STUDIES ON THE USE OF MUSTARD CAKE IN THE FEEDING OF LAYERS

Thesis

Submitted to the Faculty of
Veterinary Science and Animal Husbandry
RAJENDRA AGRICULTURAL UNIVERSITY, BIHAR
in partial fulfilment of the requirements
for the degree of
MASTER OF SCIENCE (ANIMAL HUSBANDARY)
IN
ANIMAL NUTRITION

By

Awadhesh Kumar

B. V Sc & A. H. (R. A. U.)
JUNIOR RESEARCH FELLOW (R. A. U.)
Post-Graduate Department of Animal Nutrition
BIHAR VETERINARY COLLEGE
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This is to certify that the work embodied in this Thesis entitled "STUDIES ON THE USE OF MUSTARD CAKE IN THE FEEDING OF LAYERS" is the bonafide work of Awadhesh Kumar and was carried out under my guidance and supervision.

N. K. Prasad.

(N.K. PRASAD).

C E R T I F I C A T E

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

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12/8/76

(A. KUMAR).

DEDICATED

TO

MY

PARENT

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

The author expresses his deep sense of sincere gratitude to his revere guide Dr. N.K. Prasad, B.V.Sc.& A.H. P.G.(A.H.), M.Sc.(A.H.), Diploma in Animal Science (R.V.A.U., Copenhagen), Assistant Professor and Head, Department of Animal Nutrition, Bihar Veterinary College, Patna for his inspiring guidance, continuous supervision, erudite suggestions and for exhaustive and competent review of the manuscript during the course of experiment.

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INTRODUCTION

INTRODUCTION

The old adage "half the breeding goes down the throat" has merit. The poultry are better converter of grains and other by-products into eggs and poultry meat for the nutritional benefit of mankind. Moreover, poultry products, egg stands top in their biological values for protein among the food for consumers. Thus the responsibility of poultry breeders and nutritionist is enhanced to produce eggs at reasonable rates and in abundance.

Poultry can play a great role in the economy of the country as well as in the field of food production specially of animal protein which is too meagre at present to be made available to a common man at a low cost. That is why, eggs which are cheapest in the world and are mostly used by the masses, are a luxury in India. This situation is urgently required to be changed through mass production.

Lepkovsky (1942) has paid a high tribute to the hen and her ability to concentrate such an abundance of important nutrients in the egg. The biological value of the egg protein is probably far greater than represented, since it could be wrong to claim that all the valuable nutrients of the egg have been considered. Essentially the process represents the subjection of a good diet to treatment whereby the chicken extract the most valuable constituents out of the feed and packs it into the egg according to Mitchell as shown

in the table below :

TABLE - 1.

Table showing the biological value of protein of human food.

Food	Biological value of protein	Food	Biological value of protein
Whole egg	94	Whole meat	67
Milk	85	Potato	67
Egg white	83	Rolled oat	63
Beef liver	77	Whole corn	60
Beef heart	74	Wheat flour	52
Beef round	69	Navy Bean(cooked)	38

N.B.:- Data from H.H. Mitchell, the protein values of foods in nutrition, J.Home.Econ. 19: 122-131 1927 as quoted by Maynard.

Eggs are one of the best sources of protein available to human in both the quality and quantity of protein. They contain all of the essential amino-acids. In fact, egg proteins are of such high qualities that they are used as the standard by which other proteins are compared. Two eggs supply an empressive percentage of essential nutrients which on an average is about 10 to 30 per cent of adult's requirement. Eggs are especially recognised as a rich source of high quality protein, unsaturated fats, iron, phosphorus, trace minerals, vitamin A, E and K and all B vitamin including vitamin B_{12}.

