"IN VIVO" STUDIES ON THE EFFECT OF FEEDING FORMALDEHYDE TREATED LINSEED CAKE ON GROWTH IN DESHI GOATS

Thesis

Submitted to the Faculty of Veterinary Science
And Animal Husbandry.

Rajendra Agricultural University, Bihar

IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE
(Animal Husbandry)
IN
ANIMAL NUTRITION

BY

Anand Kishore Prasad
B. V. Sc. & A. H.
JUNIOR RESEARCH FELLOW (R. A. U.)
POST GRADUATE DEPARTMENT OF
ANIMAL NUTRITION
BIHAR VETERINARY COLLEGE
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Dated, the 20. 1. 1976.

This is to certify that the work embodied in this Thesis entitled " 'IN VIVO' STUDIES ON THE EFFECT OF FEEDING FORMALDEHYDE TREATED LINSEED CAKE ON GROWTH IN DESHI GOATS" is the bonafide work of Anand Kishore Prasad and was carried out under my guidance and supervision.

N. K. Prasad.

(N.K. PRASAD).

C E R T I F I C A T E

Certified that the research work incorporated in this Thesis have not been published in part or in full in any other journal.

A K Prasad

(A. K. PRASAD).

DEDICATED

TO

MY

PARENT

WHOSE AFFECTION, SACRIFICES,

AND CONSTANT ENCOURAGEMENT

ARE RESPONSIBLE FOR EVERY

ACCOMPLISHMENT OF MY

LIFE

The author is extremely grateful to the Vice Chancellor, Rajendra Agricultural University, Bihar for the award of Junior Fellowship in Animal Nutrition in shape of financial assistance for undertaking this project.

(A.K. PRASAD).

A C K N O W L E D G E M E N T

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and Dr. Nirmal Chandra Sinha, M.Sc. (A.H.), Ex-Junior Assistant Research Officer, Physiology, Bihar Veterinary College, Patna, for his constant encouragement and invaluable advice throughout the work.

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A K Prasad

(ANAND KISHORE PRASAD).

C O N T E N T S

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INTRODUCTION

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Livestock and its products constitute a major portion in nation's economy. Its contribution is estimated to be over Rs. 30,000 million which is exclusive of an estimated Rs. 4,000 millions contributed indirectly.

The last Census was taken in 1966, according to which the livestock population (excluding poultry) was 343.7 million registering a 2.2% rise over 1961 figure of 336.4 million.

The edible livestock products like, milk, milk products and meat are very valuable items of human diet. Non-edible products like hides, skins, wool, dung, bones, horns and hooves also have considerable monetary value.

Although India possesses 15.47% and 43.49% of world's cattle and buffaloes population respectively but the milk production is far from satisfactory. This is mainly because of low genetic potential of our cattle as well as acute shortage of feeds and fodder. In our country there is a wide gap between demand and availability of proper nutrients to animals.

The price of concentrates is going up day by day and as such they are becoming beyond the reach of average farmers. Our country is short of concentrates and roughages to the extent of 80 and 40 per cent, which account for 77 %

shortage of digestible crude protein and 62% shortage of starch equivalent according to various estimates (Kehar, 1953; Amble et al, 1965; Whyte and Mathur, 1965). The malnutrition is thus responsible for slow rate of growth, late maturity, low milk yield and long dry period (Whyte, 1964).

Due to such an acute shortage of concentrates majority of our cattle have to depend on poor quality roughages which have very low nutritional value.

The economy of profitable rearing and breeding of livestock depends upon the minimal investments with maximum profits spread over long periods. Deficiency of dietary protein reduces formation of muscle tissue and growth of internal organs, as protein is their principal constituents.

The economical feeding of livestock is directly related to the judicious incorporation of nitrogeneous feeds in diets and its efficient utilisation.

So, it is an important problemfor research workers to explore the possibilities of efficient utilisation of nutrients by some means. Now a days, cross breeding programme to improve the genetic potential of our livestock has been vigorously launched. Cross breeding holds promise for improving the milk yield of the Indian cows. It has given very encouraging results for increasing milk production. Because of this the requirement of feeds and fodder for cross breds will keep on increasing day by day. Therefore, vigorous efforts have to be made to improve feeds and fodder resources.

In ruminants, digestion of protein is quite different than those of simple stomach animals and thus produce a complex picture.

The rumen bacteria readily attack food proteins, break them up into the constituents amino acids and then degrade the amino acids to ammonia and fatty acid. The non-protein nitrogen fraction which comprises of amino acids and peptides (Lewis, 1955), nucleic acids (McAllan and Smith, 1968), nitrate (Lichuan Wang et al, 1961), various amines (Neumark, 1962) and urea are also rapidly degraded to ammonia in the rumen. Thus from a variety of diets, ammonia forms an important intermediate in conversion of food nitrogen to microbial nitrogen.

High rates of ammonia production can occur if large amount of urea, soluble proteins such as casein are eaten up by ruminants.

If the rate of ammonia production exceeds the rate at which bacteria can utilise ammonia for their own body protein synthesis, the concentration of ammonia increases in rumen. To some extent ammonia is utilised by micro-organism but not all ammonia is utilised. The excess of ammonia is absorbed through rumen wall and is carried to the liver where along with ammonia obtained from other sources like deamination of amino acids in liver and that absorbed from abomasum and intestine is converted into urea. Some of the ammonia is utilised in the synthesis of non-essential amino acid. And remaining is converted to urea a part of which re-enters the

rumen through saliva and rest is excreted through urine which is the nitrogen loss to the host animal. That is why the concentration of ammonia in rumen is used as an index of usefulness of dietary protein to animal (Chalmers and Synge, 1954). Higher the ammonia concentration less useful of the protein.

It has been observed that casein, a soluble protein is degraded more rapidly than zein, an insoluble protein (McDonald, 1952; Chalmers et al, 1954; McDonald and Hall, 1957; Blackburn and Hobson, 1960).

Butz et al (1958) demonstrated that more ammonia is produced in rumen of cattle which consume groundnut meal than soyabean meal or cotton seed meal.

It has been observed that nitrogen of several different proteins was retained more efficiently by sheep when proteins were added to abomasum than when they were given orally. So, advantage might be gained by limiting degradation of dietary protein in rumen.

Therefore the most convincing approach is to reduce the solubility of good quality dietary protein or to save it from rapid degradation, by any chemical modification without greatly reducing its nutritive value in small intestine.

It has been shown that heating of protein reduces its nutritive value in rats (Cama and Morton, 1950) but Chalmers et al (1954) found that heat treated casein in groundnut meal in diets for goats gave better overall nitrogen utilisation than untreated proteins.

Treatment with formal dehyde (Ferguson et al,1967) or Tannin (Leroy et al, 1964) for protein modification have been examined.

Both of these treatments have been shown to reduce the solubility of protein and its susceptibility to microbial attack. It has been observed that formaldehyde treated casein appears to be well utilised by sheep and its inclusion in sheep diets has resulted in marked improvement in wool production, suggesting improved utilisation of sulphur containing amino acids. The rate of live weight gain in lambs was improved when formaldehyde treated casein was incorporated in their diets (Faichney, 1970). About 38% increase in wool growth was observed at I.V.R.I., Izatnagar, as a result of feeding formaldehyde treated groundnut cake proteins (Bhargava and Ranjhan, 1973). Bhargava et al (1973) also observed a significant gain in body weight in lambs fed formaldehyde treated groundnut cake. Pal and Ranjhan (1973) observed that formaldehyde treated fish meal could be better utilised by decreasing its solubility.

