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RESEARCH ARTICLE
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EFFECTIVENESS OF VARIOUS GROWTH PROMOTERS ON PERFORMANCE OF MALE BEETAL GOATS UNDER HIGH INPUT FEEDING SYSTEM

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ABSTRACT

Total 25 animals with average weight of 20±2 kg and approximately 6 months age were selected and were randomly divided into five groups with five animals in each group under CRD. Each group was supplemented with growth promoters viz, ionophores (ION), essential oils (EO), yeast product (YP) and bacterial culture (BC) and one group served as control (C). The duration of the experiment was 70 days. The animals were reared in individual stalls under same conditions. Iso-caloric and iso-nitrogenous pelleted rations were offered adlibitum. Data were collected on daily feed intake and fortnightly weight gain. Blood samples were collected at start and end of experiment to get data on blood metabolites. Grabbed fecal sample from rectum were collected to determine the digestibility using markers (AIA) in last 10 days of study. Data collected were subjected to statistical analysis in R software. Average daily gain was significantly higher in YP (110.57 g/day) followed by BC (92 g/day) and was lowest in control group (71.72 g/day). Average daily feed intake was highest (547.9 g) in control and lowest in BC (477.1g). Feed conversion ratio and digestibility were affected significantly by treatments with best results by YP (4.82 and 72.35 %) followed by BC (5.19 and 65.26 %). Other groups ION and EO showed same results but were different significantly ($P<0.001$) from control group. It is concluded that growth promoters have valuable effects on performance of male Beetal goats reared under high input feeding system.

Keywords: Growth Promoters; Growth; High Input Feeding; Beetal Goat.

INTRODUCTION

In high input feeding system, the animals are fed on agro industrial wastes, grains and straws-based diets free from green feedstuff. In Pakistan some current studies have shown added efficiency of high input feeding system in improving the growth performance of small ruminants by augmenting the nutrient availability **(1, 2, 3, 4)**

Under traditional feeding system the animals are kept on grazing and they cannot perform according to their potential due to deficiency and poor quality of nutrients **(5)** as a result feed conversion ratio (FCR) of animals is reported ranging from 6-14 **(4, 6, 7).** The FCR needed to be lowered to 4-5 especially under high input feeding system to improve economic viability. Feed conversion ratio, meat quality and quantity in goats can be improved by different approaches which include some physiological and some gut modifications ultimately decreasing feed to gain ratio, increase in digestibility and better utilization of nutrients. Classically antibiotics were used in animal industry as growth promoters but, due to ban on antibiotics and their deleterious effects some alternate approaches were required to improve the growth performance of animals without compromising meat and carcass traits.

In small ruminants, high growth and better feed conversion ratio (FCR) are considered to be the important economic characters. However, in pre and post weaning periods the economic growth characters such as weight gain significantly decreases due to lower nutrient consumption or feed efficiency as described earlier **(8).** Now a days, various growth promoters are used in the form of feed additives which improve growth by stimulating ruminant nutrient utilization in relation of live weight gain, growth performance and milk production of the animal in the tune of 7-8% **(9).**

A variety of growth promoters are used in animal feed which include ionophores, essential oils, bacterial culture, prebiotics and probiotics. These dietary supplements reveal a positive effect on the host animal performance and health by stimulating desire for food or hungriness (**10)** improving the balance of the intestinal microorganisms and digestion **(11).** The valuable influences of these products are related with the improvement of microbial balance within the digestive tract, improvement of feed efficiency, and release of indigenous products **(12).**

Moreover, they can apply their advantageous effects to the host animal by improving nutrient synthesis and their bio-availability resulting in higher growth performance **(13),** increasing rumen cellulolytic bacterial populations and thus improving feed intake, growth performance, feed conversion ratio (FCR), and nutrients absorption **(14, 15).** It is said that these supplements have many beneficial effects on the host animals such that improvement in dry matter intake (DMI), body weight (BW) gain, and FCR **(16,17).** These studies assumed that addition of different feed additives in pre-weaning and post-weaning diets may possibly have positive effects to the host animals by improving rumen cellulolytic bacterial population, and consequently would affect feed intake, growth performance, digestibility, and blood metabolites.

