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Effect of fungal treated and ensiled apple pomace paddy straw based complete feed on nutrient utilization in female Corriedale sheep

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Abstract
A study was undertaken in two phases to evaluate the effects of feeding fungal treated and ensiled apple pomace paddy straw based complete diet in the ration of eighteen female Corriedale sheep divided into three equal groups as per CRD on nutrient utilization, growth performance, haemato-biochemical parameters. Nutritional worth of experimental feeds revealed non-significant ($p \leq 0.05$) difference in % DCP, ME (kcal/g) and DE (kcal/g) and % TDN between the experimental groups with highest numerical value in T_3 in comparison to T_1 and T_2, while as NR in group T3 was significantly ($p \leq 0.05$) lower than T_1 and T_2. Intake of digestible nutrients showed significantly ($p \leq 0.05$) higher values in T_3 as compared to T_1 and T_2 ($p \leq 0.05$) in, DDMI (g/d) DOMI (g/d), DCPI (g/d) and TDNI (g/d) whereas digestible nutrient intake when expressed in % of body weight and/kg $W^{0.75}$, could not reveal any significant ($p \leq 0.05$) difference between the experimental groups. Significantly ($p \leq 0.05$) higher values were also reported in the nitrogen, calcium and phosphorous intake and nitrogen, calcium and phosphorous balance in T_3 group followed by T_2 and T_1. The studies on hemato-biochemical parameters revealed significant ($p \leq 0.05$) increase in Hb of the treatment group in T_2 in comparison to T_1 and T_3. However, PCV, serum creatinine, BUN, blood glucose and total protein showed non-significant difference between the groups. The effect of period irrespective of the treatment on Hb and total protein was found significant ($P \leq 0.05$), showing an increasing trend with the advancement of age.

Keywords: Corriedale sheep, apple pomace, paddy straw, nutrient utilization

Introduction
At present, the increasing gap between demand and supply of feed/fodder for livestock not only requires higher quantity and quality of feed resources, but there is greater need for efficient management of livestock feeds and its utilization in the animal system. According to an estimate by Kiran *et al.* 2012, [2] there is shortage of 25 million tonnes of concentrate, 159 million tonnes of green fodder and 117 million tonnes of crop residues in India that constitutes 32, 20 and 25% deficiency respectively. In the state of J&K, the situation is little worse due to large bovine population as the human to animal ratio in the state is above the national average of 1:0.4. According to Wani *et al*. (2014), [8] the requirement of green fodder in J&K is around 12563 thousand tonnes for 10938 thousands livestock against the availability of 7459 thousand metric tonnes. Severity of deficiency is more pronounced in Ladakh (85%) followed by Kashmir (45%) and Jammu (33%) divisions. The authors reported that green and dry fodder availability is only 1.62 and 0.66 kg/animal/day respectively constituting 2.28 kg/animal/day which is very low as compared to the national average of 5.15 kg/animal/day. For efficient utilization of poor quality roughages, various processing methods have been used such as physical, chemical, biological treatment and supplementation with other feed ingredients or a combination of these treatments, yet improvements of crop residues to desirable extent are still awaited. Hence, it is the need of the day to utilize these crop residues available in appreciable quantum locally in association with concept of complete feed technology and use of biological agents (lignolytic fungi) to maximize advantage from given feeds in animal system. Biological treatment of fortification of poor quality roughages is a favorable option and is believed to be more environmental friendly and safer with very low operating cost than the use of chemicals and physical treatment methods. Use of lignolytic fungi, cellulolytic enzymes and other beneficial microorganisms that are able to degrade the ligno-cellulosic components of paddy straw have been used to improve the availability of nutrients from paddy straw for the usage of

