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# **Effect of Different Levels of Protein on Growth of Crossbred ( Saanen x Osmanabadi ) Goats**

BY

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**1980**

AFFECTIONATELY DEDICATED TO MY  
BELOVED GRANDMOTHER SHRIMATI  
ANNAPURNABAI UTGE

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I hereby declare that the dissertation  
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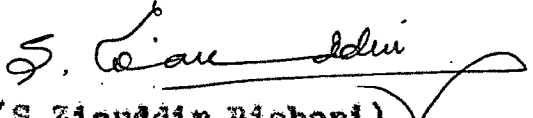
  
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Mr. Dhananjay Maharudrappa Utge has satisfactorily prosecuted his course of research for a period of not less than four semesters and that the dissertation entitled " EFFECT OF DIFFERENT LEVELS OF PROTEIN ON GROWTH OF CROSSBRED (Saanen x Osmanabadi) GOATS" submitted by him is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the dissertation or part thereof has not been previously submitted by him for a degree of any University.

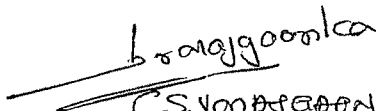
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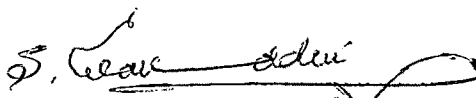
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CERTIFICATE II

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OF CROSSBRED (Saanen x Osmanabadi) GOATS" submitted  
by Dhananjay Maharudrappa Utge to the Marathwada  
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has been approved by the student's advisory committee  
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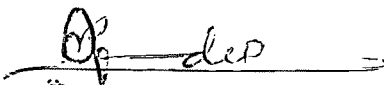
  
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## ILLUSTRATIONS

CF	=	Crude fibre
cm	=	centimetre
CP	=	Crude protein
DM	=	Dry matter
DCP	=	Digestible crude protein
EE	=	Ether extract
g	=	gram
kg	=	Kilogram
NFE	=	Nitrogen free extract
NS	=	Non-significant
TDN	=	Total digestible nutrient

1. INTRODUCTION

## 1. INTRODUCTION

The exploding human population and the resulting socio and agro-economic situation are presenting hard on the direct use of land not only in India but also in several other countries of the world. The use of land for raising livestock is being gradually eliminated and the rearing of larger animals like cattles and buffaloes is becoming more and more difficult every day. Smaller animals like goats, which have no specific and exacting demands, offer a befitting economy in such situations for producing milk and meat to the traditional poorly balanced diets. The total goat population in the world is 397.917 million heads (F.A.O., 1974). India constitutes 70.062 million heads, this represents about 17.6 per cent of the total world goat population (F.A.O., 1977). Out of 5.911 million goats in Maharashtra, Marathwada constitutes 1.144million (Livestock Census of Maharashtra, 1975).

Goat is a multipurpose animal producing meat, milk, skin and hairs. In India contribution by goats to the production of meat and milk is 47.6 and 2.8 per cent respectively. Fresh skin production is 70200 metric tons and 340 million tons of manure (F.A.O., 1977). Goats also supply horns, hooves, blood for serum and bone meal, all of which have commercial values.

The contributes of goat in earning foreign exchange also amounts to the tune of Rs 42.00 lakhs per year in the forms of skins alone, which are prominently exported to U.S.A. and U.S.S.R.

Goat milk, like that of cow, is nature's almost perfect food and is one of the best nourisher of all the liquid foods. Goat milk is safe, palatable nutritious and easily digestible. Mahatma Gandhi, the father of our Nation lived principally on goat milk for more than 50 years and some of the medical experts and dietitians have opined that goat milk was chief secret of his sound health even at his old age.

India has a largest goat population in the world with lowest productivity from this species. The goat population is increasing at the rate of 1 million per year inspite even lack of development programme for this species (Taneja, 1979). In order to obtain rapid and optimum growth rate, optimum levels of energy, protein, minerals and vitamin requirement should be fulfilled. Thus for obtaining optimum growth rate adequate energy and protein levels are to be worked out. Feeding of animal is done on certain norms, which are known as feeding standards. Growth of animal also depends upon the hereditary factors, ability of animal to adopt to its

environment and availability of the type of feeds. Goat has a variety of functions in comparison with other ruminants and display a unique ability to adopt and maintain themselves in harsh environment (P.A.O., 1976).

The application of advance reproductive technique like synchronization, superovulation and cross-breeding will tremendously increase the cost-benefit ratio of this species towards higher economic gains to the poor and landless farmers. Goat programme has been launched in India resorting to cross-breeding with reputed breeds such as Saanen and Alpine for milk production and Toggenburg and Anglonubian for meat production. Usually the goat breeds found in India and South-east asian countries have better prolificacy as compared to the breeds of temperate countries, thus by resorting to cross-breeding it is hoped to combine the high milk producing ability and better growth rate of temperate breeds of goats with higher prolificacy of Asian goats to obtain larger kidding percentage and more milk and meat production in the crossbreeds. (Patel, 1979).

The view of its special feeding habits the question has been asked whether a goat has digestive efficiency to that of other ruminants which might account for its successful adaptation to poor environment. Part of

improved digestibility apparent in goats is probably due to associative effects, that is the composition of various feeds consumed. This is particularly distinct in goats in view of their wide feeding habits of a variety of feeds (Mudgal and Devendra, 1979). ✓

With the rapid growth in population and perennial food shortage in the country, all available lands are now being brought under the cultivation and the result is a progressive shrinkage in grazing lands. Moreover, as the goat is a voracious eater and destroyer <sup>of</sup> vegetation indiscriminately, it is gradually being realized to grow more food. It would be advantageous if goats were stallfed like other farm stock (Majumdar, 1960).

The present investigation has been undertaken to investigate the nutritional requirement of goat and its digestible efficiency. Attempt has also <sup>been</sup> made to observe the effect of stallfeeding on growth, height, length, chest girth, belly girth of goat. The present investigation is mainly oriented to study the effect of different levels of protein on the growth of crossbred goats (Saanen x Osmanabadi) and cost of feeding which will provide (a) guidelines for goat farmers of this region under stallfeeding conditions.

2. REVIEW OF LITERATURE

## 2. REVIEW OF LITERATURE

With a view to fall in the line with the experiments conducted in the present studies pertain literature was screened and presented in this chapter.

### 2.1 Growth rate:

Altenkirch and Vergleichende (1957) reported that average weights of Thuringian and Bulgarian crossbred goats for eight male and 11 female kids were 3.8 kg and 3.4 kg at birth, at 12 weeks 19.5 and 16.9 and at 40 weeks 27.3 and 31.0 kg respectively.

Wilson (1958) stated that the effect of plane of nutrition on the live weights of experimental kids of both sexes was statistically significant from third week of age. High plane kids reached 33 lb live weight at approximately 26 weeks of age, low plane kids at about 46 weeks. And he also recorded external measurements illustrated centripetal growth of the skeleton of the kid. The greater linear increase was shown by the measurements on body length, and the least increase by the length of the lower hind leg. Measurements of width or depth of skeletal complexes showed greater post-natal increases than linear measurements.

Ciolca et al. (1959) reported that a breed has been produced from crosses of German improved and Saanen with

the local Carpathian, the average mature body weight was 45 kg with a range <sup>of</sup> 30 to 58 kg for the crossbreeds.

Attman and Dettmer (1964) found that the Saanen breed doe kids reached 50 per cent of their mature weight in about eight months<sup>2</sup> time.

Devendra (1966) studied the growth of Kambing Katjang kids, fed to appetite on a high plane of nutrition in Malaysia indicated a very low rate of weight increase. Kids weaned at 12 weeks of age at an average live weight of 7.5 kg only, weighed 10.6 kg at 30 weeks, in comparison to Anglo Nubian and Jamnapari crossbred weighed 24.1 and 22.4 kg respectively at the same age just over twice the weight of the indigenous goat.

Johri and Talapatra (1971) studied the rate of growth under browsing and stallfed conditions, feed consumption and digestibility coefficients of Jamnapari kids, varying in age from 3 to 12 months weighing from 7.0 to 24.0 kg. They observed that the rate of growth under browsing was 0.547 kg per fortnight as against 0.333 kg under stall-feeding. The average protein contents of the range upon which the kids browsed was 17.15 per cent while crude protein contents of various green feeds in the stall during the four months i.e. September, October, November and December varied from 9 to 18.15 per cent. It has

been concluded that the usual practice of browsing is a much cheaper method of raising kids.

Lindhal (1972) found that the weight gain of kids after the point of inflexion of the growth curve take place at a slow rate and apparently, it is difficult to alter if high energy or protein diet is given.

Ali et al. (1973) observed that the growth rate of Black Bengal goats at half yearly gain in weight for three age groups i.e. 3 months to one year, one year to 2 year and 2 year to 3 year was 10 lb, 4 lb and 4 lb respectively.

Anonymous (1973) in Cyprus Agricultural University an investigation was carried out on 102 males and 102 females. The kids were fed with three different levels of protein diet i.e. 12.9, 20.0 and 12.3 per cent of crude protein of the feed. Average daily gain in 3 diet groups were 0.21, 0.25 and 0.21 kg for males and 0.18, 0.19 and 0.17 kg for females respectively. Feed conversion ratios were 4.92, 4.78 and 5.52 for males. In 33 kids castrated within one week of birth and fed with 20 per cent protein diet for 15 week from about 100 days age, the average daily gain was 0.2 kg and food conversion ratio was 5.05.

Singh and Singh (1974) reported the monthly growth rates of the Jannapari kids during different phases of

their life viz. birth to 4th, 4th to 8th, 8th to 12th months of age. Growth was maximum in the first phase and minimum in the second. Males were significantly heavier than females, the differences between single and twin <sup>from kids</sup> for growth were not statistically significant. Again in the age group of 8th to 12th month the growth increased appreciably.

Bhandari et al. (1974) observed the mean body weight of four male goats of 3 to 5 months old which were fed for 17 weeks, on concentrate with wheat straw, minerals and vitamin A. For three groups, protein intake was adjusted to the calculated requirement of DCP 0.95 g/kg body weight daily, 30 per cent of it as urea, alone for controls or with element sulphur 3.5 g or with providing inorganic sulphur about 2 g, another group got DCP 0.77 g/kg, 30 per cent of it <sup>w</sup> as urea. Groups in that order gained 33, 53, 28 and 17 g daily, but differences in gains were not significant. Intakes and digestibility or retention of nutrients or minerals had no significant difference that was due to sulphur supplement.

Mishra and Chawla (1975) reported that the average gain in weight per day ranged from 43 to 51 g in case of Beetal kids.

Wilson (1976) observed in a 15 months study of 7 flocks of indigenous goats, <sup>that the</sup> The average rate of gain

was 37 g/day up to 3 months and 67 g/day up to 6 months age. The growth rate of single and twins were similar but triplet kids grew at slower rate.

Chopra and Rana (1977) tabulated body measurements on 20 Anglo Nubian x Beetal, 11 French Alpine x Beetal, 4 Beetal x French Alpine and 7 Beetal Females aged for 2 to 4 years, body length varied significantly in the four groups respectively. The average being 73.15, 72.81, 72.75 and 79.13 cm. There was no difference in body weights.

Singhal (1978) reported 39.00, 25.80, 32.50 and 37.50 g gain per day in basal, control, urea and biuret supplement ration respectively.

Deahmukh (1979) studied the effect of different levels of protein on growth rate of crossbred (Saanen x Omaniabadi) kids from 2 to 6 months age. Twenty four crossbred kids belonging to both sexes were selected. The kids were distributed in three groups of protein levels i.e. 100 per cent DCP (control), 120 per cent DCP and 80 per cent DCP. The average daily gain in body weight was  $62.333 \pm 3.932$ ,  $60.670 \pm 2.918$ ,  $53.000 \pm 5.296$  and  $51.334 \pm 4.489$  g at 90, 120, 150 and 180 days respectively in treatment one. The corresponding values for treatment two and three were  $80.00 \pm 2.897$ .

