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Effect of Feeding Maize Oil Cake on Feed Intake, Body Weight and Economics in Goat Kids

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ABSTRACT

Eighteen Beetal male kids were randomly divided into three groups of 6 animals each. The kids of group I were maintained on basal ration comprising of green fodder, gram straw and concentrate mixture. Maize oil cake was included in the ration of group II and group III @ 15% and 30% of concentrate mixture, respectively. The feeding trial lasted for a period of 120 days. Body weight changes and feed intake of animals were recorded at fortnightly intervals. The dry matter intake (DMI) recorded every fortnight did not vary significantly between the groups. The body weight gain over 120 days and average daily weight gain (ADG g) was found significantly ($P<0.05$) higher among the groups offered maize oil cake @ 15% and 30% of the concentrate. The mean values of nutrient intake (g/day) i.e DCP and TDN of experimental kids under different dietary treatments differed significantly and were highest in group III followed by group II and group I. The feed cost per kg body weight gain was reduced by 2.7% in T2 (15% maize oil cake) and 4.3% in T3 (30% maize oil cake) group respectively. Results of the study showed that inclusion of maize oil cake increased body weight gain as well as reduced the cost of feeding male kids per kg weight gain.

KEYWORDS : Beetal kids, Body weight, Feed intake, Maize oil cake

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INTRODUCTION

Goat meat popularity is increasing worldwide due to a growing demand for lean and nutritious meat. It is a great source of nutrients, including protein, iron, vitamin B_{12}, zinc, potassium as well as low in total fat and saturated fat compared with other forms of red meat (Pophiwa et al., 2020). Goat kids grow rapidly, have similar digestive system to other ruminants, are relatively small and easy to handle. All these characteristics make them a convenient choice for field experiments. Nutritional inadequacy for livestock is currently referred as one of the most burning global problems of agricultural countries (Katoch, 2022) due to reasons like degraded grazing lands as a result of industrialization and urbanization, diversion of feed and fodder for industrial and human use, seasonal scarcity of fodder and rising national demand for animal protein.

Maize oil cake is one such agricultural by-product obtained after extraction of maize oil from full-fat maize germ, a co-product of the starch industry (Toghdory et al*.,* 2024). Maize germ is separated, dried, and sent to a germ plant for extraction of the corn oil. After the oil is extracted, the remaining feed by-product is called maize oil cake, which used as an energy source in animal nutrition (DeTray, 2016) and rich in nutrients (protein & fat), has excellent functional properties and can be used as a concentrate source in the livestock (Bakke and Vickers, 2007).Crude protein content of corn germ meal varied from 10.13 (Ramos et al., 2007) to 24.79 (Almeida et al*.,* 2012). Ether extract content of corn germ meal varied from 0.2 (Beran et al., 2007) to 49.48 (Albuquerque et al., 2014).DDGS and maize oil cake have been recognized as an excellent source of energy due to their high digestibility and high concentration of fat (Jun et al*.,* 2014).The product's ease of availability, reasonable market pricing, and high protein and oil content necessitates a trial for goat feeding. Present research was undertaken to study the effects of dietary inclusion of maize oil cake on feed intake, body weight gain and economics of feeding kids.

MATERIALS AND METHODS

The animal experiment was conducted in accordance with guidelines approved by the

Institutional Animal Ethics Committee, 12/CPCSEA Dated 29.10.2022 via protocol number IAEC/ LUVAS/26/10 in the Department of Animal Nutrition, Lala Lajpat Rai University of Veterinary & Animal Sciences, Hisar. Eighteen Beetal kids of comparable body weight were randomly divided into three groups of 6 in each and average body wight of kids among three groups were 15.85 kg for T1, 15.81 kg for T2 and 15.89 kg for T3.. An adjustment period of fifteen days was given before the start of experiment. All the kids of group I i.e control (T1) was maintained on basal ration comprising green fodder, gram straw and concentrate mixture (Maize grain, groundnut cake, barley, mineral mixture and common salt in the ratio of 35: 35: 27: 2: 1). The experimental diet of group T2 was included with maize oil cake @15% of the concentrate mixture (Maize grain, groundnut cake, barley, maize oil cake, mineral mixture and common salt in the ratio of 30: 29: 23: 15: 2: 1)while maize oil cake was included @ 30% of the concentrate mixture in the diet of group T3 (Maize grain, groundnut cake, barley, MOC, mineral mixture and common salt in the ratio of 23: 26: 18: 30: 2: 1).The diets were kept iso-nitrogenous. Table 1 depicts the chemical composition of different feedstuffs used in preparing the experimental diets. Feeding trial lasted for a period of 120 days and kids were fed as per ICAR, 2013. Feed intake was calculated at fortnightly intervals. The kids were weighed individually at fortnightly intervals before feeding and the body weights were recorded to calculate body weight gain up to 120 days of the experimental period. Economics of feeding under different dietary treatments was calculated by taking into account daily feed consumption and by considering the cost of feed, fodder and supplements used.

