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Performance and nutrient utilization of cross-bred sheep fed yeast and herb supplemented paddy straw based complete feed

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Abstract
A growth trial of 60 days was conducted on 20 male crossbred lambs of 8-9 months old, divided in four groups of five lambs in each group with T_0 (un-supplemented), T_1 (Herb supplemented), T_2 (Yeast supplemented) and T_3 (Combination of herb and yeast). The lambs were fed a complete feed containing paddy straw 60 parts and concentrate mixture 40 parts on DM basis, supplemented with yeast (*Saccharomyces cerevisiae* 2×10^{10}cfu/g) @ 3 g/kg DM (T_2), herb (*Urtica diocia*) @ 3% (T_1). In T_3 group combination of yeast @3 g/kg DM and herb @ 3% DM was supplemented to complete feed while complete feed without supplementation served as control (T_0) The dry matter and organic matter intake was with significantly ($P<0.01$) higher in yeast supplemented groups alone and in combination (T_2 and T_3) with non-significant difference between herb (T_1) and control (T_0) group. Total gain and average gain in body weight was significantly ($P<0.01$) higher in feed additive (T_1, T_2 and T_3) groups with better FCR than control (T_0). Regarding digestibility of nutrients, a highly significant ($P<0.01$) effect on digestibility of DM, OM, CP, EE, CF, NFE, NDF, ADF, hemi-cellulose and cellulose were observed in feed additive supplemented groups. All the animals of different treatment groups were found to be in positive mineral balance, with significantly higher values in feed additive supplemented groups than control. The DCP, TDN, DE and ME content of ration was found significantly ($P<0.01$) higher in feed additive supplemented groups with nutritive ratio (NR) highest in control. Intakes of digestible DM, OM, CP and TDN were also significantly ($P<0.01$) higher in supplemented groups in comparison to control. The feeding cost per kg live weight gain were significantly ($P<0.01$) lower for feed additives supplemented groups compared to control group which was obviously due to better nutrient utilisation that supported higher growth rate of sheep in the respective groups.

Keywords: Herb, nutrient digestibility, performance, yeast

Introduction
Paddy straw is the principal crop residue fed to more than 90% ruminants during lean months in Jammu and Kashmir (Annoymus 2013) [4]. Rice straw contains low levels of nitrogen, vitamins and minerals, with high concentration of lignin and silica which hinder the availability of cellulose to be degraded by rumen microbes and eventually limit the necessary nutrient uptake for a satisfactory performance in animals. The use of feed additives in livestock ration has shown promising results for enhanced growth and production in ruminants due to enhanced nutrient digestibility and utilization. The additives such as antibiotics, arsenicals, hormones and ionophores etc. modify rumen fermentation and optimize performance in animal production systems. However, with passing time, the use of synthetic feed additives (chemicals, hormones and antibiotics) were banned in many countries for obvious reasons of ill effects on health, bacterial resistance and the accumulation of residues in the animal products. Realizing the limitations of the latest trends in animal nutrition, world is witnessing a resurgence of interest in natural, traditional and alternate health systems. The use of naturally occurring compounds like herbs, herbal preparations, yeast and enzymes are gaining much attention over time for their safety and reliability and thus becoming a new goal in livestock production (Makkar *et al.*, 2007) [17].
Many microbial species are recommended as feed additives in ruminant nutrition and among them the yeast (*Saccharomyces cerevisiae*) has been found to exert a positive effect on the enhanced uptake of nutrients in ruminants. Yeast cells contain different vitamins, enzymes and some unidentified cofactors which improve the microbial activity and growth rate of the rumen microflora (Robinson and Erasmus, 2009) [24], increase hemicelluloses degradability (Lascano *et al.* 2009) [16] and have positive effects on the absorption of some minerals. Furthermore, yeast supplementation has the potential to improve intake and growth in lambs and

can be substituted for antibiotics as growth promoting feed additives (Tripathi and Karim, 2011).

Although nutritive and medicinal properties of stinging nettle (*Urtica dioica*) have been extensively studied in humans, most of the work on nettle in animal practices is limited to its collective use with other herbs considering such combinations beneficial for increasing body weight and the quality of meat (Hanczakowska *et al.*, 2007; Kwiecien and Mieczan, 2009) [10, 15]. So, the present study was carried out to evaluate the effect of yeast (*S. cervisiae*) and herb (*Urtica dioica*) in paddy straw based complete ration on performance of growing cross bred lambs.