The information on above-mentioned aspects is scanty regarding Beetal breed specifically while raising them under high input feeding system. It is hypothesized that the growth performance of Beetal male goat could be improved with the use of various growth promoters. In this regard various growth promoters were used to choose the best one as far as the Beetal goats are concerned.

MATERIALS AND METHODS

Selection of Animals

Twenty-five Beetal young male animals born in the same season with an average body weight of 20±2 kg and approximately six months age were randomly selected for this experiment. The duration of the study was 70 days including 10 days of adjustment period.

Treatment Plan and Feeding Management

All animals were identified individually with ear tags, reared in the individual stalls and managed under same conditions. All the animals were weighed using a sensitive digital scale and were divided randomly into five groups ION, EO, YP, BC and C comprising of five animals each. Each group was provided feed supplemented with one of the above mentioned growth promoters except C which

served as control group. The animals were fed on the experimental pelleted rations ad libitum which were iso-caloric and iso-nitrogenous as per recommendations of NRC,2007 **(18).** Commercially available growth promoters were used as per recommendations of the manufacturer in feed explained in Table 1.

Table 1: Effectiveness of various growth promoters on performance of male Beetal goats under high input feeding system

Group	Growth Promoters	No. of Animals	Treatment
C	Control	5	No feed additive or growth promoter added.
ION	Ionophore	5	Ionophore (Laidlomycin @ 5mg/animal/day)
EO	Essential Oils	5	Essential oils (Vertan IDENA, Sautron, France) @ 12g/kid/day)
YP	Yeast Product	5	Yeast product (Yea- Sacc® 1026 (Alltech natural, USA), live dry yeast contains 2.8 x 108CFU of Saccharomyces cerevisiae strain 1026 @3g per head per day)
BC	Bacterial Culture	5	Bacterial culture (Yogurt with L. bulgaricus, L. acidophilus, Bifidobacterium, S. thermophillus, (2.06×10^7 cfu)

Data Collection, Slaughtering and Chemical Analysis

Data on daily feed intake were collected on daily basis, weight gain on fortnightly basis. Grabbed fecal samples from rectum were collected to determine the digestibility using markers; acid insoluble ash (AIA) in the last 10 days of the study. The blood was collected at the start and end of trial from jugular vein and serum separated by centrifugation and were stored at -20^{o}C. The serum was used for analysis of blood urea nitrogen **(19),** serum glucose, serum cholesterol and serum creatinine **(20).**

Statistical Analysis

Data were analyzed by using linear model procedures run in R-software (3.1.1 version) except body measurements which were analyzed by nonlinear mixed effect model ('*nlm*' function). The means were compared by Tukey's test if the treatments were found significantly affecting the parameters (R Core Team 2020**) [21]**

RESULTS AND DISCUSSION

Average Daily Gain (ADG)

Average daily gain in the current study was different in all the groups significantly ($P<0.001$) and it was observed that highest ADG was found in group supplemented with yeast product (110.57 g/day) followed by bacterial culture (92.00 g/day). The ADG of group fed with essential oils and ionophores were 84.86 and 85.14 g/day respectively which was significantly higher than the control group (71.72 g/day). Statistically there was no difference between groups fed with bacterial culture and ionophores and similar trend was noticed between the groups fed ionophores and essential oils. Our findings demonstrated that yeast product showed the best results and the ADG was comparatively better in this group. Our results are confirmed by the findings of Tripathi and Karim **(22)** who reported that there was a significant difference in ADG of fattening lambs fed Saccharomyces cerevisiae alone or mixed with lactate producing bacteria and the treated group showed highest ADG (220 g/day) as compared to other group (214 g/day) and control (205g/day). The reason of increased ADG in current study might be due to the utilization of nutrients more efficiently by addition of growth promoters and among all S. cerevisiae has affected the rumen environment more efficiently compared to other groups as well as improvement in nutrient digestibility of feed. As our animals are underfed and they never reached their peak performance due to less availability of nutrients and concentrates as they mostly rely upon grazing and browsing and are fed with leftover feed and kitchen wastes. All the animals in the experiment performed better due to high input feeding system and concentrate feeding with high energy and protein throughout the experiment. So their overall performance improved with the passage of time. Moreover, the performance of the group fed with SC was best due to better nutrient utilization which is evident from the results of digestibility coefficient of this group reported as 72 %. Similar results were reported by Osita et. al., **(23)** in West African dwarf sheep by use of SC as growth promoter. They reported a higher ADG and ADFI in sheep fed high concentrate rations