rumen microorganisms (Euna *et al.* 2006; Jahromi *et al.* 2011) [3, 5]. In Jammu and Kashmir, it is estimated that 20% of the fruit gets damaged due to various factors and are used for juice extraction and the left over is a by-product as 1.02 lakh tons of apple pomace is produced every year (NHB, 2013) [6]. It has been reported by Ganai *et al*. (2006) [4] that apple pomace contains 7.92% crude protein, 20% crude fibre, 2.96% ether extract, 4.27% total ash, 47.70% NDF and 36.82% ADF, 0.19% calcium and 0.14% phosphorus. Bhat *et al.* (2000) [1] and Tiwari *et al.* (2008) [7] reported that apple pomace contains 2600-2750 k.cal/kg energy and 65% TDN, respectively. Tiwari *et al.* (2008) [7] also reported that the potential digestibility of neutral detergent fiber, acid detergent fiber and hemi cellulose in apple pomace are found to be 74.90%, 71.33% and 85.42%, respectively. He further reported that apple pomace contains higher level of fiber (20.50%) and substantial amount of fermentable carbohydrates, which increases its utility for the feeding of livestock and inclusion of apple pomace make the dairy ration economical and cost effective.

Materials and Methods

The present study was carried out at Division of Animal Nutrition, Faculty of Veterinary Sciences and Animal Husbandry, Shuhama and Mushroom laboratory, Division of Plant Pathology, SKUAST of Kashmir, to assess the effect of feeding fungal treated and ensiled paddy straw with apple pomace based complete diet on growth performance, nutrient utilization, rumen fermentation parameters and hemato-biochemical constituents of sheep. The study was carried out in two phases as under;

Phase I

a) *In-vitro* screening of different fungal strains and silages to determine the best strain of fungi and silage to be used for treatment of paddy straw under local conditions.
b) To determine the optimum ratio of combination of apple pomace with paddy straw to be used for *in-vivo* feeding experiment.

Phase II

In-vivo feeding experiment of 90 days, using fungal treated paddy straw and ensiled paddy straw with apple pomace based complete diet in sheep was conducted

Metabolism Trial

To assess the digestibility of nutrients, a 7 day metabolism trial was conducted at the end of the feeding experiment, using metabolic cages, during which feed offered, residue left and faeces voided by the animals was recorded daily at the same time.

Representative samples of feed offered, residue left and faeces voided were taken in previously weighed trays and kept in a hot air oven at 100 ºC overnight for DM estimation. The dried material obtained during the trial period was pooled, processed and stored for further analysis.

Hemato-biochemical studies

Various haemato-biochemical parameters viz., haemoglobin (Hb), packed cell volume (PCV), blood glucose, total serum proteins, blood urea nitrogen (BUN) and creatinine were recorded before the start of feeding and thereafter at monthly intervals of feeding experiment in control (T_1) and treatment groups (T_2) and (T_3), to judge the physiological conditions of animals.

Collection of blood

Blood was collected from jugular vein of each animal with all aseptic precautions using 20 gauge needles to avoid rupture of corpuscles, damage of leucocytes and to allow flow of blood smoothly with a minimum of vacuum. The blood so drawn was collected in sterilized test tubes containing disodium salt of Ethylene-diamine-tetra-acetic acid (EDTA) as anticoagulant @ 1 mg/ml of blood. Hematological studies were performed soon after collection of blood. For separation of serum, some of blood was collected in second tube, without anticoagulant, and kept in slanting position. These tubes were incubated for 1 h at 37 ºC. Blood clots were broken and tubes were centrifuged at 2500 rpm for 30 minutes. The serum was pipetted out in small pyrex tubes and kept in deep freezer for further analysis.

Estimation of various blood parameters

Hb and PCV were estimated by automatic hematology analyzer (SB-21 Vet). Glucose was estimated by glucometer instantly after blood collection. Total protein, albumin, BUN and creatinine were estimated by using commercial diagnostic kits (Span diagnostics limited, Surat, Gujarat, India).

Data Processing and analysis

The data obtained in the experiment were analyzed using statistical procedures given by Snedecor and Cochran (1994). Significance of mean difference was tested by Duncan's New Multiple Range Test (DNMRT) using the Statistical Package for the Social Sciences (SPSS), Base 20.0, SPSS Software products, Marketing Department, SPSS Inc. Chicago, USA.

