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EFFECT OF DIFFERENT PLANES OF NUTRITION ON THE PERFORMANCE, NITROGEN BALANCE AND BLOOD BIOCHEMICAL CHANGES IN MALE GROWING GOATS

(With 7 Tables and 4 Figures)

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تأثير مستويات مختلفة من التغذية على كفاءة الاداء والاتزان النيتروجيني وبعض التغيرات البيوكيميائية في الدم في ذكور الماعز النامية

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تم استخدام عدد ١٥ من ذكور الماعز البلدية النامية التي تتراوح أعمارها من ٦-٨ شهور وأوزانهم من ١٥,٢الى ١٥,٦ كجم لدراسة تأثير مستويات مختلفة من الطاقة والبروتين على كفاءة الأداء والاتزان النيتروجيني وبعض التغيرات البيوكيميائية في دم هذه الحيوانات خلال فترة التجربة التي استغرقت ٣٠ يوما. تم استخدام مستويين مختلفين من كل من الطاقة والبروتين (مستوى منخفض من الطاقة ١,٩٢ ميجاكالوري /كجم عليقة , مستوي عال من الطاقة ٢,٩٤ ميجاكالوري /كجم عليقة , مستوي منخفض من البروتين ٧,٦٤% , مستوى عال من البروتين ١١,٥٧%) وقد تم اختيار هذه المستويات من الطاقة والبروتين على أساس اقل اواعلى بـ ٢٠ % عن الموصي به في جداول الـ NRC لاحتياجات الماعز في هذه المرحلة من العمر . وقد قسمت هذه الحيوانات الى خمس مجموعات (٣ حيوانات / مجموعة) وغذيت هذه المجموعات على خمس علائق مختلفة في كل من مستويات الطاقة والبروتين (مجموعة ١: طاقة – بروتين مطابق للموصي به , مجموعة ٢: طاقة منخفضة – بروتين منخفض , مجموعة ٣: طاقة منخفضة – بروتين عال , مجموعة ٤: طاقة عالية – بروتين منخفض , مجموعة ٥: طاقة عالية– بروتين عال) وقد خلصت التجربة الي الاتي مستويات التغذية المختلفة أثرت معنويا على كل من كمية المادة الجافة المستهلكة, والزيادة في وزن الحيوان ومعدل التحويل للعلائق المختلفة، زاد استهلاك المادة الجافة معنويا مع زيادة مستوي البروتين في العلائق سواء المنخفضة أو مرتفعة الطاقة، الزيادة الكلية (كجم/حيوان) ومعدل الزيادة اليومي (جم/حيوان/يوم) لوزن الحيوان كان أعلى في مجموعة الحيوانات التي غذيت على مستوي أعلي في كل من الطاقة والبروتين (مجموعة ٥) مقارنة بالمجموعات الأخرى، معدل النمو كان أعلي في المجموعتين التي تمت تغذيتهما على

مستوي عال من الطاقة سواء مع مستوي منخفض أو مستوي مرتفع من البروتين (مجموعة ٤ , ٥) بينما كان اقل في المجموعة التي غذيت علي المستوي المنخفض لكل من الطاقة والبروتين (مجموعة ٢) مقارنة بالمجموعات الأخرى، كل الحيوانات المختبرة كانت في اتزان نيتروجيني موجب , كما كان معدل استهلاك وتخزين النيتروجين داخل جسم الحيوان أعلي معنويا في المجموعات التي غذيت علي مستويات أعلي من البروتين عن التي غذيت علي مستويات منخفضة. كذلك كان معدل النيتروجين الممتص والمخزن كنسبة من النيتروجين المستهلك أعلي معنويا في المجموعات المغذاة علي مستوي أعلي من البروتين (مجموعة ٣ , ٥)؛ وقد أوضحت التحاليل البيوكيميائية لمصل دم ذكور الماعز النامية مايلي حدوث زيادة معنوية في كل من البر وتينات الكلية والجلوبيولين في المجموعات التي غذيت علي مستوي أعلي من البروتين بينما لم يوجد أي اختلاف معنوي في مستوي الالبيومين بين المجموعات المختبرة، مستوي الجلوكوز في الدم زاد معنويا في المجموعة التي غذيت علي مستويات أعلي من الطاقة والبروتين (مجموعة ٥) مقارنة بالمجموعات الأخرى، مستوي الالكتروليت في الدم (الصوديوم , البوتاسيوم , الكلور ين) لم يتأثر بأختلاف مستوي الطاقة والبروتين في العلائق، عدم وجود أي اختلاف معنوي بين مستويات كل من T4 ,T3, GOT وانزيم الفوسفاتيز القلوى في مصل دم الحيوانات المختبرة بينما كان هناك زيادة معنوية في مستوي GPT في المجموعات التي غذيت علي علائق منخفضة في مستوي البروتين مع أختلاف مستويات الطاقة. من هذه الدراسة نستنتج أنه يمكن تحسين أداء ذكور الماعز من ناحية زيادة النمو والتمثيل الغذائي والاتزان النيتروجيني داخل الجسم عن طريق زيادة مستوي الطاقة والبروتين في علائق هذه الحيوانات بنسبة ٢٠% عن الموصي به في NRC.

