USE OF UNCONVENTIONAL FEEDS IN BROILER RATIONS

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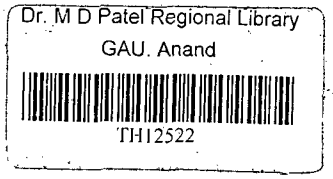

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C E R T I F I C A T E

This is to certify that the thesis entitled " Use of unconventionnal feeds in broiler rations" submitted by Shri Gian Chand in partial fulfilment of the requirements for the degree of M.Sc. (Agri.) in Animal Nutrition embodies the results of a piece of research work carried out by him under my guidance and that no part of the thesis has been submitted by him anywhere for any other degree.

Shri Gian Chand has completed his course work and passed the preliminary examination.

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I N T R O D U C T I O N

To-day India faces one of the most urgent and pressing problems of food shortage. Feeding livestock efficiently and economically therefore is a serious problem In view of the shortage of food for human consumption, it is advisable to minimise the use of ingredients used for human diets in formulating feeds for livestock. Due to such a state of affairs, feed problem for livestock has become acute from chronic shortage in the last five years or so. This is partly due to the continued failure of monsoon rains in many parts of the country and also due to the phenomenal rise in our population termed as ' population explosion '. To solve the food problem we can no longer continue to rely exclusively on our agricultural produces which are always in short supply.

As regards feed and fodder situation as early as 1937 Wright gave the figures as 50 per cent shortage of green fodder including 17 per cent extra grazing land. Kehar (1953) estimated the availability of digestible protein and starch equivalent at 23 and 38 per cent respectively. The Joint Committee of Indian Council of Agricultural Research and Indian Council of Medical

Research (1954) on the basis of 1951 cattle census, gave the figure as 50 per cent shortage of green fodder and 65 per cent concentrates. Whyte and Mathur (1965) gave the figure as 9.85 million tonnes availability of concentrates against 57.17 million tonnes requirement i.e. 82.8 per cent shortage of concentrates.

Importance of poultry products in human nutrition:

The concept that nutrition is a fundamental factor in animal's resistance goes back to prehistoric time. Poultry is an efficient producer of a good quality food. In order to solve the food problem, it is highly desirable to seek and find alternative or additional sources of food supply. In this respect poultry can effectively meet a part of food requirements of a large section of population.

Poultry, like other meat is valuable for its protein, since protein of good quality is an excellent body building material. It is a good source of phosphorus and iron. Poultry meat also contains riboflavin, thiamine and nicotinic acid. Considering only the edible

portion of the meat (taking out the bones, gristle, fat or loss in cooking) chicken is by far the best buy. Mostly poultry contains sufficient fat for tenderness and palatability, yet their calorie content is lower than any other meat. Chicken meat is higher in linolenic acid content than any other meat. Linolenic acid alongwith other polyunsaturated fatty acids is considered to be good for health. Thus, the nutrient value of the present day poultry meat ranks high compared to the other popular meats. The F.A.O. report (1965) shows that the consumption of animal protein in India is the lowest in the world. Poultry meat is very useful in fighting against malnutrition.

The egg protein has a superior biological value and is taken to be a standard for comparing other proteins from foods. The biological value of egg is 93, of milk 85, of beef liver 77, of beef muscle 69 and of wheat 67. Hen's egg occupies unique position in our diet because of its high nutritive value, decliçate flavour, comparatively easy availability; it cannot be adulterated easily, it can be cooked in different ways and it supplies important body building nutrients in a convenient form.

The importance of poultry in meeting the food requirements of a nation was recognised by an agricultural team sponsored by the Ford Foundation (1959) which in its report on ' India's food crisis and steps to meet it ' strongly recommended that steps should be taken immediately to encourage expansion of the poultry industry.

Ruminants versus poultry:

Ruminants can thrive on poor quality feed stuffs like roughages alone, quite efficiently although a portion of concentrates is required in their rations. Poultry can not utilize roughages except a small quantity of high quality roughage viz. very tender leafy shoots. This is due to the set up of the digestive tract. Quality concentrates are very essential for the life and well being of the poultry which is not the case with ruminants.

Development of poultry industry in India:

The following table shows the increase of poultry in India. It increased slightly more than double from 1945 to 1961.

Poultry population in India:

Year	Poultry population	Index of population with 1945 as base	Percentage increase
1945	5,82,28,976	100.00	-
1951	7,34,20,783	126.07	26.07 (1945-1951)
1956	7,46,83,165	162.58	28.96 (1951-1956)
1961	11,69,14,129	200.75	23.48 (1956-1961)

Over a period of 10 years from 1951 to 1961, poultry has shown the most rapid increase in number. Poultry reproduces rapidly and broilers are the most efficient in converting raw feedstuff and by-products into high protein food which is urgently needed to improve the nutritional standards of the people. A comparison in the increase of population in diffetent species from 1951 to 1961 is presented herewith.

Livestock population in India: (Million)

Year	1951	1961	Per cent increase
Sheep	39.00	40.30	3.3
Cattle	155.09	175.70	13.3
Buffaloes	43.35	51.10	17.9
Goats	47.00	60.80	29.4
Poultry	73.42	116.90	59.2

It is seen that poultry has increased very rapidly from 1951 to 1961 as compared to other species. Improved poultry and dairy goats can very rapidly increase the food supply of animal origin, for both are capable of rapid increase in number as compared to large species of livestock.

Efficiency of domestic animals in conversion of vegetable protein to animal protein:

The efficiency of domestic animals in the conversion of vegetable protein to animal protein is as follows:

S.NO:	Animal protein sources	: Protein efficiency percentage
1	Egg medium light bird (egg daily)	30.7
2	Egg medium light bird (200 eggs per year)	26.4
3	Poultry (table)	21.26
4	Pork	19.0
5	Milk whole-life	18.1
6	Beef baby (7 cwt.)	15.3
7	Bacon (restricted feeding)	15.2
8	Lamb	13.2
9	Fat bullock (12 to 15 cwt.)	8.7

From the table, it is quite evident that poultry is the efficient convertor of vegetable protein into animal protein.

Deficiency and shortage:

There are certain limiting factors in the expansion of poultry industry in India. Most of the poultry feed mixtures contain 40 per cent cereals which make poultry industry compete with the human needs for cereal grains. The dietary habits of the people are such that cereal consumption stands at a high level of about 15 ounces per head per day. As such there is an overall shortage of grains in the country and the requirements to some extent are met from imports. Certain estimates with regard to the requirements of cereals in poultry feeding have been made in the formulation of the Five Year Plans (I.C.A.R., 1967). Based on these estimates, the requirements of grains are as follows:-

Poultry population and grain requirements:

	1961	1966	1971	1977
Number of poultry(million)	116.90	235.60	470.20	940.40
Number of laying birds (million)	45.00	90.00	190.00	360.00
Feed requirement(cereals in million tonnes)	0.50	1.00	2.00	4.00

The problem of poultry feeding therefore, should be handled from the aspect of replacement of grains by agricultural or industrial by-products and wastes.

Other side problems as they arise are also to be faced. Rice polish and oil cakes used in the feeding of poultry are now being subjected to deoiling for diversion of the oil for industrial purposes. Now we get rice polish of poor quality and deoiled cakes which have lower feeding value as compared to the normal feedstuffs. By and large, there is a huge shortage of concentrate feeds for poultry feeding and so new resources need to be explored.

Need for research on substitute feeds:

Agricultural team sponsored by Ford Foundation (1959) recommended extensive use of food by-products and waste materials to make expansion of the poultry industry possible without competing with humans for grains. Indian Council of Agricultural Research (I.C.A.R.) in its publication " Report of the study group for exploring possibilities of using food by-products as poultry feed" (1967) has recommended the use of a number of by-products

which include, for example:- fish waste, meat waste, dairy waste, silk industry waste, fruit and vegetable waste, subsidiary wastes such as penicillin mycelium residue, molasses, distillers and brewer's waste, edible refuses, starch industry by-products etc.

As regards the use of substitute feeds (by-products and wastes) a few studies have been carried out on large animals at Indian Veterinary Research Institute, Izatnagar and recently I.C.A.R. sponsored project for investigation on agricultural by-products and industrial waste materials for evolving economic rations for livestock indicate that some of the waste products like tamarind seeds, cassia tora seeds, mango seed kernel, tapioca roots etc. can be used satisfactorily and economically.

Mango seed kernel, which is a by-product obtained after the use of edible portion by human beings has been estimated to be available to the extent of about one million tonnes per year and the studies on large animals indicate that it can be classed with some of the conventional concentrates. Similarly seeds of cassia tora plant, which are available to the extent of more than two

thousand tonnes per year only from Gujarat State, have given good results with large animals when used as a part of concentrate mixture. In a similar manner, tamarind seeds, tomato pomace etc. the entire produce of which are not utilized should be tried. Sufficient literature on the use of subsidiary by-products even on large animals is not available although their utility was shown by Kehar and Co-workers as far back as 1939. In case of poultry meagre data are available on this subject.

Recently I.C.A.R. is considering the utilization of non-traditinal oil cakes and meals such as castor seed oil cake, mowha seed oil cake and even neem seed cake for large animals.

In order to minimise the competition of livestock with the human race, utilization of certain waste products remains to be the only alternative for the Animal Nutritionist. However, the limitations in this respect are that such waste products should be (i) available in abundance, (ii) economic, (iii) nutritious, (iv) palatable and .

without toxic factor. In this report only such feeds have been chosen which are available in large quantities in Gujarat and if found suitable, the poultry feeders should find no difficulty in using them as feed for their birds.

In the present study an investigation is undertaken on the use of unconventional feeds like mango seed kernel, cassia tora seeds, tamarind seeds, tomato waste and penicillin mycelium residue in broiler rations.

R E V I E W O F L I T E R A T U R E

During the past few decades poultry has developed to a great extent due to the multiplication of improved and imported genetic material in our country. The conventional poultry feed mixtures generally contain about 40 per cent cereal grains which form the staple diet of the people and are in short supply. Since the use of conventional ingredients for poultry under these circumstances would compete with human nutrition, poultry rations need to be based on such ingredients which can not be used for human consumption. In view of this fact, it is imperative for the Animal Nutritionist to tap new resources of feed and particularly the so called unconventional feeds. The unconventional feeds include: Penicillin mycelium residue, Maize gluten, chunnies, Tapioca meal, corn distiller' drying grains mango seed kernel, waste apples, blood meal, swill, silk worm pupae, mohwa cake, rape seed meal, cassia tora seed, sal seeds etc. Composition of these as available in literature is given in Appendix I. A review of literature related to the use of unconventional feeds in poultry has been given below:

(1) Antibiotic by-products:

(a) Penicillin mycelium residue (PMR):

The presence of unidentified chick growth factor in PMR was demonstrated by Bruins et al (1953). Similarly Shaefer et al (1955) also studied the value of PMR and streptomycin mycelium residue (SMR) as a source of unidentified chick growth factor. It was found that growth was best stimulated by 3 per cent PMR or SMR or a combination of 1 per cent PMR and 0.5 per cent SMR.

These investigations established PMR as a nutrient having unidentified growth factor.

Obradovic (1957) described an experiment in which fresh and dried PMR was fed to chickens which gave higher gains and better feed efficiency than control groups without PMR.

Desai et al (1961) in their studies on economical rations for growers found that inclusion of 5 per cent PMR significantly improved growth in chicks.

Ogra et al (1963) in studies on econimics poultr ratibns found that PMR alongwith fish meal and meat meal gave better growth, feed efficiency, and the cost was less per unit gain.

Srivastava and Mukherjee (1966) studied the growth and egg production capacity of several cheap poultry mashes using waste products. It was found that when the ration contained rice polish 35 parts, FMR 33 parts and silk worm pupae 13 parts and costing Rs. 15.00 per 100 lbs. compared to Rs. 29.80 per 100 lbs. for the standard mash, gave much more cheaper growth (about 100 per cent) and egg production (about 40 per cent) although the efficiency of both growth and egg production was higher by about 10 and 18 per cent respectively with the standard mash.

From the results of various investigations, it is clear that FMR in combination with other feeds can be used as a satisfactory feed ingredient.

Rudolph (1957) observed that 5 and 15 per cent FMR significantly increased gains but did not improve efficiency of feed conversion of white leghorn cockerels fed a ration containing 9 per cent animal protein as fish meal. When fish meal was reduced to 3 per cent and 5 per cent FMR did not improve growth or efficiency. It

was concluded that PMR can partly replace fish meal in poultry ration but is slightly less economical. Similarly Henning et al (1961) observed that gain in weight was significantly less when PMR replaced half of the fish meal (12 per cent) of the control ration but contrary to above findings feed conversion was better. This shows that partial replacement of fish meal by PMR results in significant reduction in weight gain.

Bose et al (1959) studied the value of PMR as a protein supplement in a growing chick ration. One group received 100 parts of basal ration supplemented with 10 parts of PMR, second group received 100 parts of basal ration supplemented with 5 parts PMR and 2.5 parts fish meal. The results showed that PMR at 10 per cent without any animal protein supplement produced moderately good growth in chickens during 8 weeks experimental period, while inclusion of PMR and fish meal, in combination produced 9.6 per cent increased growth over group one.

Fernandes (1960) observed that when PMR replaced half the fish meal or completely, the growth was better than the control ration containing 10 per cent fish meal.

The respective body weights and feed efficiency at the end of 14th week were 1960, 1186 and 899 gms and 3.56, 3.45 and 4.06. It shows that PMR can replace all the fish meal. This may be due to better assortment of amino acids of different feed ingredients with PMR.

Agarwala and Agarwala (1964) observed that when 1/3 of groundnut cake was replaced by PMR, the gain in weight was significantly reduced. They further (1966) noted that the partial replacement resulted in better growth than the entire replacement of mustard cake by PMR.

These finding indicate that PMR can partially replace fish meal and mustard cake.

Bose and Sen-Gupta (1957) reported that PMR can very satisfactorily replace skim milk in chick ration. Halama (1958) observed that when 6 per cent PMR replaced same percentage of dried yeast in growing chick ration, the weight gains and feed efficiency was better than the control ration. Halaj et al (1964) observed that when PMR replaced soya preparation called stamovit, the growth

and feed efficiency was significantly improved. These investigations show that PMR can be used advantageously to replace skim milk, dried yeast and soya preparation.

Sathe and Bose (1962) observed that when PMR 15 per cent replaced 10 per cent maize meal and 5 per cent groundnut cake of basal ration chiefly containing fish meal 5 per cent, maize meal 25 per cent and groundnut cake 30 per cent, the weight gains and feed efficiency were significantly improved.

Mathur and Karnani (1965) observed that when PMR 10 per cent replaced all fish meal (5 per cent) and lucerne meal (5 per cent) of the basal ration the improvement in growth was highly significant which indicated the presence of unidentified growth factor. The increase in average weight gain over the chicks on control ration was 20 per cent.

Sayed (1969, unpublished data) in a study on broiler chicks found that groundnut cake and fish meal could be partially substituted in a conventional ration by PMR without impairing feed efficiency upto 8 weeks of age and that substitution by PMR in 1/3 or 1/2 G.N.C. protein and 1/2 fish meal groups were less economical when cost of PMR was taken into consideration.

These investigations bring out that FMR can efficiently replace two feed ingredients e.g. maize and groundnut cake or fish meal and lucerne from the rations of growing chicks.

From the results of various investigations it can be concluded that FMR has a great potentiality as a poultry ingredient and also it has been shown to posses unidentified growth factor. By and large, it has proved to be a satisfactory feed ingredient in replacing various conventional poultry feed ingredients.

(2) By-products of legumes cereals and tubers:

(a) Maize gluten feed:

Slinger et al (1944) used corn gluten meal as a vegetable protein supplement to replace meat meal from 0 to 25 per cent in the ration of growing chicks. Corn gluten proved satisfactory upto 18 per cent of the ration, with optimum at 10 per cent level. When levels of 22 and 26 per cent were used. the growth rate was some what reduced.

Clark et al (1948) found that corn gluten meal alone was not satisfactory unless fish meal was added to a ration. They found that even in combination with meat scraps, corn gluten meal was still inferior to soybean oil meal.

Camp et al (1957) reported three trials in which maize gluten replaced 2.5, 5.0 or 10 per cent soybean oil meal and milo rations for chicks. In the first trial growth upto 10 weeks of age was significantly less on the ration with 10 per cent maize gluten. In the second, methionine and also fish meal were included in the rations and growth was less only when 2.5 per cent gluten was given. In the third trial a supplement of 4 gm penicillin per ton of feed with or without 0.05 per cent methionine was added. Without methionine 5 and 10 per cent and with methionine only 10 per cent maize gluten increased growth significantly

Fangauf et al (1959) observed that maize gluten meal could replace upto 66.7 per cent and maize gluten feed upto 53.3 per cent soybean meal protein in the rations of chicken without ill effects if the resulting energy deficit was made up.

Ferreira and Decastro (1964) reported an experiment in which the basal diet contained 56 per cent maize meal. When half or all the maize meal was replaced by maize germ meal, weight gain was greater than the control.

These investigations show that the different by-products of maize which contain fair amount of protein when properly supplemented with amino acids or animal protein prove a good source of proteinous feeds.

(b) Chunnies: Mukherjee et al (1966) conducted experiment on day old R.I.R. chicks using 5 rations containing raw and autoclaved chunnies of red (Cicer arietinum), black (Phaseolus mungo var. radiatum) and green gram (Phaseolus aureus) at 25 per cent level replacing parts of yellow maize, barley, groundnut cake and fish meal. They found that untreated black gram chunni ration and the control ration gave the best growth in chicks. The former was significantly cheaper than the control. The use of red gram or green gram chunni in the ration does not offer any advantage.

(c) Tapioca waste (Manihot utilissima):

Tabayoyong (1935) compared the value of cassava meal with rice bran on chicks and found that rice bran fed chicks grew faster than those fed cassava refusal meal, while chicks fed a combination of two feeds were intermediate in rate of growth. The amount of feed consumption per unit of gain was highest in the cassava group and also mortality was higher in cassava group than in other groups. On the basis of rice bran ration as 100, the cassava refusal meal was only 77.3 per cent effective, while the combination of the two feeds was 92.3 per cent efficient.