In other words by chemical treatments of cakes the losses incurred due to production of excess ammonia in rumen by feeding soluble protein is saved, which would have been otherwise a nitrogen loss to the host animal.

It is a common practice to feed linseed cake to ruminant along with their basal diet without any chemical treatment of cakes.

Thus chemical treatment of cakes will mean better

utilisation of soluble protein or in other words less amount of total feed will be required for different productive purposes as compared with untreated one.

The present project was undertaken with a view to study the effect of feeding formaldehyde treated linseed cake on growth in deshi goats.

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REVIEW OF LITERATURE

REVIEW OF LITERATURE

Previously, it was considered that the nature of the ingested nitrogenous compounds was of little importance in the nutrition of ruminants, since these materials were all degraded in the rumen and ultimately became available as microbial protein of consistent composition to the animal.

Now it has been made clear by several workers that irrespective of protein breakdown and synthesis in the rumen, the nature of ingested protein has significant role in its utilisation. The yield of amino acids from feed protein is considerably greater if the protein is digested in the abomasum and small intestine rather than used for microbial synthesis in the rumen.

Protein can be effectively protected by the treatment with formalin. It cross links protein molecules rendering the protein insoluble in rumen. The action is reversible in the acid conditions of the abomasum. Soluble feed proteins are more readily fermented in the rumen than insoluble proteins which thus have natural protection.

Feed protein yields only 17 gms of amino acids absobed for every 100 gms of protein fermented. By contrast, every 100 g of dietary crude protein escaping fermentation in the rumen yields about 70 g of amino acids absorbed, depending on digestibility of protein and the proportion of non-protein nitrogen included in the crude protein.

Therefore, main aim of protecting proteins from breakdown in rumen, is to increase the proportions of essential amino acids absorbed from a given feed intake. In other words the purpose of protecting protein in the rumen is to increase the yield of essential amino acids which in turn will increase the utilisation.

Recently chemical and physical methods have been developed to reduce the solubility of dietary protein in the rumen without adversely affecting its utilisation in lower gut.

By heating (British workers), treatment with vegetable tannins (French workers) and treatment with formaldehyde (Australian workers) of oils meals specially of groundnut cake and linseed cake have been reported to reduce their degradation in rumen.

EFFECT OF FORMALDEHYDE ON PROTEIN PROTECTION.

Ferguson et al (1967) have reported the effect of formaldehyde treatment of casein upon protein utilisation in sheep. When formaldehyde treated casein was fed to sheep it was well utilised as compared with untreated casein. It was shown that treatment with formaldehyde reduced the solubility of casein and its susceptibility to microbial attack. Marked improvement was shown in wool growth, suggesting improved utilisation of sulphur containing amino acids.

Coetzee (1970) reported the utilisation of formaldehyde treated fish meal and groundnut oil meal by sheep. In his experiment he gave 600 g veldgrass to Dohnemerino wethers

daily and a supplement of 100 g yellow maize meal with fish meal or groundnut oil cakes treated with formaldehyde or untreated to supply, in all groups, 6.07 g nitrogen daily in the supplement. Wethers given untreated fishmeal gained most weight and produced most clean wool. On treated fish meal wether lost weight and produced least clean wool. There was no difference between the groups in intake of grass or in digestibility of D.M., organic matter, crude fibre, or nitrogen free extract but digestibility of ether extract was greater with either type of fish meal and that of nitrogen was greater with either type of untreated feed. There was less ammonia nitrogen in rumen fluid with untreated feeds. Retention of nitrogen was poorer with treated feeds, but not significantly so.

Zelter et al (1970) have studied the protection of proteins in the feed against deamination by bacteria in the rumen and have also shown in their 'In vitro' study, the behaviour of some proteins tanned with tannin from chestnut wood or some aldehydes (formaldehyde, glutaral dehyde, glyoxal) in an artificial rumen.

Proteins of groundnut, soyabean, linseed, rapeseed and sunflower seed oil meals, skimmed milk powder or dried lucern meal or casein were complexed with the different tanning agents, chestnut wood extracts, formaldehyde glutaraldehyde or glyoxal, were incubated in an artificial rumen. The minimum amount of each tanning agent which would prevent protein degradation depended on the original physico-chemical properties and

heat treatment applied to the protein. The original values for enzymic solubility of the protein were not affected by formaldehyde or glyoxal but were reduced by 5% by chestnut extract or glutaraldehyde. The minimum dose of each aldehyde which would completely protect the protein decreased cellulolytic activity of an inoculum of rumen contents on a wheat straw substrate by 13% to 20%, while doses which gave 90% protection reduced cellulolytic activity by 3%. Chestnut extract did not have its negative effect on cellulolytic activity of rumen inoculum.

Faichney (1971) reported the effect of formaldehyde treated casein on the growth of lambs. Two groups of twelve, 9-week-old Border Leicester x Australian Merino lambs were given diets for 18 weeks in which casein was untreated or treated with formaldehyde. Casein provided about 40% of total nitrogen. Nitrogen balance were estimated on the 3rd, 7th, 11th and 16th week. Some pre-feeding and post-feeding jugular vein's blood sample were obtained. Treatment of casein decr- ased nitrogen digestibility and increased live weight gain, feed conversion and nitrogen balance. The plasma insulin and alpha amino nitrogen before feeding seemed to be higher for lambs on treated casein. For 9 hour after feeding, plasma alpha amino nitrogen was more and urea was less on the treated casein.

Faichney and Weston (1971) studied the digestibility lambs of a diet containing formaldehyde treated casein. (6)-month Border Leicester x Australian Merino wether

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Faichney and Weston (1971) studied the digestion by lambs of a diet containing formaldehyde treated casein. Six (6)-month Border Leicester x Australian Merino wethers were

given, at 3 hours intervals, a diet with 10% casein for preliminary and experimental periods of 14 and 10 days. Flow of digesta from abomasum to intestine was estimated by the dilution of 2 markers. Jugular vein blood samples were taken at intervals on the last day of the experiment. The trial was repeated with the casein treated with formaldehyde. Treatment of casein decreased digestion of organic matter and starch in the rumen, digestion of nitrogen in the whole intestinal tract, rumen concentration of V.F.A.'s and ammonia and plasma urea concentration. Rumen volume, flow of digesta from the rumen, protein and starch digested in the intestine and plasma concentrations of insulin and alpha amino nitrogen increased when casein was treated.

Langlads (1971) reported the wool production of grazing sheep supplemented with casein and formaldehyde treated casein.

For 59 days grazing Australian Merino wethers were given no sodium caseinate or 40 or 80 g daily directly into abomasum. Clean wool production was increased by 35% and 38%. In second experiment grazing wethers were given no casein or 80 g or 40 g or 80 g. Casein treated with formaldehyde each day directly into rumen. Wool production was increased by 22, 38 and 51% by 80 g casein and 40 g and 80 g formaldehyde-casein respectively.

In the third experiment wethers with rumen cannulae grazed at high or low stocking rate with no HCHO-casein or 20, 40 or 60 g given through the cannulae. Wool production and

efficiency of wool production increased and herbage intake declined as supplementary feeding increased.

Wright (1971) studied body weight gain and wool growth response to formaldehyde treated casein and sulphur amino acids. Two experiments are reported with a total of 146 wethers. Growth rate was improved by 21 and feed efficiency by 34 per cent when 4 per cent casein was added to the basal diet with 8 per cent protein. When an equal amount of formaldehyde treated casein was given growth improved further by 20 and efficiency by 8%. Growth rate improved by 26 and efficiency by 19 per cent when 0.3 % methionine was added to the basal diet. Growth and efficiency were not improved by intraperitoneal injection of 1.5 to 4.5 g methionine daily or by 0.3% methionine added to diets with 12% protein. Daily intraperitoneal injections of 1.5 to 4.5 of methionine or 0.3% methionine in the feed increased wool growth on average by 53% and 4% formaldehyde treated casein increased yield by 38%.

