# EVALUATION OF RUBBER SEED MEAL IN BROILER DIETS

By

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## THESIS

Submitted in partial fulfilment
of the requirement for the degree

## MASTER OF VETERINARY SCIENCE

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Kerala Agricultural University

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COLLEGE OF VETERINARY & ANIMAL SCIENCES
MANNUTHY – TRICHUR

1978

## DECLARATION

I hereby declare that this thesis entitled "EVALUATION OF RUBBER SEED MEAL IN BROILER DIETS" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship, or other similar title, of any other University or Society.

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## CERTIFICATE

Certified that this thesis, entitled "EVALUATION OF RUBBER SEED MEAL IN BROILER DIETS" is a record of research work done independently by Kum. A. Radhamma Pillai under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to her.

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## ACKNOWLEDGEMENTS

I place on record my deep sense of gratitude to Dr. C.K. Venugopalan, Senior Scientist, All India Co-ordinated Research Project on Poultry for Eggs, for his munificent help and meticulous guidance as my Major Advisor.

I am greatly indebted to Dr. A.K.K.Unni, Professor, Department of Poultry Science, Dr.(Mrs.) Maggie D. Menachery, Associate Professor (Nutritionist), All India Co-ordinated Research Project on Poultry for Eggs and Dr.E.Sivaraman, Professor, Department of Animal Nutrition for their competent assistance, advice and encouragement given to me as members of my Advisory Committee.

I am extremely thankful to Dr.A.Ramakrishnan, Professor of Poultry Science (on deputation) for his bountiful help, valuable suggestions and constructive criticisms.

I am thankful to Dr. P.U.Surendran, Professor, Department of Statistics for the valuable guidance given in the statistical analysis of the data.

Grateful acknowledgement is made to Dr. P.G. Nair, Dean, Faculty of Veterinary and Animal Sciences, Mannuthy, for the kind permission granted to undertake this study and for the facilities provided.

I am obliged to Dr. Renchi P.George, Farm Manager, All India Co-ordinated Research Project on Poultry for Eggs and Dr.A.Jalaludeen, Instructor, University Poultry Farm, and Duck Farm, for all the help and co-operation extended to me during this study.

I express my heart-felt thanks to my colleagues and friends in the Department of Poultry Science for their timely help.

Thanks are also due to Sri.V.T.Kurian for typing out this manuscript diligently.

I dedicate this thesis to my beloved parents.

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# INTRODUCTION

# INTRODUCTION

Poultry Industry has firmly established as a part of the agricultural production in our country and contributes to the national income in the form of meat and eggs. The need for high quality animal protein in human diets has been emphasised by nutritionists. Broiler production, which was hitherto a sideline activity to commercial egg farming, is gradually becoming as an altogether independent business thereby contributing towards filling protein gap. Poultry, unlike other domestic livestock, are dependent entirely on concentrate feeds for production. Poultry meat can be produced more cheaply and quickly than any other tender meat since the efficiency of Poultry in converting concentrate feeds into meat is rather high. The availability of cheap feed ingredients for incorporation in concentrate feeds is therefore an essential pre-requisite for economic poultry production.

The profit in poultry keeping depends mainly on a favourable relationship between the production cost involved and the income derived, the most important factor being the availability and cost of the feed. The feed cost comprises 60 to 70 per cent of total production costs. Requirement of protein, the major nutrient of poultry ration is met by incorporating various feed stuffs of both vegetable and animal origin. The price factor and availability of these conventional sources place a limitation on the proportion of these widely used ingredients. The shortage of human food in India has further created a situation wherein, the poultry have to compete with human beings for the utilisation of conventional feeds like grains and their by-products. It has thus become imperative to find suitable alternate sources of feed ingredients for poultry feeding without adversely affecting their health, livability, production and economics of poultry raising thereby sparing human foods as much as possible.

Large quantities of agricultural and industrial by-products which are either unsuitable or not required for human consumption are available in our country and the poultry nutritionists have recently taken up the task of formulating economic and efficient poultry rations by utilising these. Extensive investigations on the feeding value of unconventional feeds, agricultural wastes and industrial by-products available in our country have been sponsored by the Indian Council of Agricultural Research. Many such ingredients have been shown to be suitable as protein supplements that can replace groundnut cake partly or completely. These products are not uniformly available in all parts of the country and hence are used on a regional basis where they could be procured in substantial quantities. Rubber seed meal (RSM), an agricultural by-product is regarded as a promising good protein supplement for livestock and poultry.

India occupies the sixth position in the world in Rubber Plantation with an area of 2.24 lakh hectares of rubber cultivation, of which about 93 per cent is concentrated in Kerala (Anon, 1978). The rubber seeds resembling very much as those of castor have a high content of semi-drying oil which is used in paint and soap industry and the press cake left over is potential source of high protein food (Lauw et al.1967). The availability of rubber seeds in this state is estimated to be 1.8 lakh tonnes per year (Anon, 1965-66). The cost of rubber seeds in Kerala was calculated at Rs 200/- per tonne (Varghese, 1972).

Preliminary studies carried out have shown that rubber seed meal can be safely incorporated in the rations of large animals (Anon, 1930; Macilwaine, 1931; Dawson and Messenger, 1932; Morrison, 1957; Hyderali, 1970; George, 1970 and Viswanathan, 1977). There are only few reports from Ceylon and Malaysia about the feeding value of RSM in poultry rations. (Buvanendran and Siriwardene, 1970; Rajaguru and Wettimuny, 1973 and Siriwardene and Nugara, 1972). But no work seems to have been carried out on the utilisation of RSM in broiler diets in India.

Considering the fact that Kerala is one of the important states in poultry production in India and that the rubber seed meal is locally available, the present study was undertaken to explore the possibility of utilisation of RSM as a protein supplement in place of groundnut cake in broiler rations.

# REVIEW OF LITERATURE

## REVIEW OF LITERATURE

The total cost of rubber seed oil and cake produced annually in Kerala was around ₨ 1.4 crore of which the cost of cake alone accounted for ₨ 48.9 lakhs (Varghese, 1972). It was further reported by him that the cost of rubber seed would be ₨ 200/- per tonne and that one tonne of seeds could be collected from four hectares of land under rubber cultivation.

Decorticated rubber seed cake was comparable in nutritive value and digestibility with linseed cake and decorticated cotton seed cake and could be readily used as a feeding stuff for livestock (Anon, 1919).

Early workers in Malaya reported that the rubber seed cake may not be useful as cattle feed (Anon, 1929). Conversely, Ellet et al. (1930) reported that rubber seed meal was an efficient medium-protein-concentrate for milch cows and was closely comparable with linseed meal for milk production.

Further, Pope (1930) citing experiments conducted at the Virginia Polytechnic Institute and at Virginia Agricultural Experimental Station with rubber seed meal and linseed meal in cows concluded that rubber seed meal was better for growth and milk production.

Dawson and Messenger (1932) suggested the use of rubber seed meal as a possible cattle feed supplement. But Sen (1952) opined that unless a large part of its oil was extracted, rubber seed cake is not likely to make a suitable cattle feed.