Klein and Barlowen (1954) studied tapioca meal in rearing chicks at 10, 20 or 40 per cent levels replacing maize and wheat. Feed intake and efficiency of feed utilization were reduced by tapioca meal. They concluded that tapioca meal contains something which reduces feed intake and that not more than 10 per cent should be included in chick rations.

Vogt and Penner (1963) conducted 5 trials on Nichols-Lohmann chicks lasting 8 weeks using tapioca meal

upto 30 per cent level replacing maize and found that weight gains were not affected by upto 10 per cent cassava; larger amount depressed growth during the first few days. Feed conversion was worse with tapioca meal than with maize. Nicotinic acid, calcium Pantothenate or choline chloride did not improve gain or feed conversion.

These studies reveal that tapioca meal contains some factor which depresses growth and reduces feed intake and that not more than 10 per cent should be used in poultry rations.

Sathe and Bose (1968) in an experiment on growing poultry observed slightly better responses replacing yellow maize (100 and 50 per cent) by tapioca meal. The response was little better than penicillin mycelium but the results were non significant.

Vogt and Stute (1964) studied tapioca meal in broiler feed at a level of 25 per cent replacing barley, whea and maize from 1 or 4 weeks of age found that more than 10 per cent tapioca meal reduced gain when given from one week of age.

These investigations indicate that tapioca meal can be used in poultry rations replacing cereals.

(3) Fermentation by-products:

(a) Corn distiller's dried solubles and corn distiller's dried grains with solubles:

Allman and Branion (1938) showed that the addition of corn distiller's dried grains to chick rations improved growth, feather development and feed consumption.

D'Ercole et al (1939) indicated that the distiller's grains and slop were a good source of thiamine and riboflavin.

Scott and Glista (1949) used corn distiller's dried solubles at 2 per cent level in high energy broiler ration and obtained satisfactory results.

Runnels (1955) used a factorial designed experiment to study corn distiller's dried solubles at dietary levels of 0, 2.5, 5 and 7.5 per cent. The diets were balanced for protein and vitamins but energy content

was not adjusted. A growth response was obtained with corn distiller's solubles alone or in combination with 2.5 per cent dried cheese whey or condensed fish solubles or a combination of these two materials. He (1956) continued to use the factorial experiment but adjusted the diet to contain the same levels of both protein and energy irrespective of the experimental variables. The finished feeds contained dehulled soybean oil meal and feed grade fat. Approximately the same response was obtained with corn distiller's dried solubles in both 950 and 1100 calorie diets. Broiler growth and feed efficiency also responded to corn distiller's dried solubles in the presence of 2.5 per cent level of both Menhaden fish meal and dried cheese whey and about the same improvement was observed as in the all vegetable protein diet. He further (1957) demonstrated that chicks fed a very high quality starter feed showed a growth response to corn distiller's dried solubles added to a finisher diets.

These investigations indicate that corn distiller's dried solubles can be used effectively in poultry ration to improve growth and feed efficiency.

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Insko et al (1937) presented report on the possibility of using distillery by-products for poultry feeding. The results of three feeding trials indicated that distillery slop (92 per cent moisture) fed ad libitum, could be used to advantage to replace a portion of all the gound yellow corn in the mash for growing chicks.

Shea et al (1941) reported that corn distriller's dried grains with solubles may be used to replace other more expensive riboflavin sources in chick ration and that corn distiller's dried grains with solubles may successfully replace substantial amounts of dried skim milk, soybean meal and fish meal in standard rations.

Dickens et al (1941) also found corn distiller's dried grains with solubles satisfactorily replaced dried skim milk and fish meal or all the fish meal and part of meat scraps in standard laying ration.

Fellers (1942) conducted tests with corn distiller's dried grains with solubles for two years on laying pullets. The control mash containing 5 per cent dried skim milk was replaced with corn distiller's dried grains pound for pound. At the conclusion of the test the birds

in the test pen were still laying at a good rate, while many of the birds in the control pen were molting because their body weight was not maintained. The birds in the test pen were larger and seemed to be in better physical condition at the end of the test.

In the 2nd year control ration had 2.5 per cent dried skim milk while test birds received the same mash except that all skim milk was replaced with distiller's dried grains with solubles pound for pound. The results indicated that feed per dozen eggs and feed cost per dozen eggs were lower with test pen and also mortality was low.

Nelson et al (1944) reported that corn distiller's grains without solubles were used satisfactorily in a starter and broiler ration to replace ground oats and dried solubles, but not wheat bran and dried distiller's solubles. When rations containing 2.5 per cent dried solubles were fed, both wheat bran and ground oats and wheat bran alone were effectively replaced. There was an indication that a factor present both in dried solubles and wheat bran, but absent, or of low value in corn

distiller's dried grains without solubles and ground oats. is responsible for growth differences.

These findings indicate that corn distiller's grains with and without solubles can be effictively used in poultry rations.

(4) Fruit and vegetable canning industry:

(a) Date stone: (Phoenix dactylifera)

Alifi et al (1966) reported that when 5 or 10 per cent of date stone meal replaced barley, live weight gain of RIR chicks to 6 weeks of age increased but there was no difference in case of Fayoumins. The increase in live weight gain was directly related to the greater intake of feed; efficiency of feed conversion was not affected.

(b) Jaman seeds (Eugenia Jambolana)

Bose et al (1960) reported that inclusion of Jaman seeds unto 20 per cent level resulted in great

depressing effect on egg production. The hatchability of eggs was not adversely affected and feed utilization for growth was very low.

Bose et al (1952) in an experiment with growing chicks from 0 to 8 weeks replaced 20 per cent yellow maize by Jaman seeds in the control ration and observed that the rate of growth, feed consumption and food utilization were similar to the control group.

These investigations show that Jaman seeds can be used in chick rations but not in layers.

(c) Mango seed kernel: (Mangifera indica)

Kehar and Chanda (1946) studied the supplementary value of mango seed kernel flour by partial and total replacement of wheat and maize from the stock diets by using rats for a period of over 3 generations found no declination in growth and reproduction when it replaced 60 per cent of the wheat or maize quota in stock diets, although it gave significant differences when the wheat or maize was totally replaced by mango seed kernel.

Bose et al (1950) in an experiment to minimise cost of feeding in layer ration found that mango seed kernel upto 20 per cent level gave some beneficial effects on egg production.

Bose et al (1952) studied utilization of mango seed kernel in simplified poultry rations on growing R.I.R. chicks from 0 to 8 weeks. Replacement of 20 per cent yellow maize by mango seed kernel indicated no deterimental effect. The rate of growth , food consumption and food utilization were similar in control and experimental groups.

Gupta et al (1966) in a study on W.L.H. day old chicks replaced 20 per cent maize with 20 per cent mango seed kernel and found that feed consumption in experimental group was comparatively more than the control group from the second week of age. Weight gain was slightly lesser in 8 weeks on mango seed kernel than control group and also the efficiency of feed utilization was slightly less in mango seed kernel group but it was economical.

Goswami and Kehar (1956) estimated the tannic acid content of mango seed kernel which was 2.8 per cent on dry basis in terms of gallotannic acid.

Datta and Bhattacharya (1959) determined the amino acid content of mango seed kernel of 4 varieties quantitatively and found that all the common essential and non essential amino acids are present in fairly balanced proportions. However, the amount of tryptophan, tyrosine, threonine and methionine are somewhat low and there was no significant difference in the quantitative distribution of amino acids in all the samples.

(d) Pineapple by-products (Ananas sativus)

Ross (1965) reported a study on the effect of pineapple stump by-products on chick growth. The by-products were given in place of an equal amount of basal diet based on maize and soybean oil meal but pineapple stump replaced only maize. The results indicated that pineapple stump starch could be given upto 10 per cent without significant effect on growth but 20 per cent of it significantly depressed growth and it showed that stump starch was not as well utilized as maize starch. Stump juice depressed

growth when more than 5 gm.per pound feed was given while 2.5 gm. had a beneficial effect. In another experiment upto 5 per cent stump juice was given without effect on growth or feed conversion. Growth and feed efficiency were not affected by 1, 2, or 4 per cent pineapple stump in the diet.

(e) Tomato waste (Lycopersicum esculentum):

Esselen and Fellers (1939) (on the basis of its vitamin A, B_1 and B_2 content) suggested that dried tomato pomace should be considered as a desirable feed.

(f) Waste apples (Pyrus malus):

Temperton (1944) reported an experiment wherein minced apples were fed to poultry upto a level of 77 per cent by weight of the food without affecting appetite or general health. The average daily consumption was 6 ounces per head per day and this resulted in 34 per cent saving in mash. . There was no effect on the physical condition of droppings.

(6) Miscelleneous feeds:

(a) Banyan fruit meal: (Ficus bengalonses)

Venkatakrishnan(1968) conducted feeding trials in chicks replacing maize in the conventional ration with banyan fruit meal at 20 per cent level and noted that the growth rate was statistically non-significant between control and experimental group.

(b) Blood meal:

In India blood meal is not available as yet. There is plenty of blood available from slaughter houses and a part of it is used as manure. The biological value of blood meal is affected by the conditions under which blood is processed. It is not very palatable to poultry. Blood could be absorbed by using rice or wheat bran as absorptive material. The blood and bran are mixed in equal proportions and the mass is exposed for drying. Frequent raking and breaking of the material is necessary.

Grau and Almquist (1944) fractioned beef blood into fibrin, serum and erythrocytes. It was observed that fibrin and serum fractions were good protein sources

for chick growth but erythrocyte fraction was of poor quality. It was observed that fibrin and serum supported chick growth and their efficiency of utilization was approximately equal to the sardine meal. Erythrocytes furnishing 30 per cent of the dietary protein reduce gain and feed efficiency. The erythrocyte fraction was found to supplement corn gluten meal very effectively when the ratio of corn protein to cell protein was 2:1.

SQuibb and Brahm (1955) observed that blood meal at 2 to 4 per cent level was a good supplement to sesame, corozo and cotton seed oil meal which are low in lysine.

Slinger et al (1956) showed that blood meal was equal to soybean oil meal with regard to chick growth when included in the diet at 3 per cent.

Experiments by Sathe and Bose (1962) in which basal ration with 10 per cent fish meal was replaced to the extent of 25 to 50 per cent by blood meal, the gain in weight for basal and two experimental rations were 453, 585 and 577 gm. respectively. It shows that blood meal is a valuable supplement to fish meal.

Ali and Momin (1964) reported an experiment in which protein supplement was partly of musterd cake and the rest from fish meal and blood meal. The comparative groups were fed 5, 10, 15 and 20 per cent fish meal and blood meal. At 10 per cent level blood meal gave significantly higher growth and better feed efficiency than fish meal.

Burton and Gartner (1965) observed that when ration containing meat and bone meal was replaced by blood meal in an experiment with W.L.H. X Australorp cockerels, the body weight was significantly greater with all amounts of blood meal and efficiency of feed conversion was also better than rations with no blood meal.

Gawecki *et al* (1966) fed ration containing maize meal, wheat, oat, soybean meal, lucerne and tankage to one group of chicks and other two groups were fed on rations containing 15 and 30 per cent mixture of potato peel and blood. The proportion of dried potato peel to blood was 85:15. It was observed that at both the levels, potato peel and blood mixture gave significantly lower weight gain than the control group. This shows

that blood meal in combination with potato peel is inefficient for growth of chicks.

Chaudhary and Chaturvedi (1966) used blood meal preparation (4 parts of dried blood and 1 part of wheat bran) to replace all meat meal and part of groundnut cake in the rations of growing chicks. One group had groundnut cake 20 and meat meal 10 per cent, in the second group all meat meal 10 per cent was replaced by 10 per cent blood meal preparation whereas the third group received 15 per cent blood meal preparation, the extra 5 per cent blood meal being replaced at the expense of groundnut cake. The rate of growth was significantly better in both the blood meal groups as compared to control group. This shows blood meal in combination with wheat bran is an excellent substitute for meat meal and some part of groundnut cake.

These investigations clearly indicate that blood meal is an effecient partial or complete substitute for certain conventional feeds like fish meal, meat meal or groundnut cake and it is also a satisfactory source of lysine in all vegetable protein rations.

It may be concluded that blood from slaughter houses which has no commercial value may be effectively utilized as a protein supplement in poultry rations.

(c) Cashew apple meal: (Anacardium occidentale)

Venkatakrishnan (1968) conducted feeding trials in chicks replacing 25 per cent of maize in the conventional ration with cashew apple meal. The growth rate was uniform in both the groups.

(d) Keratin products: Keratin proteins have been reported to be of little value by some research workers while some reports indicate that certain treatments applied to keratins make them useful as a protein source.

Slinger et al (1944, 1955) found that a product consisting of a finely ground mixture of hoofs and horn was of little value as a protein supplement in a chick-ration. Quereshi (1962) also found horn and hoof meal to be a poor substitute for meat meal in the absence of other additional sources of animal protein.

On the other hand, Wagner and Elvehjem (1943) and Newell and Elvehjem (1947) reported that finely powdered swine hoof was well utilized by chicks particularly if heat was minimised during grinding.

Dubiska and Wojciak (1961) estimated the digestibility of horn meal and horn meal hydrolysate to be 79.3 and 97.8 per cent respectively in four adult cocks. In the second experiment 20 per cent protein of basal ration was replaced by horn meal or horn meal hydrolysate . Gains in live weight were best with horn meal which was about 200 gms more than with hydrolysate.

Mckerns and Rittersporn (1962) have reported that keratin meal can replace 50 per cent of soybean oil meal in commercial broiler ration.

The keratin products are normally waste products in animal industry but some of these investigations have shown these to be of considerable nutritive value. The use of powdered keratin products in poultry feeds with adequate supplementation would save considerable amount of conventional feeds.

(e) Liver residue meal:

Venkatachalam et al (1965) found that 10 per cent Sun-dried liver meal was superior to 10 per cent fish meal in promoting growth of chicks.

Venkatakrishnan (1968) reported that in a chick ration containing fish meal at 10 per cent level the liver meal can replace the fish meal with advantage.

These findings indicate that liver residue meal can be efficiently utilized for poultry feeding.

(f) Meatscrap and meat meal:

March et al (1950) and Patrick (1953) found that the principal amino acid deficiency in practical type rations containing meat scrap was of lysine. Kratzer and Davis (1959) showed that addition of tryptophan and either cystine or methionine to meat scrap improved growth. There was no evidence that lysine was deficient. The fact that lysine was shown by some workers to be the main deficiency in practical rations containing meat scrap probably reflects the deficiency of lysine in other components of the ration which was not entirely corrected by the meat scrap.

Schneider et al (1958) in their experiment on growing chicken observed that cooked meat offal gave better growth than the basal diet containing all vegetable proteins.

Wismam and Engel (1961) studied hydrolysed hide scrappings replacement on the basis of protein from 12.5 to 75 per cent of the soybean meal. It was found that when more than 25 per cent of soybean meal was replaced, the growth was depressed.

Sathe and Bose (1962) reported an experiment in which the basal ration contained 10 per cent fish meal. It was observed that the entire replacement of fish meal by meat meal proved to be unsatisfactory, but when half the fish meal was replaced by meat meal, gain in weight was significantly higher than in the control. Isakov and Trifunovic (1963) obtained similar desirable results of supplementation of fish meal by meat meal.

Ali and Momin (1964) reported an experiment in which the basal ration contained 30 per cent mustard meal. Meat meal at 5, 10 and 15 per cent levels replaced mustard meal. It was observed that meat meal proved to be most efficient at 5 per cent level.

Summers et al (1964) observed that ontario meat meal was deficient in 6 amino acids, methionine, trytophan, isoleucine, cystine, threonine and atginine as compared to soybean meal. When these amino acids were added to meat meal, weight gains were satisfactory during the experimental period of two weeks.

These investigations show that supplementation of tryptophan and either cystine or methionine were found to be effective in improving growth of chicks fed meat scraps. It is also seen that the value of meat scrap or meat meal vary with the different sources.

(g) Silk worm pupae:

Mangold and Dankohler (1936) compared the feeding value of dried silk worm pupae ground to meat with equal weights of fish meal at 10 and 20 per cent levels of ration in W.L.H. pullets. The results with fish meal were superior in all respects. The higher allowances of dried pupae gave more eggs but had an unfavourable effect on live weight as compared with the lower allowances. They suggested that the unfavourable results were associated with the high oil content of pupae and that oil extracted pupae would be more suitable.

Fangauf and Haensel (1938) reported that when unextracted silk worm pupae meal was used as sole protein concentrate forming 25 per cent of the dry mash, it did not prove satisfactory.

Smirnov and Mamedov (1962) fed 220 gms pupae per head per month to hens, in that time hens laid 15.3 eggs each compared with 13.2 for control hens. Fertility and viability were also better in chicks from silk worm fed hens.

Bora and Sharma (1965) in a study on day old chicks for 4 weeks replaced 7 per cent fish meal in control diet by 4.67 per cent silk worm pupae in 2 groups. One group of experimental birds received extra Ca and P giving the same supply of Ca and P as for the control while the second group received no extra Ca and P. The gain per week in the groups with fish meal and pupae with and without supplementation with Ca and P were 13.34, 15.16 and 9.97 respectively, the first two were significantly greater than the third.

Srivastva and Mukherjee (1967) in studies on economic poultry rations found that on a mash mainly consisting rice polish 35 parts, FMR 33 parts and silk worm pupae waste 13 parts and costing Rs. 15.00 per 100 pounds compared to Rs. 29.80 for the standard mash got much cheaper growth rate (about 100 per cent) and egg production (40 per cent) although efficiency of both growth and egg production was higher by about 10 and 18 per cent respectively with the standard mash.

From these investigations it may be concluded that silk worm pupae if available at cheaper rates can be incorporated in poultry rations.