The nutrient requirement for poultry has been based for the purpose they are kept. Poultry feed mixture represents 60 to 70 per cent of the budget of the poultry keeper. Feed costs may become excessive and the business unprofitable, if, the birds are not fed sufficient and balanced rations. To obtain the best result with poultry, grains should constitute more than 50 per cent of the ration. As long as India does not produce enough grain for human consumption it is not likely that much can or should be used for feeding to poultry. Moreover, in the feeding of poultry it is a well known fact that cereal alone can not sustain good egg production. And only the protein feed stuffs constitute from 10 to 30 per cent of the ration which are most costly group of feed stuffs. So to provide the consumer a most economic product one has to consider the feed cost, their availability and palatability.

Conventional rations constitute some grains, grain by-products, oil seed by-products and animal protein supplements. Among the vegetable protein sources, Groundnut cake is the most commonly used. But the availability and quality of groundnut cake is questionable due to its increasing demands towards human food e.g. preparation of vegetarian meat (S.R. June 76; 363), breads, and its exports. Now it has become necessary on the part of poultry feed formulators to intensify their effort so that in formulations of poultry feeds there is less and less use of costly ingredients especially for protein fraction.

Mustard cake, which is a by-product during the

extraction of Mustard oil from Mustard seeds for human consumption, may be one substitute for the above mentioned costly and scarce ingredients for poultry ration. Mustard oil is used extensively as cooking medium in the northern and eastern states of India.

The annual production of groundnut cake is about 6 million tonnes whereas that of Mustard and rape is about 2 million tonnes of seeds. This stands in the second position when compared to other edible oil seed crops. In this way approximately 1.2 million tonnes of residual cake is produced annually in the country. Availability of Mustard seed and groundnut seed in India according to Indian Veterinary Research Institute are summarised in the table below :

TABLE - 2.

Production of various edible oil seeds in India for the year 1972-73.

Name of seed	Crop season	Major states	Area 1000 hectares	Production 1000 tonnes
Mustard	Rabi	Punjab, U.P., Bengal, Bihar, Assam.	3589	1975
Groundnut	Kharif	Maharastra, Gujrat, Tamil Nadu, Andhra Pradesh.	7290	6065

The average chemical composition of the cakes are stated in the table below :

TABLE - 3.

Table showing average chemical composition of Mustard oil cake and groundnut cake.

Nutrients	Mustard cake	Groundnut cake
Crude protein (per cent)	36.00	49.00
Ether extract (per cent)	12.00	7.50
Crude fibre (per cent)	10.00	7.00
Nitrogen free extract (per cent)	33.00	30.50
Total ash (per cent)	9.00	6.00
Calcium (per cent)	0.90	0.20
Phosphorus (per cent)	1.00	0.60
Lysine (per cent)	0.75	1.20
Methionine (per cent)	0.92	0.49
ME. Kcal/Kg.	2200	2400

N.B. : - Table taken from Poultry Nutrition by S.Bose.

However, the use of Mustard cake has been limited due to the presence of some deleterious principles which are known as Sinapin, Sinigrin, Mustard oil glucosides or goitronin etc. etc. in the concentration of 0.20 - 7.77 per cent in the Mustard oil seeds. On hydrolysis by an enzyme Myrosinase present in the seeds, they yield glucose, bisulphate,

isothiocynate according to Clandinin (1959). The isothiocynate is unstable and cyclizes into the antithyroid substance which apparantly inhibits the uptake of iodine by thyroid and so causes Hyperthyroidism.

Several methods have been employed to destroy the enzyme such as (1) heat treatments, (2) by treating with 2 per cent ferrous sulphate. It has also been seen that the effect of Mustard cake on thyroid can be removed by addition of Potassium iodide in the rations.

Hill (1944) has reported that rape seed meal at a level of 10 per cent in the mash was satisfactory for pullets. Recently I.S.I. has recommended 10 per cent of inclusion in grower rations.

It was shown by Cladinin et al. (1961) that inclusion of rape seed had depressed growth. Gouel (1961) showed the depressed egg production with rape seed meal.