Miller (1972) treated 12 kg groundnut meal with 6 litres of 2.4% (w/v) formaldehyde solution. The solution was mixed with groundnut meal and was spread over shallow tray and was dried immediately at 60°C over night and reported that formaldehyde treated groundnut meal increased the flow of nitrogen into abomasum, increased excretion of nitrogen in the faeces and increased nitrogen apparentely absorbed post abomasum.

Bhargava, Krishnamohan and Ranjhan (1973) studied the effect of feeding formaldehyde treated groundnut cake on the growth of Muzaffarnagri Lambs. Four groups of lambs having

5 animals each between 1½ and 2 months of age, were fed with 4 rations treatments for 4 months. In treatment 1st, untreated groundnut cake included at 50% level in the concentrate mixture according to ARC recommendation were fed to 1st group of animals. Similarly in treatment 2 untreated groundnut cake were fed at higher levels 100%. In treatment 3 formaldehyde treated groundnut cake were fed at 100% level in group three. In treatment 4 formaldehyde treated groundnut cake were fed at 50% level in concentrate mixture according to ARC recommendation in group 4. In treatment 4 the remaining 50% nitrogen was supplied through fish meal. The basal roughase was Oat hay/grass. There was significant increase in growth rate in groups 3 and 4. Correspondingly there was significant improvement in dry matter intake through roughage fed with treated groundnut cake. No significant difference in the digestibility coefficients of D.M., N.F.E., total carbohydrate and organic matter was observed. Ether extract and crude protein digestibility was decreased between groups by HCHO treatment.

Bhargava and Ranjhan (1973) reported the effect of formaldehyde treatment of groundnut cake with various levels of formalin ranging from 1.0 to 18.9% on crude protein basis observed a significant decrease in protein solubility in M NaCl solvent in the 1st part of this studies. It was also observed that any addition of water to dilute formalin for protection resulted in fungal growth in the treated samples. In part II, undiluted formalin was added, from 2 to 8% of the crude protein of groundnut cake for protecting its protein from microbial fermentation. Treatment of groundnut cake with

5% formalin decreased the solubility of its protein by about 88% with M NaCl, water, citrate phosphate buffer (pH 6) and 0.02 N NaoH solvent when compared with that of untreated cake. 'In vitro' studies with rumen liquor also confirmed that ammonia production was depressed by 86% with 5% formalin treated cake in comparison to untreated cake.

Pal and Ranjhan (1973) studied the effect of different levels of formalin to reduce the solubility of fish meal protein for better utilisation. Fish meal (184 g) was ground in laboratory and an amount equivalent to 100 g of crude protein was treated with formalin (37.41% formaldehyde solution) using 2, 3, 4, 5, 6, 7, 8 and 9 ml respectively, and preserved in air tight bottles for a fortnight. After this period the test were carried out. The solubility of nitrogen was determined in 1 M Sodium Chloride, 0.02 N Sodium Hydroxide, artifical saliva, and in strained rumen liquor. The nitrogen content of supernatant solution was determined by microkjeldahl's procedure after centrifugation for 5 minutes at 4,000 r.p.m. The distillate was collected in 2% Boric acid to which a mixed indicator (Bromocresol green and methyl red) was added. Non-protein nitrogen was determined by micro-kjeldahl in the supernatant after precipitation with an equal volume of 20% trichloroacetic acid and then filtering through Whatman Filter Paper No. 52.

The solubility per cent of crude proteins of fish meal in 1 M Sodium Chloride, 0.02 N Sodium hydroxide, artificial saliva and strained rumen liquor were 33.43 $\pm$ 0.90; 36.42 $\pm$ 0.5; 30.54 $\pm$ 0.04 and 27.27 $\pm$ 0.15 respectively.The solubility

of protein was higher in 0.02 N Sodium hydroxide.

The solubility of nitrogen as affected by incorporation of formalin treated fish meal in a concentrate mixture was also similarly tested. Three concentrate mixture having groundnut cake, fish meal, and treated fish meal, respectively, were used as the protein source and with maize in all the three as energy source. The concentration of crude proteins in the three concentrate mixtures was 25.60, 31.47 and 27.85% respectively. The three concentrate mixtures differed significantly from each other in respect of their nitrogen solubility. The average nitrogen solubility per cent of the three concentrate mixtures was found to be 39.28 $\pm$ 1.89; 29.89 $\pm$ 0.57 and 22.16 $\pm$ 1.21 respectively.

Therefore by experiment they concluded that formaldehyde treated fish meal could be better utilised by decreasing its solubility.

GROWTH RATE.

Singh and Sengar (1970) recorded highest average birth weight of 2.119, 2.069 and 2.09 kg in Barbari and 4.115, 3.644 and 3.89 kg in Jamunapari for male and female receiving medium energy and medium protein. They recorded mean body weight of kids at 6 months of age in Barbari and Jamunapari from 6.35 to 8.725 kg and 9.5 to 12.1 kg respectively in different groups which did not differ significantly.

Johri and Talpatra (1971) attempted to determine the rate of growth of Jamunapari kids from birth to 15 weeks.

On the basis of their experiment they observed that the Jamunapari kids grow at the rate of 0.63 kg per week or 90 gms/day on an average.

In another study Johri and Talpatra (1971) studied the performance of Jamunapari kids under browsing and stall fed condition. They recorded an average gain of 547 gms in two weeks when fed by browsing and 333 gms under stall fed condition.

Singh and Singh (1971) observed that growth in both sexes of kids was remarkably better in 1st four months after birth. Thereafter during the period of 4 to 8 month the gr as lowest, again in the age group from 8th to 12t e growth increases appreciably.

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DRY MATTER CONSUMPTION.

On the basis of several feeding trials it has been observed that the dry matter intake of goat is higher than larger farm animals.

Singh and Sengar (1970) studied the average dry matter consumption per 100 kg body weight per day from 3.43 to 4.20 kg in Barbari and 2.67 to 3.42 kg in Jamunapari goats. Thus dry matter consumption of Barbari appears to be more than Jamunapari goats. They also observed almost the same dry matter consumption in case of kids as mentioned for their respective dam in each group.

In metabolic trials conducted on Barbari and Jamunapari bucks they estimated the dry matter consumption between

2.03 ± 0.02 to 2.82 ± 0.03 and 1.86 ± 0.09 to 2.65 ± 0.06 kg respectively per 100 kg body weight.

Johri and Talpatra (1971) attempted to study growth rate of Jamunapari kids right from birth to 15 weeks. In the course of the experiment they observed that dry matter intake at 8th week was on an average 286 gms/day i.e. 3.41 kg/100 kg body weight.

Saxena and Maheshwari (1971) observed the performance of Jamunapari goats at Chakkarnagar range (Home range of Jamunapari goats) and at Mathura. They studied that the dry matter consumption per 100 kg body weight at Chakkarnagar range was between 2.42 to 3.58 kg whereas at Mathura it varied from 1.47 to 2.65 kg.

DIGESTIBILITY CO-EFFICIENTS.

Hossain (1959) conducted digestibility trial for 7 days in 4 goats. They were given pipal leaves (Filcus religiosa) to appetite and 20 gms rape cake with 5 gms salt. He observed digestibility co-efficient of organic matters 44, crude protein 53, ether extract 29, crude fibre 23, nitrogen free extract 56%.