SUMMARY

Fifteen castrated male growing goats aged 6-8 months and weighing from 15.2 to 15.6 kg body weight were used in this study to determine the effects and interactions of consumption of diets differing in the concentrations of crude protein and metabolizable energy on the performance, nitrogen balance and some blood biochemical changes in an 30 days experiment. They were allocated to receive diets containing 1.92 Mcal ME (low energy, LE) or 2.94 Mcal ME (high energy, HE) per kg dry matter and 7.64% (low crude protein, LP) or 11.57% (high crude protein, HP). Low and high levels of energy and protein corresponded to 20% less or more than recommended NRC requirements for growing goats. Animals were divided into 5 groups (3 kids/group) and maintained individually on five feeding regimes varying in energy and protein contents (NENP, LELP, LEHP, HELP & HEHP) for groups 1, 2, 3, 4 & 5 respectively. It is clear from the results that, the plane of nutrition significantly ($P<0.05$) influenced feed intake, weight gain and feed conversion. Dry matter intake was increased significantly ($P<0.05$) with the increase in the protein level of the diets, irrespective the energy level.

The total weight gain and average daily gain (ADG) were significantly ($P<0.05$) higher in HEHP group compared with other animal groups. Growth efficiency was significantly ($P<0.05$) higher in HEHP (13.47%) and HELP (11.31%) groups than others and reach its lowest value in LELP group (4.46%). Concerning nitrogen balance, all animals of the experimental groups showed positive nitrogen balance. The intake and retention of nitrogen was significantly ($P<0.05$) higher with the high level of protein irrespective the energy level. Besides, absorbed and retained nitrogen as a percentage of nitrogen intake were significantly ($P<0.05$) higher with the animals fed on high protein diets (LEHP & HEHP). Total serum protein and globulins were significantly ($P<0.05$) higher in LEHP & HEHP groups, while there was no significant ($P<0.05$) difference in the serum albumin between different groups. The serum glucose level was significantly ($P<0.05$) higher in HEHP group in comparison with other experimental groups. Blood serum levels of Na^+, K^+ and Cl^- were not affected by the different treatments. There was no significant ($P<0.05$) difference between the levels of T4, alkaline phosphatase, GOT and T3 in the different groups, while the level of serum GPT was significantly ($P<0.05$) higher in the groups fed on low protein level either with low or high energy content. It is concluded that the performance and nitrogen balance of growing male goats could be improved by increasing energy and protein levels of their diets.

Key words: *Energy, protein, performance, nitrogen balance, biochemical Changes, goats.*