Morrison (1957) opined that rubber seed meal was not much palatable but gave results comparable to that obtained with linseed meal when fed to milk cows and fattening cattle along with other feeds at a rate of 5 lbs per animal.

Bhushan (1958) claimed that rubber seed meal was one of the most digestible concentrated cattle foods available and that small amounts of prussic acid present was unlikely to cause any ill-effect to livestock.

Recently, Toh Khe Seng and Chia Song Kun (1977) comparing nutritive values of rubber seed meal and other oil seed meals concluded that rubber seed meal could be a good substitute for other seed meals in the diets of livestock.

Gorter (1912) concluded that rubber seed kernel contained a cyanogenetic glucoside - a compound which decomposed as a result of enzyme action yielding hydrocyanic acid as one of the products.

Experiments with rubber seed meal showed that no saponin or alkaloid was present and the meal was marketed in U.K. for use as cattle feed (Anon, 1929).

Bredeman (1931) reported the hydrocyanic acid content of Hevea seed products as 0.02 per cent.

It was suggested that the use of rubber seed cake as animal feed may be unwise because of the possible poisoning from prussic acid (Anon, 1948).

The conflicting reports about the presence of cyanogenetic glucoside in rubber seed meal might be due to environmental differences under which the plants were grown. This is evident from the findings of George _et al._ (1932) who reported that hydrocyanic acid content of rubber seed meal varied widely and decreased rapidly during storage.

Lauw _et al._ (1967) estimated the cyanide content of rubber seeds as 200 mg/100 g of fresh seeds.

The chemical composition of rubber seed as well as rubber seed meal has been reported by many workers. The values reported by various authors are summarized in Table 1.

Table 1. Chemical composition of rubber seed meal as reported by different authors (Percentage)

| Sl. No. | Author | Product | D.M. | C.P. | E.E. | C.F. | N.F.E. | Total ash | Calcium | Phosphorus |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Siqueira *et al.* (1955) | Rubber seed | - | 17.8 | 45.0 | 4.3 | - | - | - | - |
| 2. | Rajaguru and Vohra (1975) | " | 91.8 | 17.5 | 4.5 | 34.9 | - | 2.6 | - | - |
| 3. | Morrison (1957) | Rubber seed meal | 91.1 | 23.8 | 9.2 | 10.0 | 37.6 | - | - | - |
| 4. | Sankunny *et al.* (1964) | " | 48.73 | 16.75 | 26.42 | 35.69 | 19.13 | 2.01 | 0.48 | 0.86 |
| 5. | Buvanendran and Siriwardene (1970) | " | 89.63 | 23.62 | 10.93 | 9.86 | 39.33 | 5.89 | - | - |
| 6. | Siriwardene and Nugara (1972) | " | 89.73 | 28.68 | 3.80 | 10.83 | 40.03 | 6.39 | - | - |
| 7. | Orok and Bowland (1974) | " | 96.1 | 18.3 | 43.3 | 3.8 | 27.5 | 3.1 | - | - |
| 8. | Rajaguru and Vohra (1975) | " | 88.80 | 30.0 | 11.4 | 4.6 | - | 4.8 | - | - |
| 9. | Amrithavally (1977) | " | 93.90 | 26.59 | 17.56 | 3.80 | 45.55 | 6.50 | 0.35 | 0.62 |
| 10. | Ong and Yeong (1977) | " | 92.0 | 25.1 | 11.6 | 15.4 | - | 4.6 | 0.3 | 0.62 |
| 11. | Toh Khe Seng & Chia Song Kun (1977) | " | 94.11 | 26.7 | 8.20 to 14.10 | 12.30 to 17.60 | - | - | 0.09 to 0.11 | 0.29 to 0.46 |

Studies on the metabolizable energy values of rubber seed meal were carried out by Siriwardene and Nugara (1972). The mean metabolizable energy content was found to be 1788 Kcal per kg of rubber seed meal.

Toh Khe Seng and Chia Song Kun (1977) reported the metabolizable energy of rubber seed meal as 2550 Kcal/kg.

The gross energy of rubber seed meal was calculated as 6.5 Kcal/g (Orok and Bowland, 1974).

Oluyemi <u>et al.</u> (1976) reported the gross energy of autoclaved and raw rubber seed as 6.99 and 7.11 Kcal/g respectively and that of defatted rubber seed meal as 4.48 Kcal/g. They also reported the metabolizable energy (Kcal/g) of whole rubber seed (raw) as 4.96 ± 0.29, whole rubber seed (autoclaved) as 4.58 ± 0.16 and defatted rubber seed meal as 2.46 ± 0.37.

Rubber seed kernels contained 450 µg of Thiamine, 2500 µg of total nicotinic acid and 250 µg of carotene per 100 g (Siqueira <u>et al.</u> 1955).

The amino acid composition of decorticated rubber seed was worked out by many workers. The amino acid content ranged as follows: Isoleucine 3.8-4.2, Leucine 6.7-7.1, Lysine 3.6-5.4, Phenyl-alanine 3.8-4.8, Tyrosine 2.6-2.8, Cystine 1.4-2.9, Methionine 0.7-1.4, Threonine 2.8-3.8, Tryptophan 1.3-1.4, Histidine 2.2-3, Valine 6.4-8, Alanine 4.9, Arginine 9.4 and Glycine 4.4 mg/100 g of protein respectively. (Lauw *et al.*1967; Orok and Bowland, 1974 and Rajaguru and Vohra, 1975).

Siqueira *et al.*(1955) showed that when rats were fed a diet containing 52 per cent defatted meal, they lost weight. But when the defatted meal was heated at 100 to 105°C for 2 hours and then fed at a level of 50 per cent of the diet, rats accepted the food but weight gains were poor.

Deshelled, mature, over-dried, milled rubber seeds were found to be a good source of protein of high biological value for albino rats even when fed at a level of 29.6 per cent (Sankunny *et al.* 1964).

Lauw *et al.*(1967) carried out feeding trials with rubber seed protein in rats. The protein efficiency ratio was found to be 2.3 which compared well with that of casein (2.5). They also suggested that the high level of lysine and tryptophan would make it a good companion protein for maize. However, the methionine content of the protein was low. The food intake of rats receiving 10 and 20 per cent rubber seed protein was almost the same as that of casein fed control.

Orok and Bowland (1974) reported the use of Nigerian para rubber seed meal as an energy and protein source for rats fed soyabean and peanut meal supplemented diets. The results of their study indicated that levels of 7 to 12 per cent rubber seed meal from fresh or autoclaved decorticated rubber seeds could be utilised efficiently in either soyabean meal or peanut meal supplemented diets.

Nair (1969) conducted studies on the toxic effects of feeding few indigenous materials to poultry including rubber seed and rubber seed cake in 4-8 week-old White Leghorn chicks replacing groundnut cake completely in the ration. Rubber seed which had been stored for 6 months before use and fed at 20 per cent level did not produce any adverse effect. Rubber seed cake fed at 20 per cent level for a period of 12 weeks was found to be beneficial. It was concluded that rubber seed cake could be used as a protein supplement in the diets of egg-type chickens.

