



Complete Feed and Effect on Rumen Fermentation and Blood Biochemistry in Goats

Patil et al.

Effect of Feeding Gram Straw based Complete Feed Pellets on Rumen Fermentation and Haemato-biochemical Parameters in Goats

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ABSTRACT

The aim of the present experiment was to evaluate the effect of gram straw based complete feed pellets with roughage to concentrate in the ratio of 60:40 on rumen fermentation profile and haemato-biochemical parameters of goats. The present experiment was undertaken in 12 adult goats divided into 2 groups (control and treatment group) with 6 goats of approximately similar body weights in each group. Experiment was carried out for one month duration. The goats in the control group were offered *ad lib* super Napier hay and concentrate @400 g/d/goat, whereas goats in the treatment group were offered *ad lib* gram straw based complete feed pellets. The rumen liquor pH has non-significant difference between the groups. Significantly higher ($P < 0.01$) TVFA, total nitrogen concentration along with higher total bacterial and protozoan count were observed in goats of treatment group than in the control group. A non-significant difference in the all hematological and bio-chemical parameters was observed between the groups except for blood glucose level. At the end of experiment, significantly higher ($P < 0.05$) blood glucose level found in the goats of treatment group in comparison to the control group. In conclusion, gram straw based complete feed pellets with roughage to concentrate in the ratio of 60:40 could improve the rumen fermentation pattern and blood glucose level and could not affect the haemato-biochemical parameters of goats that indicated the normal health status of goats.

KEY WORDS: Blood biochemical, Complete feed pellets, Haematological, Rumen fermentation, Super Napier

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INTRODUCTION

A positive and steady rumen environment is required for the better nutrient utilization. Adopting a complete feed system leads to a steady and healthy rumen environment which would result in better nutrient utilization and performance. The complete feed is a quantitative mixture of all dietary elements, completely blended to avoid separation and selection, fed as the sole source of nutrients (excluding water), and designed in the necessary proportion to meet the specific nutrient requirements (Khan et al., 2010). The monitoring and evaluation of the physiological, nutritional and health status of ruminants can be possible by the analysis of the haemato-biochemical parameters (Al-Eissa et al., 2012). Furthermore, Mohammed et al. (2016) reported that blood

constituents of animals are the indicators of feed efficiency and nutrient utilization. Rekhate et al. (2007; 2008); Nagalakshmi and Reddy (2012), and Malik et al. (2021) found improvement in rumen fermentation pattern in livestock fed crop residue-based complete feed than the conventional ration. However, Tripathi et al. (2014) and Saijipaul et al. (2016) reported a non-significant effect on haematological parameters and Sharma et al. (2010) and Islam et al. (2017) found all the biochemical parameters in the normal physiological range.

Considering the above facts and looking to the less availability of data regarding the effect of feeding gram straw based complete feed pellets on the rumen fermentation and haemato-biochemical parameters, the present experiment undertaken to

assess the effect of gram straw-based complete feed pellets with roughage and concentrate in the proportion of 60:40 on rumen fermentation and haemato-biochemical parameters of goats.

MATERIAL AND METHODS

The present experiment was carried out during August-September 2022 for one month at Goat farm, department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Anjora, Durg, Chhattisgarh. Gram straw based complete feed pellets were prepared by maintaining 60:40 roughage to concentrate ratio. The concentrate mixture contained maize 36, soya deoiled cake 20, cotton seed cake 17, wheat bran 12, arhar chuni 12, mineral mixture 2 and salt 1 part. The chemical composition of concentrate mixture, super Napier hay and gram straw based complete feed pellets were analyzed by AOAC (2007) and Van soest (1991).

Twelve healthy adult Sirohi goats of approximately similar body weight (19.08 ± 0.18 Kg) were divided into two groups with six goats each and reared under the same intensive management system. The goats in the control group (group I) were fed *ad lib* super Napier hay and 400 g concentrate mixture to satisfy the nutrient requirement as per ICAR 2013. The goats in the treatment group (group II) were fed *ad lib* complete feed pellets containing 60%-gram straw and a concentrate mixture of 40%.