With these divergent views on the use of mustard cake in layers, this experiment was conducted to find out the suitability of mustard cake in the layer's ration by completely replacing it for groundnut cake.

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REVIEW OF LITERATURE

REVIEW OF LITERATURE

Economy and availability is one of the most important aspect in the poultry industries. Therefore, Poultry Nutritionist have tried to incorporate different agro-industrial forest by-products to prepare a cheaper but balanced ration for the said industry. Among the protein supplying by-products Mustard cake is one which although have the desired qualities of a protein supplement is not very popular for feeding poultry because of the presence of goitrogenic properties in this cake which causes enlargement of the thryoid gland.

Parthasarathy and Iyer (1950) conducted an experiment to know the comparative values of rapeseed cake meal, earthnut meal, fish meal and meat offal as protein supplements for a period of 12 weeks on R.I.R. pullets. They observed better production, feed efficiency in rape cake meal than fish meal and earthnut meal.

Frolich (1953) fed twelve groups of 25 day old white leghorn chicks rape seed meal at levels from 5 - 15 per cent and another five groups were given Ethanol extract rapeseed meal at the same level. They observed that the weight of thyroid gland was more pronounced in untreated. So ethanol could remove partly the antithyroid active principle of rapeseed meal. An adverse effect on egg production was also found in layer's experiment with rapeseed meal.

Daw and Allen (1954) replaced soyabean meal with rapeseed meal in day old chicks upto 12 weeks of age. The gain in weight was found to be insignificant in both the cases.

Kratzer et al (1954) supplemented rapeseed oil cake with lysine, arginine, cystine and tryptophane to see the influence on the growth of chicks. They did not observe any significant difference and concluded that rapeseed oil meal is an adequate source of amino acids.

Kratzer et al (1954) made another study by adding upto 300 mg/kg of 'Protamine' a thyroid active preparation to a chick ration containing 30 per cent of rapeseed oil meal. It was concluded that it had no effect on the growth of chicks. Later on the addition of 50 mg Potassium Iodide/kg was also ineffective on the weight of thyroid.

Kalin et al (1956) compared the value of rapeseed oil meal and sunflower seed oil meal in chick starter ration and found that the replacement by rapeseed meal with the addition of 0.4 per cent L-Lysine could not increase the rate of growth upto 4 weeks. In the same experiment, iodinated casein was found to reduce the weight of thyroid but not the Potassium Iodide.

Fangauf et al (1959) used 10, 14 and 20 per cent Rye in the rations of starting chicken for 8 weeks. They observed that the inclusion of Rye upto 20 per cent did not significantly affect weight gain and feed efficiency. But the mortality was higher when it was incorporated upto 30 per cent.

Clandinin et al (1959) reported that the depressing effects of rapeseed meal on growth was due to the presence of Allyl carbinyl isothiocynate which is converted to the goitrogen L-5-Vinly-2-thio-oxazalidone and the amount depended upon the variety and environmental conditions.

Clandinin (1961) extracted Sinapin from rapeseed oil meal and added to the ration of chicks containing Soyabean oil meal. He did not observe any effect on growth rate unlike the growth rate affected by rapeseed oil meal containing Sinapin. He further observed that rapeseed oil meal normally contains 0.39 per cent Sinapin.

Gobel (1961) observed little difference in digestibility of laying ration containing rapeseed oil meal. Egg production and the biological value of protein of meals were not significantly different with control ration.

Agarwala (1964) completely replaced the conventional groundnut cake 46 per cent by Mustard cake 46 per cent in growing W.L.H. pullets. In Mustard cake group the first egg laid was earlier and the production of egg was slightly less. The groundnut cake group produced 5.1 egg per month per bird whereas in the Mustard cake group it was 4.1 egg per month per bird. The percentage of fertile egg was also low in experimental group.