71.300  $\pm$  2.842, 64.833  $\pm$  3.452 and 59.900  $\pm$  1.334 g per day and 57.830  $\pm$  5.339, 51.490  $\pm$  4.432, 49.00  $\pm$  2.449 and 41.333  $\pm$  3.604 g/day respectively. The mean total gain in height was 8.7  $\pm$  0.448, 9.9  $\pm$  0.714 and 6.4  $\pm$  0.494 cm for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively. The mean total gain in length was 8.100  $\pm$  0.464, 9.3  $\pm$  0.401 and 6.9  $\pm$  0.330 cm respectively for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. The mean total gain in chest girth was 9.1  $\pm$  0.486, 9.5  $\pm$  0.324 and 8.90  $\pm$  0.490 cm for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively. The mean total gain in belly girth was 11.7  $\pm$  0.486, 14.100  $\pm$  0.324 and 11.1  $\pm$  0.490 cm respectively for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>.

Nawale (1979) studied the effect of different levels of protein on growth rate of Osmanabadi kids of 2 to 6 months of age. The average daily body weight gains of kids in different periods under different treatment was as under:

Period (days)	T <sub>1</sub> 100% DCP	T <sub>2</sub> 120% DCP	T <sub>3</sub> 80% DCP
60-90	56.041 $\pm$ 2.232	68.229 $\pm$ 1.865	50.625 $\pm$ 2.265
90-120	48.437 $\pm$ 4.043	55.104 $\pm$ 2.779	40.624 $\pm$ 2.934
120-150	33.333 $\pm$ 1.010	43.333 $\pm$ 3.012	34.166 $\pm$ 1.749
150-180	33.959 $\pm$ 2.935	41.667 $\pm$ 2.021	32.500 $\pm$ 2.103

He too observed more gain in linear body measurement in treatment two followed by treatment one and three.

Pawar et al. (1980) studied the correlations between body weight and linear body measurements in adult Osmanabadi goats and observed that all the linear body measurements are positively correlated with the body weights.

## 2.2 Protein intake:

Hajundar (1960) concluded that DCP requirement of Jamnapari goats <sup>was</sup> 106 and 127 g per 100 kg body weight for N free and low N rations respectively, which were comparable to the ARC (1965) and NRC (1966) for sheep.

Hajundar (1960b) reported that the mean DCP requirement for maintenance was 1.12 g per kg live weight, which was appreciably higher than the factorial value of 0.38 to 0.76 and also higher than the recommended value for dairy cows per kg live weight in tropics.

Mudgal and Ray (1965) studied the nutrient requirement for goats and reported that good growth can be obtained on considerably less protein than that of recommended by Morrison (1959) when TDN kept at sufficient level.

Duncan (1966) found that the maintenance requirement of the goat for digestible protein is approximately 0.06 to 0.08 per cent of body weight for tropical goats.

Morrison and Narayan Rao (1967) observed that ratio of protein to calories in the diet had a marked effect on weight gains, body composition and efficiency of nitrogen utilization.

Devendra (1970) concluded that the digestible crude protein requirement in goat is about 45 to 64 g/100 kg live weight for maintenance and 70 g DCP/litre of milk for milk production.

Stobo and Ray (1973) observed that the low level of protein in diet is expected to result in maximum efficiency of utilization of dietary energy and protein.

Sachdeva et al. (1973) studied the effect of plane of nutrition on milk production and composition of goats. Ninety seven Barbari and 87 Jamnapari females were allotted to nine different groups on the basis of protein and energy intakes. Data were tabulated for five kiddings of Barbari and four of Jamnapari does. The first three Barbari kiddings and the first Jamnapari kiddings seemed to be unaffected by plane of nutrition subsequently, does in low energy groups irrespective of protein level showed a significant decline in reproductive

performance as measured by kidding percentage and kidding intervals.

Akinseyinu et al. (1975) studied the energy and protein utilization for pregnancy and lactation by the West African Dwarf goats in Nigeria. Two trials of 21 days period were carried out using six West African Dwarf goats; aged approximately 2<sup>1</sup>/<sub>2</sub> years from the second month of gestation to 18 weeks post-partum period. Does were fed daily with 0.454 kg hay and 0.908 kg of concentrate containing 1, 6, 12, 18, 24 or 30 per cent crude protein, concentrates consisted of molasses and minerals with groundnut cake, <sup>a</sup>cassava, flour and urea. DM intake and live weight gain did not show any significant change with increasing levels of protein supplement. Overall average metabolizable energy (ME) intake for pregnancy and lactation was 781.7 ± 0.734 71.1 kg/kg/body weight. It was estimated that approximate 12.29 digestible crude protein<sup>g</sup>/kg body weight was required for the production of 330 g milk/day. Gross efficiency of ME for milk production was 18.2 per cent.

Akinseyinu et al. (1976) found that the crude protein requirement of West African dwarf goats for maintenance and gain <sup>102</sup> 2.5 years old and of <sup>an</sup> average weight of 20 kg were kept in metabolism cages with <sup>access to</sup> excess of salt licks and water. They were offered 0.454 kg giant

star grass (Cynodon nlemfuensis) and 0.908 kg dry feed daily. There were five dry feeds based on molasses and cassava starch with or without palm kernel meal and groundnut oil meal. They had from 0.4 to 21.0 per cent crude protein. The above diet was given to three castrated bucks and non-lactating does for five weeks. During last seven days N balance was estimated. The results showed no differences between sexes. Apparent digestibility of crude protein rose from 58.6 per cent on the low protein diet to a maximum of 80.2 per cent on the diet with 16.5 per cent crude protein. Actual feed intakes was different and weight change rose from a loss of 0.04 kg daily on the low protein diet to a maximum gain of 0.54 kg on the dry feed with 16.5 per cent protein. Daily retention of N increased from a loss of 0.6 g to a gain of 16.6 g on the largest intake of protein. Average metabolic faecal N loss was 4.3 g/kg DM intake. Mean daily DCP requirement estimated from these results was  $0.74 \text{ g/kg}^{0.734}$  for maintenance and  $0.6 \text{ g/kg}^{0.734}$  for each weight gain. The estimated requirement of a goat of 20 kg gaining 200 g daily was 97.2 g DCP, much more than recommended by ARC for sheep in temperate conditions.

Sengar (1978) studied that the 35 kids (of) having different ages and belonging to different breeds i.e.

Jamnepari (A), Beetal (B), Barbari (C) and Black Bengal (D). These were aged and fed ad-lib and their body weights before and after trial were taken. The intake of dry matter from different components and excretion through faeces were also recorded for each animal.

The relevant details of the trial are tabulated below.

Dry matter and DCP intake of growing kids:

Breed	No. of kids	Body weight (kg)	Gain in wt. /day (g)	Dry matter intake per day (\$ B.W.) kg	DCP intake per day (\$ B.W.) kg
A	2	12.03 (10.20-13.85)	68	3.70 (2.90-4.43)	0.375 (0.346-0.403)
B	11	17.29 (12.30-23.58)	121	3.88 (2.99-5.12)	0.393 (0.300-0.547)
C	7	11.64 (9.23-13.78)	87	3.96 (3.14-4.71)	0.414 (0.303-0.545)
D	15	9.27 (4.80-13.65)	67	4.05 (2.73-4.96)	0.418 (0.288-0.535)

Figures in parenthesis indicate the range.

Singhal and Mudgal (1979) observed in an experiment of comparative study on urea and biuret feeding on nutritional utilisation in goat that the DCP intake was 170.58, 162.83 and 157.58 g for control, urea and biuret feeding treatments. They further observed <sup>respectively</sup> the maintenance <sup>that</sup>

requirement of TDN and DCP were 430.00, 430.00 and 470.00 and 86.5, 88.6 and 94.6 g respectively for control, urea and biuret fed group of kids having body weight 41.30, 42.60 and 43.90 kg respectively.

### 2.3 Water intake:

Asuncion (1939) has reported that bucks drank 136 g and does 286 g water per day in penned conditions.

Appleman and Delouche (1958) observed that increased respiration rate <sup>has</sup> and increased consumption of water are related <sup>to</sup> in temperature controlled chamber, at 0 °C. The daily water consumption per goat was 2300 g whereas, at 35 °C it was 6.600 g falling to 4000 g per day at 40 °C, because of the failure of the heat regulatory system at this temperature. ✓

Rao and Mullick (1965) recently studied the effect of climatic factors on the metabolism of nutrients in kids over seasons during which the maximum temperature were 50, 90, 106 and 80 °F respectively. They found that the intake of water and the its ratio to intake of dry matter increased with increase in temperature, while the water excreted in faeces and urine decreased.

Devendra (1967) estimated the daily diurnal and seasonal free water intake of penned indigenous goats

weighing 18.20 kg in West Malaysia. The mean daily free water intake per goat was 680 g of which 544g was drunk between 07.00 hrs and 19.00 hrs and 136 g between 19.00 hrs and 07.00 hrs. On an average the goats varied very little from day to day (about 3 per cent) in their daily free water intake. No correlation was found between the weight of individual goats and their mean daily free water intakes, nor were the variations from day to day associated with live weight differences.

#### 2.4 Dry matter intake and digestibility:

Miya et al. (1960) conducted metabolic experiment, on goats and Kumaon bullocks when Bargad leaves formed the feed. The goats consumed on an average 929 g of leaves (on dry basis) whereas, the bullocks consumed only 387 g per 100 lb live weights. Goats maintained their live weights with negligible loss whereas Kumaoni bullocks lost weights considerably. From digestibility trials and metabolic studies it was found that the goats were more capable to digest and utilize both the organic and inorganic nutrients from Bargad leaves than the Kumaoni bullocks. It is concluded that Bargad leaves alone may just form a maintenance ration for goats but not for Kumaoni bullocks. For the latter a combination of such other cheap feeds as wheat chousa and wheat bran with the leafy ration is necessary.

Alexander et al. (1962) reported that there was highly significant correlation between digestion coefficient for DM, protein, crude protein, crude fibre, NFE, ether extract, energy and EDN content though variation among individual animal was slightly greater for sheep than for cattle.

Jang and Majumdar (1962) observed the digestibility of various dietary constituents by goat as, DM 59.7 per cent, CP 66.4 per cent and for CF 66.9 per cent.

Brannon (1966) indicated that for its size, the goat can consume substantially more than cow or sheep. The dry matter intake of the goat observed by him was 6.5 to 11 per cent of its body weight, the average being 5 to 7 per cent.

Devendra (1967) in an experiment on Kambing Katjang goats in West Malaysia, observed that DM intake was 2750 g per 100 kg of body weight. The highly significant correlation between body weight and DM intake was recorded ( $r = 0.94$ ).

Johri and Talapatra (1971) found that kids fed on whole milk had weekly growth rate of 0.630 kg in case of male and 0.635 kg in females. The average dry matter consumption was 3.4 kg/100 kg body weight.

Hamada et al. (1973) observed that digestibilities of lucerne hay cubes and Italian ryegrass hay were

estimated with four castrated goats of about 17 kg body weight. Average coefficients for the lucerne cubes were for crude protein 74, ether extract 51, N free extract 72 and fibre 41 per cent and for ryegrass 48, 44, 56 and 64 per cent respectively. Digestible crude protein and TDN in air-dry material were 12.6 and 51.4 per cent for lucerne and 3.4 and 46.4 per cent in the ryegrass. For four goats weighing about 20 kg, mean daily intakes of lucerne and ryegrass in a switch back trial were 990 and 650 g. In terms of ruminal decomposition lucerne hay cubes may be more akin to concentrates than in the ryegrass hay.

Halois (1974) carried out a comparative experiment to study digestion and renal function in East African goats and haired sheeps under controlled conditions. In both species water intake was closely related to dry matter intake. There was no significant differences in the intakes of dry matter and water between the two species. The dry matter and water intake were affected by the level of feeding and temperature.

Lee et al. (1974) found that digestibility of pasture hay, native grass hay, maize grain, wheat bran and soybean oil meal was estimated for Korean native cattle, sheep, Korean native goats and rabbits (except for native hay). The concentrates were also given to

pigs and poultry. For good hay cattle and sheep digested N free extract better than goats or rabbits. For native hay goats digested most protein followed by sheep than cattle. Sheep digested more fibre than the other ruminants. For maize and bean there were some differences among animal species for each proximate constituent. Digestibility of protein in soybean meal did not differ among species.