INTRODUCTION

In formulating rations for goats, the type of goat and the product required must be borne in mind. The formulation of practical diets should be sufficiently realistic to accommodate not only advances in research but also developments at farm level. Inadequate nutrition, particularly of energy and protein depressed the performance of the animals. The present level of productivity of goat in developing countries is generally low, mainly because of underfeeding, poor management and diseases (Devendra,1980). Immediate results in increasing efficiency of production can be obtained with improved nutrition and management practice. Efficient utilization of nutrients depends on an adequate supply of energy which is of paramount importance in determining the productivity of goats. Energy deficiency retards kid growth, delayed puberty and reduce fertility (Singh & Senger, 1970 and Sachdeva et al., 1973). Energy limitations may result from inadequate feed intake or from the low quality of the diet. Low energy intake that results from either feed restriction or low diet component digestibility prevents goats from meeting their requirements and from attaining their genetic potential. Protein deficiencies in the diet deplete stores in the blood, liver and muscles and predispose animals to a variety of serious and even fatal ailments. This deficiency, further reduces rumen function and lowers the efficiency of feed utilization (Singh and Sengar, 1970). Andrews & Orskov (1970 a&b) showed that higher protein intake increased the rate of protein deposition in the body. Whilst it has been clearly shown with cattle that nitrogen balance was increased at higher levels of dietary nitrogen intake (Bines and Balch, 1973). An important consideration in the allocation of nutrients for ruminants in the tropics is the supply of adequate amounts of both energy and protein, since the relative importance of a particular nutrients depends upon the extent to which it is a factor limiting the capacity of the feed to promote animal production. In dietary circumstances where energy is limited, it is therefore unlikely that the protein content will be efficiently used. When both protein and energy are severely limited, the consequences can be drastic. In calculating protein requirements, therefore, both the energy level of the complete diet and the nature of the energy source should be taken into account. Higher levels of energy and protein improved nutrient utilization in terms of increased dry matter intake, digestibility of proximate principles and improved nitrogen balance (Singh et al.,1991; Singh & Kumar, 1995 and Hoe et al., 1995).

The goal of the present work was to study the effects of different levels of protein and energy and to determine their interactions on the performance, nitrogen balance and some biochemical parameters in growing male goats.

MATERIALS & METHODS

Animals, experimental design and diets:

Fifteen castrated male growing Baladi kids (6-8 months old, and body weights ranged from 15.2 to 15.6 kg) were used in this study. Animals were divided into 5 groups, 3 animals per each and maintained individually on five feeding regimes varying in energy and protein content. Five nutritional treatments (NENP, LELP, LEHP, HELP and

HEHP) were fed to the experimental animals of groups 1, 2, 3, 4 & 5 respectively. They were allocated to receive diets containing 1.92 Mcal ME (low energy, LE) or 2.94 Mcal ME (high energy, HE) per kg dry matter and 7.64% (low crude protein, LP) or 11.57% (high crude protein, HP). Low and high levels of energy and protein corresponded to 20% less or more than recommended NRC requirements for growing goats. Animals were clinically healthy and housed individually in a separate cages throughout the experimental period which extended for 30 days (22 days as a preliminary period followed by 8 days as a collection period).

The kids received diets based on crushed white corn, soybean meal, undecorticated cottonseed meal, wheat bran and wheat straw supplemented with a mineral and vitamin mixture (Tables 1& 2).

Table 1: Chemical composition (%) of the feed ingredients used in the diets

Ingredients	DM	% on DM basis						
		OM	CP	EE	CF	NFE	Ash	ME*
Corn, ground	89.70	97.88	9.20	3.76	2.77	82.15	2.12	3.15
Soybean meal	91.30	93.09	47.00	5.47	7.44	33.18	6.91	3.18
Cottonseed meal**	92.50	95.40	27.00	6.40	24.50	37.50	4.60	2.17
Wheat bran	90.65	93.00	15.60	4.70	8.37	64.33	7.00	2.53
Wheat straw	90.00	86.70	3.50	1.66	38.00	43.54	13.30	1.59
Vegetable oil	99.00	99.00	---	99.0	---	---	---	7.40
Limestone	98.00	---	---	---	---	---	100.0	---

* Metabolizable energy, Mcal/kg DM (NRC, 1981).

** Undecorticated cotton seed.

Animals were daily fed ad libitum and had free access to water. Kids were weighed at the beginning and at the end of the experiment, and feed intake was recorded throughout the experimental period (30 days).

Samples:

a- Feeds, fecal matter and urine:

Feed ingredients which used in the rations formulation were sampled, dried, ground and analyzed for different nutrients. The total amount of the daily fecal matter excreted per animal was collected daily, weighed, recorded, mixed thoroughly throughout the collection period and representative samples (one-fourth) were taken from each animal,