Materials and Methods

Twenty male polled cross lambs of 8-9 months age, having uniform weight and body conformation, were selected and divided into 4 groups of five animals in each group to study the effect of paddy straw based complete feed with and without supplementation of feed additives. A complete feed was prepared containing paddy straw and concentrate mixture of ratio 60: 40 on DM basis with yeast (*Saccharomyces cerevisiae* 2×10^{10}cfu/g) @ 3 g/kg DM and herb (*Urtica diocia*) @ 3% of DM as per the *in-vitro* studies. The representative samples of feeds offered and residue collected were analyzed daily for DM content. Body weight was recorded at fortnightly intervals. At the end of the experiment, a metabolism trial of 6 days duration was conducted to know the digestibility of nutrients and balance of nitrogen, Ca and P (Talapatra *et al.*, 1940) [30]. Samples of feed offered, residues left, faeces and urine were analyzed for proximate principles (AOAC, 2005) and cell wall constituents (Van Soest *et al.*, 1991) [33]. Economics of feeding was determined on the basis of cost of experimental feed (per 100 kg feed prepared), average total feed consumed by the animal and total body weight gain by the animal in the feeding trial. The data was analyzed statistically using the Statistical Package for the Social Sciences, Base 14.0 (SPSS Software products, Marketing Department, SPSS Inc. Chicago (USA).

Results and Discussion

The chemical composition of paddy straw and complete feed reported in this study is present in Table 1. Results for chemical composition were in close agreement with observations of Ganai and Teli (2010) [6], Sheikh *et al.* (2014) [29] and Sheikh *et al.* (2017b). The chemical composition of yeast was in accordance to the existing reports of El-Ghani *et al.* (2004) [5], Rekha *et al.* (2005) [23], Ganai *et al.* (2015) [7] and Sheikh *et al.* (2017a) [27]. The chemical composition of *Urtica dioica* is in accordance with earlier reports of Andualem *et al.* (2016a; 2016b) [2, 3].

The DM intake was with significantly (P<0.01) higher in yeast supplemented groups alone and in combination (T2 and T3) with non-significant difference between herb (T1) and control (T0) group (Table 2). Possible reason for increased DMI in response to yeast supplementation may be due to positive effect on ruminal pH, leading to improved fiber degradation higher digestibility of nutrients with improvement in efficiency of utilization of nitrogen (Tripathi and Karim, 2012; Hussein,2014; Sharma *et al.*, 2016 and Sheikh *et al.* 2017a) [32, 12, 26, 27].

The average gain in body weight was significantly (P<0.01) higher in feed additive (T_1,T_2 and T_3) groups with better FCR than control (Table 2) Which could be due to higher digestibility of nutrients with improvement in efficiency of utilization of nitrogen (Kumar and Reddy 2004, Haddad and Goussous 2005 and Sheikh *et al.* 2017a) [9, 27]. Regarding digestibility of nutrients, digestibility of DM, OM, CP, EE, CF, NFE, NDF, ADF, hemi-cellulose and cellulose was significantly (P<0.01) higher in feed additive supplemented groups than that of control (Table 3). The improvement in the digestibility coefficients of different nutrients is probably due to improved number and gross activity of rumen microflora, better colonization of rumen microbes on feed particles (Morgavi *et al.*, 2000) [18], better ruminal pH and increased TVFA concentration (Qadis *et al.*, 2014) [22] on inclusion of different feed additives in the ration of animals.

All the animals of different treatment groups were found to be in positive mineral balance, with significantly higher values in feed additive supplemented groups than control (Table 3) attributed to the additive effect of feed additives Garg *et al.*(2009) [8] and Sheikh *et al.* (2017a) [27]. The feeding cost per kg live weight gain (i.e cost of production) were lower for feed additives supplemented groups compared to control group which was obviously due to better nutrient utilisation that supported higher growth rate of lambs in the respective groups (Parnerkar *et al.*, 2016; Shankhpal *et al.*, 2016 and Sheikh *et al.* 2017a) [20, 25, 27].

The DCP, TDN, DE and ME content were found significantly (P<0.01) higher in feed additive supplemented groups with nutritive ratio (NR) highest in control (Table 4). The improvement in DCP content on dietary supplementation of feed additives might be due to better utilization of fibre and higher microbial protein synthesis (Jouany, 2006, Paryad and Rashidi, 2009, Kumar and Reddy 2004) [13, 21, 14]. Similar results were also reported by El-Ghani *et al.* (2004) [5] and Garg *et al.* (2009) [8].

Table 1: Chemical composition of paddy straw, complete feed and feed additives

Chemical components (% DM)	Paddy straw	Complete feed	Probiotic (*S. cerevisae*)	*Urtica dioica* leaves
DM	93.20	89.53	99.50	88.6
OM	85.70	91.36	93.6	76.7
CP	3.90	14.00	40.10	26.7
EE	1.80	4.5	2.5	17.1
CF	35.90	19.5	3.10	10.49
NFE	37.40	49.7	-	30.5
TA	14.2	12.4	6.3	23.3
AIA	4.1	3.31	1.1	4.7
NDF	79.9	68.00	-	31.5
ADF	61.1	42.00	-	13.3
HC	18.70	25.00	-	18.2
Cellulose	44.37	34.00	-	25.8
ADL	10.6	5.4	-	3.6
Ca	0.35	1.9	1.90	0.7
P	0.24	0.6	0.80	0.03