An investigation carried out in the Department of Poultry Science of the Kerala Agricultural University on the feeding value of rubber seed meal for laying hens at levels of 0, 10, 15 and 20 per cent partially replacing groundnut cake demonstrated that rubber seed meal as a protein concentrate in layer diet could be used upto 15 per cent level (Amrithavally, 1977).

Buvanendran and Siriwardene (1970) studied the effects of feeding rubber seed meal to poultry. Results of their study showed that broilers fed 15 to 20 per cent rubber seed meal replacing coconut cake gained more weight than those fed 10 per cent and the control. They concluded that rubber seed meal was a useful substitute for coconut meal in broiler ration upto 20 per cent. It was further observed that incorporation of rubber seed meal in layer diets upto 25 per cent did not significantly affect egg production, egg weight and feed efficiency when compared to rations containing similar levels of coconut meal. These workers also reported that eventhough rubber seed meal had a relatively high crude protein content than coconut meal the essential amino acid composition of these two feed stuffs showed very close resemblance.

Rajaguru and Wettimuny (1971) worked with four levels of rubber seed meal (RSM) as a protein supplement in broiler and grower rations with two animal protein sources. It was observed that the growth of broilers was depressed as the rubber seed meal content of rations increased above 10 per cent level. Feed intake was also reduced as the RSM content increased above 30 per cent level in a meat meal based ration. However, when fish meal (65 per cent protein) was used as the source of animal protein instead of meat meal (55 per cent protein) with added methionine the growth response improved upto 20 per cent level of RSM in the diet. It was concluded that rubber seed meal could be used satisfactorily upto 10 per cent level in broiler rations with meat meal and added methionine and upto 20 per cent level with fish meal as animal protein source. In the case of growing pullets they observed that RSM could be used upto 40 per cent with meat meal in rations from 3-6 months of age. It was also indicated that chickens could overcome the adverse effects caused by higher levels of rubber seed meal (40 per cent) as they mature and could maintain normal body weight and performance.

The nutritive value of rubber seed meal was studied in poultry diets by Rajaguru and Vohra (1975). Seven week-old Cornish cross broilers were fed diets containing 10, 20, 30 and 40 per cent rubber seed meal for 7 weeks. A significant depression in growth of broilers was observed when the dietary levels of rubber seed meal was 20 per cent or above. It was also observed that incorporation of RSM at 10 per cent level adversely affected egg production and shell thickness in 12 weeks old pullets upto one year of egg production.

Ong and Yeong (1977) tried rubber seed meal in broiler diets at levels of 0, 5, 10, 15, and 20 and 25 per cent. No significant differences in performance was noticed among birds under the dietary treatments. Chickens consuming diets with 25 per cent RSM utilised the feed as efficiently as those in the control group. The amount of visceral fat tended to decrease in chickens consuming higher amounts of rubber seed meal.

# MATERIALS AND METHODS

# MATERIALS AND METHODS

A feeding trial of 10 weeks duration with two hundred, one-day old commercial broiler chicks was carried out to evaluate the nutritive value of rubber seed meal (RSM) for broilers.

The chicks were wing banded, weighed and randomly allotted to eight groups of twenty five chicks each. Two groups formed one dietary treatment and four dietary treatments were employed. The chicks were housed in the four tiers of a battery brooder separated in the middle, thus making eight compartments. At the end of three weeks brooding, the chicks in each replicate group were transferred to eight identical floor pens. The allotment of groups to different tiers in the battery and to the pens were made at random.

Rubber seed meal was procured from "Kanjirapally Rubber Seed processing and Oil extracting (workshop)", Kerala, for incorporation in the diets. The chemical composition and hydrocyanic acid (HCN) content of RSM were determined (A.O.A.C., 1970) and are set out in Table 2.

Table 2. Chemical composition of rubber seed meal (D.M.basis)

| Nutrient | Per cent |
|---|---|
| Dry matter | 92.2 |
| Crude protein | 23.9 |
| Ether extract | 13.3 |
| Crude fibre | 4.6 |
| N.F.E. | 52.8 |
| Total ash | 5.4 |
| Acid insoluble ash | 0.03 |
| Calcium | 0.49 |
| Phosphorus | 0.88 |
| Hydrocyanic acid (mg %) | 8.2 |

The experimental diets (Table 3) were computed according to ISI (1977) and were analysed for proximate composition (A.O.A.C., 1970) (Table 4). Diet I formed the control, while diets II, III and IV contained 15, 20 and 30 per cent of rubber seed meal respectively. Broiler starter diets were fed upto seven weeks of age and thereafter broiler finisher diets were given.

The data on the proximate composition of two sets of diets, viz, starter and finisher (Table 4) indicated that the diets were almost identical in nutrient make up and were as per standards. However, the acid insoluble ash in all the diets were slightly higher. All the starter diets had comparatively higher fat contents.

Feed and water were provided ad libitum throughout the experimental periods. Standard managemental practices were followed during the entire period of study.

Individual birds were weighed weekly and weekly feed consumption per group was recorded and from this the feed efficiency was calculated. The trial was run for 10 weeks at the close of which final body weights were recorded.

In the course of the experiment few birds manifested symptoms of leg disorders. Mortality and incidence of leg disorders were recorded.

Six birds from each treatment were randomly selected and subjected to slaughter studies at the end of the experiment. These birds were fasted for six hours prior to slaughter. Water was provided ad libitum during the fasting period. The birds were sacrificed, dressed and eviscerated according to procedures laid by Kilpatrick and Pond (1960). Dressed, eviscerated and ready-to-cook yields were recorded.

Data pertaining to feed efficiency, body weight gains at 10 weeks and carcase yields were subjected to statistical analysis (Snedecor and Cochran, 1967).

Table 3. Composition of experimental diets

| Ingredients Parts/100 kg | Broiler Starter | | | | Broiler Finisher | | | |
|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | I | II | III | IV |
| Groundnut cake | 33 | 27 | 25 | 21 | 24 | 18 | 16 | 12 |
| Gingelly oil cake | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Yellow maize | 35 | 30 | 27 | 20 | 45 | 40 | 39 | 32 |
| Rubber seed meal | — | 15 | 20 | 30 | — | 15 | 20 | 30 |
| Rice bran | 13 | 7 | 6 | 5 | 13 | 7 | 5 | 4 |
| Unsalted dried fish | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Animal fat | 2 | 4 | 5 | 7 | 1 | 3 | 3 | 5 |
| Mineral mixture (Poultrymin)[1] | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Metabolizable energy (K cals/kg) (calculated) | 3000 | 3010 | 3010 | 2990 | 2990 | 2990 | 2970 | 2960 |
| Added per 100 kg of diet: | | | | | | | | |
| Vitablend[2] A, $B_2$ & $D_3$ | 25 g | 25 g | 25 g | 25 g | 25 g | 25 g | 25 g | 25 g |
| Bifuran[3] | 50 g | 50 g | 50 g | 50 g | 50 g | 50 g | 50 g | 50 g |
| Common salt | 500 g | 500 g | 500 g | 500 g | 500 g | 500 g | 500 g | 500 g |

1. Poultrymin (Aries, Agro-Vet Industries Pvt.Ltd.), the mineral mixture contained 3% moisture, 32% calcium, 6% phosphorus, 0.27% manganese, 0.01% Iodine, 0.26% Zinc, 0.03% Fluorine, 100 ppm copper and 1000 ppm iron.
2. Vitablend A, $B_2$ and $D_3$ (Glaxo laboratories (India) Ltd) contained 40,000 I.U. of Vitamin A 25 mg of Vitamin $B_2$ and 6000 I.U. of Vitamin $D_3$ per g respectively.
3. Bifuran (Smith, Kline and French, India, Ltd.) contained
Veterinary Nitrofurazone B.Vet. C.25% w/w,
Veterinary Furazolidone B.Vet. C.3.6% w/w.

