Effects of Feeding Different Level of Dietary Protein with or without Probiotics or Ionophores on Performance of Growing Kids

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Abstract

The study examined the effects of high and low input feeding system on nutrients ingestion, digestibilities, nitrogen (N) retention, blood urea nitrogen (BUN), metabolic hormones and economics of weight gain in growing kids. Eighty male beetal goats of 6 month of age were randomly divided into ten groups, eight goats in each group in completely randomized design. Nine isocaloric diets with varying crude protein (CP) levels with or without ionophores and probiotics were formulated. Diets containing 12, 16 and 20% CP were designated as low protein (LP), medium protein (MP) and high protein (HP) diets, respectively, while each of these CP diets when supplemented with ionophores @ 20ppm or probiotics (Yea Sec, 0.1%) were denoted as LPI, MPI, HPI and LPP, MPP,HPP, respectively. One group was fed berseem hay (FOD) only as a representative of traditional feed. The study lasted for 3 months. Higher dry matter (DM) and CP intake and digestibilities by kids fed LP, MP and HP diets were observed than those fed FOD diet. Similar trendfor DM and CP intakes were noticed by supplementation of ionophores or probiotics. Blood glucose, BUN, N balance, tri-iodothyronine and thyroxin concentrations were higher in goats fed LPI, MPI, HPI diets than those fed LP, MP, HP and LPP, MPP and HPP diets. Outcome of the study indicated that feeding growing kids on high input feeding system compared to, regardless supplementation of ionophores or probiotics, traditional feeding system increased nutrients intake, utilization, N balance and growth with better profit margin.

Keywords: blood metabolites, growing kids, nutrient rich system, nutrient utilization, weight gain

Introduction

Diet and feeding regimens are considered important factors which not only influence growing small ruminants (sheep & goats) productivity and profitability.

Nutrition of growing ruminants plays a pivotal role to enhance mutton production and also has strong association with quality and quantity of carcass. Balanced diets can improve their growth without affecting sensory quality of mutton and also reduce the time to slaughter with increased dressing percentage (Ryan *et al*., 2007). Crude protein (CP) and energy are the major nutrients which directly affect the growth of small ruminants and manipulating these nutrients can help optimize their growth performance. Nutrient utilization at ruminal level, in nutrient rich feeding system, can further be improved by adding suitable feed additives like ionophores and probiotics. Ionophores have been reported to increase the efficiency of feed utilization in growing ruminants by improving dry matter and protein digestibilities (Potter *et al.,* 1976a; Raun*et al.,* 1974). Probiotics have also been reported to increase weight gain in small ruminants by enhancing nutrient utilization at ruminal level (Abd El-Ghani, 2004).Productivity and economic index of growing male *beetal* goats under tropical environmental conditions, maintained on high input feeding system (high dietary energy and protein with or without feed additives) versus conventional feeding system (fodder only) is limited. Therefore, the present study was planned to examine and compare the nutrients intake, digestibility, growth, blood composition, nitrogen balance and growth of growing male *beetal* goats fed on high input feeding system and traditional feeding systems.

Materials and Methods

Eighty male *beetal* goats (6 month old) were randomly divided in ten groups with eight animals each. Nine isocaloric diets with three levels of crude protein (12, 16 and 20%) with or without ionophores (@ 20ppm) and probiotics (0.1% of ration) were formulated (Table 1). These diets were fed to nine groups of lambs while tenth group was offered fodder (berseem hay) only. The goats were fed *ad libitum* and weighed weekly to know the weight gain and its economics. The study lasted for 90 days. Feed intake was recorded daily. Total collection method was used to determine the nutrient [(dry matter (DM), crude protein (CP) neutral detergent fiber (NDF), acid detergent fiber (ADF)] digestibilities. Feces were collected daily, dried at 55°C, bulked and mixed at the end of each collection period. Urine samples were acidified with 50% H_2SO_4 and stored at -20 °C for laboratory analysis. Feed and fecal samples were analyzed for DM and CP as per description of AOAC (2003) while NDF and ADF by the method described by Van Soest *et al*. (1991). Nitrogen (N) balance was calculated using equation described by NRC (2001).Blood glucose was analyzed by method described by Davies *et al*. (2007), while triiodothyroxin (T3) and thyroxin (T4) concentrations were analyzed by the methods of Todini *et al*. (2007). Blood urea nitrogen (BUN) was measured by procedure described by Bull *et al*. (1991).

