



Effect of Rumen Degradable Protein Concentrations on Nutrient Digestibility, Growth Performance and Blood Metabolites in Beetal Kids

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Abstract

This research study was planned to evaluate the influence of various rumen degradable protein levels on growth performance, nutrient intake and digestibility, blood metabolites and nitrogen balance in male Beetal kids. Twenty kids having 5-6 months of age were distributed into four groups. Four isonitrogenous and isocaloric diets were formulated containing 35, 45, 55 and 65% rumen degradable proteins and were represented as 35RDP, 45RDP, 55RDP and 65RDP, respectively. Feed was offered twice a day. The experiment lasted for 90 days during which data about feed intake/ refusal and body weight was recorded. Blood samples (n=3) from each group were collected fortnightly to determine BUN (blood urea nitrogen) and pH. Higher dry matter, crude protein, neutral detergent fiber and acid detergent fiber intake and digestibility were observed in goats offered 65RDP diet as compared to those fed 55RDP, 45RDP and 35RDP diets. Blood urea nitrogen and nitrogen balance were increased in goats fed 65RDP diet than those fed other diets. Better weight gain was achieved by goats fed 65RDP diet than other treatments. This study revealed that 65RDP diet increased nutrient intake, nutrient digestibility, growth rate and nitrogen balance and proved to be the best in terms of cost benefit analysis in goats as compared to 35RDP, 45RDP and 55RDP diets. Further research is needed to devise an effective program through the use of various levels of RDP and RUP using large number of goats in order to harvest the real benefits of the research.

Keywords: Protein Degradability; Goats; Intensive Feeding; Nitrogen Balance; Digestibility

Introduction

In ruminants, rumen degradable proteins (RDPs) and rumen undegradable proteins (RUPs) are considered important fractions of the dietary proteins NRC [1]. To improve fermentation rate, sufficient availability of RDPs has been required Davidson et al. [2]; Hassan et al. [3]. Digestibility of dry matter, organic matter and hemicellulose was improved as the level of dietary RDPs increased due to more production of volatile fatty acids and microbial function Silva, et al. [4]. To increase nitrogen utilization, it is essential to determine a certain level of RDPs Sun et al. [5]. Improper RDPs and RUPs can increase nitrogen excretion Savari et al. [6]. Inadequate RDPs tend to reduce nutrients intake and digestibility which in turn causes significant reduction in animal performance Savari et al. [6]; Xia et al. [7].

The RDPs are hydrolyzed by ruminal bacteria and are transformed to ammonia, the main source of nitrogen for synthesis of microbial protein which works as useful protein and amino acid

source for ruminants because rumen microbial protein consists of about 75% amino acids or protein Hackmann and Firkins [8] and generally supplies 70-80% of amino acids required to ruminants Chaturvedi and Walli [9]. Feeding dietary crude protein (as rumen degradable and undegradable protein) in right amount has been reported to significantly enhance animal productivity through optimizing rumen dynamics. Ruminants with flourishing microflora have been reported to perform more consistently with smaller fluctuation in dry matter intake and weight gain. Better rumen fermentation and microbial activities usually lead to increased enzymes production, better degradation of dry matter, decreased nutrient escape from rumen and nutrient loss in manure. In highly productive ruminants, more percentage of RUPs in diet is required to meet the amino acids requirement at the post-ruminal stage Sun et al. [5]. However, as a result of sufficient concentration of RDPs, adequate synthesis of microbial protein may reduce fortification of RUPs in ruminants Kaufman et al. [10]; Savari et al. [6]. On the

other hand, excessive usage of RDPs results in more production of ammonia which is absorbed readily into the blood from rumen and convert into urea by liver ultimately excreted as urinary nitrogen Savari et al. [6]. Diet plans lacking RDPs can limit the growth of rumen microbes and those with surplus RDPs are also unwanted because of disposal of nitrogen into surroundings. Therefore, the present experiment was designed to observe the effect of various levels of RDPs on growth performance, nutrient intake and digestibility, blood urea nitrogen and nitrogen balance in male Beetal kids.