Maheshwari and Talpatra (1975) compared the digestibilities of green cowpea and cowpea hay in stall fed Jamunapari goats. The average digestibility co-efficient of dry matter and organic nutrients in green cowpea were DM 72 ± 1.36, CP 67 ± 1.79, EE 84 ± 0.55, CF 67.9 ± 1.62, NFE 80.9 ± 2.10

and in cowpea hay were 71.6 ± 1.74, 73.1 ± 2.44, 85.1 ± 1.25, 67.7 ± 2.42, 75.0 ± 1.20 respectively.

In another experiment Maheshwari and Talpatra (1975) tried to estimate digestibility co-efficient of Berseem fodder for milch goats. They estimated average digestibility co-efficients of crude protein, ether extra, crude fibre and notrogen free extract as 79.4, 40.9, 70.9 and 91.3 respectively.

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MATERIALS AND METHODS

MATERIALS AND METHODS

EXPERIMENTAL ANIMALS.

Eight (8) nondescript locally available male kids of approximately three months of age were selected out of a lot of 13. After that the kids were weighed and randomely divided into two groups (control and experiment) on the basis of their body weight. The details of their distribution are present in table below : -

TABLE - 1.

The distribution of kids in groups

Control		Experimental	
Kid No.	Body weight (kg)	Kid No.	Body weight (kg)
2	7.0	1	7.2
4	7.2	3	7.2
6	6.8	5	7.1
8	7.0	7	6.7

The following feeds were taken in the present experiment :

(i) Para grass

(ii) Wheat bran

(iii) Arhar chunni

(iv) Linseed cake.

The feeds were obtained locally from Danapore and para grass was obtained from Government Cattle Farm, Patna. Among these feeds, linseed cake was finally crushed to fine powdered form.

Powdered linseed cake was treated with 6% formaldehyde solution (37% HCHO) on the basis of crude protein as suggested by Ferguson et al (1967). Formaldehyde was sprayed on powdered linseed cake, mixed thoroughly and stored in plastic bag for experimental purpose.

TABLE - 2.

Table showing the level of treatment with formaldehyde in linseed cake.

Percentage of crude protein in sample (N x 6.25)	Quantity/volume of formaldehyde added per kg of linseed cake.	Percentage treatment with formaldehyde.
28	16.8 g/15.5 ml	6

FEEDS AND THEIR ANALYSIS.

Green para grass alone was offered as roughage. The concentrate mixture consisting of linseed cake, wheat bran and arhar chunni were given to both groups of animal as detailed in Table - 3. But in the experimental group 6% formaldehyde treated linseed cake on crude protein basis was offered with other ingredients of concentrate mixture.

Proximate analysis of all the feeds ingredients were

done by A.O.A.C. Method (1970). The details are given in Chapter of result.

For calculating T.D.N. value of different ingredients of ration, the digestibility co-efficients of Para grass, Linseed cake and Wheat bran with respect of CP, EE, CF and NFE were taken from I.C.A.R. bulletin No. 25, 1967 (Sen, K.C. and Ray, S.N.) and the digestibility co-efficient of Arhar chunni with respect to CP, EE, CF and NFE was taken from review of work done at Animal Nutrition Centre, Haringhata (Kalyani, 1954-1969) for cattle because the digestibility co-efficient value of the feeds in goats were not available.

For the analysis of feeds, ten samples of individual feed were separately collected from different places of the bag. The samples of individual feed were then pooled together and powdered with mortar and pestle.

For analysis of Para grass ten samples were randomely collected from different portions of grass. Then they were finely chaffed mixed and dried in hot air oven to a constant weight. The dried sample was powdered and analysed for different proximate principles.

All analysis were done in duplicate. Result of analysis of feed has been presented in Chapter of result.

COMPUTATION OF RATION.

The proportion of roughage and concentrate mixture in the ration of both groups were kept 50:50. The concentrate

mixture consisting of Linseed cake, Wheat bran and Arhar chunni were prepared in such a way that the prepared ration contained 12% crude protein in both control and experimental groups.

The details of ration, prepared on 12% crude protein basis are given in Table - 3.

TABLE - 3.

Proportion of different ingredients of ration in both control and experimental group.

Feed ingredients	Proportion	DM	CP	TDN
Para grass	50 parts	17.32	0.50	10.09
Linseed cake	32 parts	29.02	8.96	22.87
Wheat bran	15 parts	13.30	2.15	9.85
Arhar chunni	3 parts	2.71	0.42	1.57
Total.	100 parts	62.35	12.03	44.38

In addition a mineral mixture Milkmin (Squibb) was mixed in the concentrate mixture of both groups at the rate of 1 kg for every 100 kg of concentrate mixture.

The composition of mineral mixture was following :

Calcium	-	24 %
Phosphorous	-	9 %
Magnise	-	0.12 %
Iodine	-	0.1 %

Iron	-	0.6 %
Copper -	-	0.1 %
Cobalt	-	0.02%
Sodium chloride	-	30.00%

Flourine not more than - 0.03%.

FEEDING PRACTICE.

The experiment started on 5th May 1975 and concluded on 4th July 1975. A twenty (20) days preliminary feeding period was allowed before the start of experiment. During this preliminary period the kids were believed to have been accustomed to the new environment as well as individual stall feeding. During this period both groups of kids were drenched with proper dose of parasiticidal drugs like Phenovis, Sulphamezathine, Vermex, Kerenol.

Both groups of animals were fed the computed ration as mentioned in Table - 3. But kids of experimental group were fed formaldehyde treated Linseed cake along with other ingredients of concentrate mixture. Kids of both groups were fed individually in clay troughs. Feeding of kids were done twice daily from 8 A.M. to 10 A.M. and 4 P.M. to 6 P.M. In the beginning of the experiment 100 gms each of concentrate and para grass was offered both in the morning and evening this amount was raised to 200 gms with the gradual increase in the feed intake.and the left over of feeds were also weighed. In this way the actual consumption of concentrates and roughage was observed. Water was offered to both group of kids ad lib.

WEIGHING AND BODY MEASUREMENT OF KIDS.

Before starting the experiment, kids of both groups were weighed and after that body weight, length, girth and height were recorded in every week during the whole experimental period. The length, girth and height were measured to assess the type of growth in both groups of experimental kids. Weighing of kids and measurements of length, girth and height were recorded in the morning in every week before giving them feeds and water.

RUMEN FISTULATION.

It was done surgically by a simple method of rumen fistulation using a Johnson and Johnson Adhesive bandage roller. This technique was adopted in goats No. 3 and 2 with the help of the Department of Surgery, Bihar Veterinary College, Patna. This had worked well in the absence of readymade plastic rumen fistula.

COLLECTION OF RUMEN LIQUOR.

Rumen liquor was collected from various depths and position of the rumen by inserting tube through fistula with the help of Suction pump from both groups of fistulated kids at 8 A.M. before giving them feeds after that kids were allowed to take their feeds and water. After some times when both groups of animals finished their taking feeds then feeding was stopped and again rumen liquor was collected at 10 A.M. After that

rumen liquor was collected at 12 Noon, 2 P.M. and 4 P.M.

During the rumen liquor collection period, kids were not allowed to consume feeds but water was offered. At 4 P.M. fistulated kids of both groups were allowed to consume feeds after collection of rumen liquor. In other word rumen liquor was collected between 0 - 8 hours at 2 hours interval one day in every week.

SOLUBILITY TEST OF THE UNTREATED AND TREATED LINSEED CAKE WITH FORMALDEHYDE IN M NaCl SOLUTION.

