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Effect of malt sprouts on nutrient intake and economics of feeding in Beetal goat kids

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Abstract
The present study was conducted to evaluate the effect of inclusion of malt sprouts as an alternate protein source in the diet of Beetal goat kids on nutrient intake and economics of feeding. Conventional concentrate mixtures for goat kids was prepared. Malt sprouts were included in the concentrate mixture at 0, 10, 20 and 30% level to formulate four iso-nitrogenous concentrates. Twenty beetal goat kids were randomly distributed into four groups of five animals each (designated as C, T1, T2 and T3) and a 60-day trial was conducted on Beetal goat kids. The animals of each group were fed diet consisting of green fodder and respective concentrate mixture. Intake of nutrients (DM, OM, CP, EE, NDF) was higher ($p<0.05$) in T1 group than other groups. Malt sprouts inclusion at 10% level in the diet of T1 group resulted in net saving of Rs. 9.82 per kg body weight gain as compared to control group. It was concluded that malt sprouts is cost effective and could be economically included upto 10% in the concentrate mixture of goat kids without any adverse effect on nutrient intake of animals.

Keywords: Malt sprouts, beetal goat kids, nutrient intake, economics

1. Introduction

Livestock plays an important role in Indian economy. Two-thirds of rural communities rely on livestock for their livelihood. It also employs around 8.8% of India's population. The livestock industry makes a major contribution to the socioeconomic growth of rural families. It accounts for around 6% of GDP and 25% of agricultural GDP. The overall livestock population has increased by 4.6 percent from the previous census, according to the 20th Livestock Census. In 2019, the country's goat population was estimated to be 148.88 million, up 10.1% from the previous census. Punjab has a total goat population of 3.48 lakhs (National Livestock Census, 2019) [1]. One of the key issues is increasing the production of farm animals. Agricultural by-products and residues provide a significant portion of the energy required by livestock. India has an 11% shortage in dry fodder, a 35% shortage in green fodder, and a 28% shortage in concentrate feed. Quantitatively and qualitatively, the common grazing pastures have been deteriorating. It is, therefore, desirable to augment alternative feed resources, particularly those not being used for human consumption, to meet the rise in the demand for animal protein. In India, the brewery is considered a developing and promising sector. Besides its primary produce- beer, this sector releases several products, such as malt sprouts, brewers' yeast etc. Malting is the controlled germination of cereal grains, typically barley or sorghum, followed by appropriate drying to yield a usable extract. Malt extract from germinated cereal seeds leaves a residue of shoots and roots known as malted sprouts. Malting leads to an increase in the nutritive value of grains. Moreover, various anti-nutritional factors are eliminated during germination (Girma and Gebremariam, 2018) [2]. Therefore, keeping in view the above points, a comprehensive study is proposed to evaluate the nutrient intake and economics of malt sprouts in the diet of goat kids.

2. Material and Methods

2.1 Chemical analysis

The finely ground feed ingredients (malt sprouts, conventional feed ingredients and green fodder) were analyzed for proximate principles as per AOAC (2007) [3], total carbohydrates as per Sniffen *et al.* (1992) [4] and cell wall constituents as per Van Soest *et al.* (1991) [5]. Estimation of nitrogen fractions (acid detergent insoluble nitrogen and neutral detergent insoluble nitrogen) was done according to Licitra *et al.* (1996) [6].

2.2 Selection, distribution and maintenance of animals
Conventional concentrate mixtures for goat kids was prepared. Malt sprouts were included in these concentrate mixtures at 0, 10, 20 and 30% level. Twenty Beetal goat kids were randomly distributed into four groups of five animals each. A 60-day growth trial was conducted on beetal goat kids. The animals in each group were fed as per ICAR (2013) [7] feeding standard. The animals in control group (C) were fed with basal diet consisting of green fodder (mixture of berseem, oats, shaftal, rye grass) and conventional concentrate mixture. The animals in experimental groups T1, T2 and T3 groups were fed green fodder, and concentrate mixtures in which malt sprouts included at 10%, 20% and 30% levels, respectively. The daily record of feed intake and orts was maintained. The animals were weighed for 3 consecutive days at every fortnight interval and the feeding schedule was revised accordingly.