At the end of the feeding trial, a metabolism trial of 5 days duration was conducted to assess the effects of dietary inclusion of maize oil cake on growth performance in kids. A preliminary period of 3 days was given for adaptation of the kids to new system of housing and management, followed by a collection period of 5 days. The proximate composition of feed and faecal samples was determined (AOAC, 2013).

Table1. Chemical composition of feeds offered to experimental kids offered (%DM basis) of experimental diet

Feed offered	Chemical composition (%DM basis)					
	DM	CP	EE	CF	Total Ash	NFE
Green fodder	17.42	7.97	2.65	26.31	9.53	53.5
Gram straw	91.27	5.52	1.59	38.41	7.67	46.8
Conc. Mix. T1	90.55	20.07	4.16	5.84	6.52	65.4
Conc. Mix. T2	90.63	20.2	5.32	6.14	6.11	64.2
Conc. Mix. T3	92.75	20.1	6.56	6.56	5.81	62.9

Statistical analysis

Data were analyzed statistically using general linear model procedure of operational statistics, Statistical Package for Agricultural Scientists (OPSTAT) and comparison of means tested using Duncan's multiple range test (DMRT) and significance was considered at $P< 0.05$ (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

Feed intake

Present study revealed no significant effect of maize oil cake inclusion on feed intake (Table 2) amongst different treatment groups, although, numerically it was higher in kids fed maize oil cake. The DMI recorded every fortnight (kg/animal/day) amongst all treatment groups was also found similar statistically, which shows that maize oil cake had no negative impact on palatability and intake of feed in kids, rather it slightly increased the intake by making it more palatable. Furthermore, during metabolic trial dry matter consumption in terms of grams, percent body weight (% BW) and grams per kg metabolic body weight ($g/kgW^{0.75}$) also did not differ significantly and were determined to be equivalent (Table 3).

The results in the current study were in agreement with Toghdory et al. (2024) who reported no significant difference between the experimental treatments (control and groups in which soybean meal was replaced with 50% and 100% corn germ meal) in terms of dry matter intake in lambs(P>0.05). Similarly, Bakshi et al.(2023) found comparable daily DM intake in both the groups i.e control group and maize processing industry byproducts fed cattle group. Noormohammadi et al.(2022) also reported that treatments fed corn germ to Holstein cows @12% of DM had similar dry and organic matter intake to control group. A study conducted by Kaur et al. (2019)to assess the effect of partial replacement of soybean meal and mustard cake with corn germ meal (CGM) @ 12% and 18 % in the concentrate mixture in male crossbred calves, also reported that the overall mean DMI (kg/animal/day) in control, T1 and T2 groups was similar and did not vary significantly. Kumar et al. (2018), also reported that dry matter intake did not vary significantly among different groups when the crossbred calves were fed maize germ oil cake at 1.3, 1.7 and 2.1 kg/day levels for 28 days. Furthermore, Miller et al.(2002), reported that dry matter intake did not differ among the experiment diets of control (at 3.5% fat), whole cottonseed (at 5.1% fat), tallow (at 5.1% fat) and full-fat corn germ (at 5.1% fat) in lactating dairy cows during feeding trial of 28 days. Similarly, Detray (2016) concluded that there was no significant effect of corn germ meal at 24.5% inclusion level with increasing levels of nucleotide additive (0, 2 and 4 g/d) on dry matter intake during 85 days experimental period in crossbred heifers.