with SC added @ 0.75 g/kg feed and 1.50 g/kg feed as compared sheep fed high roughage diet without SC. In contrast to our findings Hernandez **(24)** studied post-weaning management strategies for cattle in the southeast united states: measuring the efficacy of anthelmintic strategies and the use of a blend of garlic oil and cinnamaldehyde as an ionophore alternative and reported that the blend did not increase ADG when compared to the control group. The higher ADWG in animals fed HC diet could be attributed to the increased feed intake of animals fed high concentrate diet and better utilization of nutrients by addition of growth promoters. The findings of ADG are also supported by the results of klieber ratio which showed the similar trend being highest in yeast product group and lowest in control indicating a significant difference ($P<0.001$), whereas there was no significant difference between the KR of BC and ionophores as well as EO and control group. From the results shown in this experiment it is concluded that SC followed by bacterial culture has a significant effect on ADG and KR of Beetal goats under high input feeding system. Our findings are also supported by the findings of Tripathi and Karim **(22);** Pal *et al. (***25)** and Titi *et al. (***26)** who reported that the inclusion of probiotics in feed resulted in increase in ADG and lower FCR. The klieber ratio of the groups showed a similar trend being highest in YP followed by BC and lowest in control group. This result is obvious as KR is calculated on the basis of weight gain data.

Average Daily Feed Intake (ADFI)

Average daily feed intake was found comparatively less in the animals fed with bacterial culture followed by essential oils, ionophores yeast products, and control. There was no significant difference among the ADFI of all the groups statistically however, all the groups differ numerically with highest ADFI by control group (547.9 g/day) and lowest by EO and ION group (522.1 g/day). Decreased ADFI in growth promoters group might be associated with better utilization of nutrients and improved digestibility coefficients. It might be due to beneficial effects of nutrient hydrolysis and greater ruminal degradability which might have increased physical fill resulting in decreased ADFI. Other reason might be the growth promoters might have the quantity of microbial protein available to the animals and affected the efficiency of feed utilization by improvement in digestibility resulting in provision of many nutrients for ruminal flora and ultimately consuming less feed as compared to control group. It might have proved helpful for microbial growth. Moreover, growth promoters might have enhanced the total number of microflorae in the rumen resulting in synthesis of more microbial nitrogen ultimately improving the digestion of feed. Similar results are reported by Osita et al. **(23)** in lambs and Hassan eta al. **(27),** thus supporting our findings. The increase in weight gain with addition of growth promoters especially YP and BC in feed is due to improvement of digestion, as the animals can ingest less feed, simultaneously the outflow percentage of digesta reduced (retention time increased) from the rumen to the intestine by improvement of digestion process. Similar findings were reported by Eladawi et al., 2020, **(28)** in fattening calves. In contrast to our findings higher DMI was reported by Saleem et al., 2017, **(29)** in lambs fed high concentrate diets supplemented with probiotics.