At the middle of the trial, rumen liquor was collected at 4 hours post feeding by using stomach tube having a 0.15 mm internal diameter and 150 cm long plastic tube. The stomach tube was moistened and animal's mouth was opened by placing a thumb in the diastema region. The tube was then passed over the back of the tongue and entered in the oesophagus. A 50 ml syringe was used to apply suction to draw ruminal fluid in tubes. Approximately 50 ml of rumen liquor was collected from individual goats. The sucked fluid was filtered through the cheese cloth and pH was measured immediately. The filtered rumen liquor was immediately processed for digestion with sulphuric acid to estimate total

nitrogen. 15 ml of rumen liquor was frozen and stored at -20°C for determination of total volatile fatty acids. TVFA was determined using the Markham apparatus as described by Bennett and Reid (1957). The total nitrogen was analyzed as per AOAC (2007). The total bacterial count was carried out by loading SRL in Neubauer's counting chamber covered with coverslip under high power. Counted the number of bacteria in five medium squares like RBC counting. Diluted 5 ml of SRL with 25 ml of 10% Formal saline. Taken 5 ml of this diluted SRL and added 5 drops of 2% Eosin solution. Focussed the chamber under 40X and charged the diluted and strained SRL into the Neubauer counting chamber without air bubbles. Kept it undisturbed for a few minutes. Counted the number of protozoa in four WBC squares (Smith and Baker, 1944).

At the start and end of the experiment, about two and five milliliters of blood sample was collected in clean plain tubes separately from each animal. For hematological analysis, the blood was collected into EDTA-containing tubes and for biochemical analysis blood samples were collected in tubes without anticoagulant. Blood samples were subjected to haematological analysis (Haemoglobin, Packed Cell Volume, Total Erythrocyte Count, and Total Leucocyte Count). The serum was separated as per the standard procedure, and was analyzed in a semi-auto analyzer using diagnostic kits for various biochemical parameters (blood glucose (mg/dl), total protein (g/dl), albumin (g/dl), globulin (g/dl), total cholesterol (mg/dl), ALT, AST and creatinine).

The data of the study was analysed by an independent T-test. Overall data were analyzed as per the standard procedure (Snedecor and Cochran, 1994) and using IBM SPSS statistics 25 version.

RESULTS AND DISCUSSION

Chemical composition of feed stuffs

The chemical composition of super Napier hay, concentrate mixture and gram straw based complete feed pellets is given in Table 1.

Table 1. Chemical composition of concentrate mixture, super Napier hay and gram straw-based complete feed pellets

Nutrients	Concentrate mixture	Super Napier hay	Gram straw based complete feed pellets (R:C=60:40)
Dry matter%	91.2	89.4	90.6
Crude Protein%	21.8	8.07	12.1
Ether extract%	3.14	1.69	1.0
Crude fibre%	9.0	37.6	22.4
Total ash%	9.04	6.98	9.27
Nitrogen free extract%	56.9	45.6	54.4
NDF%	23.0	68.4	51.6
ADF%	11.0	39.3	31.9
ADL%	3.16	6.91	8.26
Hemicellulose%	11.9	29.1	19.7
Cellulose%	7.88	32.4	23.6
Calcium %	0.82	0.48	0.89

Rumen fermentation profile

The data regarding rumen fermentation parameters pH, total nitrogen, total volatile fatty acids

and total bacterial and protozoan count of rumen liquor is presented in Table 2.

Table 2. Rumen fermentation parameters in goats fed super Napier hay and concentrate mixture or gram straw based complete feed pellets

Parameters	Groups		P value
	Control	Treatment	
pH	6.5±0.0	6.5±0.0	1.00
Total nitrogen (mg/100 ml SRL)	80.7±2.11 ^b	91.9±2.11 ^a	0.00
TVFA (mEq/100ml SRL)	10.2±0.26 ^b	11.7±0.38 ^a	0.00
Bacterial count x 10 ¹⁰ /ml of SRL	1.03±0.02 ^b	1.23±0.01 ^a	0.00
Protozoan count x 10 ⁶ /ml of SRL	1.55±0.06 ^b	1.98±0.09 ^a	0.00

Note: 1. Means bearing different superscripts^{ab} in rows differ significantly. P < 0.01

TVFA and total nitrogen concentration

The TVFA found in the rumen liquor of goats in the control and treatment groups were 10.2±0.26 and 11.7±0.38 mEq/100ml SR, whereas, the total nitrogen level in the rumen liquor of goats was 80.7±2.11 mg/100 ml SRL in the control group and 91.9±2.11 mg/100 ml SRL in the treatment groups. The rumen liquor profile revealed highly significant variations (P<0.01) for TVFA and total nitrogen between the control and treatment groups. The goats in the treatment group had higher concentration of

TVFA and total nitrogen in rumen liquor than the goats in the control group.