2.3 Economic evaluation
Cost of feeding malt sprouts in experimental groups was taken into account by calculating dry matter intake, cost of concentrate, cost of fodder and cost of malt sprouts. Net profit per kg body weight gain was calculated for all groups.

2.4 Statistical analysis
Data were analyzed by simple ANOVA, as described by Snedecor and Cochran (1994) [8], by using SPSS (2012) [9] version 21. The differences in means were tested by Tukey's b.

3. Results and Discussion
3.1 Chemical composition of malt sprouts and conventional feed ingredients
The chemical composition of ingredients used in the experiment is given in Table 1. The organic matter (OM) content of malt sprouts was 93.23% which was almost similar to wheat bran (94.86%). The OM content of deoiled rice bran (DORB), rice polish, soybean meal (SBM) and maize was 88.38%, 91.03%, 89.91% and 95.83%, respectively. Nagadi (2019) [10] reported that malt sprouts contained 96.1% OM which was higher than the current study. The crude protein (CP) content of malt sprouts was 20.97% which was close to DORB (19.12%). The CP content of rice polish, wheat bran, SBM and maize was 15.36%, 14.89%, 42.84% and 13.88%, respectively. The CP content of malt sprouts in the current study was higher than that reported by Farghaly *et al*. (2019) [11] and Nagadi (2019) [10] which was 15.23% and 15.20%, respectively. The ether extract (EE) content in malt sprouts was 1.40% which was similar to SBM (1.35%). The EE content in DORB, rice polish, wheat bran and maize was 0.65%, 9.2%, 3.36% and 3.24%, respectively. Helal (2015) [12] reported EE in malt sprouts as 2.68% which was slightly higher than that reported in the current study. The total ash content in malt sprouts was 6.88% while DORB, rice polish, wheat bran, SBM and maize contained 11.61%, 8.96%, 5.13%, 10.18% and 4.16% total ash, respectively. Mohsen *et al*. (2015) [13] reported total ash content of malt sprouts to be 3.60% which was lower than the current study.
The NDF content of SBM (35.40%) was less than malt sprouts (69.60%). While DORB, rice polish, wheat bran and maize contained 50.50%, 36.90%, 61.60% and 36.14%, respectively. Creasy *et al*. (2001) [14] and Nurfeta and Abdu (2014) [15] reported 44.00% and 54.00% NDF in malt sprouts which was less than the current study. ADF content in malt sprouts, DORB, rice polish wheat bran, SBM and maize was 25.13%, 21.45%, 24.45%, 20.90%, 21.85% and 6.35%, respectively. Nurfeta and Abdu (2014) [15] and Creasy *et al.* (2001) [14] reported 18.70% and 21.00% ADF in malt sprouts which was lower than that in the present study.
The hemicellulose content in malt sprouts, DORB, rice polish, wheat bran, SBM and maize was 44.30%, 29.05%, 12.45%, 40.70% 13.55% and 29.79%, respectively. ADL content in malt sprouts and maize was 3.30% and 1.35% respectively. The ADICP content in malt sprouts was 3.68% while DORB, rice polish, wheat bran, SBM and maize contained 6.80%, 6.41%, 11.07%, 7.57% and 0.94% ADICP, respectively. The NDICP content in malt sprouts (13.22%) was similar to DORB (13.41%). While rice polish, wheat bran, SBM and maize contained 7.18%, 4.66%, 15.74% and 6.80%, respectively. The total carbohydrate content was 77.72%, 75.20%, 69.53%, 77.79%, 46.17% and 83.42% in malt sprouts, DORB, rice polish wheat bran, SBM and maize, respectively.