Feed Conversion Ratio

The feed conversion ratio (FCR) of the male Beetal goats fed various growth promoters is given in table 2. The FCR of goat is reported to be high ranging from 6 to 14 **(4).** The current experiment was planned to reduce the FCR to below 5 or so under the influence of high input feeding system. The results of the current study depict that we have succeeded in our objective of reducing the FCR as evident from the figures shown in table 2. As discussed earlier under ordinary conditions our goat is the most neglected animal as far as feeding is concerned and are mostly offered kitchen wastes and they remain underfed especially during the scarcity period when availability of green fodder is compromised. The animals in this experiment showed better FCR ranging from 4.84 to 7.64 which is considered good. The improvement in FCR might be due to feeding regime as all the experimental animals are fed with high energy and protein balanced ration with no green fodder at all. In the beginning of the experiment especially during the adjustment period the feed intake was low and water intake increased but after the adjustment on concentrate ration all the animals in the experiment

started improving in weight gradually. It can be seen that the animals even in control group improved their BW, ADG and KR due to high input feeding system which is validated by the findings of Kashif et. al 2016 **(4)** who reported improvement in FCR. In another study conducted by Sangameswaran and Prasad **(30),** it was evaluated that the goat keepers are unable to scientifically compute a balanced ration for their animals and if the animals are fed on concentrates and balanced ration improvement in their production performance is obvious.

In our experiment the addition of growth promoters affected FCR significantly ($P<0.001$) with lowest FCR shown by the group treated with yeast product (4.82) followed by bacterial culture (5.19), ionophore (6.15) and essential oil (6.15) treated group. The highest FCR was found in control group (7.64) There was no significant difference between YP and BC groups as well as no significant difference was found in ionophores and EO group. Improvement in FCR might be due to better utilization of feed in pelleted form and also due to high digestibility of feed animals fed with YP and BC may have converted feed more efficiently into weight. Other reason might be the potential of male animals having high growth rate and they gained more weight by taking concentrate ration. Similar findings are reported by Raghebian et. al., 2016 **(31)** who reported lowest FCR in high yeast group (5.33) followed by low yeast (5.86) and control (5.89) groups in Zandi lambs. Our results are also favored by the findings of Saleem et. al., 2017 who reported that the final BW, ADG, and FCR of the lambs receiving probiotic treatments tended to be greater ($P\leq0.10$) compared with the control group.

Table: 2. Main effects of various growth promoters on performance of male Beetal kids reared under high input feeding system

Response Factor	Control (G1)	Ionophores (G2)	Essential Oils (G3)	Yeast Product (G4)	Bacterial Culture (G5)	P-Value	SEM
Average Daily Gain (g/day)	71.72^{d}	85.14^{bc}	84.86^{c}	110.57^{a}	92.00^{b}	<0.001	2.371
Average Daily Feed Intake (g/day)	547.9^{a}	522.1^{a}	522.1^{a}	532.9^{a}	477.1^{b}	<0.001	10.91
Klieber Ratio	6.48^{c}	7.53^{b}	7.41^{bc}	9.29^{a}	8.06^{b}	<0.001	0.335
Feed Conversion Ratio	7.64^{a}	6.15^{b}	6.15^{b}	4.82^{c}	5.19^{c}	<0.001	0.125
Digestibility %	61.91^{d}	68.70^{c}	64.13^{c}	72.35^{a}	65.26^{c}	<0.001	0.604

Digestibility

The digestibility percentages of the male Beetal goats fed with various growth promoters under high input feeding system are shown in Table 2. The values showed that the highest digestibility was shown by YP (72.35 %) followed by ionophore (68.70 %), BC (65.26 %), EO (64.13 %) and control groups (61.91 %) respectively. Within the growth promoters there was a significant ($P<0.001$) difference between the digestibility values of YP and other growth promoters and no significant difference was found in EO, BC and ION. However, control group has significantly lowest digestibility percentages than treatment groups. The digestibility value of YP group was highest indicating that this group has utilized the pelleted feed more competently as compared to other groups. This is also validated by the values of ADG, KR and ADFI of this group as indicated in table 2. Similar results are reported by Saleem et al., 2017 **(29)** they explained in their experiment that with the exception of EE digestibility, the digestibility of DM, OM, CP, CF, and NFE were improved ($P\leq0.01$) in lambs receiving probiotic treatments compared to control treatment. Hassan et al., 2020 **(27)** reported increase in DM digestibility of lambs fed probiotics in solid and liquid form (0.65, 0.64 and 0.62) with a significant difference ($P=0.01$) among the treatments and confirmed our findings in the current study. The reason of increased digestibility for YP and other growth promoters as compared to control group in our experiment might be due to beneficial effects of growth promoters on feed hydrolysis by increase in microbial colonies and ultimately affecting the rumen fermentation activities. Improvement in digestibility could be connected with more residence of feed in rumen due to growth promoters addition, improving the pH to more neutral than acidic and decreasing the ciliates in the rumen as reported by Tripathi and Karim **(22).**