(h) Swill:

Temperton and Dudley (1944) reported an experiment with laying birds reared on rations containing swill. Feeding of swill in amounts rising to 63 and 69 per cent of the dry matter of the ration resulted in decrease in egg production, poor fertility and a fall in body weight. The lower amount of swill also decreased egg production but fertility and hatchability were satisfactory and the body weights of the birds and their progeny at 8 weeks were higher than those of other groups.

Mcmillon and Dudley(1941) reported that feeding 30 per cent town waste in poultry ration was a satisfactory substitute for the usual kinds of poultry food in the rearing of pullets and cockerels when given as dry mash. Higher levels produced no harmful effects although growth was less satisfactory.

Temperton and Dudley (1942) reported the effect of replacing the wheat middlings by an equal amount of dried swill or its equivalent of semi-dried swill on laying birds over six months period with no deterimental effect on egg production or health.

Temperton and Dudley (1944) reported three experiments on swill feeding. In the first experiment cockerels were successfully reared upto 9 weeks of age on the ration containing 50 per cent by weight of semi-dried concentrate swill. In the 2nd experiment they showed that capons could be fed from 9 to 36 weeks of age on a ration containing upto 96 per cent by weight of swill, although better results were obtained by the inclusion of a small amount of meat meal. In the 3rd experiment ration containing low (65 per cent) and high (upto 90 per cent) amounts of swill were fed to growing pullets from 8 weeks of age. Birds receiving the low amount of swill grew faster than control birds receiving mash

alone. Growth was not so rapid.in the high swill group.

From the above investigations it may be concluded that swill which is a waste can be incorporated successfully in poultry rations.

(6) Oil cakes:

(a) Akra cake: (Vicia sativa)

Mukherjee et al (1966) reported an experiment wherein they replaced most of the maize and groundnut cake by sesame cake 12 and akra cake 30 per cent in day old chick rations and found no significant differences between standard and experimental diets in efficiency of feed conversion.

(b) Castor Pomace (Ricinus communis)

Okamote et al (1965) in a study on castor pomace which was detoxified by washing with water or hydrochloric acid or.extraction with ethanol and fed to-chickens for 5 weeks from 2 weeks of age upto 40 per cent of the diet found some retardation of growth of males given 5 and 10 per cent while egg production by pullets was satisfactory.

(c) Coconut oil meal: (Cocos nucifera)

Coconut oil meal is high in fibre and low in energy value but surprisingly it has been found to give satisfactory results when used as one of the components in the rations of growers and layers.

Temperton and Dudley (1941) fed one group of layers a ration containing 25 per cent bran, the bran was entirely replaced by an equal weight of coconut meal in the other group. Over a period of 6 months egg production, body weight changes, mortality and return over feed cost were identical in the two groups.

Thomas and Scott (1962) described an experiment in which one group was fed solvent extracted coconut meal and the second group expeller coconut meal to the extent of 40 per cent in the ration of growing chicks. The ration was balanced in all nutrients. It was found that the growth was as good as the chicks on ration containing soybean meal, fish meal and meat scrap. There was an indication that solvent extracted coconut meal was better than expeller meal. Further, lysine in coconut meal appears to be severely damaged during expeller processing than during solvent processing.

It is evident from the above findings that coconut meal can be utilized advantageously to the extent of 40 per cent in the growers ration provided the ration is balanced in all nutrients.

Butterworth and Fox (1963) also observed that heat treatment of coconut meal lowers its content of available lysine and its net protein utilization.

Mugara (1964) reported an experiment in which day old RIR chicks were fed upto 5 weeks on complete diets containing 20, 30, 40 or 50 per cent solvent extracted coconut meal. It was found that the average weights of the chickens were about the same on all 4 diets and supplementation of methionine made no difference.

These investigations indicate that coconut cake can prove to be a potential economical ingredient in poultry feeding especially in the coastal areas of the country where it is available in plenty. Further, the solvent extracted meals are superior to expeller pressed meals.

(d) Mohwa cake: (Madhuca indica)

Mukherjee et al (1966) replaced most of the maize, some G.N. Cake and barley by mahwa cake in day old chick rations and observed that most of the chicks died on mohwa cake within one week.

Reddy et al (1966a) studied the use of mohwa residue in chick rations and observed superior weight gains and maximum feed utilization on diets containing 8 per cent mohwa residue. When levels were raised to 12 and 16 per cent there was a tendency for decrease in growth rate and feed utilization but did not differ significantly compared to the group fed control diet.

Reddy et al (1966 b) studied mohwa residue in laying pullets at 0, 5, 10 and 15 per cent levels replacing wheat refractions. No significant differences in weight gain, egg production, feed efficiency, hatchability and mortality were noticed between groups fed various levels of mohwa residue. The palatability of ration was not affected by the incorporation of 15 per cent mohwa residue in the layers mash.

These investigations indicate that further studies are needed to confirm whether mohwa cake can be used in poultry rations or not.

(e) Rape seed oil meal (Brassica compestris var.toria):

Studies on the effect of including rape seed meal in poultry rations indicated that this protein supplement possesses a goitrogenic property which resulted in sonsiderable thyroid enlargement.

Turner (1948) observed retarded growth and increase of 3.6, 5.3, 7.1 and 8.2 times in the thyroid weight to that of the controls by feeding 10, 20, 30 and 40 per cent level of the rape seed oil meal in the starting diet of the chicks for 3 weeks and concluded it should not be fed to growing chicks as it depresses thyroxine production and retards growth.

Clandinin et al (1959) studied various proportions of rape seed meal from 5 to 28 per cent of the rations for chickens replacing soybean oil meal. In all proportions rapeseed meal depressed growth and was goitrogenic. Further growth experiments with chicks showed that the processing

temperature used in preparing meal affected their feeding value. Growth was better with meals processed at 200 to 240°F than at 250° to 280° F. At the lowest temperature the lysine content of the protein was reduced from 6.24 to 5.59, at the highest to 4.12 per cent.

Clandinin (1961) concluded that sinapin, the bitter substance in rape seed oil meal is not responsible for growth depression in chick starter rations.

Agarwala (1964) studied the effect of replacement of groundnut cake with mustard cake on the performance of white Leghorn pullets. The basal ration containing 46 per cent groundnut cake was replaced by 46 per cent mustard cake. The study on eggs produced for one year revealved that mustard cake lowered egg production and percentage of hatchality of fertile eggs although it induced egg laying at an earlier date.

It may be concluded that after proper processing to remove the growth inhibiting factor from rape seed meal and supplementation with lysine would provide a useful source of protein for poultry rations.

(f) Safflower meal (Carthamus tinctorius) :

Kratzer and William (1951) fed safflower meal containing 50 per cent protein in combination with other sources of protein to provide 20 per cent protein for growing chicks. It was found that safflower meal as the only source of protein in the ration resulted in poor growth. However, 1/3 or 1/2 safflower meal protein when replaced by soybean meal or fish meal respectively, resulted in satisfactory growth. These workers demonstrated in this study that lysine and methionine were the limiting amino acids when safflower meal was included in practical chick rations. The use of adequate fish meal and soybean oil meal to supply these two amino acids resulted in the successful use of safflower meal at 15 per cent of the ration. When safflower cake completely replaced fish meal the growth was lower than control. Supplementation of lysine to safflower improved gain and efficiency.

Shoji et al (1966) have reported that decorticated safflower oil meal when used for feeding to 10 days old male chickens of W.L.H. X plymouth Rock

showed slower growth and lower feed efficiency compared to fish meal, fish meal + safflower oil meal, fish meal + soybean meal + safflower meal used as source of protein in the semi-synthetic diets. Addition of lysine improved the weight gains and feed efficiency but methionine had no improvement at all. Lysine plus methionine were not as good as lysine alone.

These findings indicate that safflower meal can be used satisfactorily at low levels as protein source and that its value is further increased by lysine supplementation.

(g) Suhflower meal: (Helianthus annus):

Pettit et al (1944) found that sunflower seed meal safely and satisfactorily replaced all of the meat meal (10 per cent) in chick starter ration.

Grau and Almquist (1945) reported that protein of sunflower seed is a complete single source of amino acids for growth of young chicks, when fed to provide 20 per cent protein in the diet.

Sokarvodki (1960) reported an experiment with white leghorn chickens in which comparison of poppy and sunflower seed oil meal was made. It was concluded that poppy seed meal is superior in nutritive value both when it replaced half and all sunflower meal.

Majer (1964) found that sunflower and cottonseed oil meal are similar in nutritive value and could wholly replace each other without ill effects in broiler starter rations.

Andric et al (1964) reported that sunflower meal satisfactorily and economically replace soybean oil meal in chick starter ration.

Patrik (1963) reported an experiment which contained groundnut cake 10 per cent and sunflower oil-cake 11 per cent in the control group or with 25, 50, 75 per cent or all of those replaced by peanut meal as 10, 20 30 or 40 per cent of the total diet. It was found that gain in weight increased with increase in the proportions of peanut meal and peanut meal alone was better than control group containing sunflower oil cake.

Botha et al (1964) reported an experiment with basal diet containing 17 per cent fish meal which was partly replaced by sunflower cake, groundnut cake or soybean meals, single or combined. It was found that sunflower by itself or with one or both of other meals gave satisfactory growth.

In view of the findings of several investigators it may be concluded that protein of sunflower is a complete single source of amino acids for the growth of chicks.

(h) Tobacco seed oil meal (Nicotiana tabacum):

Bosticco and Bonomi (1964) conducted a study on day old Arbor Acres chickens for 75 days . One group received control and the other two groupshad 5 and 10 kg tobacco seed oil meal substituted for part of soybea and groundnut cake and rice meal. At the end of experiment, average weights of chickens with 0,5 or 10 kg tobacco seed oil meal were respectively 2158, 2164 and 2112 gms. and feed per kg gain was 2.93, 2.92 and 3,03 kg. Feathering and pigmentation of skin and tarsus of all birds were normal.

(7) Seeds:

(a) Cassia tora seeds:

In a study on poultry, (I.V.R.I. report 1956-57) it was found that inclusion of 10 to 20 per cent seeds resulted in increase of intake and a decrease in the retention of nitrogen and minerals. The results indicate that cassia tora seeds may be used in poultry feeding.

Murty and Iyer (1957) in a preliminary trial on adult male birds wherein 10 per cent cassia tora seeds were incorporated showed that the metabolism of the proximate constituents and also that of water is not affected by incorporating 10 per cent seeds in an otherwise adequate ration and concluded that cassia tora seeds may be used in poultry feeding.

(b) Sal seeds (Shorea robusta):

Sal trees are found extensively in the sub-Himalayan region from Punjab to Assam and in the forests of eastern India , Bihar, West Bengal, Orissa and eastern Madhya Pradesh.

Nayak et al (1967) studied the use of decorticated sal seeds in chick rations at 2.5 and 5 per cent levels replacing maize and 2.5 and 5 per cent levels replacing

groundnut cake. They recommended that upto 5 per cent decorticated sal seeds can be used as maize substitute in poultry rations.

(d) Tamarind seeds (Tamarindus indica):

Saxena (1968, unpublished data) reported that tamarind seeds produce poor growth and result in mortality of poultry.

M A T E R I A L S AND M E T H O D S

This experiment was conducted in a full-monitor type poultry house at the Central Poultry Research Station, Institute of Agriculture, Anand, (Gujarat State). Four pens used for experimental purpose measuring 23.66 square meters each were steam sterilized with a steam jenny and then white washed. Each pen was partitioned into two compartments and these were used for the replications of each treatment. Deep litter system was followed. Litter used was bajra husk.

One hundred and fiftytwo (152) day old unsexed Arbor Acres broiler chicks from the same hatch were obtained from Arbor Acres Farm, India Ltd., Talegaon, District Poona (Maharashtra State). The chicks hatched on 3rd October, 1968 were shipped by rail and were received on 4th morning.

The birds were weighed individually, wing banded and randomly assigned to eight groups of 19 each, which were then again assigned at random in pairs to form two replications and four treatment groups. Individual weights and their group averages are given in Appendix II. The

average initial body weights of the birds which survived at the end of the experimental period for each of the replications and treatment are given in table 1.

Table 1. Average initial body weights of birds (gms.)

Replication	Treatment			
	T_I	T_{II}	T_{III}	T_{IV}
R_1	38.74	38.71	38.53	39.14
R_2	38.74	38.53	38.89	38.50
Average	38.74	38.61	38.70	38.80

The treatments were:-

I. Broiler starter feed (first 6 weeks)

(i) Control ration made up of conventional feeds (T_I)

(ii) 15 per cent mango seed kernel replacing rice polish in the control ration (T_{II})

(iii) 30 per cent mango seed kernel replacing rice polish in the control ration (T_{III})
and
(iv) 67 per cent unconventional feeds e.g. 30 per cent mango seed kernel, 12 per cent cassia tora seeds, 10 per cent tomato waste, 10 per cent tamarind seeds and 5 per cent penicillin mycelium residue mainly replacing rice polish and wheat. (T_{IV})

II. Broiler finisher feed (7th to 12th week)

(i) Control ration made up of conventional feeds (T_i)

(ii) 15 per cent mango seed kernel replacing rice polish in the control ration (T_{ii})

(iii) 15 per cent mango seed kernel and 15 per cent cassia tora seeds raplacing rice polish in the control ration (T_{iii})

(iv) 40 per cent of unconventional feeds e.g., 15 per cent mango seed kernel, 10 per cent cassia tora seeds, 10 per cent tomato waste and 5 per cent penicillin mycelium residue/ (T_{iv})

The gunny bags were spread over the litter so that birds could learn to eat from the feeders. These gunny bags were removed after 20 days. The chicks were fed ad. libitum. The left overs were again fed after weekly weighing as is the case under practical conditions. Water was also available ad. libitum and was changed daily in the morning.

In each replication one electric brooder was installed and the temperature of the brooder was kept initially at 35°C which was reduced by 2.8°C weekly till it reached 24°C at the end of 4th week when brooders were removed. Light was provided for 24 hours so as to achieve maximum feed consumption.

Feeder space and water space:

Feeder space was given at the rate of 2.5 linear cm. per chick for the first 3 weeks, 4.4 linear cms. per chick from 3 to 6 weeks and 13.5 linear cms. during 7 to 12 weeks period.

Water space was provided at the rate of 0.5 and 1.0 linear cm. for the first two weeks and 3 to 12 weeks respectively. In each pen floor space per bird was 0.62 sq. meters.

Observations:

Detailed records were kept for:-

(i) Weekly body weights of individual birds.

(ii) Weekly feed offered, left overs and actual consumption.

(iii) Mortality.

Sex was determined at the 9th weighing.

The data were processed for:-

(i) Average weekly gain in body weights.

(ii) Average weekly feed consumption per chick.

(iii) Feed efficiency which is the ratio between feed consumption per unit gain in weight.

(iv) Profit or loss at weekly intervals was estimated on the basis of prevailing market rate of the live birds viz. at Rupees 4.50 per kg. minus the cost of feed, initial cost of chick and over head charges. The feed cost taken into account was the one at which various ingredients were purchased from the market.

Methods of analysis:

The feeds were analysed individually for proximate composition according to A.O.A.C. (1965) and the rations were formulated taking into consideration the ISI standards for broiler Feeds (1967). The details of ingredients, their composition, proportion in different rations together with their market rates are given in Appendix III.

The metabolizable energy (M.E.) values were obtained from the literature for the conventional feeds while for unconventional feeds, M.E. values were calculated according to Titus (1961). Amino acids methionine, cystine and lysine were calculated in the ingredients on the basis of actual protein percentage.

The composition of the rations formulated from the composition of individual ingredients and their proportion (Appendix III) is presented in table 2.

Table 2. Composition (analytical) of different feeds.

S.NO	Particulars	ISI stds. (1967)	T_I	T_{II}	T_{III}	T_{IV}	ISI Stds. (1967)	T_i	T_{ii}	T_{iii}	T_{iv}
1.	Moisture	10.00	9.1	9.3	9.3	9.4	10.00	9.6	9.7	9.7	9.8
2.	Crude protein	22.0	23.0	23.2	22.3	22.9	19.0	20.0	19.2	20.2	19.3
3.	Ether extract	-	8.1	8.3	8.6	9.0	-	9.6	911	8.0	8.6
4.	Crude fibre	6.0	7.6	6.3	5.1	6.4	6.0	6.2	5.4	6.0	7.8
5.	N.F.E.	-	43.1	46.9	51.4	51.9	-	49.2	52.6	52.7	50.4
6.	Ash	-	18.2	15.3	11.7	9.8	-	15.0	13.7	13.1	13.9
7.	Silica	3.5	8.6	7.2	4.9	2.9	3.5	4.0	3.7	3.3	3.9
8.	Total phosphorus	-	1.44	1.32	1.09	1.0	-	1.67	1.46	1.32	1.13
9.	Available phosphorus	0.40	0.93	0.88	0.84	0.79	0.40	0.98	0.91	0.83	0.84
10.	Calcium	1.00-1.20	1.80	1.80	1.80	2.00	0.8-0.9	1.90	2.00	2.00	2.10
11.	Calculated M.E. kcap/kg.	-	3066	3059	3072	2978	-	3087	3090	3054	2989
12.	Caloric protein ratio	130-135 :1	133:1	132:1	132:1	130:1	155-165 :1	154:1	161:1	151:1	155:1

Note:- The values specified for the particulars at S.NO. 2 to 12 are on moisture-free basis.

From the cost of individual ingredients and other details given in Appendix III the cost per quintal of feed mixtures under different treatments is calculated and given in table 3.

Table 3. Cost of broiler feeds.

(Rs./quintal)

Category	Treatments			
	T_I	T_{II}	T_{III}	T_{IV}
B.S.F.	51.06	51.36	51.51	46.47
	T_1	T_{11}	T_{111}	T_{1v}
B.F.F.	46.47	46.77	46.17	44.37

Statistical analysis:

The average weekly gain in body weight, feed consumption and feed conversion were calculated on the basis of birds that survived at the end of the experiment.

The data were analysed by analysis of variance (Snedecor, 1961). Calculated variances were compared with tabulated values at 5 and 1 per cent levels of significance. In case of values that were found to be significant, C.D. values were calculated.