3.2 Chemical composition of feedstuffs offered during trial, % DM basis
The DM in control, T1, T2 and T3 concentrate mixtures was 94.00, 93.00, 95.00 and 91.00%, respectively (Table 2). The DM in green fodder was 20.05%. The OM content of concentrate mixtures was 93.95, 93.90, 94.30 and 94.15 in control, T1, T2 and T3 concentrate mixtures, respectively. The OM content of green fodder was 89.20%. The CP content in control, T1, T2 and T3 concentrate mixtures was 19.38, 19.19, 19.95 and 19.61%, respectively which indicated that concentrate mixtures were isonitrogenous. The EE content in concentrate mixtures varied from 5.63 to 5.96%. The EE content in green fodder was 2.60%. Total ash content in control, T1, T2 and T3 concentrate mixtures was 6.05%, 6.10%, 5.70% and 5.85%, respectively while in green fodder the total ash content was 10.80%.
The NDF content in control, T1, T2 and T3 concentrate mixtures was 40.80%, 41.90%, 39.90% and 38.50%, respectively. NDF content in green fodder fed during metabolic trial was 45.95%. The ADF content was 18.50%, 16.95%, 18.30% and 17.00% in control, T1, T2 and T3 concentrate mixtures, respectively while ADF content in green fodder used was 32.57%. The cellulose content in concentrate mixtures ranged between 8.50% to 12.20% as it increased with increased inclusion level of malt sprouts. The hemicellulose content was 22.30%, 24.95%, 21.60%and 21.50% in control, T1, T2 and T3 concentrate mixtures, respectively. Hemicellulose content in green fodder was 13.38%. Total carbohydrate (CHO) content in control, T1, T2 and T3 concentrate mixtures was 68.81%, 68.79%, 68.72% and 68.58%, respectively while in green fodder it was 65.61%.

3.3 Effect of dietary level of malt sprouts on nutrient intake in beetal goat kids
The overall mean DM intake (g/animal/d) was higher ($P<0.05$) in T1 group (413.59) followed by control group (398.58), T2 group (384.24) and lowest ($P<0.05$) in T3 group (341.28) (Table 3). The results of the current study are similar to that of Farghaly *et al.* (2019) [11] who reported higher ($p<0.05$) DM intake in sheep fed Egyptian clover without concentrate and with concentrate, hydroponic barley sprouts with concentrate compared to group fed hydroponic barley sprouts alone. Nurfeta and Abdu (2014) [14] also reported

significant difference ($p<0.05$) in DM intake of sheep fed malt sprouts along with atella and malt sprouts alone. They concluded that DM intake was higher ($p<0.05$) in sheep fed malt sprout at 50%, 75% and 100% level in combination with atella.

The overall mean OM intake (g/animal/d) was highest ($p<0.05$) in T1 group (380.83) followed by control group (365.33), T2 group (354.10) and lowest ($p<0.05$) in T3 group (316.25) (Table 3). Our results are in tune with those of Nurfeta and Abdu (2014) [15] who reported higher ($p<0.05$) OM intake with inclusion of malt sprouts in the diet of sheep compared to other groups fed Atella and Rhodes grass hay alone.

The overall mean CP intake (g/animal/d) was highest ($p<0.05$) in control (80.21) and T1 groups (81.81) followed by T2 group (77.50) and was lowest ($p<0.05$) in T3 group (68.14) (Table 3). The lower mean CP intake in group T3 may be due to lower DM intake in this group. Farghaly *et al.* (2019) [11] reported higher ($p<0.01$) CP intake in sheep fed hydroponic barley sprouts with concentrate compared to other groups fed Egyptian clover with and without concentrates. Nurfeta and Abdu (2014) [15] also reported higher ($P<0.05$) CP intake in sheep fed 100% malt sprouts when compared to groups fed atella alone, malt sprouts atella combination and Rhodes grass hay alone. However, Helal (2015) [12] reported no significant difference in CP intake of ewes fed control diet (berseem hay with concentrate feed mixture) and treatment diet consisting of sprouted barley grains grown on barley straw and acacia pruning along with inclusion of concentrate mixture.

The overall mean EE intake (g/animal/day) was lowest ($p<0.05$) in T3 group (11.65) and highest ($p<0.05$) in T1 group (14.47) (Table 3). Farghaly *et al*. (2019) [11] reported higher ($p<0.01$) EE intake (g/day) in sheep fed hydroponic barley sprouts with concentrate compared to the groups fed Egyptian clover with and without concentrates.

