EFFECT OF INCLUSION OF PALM KERNEL MEAL (*Elaeis guineensis*) IN THE CONCENTRATE MIXTURE ON NUTRIENT UTILIZATION IN GRADED MURRAH BUFFALO BULLS

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ABSTRACT

The present investigation was carried out to study the effect of inclusion of palm kernel meal (PKM) in the diet on intake, mineral balances and nutrient utilization in buffalo bulls. In 4x4 LSD, four graded Murrah buffalo bulls were randomly allotted to four dietary treatments (T_1 to T_4) comprising of green fodder *viz*. Super Napier, paddy straw and concentrate mixture. In the concentrate mixture, palm kernel meal is incorporated at 0 (T_1; Control), 10 (T_2), 15 (T_3) and 20 (T_4) percent levels. All the concentrate mixtures were made iso-nitrogenous. Buffalo bulls in both the groups were fed to meet the nutrient requirements as per ICAR (2013) standards. Inclusion of PKM up to 20% level in the concentrate mixture had no effect (P>0.05) on the digestibility of DM, OM, CP, EE, CF, NFE, NDF, ADF, hemi-cellulose and cellulose as compared to the control. All the buffalo bulls were in positive N, Ca and P balance. The average DMI of buffalo bulls expressed as g/kg $W^{0.75}$ or as % BW was comparable among the treatments. Inclusion of PKM at varying levels in the concentrate mixture had no significant effect (P>0.05) on DCP contents expressed as % in the diet consumed or as g/kg $W^{0.75}$. However, the TDN contents expressed as % in the diet consumed decreased (P<0.05) with increased levels of inclusion of PKM from 0 to 20% level in the concentrate mixtures. Inclusion of palm kernel meal at 10, 15 and 20% level in the concentrate mixtures resulted in decreased feed cost by ₹ 0.73, 1.09 and 1.46 as compared to the control. It is concluded that PKM can be included up to 20% level in the concentrate mixture of buffalo bulls without any adverse effects.

Keywords: *Bubalus bubalis*, buffaloes, buffalo bulls, digestibility, mineral balances, nutrient utilization, palm kernel meal

INTRODUCTION

In recent years, the increase in feed prices and scarcity of grains and vegetable protein supplements has affected both small and large animal production in India. This has forced

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the animal nutritionists to intensify research into the feeding values of potentially useful but unconventional agro-industrial by-products. One such product is oil palm (*Elaeis guineensis*) and is abundantly available for feeding livestock. Several by-products like palm kernel cake (from the kernel), palm press fibre (from the mesocarp layer), empty fruit branch, oil palm trunk and fronds were obtained from the oil palm industry. Of these by-products, palm kernel cake (PKC), also known as palm kernel meal (PKM) is widely used in ruminant diets because of its fibrous nature (Abdullah *et al*., 1995). This is available in large quantities and at competitive prices and can have a major influence in reducing the production cost.

Palm kernel meal (PKM) is the residue obtained after the extraction of palm kernel oil from the seed. It is highly fibrous, and medium grade protein feed. PKM is aflatoxin free, palatable and has considerable potential as carbohydrate and protein sources (Sundu *et al*., 2006). It contains 12 to 23% CP depending upon the efficiency of the process used to extract the oil. As constant supply of PKM was ensured throughout the year and at a relatively low price, it can be used as a good source of protein in the rations of dairy and meat animals. In practice, the response to inclusion of palm kernel meal in ruminant diets has been contradictory and in most studies no response has been reported. The digestibility of DM, CP, EE, NDF, NFC and total carbohydrates were significantly reduced with increased percentage of palm kernel cake in the diet (Silva *et al*., 2013). However, most of the studies reported that inclusion of PKM in the diet had no effect on nutrient digestibility (Tipu *et al*., 2014; Pimentel *et al*., 2015). On the other hand, several studies reported decreased feed cost for ruminants and feed cost / kg gain in poultry (Sese *et al*., 2014). Further, most of the research on feeding of palm kernel cake or meal is conducted in crossbred cattle, sheep and goats while very little work has been conducted in buffaloes.

In light of the above, an attempt has been made to study the effect of inclusion of palm kernel meal at varying levels in the concentrate mixtures on intake and nutrient utilization in buffalo bulls.