Materials and Methods

The research was accomplished at Raja Muhammad Akram Animal Nutrition Research Center, University of Agriculture, Faisalabad, Pakistan. Twenty growing (5-6 months old) male Beetal kids were bought from local market and were randomly distributed into 4 groups having 5 animals each. Blocking was done on the basis of body weights. Every group received different levels of RDPs i.e. 35, 45, 55 or 65% of dietary CP. All diets were isocaloric (2.4Mcal/Kg) and isonitrogenous (18%). Feed was offered twice a day. Fresh water was given round the clock. The research study continued for 90 days. Thirty days were given as adaptation period whereas remaining sixty days were for data collection. During collection period, data on feed offered and refusal was recorded to calculate the feed consumption. Weights of all animals were recorded earlier at the beginning of the research and then fortnightly to determine growth rate. Digestibility trial and nitrogen balance estimation were determined at the end of each month by total collection method Church and Pond [11] and as per equation described by NRC [1], respectively.

Samples of blood were collected fortnightly to evaluate urea nitrogen in blood plasma as per procedure defined by Bull et al. [12]. For the determination of blood pH, heparinized syringes were used to collect the blood samples from jugular vein of every animal AOAC [13]. At the end of trial, cost benefit analysis of each diet was calculated to compare the cost of production. Samples of feed

offered, and feces were examined for dry matter (Method 930.15; AOAC 1990), crude protein (Kjeldahl method 955.04; AOAC 1990), acid detergent fiber (ADF) Goering and Van-Soest [14] and neutral detergent fiber (NDF) Van Soest et al. [15]. The data collected were subjected to ANOVA using GLM (general linear model) method of SPSS (SPSS 10.0.1., 1999) and means were compared by DMR (Duncan's Multiple Range) Test.

Results

A considerable improvement ($P<0.05$) in nutrient intake was observed in goats fed 65RDP diet. Dry matter (DM) and crude protein (CP) intake were maximum and minimum in goats fed 65RDP and 35RDP diets, respectively (Table 1). Varying levels of RDP significantly increased ($P<0.05$) nutrient digestibility in goats. The DM digestibility was improved with elevating levels of RDP in diet. Highest and lowest dry matter digestibility was shown by goats fed diets containing 65RDP and 35RDP, respectively (Table 2). Goats fed 65RDP diet showed better CP digestibility than goats fed 45RDP and 35RDP diets (Table 3). The results of nitrogen balance, blood urea nitrogen and weight gain have been summarized in Table 3. Nitrogen balance was improved significantly ($P<0.05$) as level of RDP was enhanced in diet. However, increasing dietary RDP level decreased fecal nitrogen and increased apparent absorption. Highest nitrogen balance was exhibited by goats offered 65RDP diet and lowest was observed in goats fed 35RDP diet. Blood urea nitrogen (BUN) was remarkably improved ($P<0.05$) with the increase in RDP level in diet. Highest BUN values were observed in goats fed 65RDP diet and lowest values were exhibited by animals fed 35RDP diet. As level of RDP was increased in diet, significant ($P<0.05$) improvement in body weight gain was detected in animals. Highest weight gain was achieved by goats fed 65RDP as compared to other diets. Lowest body weight gain per day was observed in goats offered diet with 35RDP; it was not dissimilar from goats fed diet with 45RDP. Cost per kg live weight gain was significantly reduced as RDP increased in diet. It was higher in diets containing 35 and 45% RDP diets as compared to other diets.

Table 1: Ingredients and chemical composition of experimental diets.

