B-5058
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RESEARCH ARTICLE Indian Journal of Animal Research

Effect of Feeding Malt Sprouts on Nutrient Utilization and Growth Performance of Beetal Goat Kids

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10.18805/IJAR.B-5058

ABSTRACT

Background: 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.

Methods: Experimental animals (n=20) were equally divided into four groups of five animals each (average body weight 10.75±0.27 kg). C was control group fed conventional concentrate mixture, T1 group fed with concentrate containing 10% malt sprouts, T2 group fed with concentrate containing 20% malt sprouts and T3 group fed with concentrate containing 30% malt sprouts in addition to green fodder for 74 days including an adaptation period of 14 days. The body weight was recorded at fortnightly interval. Metabolic trial of 7 day duration was conducted towards the end of growth study using standard protocol.

Result: The DM intake (g/d) in T1 and T2 groups was similar to C group, however, it was lowest($P<0.05$) in T3 group.The digestibility of nutrients (DM, OM and NDF) was higher ($P<0.05$) in T1 and T2 groups having 10% and 20% malt sprouts in the concentrate mixture than T3 group (30% malt sprouts) while N balance was similar in all the groups.The average final body weight at the end of study and average daily gain (ADG) were highest ($P<0.05$) in T1 group (10% malt sprouts) and FCR was also marginally better in T1 group.

Key words: Digestibility, Growth, Goat, Malt sprouts, Nitrogen balance.

INTRODUCTION

India ranks second in terms of goat population. According to 20th livestock census (National Livestock Census,2019) total livestock population in India is 535.78 million, out of which, there are 21.23% buffaloes, 37.28% cattle, 26.40% goats, 12.71% sheep and 2.01% pigs.Punjab has a total goat population of 3.48 lakhs. Chevon (goat meat) is the country's most popular and widely consumed meat. Goat milk has traditionally been known for its medicinal properties since ancient times and has recently gained importance in human health due to its proximity to human milk for easy digestibility because of smaller size of fat globules and its health promoting traits.Inadequate nutrition is one of the major factors affecting goat productivity. Despite the naturally endowed vegetation, there are still inadequate feeds and feedstuffs for livestock. Disease outbreak sare more prevalant as a result of low immunity arising from inadequate nutrition. Due to this, there is need to explore alternate feedstuffs and find out the optimum level of their inclusion in the diet.

Malting is the controlled germination of cereal grains, typically barley or sorghum, followed by appropriate drying to yield a usable extract. The resulting malt extract is used in breweries and food processing plants to make malt drinks, syrups, beverages, baby food, microbiological media and other products (Oduguwa *et al*., 2007). Malt extract from germinated cereal seeds leaves a residue of shoots and roots known as malted sprouts. Many changes occur during seed sprouting, such as seed protein being converted to essential amino acids; carbohydrates being converted to sugar; and fats being converted to essential fatty acids. Increased enzyme levels result in an increase in these activities (Chavan and Kadam, 1989). Malt sprout protein was found to be more slowly degraded in the rumen than other proteins such as soybean meal, but it was just as digestible in the total tract (Erickson *et al*., 1986). Due to increased price of conventional feed ingredients, dairy farmers are seeking suitable and viable alternate feedstuffs. Thus, the present study was planned to determine the effect of inclusion of malt sprouts (MS) in the diet on nutrient utilization and growth performance of Beetal goat kids.

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How to cite this article: Chakkaravarthi, C.R., Kaur, J., Grewal, R.S. and Singla, M. (2023). Effect of Feeding Malt Sprouts on Nutrient Utilization and Growth Performance of Beetal Goat Kids. Indian Journal of Animal Research. doi:10.18805/IJAR.B-5058.

Submitted: 01-12-2022 **Accepted:** 26-05-2023 **Online:** 27-07-2023

MATERIALS AND METHODS

Selection, distribution and maintenance of animals

Experiment was approved by Institutional Animal Ethics Committee and was conducted in the Department of Animal Nutrition, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. Twenty Beetal goat kids were randomly distributed into four groups of five animals each. A conventional concentrate mixture (maize 40, soybean meal 22, wheat bran 20, rice polish 5, deoiled rice bran 10, mineral mixture 2, salt 1 part each) was prepared without malt sprouts (0%) for C group. In addition, three iso-nitrogenous concentrate mixtures were prepared containing malt sprouts at 10, 20 and 30% levels (w/w) partially replacing oilseed cakes and cereal byproducts for T1, T2 and T3 groups, respectively. A 60-day growth trial was conducted after giving an adaptation period of 14 days (total duration=74 days). The study was started in the month of March, 2021. The animals were fed as per ICAR (2013) feeding standard. The animals in C group were fed with basal diet consisting of green fodder (berseem, oats mix) and conventional concentrate mixture. The animals in experimental groups T1, T2 and T3 were fed green fodder and concentrate mixtures in which malt sprouts were 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.