Table 2: Physical & chemical composition of the experimental diets

Ingredients	Control	Low energy		High energy	
	Diet 1 (NENP)	Diet 2 (LELP)	Diet 3 (LEHP)	Diet 4 (HELP)	Diet 5 (HEHP)
Physical composition					
White corn, ground	46.00	13.00	6.00	75.50	69.00
Soybean meal	5.00	3.00	10.00	---	9.00
Wheat bran	5.00	8.00	7.00	---	3.00
Cottonseed meal, undec.	3.00	5.00	11.00	---	---
Wheat straw	39.43	69.53	64.63	19.33	15.33
Vegetable oil	----	---	---	3.50	2.00
Ground limestone	0.80	0.70	0.60	0.90	0.90
Mineral mixture*	0.17	0.17	0.17	0.17	0.17
Common salt	0.50	0.50	0.50	0.50	0.50
Vit.AD3E**	0.10	0.10	0.10	0.10	0.10
Chemical composition					
Dry matter, DM (%)	90.25	90.26	90.50	90.17	90.17
Organic matter, OM (%)	91.37	89.40	88.21	94.13	93.98
Crude protein, CP (%)	9.55	7.64	11.57	7.63	11.58
Ether extract, EE (%)	3.08	2.56	2.88	6.62	5.45
Crude fibre, CF (%)	17.78	28.89	28.16	9.44	8.66
Nitrogen free extract (%)	60.96	50.31	45.60	70.44	68.29
Ash (%)	8.63	10.60	11.79	5.87	6.02
ME (Mcal/kg)	2.43	1.92	1.95	2.94	2.93
Calcium (%)	0.38	0.38	0.38	0.35	0.38
Phosphorus (%)	0.28	0.25	0.33	0.22	0.30

*Mineral mixture Each 100 g ram contains; 25.6 g Na, 1.6 g K, 4.6 g Ca, 1.8 g P, 4 g Mg 300 mg Fe, 32 mg Mn, 1.5 mg Cu, 15 mg I, 5 mg Zn, 1 mg Co and 1 mg Se (AGRICO-international company).

**AD3E Each gram of AD3E contains; 20.000 IU vitamin A, 2000 IU vitamin D and 400 IU vitamin E (AGRICO-international company).

dried for 24 hours at 60°C, pooled together, mixed ground and stored in a suitable container till analysis. The volumetric urinary output was collected daily from each animal in plastic containers and recorded, then a representative samples (100ml) was taken, acidified with 2ml of concentrated HCl as a preservative and then kept in a refrigerator at 4°C for nitrogen determination.

b-Blood:

Blood samples were collected and sera were seperated and kept frozen at -20°C for futher analysis.

Analytical methods:

Feed samples were analyzed according to the official methods of AOAC (1984) for DM, CP, EE, CF and ash. Nitrogen free extract was calculated by difference. Nitrogen content of feces and urine samples were estimated according to AOAC (1984).

Biochemical parameters:

For the biochemical parameters, serum protein, albumin, globulin, serum glucose, urea and uric acid were determined using standard test kits supplied by Biomerieux (Baines/France). Blood serum electrolytes (Na^+ & K^+) were determined by means of Flame-photometry-Corning 400 and blood serum Cl^- by chloride meter-Corning 925.

Enzymes and hormones assays:

Glutamate-oxaloacetate transaminase (GOT) and glutamate-pyruvate transaminase (GPT) activities and alkaline phosphatase were assayed by the method of Reitman and Frankel (1957). All serum enzyme activities were expressed in international units (IU) i.e.μ moles of product formed per minute per litre of serum. Determination of hormones (T3 & T4) were completed using radioimmunoassay with the aid of commercial kits.

Statistical analysis:

All data were subjected to one-way analysis of variance (ANOVA) and individual differences ($P<0.05$) among treatments were determined by of Duncan's (1955) multiple range test.

RESULTS and DISCUSSION

Dry matter intake:

The dry matter intake (g/kg body weight) of animal groups varied from 35.1 in LELP to 40.8 in LEHP (Table, 3). Within each energy level, the dry matter intake was increased significantly ($P<0.05$) with the increase in the protein levels. Singh et al. (1970) in their experiment with adult sheep recorded declined daily amount of dry matter intake with the decrease in the protein content of the diet. Also, the results revealed that the different levels of energy had no effect on the dry matter intake. This is not agreement with that reported by Bhavani et al. (1997) who found that feed intake was increased with the increase in dietary energy content of the diet in lambs.

Table 3. Dry matter intake of the different experimental diets by growing kids during experimental period

Diets	Dry matter intake	
	g/kg body weight	g/head/day
Diet 1 (NENP)	35.19±2.59	570±24.5 [b]
Diet 2 (LELP)	35.07±3.12	560±32.7 [b]
Diet 3 (LEHP)	37.37±2.11	600±16.8 [a]
Diet 4 (HELP)	34.04±2.91	560±28.6 [b]
Diet 5 (HEHP)	38.07±2.23	631±26.4 [a]

*Figures in the same row having the same superscripts are not significantly different (P<0.05).