Preventive treatment:

Embazine was fed in feed at the rate of 50 gms. per 100 kg. of feed for the first 6 weeks and it was discontinued thereafter.

Disease:

During the 10th week of study, coccidiosis broke out in treatment T_{11}. Birds were treated with Bifuran at the rate of 1 tablet per litre of drinking water for 7 days period. The treatment was given uniformly to all the groups.

R E S U L T S AND D I S C U S S I O N

There are certain limiting factors in the poultry development programme in India. The most important of these being the supply of poultry feeds in the country. Most of the poultry feed mixtures contain 40 per cent cereals which are already in short supply and this makes poultry industry compete with human needs for cereal grains.

The cost of grains and other poultry feeds is higher in our country as compared to these in other countries when considered in relation to level of production of each bird and purchasing power of the population. The problem of poultry feeding is therefore required to be handled from the aspect of replacement of cereals by feeds which are not normally used viz. by-products and waste products.

Mango seed kernel is a waste product available from the factories where canning of mangoes is undertaken. The collection and processing of the mangoes used by individual household present certain difficulties as this item of waste feed is available in smaller quantities and scattered over a large area. The

processing can be done by differential grinding and the product can be availed of for use in poultry rations. Mango seed kernel has less than 3 per cent crude fibre and 77 per cent of N.F.E. on dry matter basis and hence it is a good source of carbohydrates. It contains about 2.8 per cent tannic acid. This ingredient is used at 15 per cent level in T_{II} and at 30 per cent level in T_{III} while under T_{11} it is retained at 15 per cent level and in T_{111} out of 30 per cent 15 per cent has been replaced by cassia tora seeds.

Cassia tora seeds are available from a weed which grows abundantly without being grazed by cattle. This ingredient contains 0.03 per cent of chrysophanic acid which has a purgative effect(Farooq et al. 1956) and is not relished by the birds when offered as such, but when it is boiled in water (i.e. heat treated), sun-dried and then offered, it is better relished. It is a good source of protein and has less than 5 per cent crude fibre. The ingredient is used at 12 per cent level in T_{IV}, at 10 per cent level in T_{1v} and at 15 per cent level to replace equal quantity of mango seed kernel in T_{111}.

PMR is a waste product from the factories preparing penicillin. It is obtained as a slurry and after sun drying the product can be stored and used. It is used as a source of manure at present. It is also a good source of protein but contains about 16 per cent of silica. The ingredient is used at 5 per cent level in T_{IV} and T_{iv} treatments.

Tamarind seeds are a waste product from tamarind fruit which are thrown away as useless. These seeds are having about 14 per cent of C.protein and 70 per cent of N.F.E. This ingredient is used at 10 per cent level in T_{IV} and later on it is completely discarded in T_{iv} treatment.

Tomato waste is a by-product from tomato canning industry and is a good source of protein and fat but is very high in crude fibre. The ingredient is used at 10 per cent level in T_{IV} and T_{iv} treatments.

The present study has been undertaken to investigate the use of unconventional feeds against the corventional feed ingredients in poultry rations to tap new resources of poultry feeds.

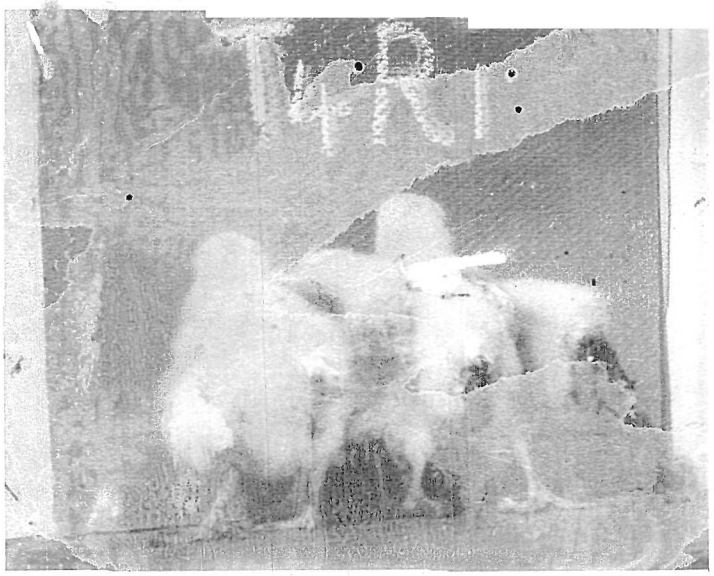
Four groups, each consisting of 38 unsexed broiler chicks (straight run) divided into two replications were kept under different treatments for a period of 12 weeks. During the experiment there were certain mortalities and some birds were culled. Data regarding percentage mortality are presented in table 4.

Table 4. Percentage mortality including culling.

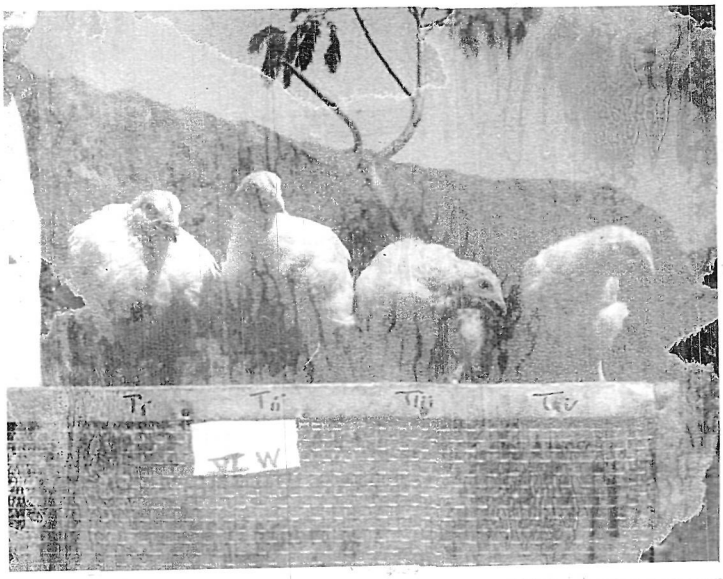
Treatments B.S.F.	Mortality (Per cent)	Treatments B.F.F.	Mortality (Per cent)
T_I	nil	T_1	Nil
T_{II}	2.6	T_{11}	15.8
T_{III}	2.6	T_{111}	Nil
T_{IV}	21.0	T_{1v}	Nil

Most of the deaths under T_{IV} were during the first two weeks period while those under T_{11} were due to coccidiosis and these were restricted mostly to one of the two replications of this treatment only.

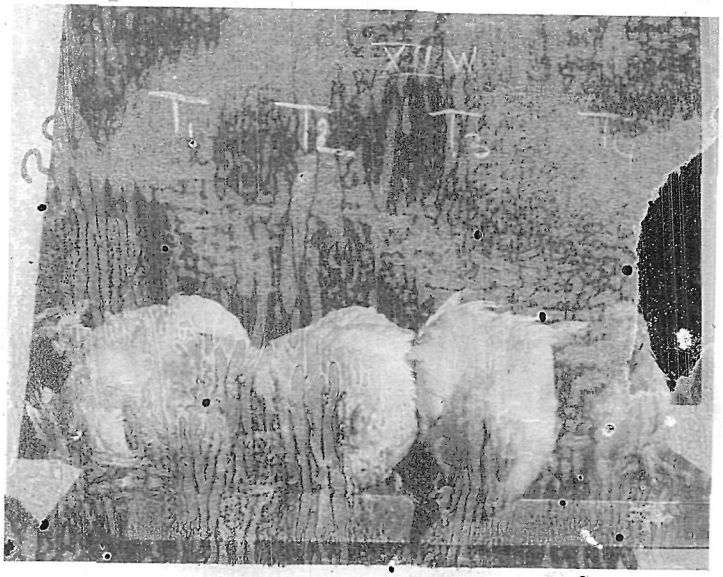
Results obtained during the experiment to study the effect of different treatments are presented and discussed in the sequence given below:-



2 (c) sticky dropping in group 4



2 (b) Body weights at 6 weeks



(i) Body weights ,(ii) Gain in weight , (iii) Feed consumption per unit gain and (iv) Economics.

(i) Effect of different rations on body weights:

Initially the chicks in all the four groups ranged between 31 and 48 gms. in body weights. Birds were weighed individually at weekly intervals and their body weights upto the period of 12 weeks have been given under Appendix IV. The average initail body weights of chicks in the 4 treatments were 39.74, 39.61, 39.70 and 39.80 gms. respectively for T_I , T_{II}, T_{III} and T_{IV}. These together with average body weights upto 12 weeks period are given in table 5.

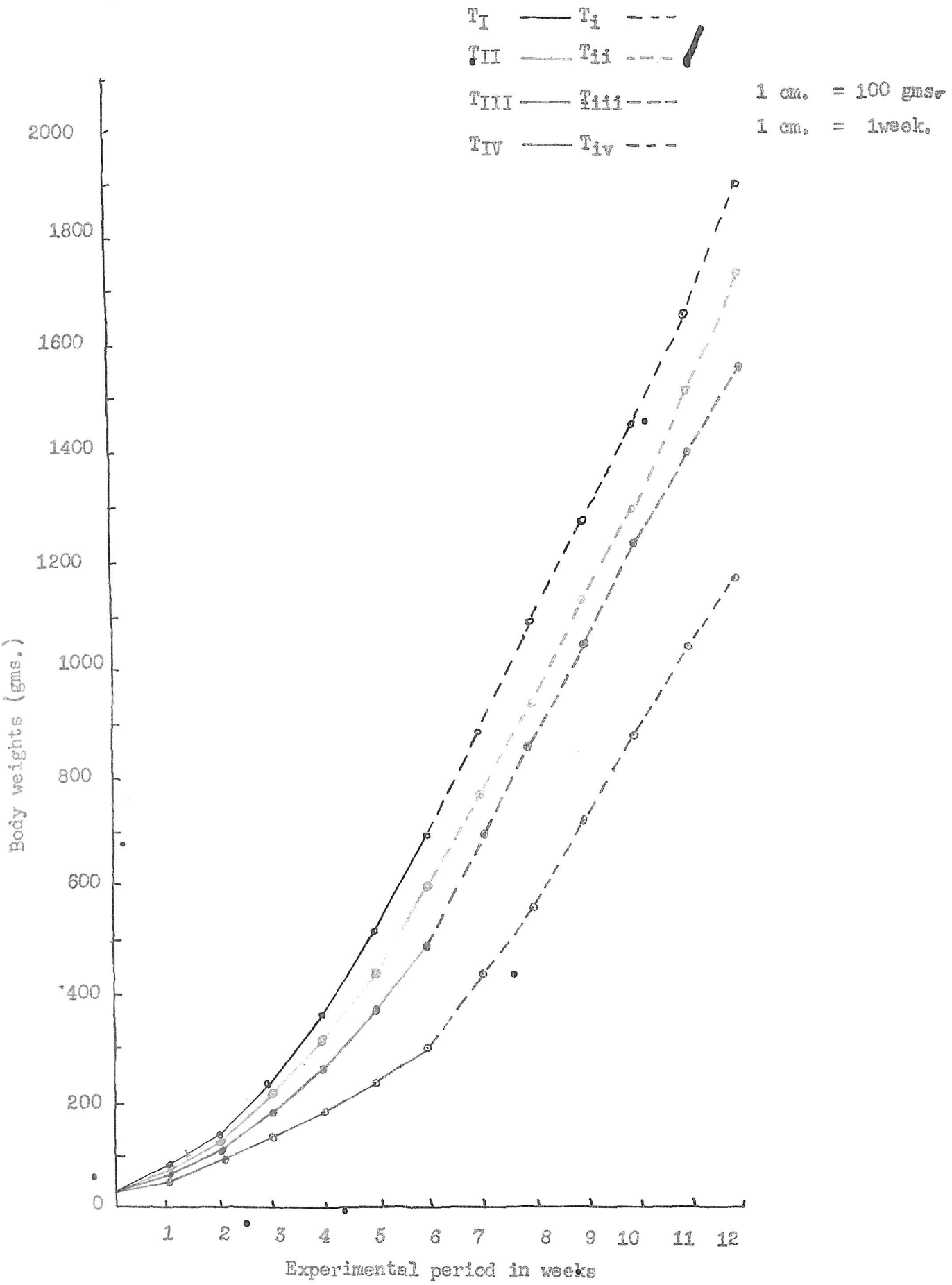
From the results it is apparent that the body weights of the chicks in the control group are highest throughout the period of first 6 weeks and of group IV are distinctly lowest throughout the experimental period. Birds receiving ration with mango seed kerbel at 15 and 30 per cent levels showed lower body weights compared to the control but are much better than the T_{IV} group.

Table 5. Average body weights of straight run chicks at weekly intervals under different treatments for 12 weeks.

(gms)

Weeks	Treatments			
	T_I	T_{II}	T_{III}	T_{IV}
	B.S.F.			
Initial	38.74	38.61	38.70	38.80
1	72.76	70.58	66.86	60.77
2	135.76	124.84	108.76	93.17
3	237.42	203.84	182.68	125.03
4	355.84	305.52	252.03	167.93
5	510.55	434.94	359.99	227.23
6	694.32	588.23	492.92	289.20
	T_i	T_{ii}	T_{iii}	T_{iv}
	B.F.F.			
7	880.26	760.65	679.89	423.93
8	1079.71	939.09	859.11	554.10
9	1267.98	1131.16	1048.35	710.97
10	1455.66	1297.26	1239.11	868.30
11	1645.02	1517.90	1403.89	1034.30
12	1891.52	1722.90	1551.89	1162.37

Fig. 1 Effect of four different rations on body weight of broiler chicks.



After 6 weeks with the change over to B.F.F. and reduction of mango seed kernel from 30 per cent level to 15 per cent in T_{iii} and T_{iv} both, the substitution of mango seed kernel by Cassia tora in T_{iii} group and reduction of unconventional feeds to 40 per cent in T_{iv} group against 67 per cent in B.S.F. gave better growth in T_{iii} and T_{iv} both. The body weights of birds in group T_{iii} showed a very narrow margin of only 58 gms. in body weight at 10 weeks of age. T_{iv} showed satisfactory growth as compared to the growth when these birds were receiving 67 per cent unconventional feeds (including 10 per cent of tamarind seeds) but the birds could never attain the growth equivalent to any of the other groups.

The graphical presentation (fig. 1) also clearly indicates that control group remains at a higher level while the group on higher level of unconventional feeds at a lower level althroughout the experimental period. Group T_{II} and T_{III} show wide differences during the starter period but when they (T_{ii} and T_{iii}) are on B.F.F. the gap narrows down and group T_{iii} just approaches T_{ii} at 10 weeks of age. It also clearly indicates better growth under B.F.F. against B.S.F. practically for all the groups and particularly for group 4. Further, it is seen that inclusion of tamarind

seeds give poor growth and when it is dropped from the ration there is a satisfactory improvement in growth. This may probably be due to some toxic or growth inhibiting factor present in tamarind seeds. Saxena (1968, unpublished data) also observed a similar trend. Sticky droppings were observed in 1st 6 weeks in group 4. This can be clearly seen in Fig. 2.(c).

Gain in body weights would give a clear cut idea regarding growth of birds as against the body weight data. Detailed gain in weights per bird in each week were calculatedl by difference in body weights of the two weeks and these are calculated from data in Appendix IV:

(11) Effect of different rations on gain in weights of straight run chicks.

Effect on gain in weights at weekly intervals upto 12 weeks of age:-

The gain in weights of experimental chicks were calculated on the number of birds that survived at the end of 12th week. The average weekly gain in weights for the different treatments were calculated from data in Appendix IV, and these are presented in table 6.

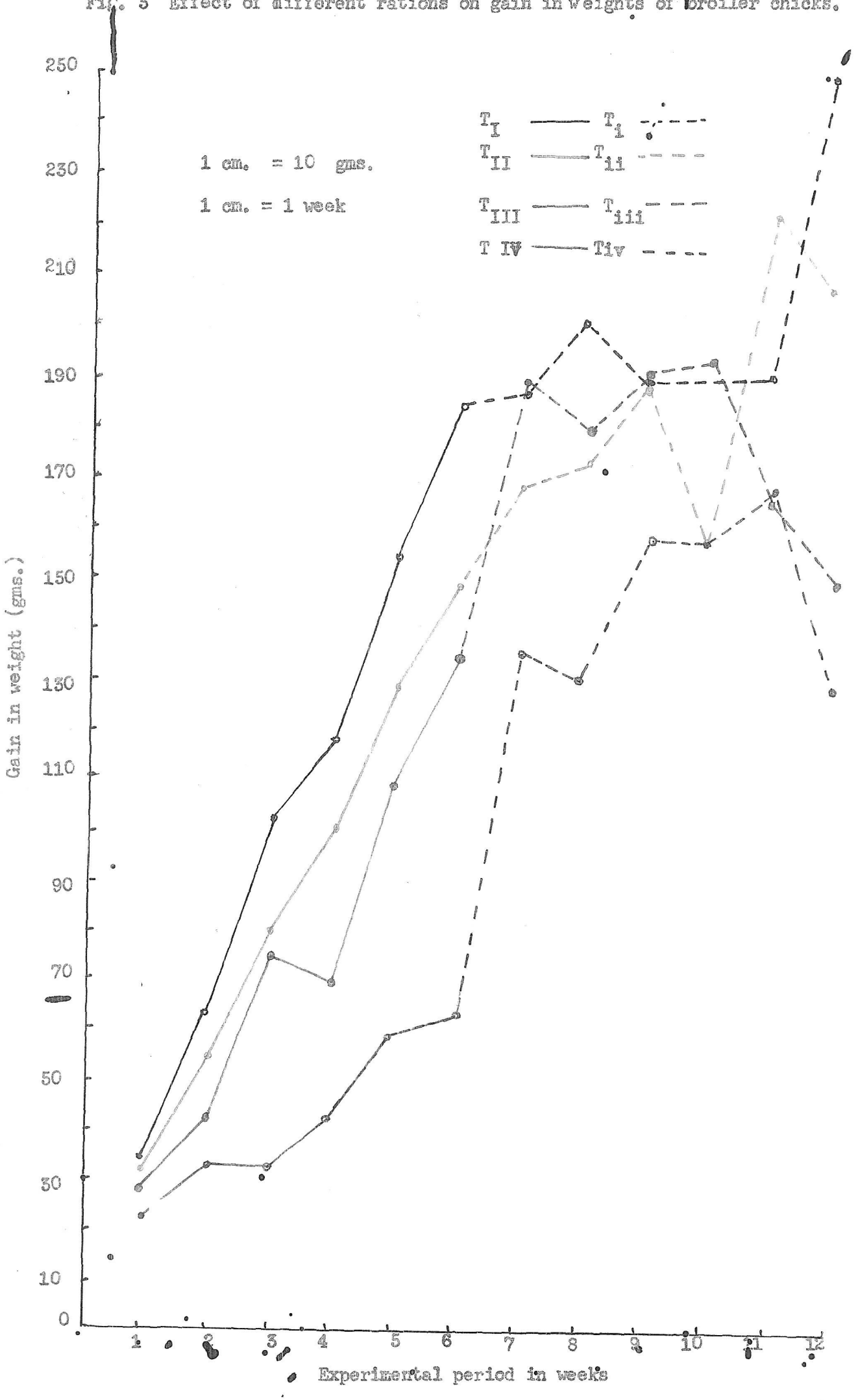
Table 6. Average gain in weight of straight run chicks at weekly intervals under different treatments for 12 weeks.

