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RESEARCH ARTICLE

Effect of herbal products on rumen fermentation pattern in goats

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Abstract

Forty non-descript healthy goats of nearly same age (5-6 months, average body wt-12 kg) were selected for the study and offered ration as per standard NRC (2001). Group-I was untreated control treatment. Group-II, III and IV were supplemented with Ruchamax@7.5 g, AV/DAC/16@7.5 g and AV/RMF/17@7.5 g, respectively twice in a day for 15 days along with standard ration. All the nitrogen fractions of rumen fluid except TCA ppt nitrogen were lower whereas TVFA and lactic acid concentration were higher on AV/RMF/17 supplemented diet as compared to other groups. Time of sampling also had significant ($P<0.01$) effect on concentration of all rumen nitrogen fractions, TVFA and lactic acid, which peaked at 4 hr post feeding irrespective of rations. Activities of polysaccharide degrading enzymes e.g., cellulase, xylanase, α glucosidase and β glucosidase were similar in different experimental groups and activities were more pronounced ($P<0.01$) after 4 hr post feeding and thereafter declined.

Introduction

Adequate number of microflora, fauna and ruminal enzymes such as cellulase, hemicellulase, xylase, glucosidase improves digestion and utilization of nutrients in addition to maintain normal pH. Disturbance of physiological functions is due to factors such as inadequate or faulty feed, improper dietary practices and overdosing of drugs and chemicals. It results in impaired digestion, scanty secretion, reduce population and activity of microflora, it may also result in hyper acidity or alkalosis in rumen. Additives in feed that improve the overall digestive process also improve the ruminal enzymatic activity.

Certain digestive tonics and appetizer products when added to feed optimizes the population and activity of ruminal microflora (both protozoa and bacteria) and enhances the activity of ruminal enzymes by efficient cellulose break down and digestion. Faster is the rate of digestion, more is the substrate available for the enzymes and better is the nutrient utilization. Herbal digestive tonic and appetizer is scientifically well proven to maintain a balance between beneficial bacteria and pathogens for intestinal and general health. It also facilitated optimal absorption and utilization of nutrients and thus improves feed conversion ratio, productivity and weight gain. Present study was undertaken to study the effect of dietary supplementation of some herbal products on modulation of rumen metabolites and enzyme activities in goats.

Materials and Methods

The study was carried out at the Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Anjora, Durg, Chhattisgarh, India. Forty non-descript healthy goats of nearly same age (5-6 months, average body weight-12 kg) were selected for the study. The animals were housed individually in separate

pens and allowed to acclimatize for 23 days prior to commencement of experimentation and offered ration as per standard NRC (2001) recommendations. The rumen fistulated animals were randomly divided into 4 groups of 10 animals in each. Feeding schedule was similar during entire feeding trial period. Group-I was control without any treatment, however group-II, III and IV were supplemented with Ruchamax@7.5 g, AV/DAC/16@7.5 g and AV/RMF/17@7.5 g, respectively twice in a day for 15 days along with standard ration. Feeding trial in each group was consisting of 15 days preliminary period followed by rumen liquor collection.

Rumen liquor was collected on 16^{th} and 17^{th} day of experiment from each animal of all the groups at 0, 2, 4 and 6 hrs post feeding. Rumen liquor samples were strained through double layer of muslin cloth to remove solid particles as suggested by Lengemann and Allen (1955) and designated as strained rumen liquor (SRL).Total volatile fatty acids (TVFA) were estimated by the method of Barnett and Reid (1957), ammonia nitrogen by Conway microdiffusion technique of Conway (1957), total nitrogen by McKenzie and Wallace (1954) and TCA precipitable nitrogen by the method of AOAC (1975) in the SRL. Soluble nitrogen estimated by substracting the TCA-ppt nitrogen from total nitrogen. Luminal enzyme activities estimated in rumen digesta by Agarwal et al. (2000).

The data obtained were subjected to statistical analysis by the software SPSS 10 (SPSS, 1997). Levels of significance were calculated as per the standard method described by Duncan (1955) whenever any effect was found significant.

Results and Discussion

Average rumen total nitrogen concentration (Table 1) was significantly ($P<0.01$) differed amongst treatments. However, nitrogen concentration on AV/RMF/17 and ruchamax supplemented goats was 2% and 10% less than AV/DAC/16 and control group, respectively. No significant difference obtained between ruchamax and AV/RMF/17 supplemented groups. The rumen total nitrogen varied from 0 to 8 hr post feeding irrespective of dietary treatment though the improvement in total nitrogen was more pronounced ($P<0.01$) after 4 hr post feeding and thereafter declined. Similar findings reported by Singh (1996). Sinha et al. (1974) observed peak total nitrogen at 3 hr post-feeding.