Growth performance:

Initial body weight of the kids were nearly similar in the all experimental groups, whereas finishing weights were higher in HEHP group compared with other groups (Table, 4). Total body weight gain (kg) was significantly (P<0.05) higher in groups fed on HELP and HEHP compared with other groups. The growth efficiency was significantly (P<0.05) higher in HEHP (13.47%) & HELP groups (11.31%) than others and the lowest figure was recorded by LELP group (4.46%).

Considering the main effects produced by differences in dietary protein intake, it was evident that the greater intake of the high protein diets (LEHP & HEHP) resulted in significantly (P<0.05) greater values for dry matter intake, weight gain and conversion of energy into weight gain. High protein intake increased weight gain as a result of favorable effect on the digestibility as reported by Griffiths (1978). The lower growth rates in the kids of LELP may be attributed to lower crude protein and energy in their diet. It is known that low dietary protein level may reduce animal performance as reported by Levy et al. (1980) and Anderson et al. (1988) on their experiment on cattle.

The greater intake of energy (HELP & HEHP) resulted in significantly (P<0.05) high values for weight gain, growth efficiency and conversion of protein into weight gain. These results came in agreement with that found by Verma & Mudgal (1971). Also, Mahgoub et al. (2000) found that daily weight gain and feed conversion increased with increasing metabolizable energy density in lamb. In addition, Ivey et al. (2000) found that average daily gain was greater for high protein and increased linearly as dietary ME level increased in goats. The increased weight gains were, however, associated with higher ME intakes, which were largely due to the favorable effects of protein on the digestibility of dry matter and to a lesser extent to lower feed refusals on the high protein diets as reported by Griffiths (1978). Also, Prior et al. (1977) and Holzer et al. (1986) found an increased average daily gain and feed efficiency with the increased crude protein and energy levels in the diets of bull. He declared that the animals which received the high energy level were probably capable of utilizing the higher protein level, as did the HEHP group, while the LEHP group received enough protein for optimal growth but insufficient energy to use that extraprotein in bull as found by Fiems et al. (1998).

Table 4. Performance of growing kids during the experimental period

Items	Control	Low energy		High energy	
	Diet 1 (NENP)	Diet 2 (LELP)	Diet 3 (LEHP)	Diet 4 (HELP)	Diet 5 (HEHP)
Initial weight (kg)	15.40 ±0.55	15.60 ±0.61	15.20 ±0.35	15.50 ±0.50	15.30 ±0.30
Final weight (kg)	17.00 ±0.65	16.35 ±0.63	16.91 ±0.52	17.40 ±0.71	17.85 ±0.75
Total weight gain (kg)	1.60 ±0.21 [b]	0.75 ±0.16 [c]	1.71 ±0.19 [b]	1.90 ±0.31 [a]	2.55 ±0.39 [a]
Average daily gain (g)	53.33 ±4.95 [b]	25.00 ±3.84 [c]	57.00 ±4.89 [b]	63.33 ±7.64 [b]	85.00 ±9.27 [a]
Dry matter intake (g/ day)	570 ±24.5 [b]	560 ±32.7 [b]	600 ±16.8 [a]	560 ±28.6 [b]	631 ±26.4 [a]
Growth efficiency (%)	9.36 ±0.39 [b]	4.46 ±0.22 [c]	9.50 ±0.47 [b]	11.31 ±0.69 [a]	13.47 ±0.87 [a]
Feed conversion ratio	10.69	22.40	10.53	8.84	7.42
Crude protein intake (g/day)	54.43 ±1.38 [b]	42.78 ±1.94 [c]	69.42 ±1.69 [a]	42.73 ±1.21 [c]	73.07 ±2.71 [a]
Protein conversion Efficiency	0.98 ±0.05 [b]	0.58 ±0.03 [c]	0.82 ±0.04 [b]	1.48 ±0.05 [a]	1.16 ±0.04 [a]
ME intake (Mcal/head/ /day)	1.39 ±0.04 [b]	1.08 ±0.02 [c]	1.17 ±0.03 [c]	1.65 ±0.07 [a]	1.85 ±0.05 [a]
Energetic efficiency	38.37 ±1.39 [b]	23.15 ±1.29 [c]	48.72 ±1.59 [a]	38.38 ±1.11 [b]	45.94 ±1.69 [a]

*Figures in the same row having the same superscripts are not significantly different ($P<0.05$).