The data collected were subjected to statistical analysis using ANOVA under completely randomized design (SAS, 1997) and Tukey`s significant difference test was used to compare means (Steel and Torrie, 1984).

Table1. Ingredients and Chemical composition of diets fed to growing goats

INGREDIENTS	Diets[1]									
	FOD	LP	MP	HP	LPI	MPI	HPI	LPP	MPP	HPP
Corn grains	-	25	25	25	25	25	25	25	25	25
Wheat bran	-	18	10	10	18	10	10	18	10	10
Rice polishing	-	18	18	18	18	18	18	18	18	18
Wheat straw	-	12.5	9.75	8	12.5	9.75	8	12.5	9.75	8
Cotton seed meal	-	7	12.5	12.5	7	12.5	12.5	7	12.5	12.5
Canola meal	-	7	12.5	12.5	7	12.5	12.5	7	12.5	12.5
Molasses	-	7	6.1	6.25	7	6.1	6.25	7	6.1	6.25
Urea	-	0	0.15	1.625	0	0.15	1.625	0	0.15	1.625
Vegetable oil	-	1.5	2	2.125	1.5	2	2.125	1.5	2	2.125
NaCl	-	1	1	1	1	1	1	1	1	1
DCP	-	2	2	2	2	2	2	2	2	2
$NaHCo_3$	-	1	1	1	1	1	1	1	1	1
Probiotics (Yea sac) %	-	-	-	-	-	-	-	0.1	0.1	0.1
Ionophores (Monensin) ppm	-	-	-	-	20	20	20	-	-	-
Total	100	100	100	100	100	100	100	100	100	100
Chemical composition, %										
Dry matter	89.8	89.8	89.9	90	89.79	89.9	90	89.79	89.9	90
Crude protein	18.9	12	16	20	12	16	20	12	16	20
Total dig. Nutrients	60.6	70	70	70	70	70	70	70	70	70
Neutral detergent fibre	51.1	29.9	28.5	27.3	29.92	28.5	27.3	29.92	28.5	27.3
Acid digestible nutrients	41.1	16.4	15.9	15.1	16.4	15.9	15.1	16.4	15.9	15.01

[1]FOD, LP, MP, HP, LPI, HPI, HPI, LPP, MPP and HPP stand for fodder (berseem hay), low protein, medium protein, high protein, low protein ionophores, medium protein ionophores, high protein ionophores, low protein Probiotics, medium protein Probiotics and high protein Probiotics, respectively.

Results and Discussion

Nutrients Intake

Higher DM intake was observed by goats fed LP, MP and HP diets than those fed FOD diet (Table 2). The DMI increased linearly in goats fed diets with gradual increase in dietary CP concentration supplemented with probiotics. Linear trend for CP intake was observed with increasing the dietary CP concentrate in goats fed diets containing ionophores and probiotics supplementation. The ADF intake was higher by goats fed FOD diet than those fed LP, MP and HP diets regardless of ionophores and probiotics supplementation. Higher nutrients intake by goats fed gradual increasing dietary CP concentration than those fed FOD diet was due to lower NDF content of these diets because high dietary NDF generally reduced nutrient intake by imparting rumen fill effect (Sarwar *et al*., 1991).Higher DMI by goats fed diets with gradual increase in dietary CP concentration than those fed FOD diet was consistent with the findings of Damry *et al*. (2001) who reported higher DM intake in animals fed concentrate diets than those fed fodder. The increased dietary CP concentration might have increased the amount of available nutrients, required for microbial growth (DelCurto *et al*., 1990).