Table 4. Proximate composition of the diets (D.M. basis)
(percentage)

| Nutrient | Broiler Starter | | | | Broiler Finisher | | | |
|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | I | II | III | IV |
| Dry matter | 92.9 | 94.2 | 92.3 | 91.9 | 94.7 | 95.0 | 95.9 | 91.1 |
| Crude protein | 22.9 | 22.1 | 22.6 | 21.9 | 19.9 | 20.8 | 19.8 | 20.7 |
| Ether Extract | 8.2 | 11.6 | 12.4 | 14.2 | 5.9 | 8.8 | 8.6 | 9.7 |
| Crude fibre | 5.6 | 4.9 | 4.9 | 4.1 | 4.2 | 3.9 | 3.9 | 4.2 |
| N.F.E. | 49.9 | 42.9 | 39.6 | 38.2 | 52.0 | 49.6 | 53.4 | 45.0 |
| Total ash | 13.4 | 12.7 | 12.8 | 12.5 | 12.7 | 11.9 | 10.2 | 11.5 |
| Acid insoluble ash | 6.2 | 6.8 | 6.7 | 6.2 | 7.8 | 5.8 | 5.3 | 4.9 |

# RESULTS

## RESULTS

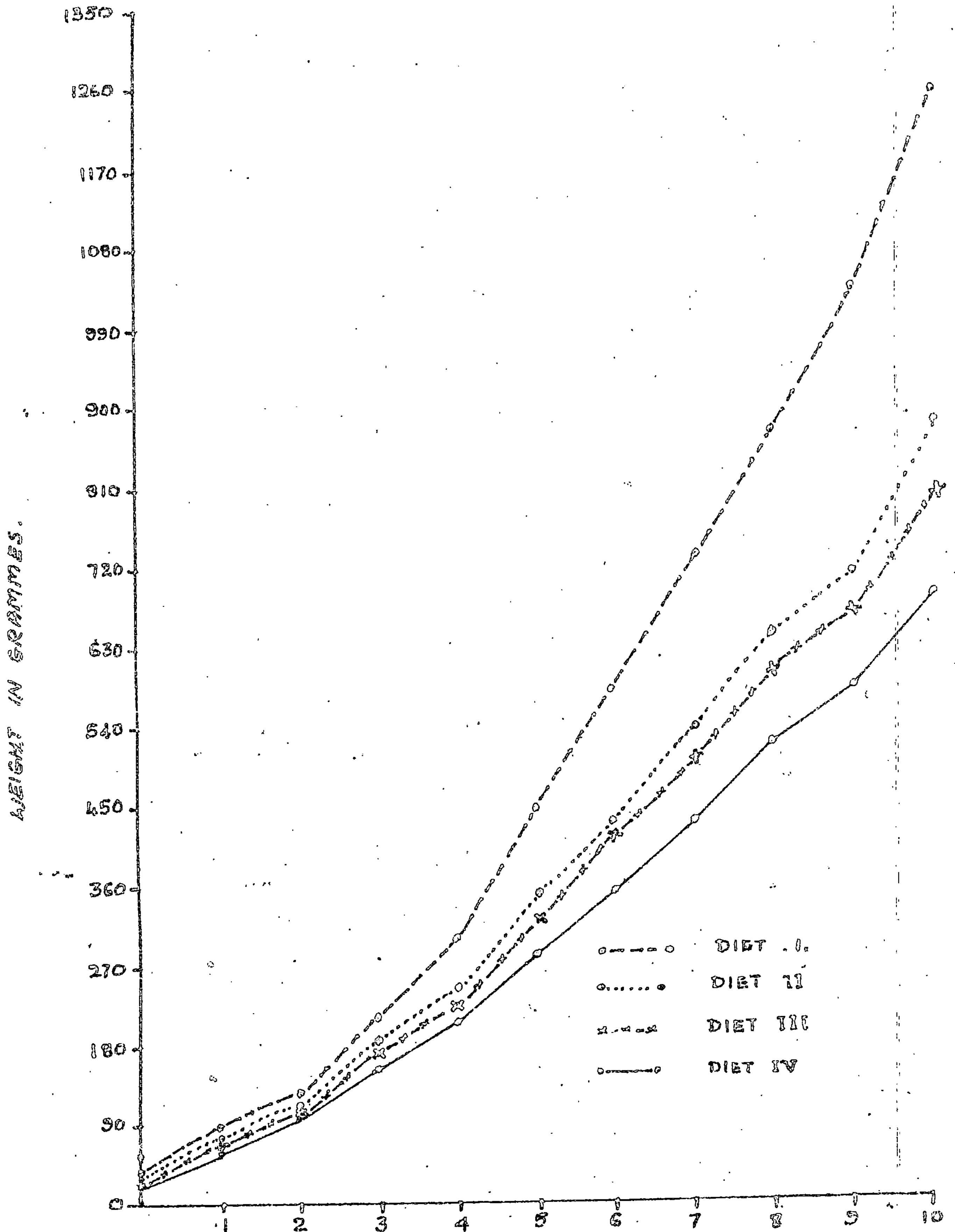
### Growth

The mean weekly body weights, treatment-wise and replicate-wise are presented in Table 5. The mean final body weights at 10 weeks of age for treatments I, II, III and IV were 1253, 887, 805 and 687 g respectively. The data pertaining to mean weekly body weight gains are presented in Table 6. The weekly body weight gains revealed that the maximum gain was made during the 10th week of age irrespective of the dietary treatments.

The mean body weight gain at 10 weeks of age (Table 7) was subjected to statistical analysis, the results of which are set out in Table 8. Analysis of body weight gain data showed significant differences ($P \angle 0.05$) among treatments. Dietary treatment I showed significantly better performance over treatments II, III and IV. Treatment IV was significantly poorer compared to I, II and III, but the difference between treatment II and III was not statistically significant. The body weight gain registered during the ten weeks period by birds on diets I, II, III and IV were 1214, 848, 767 and 649 g respectively. The mean body weight as influenced by the four dietary treatments from start to the completion of the experiment is presented graphically as well (Fig. I).