The method for solubility test was adopted according to Whitelaw et al (1961). Three gms of feed sample from treated Linseed cake and untreated Linseed cake was taken in 250 ml conical flask separately. Now 100 ml of M NaCl solution was added in the each conical flask. After that it was allowed to vigorous shaking by a automatic shaker machine for 3 hours. Then it was filtered through Whatman Filter Paper No. 41 after few minutes standing. Filtrate was used for solubility test. Now 25 ml of filtrate was taken in Kjeldahl's flask from each conical flask and was proceeded for crude protein (N x 6.25) estimation for eacn separately as recommended in A.O.A.C. method (1970).

ESTIMATION OF TOTAL VOLATILE FATTY ACID IN RUMEN LIQUOR OF EXPERIMENTAL GOATS.

The total V.F.A. in rumen liquor was estimated by the method of Elsden et al (1946). Rumen liquor was collected

separately in 250 ml conical flask between 0 - 8 hours at 2 hours interval in both treatment and control group of animals. After collection the rumen liquor was strained through muslin cloth. Now 20 ml of strained rumen liquor was taken in 250 ml beaker and 20 ml of 4 NH_2SO_4 was added and then volume was made upto 50 ml with distilled water. Out of this 10 ml was taken in 100 ml beaker and few crystals of Magnesium Sulphate was added according to Kakar and Chopra (1973). Then the aliquot was transferred quantitatively in "Markham Steam" distillation apparatus and distilled. About 150 ml distillate was collected and titrated against N/50 NaoH solution using Bromothymol Blue indicator having pH range of 6 to 7.6.Further 25 ml distillate was also collected and titrated as a precautionary measure to assure complete distillation of V.F.A. The second 25 ml of distillate invariably did not contain any acid. The end (N) point was marked when yellow colour just changes to blue.

CALCULATION.

Let the amount of N/50 NaoH used to neutralise the total V.F.A. be x ml.

$\because$ 10 ml of diluted SRL $\equiv$ x ml of N/50 NaoH solution

$\therefore$ 50 ml of diluted SRL $\equiv \frac{x}{10}$ x 50 ml of N/50 NaoH solution.

or, 20 ml of original (undiluted) SRL $\equiv \frac{x}{10}$ x 50 ml of N/50 NaoH solution

$\therefore$ 1000 ml of " " " $\equiv \frac{x}{10} \times 50 \times \frac{1}{20} \times 1000$ ml of N/50 NaoH solution.

$$= \frac{x \times 50 \times 1000}{10 \times 20} \times \frac{1}{50} \text{ ml of N}$$

(normal) NaoH solution.

∴ 1 ml of N (Normal) NaoH solution = 1 m. mole of total V.F.A.

Hence, the reading of N/50 NaoH used when multiplied by the factor "5" gave the total V.F.A. in milli moles per litre of rumen liquor.

ESTIMATION OF NH_3-N (AMMONIA NITROGEN).

The method of Schwartz et al (1964) was followed. Rumen liquor was strained through muslin cloth after collecting from experimental and control group of animals. In this method 5 ml of strained rumen liquor was taken in a centrifuge tube and 5 ml of 0.2 M HCl was added and mixed thoroughly and then kept for 2 hours. After that the sample was centrifuged at 8,000 r.p.m. for twenty minutes. Keeping in view that the solid parricles may settle on the bottom of the tube, the supernatant was preserved at 2°C till analysed. 2 ml of the supernatant was taken in a 100 ml beaker and neutralised with 1-N NaoH which was tested by adding few drops of Phenol red. After that, again 2 ml of 1 N NaoH was added. Now the whole content was transferred, quantatively in Micro-Kjeldahl's distillation apparatus using glass distilled water. 10 ml of 2 per cent boric acid solution containing modified Tashiro's indicator was taken in a 100 ml conical flask, with marks at 50 ml. The tip of the condenser of Micro-Kjeldahl's distillation apparatus was always kept dipped in the boric acid solution.

Steam was then passed into the distillate at a very slow rate and when distillate was collected upto 50 ml mark to ensure the complete distillation of all the ammonia present, the receiver was lowered down and the tip of the condensor was washed with glass distilled water. The receiving flask was then kept for titration. The distillation was stopped and the inner chamber of the Micro-Kjeldahl's distillation apparatus was washed with distilled water which was allowed to pass through back suction in the collecting chamber and finally removed out through the outlet of the collecting chamber. In this way Micro-Kjeldahl's distillation set was cleaned and made ready for the next distillation.

The distillate collected in the conical flask was titrated against N/100 HCl solution kept in a 10 ml micro-burette with graduation of 0.05 ml. The end point of titration was judged by comparing from the colour of the indicator in 10 ml of boric acid with glass distilled water in another flask.

Blank titration was also done to check the presence of ammonia as impurity in the reagents used but no ammonia in traceable amount was detected.

CALCULATION FOR AMMONIA-N ESTIMATION.

5 ml of incubated SRL was diluted with 5 ml 0.2 M HCl and after centrifugation 2 ml of the same was distilled for ammonia-N-estimation.

$\therefore$ 10 ml of diluted SRL incubation contains 5 ml of rumen liquor

$\therefore$ 2 ml of diluted SRL incubation contains 1 ml of rumen liquor.

Now 1 ml of diluted SRL liberated ammonia N which was neutralised by x ml of N/100 HCl (where x is actual volume of N/100 HCl used in titration)

or, NH_3 - N in 1 ml rumen liquor $=$ x ml of N/100 HCl

$=$ x x 0.14 mg ammonia N

($\because$ 1 ml of N/100 HCl $=$ 0.14 mg of NH_3 - N)

$\therefore$ 100 ml of rumen liquor $= \frac{x \times 0.14 \times 100}{1}$ mg ammonia N

Now mg of NH_3 - N/100 ml SRL = x x 14.

REAGENTS USED.

(1) For ammonia Nitrogen estimation :

(a) 1 N NaoH solution was made.

(b) 0.2 M HCl was made.

(c) Boric acid 2% solution - 20 g of boric acid (A.R.) was dissolved in warm glass distilled water and the volume was made upto one litre.

(d) Phenol red (B.D.H.) - as indicator was used.

(e) Modified Tashiro's indicator - 100 mg of Bromocresol green and 100 mg of Methyl red was dissolved in 100 ml of absolute alcohol. 10 ml of this mixed indicator was added per litre stock solution of 2 per cent boric acid.

(f) Standard Hydrochloric acid (A.R.) - N/100 HCl solution.

(2) For solubility test :

(a) M Sodium Chloride solution - 58.45 g of Sodium Chloride (A.R.) was dissolved in one litre of distilled water.

(b) Standard Sulphuric acid (A.R.) - $\frac{3N}{7}$ H_2SO_4 solution.

(c) Standard sodium hydroxide (A.R.) - N/7 NaoH.

(d) Sodium Sulphate and Copper Sulphate (A.R.).

(3) For total volatile fatty acid :

(a) Standard 4 NH_2SO_4 solution.

(b) N/50 NaoH solution.

(c) Magnesium Sulphate Crystals.

(d) Bromothymol blue as indicator.

NITROGEN BALANCE STUDY.

Nitrogen balance studies were conducted at the end of the experiment. For this purpose two kids from each group were randomely selected and shifted to locally prepared metabolic cage. Faeces and urine collection bags were attached to the animal. Two days preliminary period was allowed to accustom the animals in the metabolic cage and collection bags.