Growth efficiency (%) = Average daily gain / dry matter intake × 100.

Protein conversion efficiency = Average daily gain / crude protein intake.

Energetic efficiency = Average daily gain / metabolizable energy intake.

Feed conversion ratio = Feed intake / weight gain (McDonald, 1995).

Significant interaction between protein and energy for weight gain, feed conversion and growth efficiency indicated that increasing dietary protein intake had a greater positive effect on the high energy diets than on the low ones. Similarly, increasing the dietary energy consumption on the HP diets produced a greater positive effect than that recorded on the LP diets.

Nitrogen balance

The N intake (g/day) presented in Table (5) was minimum in animal groups fed on LELP (6.85) and HELP(6.84), and reach its maximum in LEHP (11.11) and HEHP (11.67) in comparison with the control group (8.71). However, nitrogen absorbed and retained (g/day) were high in LEHP (8.47, 6.84) and HEHP (8,70, 6.93) than in LELP (4.5, 2.93), HELP (4.49, 3.15) and control group (5.96, 4.74) respectively.

The intake and retention of nitrogen recorded high levels in the animal groups fed on high level of protein, irrespective the energy level. This may be a reflection for the higher N-intake by these groups owing to higher crude protein intake from their diets. The results came in agreement with that reported by Singh & Kumar (1998) who found that N-balances were higher for groups fed on higher nitrogen intake due to higher crude protein in the diets. There was a general trend that, the absolute amount of N retained increased with increasing the digested N intake. Furthermore, increasing the energy intake tended to improve N retention by sparing the amino acids oxidation and then become available for protein synthesis (Griffiths, 1978). Absorbed and retained nitrogen as a percentage of nitrogen intake were significantly ($P<0.05$) higher with the kid groups fed on the high protein diets (LEHP & HEHP), however, the fecal and urinary nitrogen values were high in groups fed low protein diets irrespective the energy.

The nitrogen retention as percentage of total N absorbed was also significantly ($P<0.05$) higher for groups fed on high protein diets, indicating thereby that higher crude protein in the diet had a significant effect on protein digestibility and its further utilization as reported by Prasad & Agarwal (1996) in heifers. Oldham (1984) reviewed studies where different concentrations and sources of protein and energy fed to cows and concluded that form of dietary energy affects protein utilization and that energy exerts a " protein sparing" effect.

Table 5. Nitrogen balance of growing kids in the different groups

Items	Control	Low energy		High energy	
	Diet 1 (NENP)	Diet 2 (LELP)	Diet 3 (LEHP)	Diet 4 (HELP)	Diet 5 (HEHP)
Nitrogen balance (g/day)					
Intake	8.71 ±0.22	6.85 ±0.31	11.11 ±0.28	6.84 ±0.19	11.69 ±0.43
Fecal	2.75 ±0.23	2.35 ±0.20	2.64 ±0.29	2.35 ±0.14	2.97 ±0.31
Urine	1.22 ±0.09	1.57 ±0.11	1.63 ±0.13	1.34 ±0.10	1.77 ±0.14
Absorbed	5.96 ±0.28	4.50 ±0.31	8.74 ±0.48	4.49 ±0.21	8.72 ±0.52
Retained	4.74 ±0.28	2.93 ±0.19	6.84 ±0.39	3.15 ±0.26	6.95 ±0.42
Nitrogen intake (%)					
Fecal	31.57	43.31	23.76	34.36	25.45
Urine	14.01	22.92	14.67	19.59	15.17
Retained	54.42 $\pm1.12^{ab}$	42.77 $\pm1.41^{b}$	61.57 $\pm0.83^{a}$	46.05 $\pm0.93^{b}$	59.45 $\pm1.36^{a}$
Nitogen digestibility (%)	68.43 $\pm1.24^{b}$	65.69 $\pm1.65^{b}$	76.24 $\pm1.18^{a}$	65.64 $\pm1.86^{b}$	74.59 $\pm2.15^{a}$

*Figures in the same row having the same superscripts are not significantly different ($P<0.05$).

Nitrogen absorbed = nitrogen intake – fecal nitrogen.