Nayaka (1965) observed the feeding effect of hot water treated rapeseed oil meal and their extract on different sexes of chicken. In males the thyroid was enlarged in all the

groups given rapeseed meal or extract but less when hot water used. In females treatment with hot water prevented the enlargement but the extract caused it.

In continuation of the previous experiment he obtained reduced growth and efficiency of feed utilization, increased weight of thyroid and reduced thyroid iodine concentration in the chicks on untreated rapeseed oil meal. The treated rapeseed oil meal failed to produce such effects.

Nakaya et al (1966) studied the histological changes of the thyroid gland of rats and chicken on rapeseed oil meal and hot water treated rapeseed oil meal respectively. The changes in epithelial heights were related to changes reported in weight of the gland. In the case of untreated meal there was typical parenchymatous goitre.

Sell (1966) obtained the ME/kg of mustard oil cake as 2295 Kcal/kg on air dry basis and 2120 Kcal/kg as fed.

Panda and Pradhan (1967) used 44 per cent Mustard cake in experimental ration and 27 per cent groundnut cake in control group in starter mash. The protein content of both the ration were 21.8 per cent and energy 1995 Kcal and 2072 Kcal/kg respectively. They obtained significant growth rate in both males and females of experimental group.

Wilson et al (1968) conducted an experiment to find out the high levels of dietary Iodine for delaying sexual maturity in egg production type pullets. The pullets delayed the egg production by 23 and 30 days when Iodine at the rate of 2500 p.p.m. and Potassium Iodide at the rate of 5000 p.p.m.

was given from 17 to 24 weeks. But when Iodine was given from 20 to 24 weeks the delay was 10 and 12 days only.

Robble and Clandinin (1967) did not observe any difference in mortality, egg production, efficiency of feed utilization, hatchtability and carcass quality using 10 per cent prepressed solvent extracted rapeseed meal in experimental ration with that of control ration containing no rapeseed oil meal.

Matsumoto et al (1968) while working on the goitrogen found Goitrin (-)-5-Vinyl-2-Oxazolidine thione), Methiomazole (1-methyl-2-mercaptoimidazole) and Methiocil (6-methyl-Thiouracil). Goitrin 0.05 per cent caused enlargement of thyroid, the highest thyroidal uptake of ^{131}I and the slow release of ^{131}I whereas methimazole caused severe enlargement of thyroid high uptake of ^{131}I and rapid release of ^{131}I. But the methiocil showed only enlargement of thyroid and increased uptake and release of ^{131}I.

Lemes et al (1969) while studying Iodine feeding in hens obtained the highest egg production when the level of I was 1.2 mg/kg in the ration.

Lodhi et al (1969) conducted experiments on growing chickens and laying hens. Chicks were fed 30 per cent rapeseed meal upto 6 weeks and hens for about 21 days. The adverse effect of hypothyroidism disappeared by 19 to 26 days because of the compensatory changes which might have occurred in thyroid gland of chicks.

Vaidya and Panda (1973) studied the nutritive value of Mustard oil cake in broiler chicks. The mustard oil cake was heated at 125°C for 15 minutes to inactivate the enzyme myrosinase. They used treated and untreated mustard oil cake in a maize, groundnut cake basal ration at 5, 10 and 15 per cent levels replacing groundnut cake on weight for weight basis for 1-7 weeks of age. They observed that at 5 and 10 per cent level the gains in body weight in both treated and untreated groups were not significantly different from control group. But at 15 per cent level the inclusion of mustard oil cake whether treated or untreated significantly lowered the growth. There was also no difference in growth of thyroid gland in any of the groups.

Singh et al (1973) obtained the digestibility of protein of mustard cake, groundnut cake, til cake and cotton seed cake in chicks. The average values were 67.7, 68.5, 57.9 and 39.7 per cent respectively.