FIG. 1.

WEEKLY BODY WEIGHT OF BROILERS FED DIFFERENT LEVELS OF RSM



## Feed consumption

It could be seen from Table 8 that the total feed consumed till 10 weeks of age were 4.56, 3.92, 3.46 and 3.42 kg respectively for the dietary treatments I to IV.

## Feed Efficiency (Feed consumed/body weight gains)

The overall feed efficiency is presented in Table 9. The statistical analysis of the data is set out in Table 8. It was observed that treatment I showed the best efficiency and treatment IV the least. The differences in mean feed efficiency among the four dietary treatments were statistically significant ($P < 0.05$). However, the difference between treatments II and III was not statistically significant.

## Carcase yields and losses

The slaughter data pertaining to the replicates of different dietary treatments are presented in Table 10 and the statistical analysis thereon in Table 11.

### Shrinkage.

The mean per cent shrinkage for the four treatments were 6.14, 5.03, 4.62 and 5.21 respectively. The differences either among treatments or between replicates within treatments were not statistically significant.

Dressed yield.

The mean per cent dressed yields for the four dietary treatments were 91.60, 91.24, 91.73 and 91.72 respectively. The differences among the treatments and between replicates within treatments were not statistically significant.

Eviscerated yield.

The mean per cent eviscerated yields were 68.90, 63.27, 66.58 and 66.31 respectively for the four dietary treatments. These values failed to show any significant difference statistically.

Giblet yield.

The per cent giblet yield showed statistically significant differences among dietary treatments ($P < 0.05$). The mean per cent yields were 4.96, 5.74, 6.15 and 5.94 respectively. Treatment III yielded 6.15 per cent which was the highest and this was found to be significantly better than treatment I. The differences among dietary treatments II, III and IV were not statistically significant.

Ready to Cook yield.

Ready to Cook yield per cent for treatment I was 73.86 which was the highest followed by 69.00, 72.73 and 73.33 for treatments II, III and IV respectively. However, neither the differences among the treatments nor replicates within treatments showed any statistically significant variation.

## Livability

The details of mortality and incidence of leg disorders are presented in Table 12. It is to be pointed out that all the birds belonging to the four dietary treatments had a mild course of coccidiosis during the seventh week of age. All the four treatments were given medication with nitrofurazone and furazolidone for seven consecutive days.

It was also observed during the course of the experiment that birds showed symptoms of leg disorders. This malady was observed in all the four treatment groups. The number of birds that showed leg disorders were 3, 7, 7 and 9 in treatments I to IV respectively. The intensity of the problem was on the increase with increasing levels of RSM in the diet.

Table 5. Mean weekly body weights (g) of broilers fed different levels of RSM

| Diets | Replications | Initial weight | Weeks | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | Rep I | 38.60 | 76.80 | 122.40 | 195.87 | 302.61 | 449.35 | 578.04 | 716.30 | 860.87 | 1000.91 | 1211.30 |
| I | Rep II | 39.69 | 78.48 | 126.88 | 209.58 | 295.42 | 446.67 | 577.92 | 729.38 | 877.08 | 1053.75 | 1294.79 |
| | Mean | 39.15 | 77.64 | 124.64 | 202.73 | 299.02 | 448.01 | 577.98 | 722.84 | 868.98 | 1027.33 | 1253.05 |
| | Rep I | 38.80 | 75.52 | 118.80 | 186.00 | 239.20 | 333.80 | 420.40 | 521.20 | 634.35 | 682.52 | 880.46 |
| II | Rep II | 38.04 | 72.96 | 116.00 | 188.20 | 245.80 | 351.20 | 439.60 | 550.40 | 652.80 | 726.00 | 893.00 |
| | Mean | 38.42 | 74.24 | 117.40 | 184.10 | 242.50 | 342.50 | 430.00 | 535.80 | 643.58 | 704.26 | 886.73 |
| | Rep I | 38.20 | 71.04 | 110.20 | 174.80 | 213.80 | 302.60 | 387.50 | 479.78 | 579.13 | 646.35 | 784.78 |
| III | Rep II | 37.92 | 73.68 | 113.80 | 175.00 | 231.20 | 330.80 | 437.20 | 523.00 | 610.83 | 687.50 | 824.38 |
| | Mean | 38.06 | 72.36 | 112.00 | 174.90 | 222.50 | 316.70 | 412.35 | 501.39 | 594.98 | 666.93 | 804.58 |
| | Rep I | 39.08 | 71.00 | 108.20 | 162.80 | 200.80 | 276.40 | 347.92 | 429.58 | 515.65 | 556.09 | 673.41 |
| IV | Rep II | 37.44 | 69.52 | 109.40 | 167.60 | 199.40 | 276.20 | 356.[illegible]0 | 431.00 | 539.20 | 591.00 | 700.44 |
| | Mean | 38.26 | 70.26 | 108.80 | 165.20 | 200.10 | 276.30 | 352.16 | 430.29 | 527.43 | 573.55 | 686.93 |
| | Overall mean | 38.47 | 73.63 | 115.71 | 181.73 | 241.03 | 345.88 | 443.12 | 547.58 | 658.74 | 743.02 | 907.82 |

Table 6. Mean weekly body weight gain (g) of broilers fed different levels of RSM

| Diets | Replications | Initial weight | Weeks | | | | | | | | | | Total gain in wt. (0-10 weeks) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| | Rep.I | 38.60 | 38.20 | 45.60 | 73.47 | 106.74 | 146.74 | 128.69 | 138.26 | 144.57 | 140.04 | 210.39 | 1255.10 |
| I | Rep.II | 39.69 | 38.79 | 48.40 | 82.70 | 85.84 | 151.25 | 131.25 | 151.46 | 147.70 | 176.67 | 241.04 | 1255.10 |
| | Mean | 39.15 | 38.50 | 47.00 | 78.09 | 96.29 | 149.00 | 129.97 | 144.86 | 146.16 | 158.36 | 225.72 | 1213.90 |
| | Rep.I | 38.80 | 36.72 | 43.28 | 67.20 | 53.20 | 94.60 | 86.60 | 100.80 | 113.15 | 48.17 | 197.94 | 841.66 |
| II | Rep.II | 38.04 | 34.92 | 43.04 | 66.20 | 63.60 | 105.40 | 88.40 | 110.80 | 102.40 | 73.20 | 167.00 | 854.96 |
| | Mean | 38.42 | 35.82 | 43.16 | 66.70 | 58.40 | 100.00 | 87.50 | 105.80 | 107.78 | 60.69 | 182.47 | 848.31 |
| | Rep.I | 38.20 | 32.84 | 39.16 | 64.60 | 39.00 | 88.80 | 84.90 | 92.28 | 99.35 | 67.22 | 138.43 | 746.58 |
| III | Rep.II | 37.92 | 35.76 | 40.12 | 61.20 | 56.20 | 99.60 | 106.40 | 85.80 | 87.83 | 76.67 | 136.88 | 786.46 |
| | Mean | 38.06 | 34.30 | 39.64 | 62.90 | 47.60 | 94.20 | 95.65 | 89.04 | 93.59 | 71.95 | 137.66 | 766.52 |
| | Rep.I | 39.08 | 31.92 | 37.20 | 54.60 | 38.00 | 75.60 | 71.52 | 81.66 | 86.07 | 40.49 | 117.32 | 634.33 |
| IV | Rep.II | 37.44 | 32.08 | 39.88 | 58.20 | 31.80 | 76.80 | 80.20 | 74.60 | 108.20 | 51.80 | 109.44 | 663.00 |
| | Mean | 38.26 | 32.00 | 38.54 | 56.40 | 34.90 | 76.20 | 75.86 | 78.13 | 97.14 | 46.12 | 113.38 | 648.67 |
| | Overall mean | 38.47 | 35.16 | 42.09 | 66.02 | 59.30 | 104.85 | 97.25 | 104.46 | 111.16 | 84.28 | 164.81 | 869.35 |