Ingredients %	Diets			
	35 RDP	45 RDP	55 RDP	65 RDP
Wheat straw	29.20	25.70	22.50	24.70
Corn	33.00	31.30	32.00	31.00
Sunflower meal	5.00	8.00	6.00	7.00
Canola meal	3.80	4.00	6.70	8.90
Urea	0.00	0.50	1.00	1.60
Cotton seed meal	2.00	2.00	2.00	2.00
Rice polish	1.00	4.00	5.00	5.10
Wheat bran	1.00	3.00	5.70	7.00
Corn gluten 30%	5.00	6.50	8.10	6.00
Corn gluten 60%	15.00	9.50	4.50	0.20
Molasses	2.50	3.00	4.00	4.00
NaHCO ₃	0.50	0.50	0.50	0.50
Mineral Mix*	2.00	2.00	2.00	2.00

Total	100	100	100	100
Chemical composition				
Crude protein %	18.10	18.18	18.17	18.17
Rumen Degradable Protein %	6.38	8.21	10.01	11.84
RDP, % of dietary crude protein	35.26	45.17	55.12	65.13
Neutral detergent fiber %	32.35	32.47	31.63	33.56
Acid detergent fiber %	20.37	20.00	18.75	20.16
ME Mcal/kg DM	2.47	2.46	2.46	2.40

*L. S. Minerals. Each kg contains Ca 155g, P 135g, Mg 55g, Na 45g, Fe 1000mg, Zn 3000mg, Mn 2000mg, Cu 600mg, Co 10mg, I 40mg and Se 3mg.

Table 2: Effect of different rumen degradable protein concentrations on nutrient intake and digestibility in goats.

Nutrient intake, g/d	Diets ¹				
	35RDP	45RDP	55RDP	65RDP	SE
Dry matter	1038.1 ^c	1102.1 ^b	1110.1 ^b	1170.3 ^a	12.6
Crude protein	187.8 ^c	200.4 ^b	201.8 ^b	212.6 ^a	2.30
Neutral detergent fiber	335.8 ^c	357.9 ^b	351.4 ^{bc}	392.7 ^a	4.11
Acid detergent fiber	211.5 ^c	220.4 ^{bc}	230.5 ^{ab}	235.9 ^a	2.56
Nutrient digestibility %					
Dry matter	56.5 ^d	59.7 ^c	61.9 ^b	65.1 ^a	0.42
Crude protein	56.6 ^c	60.8 ^b	64.4 ^a	65.7 ^a	0.37
Neutral detergent fiber	39.7 ^c	45.1 ^b	44.4 ^b	50.3 ^a	1.21
Acid detergent fiber	35.9	35.2	36.1	37.7	1.92

Means in the same rows bearing different letters were significantly different (P<0.05). 135RDP, 45RDP, 55RDP and 65RDP contained 35, 45, 55 and 65% ruminal degradable protein of dietary protein, respectively.

Table 3: Effect of different rumen degradable protein concentrations on nitrogen balance, blood pH, blood urea nitrogen and weight gain in goats.

Item (g/d)	Diets ¹				
	35RDP	45RDP	55RDP	65RDP	SE
Nitrogen intake	30.1 ^c	32.1 ^b	32.3 ^b	34.1 ^a	0.37
Fecal nitrogen	13.1 ^a	12.5 ^{ab}	11.4 ^b	11.6 ^b	0.27
Urinary nitrogen	10.1 ^a	10.2 ^a	8.7 ^{ab}	8.0 ^b	0.42
Apparent absorption	17.1 ^d	19.5 ^c	20.8 ^b	22.3 ^a	0.17
Nitrogen balance	6.9 ^d	9.3 ^c	12.1 ^b	14.3 ^a	0.39
pH	7.2	7.1	7.2	7.3	0.05
BUN2, mg/dL	12.8 ^c	14.1 ^b	15.1 ^b	16.18 ^a	0.22
Dry matter intake	1038.1 ^c	1102.3 ^b	1110.9 ^b	1170.3 ^a	12.6
Weight gain	76.1 ^c	79.7 ^{bc}	86.3 ^b	99.1 ^a	2.24
Cost (Rs.) /Kg live weight gain	652.5 ^a	617.3 ^{ab}	531.7 ^{bc}	462.9 ^c	19.8

Means in the same rows bearing different letters were significantly different (P<0.05). ¹35RDP, 45RDP, 55RDP and 65RDP contained 35, 45, 55 and 65% ruminal degradable protein of dietary protein, respectively.