MATERIALS AND METHODS

Preparation of concentrate mixtures

A concentrate mixture with 20% CP is prepared by using conventional feed ingredients and is used as control (T_1). In this concentrate mixture, palm kernel meal is incorporated at 10 (T_2), 15 (T_3) and 20 (T_4) percent level. The ingredient composition of concentrate mixtures is furnished in Table 1. All the concentrate mixtures were made iso-nitrogenous.

Animals, feeding regime, housing and management

In 4x4 LSD, four graded Murrah buffalo bulls (b. wt. 297.14±5.01 kg) were randomly allotted to four dietary treatments (T_1 to T_4) comprising of green fodder *viz*. Super Napier, paddy straw and concentrate mixture. The animals were housed in well ventilated conventional sheds. Each period of a Latin square consisted of a 21 days preliminary period and 7 days collection period. During the trial period, the buffalo bulls were offered 10 kg green fodder, 3.5 kg ground paddy straw and 1 kg respective concentrate mixtures to meet the maintenance requirements (ICAR, 2013). The green fodder was offered in chopped form while paddy straw was offered in ground form by using chopper cum grinder. The concentrate mixtures were mixed with ground paddy straw and the

buffalo bulls were fed respective diets at 9.00 AM and 3.00 PM all through the experimental period. Clean, fresh drinking water was made available throughout the trial period. During the metabolism trial, the amount of feed offered, faces and urine voided were recorded. Daily representative samples of feed, faeces and urine were collected and pooled animal wise.

Analytical procedures

The samples were analyzed for proximate constituents (AOAC, 2007) and fibre fractions (Van Soest *et al*., 1991). Estimation of Ca and P in feed and faeces was also done (Talapatra *et al*., 1940) and Ca and P in urine were analysed as per the methods described by Ferro and Ham (1957) and Fiske and Subba Row (1925), respectively.

Statistical analysis

The data were analyzed statistically (Snedecor and Cochran, 1994) and tested for significance by Duncan's multiple range test (Duncan, 1955) using SPSS 24.0 version.

RESULTS AND DISCUSSION

The chemical composition of palm kernel meal (PKM) and concentrate mixtures containing varying levels of PKM were shown in Table 2.

The apparent nutrient digestibility coefficients in buffalo bulls under different dietary treatments were presented in Table 3. Inclusion of PKM up to 20% level in the concentrate mixture had no effect (P>0.05) on apparent DM digestibility of buffalo bulls as compared to the control. This indicates that the high content of fibrous fractions of PKM at respective levels in the concentrate mixtures did not interfere with the DM digestibility. In line with the present findings, Fereira *et al*. (2012) reported that inclusion of PKC at 0, 7, 14, 21 and 28% level in concentrate diet had no effect (P>0.05) on apparent DM digestibility in Holstein x Zebu cattle. Similar findings were also reported earlier (Chanjula *et al*., 2011; Abubakr *et al*., 2013; Cunha *et al*., 2013). On the contrary, Tipu *et al*. (2014) reported that apparent digestibility of DM decreased (P<0.05) in growing Nili-Ravi buffalo male calves with increased level of inclusion of PKC from 0 to 30% in the concentrate diet.

The present study revealed that increasing the level of inclusion of PKM from 10 to 20% in the concentrate mixture had no effect (P>0.05) on OM, CP, EE, CF and NFE digestibility as compared to the control. Corroborating the findings of the present study, several authors (Adesehinwa, 2007; Chanjula *et al*., 2011; Fereira *et al*., 2012; Abubakr *et al*., 2013; Cunha *et al*., 2013) reported no effect (P>0.05) on OM, CP, EE, CF and NFE digestibility with inclusion of PKM in the diet. Inclusion of PKM up to 20% in the concentrate mixtures had no effect (P>0.05) on apparent NDF, ADF, hemi-cellulose and cellulose digestibility in buffalo bulls as compared to the control (Table 3). Similar findings were also reported earlier (Fereira *et al*., 2012; Cunha *et al*., 2013; Pulliah, 2013). In contradiction to present findings, Abubakr *et al*. (2013) reported increased (P<0.01) NDF and ADF digestibility in goats fed PKC in concentrate diets as compared to the control. Palm kernel cake is a supplemental ingredient with high NDF (73.47%) and ADF (38.01%) content. This may be attributed to the numerically lower digestibility of diets, though not significant (P>0.05) with increasing levels of PKM in the concentrate mixtures for buffalo bulls.