Nutrients digestibility and nitrogen balance

The DM digestibility was higher in goats fed LP, MP and HP diets than those fed FOD diet (Table 2). The CP digestibility was also higher in goats fed LP, MP and HP diets than those fed FOD diet. The N balance was significantly higher in goats fed HPI and HPP diets than those fed FOD diet (Table 2). Higher nutrient digestibility by goats fed gradual increasing CP concentration than those fed FOD diet might be attributed to better availability of energy and protein nutrients. Synchronized availability of sufficient N and keto-acids (carbon skeleton) at ruminal level might have improved rumen microbial fermentation leading to better digestion of nutrients in goats fed varying CP concentration than those fed FOD diet. Higher, CP, NDF and ADF digestibilities in lambs fed HP, HPI and HPP diets might be due to more digestible CP, NDF and ADF contents of these diets. Higher N balance by goats fed gradual increasing dietary CP concentration than those fed FOD diet was due to higher N intake and its degradation. Higher N balance in HP, HPI and HPI diets than those fed FOD diet in the present study was consistent with the observations of Dabiri and Thonney (2004) who reported increased N balance in ruminants fed concentrate based diet than those fed fodder. Atti *et al*. (2004) noticed increased N retention in ruminants fed diets with gradual increasing dietary CP concentration.

Blood Metabolites

Goats fed HP, HPI and HPP diets had higher T4 level than those fed LP, LPI and LPP diets (Table 3). An increasing tendency in blood glucose was observed in goats fed LP, MP and HP diets. The BUN was significantly lower in goats fed FOD diet than those fed diets with varying dietary CP concentration with or without ionophores and probiotics. Higher T4 concentration in goats fed diet with increasing dietary CP concentration was supported by Todini *et al.* (2007) who observed that lambs fed high nutrient diet had higher plasma T4 concentration than those fed low nutrient diets.Unaltered blood glucose levels in diets with increasing CP concentration with or without ionophores and probiotics were inconsistent with Anthony *et al*. (1986). Furthermore, in the present study, non-significant difference in blood glucose is consistent with findings of small ruminants fed yeast supplemented

Table 2. Nutrients intake, digestibilities and nitrogen balance by goats as influenced by fodder versus intensifying dietary crude protein with or without ionophores and probiotics

Items	Diets[1]										SE	Main Contrasts[2]				Protein	
	FOD	LP	MP	HP	LPI	MPI	HPI	LPP	MPP	HPP		F vs C	CI vs CP	C vs CI	C vs CP	L	Q
Nutrients intake , g/d																	
Dry matter	706.35	892.06	890.48	965.08	906.35	912.70	912.70	906.35	928.57	987.30	25.19	*	NS	NS	NS	*	NS
Crude protein	133.43	107.05	142.48	193.02	108.76	146.03	182.54	108.76	148.57	197.46	3.66	*	NS	NS	NS	*	NS
Neutral Detergent fibre	360.24	266.9	253.79	263.47	271.18	260.12	249.17	271.18	264.64	269.53	7.60	*	NS	NS	NS	NS	NS
Acid Detergent fibre	289.60	146.57	141.32	145.24	148.91	144.85	137.36	148.91	147.36	148.59	4.4	*	NS	NS	NS	NS	NS
Nutrients digestibility																	
Dry matter ,%	49.57	58.00	65.29	64.43	61.14	66.57	69.57	63.29	66.00	68.57	2.77	*	NS	NS	NS	NS	NS
Crude protein,%	68.71	71.15	72.61	73.55	71.51	72.11	73.65	71.59	72.66	73.98	1.69	*	NS	NS	NS	NS	NS
Neutral Det. fibre,%	39.43	42.71	43.57	47.43	46.43	46.14	48.29	47.43	48.29	49.86	3.24	NS	NS	NS	NS	NS	NS
Acid det. fibre,%	33.29	37.71	38.71	36.00	41.00	38.29	35.97	41.86	41.29	40.43	2.27	NS	NS	NS	*	NS	NS
Nitrogen balance, g/d	11.56	10.18	13.6	17.53	10	13.71	18.41	9.97	13.8	18.52	1.85	*	NS	NS	NS	*	NS

LP, MP and HP represent low (12%), medium (16%) and high (20%) dietary crude protein (DCP) concentrations, respectively. Affixes of “I” and “P” in remaining diets indicate supplementation of ionophores and Probiotics with similar low, medium and high DCP contents, respectively. Diet FOD reflects berseem hay. [2] F VS C= Fodder versus Concentrate (LP, MP, HP), CI VS CP= concentrate ionophores (LPI, MPI, HPI) versus Concentrate Probiotics (LPP, MPP, HPP), C VS CI= Concentrate verses concentrate ionophores, C VS CP= Concentrate verses concentrate Probiotics, L= linear, Q= Quadratic, * (P<0.05), NS=Non significant

Table 3. Blood metabolites and growth in goats as influenced by fodder versus intensifying dietary crude protein with or without ionophores and probiotics