However, Galaeno et al. (2022) found increased DM intake in goats fed extra-fat whole corn germ @9.5% of DM. Likewise, Zeeshan et al.(2022) found increased feed intake in goat in groups fed maize oil cake than the control group goats and reason behind this is perhaps the palatability of oil seed cakes.Sulpizio et al.(2003), also reported that dry matter intake was greater (P= 0.10) for cattle fed corn germ (16.4 lb/day) than for those fed tallow (16.4 lb/day) for 110 days. Kelzer et al.(2009) also reported that the DMI in Holstein cows fed dehydrated corn germ meal (24.3kg/d) was higher (P<0.05) than control group (22.9kg/d) during the experimental period of 21 days. Inconsistency in the obtained results may be related to the different species in different experiments and fat content of the used CGM in each study.

Table 2. Mean values of feed intake (g/d, DM basis) of growing kids at fortnight interval under different dietary treatments

Period fortnightly	Treatments		
	T1	T2	T3
	Feed intake (g/d)		
1st	536.21±16.6	553.71±17.2	568.75±26.9
2nd	568.73±19.5	593.92±15.2	605.50±21.3
3rd	627.00±20.7	649.00±15.03	687.03±21.3
4th	673.20±19.7	699.32±15.3	736.67±21.9
5th	725.72±20.7	755.08±15.2	794.69±22.2
6th	793.80±22.2	808.13±15.5	837.43±21.6
7th	835.50±21.0	870.77±14.1	890.31±20.01
8th	874.90±20.1	907.69±15.4	936.50±20.9
Overall Mean feed intake (g/d)	711.81±20.3	735.09±20.1	769.59±20.1

Nutrient intake

The mean values of nutrient intake (g/day) of experimental rations under different dietary treatments has been presented in Table 3. Statistical analysis of the data revealed that TDN intake (g/d) differ significantly (P<0.05) in dietary treatments T2

and T3 as compared to the control group. Similarly, DCP intake(g/d)of maize oil cake containing treatment groups (T2 and T3) also differ significantly (P<0.05) as compared to the control group. The mean values of DCP and TDN intake were highest for 30% maize oil cake added groups followed by 15% MOC fed group and lowest for the control group.

Results of present study were in agreement with Silva et al.(2023) reported that cows fed corn germ quadratically increased (p<0.05) intake of dry matter, crude protein, and total digestible nutrients, and linearly reduced (p<0.05) the intake of total non-fiber carbohydrates. Somashekhar. (2013) who fed corn germ meal to rabbits, also found increased DCP% in group II than group III and group I and higher TDN % in the groups III followed by group II and group I. Similarly, Nagpure.(2011) evaluated nutritional value of corn germ meal based diets in rabbit by substituting 25% and 50% of GNC protein with expeller pressed CGM on nitrogen equivalent basis in group T2 and T3 respectively and found highest TDN% in group T3 followed by group T2 and T1.

Table 3. Mean nutrient intake (g/day) of experimental kids under different dietary treatments

Attributes	Treatments			CD value
	T1	T2	T3	
		Nutrient intake		
DMI (g/d)	878.42±20.1	910.62±15.4	947.63±20.9	-
DMI (% BW)	3.33± 0.02	3.34±0.02	3.35± 0.03	-
DMI(g/kgW.75)	74.73± 0.63	75.19± 1.01	75.41± 0.75	-
DCP (g)*	79.38^{a}±1.56	88.78^{b}±1.73	90.93^{c}±1.12	4.75
TDN (g)*	619.71^{a}±14.2	655.89^{b}±19.5	696.34^{c}±19.2	40.57

abc*Mean bearing different superscripts in a row differ significantly (P<0.05)

Body weight changes

The body weight of kids at the beginning of experiment was similar in all the three treatment groups whereas body weight at the end of 120 days experimental period was found significantly (P<0.05) higher of kids fed maize oil cake @ 15% and 30%than the control kids (Table 4). The total body weight gain during experimental period significantly (P<0.05) increased in kids supplemented with 30%maize oil cake, followed by treatment group supplemented with 15%maize oil cake as compared to control group. Average daily gain was also observed significantly (P<0.05) higher in groups with maize oil cake i.e . 106.11g in T_3 followed by 98.06g in T2than the control group (90.48g). Increase in body weight gain may be due to increased ether extract content of diet containing maize oil cake due to its high EE content (12.1%) and increased intake of DCP and TDN in the groups fed maize oil cake.