Prasad, Mishra and Agarwala (1973) used four levels of groundnut cake i.e. 30, 20, 15 and 10 per cent and three levels of mustard cake i.e. 20, 15 and 10 per cent replacing the corresponding level of groundnut cake on 10 week old egg type cockerels. Diets were of equal protein content. After a period of 10 weeks no significant difference was observed in growth, feed conversion, however slight increase in the weight of thyroid and testes was observed when the mustard cake was included in ration.

Vaidya et al (1975) are of the view that the use of mustard oil cake in poultry feed is not in common practice yet. However, the various reports available to-day show that mustard cake can safely be used in poultry ration upto 20 per cent level without any adverse effect on growth, production, mortality and efficiency.

Shrivastava and Prasad (1976) reported progressive decrease in egg production with increasing levels of mustard cake in the diet of layers. They are of the view that Mustard cake is not suitable to replace groundnut cake even at 10 per cent level in layer's ration.

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MATERIALS AND METHODS

MATERIALS AND METHODS

Experimental birds.

Fifty nine M. line W. L.H. pullets of the same hatch and 5½ months old were brought from the Central Poultry Farm, Patna and maintained in Battery cages at Bihar Veterinary College, Patna-14. Egg production of these pullets were recorded for a period of 24 days for acalamatisation in the new environment. The birds were fed the mash mixture with groundnut cake which was further used as control ration. Then the birds of similar production were grouped randomly in four groups containing 14 birds in each and kept in Batteries. The actual experiment began from 3.9.1975.

Feeds and their preparations.

The ingredients of mash mixtures were procured from the local market. All ingredients were analysed in the laboratory for moisture, crude protein, crude fibre, ether extract, total ash, calcium and phosphorus. The average composition of the ingredients of rations are presented in the table below :

TABLE - 4.

Table showing the percentage composition of different ingredients of poultry ration.

Ingredients	Moisture	Crude protein	Crude fibre	Ether extract	Total ash	Calcium	Phosphorus
Ground yellow maize	9.13	11.68	3.66	5.53	2.23	0.04	0.35
Wheat bran	14.32	17.00	13.46	4.72	6.02	0.10	1.00
Rice polishings	6.40	11.83	6.80	19.56	9.18	0.18	1.92
Groundnut cake	7.40	46.60	10.85	9.90	7.11	0.20	0.60
Mustard cake	6.40	33.35	11.42	11.33	8.70	0.90	1.00
Fish meal	19.40	59.30	1.19	10.30	28.93	7.50	6.82
Lime stone	5.00	-	-	-	-	33.00	-

Four types of rations were computed for the experimental birds with almost equal protein and energy content. Potassium iodide was added in group II and IV at the rate of 51.47 mg/100 kg of the ration for counteracting the goitrogenic effect of the mustard cake as well as serving as a control in the groundnut cake group. Thus, the four groups were as follows :

1. Mash mixture with groundnut cake. (I)
2. Mash mixture with groundnut cake + Iodised salt (II)

3. Mash mixture with mustard cake. (III)

4. Mash mixture with mustard cake + Iodised salt. (IV)

TABLE - 5.

Table showing percentage composition of different poultry rations.

Ingredients	Rations			
	I	II	III	IV
Ground yellow maize	50.50	50.50	51.50	51.50
Wheat Bran	7.00	7.00	7.00	7.00
Rice polishing	20.50	20.50	12.90	12.90
Groundnut cake	13.50	13.50	-	-
Mustard cake	-	-	21.10	21.10
Fish meal	3.00	3.00	3.00	3.00
Lime stone	5.00	5.00	4.00	4.00
Common salt	0.50	0.50	0.50	0.50
	100.00	100.00	100.00	100.00

Vitamin supplements.

Vitablend A, B_2, D_3 (Glaxo) was added at the rate of 25 gm/100 kg of rations.

Each gm of Vitablend A, B_2, D_3 contains -

Vitamin A	-	40,000 I.U.
Vitamin B_2	-	25 mg.
Vitamin D_3	-	6,000 I.U.

