Indian Journal of Animal Sciences **83** (3): 290–294, March 2013/Article

Effect of diets varying in energy source on the growth and blood biochemical profile of Beetal kids under stall fed conditions

R S GREWAL[1], M SINGLA[2], J S LAMBA[3], C S AHUJA[4] and N TYAGI[5]

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab 141004 India

Received: 22 February 2012; Accepted: 7 September 2012

ABSTRACT

Three isonitrogenous concentrates were prepared with bypass fat (BC), canola oil (COC) and refined wheat flour (SC). The roughage source was green oat and oat hay. Beetal kids (27) were randomly divided into 3 equal groups of 9 animals each depending upon age and body weight. The concentrate to roughage ratio was fixed at 50:50. The ME availability calculated from net gas production and chemical analysis were 11.71, 11.70 and 11.92, 10.60 KJ/kg DM for BC, COC, SC and oat hay respectively. The DOM was highest in SC followed by COC and BC. The TDMI (g/d) was higher in BC group and comparable in COC and SC. The DM, NDF and hemicelluloses digestibility was also higher in BC than other 2 groups. The CP, OM and ADF digestibility were similar in all groups. There was no difference in faecal N excretion and N-balance but urinary N was higher in BC and SC than COC. The N-retained as % absorbed was lower in SC and higher in both the BC and COC group. The growth rate was not affected by dietary treatments over the period of 4 months. The average daily gain was 85.48, 72.50 and 80.0 g for BC, COC and SC respectively. The 3 dietary treatments had no significant impact on blood profile except on total cholesterol and HDL-cholesterol which increased significantly in canola oil supplemented group. The results indicated that stall fed growing goats can be fed high energy ration containing bypass fat.

Key words: Bypass fat, Canola oil feeding, Goat growth, Starch feeding

Goat meat production has tremendous potential in India because there is no religious taboo on the consumption of goat meat. There are 140.54 millions goats in India (DAHD 2010) most of which are grazed, often on poorly maintained grass/shrub land. Intensive feeding of goats in stalls is practiced rarely. For sustainable goat production, intensive system of goat rearing required to be evaluated. Stall fed goats require relatively higher energy ration as compared to stall fed cattle. For intensive goat rearing, the quantity as well as source of energy is important for optimum growth rate. Fat and starch both provide energy but in ruminants both has to be used judicially to avoid metabolic disorders and adverse effects on the rumen microbes. The objective of present study was to observe the effect of high energy diets, prepared using different energy supplementations, on the growth and metabolic status of the beetle kids in stall fed conditions.

Present address: [1]Nutritionist (ravigrewal71@yahoo.co.in), [3]Nutritionist, [5]Assistant Professor, Department of Animal Nutrition. [2]Assistant Animal Scientist, Department of Livestock Production Management; [4]Assistant Biochemist, Department of Veterinary Physiology and Biochemistry.

MATERIALS AND METHODS

Experimental diets: Three isonitrogenous concentrates were prepared (Table 1) using bypass fat (calcium salts of fatty acids as per Naik *et al.* 2007), canola oil and refined wheat flour, designated as BC, COC and SC respectively to increase the energy density of the diets. The roughage

Table 1. Ingredient composition of experimental concentrate mixtures

Parameter	BC	COC	SC
Maize	30	30	30
Deoiled mustard cake	10	10	10
Mustard cake	10	10	10
Soybean meal	10	10	10
Deoiled rice polish	26	26.5	21
Refined wheat flour	—	—	9
Canola oil	—	3.5	—
Bypass fat	4	—	—
Rice polish	7	7	7
Mineral mixture	2	2	2
Salt	1	1	1

source was green oats and oat hay. For chemical analysis and *in vitro* studies the hay and oven dried green oat samples were mixed in as fed ration i.e. 50:50.