The results of the present study are in agreement with Brunelli et al.(2006), who reported significant (p<0.01) increase in weight gain of birds with increasing level of defatted corn germ meal inclusion in the diets. Likewise, Somashekhar.(2013) also found significantly higher growth rate in rabbits in which 50% wheat bran was substituted by corn germ meal.

However, in contrary Toghdory et al.(2024), indicated that replacing soybean meal with corn germ meal in the diets of fattening lambs did not significantly affect body weight gain on days 28, 56, and 84. Additionally, total body weight and daily weight gain throughout the experimental period were unaffected by the dietary replacement. Likewise, Leeuw et al.(2009), reported no significant difference in the steer weight when the steers were fed defatted maize germ meal at 0, 25, 50, 75 and 100% levels, replacing hominy chop for 124 days. Jun et al.(2014) also reported that replacing forage fiber sources with non forage sources from dried distiller grains with solubles and corn germ meal at 0, 9, 18 and 27% had no effect on the average body weight in Holstein calves. Furthermore, no effect (P> 0.05) of dietary corn germ meal was found on the body weight, average daily gain in meat ducks during the experimental period by Qi et al. (2022).Contrary to

these findings, Strighini et al.(2009), observed significant ($p<0.05$) decrease in body weight gain with increasing level of corn gluten meal inclusion in diets.

Table 4. Mean values of Body weight (kg) of growing kids at fortnight interval under different dietary treatment

Fortnight Weight(kg)	Treatments		
	T1	T2	T3
Initial Body Weight	15.85±0.55	15.81±0.50	15.89±0.55
1st	16.99±0.56	16.96±0.55	17.18±0.59
2nd	18.09±0.60	18.31±0.52	18.64±0.63
3rd	19.30±0.89	19.71±0.30	20.40±0.15
4th	20.66±0.66	21.20±.46	22.19±.70
5th	22.09±0.65	22.88±0.46	23.97±0.70
6th	23.64±0.63	24.40±0.45	25.70±0.66
7th*	25.17^{a}±0.61	26.14^{b}±0.45	27.14^{c}±0.62
8th*	26.71^{a}±0.61	27.81^{b}±0.46	29.22^{c}±0.63
ADG(g)*	90.48^{a}±0.72	98.06^{b}±0.44	106.11^{c}±0.93
Total Gain(kg)*	10.85^{a}±0.08	12.00^{b}±0.05	13.33^{c}±0.11

abc*Mean bearing different superscripts in a row differ significantly ($P<0.05$)

Economics of feeding

The cost of concentrate mixtures fed to calves in control, 15% and 30%maize oil cake included groups was worked out to be Rs. 12.43/kg, Rs. 13.39/kg and Rs. 14.18/kg, respectively (Table 5). The total weight gain during the experimental period was higher($P < 0.05$) in maize oil cake containing groups than the control group. Thus, inclusion of maize oil cake at 15% and 30% levels resulted in lower cost of feeding /kg body weight gain by 2.7% and 4.3%, respectively. Feeding maize oil cake at both levels turned out to be economical and profitable as per the results obtained.

The results are in agreement with Moreira et al.(2002), who carried out the economic analysis of defatted corn germ meal (DCGM) in crossbred pigs in the growing and finishing phases, and observed that there was no effect ($P> 0.05$) on the average cost per kg of live weight. Similarly, Kaur et al.(2019) concluded that inclusion of CGM at 12% and 18% levels partially replacing SBM/MC resulted in a net saving of Rs. 0.43 and Rs. 3.86 per kg BW gain in T1 and T2 groups, respectively.

Table5. Economics of feeding (Rs/day) of growing kids under different dietary treatments

Attributes	Treatments		
	T1	T2	T3
Cost of concentrate mixture	12.4	13.4	14.2
Cost of green fodder	2.64	2.74	2.83
Cost of dry fodder	0.92	0.98	1.13
Total cost of feeding	15.9	16.9	17.92
Av. BW gain (g/d)	90.4	98.81	106.25
Cost of feeding (Rs/Kg BW gain)	176.71	171.89	169.10
Relative Profit	0.00	2.7%	4.3%

CONCLUSION

Maize oil cake inclusion at 15 and 30 % levels in concentrate mixture did not have any negative impact on feed intake. Further, it improved body weight gain in kids as well as reduced the cost of feeding/kg body weight gain ration more economical for rearing goat kids.

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