Upadhyay et.al. (1974) studied the digestion trial with four adult Barbari bucks with an average body weight of 19 kg was conducted for four month to determine the nutritive value of these leaves. The animal consumed on an average 2.16 kg DM per 100 kg body weight. One animal whose intake was maximum (2.76 kg) showed symptoms of alopecia in the last week of experimental period. Digestibility of DM, CP, EE, CF and NFE were found to be 71, 76, 47, 57 and 81 per cent respectively. The DCP and TDN values were 16.73 and 70.22 per cent respectively. All the animal showed positive nitrogen and Ca balance and only one animal out of four showed negative phosphorus balance.

Maheshwar and Talapatra (1975) studied digestibility in Jannapari goats. Eight lactating goats were individually fed freely with green cow pea



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fodder for about two months. When that was not available, cow pea hay was substituted in an attempt to obtain optimum milk yield from goats deprived of their preferred grazing habits. Digestibility was estimated with four goats fed on cow pea fodder or hay for seven days. Digestibility was satisfactory for the DM intake averaged 3.0 kg/100 kg body weight daily and with the hay 4.04 kg/100 kg suggesting that hay from leguminous forage may be more palatable than hay from other sources. Milk production was adequate, averaging 860 g/goat daily on the green fodder (1st month of lactation) and 690 g with the hay (2nd, 3rd and 4th months). It is concluded that goats may be maintained satisfactorily with stallfeeding.

Mudgal and Miss Daljit Kaur (1976) reported that the goats utilized the dry matter and organic matter at a significantly higher rate ( $P < 0.01$ ) as compared to calves. The average digestibility coefficients for crude protein were  $73.50 \pm 2.50$  and  $80.45 \pm 1.10$  per cent respectively for calves and goats. No significant difference was found in the efficiency of crude protein utilization in the two species. Similar observations were made for ether extract utilization goats digested acid detergent fibre at a significant

higher rate ( $P < 0.01$ ) than the calves. From above results it could be concluded that goats being smaller animal possess better ability to utilize dry matter and ADF and can be used to evaluate feeds and fodders for comparing ration for cattle.

Dabadghao et al. (1976) studied growth rate and digestibility in Barbari goats and reported that Male Barbari goats having 7 to 8 months age divided in three groups of four, grazed for 8 hours daily on a cultivated pasture of Pusa giant, Anjan grass (Cenchrus ciliaris) and Siratro (Phaseolus atropurpureus) without or with 175 or 90 g ground barley with 2 per cent mineral mixture. After 40 days, 2 kids from each group were taken for digestibility trials. Daily DM intake was 2.45, 1.64 and 2.59 kg/100 kg body weight respectively. Intake for C.ciliaris was 81, 72 and 83 per cent of P.atropurpureus, 6, 11 and 6 per cent and of other (unspecified) grasses 13, 17 and 11 per cent of DM from herbage. Digestibility of DM was 64.1, 56.4 and 66.2 per cent and of CP 76.2, 76.6 and 79.3 per cent. Average daily gain was 43.0, 46.6 and 40.7 g Carcass yield was 40.3, 43.5 and 40.4 per cent respectively.

Devendra (1977) reported results of five balance studies on the intake and digestibility of two varieties Serdang and Coloniae of Guinea grass (Panicum maximum)

each cut at five stages of growth, 16 to 19, 21 to 28, 28 to 35, 35 to 42 and 42 to 49 days. Coloniao was better than serdang in chemical composition with grass energy 16.9 and 16.9, 16.5 and 16.6, 16.4 and 16.5, 16.1 and 16.1 and 16.1 and 14.9 MJ/kg at the five stages there were significant differences between species among trial and interaction in daily voluntary intakes of fresh material and DM by goats and sheep. Differences between goat and sheep were significant only for coloniao in digestibility of DM at 28 to 35 days, for Serdang, the digestibility of N-free extract at 21 to 28 days and digestibility of crude fibre at 35 to 42 and 42 to 49 days. Goats had a higher digestive efficiency than sheep. Digestible energy was 6.70 to 10.18 MJ/kg and 4.19 to 7.37 MJ/kg and DCP was 1.0 to 2.3 per cent and 1.4 to 2.8 per cent in Serdang and coloniao respectively. There were significant correlations between crude protein content and DCP.

Rindsing (1977) observed that the goats consume only one sixth as much as cow, but proportionately to its weight, the goat consume more food than cow or sheep i.e. 4 to 7 per cent DM of its body weight. The lactating goat takes about twice the quantity of feed daily on body weight basis as compared to the cow.

Mishra et al. (1978) reported the dry matter intake up to 3 per cent of live weight (meat/hair goats), up to

8 per cent of live weight (milk goat) and the dry matter to total water intake ratio as 1:4.

Sengar (1978) studied the dry matter intakes of lactating and pregnant goats in the range from 3.87 to 4.46 and 3.07 to 3.48 respectively in their two separate experiments.

Singhal (1978) reported the dry matter intake and digestibility coefficient of dry matter for Beetal kids on different three types of diets which includes, control, urea based and biuret based. The dry matter intake per 100 kg body weight in these diets was  $3.43 \pm 0.21$ ,  $3.66 \pm 0.16$  and  $3.00 \pm 0.12$  kg respectively. Digestibility coefficient for control, urea based and biuret based was  $77.72 \pm 1.25$ ,  $75.67 \pm 1.81$  and  $77.90 \pm 1.03$  respectively.

Nawale (1979) observed in the Osmanabadi kids at the age of 3 to 6 months DM and DCP required for 1 kg gain was 7.953, 7.079 and 9.103 kg, and 0.987, 0.936, 0.837 kg for  $T_1$ ,  $T_2$  and  $T_3$  respectively. Cost of per kid per day more in  $T_2$  followed by  $T_1$  and  $T_3$ . The cost of feed per kg body weight gain was Rs 6.44, 6.08 and 5.73 respectively for  $T_1$ ,  $T_2$  and  $T_3$ .

Deebmukh (1979) studied on crossbred kids (Saanen x Osmanabadi) at the age of 3 to 6 months and

observed the DM and DCP required for 1 kg gain was 8.500, 8.319 and 8.642 kg, and 1.014, 0.998 and 0.880 kg in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively. Cost of feed per day per kid was Rs 0.25, 0.39 and 0.20 and cost of feed per kg of body weight gain Rs 4.40, 5.87 and 4.25 respectively for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>.

Powar, N.K. (1979) observed in the experiment of Angora half breed female goat of 15 months age while observing effect of Alkali treated sugarcane baggase, that the protein requirement per kg gain in body weight was 3.47, 2.46, 2.46, 2.64 and 2.70 kg in different treatments. In control group, the goats received sugarcane milk ration as the concentrate mixture at the rate of 200 g/head/day, where protein requirement per kg gain was 2.70 kg in all the treatments, the goats received green lucerne as a roughage at the rate of 2 kg/head/day during the experimental period.

### 3. MATERIALS AND METHODS

### 3. MATERIALS AND METHODS

Present investigation on one year old crossbred goats (Saanen x Osmanabadi) was undertaken at Goat Research Project, Department of Animal Husbandry and Dairy Science, Marathwada Agricultural University, Parbhani, " to study the comparative effect of different protein levels on the growth rate of one year old goats up to the age of 18 months".

The present investigation started from October, 1979 15th and was completed on 11th April, 1980. The recommendation of N.R.C. feeding standards (1966) given by S.K. Banjhan in his book " Animal Nutrition and feeding practices in India" were taken as a base for feeding the experimental goats.

The different treatments included in this investigation are given below:

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Treatments	Protein levels
T <sub>1</sub> (control)	100 per cent DCP
T <sub>2</sub> (120 per cent)	120 per cent DCP (20 per cent more DCP than NRC)
T <sub>3</sub> (80 per cent)	80 per cent DCP (20 per cent less DCP than NRC)

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### 3.1 Selection and distribution of goats to different treatments:

Twenty one crossbred (Saanen x Osmanbadi) goats of both sexes ( 9 male and 12 females ) having the same age and uniform body weights were selected. Care was taken to maintain uniformity in body weights and age, for all the three treatments. In each treatment or group 3 males and 4 females were allotted.

#### Distribution of goats to different treatments:

Treatment	Branding number	Sex	Age group		Body weight	
			Month	Days	kg	g
T <sub>1</sub> control 100% DCP	53	M	11	29	20	900
	49	M	11	25	22	000
	68	M	12	3	18	700
	38	F	12	5	19	500
	59	F	11	27	18	300
	24	F	11	20	17	400
	75	F	12	2	18	000
Average:			11	29	19	257
T <sub>2</sub> 120% DCP	28	M	12	7	21	500
	58	M	11	25	19	400
	55	M	11	30	20	000
	22	F	11	27	18	500
	28	F	12	5	18	300
	73	F	12	8	17	000
	53	F	11	20	20	000
Average:			12	00	19	242

Continued

Treatment	Branding number	Sex	Age group		Body weight	
			Month	Days	kg	g
T <sub>3</sub> 80% DCP	38	M	11	28	19	800
	60	M	11	25	20	700
	32	M	12	10	21	000
	27	F	11	27	19	500
	74	F	11	27	17	700
	50	F	12	05	18	000
	53	F	12	05	18	000
Average:			12	02	19	242

All the goats of different group were kept under observation for a period of 6½ months, including 15 days as pre-experimental period.

### 3.2 Feeding:

Before the start of experiment the goats were dewormed. Feed requirement was calculated on the basis of the body weight of the individual goat. The goats were fed as per the treatments for a period of 15 days as a pre-experimental period. During the experimental period, the goats were fed as per the fortnightly experimental feeding schedule. The DCP requirement of the individual goat based on body weight was calculated at fortnightly intervals as per the recommendations of N.R.C. (Feeding Standard (1966) and revised by Ranjhan).

The nutrient requirement of the goats was made through Nilwa jowar kadbi (Andropogon sorghum), green lucerne (Medicago sativa) and groundnut cake. Groundnut cake and chaffed Nilwa jowar kadbi were offered daily at 8 a.m. and green lucerne was given in the afternoon at 2 p.m. Before starting the experiment, the Nilwa jowar kadbi, lucerne and groundnut cake were analysed for different feed ingredients, mentioned in the table given below:

Chemical composition of feeds as per the actual analysis  
(on dry matter basis)

Feeds	DM%	CP%	CF%	NFE%	ES%
Nilwa jowar kadbi	90.0	1.53	36.71	50.82	1.65
Lucerne	21.1	20.60	28.10	38.44	3.85
Groundnut cake	93.0	50.00	3.12	30.58	7.95

Besides, roughages and concentrate feeding the goats were provided with lick salt bricks to be licked ad lib.

#### 3.4 Watering:

Each goat had plenty of clean and fresh water every day throughout the experimental period. Watering

was done twice a day in a measured quantity with the help of measuring flask and plastic buckets. The water intake was measured in ml.

### 3.5 Housing and management of goats:

Goats were housed in a comfortable and well ventilated single row type shades during day and night except for an hour in the morning when they were let loose for daily exercise. Care was taken to protect the goats from adverse climatic conditions. The shade and surrounding areas were regularly cleaned and disinfected. The experimental goats were examined by the Veterinary Officer weekly till the end of study.

### 3.6 Observations:

With a view to study the effect of different protein levels on the growth and development of crossbred (Saanen x Osmanabadi) goats, the following fortnightly observations were recorded. In addition, daily observations on water and feed intake were also recorded for individual goat kept under different treatments.

#### 3.6.1 Body weight:

The fortnightly body weights of individual goat were recorded in kilograms by a standard Avery balance.

### 3.6.2 Body measurements:

Observations of different linear body measurements such as height, length, chest girth and belly girth were recorded in centimetres by using a standard tape. All the observations of body measurements and body weights were recorded during early morning hours before feeding or watering.

#### 3.6.2.1 Height:

The height was recorded from the base of the ground to the wither point.

#### 3.6.2.2 Length:

This measure was recorded as the straight line from the point of shoulder to the pin bone.