(gms.)

Weeks	Treatments			
	T_I	T_{II}	T_{III}	T_{IV}
	B.S.F.			
1	34.02	31.97	28.16	21.97
2	63.00	54.26	41.89	32.40
3	101.66	79.00	73.92	31.86
4	118.42	101.68	69.35	42.90
5	154.71	129.32	107.86	59.30
6	183.76	153.39	133.03	61.97
	T_1	T_{11}	T_{111}	T_{1v}
7	185.94	172.42	186.97	134.73
8	199.45	178.38	179.22	130.17
9	188.26	192.13	189.24	156.87
10	187.68	166.10 *	190.76	157.33
11	189.36	220.64	164.70	166.00
12	246.50	205.00	148.00	128.07

* Coccidiosis

Fig. 3 Effect of different rations on gain in weights of broiler chicks.



Data on gain weight of birds under different treatments and the graphical presentation (Fig. 3) show that there are differences in weight gains between different treatments on B.S.F. (0-6 weeks) but when birds are shifted to B.F.F. (7-12 weeks), chicks in T_{iii} and T_{iv} treatments show lot of improvement and actually the chicks in T_{iii} equal control (T_i) group in weight gains at 7th, 9th and 10th weeks of age. While the birds in T_{IV} show poor gains althroughout on the B.S.F. but when they received B.F.F. there is an increase in weight gains in comparision to B.S.F. Though the gain in weights are satisfactory, these chciks could never reach in gain in weight to the extent the other groups have reached because of the lower growth during B.S.F. period.

Mortality was severe in the T_{IV} group during the first 6 weeks which was most probably due to certain growth inhibiting or toxic factor present in tamarind seeds because when tamarind seeds were dropped in the B.F.F. there was no mortality in T_{iv} group. During the 10th week, mortality in T_{ii} was due to an out breâk of coccidiosis.

For detailed discussion on the effect of different rations on gain in weight the various results have been presented for different periods and considering the sex as follows:-

(a) 0-6 weeks.

(b) 7th and 8th week.

(c) 9th and 10th week.

(d) 11th and 12th week.

(e) 7th to 12 weeks.

(f) Sex wise for different periods.

(a) Gain in weights of straight run chicks upto 6 weeks on B.S.F.

The gain in weights of experimental birds were calculated and are presented together with A.V. Table in table 7.

The gain in weights of chicks fed on T_I (control) ration are much higher than those of the other 3 rations. Amongst treatments, next to control the results are satisfactory with the ration T_{II} having 83.4 per cent growth while the T_{IV} ration gave the poorest growth (38.2 per cent). This indicates that the use of unconventional feeds at a higher level is not desirable to promote growth rate of the chicks in the earlier period of their life.

Table 7. Average gain in weights of straight run chicks upto 6 weeks on B.S.F.

(gms.)

Replications	Treatments			
	T_I	T_{II}	T_{III}	T_{IV}
1	682.68	571.15	455.31	246.72
2	628.47	549.61	453.03	253.62
Average	655.58	549.61	454.22	250.40

A.V. Table

Source	d.f.	M.S.	F	C.D.
Treatments	3	973530.4	110.63**	45.28
Replications	1	24512.6	0.28	
Error	131	8799.7		

** Significant at 1 per cent level.

The data were analysed statistically and were found to vary significantly.

C.D. was calculated and on this basis the different feeds were arranged in order of their efficiency in growth promotion as under:-

Rations	T_I	T_{II}	T_{III}	T_{IV}
Gain in weight (gms.)	655.58	549.61	454.22	250.40

The statistical analysis of the data revealed that the differences in gain in weight on B.S.F. are highly significant and all the treatments different from each other. Differences were non significant between replications.

The results of T_{IV} are in line with those of Saxena (1968, unpublished data) who observed that the use of tamarind seeds in chick rations resulted in loose droppings, poor growth and mortality. In the present study also T_{IV} having 67 per cent unconventional feeds including 10 per cent tamarind seeds had only 38.2 per cent gain in weight and as high as 21 per cent mortality and loose and stick y droppings (Fig. 2 c).

It seems from the results obtained for this period that the birds must be reared on ration with better and proven ingredients for the earlier period of life till complete data regarding the unconventional feeds are available.

(b) Gain in weights of straight run chicks during 7th and 8th weeks on broiler finisher feed:

After 6 weeks of study, the rations were switched over from B.S.F. to B.F.F. and the observations during the period 7th and 8th week of study are presented in table 8 together with A.V.Table.

Table 8. Average gain weights of straight run chick during 7th and 8th weeks on B.F.F.

(gms.)

Replications	Treatments			
	T_1	T_{11}	T_{111}	T_{1v}
1	383.47	369.85	364.95	273.90
2	387.32	335.94	367.50	257.00
Average	385.40	350.81	366.90	264.90

A.V. Table

Source	d.f.	M.S.	F	C.D.
Treatments	3	90692.0	16.84**	35.42
Replications	1	4766.9	0.89	
Error	131	5384.9		

** Significant at 1 per cent level..

From the data on gain in weight during 7th and 8th week it is seen that rations T_i , T_{II} and T_{iii} have not much difference in terms of growth promotion. Comparing the 4 rations taking growth under T_i as 100, T_{ii}, T_{iii} and T_{iv} show 95.2, 91.0 and 68.7 per cent growth respectively. This shows a marked difference for the latter three groups which had only about 83, 69 and 38 per cent growth compared to that obtained under control during the first six weeks.

The results indicate that there is not much difference between the rations T_i T_{ii} and T_{iii} in growth promotion although apparently ration T_i seems to be a superior one. Further, ration T_{iii} (containing 15 per cent mango seed kernel + 15 per cent cassia tora seeds) has given better growth than ration T_{ii} which may be due to better assortment of amino acids when mango seed kernel and cassia tora seeds are fed together and/ or due to supplementary action of each other than feeding mango seed kernel alone which is a source of tannic acid. This shows that tannic acid depresses growth when it is beyond certain limit.

The data were analysed statistically and the analysis of variance revealed significant differences between treatments but non-significant differences between replications for the various rations. C.D. was calculated and the rations were arranged in order of their efficiency in growth promotion as follows:

Rations:	T_i	T_{iii}	T_{ii}	T_{iv}
Gain in weight (gms.)	385.40	366.90	350.81	264.90

The treatments which do not differ significantly have been underlined by a bar:

Chang and Fuller (1964) found growth retardation in direct proportion to the level of tannic acid contributed by the various sorghums and this retardation was similar in magnitude to that caused by equivalent levels of tannic acid per se. Similarly Fuller et al (1966) also observed that amount of 1.6 per cent or more tannins in grain sorghums depressed growth when given as 50 per cent of the diet. Goswami and Kehar (1956) estimated the tannic acid content of mango seed kernel as 2.8 per cent. Therefore, the improved growth in ration T_{iii} might be due to low tannic acid content in the ration as compared to T_{III}.

It is also seen that, chicks on ration T_{IV} gave good growth and the growth response is far better in comparison to T_{IV} (B.S.F.) as the gain in weight during 2 weeks (7th and 8th weeks) is slightly higher than the total gain in weight during 6 weeks period in all. This shows that tamarind seeds do contain either a growth inhibiting or toxic factor and that its complete removal has led to improvement in growth. This indicates that tamarind seeds cannot and should not be used as such, in poultry rations on account of their ill effects, through this by-products has given quite encouraging results in cattle (Patnaik, 1967).

(c) <u>Gain in weight of straight run chicks during the 9th and 10th weeks on B.F.F.</u>

The growth response of the chicks recorded during the period 9th and 10th weeks is presented in table 9. Statistical data are given in A.V. table.

Table 8. Average gain in weights of straight run chicks during 9th and 10th weeks on B.F.F.

(gms.)

Replications :	Treatments			
	T_i	T_{ii}	T_{iii}	T_{iv}
1	415.22	340.00	414.00	309.42
2	336.68	373.24	344.12	318.38
Average	375.95	356.23	380.00	314.12

A.V. Table

Source	d.f.	M.S.	F	C.D.
Treatments	3	29146.8	3.76*	42.47
Replications	1	37404.7	4.83*	
Error	131	7747.9		

* Significant at 5 per cent level

The results for the period 9th and 10th weeks on gain in weights of chicks on various rations show that highest gain in weights were recorded on ration T_{iii} while ration T 4 showed a lot of improvement in gain

in weight. Taking T_1 as 100 the values for T_{11}, T_{111} and T_{1v} being 95.3, 101.1 and 83.4 respectively. This shows that during the period 9th and 10th week, T_{111} ration was utilized more efficiently than control. The data were analysed statistically and the analysis of variance exhibited significant differences between treatments and replications. The significant differences might be due to the variation in response to the coccidiostat administration which was given in drinking water during the 10th week or it may be due to the fact that chicks in some replications might be having sporocysts and the administration of coccidiostat gave better growth response because of the action of coccidiostat on the sporocysts.

The C.D. was calculated and the rations arranged in order of their superiority in growth promotion as under:

Rations:	T_{111}	T_1	T_{11}	T_{1v}
Mean gain in weight(gms.)	380.00	375.95	358.23	314.12

The treatments which do not differ significantly have been underlined by a bar.

The results indicate that there are no significant differences in between ration T_{iii} , T_{i} and T_{ii} while ration T_{iv} gave significant difference.

These findings indicate that mango seed kernel (15 per cent) + cassia tora seeds (15 per cent) feeding gives better response than mango seed kernel feeding at 15 per cent level. This may be due to the supplementary action of mango seed kerbel and cassia tora seeds and also because of the disease condition of some birds in T_{ii}.

(d) Gain in weightsof straight run chicks during 11th and 12th weeks on broiler finisher feed.

The results of various treatments on gain in weightsof straight run birds during 11th and 12th weeks on B.F.F. are presented in table 10 together with A.V. table.

Table 10. Average gain in weightsof straight run chicks during 11th and 12th weeks on B.F.F.

(gms.)

Replications	Treatments			
	T_1	T_{11}	T_{111}	T_{1v}
1	402.26	488.93	300.26	302.50
2	469.47	373.53	325.77	287.39
Average	435.87	425.66	312.70	294.07

A.V. Table

Source	d.f.	M.S.	F	C.D.
Treatments	3	206633.4	15.93**	54.94
Replications	1	2401.4	0.19	
Error	131	12951.5		

** Significant at 1 per cent level

The data on gain in weight did not show much differences between T_1 and T_{11} while T_{111} and T_{1v} show poor growth during the period 11th and 12th week.

Taking T_i as 100, the values for T_{ii}, T_{iii} and T_{iv} being 97.7, 71.7 and 67.5. This indicates that ration T_{iii} and T_{iv} are not utilized efficiently during this period. The data were analysed statistically and the analysis of variance revealed significant differences between treatments and non significant differences between replications. C.D. was calculated and the rations arranged in their order of sequence in growth promotion as below:-

Ration:-	T_i	T_{ii}	T_{iii}	T_{iv}
Gain in weight (gms.)	435.87	425.66	312.70	294.07

The treatments which do not differ significantly have been under lined by a bar. Ration T_{iii} gave significant differences during the period 11th and 12th week which could be explained on the basis of after effects of coccidiostat administered during the 10th week. The chicks on ration T_i and T_{ii} might have subclinical coccidiosis and the administration of coccidiostat killed the sporocysts and thus resulted in better growth in those two groups.

(e) Gain in weights of straight run chicks during 7th to 12 week on broiler finisher rations.

The results of the study as regards weight gains during the finisher period are presented in table 11 together with

Table 11. Average gain in weights of straight run chicks during 7th to 12 weeks on R.F.F.

Replications	Treatments			
	T_I	T_{II}	T_{III}	T_{IV}
1	1200.95	1197.78	1079.27	885.85
2	1193.47	1082.71	1037.39	862.07
Average	1197.21	1134.68	1058.89	873.17

A.V. Table

Source	d.f.	M.S.	F.	C.D.
Treatments	3	636439.2	13.12 **	100.72
Replications	1	77217.5	1.59	
Error	131	48509.2		

** Significant at 1 per cent level

From the data on gain in weights it is seen that during the 1st 6 weeks, the gain in weight are 93.4, 69.3 and 38.2 per cent in T_{II}, T_{III} and T_{IV} groups when T_I is taken as 100 while during 7th -12 weeks, the gain in weights being 94.8,

per cent, 88.4 and 72.9 per cent for T_{II}, T_{iii} and T_{iv} respectively when T_i is taken as 100. This indicates that the unconventional feeds are utilized better during the finisher period as compared to starter period. Further, it is seen that mango seed kernel + cassia tora are utilized better than mango kernel alone. Also discontinuation of tamarind seeds and use of unconventional feeds at lower level is better utilized than at higher level. The results reveal not much difference between T_{ii} and control ration during the period 7th to 12 weeks while T_{iii} and T_{iv} gave poorer growth although in comparison to B.S.F. there is lot of improvement especially in T_{iv}. The data were analysed statistically and the analysis of variance revealed significant difference between treatments, so C.D. was calculated which was 100.72 and the rations have been arranged in sequence for growth promotion as follows.

Rations:	T_i	T_{ii}	T_{iii}	T_{iv}
Gain in weight (gms.)	1107.21	1134.68	1058.89	873.17

C.D. values showed non significant difference between ration T_i, T_{ii} and T_{iii} while ration T_{iv} gave

significantly lower results. These results can be explained in the light of following reasons:-

The growth inhibited during the period of 1st six weeks on broiler starter ration in ration T_{IV} may be either due to the growth inhibiting factor or toxic property of the tamarind seeds which resulted in poor growth and subsequently reflected on the after-math life period i.e. on the finisher period of feeding (T_{iv}). After 6 weeks feeding on broiler starter ration, when the chicks in group IV were switched over to a ration containing no tamarind seeds, they showed satisfactory improvement in growth rate and growth graph showed abrupt changes.

Saxena (1968, unpublished data) also observed poor growth and high mortality in chicks when they were reared on rations containing tamarind seeds.

PMR which was included at 5 per cent level as the previous workers have indicated that it can be used efficiently might also be the contributing factor. This is due to the fact that this product might have no antibiotic activity (Fernandes, 1960) thus it is not contributing for increase in growth.

Higher level of unconventional feeds can also be the contributing factor i.e. , they are not utilized efficiently because of non availability of information on the amino acid content and also the presence of harmful factors.

(f) Effect of different rations on weight gains of male and female birds at different periods of growth.

The sex determination was made at the 9th weighing from certain external characteristics such as development of comb, wattles andspur and from the appearance of neck and tail feathers. Though the birds of both sexes were reared together, the data for gain in weights for males and females were separately analysed statistically. The data for gain in weights at different periods are given in Appendix IV and the average figures together with A.V. table are given in table 12.

Table 12. Average gain in weight of male and female chickens at different periods.

Particulars	Treatments			
	T_I	T_{II}	T_{III}	T_{IV}
		0-6 weeks		
Weight gain, males	684.63	594.12	500.06	279.29
Weight gain, females	626.66	502.11	415.26	225.12
		7th and 8th weeks		
Weight gain, males	441.21	381.44	411.41	301.29
Weight gain, females	329.58	318.11	327.75	233.06
		9th and 10th weeks		
Weight gain, males	432.32	387.94	442.53	365.29
Weight gain, females	319.58	326.53	326.85	269.50
		11th and 12th weeks		
Weight gain, males	505.79	477.38	373.00	331.29
Weight gain, females	365.95	370.47	261.45	261.50
		7th to 12th week		
Weight gain, males	1379.32	1246.75	1226.94	997.86
Weight gain, females	1015.11	1015.13	916.05	764.06

A.V. Table , Males

0-6 weeks

Source	d.f.	M.S.	F	C.D.
Treatments	3	471559.8	51.54**	66.98
Replications	1	15248.3	16.7	
Error	61	9150.2		

T_I	T_{II}	T_{III}	T_{IV}
684.63	594.12.	500.06	278.27

7th and 8th weeks

Treatments	3	56317.1	16.08**	41.44
Replications	1	344.5	0.98	
Error	61	3503.0		

T_1	T_{iii}	T_{11}	T_{iv}
441.21	411.41	381.44	301.29

9th and 10th weeks

Tr				
Treatments	3	21076.6	3.04*	53.38
Replications	1	17235.2	2.48	
Error	61	6944.0		

T_{iii}	T_1	T_{11}	T_{iv}
442.53	432.32	387.94	365.29

11th and 12th weeks

Treatments	3	112116.1	9.85**	72.76
Replications	1	3326.7	0.29	
Error	61	11388.0		

T_1	T_{ii}	T_{iii}	T_{iv}
505.79	477.38	373.00	331.29

7th to 12th week

Treatments	3	394044.4	20.11**	96.04
Replications	1	3049.6	0.16	
Error	61	19592.0		

T_1	T_{11}	T_{111}	T_{iv}
1379.32	1246.75	1226.94	997.86

Significant at 1 per cent level.
Significant at 5 per cent level.