TCA-ppt-N is a relevant index of net microbial protein synthesis. The differences in the TCA-ppt-N concentrations were statistically significant ($P<0.01$) (Table 1). The highest concentration (119.07 mg /100 mL) was observed in AV/RMF/17 supplemented animals and lowest (99.56 mg/ 100 mL) in control group. The TCA-ppt-N peaked significantly ($P<0.01$) from 2 to 4 hr post feeding and declined thereafter. Increased TCA ppt nitrogen might be due to increased microbial population and hydrolysis of nitrogenous substances.

The differences in the soluble nitrogen concentration were statistically significant ($P <0.05$) (Table 1). The highest concentration (60.60 mg /100 ml) was observed in control group whereas no significant difference obtained due to ruchamax and AV/RMF/17 supplementation and soluble nitrogen concentration were 27.35 and 23.55 mg /100 ml SRL, respectively.

Luminal bacteria are considered good scavengers of ammonia and can grow on relatively low concentrations of ammonia in luminal fluid. Significant ($P <0.05$) difference existed amongst treatments and higher ammonia nitrogen obtained in control groups followed by AV/DAC/16 supplemented group (Table 1). No significant differences were however observed in the ammonia nitrogen between the Ruchamax and AV/RMF/17 supplemented animals.

The TVFA concentrations of various groups differed significantly ($P <0.01$) (Table 1) and the highest values (89.55 mmoles /l) were obtained in AV/RMF/17 supplemented animals followed by ruchamax supplemented group (86.91 mmoles /l) indicating the efficacy of herbal formulation improving the rate of digestion. Irrespective of dietary treatments TVFA concentration peaked significantly ($P<0.01$) 4 hr post feeding. The level of volatile fatty acid remain significantly low in indigestion, which might be due to suppression of microbial fermentation (Pal et al .1994).

The post treatment value of lactic acid of AV/RMF/17 group was significantly ($P<0.01$) higher (5.66mg/dl) as compared to other groups (Table 1). Rumen liquor lactic acid concentration in healthy animal ranges between 4.50 - 8.50 mg/dl of rumen liquor (Basak et al. 1993).

Ruminal enzyme activities due to herbal supplementation presented in Table 2. Activities of polysaccharide degrading enzymes e.g., cellulase, xylanase, α glucosidase and β glucosidase were similar in the rumen of all experimental animal and no significant difference was obtained due to different dietary supplementations. Activities of all polysaccharide degrading enzymes was more pronounced ($P<0.01$) after 4 hr post feeding and thereafter declined.

Table 1. **Effect of different herbal products Ruchamax, AV/DAC/16 and AV/RMF/17 on rumen fermentation pattern in goats**