#### 3.6.2.3 Chest girth:

This was measured as the circumference of the chest just behind the withers.

#### 3.6.2.4 Belly girth:

This was measured as the circumference of belly.

### 3.7 Fodder intake:

The actual intake of fodder fed daily to individual goat was measured in kg by feeding weighed quantity of feed and left over was weighed every day.

### 3.8 Methods for chemical analysis:

The feeds and fodders fed during this investigation were analysed for their chemical constituents by adopting the methods as described by A.O.A.C. (1975).

### 3.9 Digestibility trial:

This was carried during last week of the experimental period for seven days. In each treatment two bucks were selected. The droppings void-out was collected daily for chemical analysis.

### 3.10 Statistical analysis and design for experiment:

The data was processed statistically. The Randomized Block Design was used for the data obtained from the start of experiment to the end of experiment. Whereas, Completely Randomized Design was used for processing the data, obtained during digestibility trial. In order to know the significance of different treatments, the 'F' test was applied. The treatment effect are presented in proper tables and also with the help of figures. The statistical analysis was done according to the standard procedures given by Snedecor and Cochran (1968).

#### 4. RESULTS

#### 4. RESULTS

The experimental findings obtained from the present investigations are presented below.

##### 4.1 Body weight:

The differences in mean initial body weights of experimental goats under each treatment at the start of experiment were non-significant. This revealed the fact that the population under study was quite homogeneous in respect of body weight. The data as regards to the mean initial body weight, the mean final body weight, the mean gain in body weight and the mean daily gain in body weight as affected by various treatments is presented in Table 1. Similarly the data regarding the daily body weight gain at different stages as affected by different treatments is presented in Table 2.

It is observed from the Table 1 that mean final body weight of the crossbred goats under treatment two ( $T_2$ ) where 120 per cent DCP was provided was significantly higher than the mean final body weights of the goats under treatment one ( $T_1$ ) where 100 per cent DCP was given, followed by treatment three ( $T_3$ ) where 80 per cent DCP was given. Similarly total gain in body weight was more in treatment two followed by treatment one and three.

Table 1: Mean initial body weight, mean final body weight, total mean gain in body weight and daily gain in body weight of the experimental crossbred goats:

Treatments	Initial body weight (kg)	Final body weight (kg)	Weight gain (kg)	Average body weight gain/goat/ day (g)
T <sub>1</sub> Control (100% DCP)	19.285±0.6800	26.014±1.0700	6.771±0.5230	37.6
T <sub>2</sub> (120% DCP)	19.242±0.5948	28.542±0.9568	9.122±0.7167	50.7
T <sub>3</sub> (80% DCP)	19.242±0.5542	24.771±0.8855	5.571±0.3761	30.9

S.E. ±

0.26

C.D. at 5%

0.801

Table 2: Average daily body weight gain (g) in crossbred goats:

Monthwise gain	T <sub>1</sub> (100% DCP) (control)	T <sub>2</sub> (120% DCP)	T <sub>3</sub> (80% DCP)
Per day gain in body weight in 13th month	19.516±3.184	23.530±5.092	14.758±1.900
Per day gain in body weight in 14th month	43.331±9.028	61.910±4.898	35.710±2.909
Per day gain in body weight in 15th month	44.282±7.629	53.185±7.633	36.187±2.984
Per day gain in body weight in 16th month	33.748±9.369	55.327±4.618	29.518±2.412
Per day gain in body weight in 17th month	45.711±4.554	54.284±5.426	36.664±1.924
Per day gain in body weight in 18th month	39.044±2.905	51.424±5.143	32.854±1.830

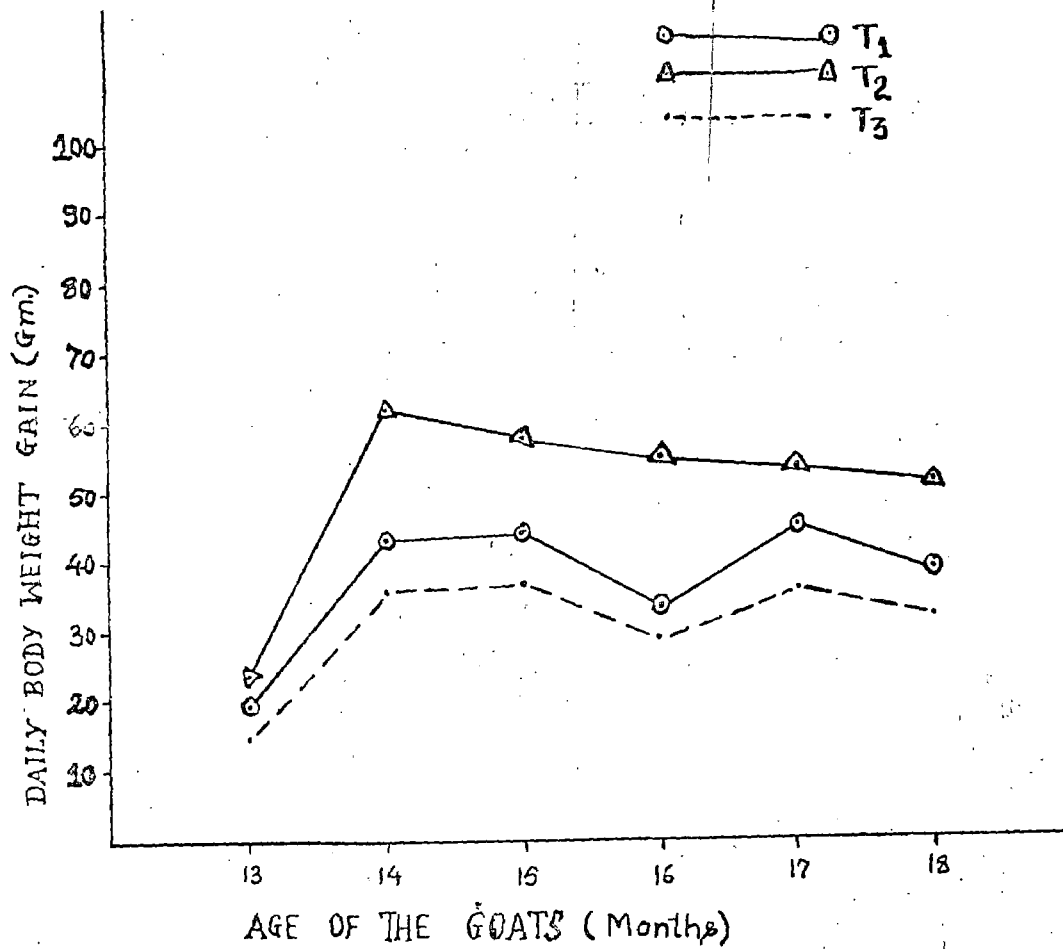


FIG.1. AVERAGE DAILY BODY WEIGHT GAIN  
IN CROSSBRED GOATS.

The data presented in Table 2 shows the mean daily gain in body weight at different age groups as affected by different treatments. It is observed from the Table 2 that daily gain in body weight was more under treatment two followed by treatment one and treatment three.

#### 4.2 Height at Withers:

In order to ascertain the magnitude of treatment and its effect on gain in height at withers, the data was subjected to statistical analysis and presented in Tables 3 and 4.

The data presented in Table 3 revealed that the mean gain in height of the goats under treatment two (120 per cent DCP) is significantly higher than the treatment one (100 per cent DCP) followed by treatment three (80 per cent DCP). However, the mean gain in height of the goats under treatment one and treatment three was at par. Accordingly the daily gain in heights at withers was more in case of the goats fed with 120 per cent DCP than the goats fed with 100 per cent DCP. The differences observed in daily gain in height of the goats fed with 100 per cent DCP ( $T_1$ ) and the goats fed with 80 per cent DCP ( $T_2$ ) were at par.

Table 3: Mean initial height, mean final height, total mean gain in height and mean daily gain in height at withers (cm) of crossbred goats:

Treatments	Initial height (cm)	Final height (cm)	Height gain (cm)	Average daily gain in height per goat (cm)
T <sub>1</sub> (100% DCP) (control)	62.000±0.891	74.857±0.863	12.857±1.556	0.071
T <sub>2</sub> (120% DCP)	61.857±0.367	79.285±0.511	17.571±0.570	0.097
T <sub>3</sub> (80% DCP)	59.714±0.308	73.000±0.527	11.714±0.388	0.065
S.E. ±			0.48	
C.D. at 5%			1.478	

Table 4: Average monthly gain in height (cm) of crossbred goats:

Monthwise gain	T <sub>1</sub> (100% DCF) control	T <sub>2</sub> (120% DCF)	T <sub>3</sub> (80% DCF)
Total gain in height(cm) in 13th month	2.571±0.218	3.570±0.398	2.285±0.308
Total gain in height(cm) in 14th month	2.000±0.333	3.000±0.471	2.142±0.281
Total gain in height(cm) in 15th month	2.000±0.235	3.000±0.235	2.142±0.281
Total gain in height(cm) in 16th month	1.714±0.511	2.571±0.218	2.000±0.353
Total gain in height(cm) in 17th month	2.285±0.308	2.429±0.218	2.714±0.308
Total gain in height(cm) in 18th month	2.285±0.308	2.714±0.308	2.000±0.235

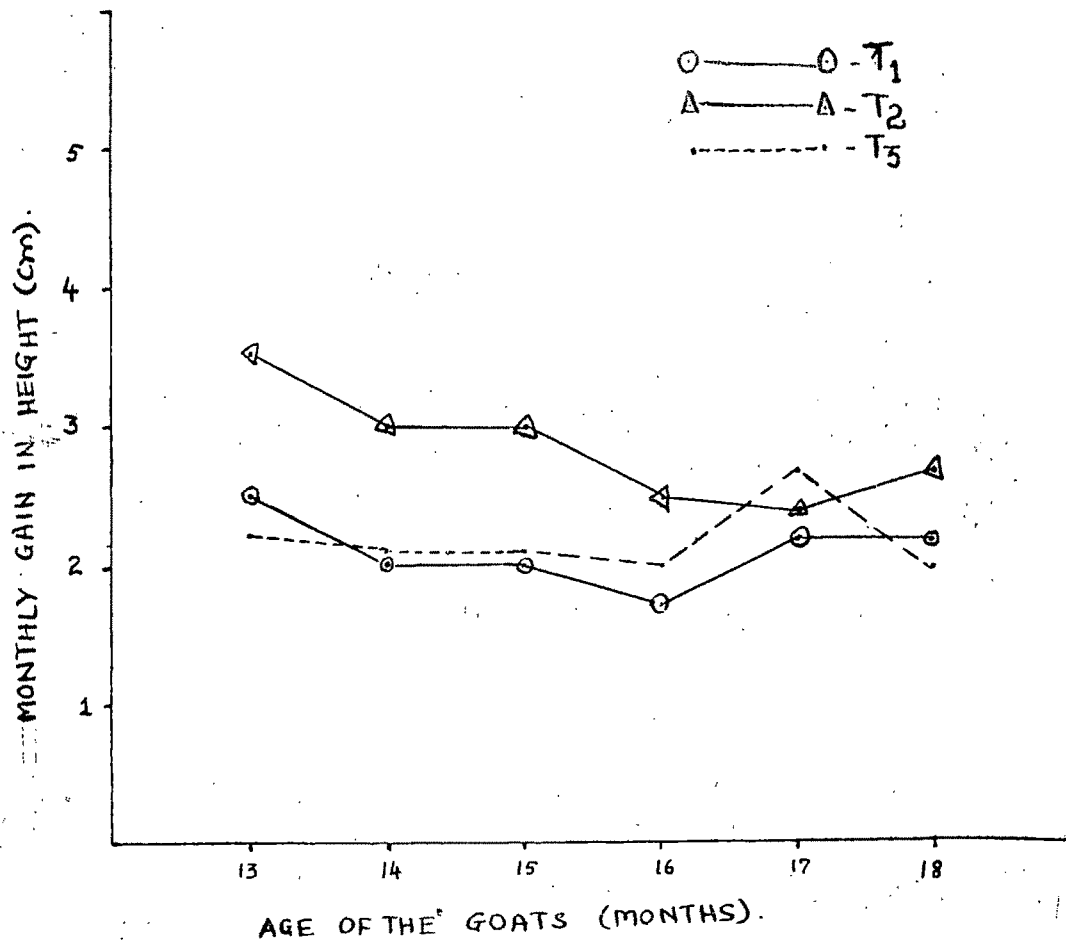


FIG-2. AVERAGE MONTHLY GAIN IN HEIGHT OF CROSSBRED GOATS

It is observed from the figures presented in Table 4 regarding the monthly gain in height at withers of experimental goats at different ages, that the goats under treatment two gained more height than treatment one and treatment three from 13th to 16th months. However, treatment three group surpassed in height gain over treatment two feed group at the age of 17th month and again it was reduced in treatment three feed group than treatment two feed group at the age of 18th month. Similarly total gain at the age of 14th, 16th, 17th and 18th months was more in treatment three feed group than treatment one feed group.