In vitro *gas production and chemical analysis*: The 3 diets were subjected to *in vitro* gas production for calculating their energy availability and to ascertain any deleterious effect of dietary treatments on rumen microbes according to Menke *et al.* (1979). The DOM (Menke and Steingass 1988) and ME availability (Choudhary 1999) were calculated using equations given below :

DOM= 0.9991*gas (ml/200 mg DM) +0.595*CP (%DM) +0.181ash (%DM) +9

ME=1.06+0.157*gas (ml/200 mg DM) +0.0084*CP+ 0.022*EE+0.0081*ash (for concentrates)

ME=1.24+0.146*gas (ml/200 mg DM) +0.007*CP+ 0.0224*EE (for roughages)

Growth trial: Beetal kids (27) were randomly divided into 3 equal groups of 9 animals each based on age and body weight. The average age was 10 months for all 3 groups and body weight was 17.34, 17.74 and 17.68 kg in BC, SOC and SC groups respectively. The roughages were green oats and oat hay. The concentrate to roughage ratio was fixed at 50:50. The roughage was 50% hay and 50% green fodder on DM basis. The amount of feed offered was adjusted at fortnightly interval. The animals were fed TMR daily at 10:00 AM in groups. The animals were housed in loose housing system and water was available 24 h. After 1 months of feeding 5 animals from each group were selected and tied individually for 21 days. During the last 6 days, the animals were put in the metabolic cages and metabolic trial was conducted. Total faeces, urine and residue was weighed daily at 9:30 AM. Feed, faeces and residue sample were subjected to fibre fractions according to Robertson and VanSoest (1981) and proximate principles according to AOAC (2000). The body weight measurement was done at monthly interval before offering feed in the morning.

Blood sampling and analysis: Blood samples of all 3 dietary treatments of animals were collected via jugular vein puncture at the start and at the end of experiment. Approximately 10 ml blood was collected in clean and dry glass vials containing heparin and immediately placed in an ice bath. Plasma was collected by centrifugation at 1700 g for 10 min using a refrigerated centrifuge and stored at –20°C till these were analyzed for concentration of glucose (Trinder 1969), total cholesterol (Allain *et al.* 1974), HDL-cholesterol (Lopes-Virella *et al.* 1977), triglycerides (McGrowan *et al.* 1983), blood urea nitrogen (Talke and Schubert 1965), creatinine (Henry *et al.* 1974) and the activities of aspartate amino transferase,AST (Bergmeyer *et al.* 1976), alanine amino transferase,ALT (Bergmeyer 1980), alkaline phosphatise, ALP (Linhardt and Walter 1965) and ã-glutamyl transferase GGT (Szasz 1976) in chemistry analyzer (RA-50) using autopak analyzing kits.

Statistical analysis: The statistical analysis was done according to Snedecor and Cochran (1994) using Duncan's multiple range test. The software used was SPSS version 12 (SPSS, 2003).

RESULTS AND DISCUSSION

The chemical composition and in vitro gas production of concentrates are given in Table 2. All the concentrates were isonitrogenous and CP varied from 19.66 to 19.82%. The fibre fractions (NDF, ADF and lignin) decreased with addition of refined wheat flour which might be due to the fact that BC and COC had more deoiled rice polish which has high fibre content. Ash content was almost similar in all the concentrates though it was higher in oat hay. The *in vitro* net gas production (ml/200 mg DM) was similar in concentrates having bypass fat and canola oil but higher in refined wheat flour containing concentrate and lowest in oat hay. Starch in refined wheat flour is readily fermentable carbohydrate resulting in higher gas production which is in sync with the findings of Getachew *et al.* (2004). The ME availability calculated from net gas production and chemical analysis were 11.71, 11.70 and 11.92, 10.60 KJ/kg DM for bypass fat, canola oil, refined wheat flour containing concentrates and oat hay, respectively. The DOM was highest in SC followed by COC and BC and it was lowest in oat hay.

The digestibility coefficients of nutrients and N-balance are given in Table 3. The TDMI (g/d) was significantly ($P<0.05$) high in BC group and statistically similar in COC and SC. This indicated effect of canola oil and refined wheat flour on the rumen function. The DMD, NDFD and hemicelluloses digestibility was also significantly ($P<0.05$) higher in BC than other 2 groups. The CPD, OMD and ADFD were statistically similar in all the groups. The digestibility coefficients of fibre fraction was higher in this study than obtained by Lallo (1996) but in that study the diet contained 26–29% sugarcane bagasse which is poorly digestible as compared to oat hay and green fodder. The ME intake was significantly ($P<0.05$) higher in BC as compared to COC

Table 2. Chemical composition and *in vitro* gas production parameters of experimental concentrates and roughage

Parameter	BC	COC	SC	Oat fodder
CP	19.74	19.82	19.66	11.00
NDF	47.2	43.3	36.4	55.70
ADF	18.55	16.50	17.30	37.00
OM	89.50	89.15	89.68	85.95
Ash	10.50	10.85	10.32	14.05
Lignin				
In vitro gas, ml/ 200 mgDM	55.66	55.75	59.66	48.3
ME availability*, KJ/kg DM	11.71	11.70	11.92	10.60
DOM	78.26	78.46	82.17	66.34
Partition factor	2.81	2.81	2.75	2.73

*Calculated as per Chaudhary (1999).