Table 7. Mean body weight gain (g) of broilers fed different levels of RSM in 10 weeks

| Diets | Replica-tions | Initial weight | Final weight | Weight gain |
|---|---|---|---|---|
| | Rep. I | 38.60 | 1211.30 | 1172.70 |
| I | Rep. II | 39.69 | 1294.79 | 1255.10 |
| | Mean | 39.15 | 1253.05 | 1213.90[a] |
| | Rep. I | 38.80 | 880.46 | 841.66 |
| II | Rep. II | 38.04 | 893.00 | 854.96 |
| | Mean | 38.42 | 886.73 | 848.31[b] |
| | Rep. I | 38.20 | 784.78 | 746.58 |
| III | Rep. II | 37.92 | 824.38 | 786.46 |
| | Mean | 38.06 | 804.58 | 766.52[b] |
| | Rep. I | 39.08 | 673.41 | 634.33 |
| IV | Rep. II | 37.44 | 700.44 | 663.00 |
| | Mean | 38.26 | 686.93 | 648.67[c] |
| | Overall mean | 38.47 | 907.82 | 869.35 |

Means carrying different superscripts differed significantly.

C.D. ($P < 0.05$) = 95.23.

Table 8. Analysis of variance for the various growth characteristics studied

| Factor | Source | df | SS | MSS | F |
|---|---|---|---|---|---|
| 1. Body weight gain for 10 weeks | Between diets | 3 | 8307350.93 | 2769116.98 | 100.25** |
| | Between replications within diets | 4 | 110489.10 | 27622.28 | 0.91ns |
| | Error | 178 | 5400414.59 | 30339.41 | |
| | Total | 185 | 13818254.62 | | |
| 2. Feed efficiency | Between diets | 3 | 2.30 | 0.77 | 15.40* |
| | Error | 4 | 0.18 | 0.05 | |
| | Total | 7 | 2.48 | | |

* significant at 5% level

** significant at 1% level

ns non-significant

Table 9. Feed Efficiency at 10 weeks of age as influenced by dietary treatments

| Diets | Replica-tions | Initial body weight (g) | Final body weight (g) | Gain in weight (0-10 weeks) (g) | Total quantity of feed consumed (Kg) | F.E. |
|---|---|---|---|---|---|---|
| | Rep. I | 38.60 | 1211.30 | 1172.70 | 4.554 | 3.88 |
| I | Rep. II | 39.69 | 1294.79 | 1255.10 | 4.560 | 3.63 |
| | Mean | 39.15 | 1253.05 | 1213.90 | 4.557 | 3.76[a] |
| | Rep. I | 38.80 | 880.46 | 841.66 | 3.938 | 4.68 |
| II | Rep. II | 38.04 | 893.00 | 854.96 | 3.898 | 4.56 |
| | Mean | 38.42 | 886.73 | 848.31 | 3.918 | 4.62[b] |
| | Rep. I | 38.20 | 784.78 | 746.58 | 3.230 | 4.33 |
| III | Rep. II | 37.92 | 824.38 | 786.46 | 3.695 | 4.70 |
| | Mean | 38.06 | 804.58 | 766.52 | 3.463 | 4.52[b] |
| | Rep. I | 39.08 | 673.41 | 634.33 | 3.224 | 5.08 |
| IV | Rep. II | 37.44 | 700.44 | 663.00 | 3.615 | 5.45 |
| | Mean | 38.26 | 686.93 | 648.67 | 3.420 | 5.27[c] |
| | Overall Mean | 38.47 | 907.82 | 868.35 | 3.840 | 4.54 |

Means carrying atleast one similar superscript did not differ significantly.

C.D. = 0.62 (P ∠ 0.05)

Table 10. Mean slaughter data at 10 weeks of age of broilers fed different levels of RSM

| Diets | Repli- ca- tions | Body wt. before fasting | Fasting Shrinkage | | Dressed yield | | Eviscerated yield | | Giblet yield | | R to C yield | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (g) | (g) | (%) | (g) | (%) | (g) | (%) | (g) | (%) | (g) | (%) |
| | Rep. I | 1316.67 | 68.33 | 5.32 | 1126.67 | 90.44 | 873.33 | 69.97 | 61.67 | 4.98 | 935.00 | 74.94 |
| I | Rep. II | 1368.33 | 95.00 | 6.96 | 1181.67 | 92.76 | 865.00 | 67.83 | 63.33 | 4.94 | 928.33 | 72.78 |
| | Mean | 1342.50 | 81.67 | 6.14[a] | 1154.17 | 91.60[a] | 869.17 | 68.90[a] | 62.50 | 4.96[a] | 931.67 | 73.86[a] |
| | Rep. I | 866.67 | 41.67 | 4.56 | 756.67 | 91.64 | 545.00 | 66.17 | 48.33 | 5.92 | 593.33 | 72.08 |
| II | Rep. II | 1020.00 | 56.67 | 5.50 | 875.00 | 90.83 | 581.67 | 60.37 | 53.33 | 5.55 | 635.00 | 65.92 |
| | Mean | 943.34 | 49.17 | 5.03[a] | 815.84 | 91.24[a] | 563.34 | 63.27[a] | 50.83 | 5.74[b] | 614.17 | 69.00[a] |
| | Rep. I | 796.67 | 35.00 | 4.41 | 696.67 | 91.55 | 506.67 | 66.59 | 48.33 | 6.34 | 555.00 | 72.93 |
| III | Rep. II | 818.33 | 38.33 | 4.82 | 716.67 | 91.90 | 518.33 | 66.56 | 46.67 | 5.96 | 656.00 | 72.53 |
| | Mean | 807.50 | 36.67 | 4.62[a] | 706.67 | 91.73[a] | 512.50 | 66.58[a] | 47.50 | 6.15[b] | 560.00 | 72.73[a] |
| | Rep. I | 725.00 | 31.00 | 4.30 | 641.67 | 92.44 | 481.67 | 69.29 | 41.67 | 6.01 | 523.33 | 75.30 |
| IV | Rep. II | 783.33 | 50.00 | 6.11 | 666.67 | 90.99 | 480.00 | 63.33 | 43.33 | 5.86 | 523.33 | 71.36 |
| | Mean | 754.17 | 40.50 | 5.21[a] | 654.17 | 91.72[a] | 480.84 | 66.31[a] | 42.50 | 5.94[b] | 523.33 | 73.33[a] |
| | Overall mean | 961.88 | 52.00 | 5.25 | 832.71 | 91.57 | 606.46 | 66.27 | 50.83 | 5.70 | 657.29 | 72.23 |

Means carrying same superscript did not differ significantly.