#### 4.3 Body length:

The data as regards to mean initial body length, mean final body length, mean gain in body length of experimental goats has been presented in Table 5 and for monthly gain in body length at different ages in Table 6.

It was observed from the data presented in Table 5 that the mean gain in body length of the experimental goats reared under treatment two was significantly higher than the goats reared under treatment one and treatment three. Similarly mean daily gain in body length of the goats under treatment two was found more than the goats under treatment one followed by the goats under treatment three.

Table 5: Mean initial body length, mean final body length, total mean gain in body length and mean daily gain in body length(cm) of the crossbred goats:

Treatments	Initial length (cm)	Final length (cm)	Length gain (cm)	Average daily gain in cm/ goat
T <sub>1</sub> (100% DCP)	59.857±0.367	71.714±0.368	13.428±0.740	0.074
T <sub>2</sub> (120% DCP)	59.142±0.436	75.857±0.549	16.714±0.308	0.092
T <sub>3</sub> (80% DCP)	59.142±0.549	70.571±0.617	11.428±0.617	0.063
S.E. ±			0.58	
C.D. at 5%			1.787	

Table 6: Average monthly gain in/length (cm) of crossbred goats:  
 Body

Monthwise gain	T <sub>1</sub> (100% DCP) control	T <sub>2</sub> (120% DCP)	T <sub>3</sub> (80% DCP)
Total gain in length (cm) in 13th month	2.000±0.235	3.428±0.218	1.571±0.321
Total gain in length (cm) in 14th month	2.428±0.218	2.714±0.308	1.714±0.308
Total gain in length (cm) in 15th month	1.714±0.388	2.857±0.456	1.714±0.199
Total gain in length (cm) in 16th month	2.571±0.218	2.428±0.218	2.142±0.367
Total gain in length (cm) in 17th month	1.714±0.308	2.857±0.456	2.142±0.281
Total gain in length (cm) in 18th month	1.571±0.321	2.428±0.398	2.100±0.281

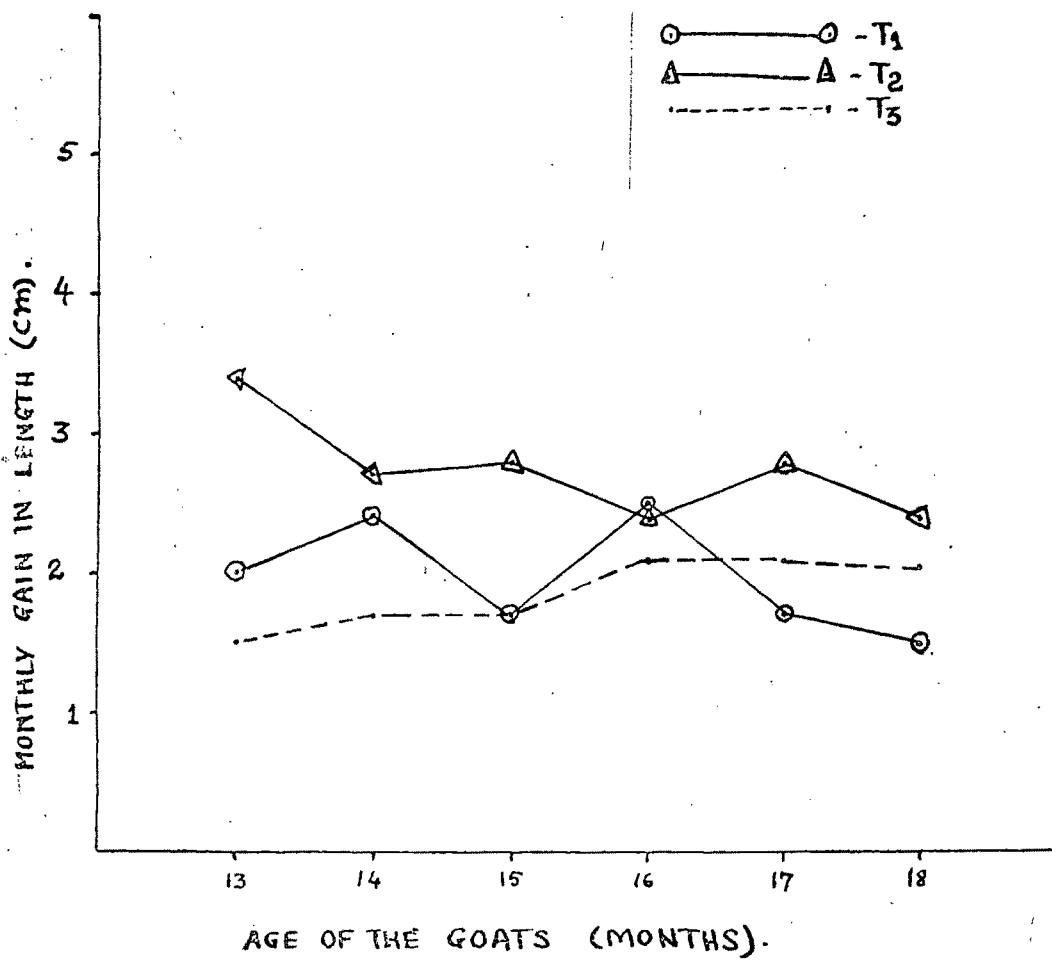


FIG. 3. AVERAGE MONTHLY GAIN IN LENGTH OF CROSSBRED GOATS.

It is revealed from the data presented in Table 6 that monthly gain in body length of experimental goats was more in treatment two at 13, 14, 15, 17 and 18th months of age than treatment one, whereas it was slightly reduced in treatment two than treatment one at the age of 16th month but again it was more in treatment two than treatment one at 17th and 18th month of age. The total monthly gain in body length of experimental goats was more in treatment two than treatment three at all age groups (13th to 18th month). The total monthly gain in body length of experimental goats under treatment one was more than treatment three at 13th and 14th months whereas, the total monthly gain was same in treatment one and three at the age of 15th month. However, it was surpassed by treatment one over treatment three at the age of 16th month and vice-versa at the age of 17th and 18th months.

#### 4.4. Chest girth:

The data as regards to the mean initial chest girth, mean final chest girth and total mean gain in chest girth <sup>average daily gain</sup> and <sup>and</sup> of experimental goats has been presented in Table 7 and for monthly gain in chest girth of goats at different ages in Table 8.

Table 7: Mean initial chest girth, mean final chest girth, total mean gain in chest girth and mean daily gain<sup>in</sup>/chest girth (cm) of crossbred goats:

Treatments	Initial chest girth (cm)	Final chest girth (cm)	Gain in Chest girth (cm)	Average daily chest girth gain/goat (cm)
T <sub>1</sub> (100% DCP)	59.142±0.723	70.142±0.761	12.714±0.308	0.070
T <sub>2</sub> (120% DCP)	59.142±0.567	74.000±0.816	16.571±0.660	0.092
T <sub>3</sub> (80% DCP)	57.285±0.454	68.285±0.454	11.285±0.511	0.062
S.E. ±			0.46	
C.D. at 5%			1.417	

Table 8: Average monthly gain in chest girth (cm) of crossbred goats:

Monthwise gain	T <sub>1</sub> (100% DCP) control	T <sub>2</sub> (120% DCP)	T <sub>3</sub> (80% DCP)
Total gain in chest girth(cm) in 13th month	1.571±0.218	2.142±0.281	1.428±0.218
Total gain in chest girth(cm) in 14th month	2.000±0.333	3.285±0.386	1.857±0.281
Total gain in chest girth(cm) in 15th month	1.857±0.281	3.142±0.367	1.714±0.308
Total gain in chest girth(cm) in 16th month	2.428±0.218	2.857±0.281	2.571±0.218
Total gain in chest girth(cm) in 17th month	1.857±0.154	2.428±0.398	2.000±0.408
Total gain in chest girth(cm) in 18th month	2.000±0.333	2.857±0.281	1.857±0.367

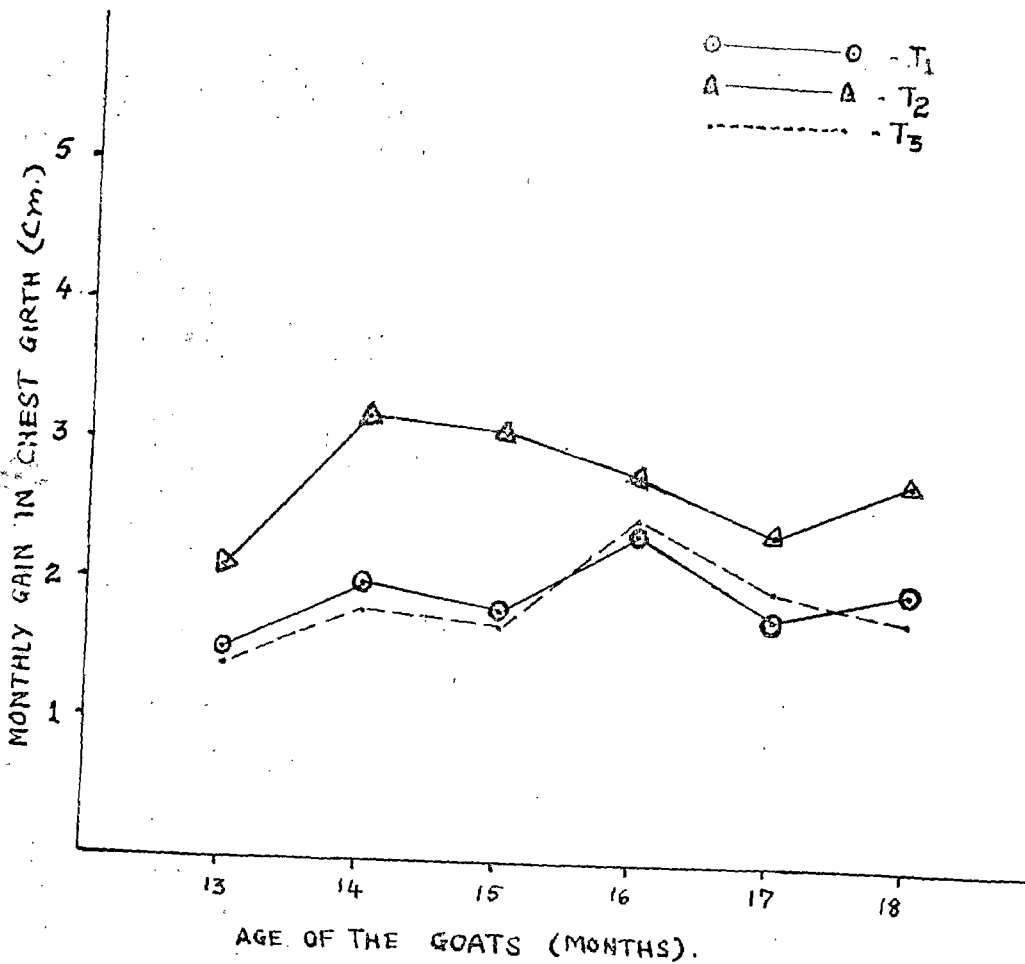


FIG. 4. AVERAGE MONTHLY GAIN IN CHEST GIRTH OF CROSSBRED GOATS.