Table: 3. Main effects of various growth promoters on blood metabolites of male Beetal kids reared under high input feeding system.

Treatment / Response Factor	Control (G1)	Ionophores (G2)	Essential Oils (G3)	Yeast Product (G4)	Bacterial Culture (G5)	P-Value	SEM
Serum Glucose (mg/dL)	57.00 ^{cd}	62.40^{ab}	67.40^{a}	54.32^{d}	60.60^{bc}	<0.001	1.792
Serum Albumin (g/dL)	3.42d	4.32^{bc}	3.72^{cd}	5.14^{a}	4.60^{ab}	<0.001	0.2567
Serum Total Protein (g/dL)	6.30^{b}	6.94^{a}	6.12^{b}	7.08^{a}	6.18^{b}	<0.001	0.1055
Blood Urea Nitrogen (mg/dL)	19.84^{b}	21.26^{ab}	20.98^{ab}	22.06^{ab}	22.48^{a}	<0.05	0.8475
Serum Creatinine (mg/dL)	0.87^{c}	1.06^{bc}	1.20^{b}	1.44^{a}	1.24^{b}	<0.001	0.0638
Serum Cholesterol (mg/dL)	75.6	75.4	73.2	69.2	70.8	<0.001	114
Serum Triglycerides (mg/dL)	32.76^{b}	33.78^{ab}	32.78^{b}	33s.60^{a}	35.84^{a}	<0.01	0.7945

Blood Metabolites

Main effects of various growth promoters on blood metabolites of male Beetal kids reared under high input feeding system are given in table no 3. This data shows that there is a significant decrease in serum cholesterol level of animals supplemented with different growth promoters as compared to control. Literature shows that serum cholesterol level decreases with probiotics supplementation **(11).** Serum cholesterol might be reduced due to mor utilization of fat for energy production with increased ADG and performance. Contrary to this serum creatinine and blood urea nitrogen increased by supplementation of growth promoters as compared to control with no significant difference among all the groups except bacterial culture (BC) and control. The concentration of serum creatinine was highest in YP due to higher lean meat production with heavy musculature of this group. It is further explained here that the increase in serum creatinine was not much and remained in normal limits with no deleterious effects on kidneys of animals due to treatment. Serum albumin also increased in the animals supplemented with growth promoters which indicated higher feed efficiency of animals supplemented as increased serum albumin is associated with higher feed efficiency. Almost similar trend was shown by serum glucose except EO which have highest glucose concentration followed by ionophores. This difference might be due to higher fat deposition and less energy metabolism in EO group.

High concentrations of BUN in response to probiotic supplements can be due to decreased ability of the rumen microflora in trapping ammonia **(32).** BUN is an indicator of the protein status in ruminants **(33)** and its concentration is related to the level of ammonia absorption from the rumen and the deamination of amino acids not deposited in the tissues **(34).**

Conclusion

The outcomes of this study look like endorsing the favorable effects of growth promoters supplementation on male Beetal goats under high input feeding system. It is concluded that addition of different growth promoter in the feed of the goats have improved their growth performance and nutrient digestibility as compared to control animals. It is assumed that use of yeast product and bacterial culture proved more beneficial in performance and nutrient utilization and has improved the digestibility and FCR of the Beetal goats which was the primary objective of the study. It is recommended that more investigation should be done on the ruminal digestive characteristics in future in native goats. Our team is also intended to investigate the effect of growth promoters on health and immune system of Beetal goat in future.

Conflict of Interest Declaration

The authors declare that they have no conflict of interest.

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