Results and Discussion

The present scenario also necessitates the need for looking out for various technologies that can improve the nutritive value of poor quality roughages which are available in appreciable amounts but cannot be fed as maintenance diet for any species of the ruminants due to poor nutrient and high lignin content. Many agricultural and agro-industrial by-products which are available locally are inexpensive and have a substantial potential value as animal feedstuffs but have not been fully exploited. In addition to those alternate feed resources, various species of fungi are yet to be explored for their ligno-lytic properties and more work needs to be done to explore the potential of such fungi and other microbes and their extracts for the improvement of poor quality roughages in order to bridge the gap that exists between the demand and supply of feed resources. The ligno-lytic fungi such as white rot fungi, brown rot fungi and soft rot fungi are easily available round the year and can efficiently be grown on roughages with minimum amount of look after and care. The fungus treated straws like paddy straw and wheat straw are nutritious and more pala Table as compared to their untreated counter-parts. Furthermore, biological treatment of straws is an environment friendly technique that poses no threat to the environment and has no toxicity issues for the animals. The fungi can be grown under moderate temperature and a varying range of humidity hence can easily be accepted by the common farmers as a means of improvement of nutritive value of the poor quality roughages. Some of the NCFRs have the potential to either replace some of the costly concentrate feed ingredients or have the ability to enhance nutritive value of poor quality roughages for economizing livestock feeding. Among these, by-products from fruit industry such as apple pomace, tomato pomace, grape pomace, sugar beet pulp and pomegranate pulp etc. have substantial potential to be used as animal feeds. Thus, the utilization of such by-products or NCFR as animal feed may be economically a viable proposition. In this context, an experiment was conducted to assess the effect of feeding fungal treated and apple pomace ensiled paddy straw in complete ration of sheep to elucidate its effect on growth, nutrient utilization, physiological health status and haemato-biochemical parameters in Corriedale sheep.

Feed consumption by the experimental animals

The intake of feed is one of the main parameters to ascertain the palatability of the experimental rations and was calculated on DM basis. Dry matter intake in terms of g/d, % of b.wt. And g/ kg$W^{0.75}$.The average values of dry matter intake calculated at every 15 day interval during experimental period of 90 days in terms of g/d was 661.06±33.82, 692.74±41.15 and 739.46±57.36 in T_1, T_2 and T_3 groups respectively. The mean values of dry matter consumption in terms of % of b. wt. was found to be 3.04±0.03, 3.10±0.02 and 3.11±0.05 for $T_{1,}$ T_2 and T_3 groups, respectively, whereas, the dry matter intake in terms of g/kg $W^{0.75}$ was found to be 67.35±1.77, 67.23±1.40 and 68.51±2.18 for $T_{1,}$ T_2 and T_3 groups, respectively. Statistical analysis of the data revealed that intake of dry matter did not differ significantly from each other in every group when DMI was expressed in terms of g/d, % of b.wt. And g/ kg$W^{0.75}$, although numerically higher values were obtained in T_3 as compared to T_2 and T_1 when DMI was expressed in terms of g/d and % of body weight. Comparison of means by DNMRT also revealed that DMI when expressed in terms of g/kg $W^{0.75}$ showed non-significant difference between the groups, however, numerically higher values were found in T_3 followed by T_1 and T_2 group. The effect of period irrespective of the treatment on dry matter intake was observed to be significant ($P \leq 0.05$) in terms of kg, % of b.wt. And g/kg $W^{0.75}$ with the values showing increasing trend in g/d and g/kg$W^{0.75}$ and% of b.wt. With the advancement of age.

Table 4.1: Periodical feed conversion ratio of experimental animals in different treatment groups