After preliminary period actual collection of faeces and urine was done. The faeces collection was done in rectangular

bag whose inner covering was made of plastic sheet and outer of thick cotton cloth. Urine was collected in a conical funnel shaped bag whose inner covering was made of plastic and outer of thick cotton. This conical bag was connected with a plastic funnel and that from a rubber tube. The rubber tube was connected into the bottle through a hole in the cage. Faeces was collected twice daily and stored in a separate container. 24 hours collection of faeces of individual animal was weighed and recorded. Then a representative sample of 10 gms of faeces was weighed in a almunium moisture cup and kept in hot air oven for moisture estimation. Moisture was estimated every day. Seven days dried faeces was pooled together and powdered. This pooled dried sample was used for analysis work.

Likewise "24 hours" collection of urine was measured by means of measuring cylinder and recorded. Every day 50 ml urine was collected in a bottle containing 3.3 ml concentrated Sulphuric acid as preservative for 3 days. Then the pooled sample was kept for analysis of urinary nitrogen. Nitrogen estimation of faeces and urine was done according to Kjeldahl's method. In this way outgo of nitrogen through faeces and urine was thus obtained. The value was deducted from the total nitrogen intake so as to know nitrogen retention in animals.

Statistical Methods:

The data obtained during the period of investigations were subjected to statistical analysis. The following formulae were used for different types of statistical tests by the method

(Snedecor, 1967).

(i) Standard Error

$$S.E. = \sqrt{\frac{xi^n 2 - \frac{\left(\sum_{i=1}^{n} xi^n\right)^2}{n}}{n(n-1)}}$$

Where S.E. = Standard error

$\sum_{xi}^{n} 2$ = Crude sum of squares

$\frac{\left(\sum_{i=1}^{n} xi\right)^2}{n}$ = Correction factor

n = number of observations.

(ii) Analysis of variance:

Skeleton of analysis of variance

Source of variation	df	S.S.	M. S.	F
Between groups	P-1	B	$\frac{B}{P-1} = x$	
Within groups	N-P	A-B	$\frac{A-B}{N-P} = y$	$\frac{x}{y}$
Total	n-1	A		

Where df denotes degree of freedom.

S.S. denotes corrected sum of squares.

M.S. denotes mean sum of squares.

N denotes total number of observations.

P denotes total number of groups.

A denotes total sum of squares.

B denotes between groups sum of squares.

A-B denotes within groups sum of squares.

x denotes mean square between groups.

y denotes mean square within groups.

F denotes ratio of, between groups mean squares and within group mean squares.

(iii) Paired 't' test :

$$t\,(n-1) = \frac{\bar{d}}{\text{S.E. of } d}$$

$$\bar{d} = \frac{\sum_{i=1}^{n} di}{n}$$

$$\text{S.E. of } d = \sqrt{\frac{\sum_{i=1}^{n} di^2 - \left(\sum_{i=1}^{n} di\right)^2}{n(n-1)}}$$

Where $\bar{d}$ = Difference of the pair

t(n-1) = paired t test at one degree of freedom.

N.B.: The value obtained was compared with the tabulated value for the test of significance.

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RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

In order to know the effect of feeding formaldehyde treated linseed cake on growth in deshi goats, the following investigations were conducted in the present study:

1. Chemical composition and nutritive value of feeds.
2. Dry matter consumption.
3. Digestibility co-efficient of dry matter and crude protein.
4. Nitrogen balance study.
5. Body measurement.
6. Solubility of linseed cake in M NaCl solution.
7. Ammonia nitrogen production in formaldehyde treated and un-treated linseed cake from 0 - 8 hours of incubation.
8. Total volatile fatty acid production in formaldehyde treated and un-treated linseed cake from 0 - 8 hours of incubation.

The data are presented and described below :

1. Chemical composition and nutritive value of feeds.

Chemical composition of each feed ingredients was estimated which is given in Table - 4.

TABLE - 4.

Chemical composition of feed ingredients in % (on air dry basis).

Feed ingredient	Moisture	Crude protein	Crude fibre	Ether extract	Total ash	Nitrogen free extract.
Linseed cake	9.30	28.00	7.86	8.87	6.57	39.40
Wheat bran	11.3	14.50	10.09	4.80	5.40	53.91
Arhar Chunni	9.6	14.00	23.70	1.75	11.60	39.35
Para grass	65.36	1.00	11.32	1.01	4.50	16.81

TABLE - 5.

Chemical composition of feed in percentage (on dry matter basis).

Name of the feed	Crude protein	Crude fibre	Ether extract	Total ash.	Nitrogen free extract
Linseed cake	30.87	8.66	9.77	7.24	43.46
Wheat bran	16.35	11.37	5.41	6.08	60.79
Arhar chunni	15.48	26.21	1.93	12.83	43.55
Para grass	2.88	32.67	2.91	12.98	48.56

To provide optimum amount of energy in both control and experimental groups of animals, it was very essential to know the T.D.N. value of all feeds. As there digestibility coefficients of different nutrients of the feeds used in this experiment for goats were not available. The digestibility

coefficients of different nutrients of feeds used in cattle was taken as guide line.

TABLE - 6.

Digestibility coefficients of the nutrients of different ingredients of experimental feed (in percentage).

Feeds ingredients	Digestibility coefficients			
	Crude protein	Crude fibre	Ether extract	Nitrogen free extract
*Linseed cake	85	27	96	67
*Wheat bran	77	20	63	84
**Arhar chunni	52.83	45.18	57.67	80.05
*Para grass	68	66	63	63

*Data for linseed cake, wheat bran and paragrass has been taken from I.C.A.R. bulletin No.25, 1967 (Sen and Ray).

**Data for Arhar chunni has been taken from the review of work carried out at Animal Nutrition Centre, Haringhata (Kalyani) (1954-1969).

According to the TDN value of the feeds which were calculated from the data of Table 5 and 6. In computing the TDN value of feeds the digestible ether extract was multiplied by 2.25 in each case.

TABLE - 7.

Digestible nutrient contents and TDN value of different feeds (in percentage).

Feeds	DCP	DCF	DEE	DNFE	TDN
Linseed cake	23.8	2.12	8.51	26.39	71.47
Wheat bran	11.16	2.01	3.02	45.76	65.68
Arhar chunni	7.39	10.70	1.01	31.89	52.26
Para grass	0.68	7.47	0.64	10.59	20.17

2. Dry matter consumption.

Dry matter consumption of both the group (control and experimental) were calculated from feed intake and are presented in Table 8.

TABLE - 8.

Mean dry matter consumption (kg) per 100 kg body weight per day from 1st (3 months age) to 8 weeks in deshi male kids in both control and experimental group.

Weeks	Control group Mean ± S.E.	Experimental group Mean ± S.E.
1st	3.57 ± 0.14	3.64 ± 0.09
2nd	3.73 ± 0.09	3.93 ± 0.17
3rd	3.91 ± 0.08	4.21 ± 0.20
4th	4.40 ± 0.07	4.52 ± 0.12
5th	4.50 ± 0.12	4.65 ± 0.09
6th	4.31 ± 0.08	4.89 ± 0.15
7th	4.52 ± 0.09	5.24 ± 0.18
8th	4.68 ± 0.06	5.56 ± 0.04
Average.	4.20 ± 0.09	4.58 ± 0.13

TABLE - 9.

Analysis of variance table showing the effect on dry matter consumption in control and experimental group of male deshi kids.

Sources of variation	df	M. S.
Between treatments	1	2.23**
Between weeks	7	2.18**
Error	55	0.07
Total	63	

C.D. between weeks = 0.35

** indicates significance at 1% level.

From the above table, the DM consumption in the control group ranged from 3.57 ± 0.14 to 4.68 ± 0.06 and in the experimental group ranged from 3.64 ± 0.09 to 5.56 ± 0.04 kg per 100 kg body weight per day.