Discussion

In the diet of ruminants, protein is one of the limiting nutritional components Cônsolo et al. [16]; Xia et al. [7]. Production of ruminants might be improved by balanced ration Muhammad et al. [17]. In this context, respective forms and adequate concentrations of protein in diet are of vital significance. Sufficient protein provision becomes very essential in animals when energy and protein requirements are more, and dry matter intake is relatively less Xia et al. [7]. In our

present research study, improved nutrient intake was observed in goats with rising RDP percentage in diet. This might be endorsed to the sufficient RDPs supply which has optimized the production of rumen microbes by ensuring the optimum ammonia and nitrogen in rumen rather than undue NH₃ (ammonia). Our results are in agreement with the previous findings of Ding et al. [18] and Mutsvangwa et al. [19], who reported better dry matter intake in animals offered diet with high RDPs than those fed with low RDPs.

Similar results were also found by the Sahoo and Walli [20] in goats, who stated that diet having 72% RDP had better intake than 55% RDP diet. Improved dry matter intake in ruminants fed high RUPs concentration might be endorsed to low concentration of RDPs in these research studies.

Nutrient digestibility improved with gradual increase in level of RDP. Similar results have been observed by May et al. [21] and Kaufman, et al. [10]. The microbial activity in rumen was increased with increasing level of RDPs. Ultimately digestibility of nutrients was improved Savari et al. [5]. Goats fed 65% RDP diet showed highest nitrogen balance Mutsvangwa et al. [19]; Javaid, et al. [22]. However, increasing tendency of fecal and urinary N losses with reduced RDPs in diets is not different from results reported earlier Jabbar et al. [23]; Ding et al. [18]; Savari et al. [6]. An increase in ruminal NH₃-N proportions and improved BUN percentage might be due to more quality and quantity of amino acids Chumpawadee et al. [24]. Increased levels of RDPs in diet caused improved weight gain in goats as reported by Rivas and Serrato-Corona [25]. Similarly, Shahrabak et al. [26] reported better live weight in Kermani male lambs fed higher level of RDPs. The results of our research study are similar to findings of Rodríguez et al. [27] and Thornton and Ferreira [28], who found improved weight gain in lambs and goats respectively, by using different concentrations of RDPs in diets. This is due to the fact that ruminants obtain their 70-80% requirements of amino acid by the microbial protein Hackmann and Firkins [8]. To improve digestibility and fermentation, adequate availability of RDPs has been required to improve their growth performance Davidson et al. [2]. However, some scientists also observed insignificant results regarding weight gain with varying levels of RDPs Hassan et al. [3]; Jabbar et al. [23]; Ding et al. [18]; Bahrami-Yekdangi et al. [29]. This might be due to little difference among the levels of RDPs in diets; whereas, some scientists stated higher weight gain by decreasing RDP level and increasing RUP level in experimental diets May et al. [21]; Azizi-Shotorkhoft et al. [30]. The possible reason might be the proteins obtained from ruminal microbes are incapable to fulfill metabolizable protein requirement of animals in rapid growth phase, hence supplements of RUP have been proven to improve the performance Sultan et al. [31]. In conclusion, diet containing 65% RDP improved the nutrient intake, nutrient digestibility, positive nitrogen balance and growth rate and proved to be the best in terms of cost benefit analysis as compared to diets containing 55%, 45% and 35% RDP in goats.

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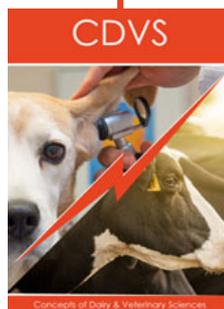
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