Conduction of metabolic trial

A 7-day metabolic trial was conducted on all the animals towards the end of growth trial. During metabolic trial, the animals were kept in specially designed metabolic cages, where a metallic pipe led the excreted urine into a narrow mouth plastic container (5 litres capacity) containing 40 ml of 20% H_2SO_4. The faeces voided were collected manually for 24 hours. The collection of faeces and urine was done for 7 days. The combined residue of green and concentrate mixture, if any, was weighed every morning at 9:00 AM in the morning before offering the next day's ration. Samples of feed, faeces and orts were analyzed for total ash, N as per AOAC (2007), cellulose as per Crampton and Maynard (1938) and cell wall constituents as per Van Soest*et al.* (1991).

Statistical analysis

Data were analysed by ANOVA, as described by Snedecor and Cochran (1994), by using SPSS (2012) version 21. The differences in means were tested by Tukey's b.

RESULTS AND DISCUSSION

Chemical composition of feedstuffs offered during trial

The dry matter (DM) in C, T1, T2 and T3 concentrate mixtures was 94.00, 93.00, 95.00 and 91.00%, respectively (Table 1). The DM in green fodder was 20.05%. The organic matter (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 fed during trial was 89.20%. The crude protein (CP) content in C, T1, T2 and T3 concentrate mixtures was 19.38, 19.19, 19.95 and 19.61%, respectively which indicated that concentrate mixtures were iso-nitrogenous. The ether extract (EE) in concentrate mixtures varied from 5.63 to 5.96%. The EE content in green fodder was 2.60%. Total ash in C, 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 C, T1, T2 and T3 concentrate mixtures was 38.80%, 39.00%, 39.90% and 38.50%, respectively. The NDF content in green fodder was 45.95%. The ADF content was 18.50%, 16.95%, 18.30% and 17.00% in C, 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% and it increased with increased inclusion level of malt sprouts. The hemicellulose content was 20.30%, 22.05%, 21.60% and 21.50% in C, T1, T2 and T3 concentrate mixtures, respectively. Hemicellulose content in green fodder was 13.38%. Total carbohydrate (TCHO) 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%.

Effect of dietary level of malt sprouts on nutrient digestibility

The DM intake (g/d) was lowest (P<0.05) in T3 group (428.24) fed concentrate with 30% malt sprouts (Table 2). The DM intake in T1 and T2 groups was similar to that of C group. However, Farghaly *et al*. (2019) reported that feeding

Table 1: 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	10.80
NDF	38.80	39.00	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	20.30	22.05	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, MS- Malt sprouts.

hydroponic barley sprouts alone in sheep decreased their DM intake significantly when compared to groups fed with concentrate mixture and Egyptian clover alone.

The DM digestibility in T1 (72.97%) and T2 groups (73.30%) was similar to control (70.69%) while it was lowest (P<0.05) in T3 group (66.79%). Nagadi (2019) reported that rabbits fed sprouted barley as a partial replacement for concentrate mixture showed significantly higher (P<0.05) digestibility coefficient of DM when compared to control group fed only 100% concentrate mixture. The OM digestibility (%) was lowest (P<0.05) in T3 group (69.55). The OM digestibility in T1 (75.62%) and T2 (75.82%) groups was similar to that of control group (73.16%). Farghaly *et al*. (2019) reported that OM digestibility was significantly higher (P<0.05) in rams fed sprouted barely along with concentrate mixture compared to groups fed sprouted barley alone. The CP digestibility (%) in C (82.44) group was similar to T1 (84.71), T2 (86.77) and T3 (86.64) groups and the values varied non-significantly among the groups. However, Farghaly *et al*. (2019) reported that the digestibility of CP was significantly higher (P=0.001) in rams fed sprouted barely with concentrate when compared to groups fed sprouted barley without concentrate mixture. Nagadi (2019) also reported that rabbits fed sprouted barley as a partial replacement for concentrate feed @ 25% sprouts and 50% sprouts showed significantly higher (P<0.05) digestibility coefficient of CP when compared to control group fed 100% concentrate.