The average DM intake was 4.20 ± 0.09 kg/100 kg body weight per day in the control group and 4.58 ± 0.13 kg/100 kg body weight/day in the experimental group. The difference in the DM consumption between two groups are highly significant. The DM consumption in the control group is in agreement with the observations made by Maheshwari and Talpatra (1975) in Jamunapari goats fed cow pea hay and Maheshwari and Talpatra (1975) in Jamunapari milch goats fed green berseem ad lib, who observed 4.04 and 4.67 kg dry matter intake per 100 kg body weight respectively. While of the experimental group the

DM consumption is in the agreement with the observations made by Bhargava and Ranjhan (1973) in Muzaffarnagri lambs in which there was marked improvement in dry matter consumption in the group fed HCHO treated cakes.

3. Digestibility coefficient of dry matter and crude protein.

The average digestibility coefficient of dry matter and crude protein in kids of control and experimental groups have been presented in Table - 10.

TABLE - 10.

Mean digestibility coefficient of dry matter and crude protein in control and experimental groups of deshi male kids.

	No. of observation	Mean ± S.E.		
		Control	Experimental	Difference between means
Dry matter.	14	76.4 ± 0.04	75.6 ± 0.07	0.57 NS
Crude protein.	14	84.6 ± 0.07	74.3 ± 0.04	7.38**

** indicates significance at 1% level.
NS indicates non-significance.

From the above table it appears that there was no significant difference between the digestibility coefficient of dry matter in control and experimental group.

These observations are in close agreement with the findings of Faichney (1972) with sheep, Faichney and Davies (1972) with calves and Bhargava and Ranjhan (1973) with

Muzaffarnagri lambs.

However, the digestibility coefficient of crude protein was significantly decreased in experimental group which was closely associated with the findings of Faichney (1971), Hughes and Williams (1971), Faichney and Davies (1972), Sharma et al (1972) with ruminants and Bhargava and Ranjhan (1973) with lambs.

Faichney (1972) also observed lower digestibility of nitrogen when low protein diets were given.

4. Nitrogen balance study.

Nitrogen balance study was carried for the purpose of determining the nitrogen status of the animals in both control and experimental group.

The details of balance study are presented in Table-11.

TABLE - 11.

Mean nitrogen intake, excretion and retention per day in both control and experimental groups.

	Mean ± S.E.			
	Nitrogen intake (gms) (concentrate + roughage)	Nitrogen excretion (gms) (Faeces + urine)	Nitrogen retention (gms)	Difference in nitrogen
Control.	5.98±0.19	4.74±0.21	1.92±0.29	0.25 NS
Experimental.	6.74±0.21	4.11±0.43	2.17±0.41	Calculated $t_{26\ df} = 1.011$

NS indicates non-significance.

From the above table it will be clear that the animals of both control and experimental groups were in positive nitrogen balance. There was no significant difference on nitrogen retention between the groups and this finding is in agreement with the observations made by Hughes and Williams (1971) with sheep, Sharma et al (1972) with calves, and Bhargava and Ranjhan (1973) with Muzaffarnagri lambs.

Singh and Sengar (loc. cit.) recorded balance of nitrogen from 2.02 ± 0.16 to 1.68 ± 0.09 in Barbari bucks and 0.26 ± 0.39 to 2.57 ± 0.35 in Jamunapari bucks receiving different combinations of energy and protein.

5. Body measurement.

The details of body measurement of kids from 1st to 8th weeks of experiment has been given in Table - 12.

From Table - 12, it will appear that there was no significant difference in length, girth and height of kids between the groups.

Weekly body weight and rate of gain of deshi male kids in both the groups have been presented in Table - 13.

Mean length (cms), Girth and Height (cms) of different male kids in control and experimental groups in different weeks of growth.

Weeks	Control (Mean ± S.E.)			Experimental (Mean ± S.E.)		
	Length	Girth	Height	Length	Girth	Height
Initial.	35.5 ± 1.67	42.22 ± 2.17	42.0 ± 1.08	36.5 ± 1.32	43.0 ± 1.28	44.0 ± 1.53
1st	35.5 ± 1.38	42.25 ± 1.89	42.92± 1.38	36.5 ± 2.12	43.75± 1.73	45.0 ± 1.89
2nd	35.5 ± 1.67	44.5 ± 2.31	43.0 ± 2.18	36.5 ± 2.32	45.75±1.59	45.0 ± 1.93
3rd	35.5 ± 1.68	45.25 ± 2.16	43.72± 1.76	37.0 ± 1.83	46.50± 2.10	45.5 ± 1.87
4th	37.0 ± 1.18	45.75 ± 2.27	44.87 ±1.56	37.61± 2.08	47.75± 2.19	46.12± 1.98
5th	37.0 ± 1.18	47.22 ± 2.18	45.5 ± 1.93	37.75± 2.08	48.5 ± 2.32	46.5 ± 2.01
6th	37.75± 2.19	47.22 ± 2.31	46.5 ± 1.87	38.25± 2.11	48.75± 2.38	48.0 ± 2.13
7th	38.25± 2.43	47.5 ± 2.73	47.0 ± 2.13	39.50±2.17	49.0 ± 2.87	48.73± 2.32
8th	39.0 ± 2.54	49.0 ± 2.76	48.0 ± 2.89	40.50± 2.27	50.5 ± 3.19	50.02 ±2.51

TABLE - 13.

Mean body weight (kg) of deshi male kids of about 3 months age in different weeks in both groups.

Weeks	Mean ± S.E.	
	Control group	Experimental group
Initial.	7.00 ± 0.08	7.05 ± 0.12
1st	7.25 ± 0.06	7.32 ± 0.09
2nd	7.45 ± 0.03	7.62 ± 0.13
3rd	7.85 ± 0.05	7.95 ± 0.03
4th	8.25 ± 0.06	8.40 ± 0.04
5th	8.52 ± 0.05	8.80 ± 0.04
6th	9.02 ± 0.03	9.2 ± 0.04
7th	9.52 ± 0.05	9.70 ± 0.04
8th	10.12 ± 0.11	10.20 ± 0.06
Growth rate.	0.39 kg/week or 55.7 gms/day	0.393 kg/week or 56.1 gms/day

TABLE - 14.

Analysis of variance table showing the effect of different weeks and treatments on body weight of deshi male kids.

Sources of variation	df	M. S.
Between treatments	1	0.2944**
Between weeks	8	9.1072**
Error	62	0.0322
Total.	71	

C.D. between weeks = 0.18. ** indicates significance at 1% level.

From the perusal of Table - 13, the difference between the initial body weight and final body weight between control and experimental group are not significant. Accordingly the difference in rate of gain between groups, was also not significant. The average rate of growth was 55.7 gms/day in control and 56.1 gms/day in experimental group. Singh and Senger (1970) recorded the growth rate in Jamunapari kids (37 to 51 gms/day) maintained on different combinations of energy and protein from birth to 6 months of age. Although there is a tendency of better rate of gain in the experimental group compared to the control, this observation appears to be contradictory with the findings of Ferguson et al (1967), Langlads (1971), Fairchney (1971), Bhargava and Ranjhan (1973) with lambs.

Taking into the considerations the observation of other parameters in this experiment where the findings are closely related with the finding of other research workers (cited before) there ought to have been better growth rate and higher final body weight in the experimental group. Therefore the only possible reason for this contradictory observation might be due to shorter period of experiment, less number of animals, as well as unknown genotype of the deshi kids.