It is revealed from Table 7 that the mean gain in chest girth of the goats under treatment two (120 per cent DCP) is significantly more than the goats under treatment one (100 per cent DCP) followed by the goats under treatment three (80 per cent DCP). Same trend was observed for the average daily gain in chest girth of experimental goats.

The data in Table 8 shows that the goats under treatment two (120 per cent DCP) were having more monthly gain in chest girth than the goats under treatment one and three at all ages i.e. from 13th to 18th months of age. The goats under treatment one were having more monthly gain in chest girth than the goats under treatment three at the age of 13th, 14th and 15th months. However the goats under treatment three were having more monthly gain in chest girth than goats under treatment one at the age of 16th and 17th months, whereas, it was again more in treatment one than treatment three at the age of 18th month

#### 4.5 Belly girth:

In order to assess the treatment effects on gain in belly girth of the experimental goats the data was subjected to statistical analysis and presented in Tables 9 and 10.

Table 9: Mean initial belly girth, mean final belly girth, total mean gain in belly girth and daily mean gain in belly girth(cm) of crossbred goats:

Treatments	Initial belly girth (cm)	Final belly girth (cm)	Belly girth gain (cm)	Average daily belly girth gain (cm)
T <sub>1</sub> (100% DCP)	75.428±0.519	86.857±0.642	14.285±0.610	0.079
T <sub>2</sub> (120% DCP)	71.714±0.454	89.714±0.454	17.428±0.701	0.096
T <sub>3</sub> (80% DCP)	70.571±0.218	83.857±0.367	13.714±0.454	0.070
S.E. ±			0.54	
C.D. at 5%			1.663	

Table 10: Average monthly gain in belly girth (cm) of crossbred goats:

Monthwise gain	T <sub>1</sub> (100% DCP) control	T <sub>2</sub> (120% DCP)	T <sub>3</sub> (80% DCP)
Total gain in belly girth (cm) in 13th month	2.142±0.281	3.420±0.218	2.285±0.308
Total gain in belly girth (cm) in 14th month	2.571±0.321	3.428±0.462	1.714±0.308
Total gain in belly girth (cm) in 15th month	2.428±0.218	3.142±0.281	2.857±0.281
Total gain in belly girth (cm) in 16th month	2.571±0.321	2.857±0.436	1.857±0.281
Total gain in belly girth (cm) in 17th month	2.142±0.281	2.571±0.218	2.571±0.321
Total gain in belly girth (cm) in 18th month	1.714±0.199	2.142±0.496	2.000±0.255

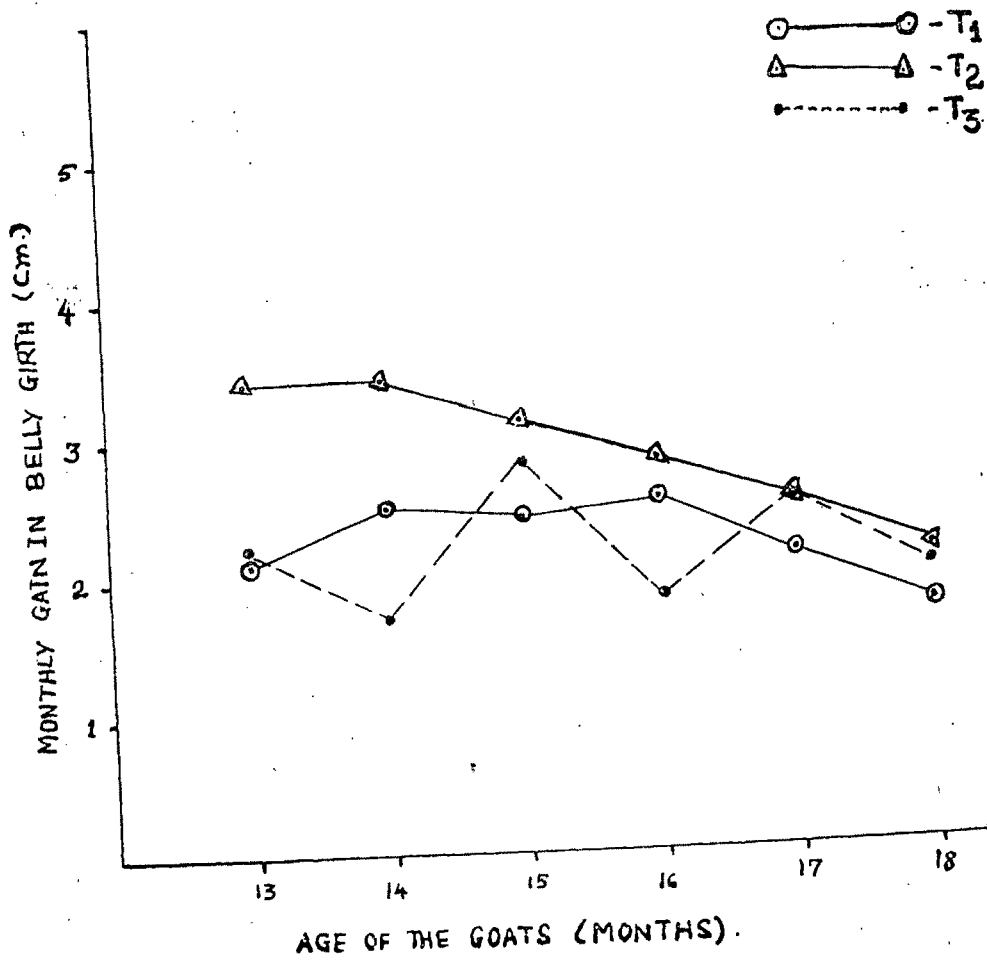


FIG.5. AVERAGE MONTHLY GAIN IN BELLY GIRTH OF CROSSBRED GOATS.

It is observed from Table 9 that mean gain in belly girth of the crossbred experimental goats was significantly more in treatment two (120 per cent DCP) than in treatment one (100 per cent DCP) and treatment three (80 per cent DCP). The same trend was observed for the average daily gain in belly girth. However, the mean gain in belly girth and average daily gain in belly girth of the goats under treatment one and treatment three were at par.

The Table 10 revealed the fact that monthly gain in belly girth of the experimental goats was more in treatment two (120 per cent DCP) than the goats under treatment one and treatment three at all ages. Average monthly gain in belly girth was more in treatment three than treatment one at the age of 13th, 15th, 17th and 18th months. Whereas, it was observed more in treatment one than treatment three at the age of 14th and 16th month age.

#### 4.6 Dry matter and digestible crude protein intake:

In order to assess the intake of dry matter and digestible crude protein the data as regards to the intake of DM and DCP in crossbred goats in each treatment was computed on the basis of the standard weight gain of 1 kg, presented in Table 11.

Table 11: Total dry matter consumed, total DCP consumed, total gain in weight, dry matter intake and DCP intake per kg gain and dry matter intake per 100 kg body weight:

Treatment	Total DM consumed (kg)	Total DCP consumed (kg)	Total gain (kg)	DM intake per kg gain (kg)	DCP intake per kg gain (kg)	DM intake per 100 kg body weight (kg)
T <sub>1</sub> (100% DCP)	2368.12	104.665	47.40	49.96	2.208	6.631
T <sub>2</sub> (120% DCP)	2417.55	123.165	63.90	57.83	1.927	6.619
T <sub>3</sub> (80% DCP)	2334.69	85.251	30.00	59.86	2.165	7.092

Table 11 shows data on total consumption of DM, DCP, total gain in body weight, DM and DCP requirements per kg body weight gain and DM requirement for 100 kg body weight. It is observed from the Table that total DM and DCP intake was more in treatment two than treatment one followed by treatment three. DM requirement per kg body weight gain was higher in treatment three followed by treatment one and treatment two respectively.

As regard to the intake of digestible crude protein, the goats under treatment two required less amount of DCP per kg body weight gain. The treatment three required more DCP than treatment two. Treatment one has also shown slightly higher intake of DCP per kg gain in body weight than treatment two. The DM requirement per 100 kg body weight was more in treatment three (80 per cent DCP) 7.092 per cent followed by treatment one (100 per cent DCP) 6.631 per cent and treatment two (120 per cent DCP) 6.611 per cent.

#### 4.7 Digestibility trial:

The digestibility trial was conducted for a period of seven days at the end of experiment. The data obtained during the digestibility trial was analysed and the results are shown in Tables 12 and 13.

Table 12: Average daily dry matter, digestible crude protein, total digestible nutrients and water intake of crossbred goats:

Treatments	DM (kg)	DCP (g)	TDN (kg)	Water (ml)
T <sub>1</sub> (100% DCP)	1.946	83.07	1.310	885
T <sub>2</sub> (120% DCP)	2.051	97.75	1.376	955
T <sub>3</sub> (80% DCP)	1.900	67.66	1.260	865
S.E. ±	0.005	0.860	0.006	12.582
C.D. at 5%	0.026	3.872	0.028	56.614

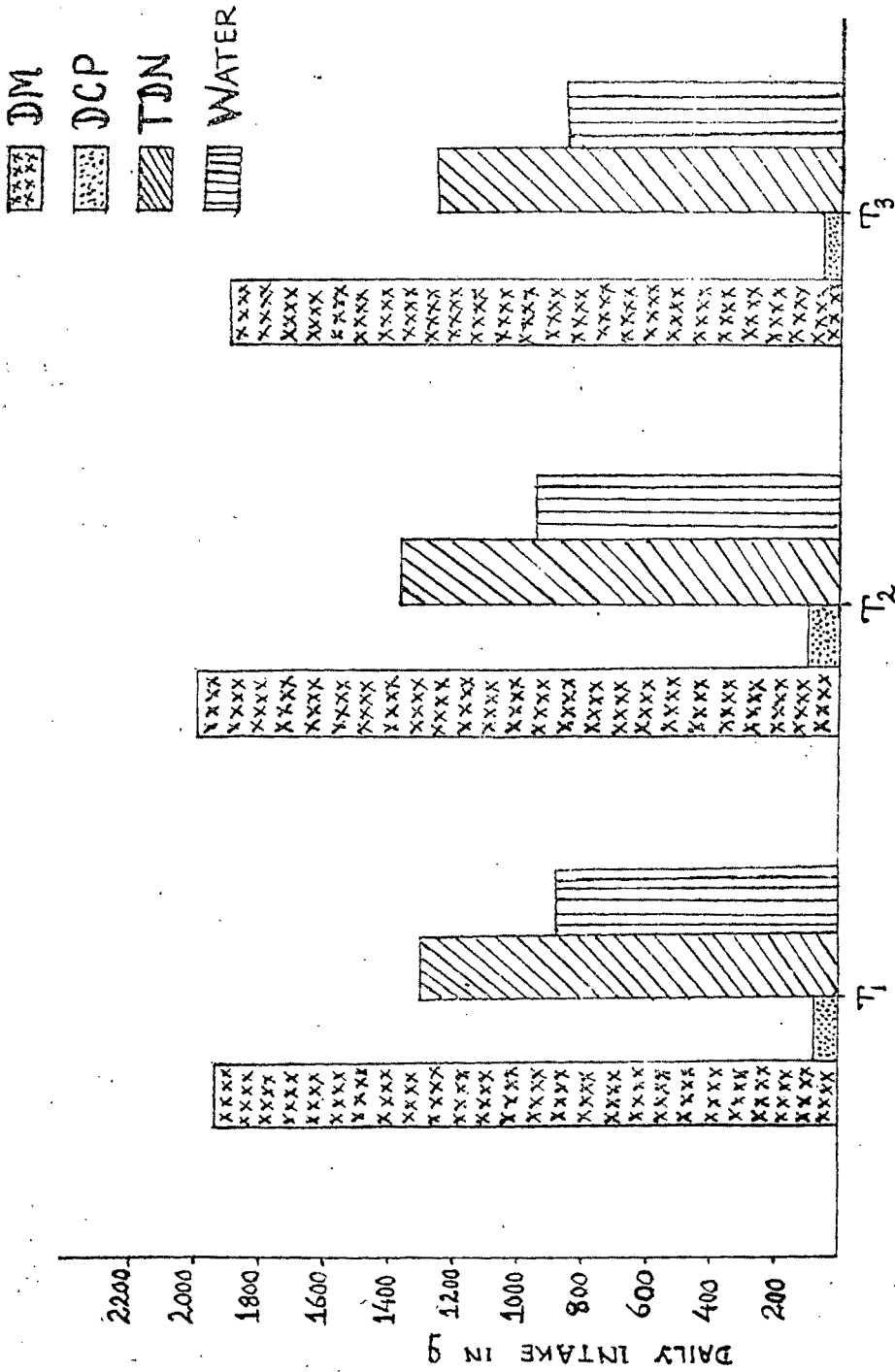


FIG. 6. AVERAGE DAILY DM, DCP, TDN AND WATER INTAKE.