Period (days)	Treatment groups			
	T_1	T_2	T_3	Mean
15	$4.11^{bA}\pm0.09$	$4.36^{bA}\pm0.11$	$3.14^{aA}\pm0.11$	$3.87^{A}\pm0.15$
30	$6.06^{bA}\pm0.18$	$5.22^{aA}\pm0.12$	$4.05^{aA}\pm0.09$	$5.11^{A}\pm0.33$
45	$7.57^{cB}\pm0.11$	$5.56^{bB}\pm0.11$	$5.38^{aB}\pm0.08$	$6.17^{B}\pm0.17$
60	$9.90^{cC}\pm0.58$	$7.82^{bC}\pm0.13$	$6.83^{aC}\pm1.10$	$8.18^{B}\pm1.01$
75	$15.53^{cD}\pm0.84$	$11.87^{bC}\pm0.12$	$9.62^{aD}\pm0.99$	$12.34^{C}\pm1.03$
90	$19.06^{cE}\pm0.57$	$14.60^{bD}\pm0.12$	$12.04^{aE}\pm0.10$	$15.23^{D}\pm1.49$
Mean	$10.37^{b}\pm0.21$	$8.24^{a}\pm0.13$	$6.84^{a}\pm0.18$	

Digestibility coefficients of nutrients

The digestibility of nutrients present in feed is considered to be very important parameter in assessing the nutritional worth of feed. Therefore, digestion studies were undertaken to determine the digestibility coefficients of dry matter, organic matter, CP, EE, CF, NFE, NDF, ADF, hemicellulose and cellulose in experimental diets offered to experimental animals. The daily feed intake and faeces voided by the experimental sheep were recorded during the metabolism trial of seven days. Samples were analyzed for proximate constituents as well as various fibre fractions in T_1, T_2 and T_3 treatment groups and the data obtained were compiled for calculation of digestibility coefficients of DM, CP, EE, CF, NFE, NDF and ADF for assessment of nutrient availability from experimental feeds. The results obtained have been presented in Table 4.17

Dry matter and organic matter digestibility

The mean values of digestibility coefficients of dry matter (DM) and organic matter (OM) were found to be 57.97±0.19, 60.72±0.27, 65.48±0.26 and 61.78±0.29, 64.23±1.11 and 68.40±1.01 in T_1, T_2 and T_3 groups respectively. The statistical analysis of the data revealed

Table 2: Periodical dry matter intake (g/d, %kg b. wt and DMI g/ kg$W^{0.75}$) of animals in different treatment groups

Period (days)	Treatment groups			
	T_1	T_2	T_3	Mean
DMI g/d				
15	$545.67^{bA}\pm30.77$	$552.01^{aA}\pm21.42$	$532.79^{aA}\pm24.66$	$543.49^{A}\pm43.14$
30	$595.53^{bB}\pm32.34$	$610.36^{abAB}\pm33.48$	$632.99^{aB}35.33$	$612.96^{B}\pm47.23$
45	$642.31^{abC}\pm41.71$	$663.77^{aC}\pm35.09$	$710.01^{aC}\pm38.97$	672.02c±53.32
60	$688.32^{cD}\pm44.81$	$745.52^{bD}37.54$	$798.03^{aC}\pm44.91$	$743.96^{D}\pm56.37$
75	$727.68^{cE}\pm51.39$	$773.21^{bE}\pm35.12$	$876.54^{aD}\pm51.17$	$792.48^{E}\pm57.32$
90	$766.84^{cF}\pm53.84$	$811.59^{bE}\pm35.05$	$886.39^{aE}\pm51.01$	$821.61^{F}\pm59.57$
Mean	661.06±41.12	692.74±41.13	739.46 ±48.11	
DMI %kg b. wt				
15	$2.98^{A}\pm0.11$	$3.04^{A}\pm0.08$	$2.91^{A}\pm0.11$	$2.98^{A}\pm0.13$
30	$2.96^{bA}\pm0.17$	$3.05^{aA}\pm0.11$	$3.05^{aA}\pm0.09$	$3.02^{A}\pm0.17$
45	$2.96^{bA}\pm0.12$	$3.04^{aA}\pm0.17$	$3.09^{aA}\pm0.12$	$3.03^{A}\pm0.11$
60	$3.04^{bB}\pm0.13$	$3.18^{aAB}\pm0.12$	$3.18^{aA}\pm0.14$	$3.13^{B}\pm0.12$
75	$3.09^{bB}\pm0.10$	$3.12^{aB}\pm0.15$	$3.28^{aAB}\pm0.14$	$3.17^{B}\pm0.13$
90	$3.16^{bB}\pm0.09$	$3.16^{aAB}\pm0.10$	$3.15^{aAB}\pm0.11$	$3.16^{B}\pm0.15$
Mean	3.04±0.13	3.10±0.16	3.11±0.15	
DMI g/ kg$W^{0.75}$				
15	$61.85^{cA}\pm5.31$	$62.72^{bA}\pm4.04$	$60.20^{aA}\pm5.72$	$61.59^{A}\pm7.19$