Table 3. Digestibility of nutrients and N-balance of different diets

Parameter	BC	COC	SC	Pooled SE
TDMI, g/d	657.10[b]	491.11[a]	461.33[a]	18.90
ME intake, MJ/d	7.33[b]	5.44[a]	5.19[a]	0.21
DMD,%	68.66[b]	54.11[a]	58.03[a]	1.58
OMD,%	78.80	75.91	78.16	0.95
NDFD,%	73.04[b]	64.65[a]	68.53[ab]	1.39
ADFD,%	67.05	58.25	58.26	1.89
H. Cell digest,%	86.39[b]	81.61[a]	87.70[b]	0.66
CPD,%	65.22	60.52	67.40	2.26
DM Intake, g/kg$^{0.75}$	62.50[b]	48.35[a]	44.02[a]	1.80
DCP Intake, g/kg$^{0.75}$	4.95[b]	3.36[a]	3.39[a]	0.17
N-balance				
N-Intake, g/d	18.91[b]	15.25[a]	16.12[a]	0.27
Faecal N, g/d	6.76	6.04	5.32	0.42
Urinary N, g/d	5.43[b]	3.57[a]	5.92[b]	0.30
N-balance, g/d	6.71	5.63	4.88	0.38
N retained as% of absorbed	53.78[ab]	58.88[b]	40.89[a]	3.10
Average daily gain, g/d	85.48	72.50	80.00	4.34

*Different superscripts in a row vary significantly (P<0.05).

and SC. Lallo (1996) observed increased intake of energy with increase in energy density of the diet, however Dinius and Baumgardt (1970) reported that intake of DE remained constant above the energy density of 10.5 MJ/kg DM. The N- intake was higher (P<0.05) in BC and similar in COC and SC. This was due to higher TDMI in BC group. There was no difference in FN excretion and N-balance but UN was higher in BC and SC than COC. This low N- excretion with canola oil supplementation has no obvious explainable reasons. The N-balance in growing goats obtained in this study was quite similar to that of Lallo (1996). The N-retained as % absorbed was significantly low (P>0.05) in SC and higher but similar in both the BC and COC group. Schmidely *et al.* (1999) studying the effect of degradation rate of energy and protein in rumen on lactating dairy goats, reported that the output of N in urine and the efficiency of N use for milk output was greater, and N balance was lower, for goats fed the rapidly degraded diet.

Initial average body weights of the kids were 18.13, 17.44 and 18.60 kg for BC, COC and SC respectively. There was no significant difference in growth rate over the period of 4 months between the experimental groups. The average daily gain was 85.48, 72.50 and 80.0 gm for BC, COC and SC respectively (Table 3). The gain was highest in BC and lowest in COC although the difference was non-significant at p value of 0.05 level. The average body weight gain of 72–85 g/d observed in this study was higher than 55–65 g/d, obtained by Bhatta *et al.* ((2002), but lower than 99–115 g/d, reported by Lu and Potchoiba (1990) The DM intake and DCP intake/ kg $W^{0.75}$ was significantly (P<0.05) higher in BC as compared to other 2 groups. This intake was lower and growth rate higher as compared to Bhatta *et al.* (2002) who reported that 55–65 g/d weight gain was achievable in kids with intake of 85.8 g DM and 6.44 g DCP/kg 0.75 body weight on the pasture having tannin rich shrubs. This discrepancy between two studies might be due to fact that in our study diet was higher in nutrients than the diets used in earlier study. When energy requirement for maintenance and growth according to NRC (1981) was considered than the energy allowable gain in g/d with the ME intake of 7.33, 5.44 and 5.19 MJ/d theoretically should be 103.7, 42.12 and 36.05 g/d for BC, COC and SC respectively but observed values in this study indicates energetically more efficient gain in SC and COC than BC group.