A.V. Table, Females

Source	d.f.	M.S.	F.	C.D.
0-6 weeks				
Treatments	3	488817.4	76.30**	54.50
Replications	1	3622.6	0.57	
Error	65			
	T_I	T_{II}	T_{III}	T_{IV}
	626.66	502.11	415.25	225.12
7th and 8th weeks				
Treatments	3	35734.1	9.59**	41.54
Replications	1	5554.6	1.49	
Error	65	3725.1		
	T_i	T_{iii}	T_{ii}	T_{iv}
	329.58	327.75	318.11	233.06
9th and 10th weeks				
Treatments	3	12521.3	3.12**	43.12
Replications	1	9238.1	2.30	
Error	65	4014.1		
	T_{iii}	T_{ii}	T_i	T_{iv}
	326.85	326.53	319.58	269.50
11th and 12th weeks				
Treatments	3	82481.6	9.91**	63.92
Replications	1	4607.5	0.55	
Error	65	8319.2		
	T_{ii}	T_i	T_{iv}	T_{iii}
	370.47	365.95	261.50	261.45
7th to 12 week				
Treatments	3	230254.6	10.51**	100.76
Replications	1	37888.9	1.73	
Error	65	21909.0		
	T_{ii}	T_i	T_{iii}	T_{iv}
	1015.13	1015.11	916.05	764.06

** Significant at 1 per cent level.

From the perusal of data in table 12, it is seen that males have shown better growth in all treatments at all the periods during the experimental period. Considering the gain in weights at different periods, it is seen that during the first 6 weeks females have 91.53, 84.51, 93.04 and 80.60 per cent gain weight in treatments T_I, T_{II}, T_{III} and T_{IV} respectively in comparison to males in the respective treatments. During the three periods of two weeks after the first 6 weeks it is observed that particularly in T_{II} females show better growth as compared to the growth shown by females in the other three groups except in the 11th and 12th week when group IV has the same gain in weight as T_{II}. Considering the period under D.F.F. (7th to 12th week) females in T_{II} have more than 81 per cent gain in weight as compared to about 73-76 per cent in the other 3 groups when the gain in weight of males in respective groups are taken as 100.

While comparing the effect of different rations on gain in weights in males and females separately taking the growth in control group to be 100 per cent it is seen that both the sexes show similar trend for the first 6 weeks period. The growth remains constant for group two for 7th and 8th and 9th and 10th weeks period for males but there is 16 and 22 per cent rise in growth for females during these periods respectively. For group three both males and females

show sudden improvement in growth for there periods and are showing about 22 per cent and 33 per cent increased growth respectively for these two periods. Group four also has improved but both the sex show similar increase.

For the 11th and 12th weeks period only in T_{11} and T_{iv} the females show higher growth than males while in the 3rd group the growth is equal for both the sexes. During this period it is further seen that the growth remains the same for T_{11} while it has decreased for T_{111} and T_{1v} compared to the previous two periods. For the B.F.F. period (7th to 12 weeks) in general it can be said that for all the groups females have gained better compared to the respective growth of same sex taking growth in control as 100 which is a reverse trend compared to B.S.F. period.

Data for two replications under each treatment considering the sex factor also were analysed statistically. The statistical analysis of the data of mean weight gain of male birds at 6 weeks of age revealed that chicks fed on T_I ration (control) were showing significantly higher growth than all the other groups. Among the treated-

groups, T_{II} gave the highest gains whereas ration T_{IV} gave the poorest gain. The trend in growth rate in case of female birds was observed to be similar to male birds. The differences were significant between treatments in case of males as well as females and the trend for the effect of ration was also the same during the first 6 weeks period.

After 6 weeks rations were changed from broiler starter to broiler finisher rations in all the treatments. The results indicated non-significant differences between treatments T_{i} and T_{iii}, T_{iii} and T_{ii} during the period 7th and 8th weeks. Although there was improvement in weight gains in birds on ration T_{iv}, the results were significantly lower. It is further noticed that though ration T_{iii} showed superiority over ration T_{ii} during this period in both males as well as females, the results are statistically non-significant.

Taking into consideration the growth performances during the 9 and 10 weeks period the results indicate non significant differences in case of male birds on different rations but in case of females, ration $T_{...}$

gave significantly lower results. This indicates that the males utilized the unconventional ration better than females during this period.

During the period of 11th and 12th weeks non significant differences were observed between T_i and T_{ii}, T_{iv} and T_{iii} but the results between T_{ii} and T_{iii} were significant in case of males showing the sequence of rations as T_i, T_{ii}, T_{iii} and T_{iv}. In case of females the superiority of ration was T_{ii}, T_i, T_{iii} and T_{iv} and there were non significant differences between ration T_{ii} and T_i and T_{iii} and T_{iv} respectively.

Considering the mean weight gains for the period 7th to 12 week the results are non significant between T_{ii} and T_{iii} for males and T_{ii} and T_i; and T_i and T_{iii} for females.

On the whole it is seen that (i) male birds have superior weight gains than those of females at all stages of growth (ii) both the sexes have improved growth under B.F.F. compared to B.S.F. and (iii) that growth of females under B.S.F. remained better for group one while for B.F.F. period it remained better for group two when it is compared to the growth of males.

Titus (1961) observed that among the chickens and other kinds of poultry, the males tend to grow more rapidly than the females. Wagner (1961), Mahner et al(1964), Ferreira and Decastro (1964) Szymkiewicz et al (1966), Znanieckna et al (1966) and Quilici (1967) in growth studies with different feed ingredients in chicks found superior growth rate in males than in females. In the present investigation also, the males have been found to have better growth response on all rations at all stages which indicates that it would be a more gaining concern if only male broilers are raised.

(iii) Feed consumption per unit gain:

The growth response obtained with different rations is not the only criteria of the feed evaluation because the poultry keeper is interested in the efficiency of feed utilisation. Since feed is the largest single item of cost in poultry production, it follows that the rate at which feed is converted into poultry meat is an important measure of evaluation. The feed consumption per unit gain (gm.) for the different rations at different stages of growth are presented in table 13, while the detailed feed consumption data are given in Appendix V.

Table 13. Average feed consumption per unit gain for the different rations during different periods:

Period	Treatments			
	T_I	T_{II}	T_{III}	T_{IV}
0-6 weeks	3.12	3.27	4.00	4.46
	T_i	T_{ii}	T_{iii}	T_{iv}
7th and 8th weeks	3.64	4.09	4.16	4.78
9th and 10th weeks	4.78	5.42	5.06	5.17
11th and 12th weeks	4.94	6.36	6.95	6.51
7th to 12th weeks	4.47	5.19	5.30	5.50

A.V. Table

Period	Source	d.f.	M.S.	F	C.D.
0-6 weeks	Treatments	3	0.94	3.03	
	Replications	1	0.03	0.10	
	Error	3	0.31		
7th and 8th weeks	Treatments	3	0.45	9.0	
	Replications	1	-	-	
	Error	3	0.05		
9th and 10th weeks	Treatments	3	0.43	1.19	
	Replications	1	-		
	Error	3	0.36		
11th and 12th weeks	Treatments	3	4.53	13.73*	1.05
	Replications	1	-		
	Error	3	0.11		
	T_i	T_{ii}	T_{iv}	T_{iii}	
	4.94	6.36	6.51	6.95	
7th to 12th weeks	Treatments	3	0.40	20.0	0.45
	Replications	1	-		
	Error	3	0.02		
	T_i	T_{ii}	T_{iii}	T_{iv}	
	4.47	5.19	5.30	5.50	

Data on feed consumption reveal that mango seed kernel at both the levels seems to be quite palatable as against the ration containing tamarind seeds and other unconventional seeds at higher level for B.S.F. period. Similarly under B.F.F. period it is seen that mango seed kernel at 15 per cent level alone, in combination with 15 per cent cassia tora and with 25 per cent other unconventional feeds is also fairly palatable.

From the data in table 13, it is seen that during the first 6 weeks feed consumption per unit gain is 104.8, 128.1 and 142.9 per cent for T_{II}, T_{III} and T_{IV} respectively when T_I is 100 per cent. During the period 7-8 weeks with the change over to B.F.F. feed consumption per unit gain is 112.4, 114.3 and 131.3 per cent for T_{II}, T_{iii} and T_{iv} respectively when T_i is considered as 100 per cent, while during 9-10 weeks and 11-12 weeks periods the values are 113.4, 105.9, 108.2 and 128.7, 140.7, 131.8 per cent for T_{ii}, T_{iii} and Tiv for the two periods when T_i is taken as 100 per cent. In general, the feeds consumption per unit gain during B.F.F. period (7-12 weeks) the values

for T_{11}, T_{111} and T_{1v} are 116.1, 118.6 and 123.0 per cent respectively. The higher values in T_{111} may be due to less retention of nitrogen as reported in an I.V.R.I. report (1956-57) after conducting an experiment with 10 to 20 per cent of cassia tora seeds in the ration of poultry.

From the perusal of statistical analysis (table 13) it is seen that differences among the treatments for the periods 0-6 weeks, 7th-8th weeks, 9th-10th weeks are non significant except for 11th - 12th week and D.F.F. period in general. Also for the 11th-12th weeks period control shows significant differences but other 3 groups are not showing significant differences among themselves.

As a general routine experimental work on nutritive requirements of animals is based either on the basis of gain in weight, feed efficiency or presence or absence of deficiency symptoms. In the present study it is seen that all the rations showed non significant differences except control showing that efficiency of food conversion is rather low with the unconventions feeds used under this study. The reasons for this may be high

content of tannic acid in mango seed kernel, growth inhibiting effect of tamarind seeds and less efficient utilization of unconventional feed ingredients. Gupta et al. (1966) also observed less efficient feed utilization with mango seed kernel when it replaced 20 per cent maize. Rudolph (1957) and Henning et al (1961) observed less efficient utilization with P.M.R. when it replaced fish meal. The indications are that detailed information for these feeds might help in increasing efficiency in poultry.

iv) Economics of feeding:

Feed alone constitutes 60 to 70 per cent of the cost of feeding poultry. It is therefore very important to know as to which ration gives greatest economic returns.

To know the profit or loss made on different rations at weekly intervals from 1st to 12th weeks calculations have been made considering the actual cost of ingredients (Appendix III) and the amount received by sale procedure of live birds at Rs. 4.50 per kg. The net return per chick at weekly intervals have been calculated as follows:

Net return = Income- (Cost of chick + cost of feed + other costs). The other costs include building, labour cost,

establishment, depreciation, interest, medication, water, eletricity, litter and mortality minus receipt for manure. This figure adopted here for other expenses has been taken up from M/S Arbor Acres Farm, India Ltd., Talegaon. The details of calculation are given in Appendix VI. Average net return per chick (in paise) for the four treatments upto 12 weeks of age is presented in table 14.

Table 14. Average net return (in paise) per chick at weekly intervals for different rations from 1-12 weeks.

Weeks	Treatments			
	T_I	T_{II}	T_{III}	T_{IV}
1	-149.9	-150.8	-152.5	-154.6
2	-144.1	-148.0	-155.2	-162.7
3	-127.8	-140.3	-149.3	-176.5
4	-110.2	-126.4	-153.0	-176.8
5	- 80.0	-102.9	-140.8	-171.9
6	-40.6	-74.5	-122.3	-170.4
	T_1	T_{11}	T_{111}	T_{1v}
7	+0.4	-39.8	-80.8	-148.0
8	+40.0	-11.6	-55.7	-135.2
9	+71.1	+19.2	-28.3	-113.6
10	+97.7	+34.4	-1.1	-93.7
11	+120.9	+61.5	+10.7	-73.9
12	+165.9	+76.1	+11.4	-74.0

From the results it is seen that treatments T_1 T_{11} and T_{111} show profits from 7th, 9th and 11th weeks respectively. Group four shows loss till 12 week period. It is also seen that in treatment T_1, the net return between the successive weeks for 7th week onwards are 39.6, 31.1, 26.6, 23.2 and 45.0 paise per chick per week upto 12 weeks period. In T_{11}, the net returns between the successive weeks from 9th week are 15.7, 27.1 and 14.6 paise per chick per week and for T_{111} the values are 0.7 between 11th and 12th weeks while T_{1v} shows loss until 12 weeks. The cost of 4 rations being Rs. 51.06, 51.36, 515.51 and 46.4' for B.S.F. period and Rs. 46.47, 46.77 and 44.37 per quintal for B.F.F. It is seen that ration T_{1v} though was cheapest it gave low production and thus proved uneconomical. Group two and three also showed lower profit than control. On percentage basis the net returns are 24.2, 10.3, 1.7 for T_1, T_{11} T_{111} respectively. Gupta *et al* (1966) observed that mango seed kernel used at 20 per cent level was slightly economic. Rudolph (1957) and Henning *et al* (1961) observed that P.M.R. can partially replace conventional feeds like fish meal but is slightly less economical.

The results of the present study indicate that mango seed kernel alone at 15 per cent and mango seed kernel 15 per cent + cassia tora 15 per cent can be utilized in finisher ration when the cost of the ingredient is reasonable.

SUMMARY AND CONCLUSION

A study was made for knowing the feasibility of using unconventional feeds in broiler rations.

One hundred and fiftytwo day old unsexed Arbor Acres broiler chicks from the same hatch were divided into four treatments, each with two replications. The four treatments were:-

1. B.S.F. (first 6 weeks)

   (i) Control ration made up of conventional feeds (T_I)

   (ii) 15 per cent mango seed kernel replacing rice polish in the control ration (T_{II})

   (iii) 30 per cent mango ssed kernel replacing rice polish in the control ration (T_{III})

   and

   (iv) 67 per cent unconventional feeds (T_{IV})

2. B.F.F. (7th-12 weeks)

   (i) Control ration made up of conventional feeds (T_i)

   (ii) 15 per cent mango seed kernel replacing rice polish in control ration (T_{ii})

   (iii) 15 per cent mango seed kernel + 15 per cent cassia tora seeds replacing rice polish in control ration (T_{iii})

   and

   (iv) 40 per cent unconventional feeds (T_{iv})

Feed and water were provided ad. libitum. In each replication one electric brooder was installed and

the temp. was kept initially at 35°C which was reduced by 2.8°C weekly till it reached 24°C at the end of 4 weeks when brooders were removed. Light was provided for 24 hours.

The feeds were analysed individually according to A.O.A.C. (1965) and the rations formulated taking into consideration ISI standards for broiler feeds (1967). The M.E. values for conventional feeds were calculated from the literature while for unconventional ones, these were calculated according to Titus (1961).

The average weekly gain in body weights, feed consumption and feed conversion were calculated on the basis of number of birds that survived at the end of experiment and the data were analysed statistically by analysis of variance. In case the 'F' values were significant, C.D. values were calculated.

The individual body weights ranged between 31 to 48 gms while for each of the replications for different treatments it was round about 38 gms. The results of body weights of chicks in different treatments at the end of B.S.F. period showed the average weights 694.38, 588.23.

492.92 and 289.20 gms. for T_I, T_{II}, T_{III}, and T_{IV} respectively. At the end of 12 weeks the body weights were 1891.52, 1722.90, 1551.89 and 1162.37 gms. for T_1, T_{11}, T_{III} and T_{1v} respectively.

Data on gain in weights revealed that there are differences on B.S.F. for different treatments while on B.F.F. (7-12 weeks) chicks in T_{111} and T_{1v} showed lot of improvement in growth as compared to B.S.F. period and chicks in T_{111} actually equal control in gain in weights at 7th, 9th and 10th weeks of age.

Considering the gain in weight of straight run chicks for the first 6 weeks it was seen that the four groups differ significantly among themselves and the chicks on treatment T_I were much higher in growth while in T_{IV} showed poor growth. The poor growth in T_{IV} might be due to growth inhibiting factor present in tamarind seeds and less efficient utilization of unconventional feeds at higher level.

For the period 7-8 weeks, the results did not indicate much difference between groups one, two and three- while T_{IV} showed significantly poor growth. The improvement

in T_{iii} may be due to supplementary action of mango seed kernel + cassia tora in comparison to mango seed kernel alone (T_{III}). The growth in T_{iv} was improved as compared to T_{IV} .

The gain in weights for the period 7-8 weeks revealed the percentages as 95.2, 91.0 and 68.7 in T_{ii} T_{iii} and T_{iv} taking T_i as 100.

Gain in weights for 9-10 weeks and 11-12 weeks revealed that the gain in weights are 95.3, 101.1, 83.4 and 97.7, 71.7 and 67.5 per cent respectively for the periods when T_i is taken as 100 per cent. The results indicated non significant differences among T_{iii}, T_i and T_{ii} for 9-10 weeks period and between T_i, T_{ii} and T_{iii}, T_{iv} for 11-12 weeks period. The significant differences for T_{iii} during 11-12 weeks might be due to after effects of administration of coccidiostat during 10th week.

In general gain in weights for B.S.F. and B.F.F. period the gain in weights for the four groups are 83.4, 69.3 and 38.2 for B.S.F. and 94.8, 88.4 and

72.9 per cent for groups two, three and four when control is taken as 100 per cent. The results for B.F.F. period indicate that mango seed kernel + cassia tora are utilized better than mango seed kernel alone at 30 per cent level. Statistically groups one, two and three did not differ significantly on B.F.F.

The sex was determined from certain external characteristics. The data showed that males show better growth than females. Comparing the gain in weights of two sexes under different treatments for different periods it is seen that for the first 6 weeks females have 91.53, 84.51, 83.04 and 80.60 per cent gain in weight in group one, two , three and four taking the gain in weights of males as 100 per cent in respective groups. In a similar manner, the comparison showed that during the 3 periods of 2 weeks each after B.S.F. period females in T_{11} showed better growth than other 3 groups except in the 11-12 weeks when females in T_{1v} also have the same gain in weight. For the B.F.F. period as a whole females in T_{11} have more than 81 per cent gain in weight as compared to

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73-76 per cent for the other 3 groups when gain in weights of males are taken as 100.