30	63.72^{cA}±5.11	64.39^{bA}±4.16	65.02^{aA}±6.16	64.38^{A}±5.17
45	65.84^{cA}±6.09	65.63^{bA}±5.33	67.55^{aA}±6.11	66.34^{A}±6.37
60	68.61^{cB}±4.81	69.94^{bAB}±4.18	71.12^{aA}±5.18	69.89^{AB}±6.15
75	70.85^{cBC}±5.71	69.64^{bBC}±6.15	74.59^{aAB}±5.55	71.69^{B}±7.05
90	73.22^{bC}±5.48	71.08^{bBC}±5.98	72.59^{aB}±6.34	72.29^{B}±5.21
Mean	67.35±4.33	67.23 ±5.27	68.51±6.08	

Note: Means superscripted with different letters in a row (ab) or column AB) for a particular data differ significantly ($P \leq 0.05$)

significant ($P \leq 0.05$) effect of treatment on the dry matter and organic matter digestibility and the values were higher in T_3 followed by T_2 and T_1. On comparison of means, significantly ($P \leq 0.05$) higher dry matter and organic matter digestibility were observed in T_3 compared to T_2 and T_1, however, there was no statistical difference in the DM and OM digestibilities of T_1 and T_2 groups though the values were higher in T_2 group as compared to T_1 group (Table 3).

Table 3: Average digestibility coefficients of DM and other nutrients in different treatments

Attributes	Treatments		
DM	57.97^{a}±0.19	60.72^{a}±0.27	65.48^{b}±0.26
OM	61.78^{a}±0.29	64.23^{a}±1.11	68.40^{b}±1.01
CP	61.04^{a}±0.54	64.13^{ab}±0.77	67.66^{b}±0.81
EE	64.00^{a}±0.99	69.78^{ab}±0.87	73.13^{b}±1.04
CF	64.98^{a}±0.32	66.83^{a}±0.31	71.85^{b}±0.37
NFE	70.17±0.79	70.92±0.71	72.70±0.83
NDF	55.77±0.43	57.74±0.55	61.65±0.52
ADF	64.92±0.51	68.54±0.52	69.93±0.68
Hemicellulose	69.55±0.76	72.37±0.78	74.99±0.82
Cellulose	64.17^{a} ±0.76	62.23^{a} ±0.78	68.68^{b}±0.82

Note: Means superscripted with different letters in a row differ significantly ($P \leq 0.05$)

Table 4: Practical nutritional worth of different experimental rations

Attributes	Treatments		
	T_1	T_2	T_3
DCP %	6.41±0.10	6.90±0.10	8.23±0.11
TDN %	61.63±1.95	65.02±2.43	64.60 ±1.74
NR	8.61^{b}±0.16	8.42^{b}±0.21	6.85^{a}±0.19
ME (Kcal/g)	8.26±0.08	8.28±0.08	8.91±0.06
DE (Kcal/g)	10.07±0.07	10.10±0.10	10.86±0.07

Note: Means superscripted with different letters in a row for a particular data differ significantly ($P \leq 0.05$)