Particulars	Treatment	Sampling time (hr)				Mean±SE
		0	2	4	6	
Total nitrogen (mg/100 ml SRL)	Control	162.50	163.33	164.83	150.00	160.16^{c}±0.52
	Ruchamax	104.00	162.50	168.00	134.00	142.12^{a}±0.65
	AV/DAC/16	102.75	156.50	183.75	135.25	144.56^{b}±0.69
	AV/RMF/17	104.00	160.50	171.00	135.00	142.62^{a}±0.75
	Mean±SE	118.31^{a}±0.53	160.71^{c}±0.74	171.89^{d}±0.46	138.56^{b}±0.55	
TCA ppt nitrogen (mg/100 ml SRL)	Control	80.25	105.00	115.00	98.00	99.56^{a}±2.36
	Ruchamax	82.76	126.65	129.50	115.43	113.58^{c}±3.01
	AV/DAC/16	80.00	118.75	122.50	101.75	105.75^{b}±2.54
	AV/RMF/17	76.50	139.00	146.66	114.14	119.07^{d}±2.79
	Mean±SE	79.87^{a}±2.44	116.35^{c}±2.98	128.41^{d}±2.67	107.33^{b}±2.87	
Soluble nitrogen (mg/100 ml SRL)	Control	82.25	58.33	49.83	52.00	60.60^{z}±0.65
	Ruchamax	21.24	29.85	38.50	19.82	27.35^{x}±0.54
	AV/DAC/16	24.00	43.75	61.25	32.25	40.31^{y}±1.02
	AV/RMF/17	27.50	21.50	24.34	20.86	23.55^{x}±0.44
	Mean±SE	38.74^{a}±1.98	44.36^{b}±1.54	43.48^{b}±0.87	34.23^{a}±0.67	
Ammonia nitrogen (mg/100 ml SRL)	Control	12.36	18.52	20.45	14.32	16.41^{y}±0.51
	Ruchamax	11.48	15.00	15.50	13.50	13.87^{x}±0.54
	AV/DAC/16	12.00	17.25	18.05	13.40	15.17^{xy}±0.75
	AV/RMF/17	10.00	15.36	16.03	13.36	13.69^{x}±0.67
	Mean±SE	11.46^{a}±0.38	16.53^{c}±0.87	17.51^{c}±0.33	13.64^{b}±0.57	
TVFA(m.moles/l SRL)	Control	54.16	76.24	80.81	79.15	72.44^{a}±1.07
	Ruchamax	76.65	84.89	91.55	90.33	86.91^{c}±2.33
	AV/DAC/16	78.16	90.22	92.66	86.60	84.41^{b}±1.28
	AV/RMF/17	83.27	93.00	94.52	87.43	89.55^{d}±2.05
	Mean±SE	73.06^{a}±2.21	86.09^{b}±1.79	89.89^{c}±1.45	85.87^{b}±1.88	
Total lactic acid (mg/dl)	Control	3.42	4.27	4.29	4.10	4.02^{a}±0.09
	Ruchamax	3.46	4.58	5.36	4.68	4.52^{ab}±0.01
	AV/DAC/16	3.57	5.10	5.17	4.36	4.55^{ab}±0.08
	AV/RMF/17	4.87	5.80	6.24	5.75	5.66^{c}±0.02
	Mean±SE	3.83^{a} ±0.09	4.94^{b} ±0.08	5.26^{b}±0.09	4.72^{b}±0.08	

Mean values bearing different superscripts in a row and column differ significantly abc (P<0.01), xyz (P<0.05)

Table 2. **Effect of different herbal products Ruchamax, AV/DAC/16 and AV/RMF/17 on ruminal enzyme activites**

Particulars	Treatment	Sampling time (hr)				Mean±SE
		0	2	4	6	
Cellulase (units/mg protein)	Control	34.84	41.41	44.52	39.86	40.15±0.16
	Ruchamax	36.76	39.08	41.96	38.76	39.14±0.26
	AV/DAC/16	36.21	41.87	46.98	38.52	40.89±0.11
	AV/RMF/17	37.54	40.98	44.87	37.89	40.32±0.18
	Mean±SE	36.34^{a}±0.32	40.83^{c}±0.21	44.58^{d}±0.40	38.75^{b}±0.19	
Xylanase (units/mg protein)	Control	20.98	28.32	32.89	26.99	27.29±0.14
	Ruchamax	22.76	27.12	31.23	25.04	26.53±0.12
	AV/DAC/16	22.41	27.85	30.56	24.34	26.29±0.27
	AV/RMF/17	21.52	27.07	30.98	25.21	26.19±0.34
	Mean±SE	21.91^{a}±0.18	27.58^{b}±0.27	31.41^{c}±0.21	25.39^{b}±0.37	
β glucosidase (units/mg protein)	Control	7.65	10.32	13.37	8.76	10.02±0.09
	Ruchamax	8.31	10.43	13.04	9.01	10.19 ±0.18
	AV/DAC/16	8.47	10.04	12.66	8.65	9.95 ±0.09
	AV/RMF/17	8.66	9.98	12.89	9.55	10.27 ±0.15
	Mean±SE	8.27^{a}±0.08	10.19^{b}±0.07	12.99^{c}±0.09	8.99^{a}±0.07	
α glucosidase (units/mg protein)	Control	5.11	8.98	11.23	7.44	8.19±0.07
	Ruchamax	6.09	7.69	10.97	7.57	8.08±0.08
	AV/DAC/16	6.21	9.02	11.04	6.31	8.14±0.03
	AV/RMF/17	5.76	8.54	10.88	8.21	8.35±0.05
	Mean±SE	5.79^{a}±0.11	8.56^{b}±0.09	11.03^{c}±0.05	7.38^{b}±0.08	

Mean values bearing different superscripts in a row and column differ significantly abc (P<0.01)

Conclusion

Herbal formulations Ruchamax, AV/DAC/16 and AV/RMF/17 supplementation improves the microbial fermentation and the overall best effect obtained by AV/RMF/17 supplementation.

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