The amount of Potassium iodide (KI) was first dissolved in distilled water and then sprayed over the common salt and air dried. The rest of the ingredients were thoroughly mixed by hand. The rations were then analysed for their chemical composition which is presented in Table 6.

TABLE - 6.

Table showing percentage chemical composition of rations on dry matter basis.

Nutrients in percentage	RATIONS			
	I	II	III	IV
Crude protein	17.56	17.56	17.52	17.52
Crude fibre.	5.66	5.66	6.17	6.17
Ether extract	8.75	8.75	8.33	8.33
Total ash.	6.67	6.67	6.75	6.75
Calcium.	2.01	2.01	2.01	2.01
Phosphorus.	0.92	0.92	0.96	0.96
Lysine.	0.52	0.52	0.55	0.55
Total sulphur amino acid.	0.51	0.51	0.75	0.75
ME Kcal/kg.	2934	2934	2916	2916
ME: CP	167:1	167:1	166:1	166:1

Lysine, total sulphur amino acid and ME Kcal/kg value of the individual ingredients has been taken from Poultry Nutrition by S. Bose.

Ration No. I, II, III and IV were offered to the respective birds of group No. I, II, III and IV.

The egg production of the birds were observed daily and the group egg weight was recorded. Feed consumption was recorded at weekly interval. Efficiency of feed conversion was calculated by comparing the amount of feed consumed per dozen of eggs between the groups.

Method of analysis.

(i) Estimation of moisture, crude protein, crude fibre, ether extract, total ash, calcium and phosphorus were done by A.O.A.C.method (1970).

(ii) Method of weighing thyroid : - At every 4 week two birds of each group were picked up randomly and subjected to further tests as noted under.

Killing of birds : - The birds were first weighed alive and then killed by dislocation of the neck.

Extraction of thyroid : - The thyroid gland was extracted by the side of trachea on the ventral - lateral aspect of the neck just exterior to the thoracic cavity. The torsion balance was used in weighing the thyroid gland.

Managements.

The following table gives the schedule of management observed during the experimental period.

TABLE - 7.

Table showing the daily schedule of managemental practice.

Items	Time	Remarks
Mash	7 A.M.	All groups.
Mash	4 P.M.	All groups.
Egg production record and egg weight.	5 P.M.	-
Water	-	Water trough was always kept full.
Vermex	-	With clean water on every 10th day of the month at the rate of 60 ml per 8 litre.

Statistical method.

The results of the whole experimental period were subjected to the statistical analysis with a view to know whether the result was significant or not. Different tests were done.

For this 'F' and Chisquare tests were carried out. Besides Mean and S.E. were calculated for different groups (Snedecor, 1967).

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RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

COMPOSITION OF RATION.

From the perusal of Table 6 it will be evident that crude protein content of the four mashes were 17.56, 17.56, 17.52 and 17.52 % and calculated ME values were 2934, 2934, 2916 and 2916 Kcal/kg respectively.

EGG PRODUCTION.

The total number of eggs produced per week in the four different groups are presented in the Table 8 with the numbers of birds in the groups.

The egg production of the layers was recorded upto 9 weeks maintained under the different nutritional treatment. From the table it is quite evident that the total number of egg produced during the period of 9 weeks in four groups were 177, 164, 200 and 194 respectively. These differences in egg production observed among the groups during the experimental period of 9 weeks did not differ significantly. This revealed that the replacement of Groundnut cake by Mustard cake did not affect egg production. Although the difference was non-significant it was interesting to note that the highest number of egg produced was recorded in the group treated with mustard cake which was closely followed by that of mustard cake plus iodised salt. The group with groundnut cake plus

TABLE - 8.

Table showing the egg production per week.