Table 13: Digestibility coefficient of various feed nutrients of crossbred goats:

Treatments	DM	CP	EE	CF	NFE
T <sub>1</sub> (100% DCP)	71.945	71.125	46.91	65.325	79.530
T <sub>2</sub> (120% DCP)	72.450	70.150	46.75	65.265	79.320
T <sub>3</sub> (80% DCP)	71.595	72.915	48.16	64.255	78.715
S.E. ±	0.390	0.067	0.680	0.474	0.158
C.D. at 5%		0.304			

It is observed from the Table 12 that there was significantly higher requirement of DM, DCP, TDN and water for the goats under treatment two (120 per cent DCP) than the goats under treatment one (100 per cent DCP) followed by treatment three (80 per cent DCP).

Table 13 represents digestibility coefficient of various feed nutrients obtained actually after the completion of digestibility trial on experimental goats. It is observed from this table that the goats under treatment two has more digestibility of DM than goats under treatment one and treatment three. However, the differences are non-significant. The digestibility of crude protein was significantly higher in treatment three followed by treatment one and treatment two respectively. The goats under treatment one showed slightly higher digestibility of CP, EE and NFE than the goats under treatment two followed by the goats under treatment three. However, the differences are non-significant.

#### 4.8 Economics of feeding:

In order to findout the rearing of goats under stallfeeding condition under different feeding regimes the economics of feeding was worked out. The cost of feed was computed and presented in Table 14.

Table 14: Cost of feed per kg body weight gain and feed cost per day per goat of crossbred goats :

Treatments	Quantity of feeds			Total cost of feeds (Rs)	Cost of feed / goat day (Rs)	Total body weight gain (kg)	Cost of feed/kg body weight gain (Rs)
	Nilwa Jowar kadbi (kg)	Lucerne (green) (kg)	Concentrates (GNC) (kg)				
T <sub>1</sub> (100% DCP)	2180.62	1390.43	120.83	325.95	0.65	47.4	17.42
T <sub>2</sub> (120% DCP)	2155.65	1656.56	137.08	385.53	0.70	63.9	13.65
T <sub>3</sub> (80% DCP)	2245.08	1033.20	92.00	749.49	0.59	59.0	19.21

Rate of feeds:

- 1) Groundnut cake                   Rs 150/quintal
- 2) Kadbi (dry)                       Rs 20/quintal
- 3) Lucerne (green)                 Rs 15/quintal

It is observed from Table 14 that total cost of feed was more in case of treatment two where 120 per cent DCP was given to the goats than treatment one (100 per cent DCP) followed by treatment three (80 per cent DCP).

The cost required per kg gain in body weight was Rs 17.42, Rs 13.85 and Rs 19.21 in treatment one, two and three respectively. The cost per kg body weight gain is lowest in  $T_2$  followed by  $T_1$  and  $T_3$  respectively. The cost of feed required per day per goat was Rs 0.65, Rs 0.70 and Rs 0.59 in treatment one, two and three respectively.

5. DISCUSSION

## 5. DISCUSSION

The animals are in competition with human beings for food. Goats are one of the animals which can eat varieties of feeds and grains. Very little concentration is given towards the feeding of goats. Mostly this species is being reared by the poorer class of the society from which it takes its name as 'Poor man's cow'. It is necessary to know the nutritional requirements of goats of different ages. Supply of balanced feed is an important factor in achieving the more profit from the animals. Therefore, an attempt has been made to find out the nutritional requirement of goats from the age of 12<sup>th</sup>/<sub>to</sub>18<sup>th</sup> months to get optimum level of growth without any adverse effect on the health under different three feeding regime. The research finding obtained from the present investigation have been presented in previous chapter. In this chapter an attempt has been made to discuss the results broadly.

### 5.1 Body weights

The data presented in Tables 1 and 2 is related to body weight and body weight gains at different age groups. It is revealed from this table that maximum growth of crossbred goats was obtained in treatment two wherein goats were fed with 20 per cent more DCP than

the recommended levels of protein. This is because of the fact that the goats under treatment two received 20 per cent more digestible crude protein than the goats under treatment one. The gain in body weight was less in treatment three because of the fact that these goats received 20 per cent less digestible crude protein than the goats under treatment one. It is clear from this fact that higher level of protein was responsible for giving maximum gain in body weights. The differences in gains of body weights under different treatments were significantly higher. The requirement of DCP for kids was higher in an experiment reported by Majumdar (1960b) and also by Deshmukh (1979). The same trend of growth rate was also observed due to the effect of different protein levels by Nawale (1979). The trend of growth is also in agreement as reported by Singh and Singh (1974), and by Mishra and Chawala (1975). The trend of growth rate is also supported by the findings of the research workers at Cyprus Agricultural University (1973). The trend of slow growth rate obtained by Lindhal (1972) and Ali et al. (1973) is also supporting the present findings.

#### 5.2 Height at wither:

It is revealed from the Tables 3 and 4 that height at withers of the crossbred goats was more in treatment

two (20 per cent more DCP than recommended) than in treatment one (recommended DCP) and treatment three (20 per cent less DCP). However, the differences in height were at par in treatment one (recommended DCP) and treatment three (20 per cent less DCP).

It means that the higher protein level than the recommended has its effects for higher gain in height at withers, whereas lower protein level has not shown any ill effect on height when compared to the recommended level of protein in treatment one. The slight variation was observed in total monthly gain. The same trend was observed by Deehmukh (1979) in crossbred kids at different ages.

### 5.3 Body length:

The data presented in Tables 5 and 6 showed that gain in body length was significantly more in the goats reared under treatment two (20 per cent more DCP) than the goats reared under treatment one (recommended level of DCP) followed by the goats reared under treatment three (20 per cent less DCP). Similar trend for monthly gain in body length was observed. It is clear from this fact that higher protein level has direct effect on gain in body length of the goats. The results of the present

investigation are in agreement with the findings of Deshmukh (1979) and Nawale (1979).

#### 5.4 Chest girth:

The data presented in Tables 7 and 8 represents the chest girth gain and monthly gain in chest girth of experimental crossbred goats at different ages. The chest girth gain was observed more ( $16.57 \pm 0.666$  cm) in the goats under treatment two (20 per cent more DCP); followed by treatment one ( $12.714 \pm 0.308$  cm recommended level of DCP) and treatment three ( $11.286 \pm 0.511$  cm; 20 per cent less DCP). These figures are indicative of the effect of different protein levels. The results clearly indicate that the amount of higher protein played a vital role in the development of muscular tissues of the goats which resulted in higher chest girth gain at higher levels of protein. Higher the body weight more will be the chest girth; as it has been reported by Pawar et al. (1980) the positive correlation between body weight and chest girth in Osmanabadi goats. The trend of chest girth gain observed by Deshmukh (1979) in crossbred kids and by Nawale (1979) in Osmanabadi kids was also in agreement with the findings.

#### 5.5 Belly girth:

It is observed from the Tables 9 and 10 that the average total gain in belly girth was  $14.285 \pm 0.610$  cm,

17.428  $\pm$  0.701 cm and 12.714  $\pm$  0.454 cm in the goats under treatment one, two and three respectively. The gain in belly girth was significantly higher in treatment two (20 per cent more DCP) than treatment one (recommended DCP) and treatment three (20 per cent less DCP). For this parameter also higher protein level has played its role for increased gain, whereas lower level of protein (20 per cent less DCP) has not shown any effect on the gain in belly girth than recommended level of protein in treatment one.

## 5.6 Dry matter and protein intake:

### 5.6.1 Dry matter intake:

It is revealed from the Table 11 that total dry matter intake was 2368.120 kg, 2417.534 kg and 2334.694 kg in treatment one, two and three respectively. The corresponding figures for dry matter requirement per kg body weight gain were 49.96 kg, 37.83 kg and 59.86 kg respectively. The dry matter intake per kg gain in body weight was more in treatment three followed by treatment one and treatment two. This might be due to the fact that goats under treatment three gained less body weight (39.0 kg) which has affected on direct increase in dry matter intake for per kg gain in body weight. On the other hand, the goats under treatment two and treatment one

gained more body weights (65.9 kg and 47.4 kg respectively) which resulted in giving less dry matter intake per kg gain in body weight. From this, it is clear that higher the gain lower will be the dry matter intake if protein level is maintained higher. These findings are in agreement with the results obtained by Deshmukh (1979) and Nawale (1979).

#### 5.6.2 Digestible crude protein:

The total intake of DCP was more (123.165 kg) in treatment two than treatment one (104.668 kg) and treatment three (85.251 kg). The DCP requirement per kg gain in body weight was 2.208, 1.927 and 2.185 kg in treatment one, two and three respectively. This is because of the fact that goats under treatment three actually received less DCP (20 per cent less) which has affected on less gain in body weight. In treatment two the DCP intake per kg gain was less because the goats gained more body weight under this treatment and in treatment one goats required more DCP for per kg gain in body weight where DCP was given as per the recommended levels of protein.

Table 12 shows actual requirement of DCP and TDN per day for the goats. The goats under treatment two required significantly higher DCP (97.7 g) than treatment

one (82.0 g) and treatment three (67.66 g). The daily DM requirement was observed more in treatment two (2.05kg) than treatment one (1.946 kg) and treatment three (1.900 kg). The goats under treatment two also required more water per day (955 ml) than treatment one (885 ml) and treatment three (865 ml). The maintenance requirement of DCP was more in treatment two because these goats were fed with 20 per cent more DCP level than treatment one. Higher intake of protein and DM per day has affected intake of water also. The results obtained are in agreement with the results of Akinsoyinu et al. (1976), Senger (1978) and Singhal and Mudgal (1979). The same trend was observed by Dashmukh (1979) and Nawale (1979). DM intake and DCP intake per kg gain of body weight was observed higher during this investigation; when compared with the results of other research workers. This is because of the fact that the goats selected for the experiment were of one year age. After the maturity age the growth rate retards. Due to this, the total gain in growth rate from 12 to 18th month of age was less, but actually the goats under experiment consumed more DM and DCP. This has resulted in giving the higher figures of DM and DCP intake per kg gain. The DM requirement for per 100 kg body weight was observed as 6.651 kg, 6.619 kg and 7.092 kg respectively in treatments one, two

and three. The results are in agreement with the findings of Brannon (1966), Rindsing (1977) and Mishra et al. (1978).

### 5.6.3 Digestibility coefficient of various feed nutrient:

Table 13 represents the digestibility coefficient of various feed nutrients obtained after the digestibility trial. Though the goats under treatment two has shown the slightly higher digestibility of DM than the goats under treatment one and three, but differences are non-significant. Similarly the digestibility coefficient of CP, EE and NFE were also non-significant in all the treatments. However, the goats under treatment three (20 per cent less DCP) have digested more protein than the goats under treatment one (recommended DCP) and treatment two (20 per cent more DCP). This is because of the fact that there was a better utilization of protein in treatment three where the goats were supplied 20 per cent less protein than the recommended protein level. On the other hand, the digestibility of protein was significantly less in treatment two where the goats were supplied 20 per cent more protein. This has affected on lower utilization of protein. This trend of utilization of protein is in agreement with the findings of Stobo (1973). Digestibility coefficient observed during this investigation for DM, CP, EE, CF

and NFE are also in agreement with the findings of Upadhyay et al. (1974).