The overall mean NDF intake (g/animal/day) was highest ($p<0.05$) in T1 group (185.45) followed by T 2 group (179.80), control group (174.57) while it was lowest ($p<0.05$) in T3 group (160.24) (Table 3). Nurfeta and Abdu (2014) [15] reported significantly higher ($p<0.05$) NDF intake in sheep fed malt sprouts with atella at 50%, 75% and 100% levels compared to atella and Rhodes grass hay alone.

The overall mean ADF intake (g/animal/day) during the whole experimental period was lowest ($p<0.05$) in T3 group and highest ($p<0.05$) in control group (Table 3). However, Nurfeta and Abdu (2014) [15] reported significantly higher ($p<0.05$) ADF intake in sheep fed malt sprouts with atella at 50%, 75% and 100% level compared to atella and Rhodes grass hay alone.

The overall mean cellulose intake (g/animal/d) was higher ($p<0.05$) in T1 (61.28) and T2 (61.71) groups whereas it was lower ($p<0.05$) in T3 group (56.30) than control (58.74) group (Table 3). The overall mean hemicellulose intake (HCI) (g/animal/day) was highest ($p<0.05$) in T1 (85.63) and T2 (84.79) groups followed by T3 (79.01) group and was lowest ($p<0.05$) in control group (71.50). The results of the current study are in accordance with those of Nurfeta and Abdu (2014) [15] who reported significantly higher ($p<0.05$) hemicellulose intake in sheep groups fed malt sprouts with atella at 50%, 75% and 100% levels compared to groups fed atella and Rhodes grass hay alone.

3.4 Economics of feeding

The economics of feeding malt sprouts at graded levels in the diet of goat kids during 60 days is given in Table 4. At the time of experiment, the cost of malt sprouts, SBM, maize, wheat bran, DORB and rice polish was Rs. 1900/Q, Rs. 5000/Q, Rs. 1850/Q, Rs. 1750/Q, Rs. 900/Q and Rs. 1900/Q, respectively. The cost of concentrate mixtures fed to Beetal goat kids was worked out to be Rs. 25.12/kg, Rs. 24.87/kg, Rs. 24.63/kg and Rs. 24.38/kg for control, T1, T2 and T3 groups, respectively. Malt sprouts inclusion at 10% level in the diet of beetal goat kids in T1 group over 60 days resulted in net saving of Rs. 9.82 per kg body weight gain as compared to control group. The results obtained in the present study are in tune with those of Nagadi (2019) [10] who reported that using sprouted barley in growing rabbit diets enhanced the net revenue and reduced the total feed cost when replaced with concentrate mixture at 25% and 50% levels with and without using probiotic. Helal (2015) [12] also reported decreased total daily feeding costs in goats fed diet containing sprouted barley grains grown on 75% olive cake and 50% barley straw compared to control diet containing *ad libitum* alfalfa. Saidi and Omar (2015) [16] observed significant reduction in feed cost in lactating Awassi ewes fed with hydroponic barley (HB) as a replacement of wheat hay and TMR ration.

Table 1: Chemical composition of ingredients used in the experiment, % DM basis

Parameter	Malt sprouts	DORB	Rice polish	Wheat bran	SBM	Maize
OM	93.23	88.38	91.03	94.86	89.91	95.83
CP	20.97	19.12	15.36	14.89	42.84	9.18
EE	1.40	0.65	9.20	3.36	1.35	3.24
Total ash	6.88	11.61	8.96	5.13	10.08	4.16
NDF	69.60	50.50	36.90	61.60	35.40	36.10
ADF	25.30	21.45	24.45	20.90	21.85	6.35
Hemicellulose	44.3	29.05	12.45	40.70	13.55	29.79
ADL	3.30	11.25	8.00	3.60	7.95	1.35
ADICP	3.68	6.80	6.41	11.07	7.57	0.94
NDICP	13.22	13.41	7.18	4.66	15.74	6.80
TCHO	77.72	75.20	69.53	77.79	46.17	83.42