The average DMI of buffalo bulls expressed as g/kg $W^{0.75}$was similar among the treatments

Table 1. Ingredient composition of concentrate mixtures.

Ingredient	CM - 1	CM - 2	CM - 3	CM - 4
Maize	32.5	27.0	24.5	21.5
DORB	39.0	37.5	36.5	36.0
Cotton seed Meal	25.5	22.5	21.0	19.0
Palm Kernel Meal	0.0	10.0	15.0	20.0
Mineral mixture	2.0	2.0	2.0	2.0
Salt	1.0	1.0	1.0	1.0
Total	100	100	100	100
Cost / kg (₹)	15.90	15.17	14.81	14.44

Table 2. Chemical composition of palm kernel meal and concentrate mixture.

Nutrient	PKM	CM-1	CM-2	CM-3	CM-4
Dry matter	87.05	89.82	91.37	89.78	90.24
Organic matter	94.76	89.90	88.54	88.0	87.08
Total ash	20.50	10.10	11.46	12.0	12.92
Crude protein	0.62	20.00	20.00	20.00	20.00
Ether extract	18.82	1.36	1.28	1.24	1.20
Crude fibre	45.18	9.37	10.47	10.99	11.56
Nitrogen free extract	5.23	59.17	56.79	55.78	54.32
Neutral detergent fibre	73.47	26.71	31.46	33.8	36.2
Acid detergent fibre	38.01	12.32	15.08	16.44	17.85
Hemi-cellulose	35.46	14.39	16.37	17.36	18.35
Cellulose	17.45	6.5	7.62	8.17	8.73
Acid detergent lignin	18.2	3.74	5.21	5.95	6.69
Silica	0.9	1.6	1.56	1.54	1.52
Calcium (%)	0.31	0.34	0.35	0.36	0.37
Phosphorus (%)	0.72	0.92	0.93	0.93	0.93

Values are on dry matter basis except for CP.

Table 3. Effect of inclusion of PKM in the concentrate mixture on intake and digestibility of nutrients in buffalo bulls.

Particulars	T_1	T_2	T_3	T_4
Dry matter	58.78±0.37	57.75±0.41	56.89±1.29	56.20±1.04
Organic matter	64.71±0.35	64.04±0.15	63.40±1.01	62.91±0.73
Crude protein	65.54±2.17	64.16±4.16	62.46±1.66	61.56±2.07
Ether extract	72.69±0.37	72.45±0.55	71.77±0.59	70.99±0.65
Crude fibre	64.60±0.59	63.93±0.82	63.18±1.05	62.25±0.68
Nitrogen free extract	65.34±1.60	62.30±2.68	61.09±1.80	59.97±1.83
Neutral detergent fibre	63.97±0.89	62.90±1.27	60.47±1.93	59.22±1.76
Acid detergent fibre	56.63±1.63	55.71±1.78	52.54±2.25	51.42±1.96
Hemi cellulose	75.92±1.33	74.57±0.40	73.33±1.52	71.88±1.44
Cellulose	65.04±1.64	63.07±2.08	62.40±2.32	61.11±2.31
Nutrient intake (g/kg $W^{0.75}$)				
DM	84.15	84.47	84.36	84.70
DCP	5.15	5.03	4.93	4.88
TDN	45.15	43.78	42.92	42.33
Plane of nutrition				
DCP (%)	2.66	2.60	2.53	2.49
TDN* (%)	53.64^{b}	51.82^{ab}	50.84^{a}	49.94^{a}
DE* (M Cal/kg)	14.85^{b}	14.39^{ab}	14.07^{a}	13.85^{a}
ME* (M Cal/kg)	12.18^{b}	11.80^{ab}	11.55^{a}	11.36^{a}

Values in the rows bearing different superscripts differ significantly (*P<0.05).

Table 4. Nutrient balances in buffalo bulls fed diets containing PKM at varying levels in the concentrate mixture.