The concentration of all the parameters in the blood as well as the enzyme activities were within the normal physiological limits. The three dietary treatments had no significant impact on blood profile (Table 4) except on total cholesterol and HDL-cholesterol which were significantly (P<0.05) increased in canola oil supplemented group. Our

Table 4. Blood biochemical parameters of goat kids at the start of experiment

Parameter	BC		COC		SC		Significance between dietary treatments	
	0 d	120 d	0 d	120 d	0 d	120 d	0 d	120 d
Glucose, mg/dL	63.70	64.43	63.57	64.23	64.47	67.90	NS	NS
Cholesterol, mg/dL	108.45	124.37[a]	109.98	135.80[b]	108.53	123.77[a]	NS	**
HDL cholesterol, mg/dL	42.57	38.17[a]	43.35	57.35[b]	45.28	39.02[a]	NS	**
TG, mg/dL	34.60	39.97	32.98	42.53	33.33	40.85	NS	NS
BUN, mg/dL	14.40	14.75	15.00	15.37	14.68	14.60	NS	NS
Creatinine, mg/dl	1.04	1.09	1.08	1.07	1.06	1.05	NS	NS
AST,U/L	99.32	107.37	107.77	103.60	107.80	99.22	NS	NS
ALT, U/L	28.40	29.47	26.62	27.88	26.63	28.12	NS	NS
ALP, U/L	72.08	74.90	74.43	74.43	73.27	75.83	NS	NS
GGT, U/L	26.23	27.20	23.52	25.75	23.37	25.67	NS	NS

**Denotes the significant difference at P<0.05.

results of plasma total cholesterol and ã-glutamyl transferase activity of bypass fat group differ from those of Baldi *et al.* (1991) who reported a significantly higher levels of these parameters in goats fed calcium salts of long chain fatty acids. This difference in the results could be because of high concentration of bypass fat (6%) in their study versus a relatively less bypass fat (4%) in our experiment. Our findings of no effect on blood glucose and BUN levels of bypass fat group were in agreement with Hortan *et al.* (1992) who observed no effect of rumen protected lipid on these parameters in sheep.

Cholesterol content in blood plasma was used to assess the changes in lipid metabolism by oil feeding. The simultaneous increase in total cholesterol and HDL-cholesterol levels in the plasma by canola oil supplementation in this study indicated that the oil supplementation was clearly reflective in the plasma cholesterol level in goat and increased total cholesterol was mostly due to the increased HDL-C (Table 4). This was in agreement with the findings of Choi *et al.* (2006) and Chen *et al.* (2008) who reported a significant rise in total cholesterol and HDL-cholesterol in the plasma of soybean oil fed sheep and lambs, respectively.

Our results indicated that growing goats could be stall fed on high energy ration containing bypass fat or starch or canola oil as supplementary energy source but apparent growth rate and digestibility of fibre fractions was highest in goats fed ration containing bypass fat.

REFERENCES

Allain C C, Poon L S, Chan C S G, Richmond W and Fu P C. 1974. Enzymatic determination of total serum cholesterol. *Clinical Chemistry* **20**: 470–75.

AOAC. 2000. *Official Methods of Analysis.* 17th edn. Association of Official Analytical Chemists. Washington DC.

Baldi A, Cheli F, Corino C, Dell'Orto V and Polidori F. 1991. Effects of feeding calcium salts of long chain fatty acids on milk yield, milk composition and plasma parameters of lactating goats. *Small Ruminant Research* **6**: 303–10.

Bergmeyer H U, Bowes Jr G N, Horder M and Moss D W. 1976. IFCC methods for aminotranfrases. *Clinical Chemica Acta* **70**:F19-F42.

Bergmeyer H U. 1980. IFCC method for alanine aminotransferase. *Clinical Chemica Acta* **105**: 147–54.

Bhatta R, Shinde A K, Sankhyan S K and Verma D L. 2002. Nutrition of range goats in a shrub land of western India. *Asian-Australian Journal of Animal Science* **12**:1719–24.

Chen X J, Mao H L, Lin J and Liu J X. 2008. Effects of supplemental soybean oil and vitamin E on carcass quality and fatty acid profiles of meat in Huzhou lamb. *Acta Agriculturae Scandenavia Section A* **58**: 129–35.

Choi S H, Wang J H, Kim Y J, Oh Y K and Song M K. 2006. Effect of soybean oil supplementation on the contents of plasma cholesterol and Cis9, trans11–CLA of the fat tissues in sheep. *Asian-Australian Journal of Animal Science* **19** : 679–83.