OM- Organic matter, CP- Crude protein, EE- Ether extract, NDF- Neutral detergent fibre, ADF- Acid detergent fibre, ADL- Acid detergent lignin, ADICP- Acid detergent insoluble crude protein, NDICP- Neutral detergent insoluble crude protein, TCHO- Total carbohydrates

Table 2: Chemical composition of feedstuffs offered during trial, % DM basis

Parameter	C (0% MS)	T1 (10% MS)	T2 (20% MS)	T3 (30% MS)	Green fodder
DM	94.00	93.00	95.00	91.00	20.05
OM	93.95	93.90	94.30	94.15	89.20
CP	19.38	19.19	19.95	19.61	20.99
EE	5.76	5.92	5.63	5.96	2.60
Total ash	6.05	6.10	5.70	5.85	10.8
NDF	40.80	41.90	39.90	38.50	45.95
ADF	18.50	16.95	18.30	17.00	32.57
Cellulose	8.50	9.30	11.50	12.20	20.90
Hemicellulose	22.30	24.95	21.60	21.50	13.38
TCHO	68.81	68.79	68.72	68.58	65.61

DM- Dry matter, OM- Organic matter, CP- Crude protein, EE- Ether extract, NDF- Neutral detergent fibre, ADF- Acid detergent fibre, TCHO- Total carbohydrates

Table 3: Effect of dietary level of malt sprouts on nutrient intake (g/animal/day) in beetal goat kids

Parameter	C (0% malt sprouts)	T1 (10% malt sprouts)	T2 (20% malt sprouts)	T3 (30% malt sprouts)	SEM
DMI	398.58[c]	413.59[d]	384.24[b]	341.28[a]	2.12
OMI	365.33[c]	380.83[d]	354.10[b]	316.25[a]	1.88
CPI	80.21[c]	81.81[c]	77.50[b]	68.14[a]	0.49
EEI	14.05[c]	14.47[d]	13.63[b]	11.65[a]	0.06
NDFI	174.57[b]	185.45[c]	179.80[bc]	160.24[a]	1.02
ADFI	103.28[c]	99.82[c]	95.01[b]	81.23[a]	0.62
CLI	58.74[b]	61.28[c]	61.71[c]	56.30[a]	0.38
HCLI	71.50[a]	85.63[c]	84.79[c]	79.01[b]	0.45

DMI- Dry matter intake, OMI- Organic matter intake, CPI- Crude protein intake, EEI- Ether extract intake, NDFI- Neutral detergent fibre intake, ADFI- Acid detergent fibre intake, CLI- Cellulose intake, HCLI-Hemicellulose intake; Means bearing different superscripts in a row differ significantly ($p<0.05$)

Table 4: Comparative cost of feeding graded levels of malt sprouts to goat kids over 60 days experimental period

Parameter	C	T1	T2	T3
Amount of fresh feed given, kg				
Concentrate mixture	76.33	82.81	77.71	70.89
Green fodder	414.08	448.80	421.55	385.13
Feed cost (Rs/kg)				
Concentrate mixture	25.12	24.87	24.63	24.38
Green fodder	2.50	2.50	2.50	2.50
Total feed cost for 60 days (Rs)	2952.60	3181.35	2967.94	2691.23
Total BW gain in 60 days/ group (kg)	16.45	18.75	15.85	10.85
Feed cost (Rs/kg BW gain)	179.49	169.67	187.24	248.04

4. Conclusion

The present study in beetal goat kids revealed that nutrient intake (DM, OM, CP, EE, NDF) was higher ($P<0.05$) in T1 group than other groups. Malt sprouts inclusion at 10% level in the diet of T1 group resulted in net saving of Rs. 9.82 per kg body weight gain as compared to control group. Therefore, from the present study it was concluded that malt sprouts is cost effective and can be economically included upto 10% in the concentrate mixture of goat kids without any adverse effect on nutrient intake of animals.

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