The significant variations for TVFA and total nitrogen might be due to the better adaptation of ruminal microbes to the pelleted complete feed. It has been reported that feeding complete rations might lead to higher availability of soluble sugars, to an increase in the rumen microbial activity and increased microbial fermentation that favours more TVFA production (Konka et al., 2015). As reported by Chaturvedi and Walli (2002), the higher concentration

of total nitrogen in the rumen liquor of goats in the treatment group of present study could be because of higher CP intake and digestibility in goats fed gram straw based complete feed pellets. The values of TVFA found in this experiment were higher, and the total nitrogen value was lower than that recorded by Rekhate et al. (2005), with similar pH values. Similar to our observations, Rekhate et al. (2007); Nagalakshmi and Reddy (2012); Jadhav (2019); Shembekar (2019) reported increased concentrations of TVFA and total nitrogen in the rumen liquor on feeding crop residue-based complete feed either in block or pellets form. Samanta et al. (2003) reported lower TVFA values in rumen liquor of Barbari goats fed natural grass hay based complete ration with roughage to concentrate in the ratio of 60:40 than the present study. Whereas, Chopade et al. (2010) found lower total nitrogen in goats fed either treated or untreated soybean straw based complete pelleted feed than found in the present study. In contrast, Karimizadeh et al. (2017) observed similar TVFA concentration in rumen liquor of lambs fed either Bagasse pith based complete feed in mash, pellet or block form. However, Thirumalesh et al. (2003) reported higher total nitrogen in rumen liquor of adult sheep fed bajra straw based complete feed pellet and mash with roughage to concentrate ratio of 60:40.

Rumen liquor pH

The pH of rumen liquor of goats in the control (6.5 ± 0.0) and treatment (6.5 ± 0.0) groups has a non-significant difference. The results are also in agreement with Rekhate et al. (2007) who tested complete pelleted feed with 60% arhar straw; and Thirumalesh et al. (2003) on feeding bajra straw based complete pelleted feed with roughage to concentrate ratio of 60:40%. In line with the pH in the present study, Rekhate et al. (2008) found goat rumen liquor pH values on feeding either arhar stalk or gram straw based complete feed pellets with roughage to concentrate in the ratio of 60:40. The pH of rumen liquor of goats in both groups was in the normal physiological range of 6.2 to 7.2 reported by Radostitis et al. (2007) for ruminants. The rumen liquor pH was in the normal range after feeding of

experimental diet to the goats and created a positive ruminal environment for optimum fermentation. Aschenbach et al. (2011) noted that the rumen pH was dependent on saliva production, the absorption and generation of short-chain fatty acids, the type and amount of feed intake, and the exchange of phosphates and bicarbonates via the ruminal epithelium. The pH value reported in the present experiment was slightly less than the one reported by Raut et al. (2002) in non-descript male goats fed pelleted complete feed comprised of 60% *Cajanus cajan* straw and 40% concentrate mixture.

Microbial count in the rumen liquor

A highly significant ($P < 0.01$) increase in the total bacterial and protozoan count was observed in the rumen liquor of goats in the treatment group than in the control group. Akin to results in the present study, Senani et al. (2013) reported a higher total bacterial count in the rumen liquor of Bandur lambs on feeding ragi straw and maize cobs based complete ration, whereas Mishra et al. (2013) noticed a higher protozoan count in the rumen liquor of Malpura sheep on feeding fallen tree based complete feed block with roughage to concentrate ratio 60:40. However, similar protozoan count in rumen liquor of Murrah buffalo bulls was observed by Konka et al. (2016) on feeding maize stover, red gram straw and black gram straw based complete rations individually or conventional ration. As found in the present study, the complete feed is a nutritionally balanced diet that provides a healthy and steady rumen environment that maximises the growth and activity of rumen microbes (Matthews et al., 2019). In contrast, Karimizadeh et al. (2017) noted higher protozoan count in the rumen liquor of lambs fed Bagasse pith-based complete feed blocks than in the form of mash and pellets. The variations in the results reported by different researchers might be due to the variation in chemical composition of the different complete rations.

Haematological parameters

The data regarding Hb, PCV, TEC and TLC in goat blood of the control and treatment groups are presented in Table 3.