Items	Diets[1]										SE	Main Contrasts[2]				Protein	
	FOD	LP	MP	HP	LPI	MPI	HPI	LPP	MPP	HPP		F vs C	CI vs CP	C vs CI	C vs CP	L	Q
T3 (n mol/L)	1.01	1.16	1.16	1.51	1.20	1.36	1.14	1.19	1.30	1.47	0.20	NS	NS	NS	NS	NS	NS
T4 (n mol/L)	54.57	57.57	62.00	63.86	57.14	56.00	67.00	59.86	60.14	65.71	4.94	NS	NS	NS	NS	*	NS
Blood glucose (mg/dl)	50.57	60.57	62.14	66.71	67.57	69.43	68.86	59.57	67.57	67.00	4.75	NS	NS	NS	NS	NS	NS
Blood Urea N, mg/dl)	12.57	14.29	16.71	20.43	16.14	17.43	22.14	15.29	15.14	22.71	1.94	*	NS	NS	NS	*	NS
Daily gain (g)	75	149	159	175	153	169	161	162	131	150	18.88	*	NS	NS	NS	NS	NS
FCR	11.04	6.41	5.94	6.69	6.64	5.83	6.32	5.90	8.68	7.65	1.27	*	NS	NS	NS	NS	NS
Economics[3]	1.79	1.0	1.07	1.23	1.04	1.05	1.16	0.94	1.56	1.40	0.22	*	NS	NS	NS	NS	NS

[1]LP, MP and HP represent low (12%), medium (16%) and high (20%) dietary crude protein (DCP) concentrations, respectively. Affixes of “I” and “P” in remaining diets indicate supplementation of ionophores and Probiotics with similar low, medium and high DCP contents, respectively. Diet FOD reflects berseem hay. [2] F VS C= Fodder versus Concentrate (LP, MP, HP), CI VS CP= concentrate ionophores (LPI, MPI, HPI) versus Concentrate Probiotics (LPP, MPP, HPP), C VS CI= Concentrate verses concentrate ionophores, C VS CP= Concentrate verses concentrate Probiotics, L=linear, Q=Quadratic, * ($P<0.05$), NS=Non significant

[3]Cost of feed to produce 1Kg live weight (U$)

(Galip *et al.,* 2006) and ionophores (Yang *et al.,*2003). Increasing tendency of BUN concentration with increasing the dietary CP concentration has also been supported by other workers (Hristove *et al*., 2004; Castillo *et al*., 2001; Armentano *et al*., 1993; Jia *et al*., 1995). Blod urea nitrogen BUN concentration with increase in dietary CP is generally influenced by multiple factors like dietary concentrate, dietary ruminally degradable protein, range of dietary CP, adaptation period and age of ruminant animals etc (Castillo *et al*., 2001; Armentano *et al*., 1993; Jia *et al*., 1995). Similar findings were reported by Yang *et al*. (2003) who noticed that ionophores supplemented diets had no effect in goats.

Growth Performance and Economics

Goats fed increasing dietary CP concentration gained more weight than those fed FOD diet (Table 3). Gradual increase in weight gain was observed in goats receiving diets with increasing dietary CP concentration. Cost of feed to produce one kg live weight and feed conversion ratio were higher in goats fed FOD diet than those fed any of experimental diets with or without ionophores and probiotics (Table 3).The findings of higher daily weight gain by goats fed diets with gradual increase in dietary CP concentration than those fed FOD diet were consistent with the finding of Murphy *et al*. (1994) who reported higher daily weight gain in small ruminants fed concentrate than those fed fodder diets. Furthermore, Haddad *et al*. (2001) observed higher growth rate in lambs fed diets containing high dietary CP (16 and 18%) than those fed diets containing low dietary CP contents (12 and 14%). Unaltered FCR by goats fed diets with gradual increasing dietary CP concentration were consistent with the finding of Duff *et al*., (1994) who reported that gain to feed ratio remained unaltered in ionophores supplementation. Likewise, Raeth-Knight *et al*. (2007) reported that probiotic supplementation had no effect on feed to gain ratio in dairy animals.

Conclusion

Outcome of the study indicated that feeding growing kids on high input feeding system compared to traditional feeding system increased nutrients intake and utilization, N balance and growth with better profit margin.

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