Nitrogen retained = nitrogen intake – (fecal nitrogen + urinary nitrogen)

Nitrogen digestibility = nitrogen absorbed / nitrogen intake × 100 (Maynard, 1979)

In metabolic terms, it would appear that, the increased deposition of protein on HE diets may have been attributed to an enhanced supply of oxidizable substrate from protein sources, producing a protein sparing effect, which in turn may have contributed to an enhanced supply of amino acids for tissue anabolism. The greater accretion of lean tissue on HP diets may be due to an improved supply of amino acids at the small intestine from undegradable protein (UDP) and rumen microbial sources which stimulated protein deposition following absorption, particularly on the HE diet in goats as reported by Shahjalal et al. (1992). It is also possible that there was insufficient rumen degradable protein (RDP) in the HELP diet for the rumen microorganisms, which required to optimize microbial protein synthesis (ARC, 1984). In contrast, it is likely that for goats receiving diet HEHP, optimum synthesis of microbial protein probably occurred.

Blood biochemical changes:

Total serum protein (g/dl) of the kids in LEHP (8.0±1.12) and HEHP (8.8±1.17) groups were significantly ($P<0.05$) higher than kids in LELP, HELP & NENP groups (6.0±1.43, 5.7±1.00, 6.2±1.31) respectively as shown in Table (6). This level of serum total proteins higher in than the normal level which reported by some authors in goats (Jessica & Lewis, 1976; Castro et al., 1977; Chauhan, 1995). This means that, total serum proteins were affected by the protein levels of the diets. No significant ($P<0.05$) differences were observed in the serum albumin of all kid groups and this indicated that, different levels of protein and energy had no effect on serum albumin of animals. The mean values of total serum globulin (g/dl) in LEHP (4.5±1.58) and HEHP (4.9±1.31) were significantly ($P<0.05$) higher than other groups. The biochemical study declared significant ($P<0.05$) increase in the serum glucose level in the kids of HEHP (80±5.5 mg/dl) in comparison with other experimental groups.The level of serum glucose in all animal groups was higher than the normal level (55, 60 mg/dl) which reported in goats by Jessica & Lewis (1976) and Chauhan (1995) respectively. The serum levels of Na^+ & K^+ found in this study were lower, while Cl^- level was high in comparison with that found by Castro et al. (1977) in normal goats (Na^+, 150; K^+, 5.9; Cl^-, 106.8 mEq/L respectively).

Table 6. Blood serum proteins, albumin, globulin, urea, uric acid, glucose and electrolytes of the different groups

Items	Control	Low energy		High energy	
	Diet 1 (NENP)	Diet 2 (LELP)	Diet 3 (LEHP)	Diet 4 (HELP)	Diet 5 (HEHP)
Total protein (g/dl)	6.2±1.31 ^{b}	6.0±1.43 ^{b}	8.0±1.12 ^{a}	5.7±1.00 ^{b}	8.8±1.17 ^{a}
Albumin (g/dl)	2.8±1.16 ^{a}	3.3±1.28 ^{a}	3.5±0.79 ^{a}	2.8±0.75 ^{a}	3.9±0.97 ^{a}
Globulin (g/dl)	3.4±1.39 ^{b}	2.7±1.18 ^{b}	4.5±1.58 ^{a}	2.9±1.08 ^{b}	4.9±1.31 ^{a}
Alb./glob. Ratio	0.82	1.22	0.78	0.97	0.80
Urea (mg/dl)	15.6±2.3 ^{ab}	15.3±2.4 ^{b}	16.7±2.6 ^{a}	17.5±2.1 ^{a}	15.5±2.3 ^{ab}
Uric acid (mg/dl)	0.6	0.3	0.4	0.4	0.6
Glucose(mg/dl)	75±3.7 ^{ab}	70±5.2 ^{b}	75±5.1 ^{ab}	75±4.9 ^{ab}	80±5.5 ^{a}
Na^+ (mEq/L)	146±10.9	145±8.3	147±9.2	146±10.4	148±8.8
K^+ (mEq/L)	5.6±0.42	5.6±0.51	5.2±0.69	4.7±0.89	5.4±0.52
Cl^- (mEq/L)	108±5.6	109±6.8	110±5.9	109±4.9	107±6.9

*Figures in the same row having the same superscripts are not significantly different ($P<0.05$).