#### 5.7 Economics for feeding:

From Table 14 it was observed that total cost required was more in treatment two (Rs 885.53) followed by treatment one (Rs 825.95) and in treatment three (Rs 749.49). The cost of feed per kg gain in body weight was less in treatment two (Rs 13.85) than treatment one (Rs 17.42) and treatment three (Rs 19.21). Total cost was more because of the fact that, in treatment two goats received more concentrates increasing its cost, and in treatment three less concentrates decreasing its cost. There is very minor difference in the cost of feed required per day per goat in all the treatments. It means if higher DCP is given it will not affect significantly more on per day feeding cost of the goats. Findings are in agreement with the findings of Deshmukh (1979) and Nawale (1979).

6. SUMMARY AND CONCLUSION

## 6. SUMMARY AND CONCLUSIONS

### Summary:

With the object of studying the growth rate of crossbred (Saanen x Osmanabadi) goats under different levels of protein, the present investigation was undertaken.

Twenty one crossbred goats (Saanen x Osmanabadi) of 12 months age were selected for study, from the flock of Goat Research Project, Marathwada Agricultural University, Parbhani. They were divided into three groups randomly 7 goats in each group having 3 male and 4 females, with non-significant differences in initial body weights of each group. They were fed at three levels of protein i.e.  $T_1$  100 per cent DCP as per the recommended level by N.R.C. (1966) mentioned by S.K. Ranjhan in his book "Animal Nutrition and Feeding Practices in India",  $T_2$  20 per cent more DCP than recommended level and  $T_3$  20 per cent less DCP than recommended level. The experiment lasted for 6 months when goats were of 18 months of age. The results obtained are summarised below.

- 1) The mean initial body weights of experimental goats were  $19.285 \pm 0.680$ ,  $19.242 \pm 0.594$  and  $19.242 \pm 0.554$  kg in  $T_1$ ,  $T_2$  and  $T_3$  respectively.

- 2) The mean total gain in body weight was  $6.771 \pm 523$ ,  $9.128 \pm 0.716$  and  $5.571 \pm 0.376$  kg in  $T_1$ ,  $T_2$  and  $T_3$  groups respectively.
- 3) The average daily gain in body weight was  $19.518 \pm 3.184$ ,  $43.331 \pm 9.023$ ,  $44.262 \pm 7.629$ ,  $33.748 \pm 9.369$ ,  $45.711 \pm 4.354$  and  $39.044 \pm 2.905$  g at 13, 14, 15, 16, 17 and 18th months respectively in treatment one. The corresponding values for treatment two and three were  $23.330 \pm 5.092$ ,  $61.910 \pm 4.898$ ,  $58.185 \pm 7.633$ ,  $55.327 \pm 4.618$ ,  $54.284 \pm 5.426$  and  $51.424 \pm 5.143$  g/day and  $14.758 \pm 1.900$ ,  $35.710 \pm 2.909$ ,  $36.187 \pm 2.984$ ,  $29.518 \pm 2.412$ ,  $36.664 \pm 1.924$  and  $32.854 \pm 1.830$  g/day respectively.
- 4) The mean total gain in height was  $12.857 \pm 1.556$ ,  $17.571 \pm 0.570$  and  $11.714 \pm 0.388$  cm for  $T_1$ ,  $T_2$  and  $T_3$  respectively.
- 5) The mean total gain in length was  $13.428 \pm 0.740$ ,  $16.714 \pm 0.308$  and  $11.428 \pm 0.617$  cm respectively for  $T_1$ ,  $T_2$  and  $T_3$ .
- 6) The mean total gain in chest girth was  $12.714 \pm 0.308$ ,  $16.571 \pm 0.660$  and  $11.285 \pm 0.511$  cm for  $T_1$ ,  $T_2$  and  $T_3$  respectively.
- 7) The mean total gain in belly girth was  $14.285 \pm 0.610$ ,  $17.428 \pm 0.701$  and  $12.714 \pm 0.454$  cm

respectively for  $T_1$ ,  $T_2$  and  $T_3$ .

- 8) The DM intake per kg gain in body weight was 49.96, 37.83 and 59.86 kg in  $T_1$ ,  $T_2$  and  $T_3$  respectively.
- 9) The DCP intake per kg gain in body weight was 2.208, 1.927 and 2.185 kg respectively for  $T_1$ ,  $T_2$  and  $T_3$ .
- 10) The DM requirement per 100 kg body weight was 6.631, 6.619 and 7.092 kg in  $T_1$ ,  $T_2$  and  $T_3$  respectively.
- 11) The average daily DM, DCP, TDM and water intake of goat was 1.946 kg, 83.07 g, 1.310 kg and 885.00 ml respectively in treatment one. The corresponding values for treatment two and three were 2.057 kg, 97.75 g, 1.377 kg and 955.00 ml/day and 1.900 kg, 67.66 g, 1.261 kg and 865 ml/day respectively.
- 12) The digestibility coefficient observed were 71.946, 71.125, 46.91, 65.325 and 79.530 for DM, CP, EE, CP and NFE respectively in treatment one. The corresponding values for treatment two and three were 72.450, 70.150, 46.25, 65.265 and 79.320, and 71.595, 72.915, 48.16, 64.255 and 78.715 respectively.

- 13) The cost of feed per kg gain body weight was Rs 17.42, 13.85 and 19.21 respectively for  $T_1$ ,  $T_2$  and  $T_3$ .
- 14) The cost of feed per day per goat was Rs 0.65, 0.70 and 0.59 respectively for  $T_1$ ,  $T_2$  and  $T_3$ .
- 15) In all the treatments, all the body weights gains and linear body measurements were found more in  $T_2$  followed by  $T_1$  and  $T_3$  respectively.

Conclusion:

The results obtained in present investigation indicated clearly that if crossbred goats are fed with higher level of protein (above recommended level) gains in growth rate was superior than the recommended level of protein. There was a better feed conversion efficiency and better utilization of digestible crude protein. The goats reared on 20 per cent less DCP (below recommended level) gained less, showing more requirement of DCP. The growth rate was medium for the goats reared on recommended level of protein. As the goats under experiment were of one year age, the total gain in all treatments was considerably low. However, the goats under treatment two were superior to treatment one and three.

This has shown that the higher amount of protein is required for the goats after maturity age also for their maintenance. The DM consumption per 100 kg body weight ranged between 6 to 7 per cent which shows that crossbred goats consume more DM also at the age of 12 to 18 months.

The differences in cost of feed required per day per goat are not too much in all the treatments, which indicates that the crossbred goats can be reared cheaply under stallfed condition with a minimum expenditure of 60 to 70 paise per day per goat.

Therefore, the present findings may be considered as indicative of the fact that particular dietary level of protein (in this case 20 per cent more than the recommended level of protein) prove more economical for crossbred goats. This may result in better production and more profit from the crossbred goats in the form of milk and meat.

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### LITERATURE CITED

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APPENDICES

APPENDIX I

S.K. Banjhan in his book "Animal nutritional feeding practices in Indian recommended following schedule for feeding goats at different body weight which is given below.

Nutritional requirement % or per kg feeds						
Body wt. (kg)	Air dry feeds	D.C.P. (%)	T.D.N. (%)	Calcium (%)	Phosphorus (%)	Contente (mg)
5	0.20	12	70	0.25	0.21	1.0
10	0.45	10	56	0.23	0.21	1.0
15	0.60	7	65	0.21	0.20	1.0
20	0.80	6	60	0.20	0.19	1.0
25	1.00	5.5	60	0.20	0.19	1.0
<u>(A) Small breeds (slaughters 20-25 kg)</u>						
<u>(B) Large breeds slaughter 30-35 kg up to)</u>						
10	0.40	12	70	0.23	0.21	1.0
15	0.68	10	65	0.21	0.20	1.0
20	0.88	7	65	0.20	0.19	1.0
25	1.10	6	60	0.20	0.19	1.0
30	1.29	5.5	60	0.19	0.18	1.0
35	1.40	5.0	55	0.19	0.18	1.0

### APPENDIX II

#### Analysis of variance for body weight gain

Sources of variation	d.f.	S.S.	M.S.S.	Cal. 'F'	't' value	
					5%	1%
Within group	6	27.85				
Between group	2	45.85	22.92	48.87**	3.88	6.93
Error	12	5.61	0.47			

S.E.  $\pm$  0.26      \*\* = Highly significant  
C.D. at 5% 0.801

### APPENDIX III

#### Analysis of variance for body height gain

Sources of variation	d.f.	S.S.	M.S.S.	Cal. 'F'	't' value	
					5%	1%
Within group	6	12.28				
Between group	2	134.95	67.48	41.15**	3.88	6.93
Error	12	19.72	1.64			

S.E.  $\pm$  0.48      \*\* = Highly significant.  
C.D. at 5% 1.478

APPENDIX IV

Analysis of variance for body length gain

Sources of variation	d.f.	S.S.	M.S.S.	Cal.'F'	't' value	
					5%	1%
Within group	6	7.9				
Between group	2	99.79	49.89	20.7**	3.88	6.93
Error	12	28.96	2.41			

S.E.  $\pm$  0.58

\*\* = Highly significant.

C.D.at 5% 1.787

APPENDIX V

Analysis of variance for body chest girth gain

Sources of variation	d.f.	S.S.	M.S.S.	Cal.'F'	't' value	
					5%	1%
Within group	6	10.57				
Between group	2	104.66	52.33	34.89**	3.88	6.93
Error	12	18.01	1.5			

S.E.  $\pm$  0.46

\*\* = Highly significant.

C.D.at 5% 1.417

### APPENDIX VI

Analysis of variance for body belly girth gain

Sources of variation	d.f.	S.S.	M.S.S.	Cal. 'F'	't' value	
					5%	1%
Within group	6	13.24				
Between group	2	80.66	40.33	19.11**	3.88	6.93
Error	12	25.34	2.11			

S.E.  $\pm$  0.54

C.D. at 5% 1.663

\*\* Highly significant

### APPENDIX VII

Percentage chemical composition of faeces

Treatments	DM	CP	EE	CF	NFE	Ash
T <sub>1</sub>	46.49	6.19	4.15	42.22	35.27	12.19
T <sub>2</sub>	47.51	7.31	4.40	42.27	35.69	10.30
T <sub>3</sub>	46.87	4.59	3.71	42.56	36.22	12.82

APPENDIX VIII

Analysis of variance for daily intake of nutrients

Sources of variation	d.f.	S.S.	M.S.S.	Cal. 'F'	't' value	
					5%	1%
<u>DM</u>						
Between group	2	0.024133	0.0120665	180.097**	9.55	30.81
Error	3	0.000201	0.000067			
S.E. ±		0.0057				
C.D. at 5%		0.0260				
<u>DCP</u>						
Between group	2	905.591	452.795	305.736**	9.55	30.81
Error	3	4.443	1.481			
S.E. ±		0.660				
C.D. at 5%		3.872				
<u>FDN</u>						
Between group	2	0.01442	0.00721	90.125**	9.55	30.81
Error	3	0.00024	0.00008			
S.E. ±		0.0063				
C.D. at 5%		0.0284				
<u>Water</u>						
Between group	2	8933.4	4466.7	14.105*	9.55	30.81
Error	3	950.0	316.66			
S.E. ±		12.582				
C.D. at 5%		56.614				

\*\* = Highly significant.  
\* = Significant.

APPENDIX IX

Analysis of variance for digestibility coefficient

Sources of variation	d.f.	S.S.	M.S.S.	Cal. 'F'	't' value	
					5%	1%
<u>DM</u>						
Between group	2	0.739	0.3695	1.210 N.S.	9.55	30.81
Error	3	0.916	0.3053			
S.E. ±	0.390					
<u>CP</u>						
Between group	2	7.866	3.933	437.00**	9.55	30.81
Error	3	0.027	0.009			
S.E. ±	0.067					
C.D. at 5%	0.304					
<u>EE</u>						
Between group	2	2.374	1.187	1.263 N.S.	9.55	30.81
Error	3	2.777	0.925			
S.E. ±	0.680					
<u>CF</u>						
Between group	2	1.446	0.723	1.603 N.S.	9.55	30.81
Error	3	1.353	0.451			
S.E. ±	0.474					
<u>HEE</u>						
Between group	2	0.717	0.358	7.306 N.S.	9.55	30.81
Error	3	0.148	0.049			
S.E. ±	0.158					

N.S. = Non-significant.    \*\* = Highly significant.