C.D. = 0.56 (P $\angle$ 0.05) (giblet yield)

Table 11. Analysis of variance table of slaughter data

| Sl. No. | Factors | Source of variation | df | SS | MSS | F |
|---|---|---|---|---|---|---|
| 1. | Shrinkage | Between diets | 3 | 7.47 | 2.49 | $0.35^{ns}$ |
| | | Between replications within diets | 4 | 28.45 | 7.11 | $1.14^{ns}$ |
| | | Error | 16 | 100.20 | 6.26 | |
| | | Total | 23 | 136.12 | | |
| 2. | Dressed yield | Between diets | 3 | 0.95 | 0.316 | $0.102^{ns}$ |
| | | Between replications within diets | 4 | 12.38 | 3.095 | $0.77^{ns}$ |
| | | Error | 16 | 64.07 | 4.004 | |
| | | Total | 23 | 77.40 | | |
| 3. | Eviscerated yield | Between diets | 3 | 96.07 | 32.02 | $1.16^{ns}$ |
| | | Between replications within diets | 4 | 110.69 | 27.67 | $1.88^{ns}$ |
| | | Error | 16 | 235.77 | 14.74 | |
| | | Total | 23 | 442.53 | | |
| 4. | Giblet yield | Between diets | 3 | 4.87 | 1.62 | $13.5^{*}$ |
| | | Between replications within diets | 4 | 0.46 | 0.12 | $0.29^{ns}$ |
| | | Error | 16 | 6.58 | 0.41 | |
| | | Total | 23 | 11.91 | | |
| 5. | Ready to Cook yield | Between diets | 3 | 87.34 | 29.11 | $1.33^{ns}$ |
| | | Between replications within diets | 4 | 87.61 | 21.90 | $1.76^{ns}$ |
| | | Error | 16 | 198.92 | 12.43 | |
| | | Total | 23 | 373.87 | | |

* Significant at 5% level

ns Non-significant.

Table 12. Leg disorders, mortality and cause of death

| Treatments | Replications | Total no.of birds | No.of birds affected with leg disorders | Mortality (no.) | Cause of death |
|---|---|---|---|---|---|
| I | Rep. I | 25 | 2 | 2 | Pericarditis (1) Pulmonary oedema and congestion (1) |
| | Rep.II | 25 | 1 | 1 | Accidental death |
| II | Rep. I | 25 | 3 | 3 | Coccidiosis |
| | Rep.II | 25 | 4 | - | — |
| III | Rep. I | 25 | 4 | 2 | Coccidiosis |
| | Rep.II | 25 | 3 | 1 | " |
| IV | Rep. I | 25 | 4 | 3 | " |
| | Rep.II | 25 | 5 | 2 | " |
| | Total | 200 | 26 | 14 | |

# DISCUSSION

## DISCUSSION

### Growth

It was evident from the results that the control group had the best final body weight at ten weeks of age and it was uniformly poor for all the treatment groups. (Table 5). The data on weekly body weight gains during the ten week-period also showed that the birds receiving RSM in their diet tended to gain comparatively less weight than the control (Table 6). Incorporation of RSM at all levels (15, 20 and 30 per cent) used in this experiment decidedly retarded growth in broilers, the adverse effect being highly pronounced at 30 per cent level ($P < 0.05$). Growth depression as a consequence of incorporation of RSM at levels above 10 per cent in broiler diets has been reported by Rajaguru and Wettimuny (1971) and Rajaguru and Vohra (1975). However, the present finding is in contrast to that reported by Ong and Yeong (1977) who observed no significant difference in body weight gains even when RSM formed 25 per cent of the broiler diet. It is reasonable to presume that RSM may contain factor or factors that might interfere with the growth of fast growing chickens like broilers as evidenced from the results of this study. The reason for the growth depression in broilers fed RSM is not very clear at the moment. The starter diet used in the experiment had higher levels of ether extract. This may have contributed to the depression of growth. According to Buvanendran (1971) the presence of free fatty acids in RSM might be a factor that interferes with growth. It could be possible that the hydrocyanic acid content of RSM be another probable factor. The HCN content of the sample of RSM used in the present study was 82 ppm. Tolerance level to HCN by broilers has not been reported. However, Syed Jalaludin and Oh (1972) reported that hens could tolerate HCN as high as 135 ppm in the diet. Moreover, the HCN content is unlikely to produce harmful effects since it is excreted partly through lungs and a greater part as thiocyanate in urine (Dawson and Messenger, 1932; Garner, 1961 and Radeleff, 1970). The conversion of absorbed cyanide to thiocyanate ion is by an enzymatic process which is accelerated by thiosulphate and by some sources of available sulphur (Radeleff, 1970). For this reaction, naturally, sulphur from sulphur containing amino acids is made use of leading to methionine deficiency (Ross and Enriquez, 1969). It is evident from the amino acid composition of RSM that it has low levels of sulphur containing amino acids especially methionine (Lauw et al. 1967 and Orok and Bowland, 1974). Therefore, an indirectly produced methionine deficiency might have contributed to the depression in growth. Nevertheless, the limitted information from the present experiment does not allow to draw any conclusive interpretation for the lowered weight gains of broilers fed RSM supplemented diets. Therefore, further detailed investigation is warranted to identify the incereminating factor if any, in RSM, the effect of supplementation of methionine, and to evolve appropriate technology to eliminate or to overcome the deleterious effects.

## Feed consumption

The feed consumption data (Table 9) revealed that the birds fed control diet consumed comparatively more than the birds fed diets containing RSM, the feed consumption decreasing with increase in the level of RSM in the diet. Reduced feed intake as a result of enhanced levels of RSM in the diets of broilers has been reported by Rajaguru and Wettimuny (1971) who attributed the phenomenon to an unidentified factor. In a very early report, Morrison (1957) had opined that RSM was not much palatable. However, the feed consumption in 20 and 30 per cent levels of incorporation was not much different. Poor palatability could be an added reason for the reduced growth observed in this experiment.

## Feed Efficiency

The data on this parameter indicated that the efficiency was poorer in all groups fed RSM. The best efficiency was recorded by the control group while the poorest efficiency was observed in group IV with groups II and III showing intermediary efficiency. On a comparison of feed efficiency and of weight gain data it could be seen that the trend is similar in both the cases. The variations which existed in feed efficiency, as measured by kg of feed consumed per kg of weight gained, resulted mostly from differences in growth and partly from differences in feed intake.

## Carcase yields and losses

Shrinkage.