Particulars	T_1	T_2	T_3	T_4
N intake (g/d)	94.07	94.07	93.87	94.07
N excretion in faeces (g/d)	32.42±2.04	33.72±3.91	37.13±1.18	44.23±4.48
N excretion in urine (g/d)	15.95±3.86	16.82±2.02	15.96±2.14	14.51±0.52
N balance (g/d)	45.71±2.27	43.54±3.24	40.78±2.56	35.33±4.87
N retention as % intake	48.59±2.41	46.28±3.45	43.44±2.72	37.55±5.17
Ca intake (g/d)	76.50	76.59	76.74	76.84
Ca excretion in faeces (g/d)	30.83±3.00	31.45±3.80	33.61±3.64	34.94±3.13
Ca excretion in urine (g/d)	11.58±1.30	11.74±1.11	11.30±1.27	11.27±0.86
Ca balance (g/d)	34.09±2.19	33.40±2.70	31.84±2.79	30.63±2.67
Ca retention as % intake	44.56±2.87	43.61±3.53	41.49±3.63	39.86±3.48
P intake (g/d)	55.05	55.15	55.15	55.15
P excretion in faeces (g/d)	11.19±0.60	10.35±0.62	10.13±0.79	11.26±0.58
P excretion in urine (g/d)	7.41±0.14	8.51±0.45	8.90±1.00	8.71±0.90
P balance (g/d)	36.45±0.51	36.29±0.37	36.12±0.90	35.18±0.73
P retention as % intake	66.21±0.93	65.80±0.68	65.49±1.64	63.80±1.33

Values in the rows bearing no superscripts do not differ significantly ($P>0.05$).

and was comparable to the values recommended by ICAR (2013) standards. This indicates that the diets are palatable and that inclusion of PKM in concentrate mixture up to 20% level had not affected the palatability. Similarly, inclusion of PKM in the concentrate mixtures had no effect (P>0.05) on the DCP (%) content reflecting the CP digestibility observed in the present study. These results agree with the findings of Pullaiah (2013) in both sheep and goats, who reported that inclusion of PKC at 20% level in complete rations containing red gram bhoosa as roughage source had no effect (P>0.05) on DCP content expressed as % in diet or as g/kg $W^{0.75}$. The TDN (%) content decreased (P<0.05) with increased levels of inclusion of PKM from 10 to 20% in the concentrate mixtures as compared to the control (Table 3). Though not significant (P>0.05), the numerically lower nutrient digestibilities recorded in bulls fed rations containing varying levels of PKM in concentrate mixtures (Table 3) might have resulted in lower (P<0.05) TDN content compared to the control. On the contrary, several researchers reported no effect (P>0.05) on TDN intake up on feeding PKM in the diets (Macome *et al*., 2011; Fereira *et al*., 2012; Cunha *et al*., 2013; Silva *et al*., 2013; Pimentel *et al*., 2015). The DE and ME intakes (Mcal) reported in the present study followed similar trend as observed with TDN intakes. Further, it is observed that all dietary treatments recorded higher DCP and TDN intakes (kg/d) when compared to that recommended by ICAR (2013).

All the buffalo bulls were in positive nitrogen, calcium and phosphorous balance indicating that all the diets supplied required quantity of respective nutrients and that the nutrients absorbed were fully utilized by the animals (Table 4). Inclusion of PKM up to 20% level in the concentrate mixture of buffalo bulls had no effect (P>0.05) on the retentions of N, Ca and P expressed as g/d or as % intake. Similarly, no effect (P>0.05) on N retention up on feeding PKC in the diet was reported by Chanjala *et al.* (2011) in goats and Pullaiah (2013) in both sheep and goats. Further, increased levels of inclusion of PKM from 10 to 20% in the concentrate mixtures resulted in decreased cost of concentrate feed by ₹ 0.73, 1.09 and 1.46 in T_2, T_3 and T_4, respectively as compared to the control (T_1).

CONCLUSION

Thus, it is concluded that palm kernel meal (PKM) can be incorporated up to 20% level in the concentrate mixtures to decrease the cost of production and can be fed to buffalo bulls without any adverse effects.

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