Comparing the effect of different rations on gain in weights in males and females seperately it is seen that both sexes show similar trend of decrease in growth from group one to group four for the first 6 weeks when control is taken as 100 per cent. The growth remains practically constant for group two for 7-8 weeks and 9-10 weeks period for males but there is rise in growth of females during these periods. For group three there is sudden improvement for both males and females. In group four there is improvement, both sexes show similar trend.

For the 11-12 weeks period, in T_{ii} and T_{iv} females show higher growth than males while in group three it is about equal for both the sexes. Further, it is seen that growth remains the same for T_{ii} while it has decreased for T_{iii} and T_{iv} compared to previous two periods. For the B.F.F. period, in general it is seen that females have gained better compared to the respective growth of same sex taking growth in control as 100 per cent, a trend which is reverse in comparison to B.S.F. period.

On the whole it is seen that male birds have superior gain in weights than those of females at all stages of growth. Further the growth of females under B.S.F. remained better for group one while for B.F.F. period it remained better for group two when it is compared to the growth of males.

Data on feed consumption revealed that unconventional feeds are quite palatable upto 40 per cent. Feed consumption per unit gain for first 6 weeks being 104.8, 128.1 and 142.9 per cent for T_{II}, T_{III} and T_{IV} respectively when T_I is taken as 100 per cent. For the period 7-8 weeks it is 112.4, 114.3, 131.3 for T_{ii}, T_{iii} and T_{iv} groups respectively on similar basis. For the periods 9-10 weeks and 11-12 weeks, the values are 113.4, 105.9, 108.2 and 128.7, 140.7, 131.8 per cent for groups two, three and four respectively when T_i is taken as 100 per cent. In general feed consumption per unit gain for B.F.F. period for T_{ii}, T_{iii} and T_{iv} is 116.1, 118.6 and 123.0 per cent respectively when T_i is considered as 100 per cent. The statistical analysis revealed that differences among treatments for the periods 0-6 weeks, 7th-8th weeks,

9-10 weeks are non significant except for 11th-12th weeks and B.F.F. period in general.

Calculating the economics of feeding for different rations it is seen that groups one, two and three show profits from 7th, 9th and11th weeks respectively. Group four shows loss till 12 weeks. The net returns on percentage basis of total investment are 24.2, 103 and 1.7 for T_1 T_{11} and T_{111} respectively.

CONCLUSIONS:

(1) Substitution of rice polish by mango seed kernel at 15 per cent level is fairly satisfactory during the finisher period.

(2) Use of mango seed kernel + cassia tora gives better growth than mango seed kernel alone at higher level (30 per cent).

(3) Tamarind seeds contain some growth inhibiting or toxic factor and result in heavy mortality in chicks.

(4) On starter rations, mango seed kernel is less efficient when it substitutes rice polish either at 15 or 30 per cent level.

(5) Males grow more rapidly than females.

(6) Use of unconventional feeds would be of practical use when the cost of these ingredients would be reasonable as at present these are costlier than some of the conventional ones.

(7) Unconventional feeds could be fed more efficiently in finisher than starter rations.

It is felt that work on unconventional feeds should be intensified for proximate analysis, available phosphorus values, amino acid composition and M.E. values. Palatability and harmful factors must also be studied in details.

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APPENDIX

APPENDIX I

Composition of unconventional feed

S.NO:	Feeding stuffs	Source	Crude Protein	E. Ext.	Crude fibre	N.F.E.	Ash	Silica	P	Ca
1.	Babul seeds	Anand	10.00	5.60	7.70	65.90	10.80	2.80	0.11	1.18
2	Babul pods	Anand	13.10	2.30	12.30	67.00	5.30	3.40	0.28	1.09
3	Banyan friut meal	Madras	9.32	10.64	31.08	36.72	12.24	7.43	0.41	0.95
4	Bill root	Anand	3.50	1.40	9.50	81.60	3.60	2.60	0.13	0.09
5	Blood meal	Morrison	89.74	2.06	0.90	0.99	6.22	-	0.27	0.35
6	Brewer's dried grains	Morrison	21.95	6.26	19.87	47.86	4.06	-	-	-
7	Cashew apple meal	Madras	7.19	3.73	12.09	70.14	6.85	1.58	0.32	0.17
8	Cashew kernel cake	Trichur	23.03	16.58	9.76	44.87	5.76	-	0.56	0.79
9	Cashew kernel husk	Evans	13.66	12.44	12.44	59.37	2.09	-	-	-
10	Cassia tora seeds	Anand	18.20	7.40	4.60	60.70	9.10	3.30	0.20	0.72
11	Castor bean meal (detoxicated)	Evans	38.40	1.56	41.22	17.67	7.11	-	-	-
12	Coconut cake	Anand	20.40	12.10	6.00	55.00	6.50	0.70	0.59	0.14
13	Custard apple seed	Trichur	33.84	40.34	7.11	16.36	2.35	-	0.23	1.05
14	Date stone	Izatnagar	5.99	6.89	10.48	74.08	2.65	-	-	-
15	Distiller's dried corn grains	Morrison	27.64	9.42	13.56	46.84	2.54	-	0.51	0.12
16	Distiller's dried corn grains with solubes	Morrison	28.63	10.55	9.90	45.86	5.06	12.29	0.80	0.17
17	Duck weed (Lemna minor)	Anand	14.34	2.20	8.42	44.82	30.22	-	-	
18	Feather meal	Madras	92.29	1.62	0.57	1.72	3.80	1.17	0.36	0.72

Contd.....

S.NO:	Feeding stuff	Source	Crude Protein:	E.Ext	Crude fibre	N.F.E.	Ash	Silica	P	Ca
19	Frog meal	Trichur	68.60	4.90	-	2.40	24.10	-	5.52	12.06
20	Garbage	Morrison	15.27	18.32	2.80	56.49	7.12	-	-	-
21	Garbage, Processed	Morrison	18.25	24.71	20.86	22.73	13.45	-	0.34	-
22	Jaman seeds (Eugenia Jambolana)	Izatnagar	8.50	1.18	16.90	51.70	21.72	-	0.07	0.29
23	Jeel seeds (Indigofera Pauci-folia)	Anand	32.20	11.10	5.00	44.60	7.10	2.00	0.65	0.44
24	Kapok cake	Evans	31.23	8.14	29.88	23.42	7.33	-	-	-
25	Liver residue meal	Madras	75.68	15.93	0.01	4.97	3.41	0.73	0.66	0.21
26	Maize germ cake	Anand	19.70	10.90	8.10	59.80	1.50	0.40	0.38	0.08
27	Maize germ discarded	Anand	8.50	10.60	5.20	73.20	2.10	-	0.24	0.24
28	Makhan kauncha seeds (Macuna monosperma)	Anand	27.80	5.90	1.80	60.10	4.40	0.10	0.58	0.19
29	Mangoes unmatured dried	Anand	7.00	3.10	4.20	79.20	6.00	0.70	0.14	0.57
30	Mango seed kernel	Anand	6.40	10.20	1.80	79.30	2.30	0.20	0.27	0.29
31	Meat meal	Anand	52.00	4.60	2.00	5.00	36.40	16.30	1.70	2.49
32	Mohwa cake (Madhuca indica)	Anand	16.00	10.90	3.10	64.30	5.70	1.10	0.32	0.12
33	Mohwa flowers	Anand	4.50	1.60	2.20	85.90	5.80	1.70	0.11	0.21
34	Mohwa seeds	Anand	10.30	48.00	3.50	35.40	2.80	0.20	0.14	0.20
35	Niger cake (Guizotia abyssina)	Evans	36.40	6.52	22.34	26.29	10.45	-	-	

Contd.....

S.NO	Feeding stuff	Source	Crude Protein	E. Ext.	Crude Fibre	N.F.E.	Ash	Silica	P	Ca
36	Okra cake (Hibiscus esculcutus)	Anand	22.30	7.10	19.80	43.40	7.40	1.20	0.85	0.29
37	Poppy seed oil cake	Morrison	40.91	11.60	13.41	22.38	11.70	-	-	-
38	Penicillin mycelium residue	Anand	22.60	6.23	9.61	35.40	26.16	15.93	2.79	0.76
39	Pineapple bran	Trichur	4.31	1.99	16.48	72.58	4.64	-	0.19	0.44
40	Pineapple crown	Trichur	6.65	6.35	20.78	58.84	7.38	-	0.68	1.13
41	Rape seed cake	Morrison	38.67	5.67	13.00	33.77	8.89	-	-	-
42	Rain tree pods (Enterolobium saman)	Izatnagar	15.91	1.51	11.80	67.02	3.76	-	0.01	0.29
43	Rubber seeds	Trichur	16.75	26.42	35.69	19.13	2.01	-	0.86	0.48
44	Sundarsan seeds (Cassia occidenta -lis)	Anand	14.70	5.50	21.80	48.40	9.60	0.80	0.30	1.69
45	Sal seeds (Shorea robusta)	Orissa	6.50	17.70	5.08	24.12	11.20	-	-	-
46	Safflower cake	Anand	20.70	4.80	33.90	36.30	4.30	0.80	0.64	0.25
47	Sunflower seeds	Lyallpur	19.29	27.55	30.12	15.22	7.82	-	0.71	0.39
48	Sunflower seed cake	Bombay	42.79	8.60	15.31	26.48	6.82	-	-	-
49	Sunflower seed cake(decorticated)	Morrison	38.67	20.33	12.11	24.20	4.69	-	1.20	0.48
50	Silk cotton seeds	Trichur	31.43	20.62	12.36	30.28	5.31	-	0.60	0.52

Contd.....

S.NO:	Feeding stuff	Source	Crude protein:	E.Ext.	Crude fibre :	N.F.E.	Ash	Silica:	P	Ca.
51	Silk worm pupae	I.C.A.R.	54.50	20.40	3.58	18.21	3.31	-	-	-
52	Sennhemp seeds	Evans	20.00	35.82	16.48	23.02	4.62	-	-	-
53	Shevari seeds (Sesbania agypticum)	Anand	21.20	2.60	8.50	60.60	7.20	1.00	0.68	0.44
54	Tamarind seeds	Anand	10.05	5.30	6.80	74.75	3.10	0.20	0.23	0.40
55	Tomato waste	Anand	23.65	17.25	22.35	27.00	9.75	4.55	0.59	0.20
56	Virginia tobacco seed cake	Izatnagar	29.95	10.37	22.33	24.66	12.69	-	-	-
57	Watermelon seed cake	Anand	25.10	12.40	30.20	27.70	4.60	1.70	0.46	0.19

Appendix II

Initial body weights of individual birds.

(gms.)

S.NO:	Treatments							
	T_I		T_{II}		T_{III}		T_{IV}	
	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
1.	40	36	38	39	40	42	36	38
2.	43	33	35	37	40	36	35	40
3.	34	34	44	41	44	39	40	37
4.	42	37	40	41	40	41	38	39
5.	37	42	41	35	44	42	42	38
6.	38	48	36	40	41	43	44	40
7.	40	42	33	35	40	38	44	37
8.	42	33	35	42	33	39	40	38
9.	36	41	38	42	37	34	39	42
10.	41	40	40	40	38	38	40	38
11.	40	39	40	43	35	37	37	39
12.	43	42	48	35	39	37	38	36
13.	38	40	36	33	41	35	37	41
14.	37	43	38	31	35	38	38	37
15.	37	39		40	37	38		41
16.	40	35		39	43	39		35
17.	36	40		42	35	41		
18.	36	36			34	43		
19.	36	36			36			
Avearge	38.74	38.74	38.71	38.53	38.53	38.89	39.14	38.50

Ingredients used, their composition, proportion in different

S.NO	Ingredients	COMPOSITION (Per cent on dry matter basis)												Broiler starte	
		C.Protein	E. Ext.	C.Fibre	N.F.E.	Ash	Silica	P		Ca	Methio-nine + Cystine	Lysine	Metaboli-zable energy Kcal/kg	T_I	T_{II}
								Total	Availa-ble						
1	Maize gluten I	58.7	5.6	0.8	35.5	1.6	0.7	0.16	0.05	0.14	0.86	3.30	2414	12	12
2	Maize gluten II	29.3	4.9	5.4	53.4	7.0	2.5	0.15	0.05	0.12	0.44	1.66	1688	-	-
3	Wheat broken I	14.6	5.1	5.6	66.5	8.4	3.8	0.36	0.21	0.56	0.45	0.40	3284	12	12
4	Wheat ground II	12.3	2.7	9.7	62.3	13.0	6.9	0.71	0.18	0.43	0.38	0.54	3284	-	-
5	Rice polish I	8.9	10.4	10.7	50.0	20.0	13.8	1.05	0.41	0.24	0.17	0.46	3428	50	33
6	Rice polish II	11.9	14.5	5.2	58.2	10.2	2.9	1.48	0.49	0.42	0.23	0.61	3428	-	-
7	Fish meal	43.4	5.8	3.7	13.7	33.4	4.5	5.51	5.49	6.62	1.82	5.04	2006	10	10
8	Groundnut cake	43.8	8.3	8.8	32.4	6.7	3.5	0.97	0.28	0.45	0.12	0.14	3593	15	15
9	Mango seed kernel	5.7	12.0	2.6	77.0	2.7	0.0	0.24	0.09	0.18	-	-	3430	-	15
10	Cassia tora seeds	17.0	6.6	5.6	64.6	6.2	0.7	0.50	0.20	0.85	-	-	3176	-	-
11	Tamarind seeds	13.7	5.2	8.0	70.1	3.0	0.2	0.20	0.05	0.28	-	-	3186	-	-
12	Tomato waste	22.6	18.2	23.9	30.0	5.3	1.3	0.56	0.19	0.17	-	-	3413	-	-
13	Penicillin mycelium residue	22.6	6.2	9.6	35.4	26.2	15.9	0.76	0.30	2.79	-	-	2134	-	-
14	Oyster shell	-	-	-	-	97.2	10.7	-	-	32.81	-	-	-	2	2
15	Bone meal	-	-	-	-	84.6	3.4	11.48	11.40	25.97	-	-	-	1	1
														gms/100 kg	
16	Manganese sulphate													22	22
17	*Rovimix													25	25
18	Common salt													250	250
19	Embazine													50	50

Rovimix, a Glaxo Product contain vitamins A = 40,000 I.U. B_2 = 20 mg and D_3 = 5,000 I.U. per

APPENDIX IV

Body weights of chicks on different feeds at weekly intervals.

(Gms.)

Bird No.	T_I R_1 (B.S.F.)							T_1 R_1 (B.F.F.)					
	Weeks												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Males													
221.	40	78	145	255	407	595	805	1007	1272	1525	1795	1975	2257
222	43	68	117	203	295	453	652	834	1054	1207	1465	1620	1915
223	34	63	119	227	368	548	755	937	1135	1350	1602	1740	2070
228.	42	86	168	290	430	600	825	984	1225	1445	1722	1867	2224
415	37	67	122	210	337	492	670	850	1025	1247	1412	1552	1720
232	38	70	134	244	385	585	825	1064	1340	1602	1900	2065	2400
226	40	88	169	300	448	614	784	1024	1224	1442	1670	1807	2140
235	42	94	182	320	468	665	865	1097	1367	1570	1880	2005	2347
239	36	95	178	295	420	538	745	962	1142	1362	1655	1885	2192
240	41	78	146	262	395	540	718	917	1100	1230	1450	1570	1805
Av.	39.30	78.2	148.0	260.6	395.30	563.00	764.40	965.60	1184.40	1398.00	1655.10	1810.60	2107.00
Females													
224	40	83	156	280	410	565	742	940	1135	1297	1450	1620	1855
225	43	81	136	258	395	550	725	905	1082	1270	1600	1699	1785
479	38	82	170	302	442	610	800	1003	1177	1317	1485	1660	1955
229	37	65	120	226	345	507	707	873	1003	1212	1432	1635	1925
230	37	61	101	182	278	412	592	815	1025	1197	1390	1552	1760
233	40	73	135	252	388	532	685	872	1108	1350	1550	1702	1855
236	36	57	98	192	314	455	615	780	910	1095	1272	1387	1610
237	36	59	100	181	287	438	595	784	924	1112	1257	1422	1595
238	36	74	143	258	368	482	602	660	745	875	995	1085	1155
Av.	38.11	70.56	128.78	236.78	358.56	505.67	673.67	848.00	1012.11	1190.56	1370.11	1519.22	1717.22
R_1 Av.	38.74	74.58	138.89	249.34	377.89	535.84	721.42	909.89	1104.89	1299.74	1520.11	1672.58	1922.57

Contd.....

Contd..

Bird NO:	T_I R_2 (B.S.F.)							T_1 R_2 (B.F.F.)					
	Weeks												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Males													
242	36	74	160	245	390	589	820	1040	1225	1280	1455	1665	1900
243	53	59	82	133	217	370	498	675	900	1140	1300	1670	1975
246	54	61	124	218	336	477	595	778	1007	1202	1375	1600	1880
247	57	58	113	217	298	432	615	825	1070	1295	1487	1695	1955
248	42	80	87	151	207	325	502	734	984	1220	1450	1720	1962
253	43	67	188	333	503	695	952	1216	1450	1782	1835	2250	2600
255	42	91	178	296	438	550	820	1028	1398	1550	1657	2010	2310
256	33	56	98	148	220	350	524	724	880	1145	1395	1645	1900
260	41	68	130	215	357	552	795	1024	1350	1585	1857	2075	2400
Av.	38.44	70.33	128.89	217.33	329.00	482.22	677.89	884.11	1138.22	1349.89	1532.33	1814.44	2098.00
Females													
241	40	71	135	219	297	395	515	638	753	865	935	955	1157
244	39	66	117	196	298	444	612	780	918	1047	1117	1367	1618
245	42	78	136	232	335	505	714	852	1095	1277	1390	1540	1762
249	40	73	140	226	322	450	600	730	857	1032	1160	1350	1482
250	43	91	178	292	400	550	670	750	800	1017	1180	1550	1555
251	39	73	138	252	372	555	750	957	1100	1302	1480	1670	1892
254	35	60	112	210	305	455	655	857	1067	1200	1335	1555	1800
257	40	76	149	255	364	527	725	922	1090	1265	1420	1665	1820
258	36	61	128	235	383	542	745	930	1143	1312	1465	1620	1860
259	36	66	127	212	325	457	590	739	889	1022	1160	1330	1525
Av.	39.00	71.50	136.00	232.90	338.10	488.00	657.80	811.50	979.20	1135.90	1264.20	1440.20	1647.10
R_2 Av.	38.74	70.95	132.63	225.53	333.79	485.26	667.21	850.63	1054.53	1236.21	1391.21	1667.47	1860.88
Treat. Av.	38.84	72.76	135.76	237.42	351.84	510.55	694.32	880.26	1079.71	1269.98	1455.66	1645.02	1891.52

Contd.....