No. of week	Group I		Group II		Group III		Group IV	
	No.of birds	No.of eggs	No.of birds	No. of eggs	No. of birds	No.of eggs	No.of birds	No.of eggs
1st week	14	20	14	19	14	28	14	22
2nd week	14	22	14	21	14	25	14	26
3rd week	14	22	14	18	14	22	14	22
4th week	14	21	14	21	14	25	14	30
5th week	10	19	11	15	11	16	11	22
6th week	10	18	11	17	11	21	11	25
7th week	10	22	11	27	11	19	11	24
8th week	10	16	11	18	11	20	11	13
9th week	9	17	9	8	9	14	9	10
Total:		177		164		200		194

iodised salt showed the lowest total number of eggs produced.

The present findings are in agreement with the observation made by Gobel (1961), Robblee et al (1967) and Vaidya et al (1975) who did not find any significant difference in egg production when groundnut cake was replaced with rapeseed meal or mustard cake.

Contrary to the present findings , Frolich (1950), Agarwala (1964) and Shrivastava and Prasad (1976) recorded decrease in egg production with increasing levels of mustard cake. They are of the opinion that replacement of groundnut cake by mustard cake should not be more than 10 % in the layer's ration.

However, the present findings does not support their views. In this experiment the replacement of groundnut cake by mustard cake was 100 % and the level of mustard cake in the ration was about 21.00 %. Moreover, it was the mustard cake group which produced more eggs as compared to groundnut cake groups with or without iodised salt. Although the difference in egg production between the groups are insignificant, it definitely indicates that mustard cake at a level of about 21.00 % instead of causing a decrease in egg production efficiently maintained the egg production. It is also interesting to note that the addition of Potassium Iodide in the mustard cake group did not show any beneficial effect in terms of higher egg production as compared to the mustard cake group only. Similarly the addition of Potassium Iodide in the groundnut cake group has similar

effect when compare to groundnut cake group only. Thus, it appears, that the expected effect of adding Potassium Iodide to counteract the effect of the goitrogenic principles of mustard cake and thereby increased egg production by this group was only limited upto less increase in the weight of thyroid gland. This might possibly be due to the fact that the laying trial was conducted for a very short period.

FEED CONSUMPTION.

The feed consumption of the four groups of birds in different weeks have been shown in Table 9.

The feed consumption of the birds was recorded weekly. It was done by substracting the amount of feed left in the hopper from the total amount of feed offered during the week.

Feed consumption per bird per week varied from 611.65 ± 36.29 gm (87.38 gm per bird per day) to 929.02 ± 41.20 gm (132.72 gm per bird per day) in group I, 555.99 ± 18.70 gm (79.42 gm per bird per day) to 919.07 ± 27.19 gm (131.43 gm per bird per day) in group II, 595.17 ± 22.68 gm (85.02 gm per bird per day) to 920.07 gm (131.43 gm per bird per day) in group III and 625.04 ± 31.91 gm (89.29 gm per bird per day) to 919.43 ± 51.32 gm (131.35 gm per bird per day) in group IV.

However, these differences in feed consumption between the groups and within the weeks are not significantly

TABLE - 9.

Table showing feed consumption with S.E. (gm) per bird per week under different groups (on dry matter basis).

No. of week	Group I	Group II	Group III	Group IV
1st week	619.04±23.58	555.99±18.78	595.17±22.69	626.04±31.23
2nd week	616.85±14.93	627.98±36.83	602.84±29.31	628.60±40.11
3rd week	611.65±36.29	621.41±40.01	597.00±36.47	625.04±31.91
4th week	654.99±25.83	709.74±39.23	625.04±41.34	701.31±29.31
5th week	720.88±41.24	726.62±41.76	609.51±50.12	620.75±14.23
6th week	689.85±47.13	740.40±50.21	614.44±43.80	723.23±26.86
7th week	693.04±30.19	732.10±21.76	619.83±40.12	815.39±31.32
8th week	690.76±28.16	722.52±37.12	616.18±38.67	818.68±45.19
9th week	929.02±41.20	919.07±27.19	920.07±34.97	919.43±51.32
Average feed consumption/ bird/day	88.94	100.89	91.76	102.82
Average feed consumption/ bird/week	620.48	706.23	642.18	719.74

TABLE - 10.

