trial, all calves were offered mixed diets on ad-*libitum* along with 7-8 kg green fodders daily. ±SE= standard error of means

Table 4. Feed cost of live body weight gain in growing buffalo calves.

Description	Mixed diets*		
	A	B	C
Dry matter intake (kg/day/head)			
Mixed concentrate	2.67	2.69	2.74
Green fodders (oats, maize and millet)	2.25	2.42	2.64
Total	4.92	5.11	5.38
Cost of feed (Rs/day)**			
Concentrate	51.40	51.79	52.75
Wheat straw	10.01	4.84	--
Corncobs	--	1.94	3.96
Green fodders	25.57	27.44	29.99
Total cost (Rs.)	86.98	86.01	86.70
Average daily weight gain (kg/head)	0.670	0.696	0.778
Feed cost per kg gain (Rs.)	129.82	123.58	98.86

*Mixed diet A contained 75% DM from concentrate +25% DM from wheat straw; diet B had 75% DM from concentrate +13% DM from wheat straw +12% DM from corncobs while, diet C consisted of 75% DM from concentrate +25% DM from corncobs. During feeding trial, all calves were offered mixed diets on ad-*libitum* along with 7-8 kg green fodders daily.
**Cost per kilogram of mixed concentrate was Rs. 25.67; wheat straw Rs. 15, corn cobs Rs. 6 and fodders Rs. 3.71.

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