Contd..

Bird NOs	T_{II} R_1 (B.S.P.)							T_{11} R_1 (B.F.P.)					
	Weeks												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Males													
204	38	75	125	192	290	430	650	857	1070	1295	1475	1620	2035
205	35	78	140	218	350	532	722	950	1218	1450	1720	1892	2240
209	44	68	116	207	312	450	627	796	978	1145	1340	1627	1852
140	40	72	132	258	361	545	752	965	1160	1370	1525	1612	2077
211	41	66	118	198	294	432	605	767	945	1135	1332	1562	1815
215	36	88	154	222	345	508	718	950	1150	1350	1522	1735	2095
216	53	91	160	276	361	497	652	752	880	980	1045	1275	1497
219	35	69	112	163	248	352	488	725	985	1217	1417	1715	2097
Av.	37.75	75.88	132.12	214.50	322.38	468.25	651.75	845.00	1049.50	1240.25	1422.00	1662.25	1963.50
Females													
202	38	57	95	162	235	360	488	635	780	950	1065	1302	1447
206	40	64	134	227	323	486	670	795	1002	1160	1272	1522	1695
208	50	65	110	165	231	268	345	507	683	760	872	1042	1205
213	48	66	130	214	317	458	615	739	912	1082	1202	1432	1615
471	36	58	104	196	302	455	654	840	1009	1170	1255	1495	1717
217	38	52	75	142	225	357	552	772	970	1222	1400	1662	1920
Av.	40.00	60.00	108.00	184.33	272.17	397.33	554.00	714.67	889.33	1049.00	1181.60	1412.50	1599.83
R_1 Av.	38.71	69.07	121.79	201.57	300.86	437.96	609.86	788.00	978.71	1158.29	1318.71	1556.21	1807.64

Contd.....

Bird No:	T_{II} R_2 (B.S.F.)							T_{11} R_2 (B.F.F.)					
	Weeks												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Males													
325	39	86	152	252	370	518	710	850	972	1285	1557	1837	2067
326	37	94	162	246	366	466	558	772	985	1157	1345	1567	1765
328	41	74	155	213	335	498	647	872	1085	1312	1537	1827	2105
333	41	84	155	250	376	507	678	842	1040	1237	1417	1430	1565
336	35	47	65	97	127	200	317	490	678	867	1047	1250	1417
341	40	72	125	207	295	415	575	750	925	1087	1222	1437	1537
343	35	64	130	235	377	527	703	897	1082	1280	1420	1637	1812
344	42	68	145	231	357	530	718	865	1078	1307	1507	1830	2040
Av.	38.75	73.62	133.62	216.38	325.38	457.62	613.00	792.12	976.12	1192.75	1381.50	1598.38	1794.75
Females:													
329	42	90	165	244	355	470	580	690	921	1070	1257	1357	1560
330	40	70	114	188	290	400	498	648	755	957	1170	1492	1687
332	43	89	148	235	328	490	655	860	1027	1235	1395	1585	1690
334	35	82	81	135	223	357	513	677	804	1012	1212	1442	1592
335	33	78	145	236	348	503	625	802	988	1185	1425	1632	1787
338	31	49	85	152	268	290	380	510	646	837	885	962	1057
339	40	81	110	178	275	391	498	677	855	1017	1180	1375	1480
340	39	73	128	200	275	398	530	694	844	1110	1140	1420	1555
342	42	70	122	198	296	400	514	658	758	880	1057	1242	1317
Av.	38.33	70.22	121.78	196.22	295.11	409.89	532.56	690.00	842.56	1034.78	1189.00	1387.44	1527.22
R_1 Av.	39.53	71.82	127.35	205.70	309.35	452.55	570.41	738.11	906.35	1106.82	1279.59	1487.18	1655.12
Treat. Av.	38.61	70.58	124.84	203.84	305.52	434.84	580.23	760.65	939.09	1131.16	1297.28	1517.90	1722.90

Contd....

Contd....

Bird NO:	T_{III} R_1 (B.S.F.)							T_{111} R_1 (B.F.F.)					
	Weeks												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Males													
281	40	87	145	256	364	502	655	792	1020	1295	1572	1850	2075
282	40	61	94	157	239	352	510	675	820	1022	1210	1280	1390
283	44	69	95	178	254	372	510	719	925	1162	1422	1652	1810
284	40	65	100	157	193	298	448	662	892	1120	1405	1605	1790
286	44	98	127	188	262	398	547	725	938	1180	1417	1612	1775
287	41	78	134	216	287	362	487	667	830	970	1122	1275	1422
294	40	57	100	160	209	305	430	620	807	1028	1285	1410	1590
295	33	55	98	189	295	452	627	892	1150	1582	1710	1892	2010
296	37	68	108	184	236	340	488	757	990	1225	1517	1750	1982
Av.	39.89	69.67	109.89	187.22	257.67	373.44	522.44	721.56	928.00	1152.00	1406.67	1589.56	1780.44
Females													
285	38	77	127	217	315	424	584	839	1025	1240	1445	1680	1805
292	35	74	132	204	280	380	519	717	910	1042	1245	1565	1500
289	39	55	85	117	140	200	295	410	505	625	825	905	1100
290	41	61	104	180	255	385	532	700	888	1050	1235	1420	1570
291	35	52	75	114	162	259	362	535	695	812	1007	1125	1205
293	37	55	77	128	177	270	392	532	715	860	1065	1115	1228
297	45	92	160	264	350	465	609	717	840	977	1157	1317	1452
298	35	67	88	151	188	254	347	532	702	885	1115	1290	1440
299	34	54	92	163	206	301	427	634	815	985	1192	1307	1395
300	36	77	145	242	331	462	604	789	920	1070	1237	1405	1550
Av.	37.30	66.40	108.50	178.00	240.40	340.00	468.10	640.50	796.50	952.60	1152.30	1292.90	1404.60
R_1 Av.	38.53	67.95	109.16	182.37	248.58	355.84	493.84	678.89	858.79	1047.05	1272.79	1453.42	1573.11

Contd.....

Contd....

Bird No.	T_{III} R_2 (B.S.F.)							T_{111} R_2 (B.F.F.)					
	Weeks												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Males													
262	42	71	104	163	247	360	496	707	955	1140	1170	1370	1620
263	38	69	114	212	302	417	555	705	963	1205	1420	1472	1525
268	39	64	116	190	277	415	567	779	1038	1280	1442	1680	1970
270	41	65	125	232	304	469	630	867	1005	1232	1450	1677	1925
274	42	88	157	234	312	445	586	789	977	1200	1375	1562	1805
276	43	87	144	245	344	475	637	875	1102	1312	1470	1690	1855
277	38	62	90	152	223	340	480	700	830	1040	1240	1462	1582
280	39	56	86	155	242	370	525	757	972	1222	1470	1717	1952
Av.	40.00	70.25	117.00	200.38	281.38	411.38	559.75	772.38	977.75	1205.88	1379.62	1576.75	1774.25
Females:													
265	34	55	100	195	304	397	527	709	855	1042	1148	1265	1375
266	38	61	94	171	256	365	473	669	850	1070	1205	1392	1355
267	37	72	118	180	236	338	459	620	770	910	1042	1102	1190
269	37	65	114	162	237	324	425	612	765	957	1135	1295	1422
271	35	58	94	140	193	270	409	575	747	915	1060	1210	1382
272	38	64	112	195	275	359	467	642	790	895	985	1147	1355
273	38	47	72	122	163	252	362	512	685	865	1022	1200	1380
275	39	64	98	158	218	298	377	547	700	800	980	1050	1190
279	41	60	87	143	195	232	408	590	768	950	1080	1260	1450
490	43	75	125	205	274	361	450	602	758	860	970	1165	1295
Av.	38.00	61.10	101.40	169.10	235.10	326.40	457.70	607.80	764.80	926.40	1062.70	1207.60	1355.00
R_1 Av.	38.89	65.72	108.33	183.00	257.67	364.17	491.94	680.94	869.44	1048.72	1203.56	1372.56	1529.33
Treat. Av.	38.70	66.86	108.76	182.68	252.05	359.99	492.92	679.89	859.11	1048.35	1239.11	1403.89	1551.89

Contd.....

Contd..

Bird NO:	T_{IV} R_1 (B.S.F.)							T_{IV} B_1 (B.F.F.)					
	Weeks												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Males													
306	36	55	82	125	161	222	288	447	607	737	1015	1165	1565
308	35	51	92	136	169	232	297	457	590	780	932	1100	1220
312	40	59	97	147	189	260	317	475	650	822	1060	1305	1525
313	38	67	112	160	228	302	404	574	722	925	1077	1247	1370
316	42	71	110	167	210	277	348	472	642	815	957	1157	1315
317	44	74	105	136	180	225	276	426	572	765	960	1162	1280
321	44	72	109	162	205	278	340	460	573	710	872	1052	1070
Av.	39.86	64.14	101.00	147.57	191.29	256.29	323.57	473.00	622.29	802.00	981.86	1164.00	1306.85
Females													
307	40	68	107	135	188	245	281	387	480	570	642	742	810
310	39	56	84	108	154	180	250	400	520	662	810	1010	1190
311	40	61	95	130	165	246	332	454	596	795	910	1092	1205
318	37	45	62	80	93	130	168	288	400	537	695	812	892
319	38	48	75	111	130	171	230	359	505	635	817	975	1062
320	37	45	58	77	101	142	205	339	467	615	677	847	1130
324	38	59	88	110	142	192	271	403	518	697	745	910	970
Av.	38.43	54.57	81.29	107.29	135.86	186.57	248.14	376.57	497.29	644.43	756.57	912.57	1037.00
R_1 Av.	39.14	59.36	91.14	127.43	163.57	221.43	285.86	424.79	559.79	723.21	863.21	1038.29	1171.71

Contd.....

Contd..

Bird NOs	T_{IV} R_2 (B.S.F.)							T_{IV} R_2 (B.F.F.)					
	Weeks												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Males													
346	38	62	100	131	215	287	365	542	693	910	1125	1305	1465
349	40	48	75	91	131	178	225	350	475	607	780	917	1035
352	37	70	114	142	201	275	348	482	640	855	1100	1327	1480
354	39	57	84	105	146	213	275	455	605	812	1030	1235	1415
357	38	72	127	171	258	315	392	559	707	812	1015	1205	1308
361	40	69	90	118	173	237	275	420	578	722	890	1060	1165
212	37	69	102	137	186	236	315	470	622	800	977	1215	1455
Av.	38.43	63.86	98.86	127.86	184.29	248.71	313.29	468.29	617.14	788.29	988.14	1180.57	1326.1
Females													
345	38	61	98	124	179	222	274	414	583	755	945	1090	1175
350	42	68	100	139	178	253	335	442	601	805	870	1060	1117
351	38	54	82	106	143	188	240	330	450	587	742	842	1002
355	39	62	93	118	174	236	288	434	582	722	920	1045	1170
358	36	61	95	120	156	215	285	413	530	667	842	1012	1110
358	41	68	101	142	195	280	367	516	625	780	882	1080	1255
359	37	55	78	88	110	140	161	217	258	335	445	555	650
360	41	62	95	117	146	195	246	355	440	570	730	870	945
327	35	54	85	119	179	247	295	372	422	485	567	675	730
Av.	38.66	60.56	91.89	119.11	162.00	219.56	275.67	388.11	496.22	631.78	775.67	914.33	1020.44
R_1 Av.	38.50	62.00	94.94	122.94	171.75	232.31	282.12	425.19	549.12	700.25	867.50	1030.81	1154.19
Treat. Av.	38.80	60.77	95.17	125.05	167.95	227.25	289.20	423.93	554.10	710.97	868.59	1054.80	1162.37

APPENDIX V

Average feed consumption per bird per week.

(gms.)

Weeks	Treatments							
	T_I		T_{II}		T_{III}		T_{IV}	
	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
				B.S.F.				
1st	72.63	70.79	68.95	73.53	68.16	73.72	68.24	66.05
2nd	171.32	170.00	146.32	152.22	144.84	150.28	208.67	171.47
3rd	316.58	291.32	281.05	260.56	248.68	282.50	322.96	289.41
4th	499.21	406.05	317.89	397.67	378.42	390.56	127.96	122.65
5th	515.26	484.21	405.26	406.11	442.11	422.22	217.96	129.69
6th	603.68	548.05	522.65	516.67	515.79	555.56	314.29	225.00
Av. 0 to 6 weeks	2048.55		1767.04		1856.22		1121.46	
				B.F.F.				
	T_1		T_{11}		T_{111}		T_{1v}	
	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
7th	646.84	594.74	655.68	609.94	607.89	641.67	550.00	548.12
8th	951.58	728.95	810.53	820.56	897.37	902.78	757.14	682.50
Av.7-8 week	1401.05		1436.42		1524.52		1266.33	
9th	871.32	855.26	916.67	874.17	975.68	925.00	741.43	856.25
10th	952.68	933.86	1033.33	927.78	1000.00	955.33	800.00	862.50
Av. 9-10 weeks	1798.03		1840.54		1917.57		1825.53	
11th	1010.53	1065.61	1380.00	1158.89	1026.32	1072.22	914.29	931.25
12th	1131.58	1105.26	1460.00	1282.35	1105.26	1150.00	1021.43	926.50
Av. 11-12 weeks	2155.26		2608.74		2175.68		1915.53	
Av. 7-12 weeks	5354.34		5885.70		5817.57		4804.99	

Appendix VI

Economics of different rations at weekly intervals

(Paise per chick)

Period in weeks	Income	Expenditure				Net return
		Cost of chick	Cost of feed	other costs	Total	
			T_I (B.S.F.)			
1	32.7	165.0	3.7	13.9	182.6	- 149.9
2	61.1	165.0	12.4	27.8	205.2	- 144.1
3	106.8	165.0	27.9	41.7	234.6	- 127.8
4	160.1	165.0	49.7	55.6	270.3	- 110.2
5	229.7	165.0	75.2	69.5	309.7	- 80.0
6	312.4	165.0	104.6	83.4	353.0	- 40.6
			T_1 (B.F.F.)			
7	396.1	165.0	133.4	97.3	395.7	+0.4
8	485.9	165.0	169.7	111.2	445.9	+40.0
9	570.6	165.0	209.4	125.1	499.5	+71.1
10	655.0	165.0	253.3	139.0	557.3	+97.7
11	740.3	165.0	301.5	152.9	619.4	+120.9
12	851.2	165.0	353.5	166.8	685.3	+165.9
			T_{II} (B.S.F.)			
1	31.8	165.0	3.7	13.9	182.6	-150.8
2	56.2	165.0	11.4	27.8	204.2	-148.0
3	91.7	165.0	25.3	41.7	232.0	-140.3
4	137.5	165.0	43.3	55.6	263.9	-126.4
5	195.7	165.0	64.1	69.5	298.6	-102.9
6	264.7	165.0	90.8	83.4	339.2	-74.5
			T_{11} (B.F.F.)			
7	342.5	165.0	119.6	97.3	382.1	-39.6
8	422.6	165.0	158.0	111.2	434.2	-11.6
9	509.0	165.0	199.8	125.1	489.8	+19.2
10	585.8	165.0	245.4	139.0	549.4	+34.4
11	683.1	165.0	303.7	152.9	621.6	+61.5
12	775.5	165.0	367.4	166.8	699.8	+76.1

contd.....

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Period in weeks	Income	Expenditure				Net return
		Cost of chick	Cost of feed	Other costs	Total	
			T_{III} (B.S.F.)			
1	30.1	165.0	3.7	13.9	182.6	-152.5
2	48.9	165.0	11.3	27.8	204.1	-155.2
3	82.2	165.0	24.8	41.7	231.5	-149.3
4	113.4	165.0	45.8	55.6	266.4	-153.0
5	161.8	165.0	68.1	69.5	302.6	-140.8
6	221.8	165.0	95.7	83.4	344.1	-122.3
			T_{111} (B.F.F.)			
7	306.0	165.0	124.5	97.3	386.8	-80.8
8	386.6	165.0	166.1	111.2	442.3	-55.7
9	471.8	165.0	210.0	125.1	500.1	-28.3
10	557.6	165.0	254.7	139.0	558.7	-1.1
11	631.7	165.0	303.1	152.9	621.0	+10.7
12	698.3	165.0	355.1	166.8	686.9	+11.4
			T_{IV} (B.S.F.)			
1	27.5	165.0	5.0	13.9	181.9	-154.6
2	41.9	165.0	11.3	27.8	204.6	-162.7
3	56.2	165.0	26.0	41.7	232.7	176.5
4	75.6	165.0	31.8	55.6	252.4	-176.8
5	102.3	165.0	39.7	69.5	274.2	-171.9
6	130.1	165.0	52.1	83.4	300.5	-170.4
			T_{1v} (B.F.F.)			
7	190.8	165.0	76.5	97.3	338.8	-148.0
8	249.3	165.0	108.3	111.2	384.5	-135.2
9	319.9	165.0	143.4	125.1	433.5	-113.6
10	390.7	165.0	180.4	139.0	484.4	-93.7
11	465.4	165.0	221.4	152.9	539.3	-73.9
12	525.1	165.0	265.3	166.8	597.1	-74.0