The mean fasting shrinkage observed during the study is within the normal range as reported by Ranganathan *et al.* (1967) and Prabhakaran and Ranganathan (1971). The differences observed among the four dietary treatments were not statistically significant.

Dressed yield.

The mean per cent dressed yields were comparable and were not statistically different. The overall mean dressed yield recorded during the course of the experiment was 91.57 with a range of 91.24 to 91.73 which agrees well with those reported by Jull (1951), Mathur and Ahmed (1968), Nair (1976) and Elizabeth (1978).

Eviscerated yield.

The mean percent eviscerated yields for the dietary treatments were in the range of 63.27 to 68.90. These values were within the normal limits reported for broilers. The mean per cent eviscerated yields were not statistically different.

Giblet yield.

The overall mean per cent giblet yield of 5.7 is within the range reported for broilers (Nair, 1976 and Elizabeth, 1978). Card and Nesheim (1972) reported a higher per cent yield for broilers (57.5 per cent). The group fed control diet had the least giblet yield while that receiving 20 per cent RSM had the highest yield. In general the per cent yield of giblet was uniformly higher for the rubber seed meal supplemented groups. However, the differences observed among these groups were not statistically significant. The higher giblet yield in the RSM fed groups might possibly be due to heavier weights of liver as a consequence to increased activity for handling the possible toxic material that might have been present in the RSM. This requires detailed further investigation on the histology and on the functional efficiency of liver before drawing valid conclusions.

Ready to Cook yield.

The overall mean ready-to-cook yield of 72.23 per cent observed in the present study is in close agreement with the values reported by Mountney (1966). The values in respect of the four dietary treatments varied from 69.00 to 73.86. However, the differences among the four treatment groups were not statistically different.

The absence of any statistically significant difference in respect of per cent fasting shrinkage, per cent dressed yield, per cent eviscerated yield and per cent ready-to-cook yield among the four dietary treatments suggested that incorporation of RSM in diets had not exerted any particular influence on the carcase quality of broilers. Generally, the inclusion of RSM in diets did not influence the carcase quality in terms of yields and losses. However, the lowered final body weight at finish at all levels of incorporation of RSM in the diet has to be viewed with concern.

### Livability

Eventhough there was mortality among all the four groups, this did not affect the overall performance of the birds in all the groups as is evident from the body weight gains after seventh week of age. Inspite of the fact that all the groups suffered from coccidiosis, the deaths due to this disease were confined in the treatment groups suggesting that these groups had lesser resistance to infection than the control. However, it appeared that RSM did not influence the livability of broilers adversely to any appreciable extent.

The incidence of leg disorders was less in the control group and more severe in the group fed 30 per cent RSM. Incidence of leg disorders in the form of perosis was progressively higher in the treatment groups in proportion to the level of RSM in the diet. Affected birds in the RSM fed groups gained lesser weight compared to other birds in the groups thereby contributing to lower average body weights of the groups. The control group also had three birds showing lameness, but the degree of the disorder was not as intense as in the treatment groups. Also, these birds were eating well and had attained comparable final body weight as other birds in the group.

Rubber seed meal could possibly contain a factor or factors that adversely affect the utilisation of minerals and/or B Vitamins, the deficiencies of which are known to be associated with perosis. The perotic birds generally ate less feed and gained lesser weight compared to others in the groups. The exact mechanism by which a deficiency is precipitated which lead to perosis like symptoms is not known. Rubber seed meal may interfere with the utilisation of some minerals/vitamins or the same are required in higher amounts to detoxify the toxic principles in RSM. Further detailed investigation to identify the situation and to find out the remedial measures are warranted.

# SUMMARY

## SUMMARY

An experiment to study the feeding value of rubber seed meal (RSM) for broilers was conducted and the results are detailed in this thesis.

Two hundred, one-day old commercial broiler chicks were allotted to the following dietary treatments at random, Diet I (control), Diet II (15 per cent RSM), Diet III (20 per cent RSM), and Diet IV (30 per cent RSM). Each treatment group had two replicates with twenty five chicks each. They were raised in a battery brooder upto three weeks and were subsequently transferred to floor pens.

Weekly body weight and feed consumption were recorded and the feed efficiency was calculated. The final body weight at ten weeks of age was also recorded. Six birds from each treatment were randomly selected at ten weeks of age and were subjected to slaughter studies using the standard techniques. Carcase yields and losses were arrived at.

The following conclusions were drawn based on this study:-

1. Incorporation of rubber seed meal at levels of 15 per cent and above in broiler diets adversely affected body weight gains. Higher levels of incorporation (20 and 30 per cent) resulted in marked depression of growth. The growth depression was highly pronounced at 30 per cent level. Further investigation is needed to elucidate the factors responsible for growth depression.

2. Feed consumption showed a gradual decrease with increase in the levels of RSM in the diet.

3. The maximum feed efficiency was recorded by the control group while the lowest feed efficiency by birds fed 30 per cent RSM. Feed efficiency was affected with increase in the level of RSM in diets.

4. The slaughter studies revealed that carcase yields and losses were not influenced by the incorporation of RSM in broiler diets. The percentage giblet yield was uniformly higher for the RSM supplemented groups. However, the differences observed among these groups were not statistically significant.

5. Mortality rate was almost similar in all groups thereby suggesting that RSM contained no toxic factor lethal to chicks. However, leg disorders in the form of perosis was noticed among all the groups, the number and intensity being less in the control group. Higher levels of RSM in the diet appeared to promote leg disorders.

Based on the above results it can be reasonably concluded that the use of RSM at levels of 15 per cent and above in broiler diet is not safe till such time the deleterious factors are identified and remedial measures evolved.

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ABSTRACT

# EVALUATION OF RUBBER SEED MEAL IN BROILER DIETS

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ABSTRACT OF A THESIS

Submitted in partial fulfilment of the requirements for the degree

MASTER OF VETERINARY SCIENCE

Faculty of Veterinary and Animal Sciences

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COLLEGE OF VETERINARY AND ANIMAL SCIENCES

MANNUTHY - TRICHUR

1978

## ABSTRACT

An experiment was conducted to study the utility of three levels of rubber seed meal in broiler diets. Two hundred, one-day old commercial broiler chicks were divided randomly into eight groups of twenty five chicks each to form four treatments of two replicates each. The four dietary treatments contained 0, 15, 20 and 30 per cent RSM.

Weekly body weights and weekly feed consumption were recorded and the feed efficiency was calculated. At ten weeks of age, six birds from each treatment were subjected to slaughter studies. The results of the study revealed that incorporation of RSM at levels of 15 per cent and higher in broiler diet adversely affected body weight gains and that higher levels of incorporation resulted in marked depression of growth. The feed efficiency was poor among all the treatment groups. Analysis of slaughter data showed no significant difference among dietary treatments except the giblet yield.

Based on the above results it can be reasonably concluded that RSM at levels of 15 per cent and above cannot be considered as a poultry feed ingredient in the diets meant for broilers till such time the deleterious factors are identified and remedial measures evolved.