Choudhary L C. 1999. *In vitro* gas production. In: *Laboratory Mannual of Animal Nutrition*. V R B Sastry, D N Kamra and N N Pathak. Centre of Advanced Studies Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar, UP, India. Pp145–148

DAHD. 2010. *Basic Animal Husbandry Statistics.* Government of India, Department of Animal Husbandry, Dairying and Fisheries, New Delhi.

Dinius D A and Baumgardt B R. 1970. Regulation of food intake in ruminants. VI. Influence of caloric density of pelleted rations. *Journal Dairy Science* **53**:311–16.

Getachew G, Robinson P H, DePeters E J, and Taylor S J. 2004. Relationship between chemical composition, dry matter degradation and *in vitro* gas production of several ruminant feeds. *Animal Feed Science and Technology* **111**: 57–71.

Henry R J, Canon D C and Winkelman J W. 1974. *Clinical Chemistry, Principles and Technolniques.* 2nd edn. Haper and Row.

Horton G M J, Wohlt J E, Palatini D D and Baldwin J A. 1992. Rumen-protected lipid for lactating ewes and their nursing lambs. *Small Ruminant Research* **9**: 27–36

Lallo C H O. 1996. Feed intake and nitrogen utilisation by growing goats fed by-product based diets of different protein and energy levels. *Small Ruminant Research* **22**:193–204.

Linhardt K, and Walter K. 1965. Phosphatases (phosphomonoestrases). *Methods of Enzymatic Analysis.* Vol II, pp783–85. N.U. Bergmeyer. Academic Press, New York.

Lopes-Virella M F, Stone P, Ellis S and Colwell J A. 1977. Cholestrol determination in high density lipoproteins separated by three different methods. *Clinical Chemistry* **23**: 882–84.

Lu C D and Potchoiba M J. 1990. Feed intake and weight gain of growing goat fed diets of various energy and protein levels. *Journal Animal Science* **68**: 1751–59.

McGrowan M W, Artiss J D, Strandbergh D R and Zak B. 1983. A peroxide coupled method for two calorimetric determination of serum triglycerides. *Clinical Chemistry* **29**: 538–42.

Menke K H and Steingass H. 1988. Estimation of energetic feed value obtained from chemical analysis and gas production using rumen fluid. *Animal Research and Development* **28**: 7–55.

Menke K H, Raab L, Salewski A, Steingass H, Fritz D and Shneider W. 1979. The estimation of the digestibility and metbolisable energy content of ruminant feedstuffs from the gas production when they are incubated with rumen liquor *in vitro. Journal Agriculture Science (Cambridge)* **93**:217–22.

Naik P K, Saijpaul S and Neelam Rani. 2007. Evaluation of rumen protected fat prepared by fusion method. *Animal Nutrition and Feed Technology* **7**: 95–101.

NRC. 1981. *Nutrient requirements of goats: Angora, Dairy and Meat goats in Temperate and Tropical Countries.* National Academy Press, Washington DC. Pp2–3.

Robertson J B and VanSoest P J. 1981. The detergent system of analysis and its application to human foods. *The Analysis of Dietary Fibre in Food.* (Eds) James W P T and Theander O. pp. 123–58. Marcel Dekker, Inc., New York.

Schmidely P, Lloret-Pujol M, Bas P, Rouzeau A, Sauvant D. 1999. Influence of feed intake and source of dietary carbohydrate on milk yield and composition, nitrogen balance, and plasma constituents of lactating goats. *Journal Dairy Science* **82**: 747–55.

Snedecor G W and W G Cochran. 1994. *Statistical Methods*. Iowa State University Press, Ames, Iowa.

SPSS. 2003. Statistical Packages for Social Sciences Version 12.

SPSS Inc.,Chicago, IL, USA.

Szasz G. 1976. Reaction rate methods for gama glutamyl transferase activity in serum. *Clinical Chemistry* **22**: 2051–55.

Talke H and Schubert G E. 1965. Urease method for determination of urea nitrogen of serum. *Klin Wchenschr* **43**: 174.

Trinder P. 1969. Determination of glucose in blood using glucose-oxidase with an alternate oxygen accepter. *Annual Clinical Biochemistry* **6** : 24–27.