Plane of nutrition

The intake of digestible nutrients were calculated in terms of digestible dry matter intake (DDMI), digestible organic matter intake (DOMI), digestible crude protein intake (DCPI) and total digestible nutrient intake (TDNI). The intake was expressed in terms of g/d, %of b.wt. And g/kg $W^{0.75}$ and are presented in Table 4.16. The DDMI in terms of g/d, % kg b.wt. And g/kg $W^{0.75}$ were 421.53±11.34, 1.86±0.11 and 40.50±3.76 for T_1 group, 445.88±13.76, 1.94±0.10 and 42.77±3.89 for T_2 and 583.23±18.83, 2.35±0.15 and 52.55±5.60 for T_3, respectively. Statistical analysis of the data (appendix-V) revealed that DDMI in the experimental group T_3 was significantly ($P \leq 0.05$) higher than T_2 and T_1 groups when expressed as g/d, %of b.wt. and g/kg $W^{0.75}$: however, the values in T_1 and T_2 could not reach statistical significance though values in T_2 were numerically higher than T_1.In case of DOMI, the values in terms of g/d, % kg b.wt. and g/kg$W^{0.75}$ were found to be 404.34±16.09, 1.80±0.07 and 39.05±2.37 for T_1 group, 438.91±18.98, 1.87±0.11 and 41.15±2.11 for T_2 group and 555.17±21.09, 2.22±0.21 and 49.66±3.05 for T_3 group, respectively. Statistical analysis of the data revealed that DOMI in the experimental group T_3 was significantly ($P \leq 0.05$) higher than T_2 and T_1 groups when expressed as g/d, %of b.wt. And g/kg $W^{0.75}$: however, the values in T_1 and T_2 could not reach statistical significance though values in T_2 were numerically higher than T_1. The average values of DCPI in terms of g/d, % of b.wt. and g/kg $W^{0.75}$ were found to be 46.37±7.09, 0.2±0.04 and 4.48±0.34 for T_1 group, 48.89±6.55, 0.2±0.01 and 4.58±0.31 for T_2 group and 60.13±7.03, 0.24±0.03 and 5.38±0.11 for T_3 group, respectively. Statistical analysis of data revealed that the DCPI (g/d) in T_3 group differed significantly ($P \leq 0.05$) from T_1 and T_2, however the difference between T_1 and T_2 could not reach statistical significance. On comparison of means by DNMRT, the data revealed significantly higher values in T_3 than T_2 and T_1, whereas, the difference between T_1 and T_2 were non-significant. The results of TDNI when expressed in terms of g/d, % of b.wt. And g/kg $W^{0.75}$ were 445.84±13.55, 1.98±0.04 and 43.05±2.53 for T_1 group, 488.45±16.74, 2.08±0.06 and 45.79±2.98 for T_2 group and 579.60±15.09, 2.32±0.11 and 51.80±3.34 for T_3 group, respectively. On comparison of means by DNMRT, the data revealed significantly ($P \leq 0.05$) higher values in T_3 than T_1 and T_2, when TDNI was expressed in terms of g/d, whereas, the difference between T_1 and T_2 was non-significant. When expressed in terms of % of b.wt. And g/kg $W^{0.75}$ the values in the experimental groups could not reach statistical significance.

Table 5: Intake of digestible nutrients in different treatment groups

Attributes	T_1	T_2	T_3
DDMI			
g/d	421.53^{a}±11.34	445.88^{a}±13.76	583.23^{b}±18.83
% of b wt.	1.86^{a}±0.11	1.94^{a}±0.10	2.35^{b}±0.15
g/kg$W^{0.75}$	40.50^{a}±3.76	42.77^{a}±3.89	52.35^{b}±5.60
DOMI			
g/d	404.34^{a}±16.09	438.91^{a}±18.98	555.17^{b}±21.09
% of b.wt.	1.80±0.07	1.87±0.11	2.22±0.21
g/kg$W^{0.75}$	39.05±2.37	41.15±2.11	49.66±3.05
DCPI			
g/d	46.37^{a}±7.09	50.58^{a}±6.55	63.74^{b}±7.03
% of b.wt.	0.21±0.04	0.22±0.01	0.26±0.03
g/kg$W^{0.75}$	4.48±0.34	4.74±0.31	5.70±0.11
TDNI			
g/d	445.84^{a}±13.55	488.45^{a}±16.74	579.60^{b}±15.09
% of b.wt.	1.980.04	2.08±0.06	2.32±0.11
g/kg $W^{0.75}$	43.06±2.33	45.80±2.98	51.84±3.34

Note: Means superscripted with different letters in a row differ significantly ($P \leq 0.05$).