The overall mean values of urea in kid's serum in LEHP & HELP groups (16.7±2.65, 17.5±2.08 mg/dl) were significantly ($P<0.05$) higher than other experimental groups. The value of uric acid (mg/dl) was high in the serum of animal groups fed on NENP & HEHP in comparison with other groups. There was no significant ($P<0.05$) differences in the serum levels of T4, T3, GOT & alkaline phosphatase between different experimental groups, while significant ($P<0.05$) differences were recorded in the serum GPT of animals fed on LELP (12.0±1.85) and HELP (13.0±1.46) in comparison with other kid groups (Table, 7). The levels of T4, T3 and alkaline phosphatase found in this study are in agreement with the range which reported by Kallfelz & Erali (1973) and Jessica & Lewis (1976) in growing goats (5.68±0.46, 28.9±1.97 µg/dl and 173±37.1 IU/L respectively), while, the levels of GOT and GPT are high in values than that reported by Adam et al. (1974) in goats (13.5 & 5.65 IU/L).

Table 7: Blood serum enzymes and hormones of growing kids during experimental periods

Items	Control	Low energy		High energy	
	Diet 1 (NENP)	Diet 2 (LELP)	Diet 3 (LEHP)	Diet 4 (HELP)	Diet 5 (HEHP)
T4 (µg/dl)	5.8±0.29	5.32±0.42	5.63±0.36	5.67±0.32	5.66±0.25
T3 (mg/dl)	26.9±2.09	26.65±2.11	28.65±2.14	27.82±2.1	25.73±2.12
GOT (IU/L)	15.0±0.82	16.0±0.94	14.0±0.82	16.0±0.93	17.0±0.47
GPT (IU/L)	7.0 ± 1.54^{b}	12.0 ± 1.85^{a}	11.0 ± 1.73^{ab}	13.0 ± 1.46^{a}	8.0 ± 1.92^{b}
Alka. Phosph. (IU/L)	176±4.7	178±6.9	170±8.1	176±5.8	173±7.4

*Figures in the same row having the same superscripts are not significantly different ($P<0.05$).

Thus, it could be concluded that, a particular level of energy and protein affected positively the growth rate, feed conversion and nitrogen retention and the high energy-high protein diet is superior in view of the utilization and sparing of nutrients for male growing goats.

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Fig.1.Dry matter intake of different groups of growing kids

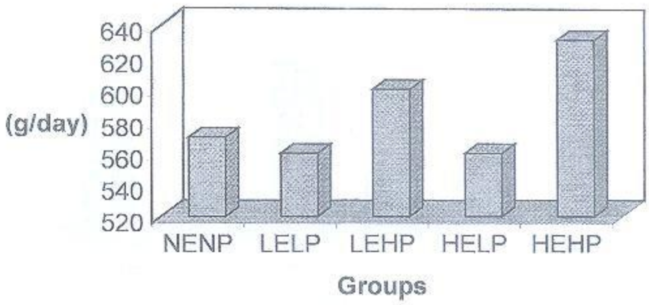

Fig.2.Average daily gain of different groups of growing kids

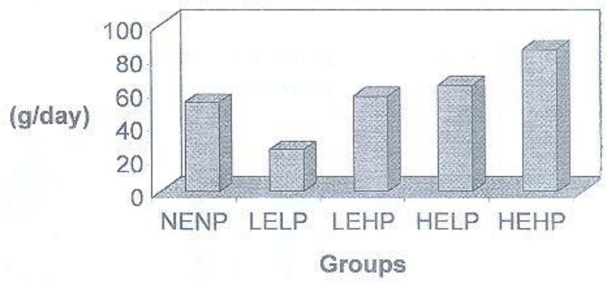

Fig.3.Absorbed nitrogen as % of nitrogen intake of different groups of growing kids

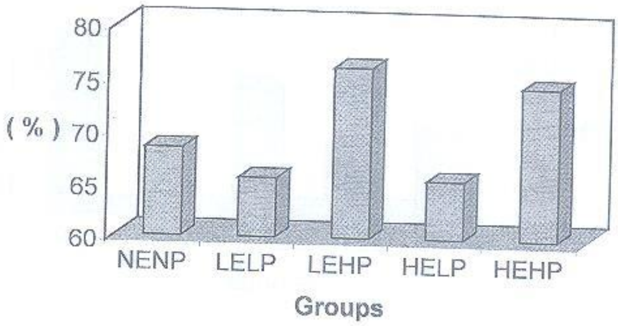

Fig.4.Total serum protein of different groups of growing kids