The EE digestibility varied non significantly among the groups (Table 2). However, Fayed (2011) reported that the EE digestibility in lambs fed sprouted barley grains grown on rice straw (BRs) or Tamarix (BTm) showed significant (P<0.05) improvement than lambs fed with untreated rice straw and Tamarix. The NDF digestibility (%) was higher (P<0.05) in groups T1 (58.03) and T2 (59.49) groups followed by C group (55.68) while it was lowest (P<0.05) in T3 group (50.69). Nurfeta and Abdu (2014) also reported that sheep fed 50% Atella+50% malt sprouts and malt sprouts alone had higher (P<0.05) NDF digestibility as compared to Atella alone, 75% Atella+25% malt sprouts and Rhodes grass hay alone. The ADF digestibility (%) in C, T1, T2 and T3 group was 54.78, 52.80, 55.31 and 47.75, respectively. There was no significant difference among the groups. Our results are contrary to those of Nurfeta and Abdu (2014) who reported that sheep fed 50% Atella+50% malt sprouts and malt sprouts alone had higher (P<0.05) ADF digestibility as compared to Atella alone, 75% Atella+25% malt sprouts and Rhodes grass hay alone.

Effect of dietary level of malt sprouts on nitrogen balance

The total nitrogen intake (g/d) was highest (P<0.05) in T2 group (17.70) (Table 3). Nurfeta and Abdu (2014) reported that the sheep fed with malt sprouts alone shown significantly higher (P<0.05) N intake than groups fed Atella replacing malt sprouts at 100%, 75%, 50%, 25% levels and grass hay alone.The mean urinary N (g/d) outgo was lower(P<0.05) in T3 group (2.38) fed concentrate with 30% malt sprouts than T2 group (20% malt sprouts), however, it was similar to C and T1 group.

The mean faecal N (g/d) output was lower (P<0.05) in T3 group than C with intermediate value in T1 group (2.14) and T2 group (2.33). Nurfeta and Abdu (2014) also reported that sheep fed Atella alone significantly (P<0.05) lost more N in faeces compared to groups fed Atella along with malt sprouts and grass hay alone.The N balance varied non-significantly among the groups, though the values were numerically higher in treatment groups fed graded levels of malt sprouts. Similarly, Farghaly *et al*. (2019) reported that feeding of concentrate with sprouted barley increased (P<0.05) the N retention in rams than rams fed sprouts without concentrate. Nurfeta and Abdu (2014) reported that N retention in sheep fed malt sprouts alone (100%) along with *ad libitum* grass hay was significantly higher (P<0.05) than other diets containing a combination of malt sprouts and atella along with *ad libitum* grass hay.

Effect of dietary level of malt sprouts on body weight changes

The initial body weight (kg) of Beetal goat kids in C, T1, T2 and T3 groups was 10.54, 11.49, 10.80 and 10.19 kg, respectively at the beginning of the experiment (Table 4). No significant difference was observed among the groups. The final body weight at the end of the experiment was

Table 2: Effect of dietary level of malt sprouts on nutrient digestibility (%) in goat kids.

Parameter	C (0% MS)	T1 (10% MS)	T2 (20% MS)	T3 (30% MS)	SEM
DM intake, g/d	511.20^{b}	484.17^{b}	522.74^{b}	428.24^{a}	9.54
			% Nutrient digestibility		
DM	70.69^{ab}	72.97^{b}	73.30^{b}	66.79^{a}	0.72
OM	73.16^{ab}	75.62^{b}	75.82^{b}	69.55^{a}	0.66
CP	82.44	84.71	86.77	86.64	0.65
EE	75.56	78.01	78.08	74.44	0.61
NDF	55.68^{ab}	58.03^{b}	59.49^{b}	50.69^{a}	0.93
ADF	54.78	52.80	55.31	47.75	1.32

DM- Dry matter, OM- Organic matter, CP- Crude protein, EE- Ether extract, NDF- Neutral detergent fibre, ADF- Acid detergent fibre; Means with different superscripts in a row differ significantly (P<0.05).

Table 3: Effect of dietary level of malt sprouts on nitrogen balance (g/d) in goat kids.

Parameter	C	T1	T2	T3	SEM
Total nitrogen intake	14.98^{a}	14.59^{a}	17.70^{b}	14.51^{a}	0.39
Urinary N	4.00^{ab}	3.88^{ab}	4.63^{b}	2.38^{a}	0.25
Faecal N	2.43^{b}	2.14^{ab}	2.33^{ab}	1.93^{a}	0.07
Total N outgo	6.43^{b}	6.02^{b}	6.96^{b}	4.30^{a}	0.27
N balance	8.55	8.57	10.74	10.21	0.37

N- Nitrogen; Means with different superscripts in a row differ significantly (P<0.05).