6. Solubility of linseed cake in M NaCl solution.

Solubility test of linseed cake (untreated and treated) in M NaCl was carried out and the results are tabulated in Table - 15.

TABLE - 15.

Table showing solubility test in M NaCl of formaldehyde treated and untreated linseed cake.

Linseed cake (crude protein - 28 per cent N x 6.25).

	Percentage of soluble protein (N x 6.25)	Percentage of total crude protein which is soluble	Percentage reduction in solubility of formaldehyde treated linseed cake.
Untreated linseed cake.	16	57.1	-
6% formaldehyde treated linseed cake.	2.5	8.9	84.41

As expected, the solubility of protein of linseed cake decreased by about 84.4% at 6 % formaldehyde treatment. Similar observations were made by Faichney (1970), Faichney and Weston (1971), Bhargava and Ranjhan (1973), Pal and Ranjhan (1973).

7. Ammonia nitrogen production in formaldehyde treated and untreated linseed cake from 0-8 whours of incubation.

Ammonia production in SRL of control and experimental groups of kids at different hours are given in Table 16.

TABLE - 16.

Table showing mean ammonia nitrogen in mg per 100 ml of centrifuged SRL in control and experimental groups of kids in different hours.

Hours after feeding	Mean ± S.E.		% reduction in ammonia production
	Control	Experimental	
0	31.45 ± 1.69	9.77 ± 0.27	68.8
2	40.70 ± 1.91	11.40 ± 0.41	72.5
4	51.03 ± 0.57	12.40 ± 0.28	75.7
6	38.90 ± 1.36	11.27 ± 0.39	71.03
8	37.15 ± 1.23	10.10 ± 0.31	72.8

TABLE - 17.

Analysis of variance table showing the effect of different hours and treatments on production of total ammonia nitrogen in both groups of kids.

Sources of variation	df	M. S.
Control vs treatment	1	8305.92**
Between hours	4	133.02**
Interraction(hours x control vs treatment)	4	76.22 NS
Error	30	43.067
Total	39	

** indicates significance at 1% level.
NS indicates non-significance.

From the perusal of Table - 16, it will appear that ammonia concentration in both groups were increasing till 4 hours of incubation and after that ammonia concentration declined.

In the control group ammonia nitrogen concentration ranged from 31.45 ± 1.69 to 51.03 ± 0.57 mg/100 ml SRL and in the experimental group there was significant reduction of ammonia nitrogen concentration ranged from 9.77 ± 0.27 to 12.40 ± 0.28 mg/100 ml SRL. This significant reduction of ammonia concentration in experimental group compared to control indicate the relationship between solubility reduction and ammonia nitrogen production and this is in agreement with the observations made by Ferguson et al (1967), Faichney and Eston (1971), Bhargava and Ranjhan (1973) with lambs.

8. Total volatile fatty acid production in formaldehyde treated and untreated linseed cake from 0-8 hours of incubation.

Concentration of total volatile fatty acid in SRL of both groups of kids at different intervals are tabulated in Table - 18.

TABLE - 18.

Mean total volatile fatty acid (m. mole) per litre of SRL in control and experimental group of deshi kids.

Hours after feeding	Mean ± S.E.	
	Control	Experimental
0	72.62 ± 2.34	60.00 ± 2.68
2	101.75 ± 1.93	91.25 ± 1.99
4	60.56 ± 1.79	47.68 ± 3.32
6	55.5 ± 1.85	44.68 ± 1.82
8	52.25 ± 1.32	43.87 ± 1.39

TABLE - 19.

Analysis of variance table showing the effect of different hours and treatments on production of total volatile fatty acid in both groups.

Sources of variation	df	M. S.
Between treatments	1	1217.71**
Between hours	4	3187.64**
Error	34	15.49
Total	39	

** indicates significance at 1% level.

From perusal of Table - 18 it will appear that total volatile fatty acid concentration was maximum at 2 hours incubation in both groups and after that it declined.

In control and experimental group the highest concentration of V.F.A. at 2 hours was 101.75 ± 1.93 and 91.25 ± 1.99 (m. mole/litre SRL).

In the experimental group the total volatile fatty acid was less at all the hours (0-8) of incubation when compared with the control.

This significant decrease in total volatile fatty acid production in the experimental group is in agreement with the observations made by Faichney (1970), Faichney and Veston (1971) with lambs, Faichney (1972) and Sharma et al, (1972) with lambs, Bhargava and Ranjhan (1973) with sheep.

Considering all the above findings it can be summed up that the feeding of formaldehyde treated linseed cake did not show any difference in rate of growth and final body weight during 8 weeks of experimental period or upto five months of age in deshi kids.

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S U M M A R Y

S U M M A R Y

The present investigation consisted of -

1. Locally available eight nondescript male kids of about 3 months age which were weighed and randomely divided into control and experimental groups on the basis of their body weight.

2. The feed sample of wheat bran, arhar chunni, linseed cake and para grass were taken in which linseed cake was finally crushed to fine powdered form and was treated with formalin on crude protein basis as adopted by Ferguson *et al*, (1967).

3. Proximate analysis of all the feeds ingredients was done by A.O.A.C. Method (1970) and the ration was prepared in such a manner that the proportion of roughages and concentrate mixture in ration were kept 50:50 having 12% crude protein. Feeds were offered morning and evening in both groups and left out were measured for knowing the feed intake.

4. Solubility test of untreated linseed cake and treated linseed cake with formaldehyde was done according to White Law *et al* (1961). The solubility of linseed cake was reduced to 84.4 per cent.

5. The DM consumption in control group ranged from 3.57 $\pm$ 0.14 to 4.68 $\pm$ 0.06 and in the experimental group from 3.64 $\pm$ 0.09 to 5.56 $\pm$ 0.04 kg per 100 kg body weight per day.

The average DM intake was 4.20 ± 0.09 kg/100 kg body weight per day in control group and 4.58 ± 0.13 kg/100 kg body weight/day in experimental group. Dry matter intake markedly increased in the experimental group.

The digestibility coefficient of dry matter and crude protein was 76.4 ± 0.04 and 84.6 ± 0.07 in control group and 75.6 ± 0.07 and 74.3 ± 0.04 in experimental group. There was no significant difference in digestibility coefficient of dry matter between control and experimental group, although the digestibility coefficient of crude protein was significantly decreased in the experimental group.

In the nitrogen balance study the nitrogen retention was 1.92 ± 0.29 in control and 2.17 ± 0.41 in experimental group. Both the group was in positive nitrogen balance. There was no significant difference on nitrogen retention between the groups.

6. The mean body weight ranged from 7.00 ± 0.08 to 10.12 ± 0.11 (kg) in the control and 7.05 ± 0.12 to 10.20 ± 0.06 (kg) in the experimental group. The difference in rate of gain between groups was not significant. The average rate of growth was 55.7 gms/day in control and 56.1 gms/day in experimental group.

7. The highest production of total volatile fatty acid at 2 hours of incubation was 101.75 ± 1.93 (m. mole) per litre SRL in control and 91.25 ± 1.99 (m. mole)/litre SRL in experimental group.

The total volatile fatty acid was reduced in the experimental group when compared with control.

8. Rumen liquor was collected from each fistulated goat in both groups at 0, 2, 4, 6, 8 hours intervals after feeding.

9. Ammonia nitrogen in rumen liquor were estimated by Schwartz et al (1964) in both groups. The rate of protein degradation was indicated by decrease in ammonia nitrogen during incubation. In experimental group of kids ammonia nitrogen production was reduced by maximum 75 per cent when compared to control.

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