Table 2: Dry matter intake, weight gain, FCR and economics of feeding of animals in different treatment groups

Particular	Control	T1	T2	T3
Dry Matter Intake				
DMIg/day**	733.13 ±14.74[a]	756.70 ±11.78[a]	794.69 ±8.16[b]	809.54 ±8.09[b]
DMI %kg b. wt	2.51 ±0.06	2.54 ±0.07	2.65 ±0.06	2.68 ±0.08
Body weight				
Initial weight	26.24±1.45	26.40±1.75	26.46±1.57	26.70±2.04
Final weight	31.27±1.38	32.36±1.75	32.42±1.60	33.10±2.04
Gain in weight **	5.05±0.10[a]	5.96±0.03[b]	5.96±0.04[b]	6.34±0.10[c]
Feed conversion ratio				
FCR**	8.82±0.28[b]	7.64±0.18[a]	8.02±0.14[a]	7.60±0.14[a]
Economics				
Reduction in feed cost/animal	-	16.08	8.40	14.41

Means superscripted with different letters in a row ([abcd]) for a particular data differ significantly from each other ** ($P<0.01$)

Table 3: Nutrient Digestibility and Mineral balance in lambs supplemented with Probiotic and Herb

Attribute	Control	T1	T2	T3
Nutrient Digestibility (%)				
DM**	42.33±0.37[a]	50.88±0.19[b]	51.43±0.38[b]	57.86±0.12[c]
OM**	47.04±0.34[a]	55.37±0.44[b]	56.64±0.36[c]	62.01±0.15[d]
CP**	46.65±0.29[a]	56.68±0.57[b]	56.25±0.73[b]	66.15±0.12[c]
EE**	50.49±0.18 [a]	60.31±0.23[c]	55.21±0.38[b]	63.63±0.14 [d]
CF**	40.69±0.87[a]	50.91±0.74 [b]	53.01±0.49[b]	60.64±0.79[c]
NFE**	43.42±0.47[a]	50.91±0.48[b]	52.64±0.57[c]	57.40±0.34[d]
NDF**	45.40±0.26[a]	52.62±0.18[b]	52.55±0.34[b]	59.27±0.12[c]
ADF**	44.41±0.26[a]	49.92±0.26[b]	52.42±0.36[c]	58.25±0.25[d]
HC**	46.21±0.29[a]	54.03±0.93[b]	53.72±0.70[b]	60.36±0.66[c]
Cellulose**	49.03±0.27[a]	56.03±0.11[b]	56.55±0.30[b]	62.23±0.10[c]
Mineral Balance				
N Balance g/day**	3.47±0.08[a]	5.30±0.04[b]	5.64±0.11[c]	7.27±0.14[d]
Ca Balance g/d**	3.94±0.05[a]	6.03±0.05[b]	6.58±0.05[c]	7.35±0.04[d]
P Balance g/d**	1.48±0.04[a]	2.42±0.03[b]	2.47±0.01[b]	2.86±0.02 [c]

Means superscripted with different letters in a row ([abcd]) for a particular data differ significantly from each other ** ($P<0.01$)

Table 4: Nutritive values of rations affected by feed additive supplementation

Attributes	Treatment groups			
	T_0	T_1	T_2	T_3
Practical Nutrtional worth of Rations				
DCP%**	3.00±0.04[a]	4.70±0.09[b]	4.53±0.12[b]	6.42±0.26[c]
TDN%**	37.04±0.65[a]	47.04±0.52[b]	47.99±0.32[b]	56.50±0.58[c]
NR**	1:11.32±0.16[c]	1:9.02±0.23[b]	1:9.62±0.28[b]	1:7.79±0.82[a]
ME (Kcal/g)**	1.33±0.02[a]	1.70±0.01[b]	1.73±0.12[b]	2.04±0.02[c]
DE (Kcal/g)**	1.63±0.29[a]	2.07±0.22[b]	2.11±0.13[b]	2.49±0.26[c]
Intake of Digestible Nutrients (g/day)				
DDMI**	331.38±3.82[a]	431.41±1.97[b]	439.71±4.79[b]	510.72±1.31[c]
DOMI**	368.20±3.41[a]	469.48±3.71[b]	484.13±3.36[c]	547.30±1.26[d]
DCPI**	23.53±0.38[a]	39.86±0.93[b]	38.75±1.17[b]	56.69±0.21[c]
TDNI**	289.87±5.23[a]	398.77±3.92[b]	410.26±4.16[b]	498.64±4.46[c]

Means superscripted with different letters in a row ([abcd]) for a particular data differ significantly from each other ** ($P<0.01$)

Conclusion

Therefore, it could be concluded that probiotic supplementation @ 3g and herb @ 3% in the rations of polled cross lambs containing paddy straw and concentrate mixture in 60:40 ratio improved DM intake, growth, nutrient utilization and economics of feeding.

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