Table 4: Effect of dietary level of malt sprouts on body weight (kg) changes of goat kids.

Parameter	C	T1	T2	T3	SEM
Initial body weight	10.54	11.49	10.80	10.19	0.27
Final body weight	13.83^{ab}	15.24^{b}	13.97^{ab}	12.36^{a}	0.38
BW gain	3.29^{ab}	3.75^{b}	3.17^{ab}	2.17^{a}	0.20
Average daily gain, g	54.78^{ab}	62.56^{b}	52.78^{ab}	36.22^{a}	3.32
FCR	7.58	7.23	8.25	10.96	0.55

BW- Body weight; FCR- Feed conversion ratio; Means with different superscripts in a row differ significantly (P<0.05).

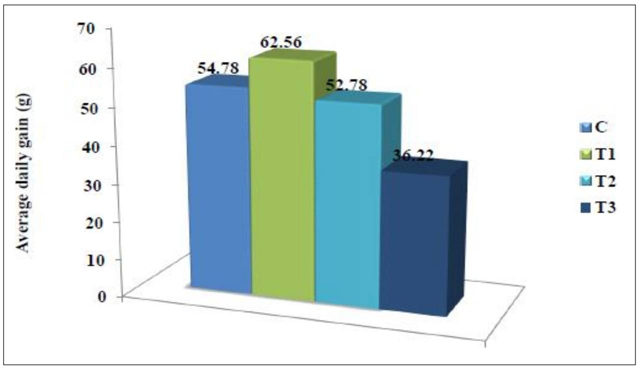

Fig 1: Effect of dietary level of malt sprouts on average daily gain (g) in beetal goat kids.

highest (P<0.05) in group T1 (15.24 kg) whereas it was lowest (P<0.05) in group T3 (12.36 kg) (where malt sprouts were added @30% in concentrate mixture), indicating that optimum inclusion level of malt sprouts is 10% as it resulted in higher final body weight in group T1. The higher (P<0.05) digestibility of DM and OM might be responsible for higher (P<0.05) final body weight in T1 group than T3 group. Final body weight of T2 group (13.97 kg) was similar to that of control group (13.83 kg). The gain in body weight during the experimental period was highest (P<0.05) in group T1 (3.75 kg) group. The body gain in T3 group (2.17 kg) was numerically lower than other groups, however, the value with statistically similar to C (3.29 kg) and T2 (3.17 kg) groups. The average daily gain (ADG, g) was highest (P<0.05) in group T1 (62.56) whereas it was lowest (P<0.05) in T3 (36.22) group (Table 4 and Fig 1).

The feed conversion ratio (FCR) in C, T1, T2 and T3 groups was 7.58, 7.23, 8.25 and 10.96, respectively (Table 4). The FCR was marginally better in T1 group than the other groups. The reason might be the highest (P<0.01) final body weight and body weight gain in group T1. The results of the present study are contrary to those of Kim *et al*. (2020) who reported no significant difference in body weight, average daily weight gain and live body weight in Holstein heifers corn meal-based control diet and corn meal replaced by 10% and 30% hydroponically sprouted barley (HSB). However, Nagadi (2019) also reported that rabbits fed sprouted barley as a replacement for concentrate mixture at 25% and 50% levels along with anaerobic probiotic showed significantly higher (P<0.05) daily body weight gain and total body weight gain when compared to groups fed a combination of concentrate mixture and malt sprouts without probiotic. Ata (2016) reported that lambs fed hydroponic barley based diet showed positive effect (P<0.05) on feed intake, final body weight, total body weight gain, ADG and FCR when compared to lambs fed control barley grain based diet.

CONCLUSION

The present study revealed that the digestibility of nutrients (DM, OM and NDF) was higher (P<0.05) in T1 and T2 groups having 10% and 20% malt sprouts in the concentrate mixture than T3 group (30% malt sprouts) while N balance was similar in all the groups.The overall average body weight and ADG were highest (P<0.05) in T1 group (10% malt sprouts) and FCR was also marginally better in T1 group.Therefore, from the present study, it was concluded that malt sprouts could be incorporated upto 10% in the concentrate mixture of Beetal goat kids on w/w basis partially replacing oilseed cakes and cereal byproducts without any adverse effect on nutrient digestibility, nitrogen balance, average daily gain and feed conversion ratio.

Conflict of interest: None.

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