Average values of calcium intake, balance, per cent retention of intake and per cent of absorbed calcium in animals fed on apple pomace ensiled paddy straw based complete and fungal treated paddy straw based complete feed have been presented in Table 4.26. Mean values of calcium intake (g/d) were found to be 5.79±0.34, 10.74±0.80 and 16.49±1.66 g/d,

(Table 6) in T_1, T_2 and T_3 groups respectively. The statistical analysis of data revealed significant (P<0.05) difference between calcium intake in all the treatment groups. Comparison of means using DNMRT revealed significantly higher intake in T_3 group followed by T_2 and T_1 group.

The average values of calcium balance as g/d were found to be 3.00±0.36, 6.84±0.82 and 11.74±2.15 g/d in T_1, T_2 and T_3 treatment groups, respectively. The statistical analysis of data (appendix-XXII) revealed significant (P<0.05) difference between calcium balance in all the treatment groups. Comparison of means using DNMRT revealed significantly higher values in T_3 group followed by T_2 and T_1 group. All the animals subjected to various treatment groups including control were in positive Ca balance.

Mean values of Ca balance as % intake and % absorbed were found to be 50.93±3.13 and 77.18±1.77 for T_1, 63.31±3.11 and 84.03±1.09 T_2 and 70.85±1.17 and 87.00±0.44 for T_3 treatments, respectively. The statistical analysis of data showed significant (P<0.05) effect of fungal treatment and apple pomace treatment on paddy straw based complete feeds on % of absorbed Ca and % retention of Ca. Comparison of means using DNMRT revealed significantly lower values with respect with % absorbed and retained Ca in T_1 group followed by T_2 and T_3. All the animals subjected to experiment irrespective of treatments were in positive Ca balance.

Table 6: Effect of different rations on calcium and phosphorus balance (Mean ± SE)

Parameters	Treatment groups		
	Calcium		
	T_1	T_2	T_3
Intake (g/d)	5.79 ^{a} ±0.34	10.74 ^{b} ±0.80	16.49 ^{c} ±1.66
Excretion			
Faecal	1.95 ^{a} ±0.25	2.62 ^{b} ±0.80	3.04 ^{c} ±0.78
Urinary	0.11 ^{a} ±0.31	1.28 ^{b} ±0.13	1.70 ^{c} ±0.649
Total	2.79 ^{a} ±0.05	3.93 ^{b} ±0.58	4.74 ^{c} ±0.77
Balance			
Balance	3.00 ^{a} ±0.36	6.84 ^{b} ±0.82	11.74 ^{c} ±2.15
% Intake	50.93 ^{a} ±3.13	63.31 ^{b} ±3.11	70.85 ^{c} ±1.17
% Absorbed	77.18 ^{a} ±1.77	84.03 ^{b} ±1.09	87.00 ^{c} ±0.44
Phosphorus			
	T_1	T_2	T_3
Intake (g/d)	3.78 ^{b} ±0.29	2.93 ^{a} ±0.28	6.30 ^{c} ±0.33
Excretion			
Faecal	1.02 ^{b} ±0.005	0.58 ^{a} ±0.002	1.21 ^{c} ±0.648
Urinary	0.81 ^{b} ±0.004	0.41 ^{a} ±0.001	0.52 ^{c} ±0.000
Total	1.84 ^{b} ±0.006	0.98 ^{a} ±0.003	2.10 ^{c} ±0.648
Balance			
Balance	1.94 ^{a} ±0.30	1.95 ^{a} ±0.28	4.20 ^{b} ±0.34
% Intake	50.41 ^{a} ±3.47	65.88 ^{b} ±3.22	66.07 ^{c} ±2.87
% Absorbed	69.20 ^{a} ±1.89	82.31 ^{b} ±2.91	88.66 ^{c} ±2.88

Phosphorus balance

Average values of P intake, balance, per cent retention of intake and per cent of absorbed P in animals fed on apple pomace ensiled paddy straw based complete and fungal treated paddy straw based complete feed have been presented in Table 4.18. Mean values of P intake (g/d) were found to be 3.78±0.29, 2.93±0.28 and 6.30±0.33 g/d, (Table 4.26) in T_1, T_2 and T_3 groups respectively. The statistical analysis of data revealed significant (P<0.05) difference between P intake in all the treatment groups. Comparison of means using DNMRT revealed significantly higher intake in T_3 group followed by T_1 and T_2 group.