Table 3. Haematological parameters in goats fed super Napier hay and concentrate mixture or gram straw based complete feed pellets

Parameter	Start of experiment		P Value	End of experiment		P value
	Control	Treatment		Control	Treatment	
Hb g/dl	8.20±0.15	8.28±0.16	0.53	8.27±0.15	8.33±0.18	0.49
PCV%	22.7±0.70	22.8±0.78	0.74	22.9±0.71	22.9±0.78	0.79
TEC x 10 ⁶ /µl	8.37±0.25	8.37±0.22	1.00	8.40±0.24	8.38±0.21	0.90
TLC x 10 ³ /µl	7.53±0.87	7.55±0.83	0.91	7.67±0.85	8.27±0.87	0.25

Note: Hb-Haemoglobin, PCV-Packed cell volume, TEC-Total Erythrocyte Count, TLC-Total Leucocyte Count

At the start and end of an experiment, the haematological values have a non-significant difference between the groups. All the haematological values were in the normal physiological range as reported by Bhikane and Kawitkar, (2022). Normal haematological values indicated the normal health status of an animal.

Tripathi et al. (2014) reported a non-significant difference in haematological values in goat kids fed

a complete diet with monsoon herbage plus concentrate and herbage and concentrate separately with roughage to concentrate in the ratio of 60:40. The results reported by Malik et al. (2020) are in agreement with the results found in the present study. They observed that blood metabolites and blood cell count were not influenced by straw level or the physical form of the diet of the male Beetal goats.

Blood biochemical parameters

Table 4. Blood biochemical parameters in goats fed super Napier hay and concentrate mixture or gram straw based complete feed pellets

Parameter	Start of experiment		P Value	End of experiment		P value
	Control	Treatment		Control	Treatment	
Blood glucose mg/dl	47.4±1.77	47.2±1.82	0.86	48.4±1.55 ^b	52.5±1.62 ^a	0.001
Total protein g/dl	6.57±0.23	6.60±0.23	0.80	6.62±0.21	6.78±0.20	0.19
Serum creatinine mg/dl	0.97±0.03	0.97±0.03	0.80	0.97±0.03	0.97±0.04	0.87
Total cholesterol mg/dl	61.2±5.73	62.1±5.48	0.79	60.8±6.06	61.6±5.54	0.82
SGOT U/L	179.02±12.03	179.38±15.98	0.96	179.03±12.05	178.48±15.9	0.94
SGPT U/L	8.18±0.82	8.27±0.73	0.93	8.30±1.62	8.18±1.72	0.90
Serum albumen g/dl	3.78±0.17	3.80±0.15	0.83	3.76±0.30	3.81±0.06	0.70
Serum globulin g/dl	2.79±0.17	2.81±0.18	0.89	2.86±0.20	2.97±0.16	0.29

Note: SGOT- Serum glutamic-oxaloacetic transaminase, SGPT-Serum glutamic pyruvic transaminase, Means bearing different superscripts^{ab} in rows differ significantly. **P < 0.01

The blood biochemical profile of goats in the control and treatment groups is presented in Table 4, indicating a non-significant difference in the blood biochemical parameters between the control and treatment groups except for the blood glucose level. Blood glucose level was significantly higher ($P < 0.01$) in goats of the treatment (52.48 ± 1.62 mg%) group than the control (48.43 ± 1.55 mg%) group. All the values of blood biochemical parameters are in the normal physiological range as reported by Bhikane and Kawitkar (2022). Higher blood sugar levels in the treatment group might be due to better nutrient utilization from the complete feed pellets than the conventional ration.

Rumen fermentation pattern changes on feeding the complete pellet diet that increases propionate production leads to high energy yield by enhancing glucose production which is efficiently utilized for cellular growth and development and hence reduces the feeding/production cost of growing animals (Huyen et al., 2012). The blood glucose level found in the present experiment is in agreement with Behera et al. (1993) who reported similar observations in black Bengal goats and Delany et al. (2010) in cows. The results are in partially agreement with Rekhate et al. (2008) who reported a significant difference ($p < 0.01$) in total protein, calcium and globulin concentrations, whereas a non-significant difference was observed for other blood biochemical parameters viz., total protein, serum creatinine, total cholesterol, SGOT, SGPT, serum albumen and serum globulin of goats fed arhar stalk and gram straw based complete feed pellets. Further, they observed that all the biochemical parameters observed were in the normal physiological range. Also, Kumar et al. (2013) observed the similar values of blood glucose, blood urea nitrogen, total plasma proteins, immunoglobulins, albumen and globulin in Sahiwal calves fed TMR with three different levels of protein and all the values found were within the normal physiological range.

CONCLUSION

Feeding of gram straw based complete feed pellets with 60:40 roughage to concentrate ratio could

improve rumen fermentation pattern and enhancing blood glucose level without affecting other haemato-biochemical parameters of goats.

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