The average values of phosphorous balance as g/d were found to be 1.94±0.30, 1.95±0.28 and 4.20±0.34 g/d in T_1, T_2 and T_3 treatment groups, respectively. The statistical analysis of data revealed significant (P<0.05) difference in P balance between the treatment group T_3 as compared to T_1 and T_2. Comparison of means using DNMRT revealed significantly higher values in T_3 group followed by T_2 and T_1 group. All the animals subjected to various treatment groups including control were in positive P balance.

Mean values of P balance as % retention and % absorbed were found to be 50.41±3.47 and 69.20±1.89 for T_1, 65.88±3.22 and 82.31±2.91 T_2 and 66.07±2.87 and 88.68±2.88 for T_3 treatments, respectively. The statistical analysis of data showed significant (P<0.05) effect of fungal treatment and apple pomace treatment on paddy straw based complete feeds on % of absorbed P and % retention of P. Comparison of means using DNMRT revealed significantly different values with respect to % intake of P in all the treatment groups with higher values in T_3 group followed by T_2 and T_1. Comparison of means using DNMRT also revealed significantly different values with respect with % absorbed P in all the treatment groups with higher values in T_3 group followed by T_2 and T_1. All the animals subjected to experiment irrespective of treatments were in positive P balance.

Conclusion

Looking at the results of feed intake, nutrient utilization efficiency, physiological health status and rumen functioning of sheep, it appears that feeding of ensiled paddy straw with apple pomace and fungal treated paddy straw could be a practical and viable proposition that can be adopted for feeding of sheep and other ruminants especially in winter months for sustainable production in the state and to alleviate the feed deficit.

Therefore, from the present study, it was concluded that both ensiling of paddy straw with apple pomace and the fungal treatment of paddy straw has a potential to increase the nutritive value of paddy straw as well as the animal performance and can be used as a potential means to fortify poor quality crop residues especially paddy straw. However long term feeding trials involving large number of animals is required to arrive at final recommendations.

References

1. Bhat GA, Mattoo FA, Bandey MT, Ganai TAS. Effect of incorporating apple pomace in the rations of broiler birds on their performance. Indian Journal of Poultry Science. 2000; 35:182-185.
2. Kiran GR, Suresh KP, Sampath KT, Giridhar K, Anandan S. Modeling and forecasting livestock and fish feed resources, Requirements and Availability in India. National Institute of Animal Nutrition and Physiology, Bengaluru, 2012.
3. Euna JS, Beauchemin KA, Hong SH, Bauer MW. Exogenous enzymes added to untreated or ammoniated paddy straw: Effects on in vitro fermentation characteristics and degradability. Journal of Animal Feed Sciences Technology. 2006; 131:86-101.
4. Ganai AM, Matoo FA, Singh PK, Ahmad HA, Samoon MH. Chemical composition of some feeds, fodders and plane nutrition of livestock of Kashmir valley. SKUAST Journal of Research. 2006; 8:145-151.
5. Jahromi MF, Liang JB, Rosfarizan M, Goh YM,

Shokryazdan P, Ho YW. Efficiency of paddy straw lignocellulose degradability by Aspergillus terreus ATCC 74135 in solid-state fermentation. African Journal of Biotechnology. 2011; 10(21):4428-4435.
6. NHB. Indian Horticulture Database. National Horticulture Board, Ministry of Agriculture, Government of India, New Delhi, 2013.
7. Tiwari SP, Narang MP, Dubey M. Effect of feeding apple pomace on milk yield and milk composition in crossbred Red Sindhi x Jersey cow. Livestock Research and Rural Development. 2008; 20:274-276.
8. Wani M, Zahid AM, Nazir S. Spatial variability of DTPA Extractable Cationic Micronutrients in Northern part of lesser Himalayas using GIS Approach, 115th Esri India User Conference. Geo-enabling Digital India, 2014, 1-14.