Table showing the analysis of variance between the groups.

Sources of variance	df	M. S.
Between groups	3	293.20 NS
Within groups	532	104.61
Total :	535	

NS denotes non-significance.

different. Robblee and Clandinin (1967) did not find any significant differences in the feed consumption of the birds when groundnut cake was replaced by mustard cake at the level of 10 %. Fungauf et al (1959) was also of the similar view while working on the feeding of Rye to chicks at a level of 20 %.

However, from the table it will be clear that the bird of group IV (Mustard cake + Iodised salt) and group II (Groundnut cake + Iodised salt) ate more when compared with the other two groups where no iodised salt was incorporated. This indicates that iodised salt did exert more influence on the feed intake by increased metabolic activity of the birds. Moreover, it can also be concluded that the palatability of the ration with mustard cake irrespective of iodised salt was quite satisfactory in comparison to the one with groundnut cake.

From the foregoing observation, it can be concluded that the possible reason for insignificant differences in egg production between the mustard cake and groundnut cake group (with or without iodised salt) might possibly be due to the fact that the birds of the mustard cake group (III and IV) ate well and received equally well the optimum amount of energy, protein as well as the limiting amino acids i.e. lysine and methionine from mustard cake.

FEED EFFICIENCY.

Efficiency of feed conversion of layers in

different groups was calculated by the amount of feed consumed per dozen of eggs produced. The value has been tabulated (Table 11).

These variation between the group for feed efficiency was insignificant.

The average feed efficiency in term of egg production i.e. kg of feed per dozen of eggs was 4.850 in group I, 6.070 in group II, 4.369 in group III and 5.296 kg in group IV respectively. The differences in feed efficiency were found to statistically insignificant. However, it will noteworthy to observe that the birds in the Mustard cake (group III) were the best in feed efficiency. Next to this, was that of group I with groundnut cake only.

The groups with Iodised salt (group II and IV) showed lesser feed efficiency. It has been mentioned earlier that iodised salt might have caused an increase in the metabolic activity of the birds and as the groups ate more when compared with group I and III. The feed efficiency got lowered.

No definite reason can be assigned to this slightly lowered insignificant difference in feed efficiency excepting that the experiment lasted for a very short period.

EGG WEIGHT.

Individual weight of the egg were taken on the egg weighing machine. The average egg weight has been presented in Table 12.

TABLE - 11.

Table showing the efficiency of feed conversion in different groups (feed in kg/dozen of eggs) in different weeks.

No.of weeks	Group I			Group II			Group III			Group IV		
	No.of eggs	Feed consumed(kg)	Feed consumed/ dozen eggs.	No.of eggs	Feed consumed(kg)	Feed consumed/ dozen eggs	No.of eggs	Feed consumed(kg)	Feed consumed/ dozen eggs.	No.of eggs	Feed consumed(kg)	Feed consumed/ dozen eggs.
1st week	20	8.666	5.199	19	7.783	4.915	28	8.332	3.570	22	8.764	4.234
2nd week	22	8.635	4.710	21	8.788	5.022	25	8.439	4.050	26	8.800	4.061
3rd week	22	8.563	4.670	18	8.699	5.799	32	8.358	3.134	22	8.750	4.772
4th week	21	9.169	5.239	21	9.936	5.677	25	8.750	4.210	30	9.818	3.927
5th week	19	7.208	4.552	15	7.992	6.399	16	6.704	5.028	22	7.828	4.269
6th week	18	6.898	4.598	17	8.144	5.748	21	6.758	3.861	25	7.955	3.837
7th week	22	6.930	3.780	27	8.053	3.579	19	6.818	4.306	24	8.969	4.485
8th week	16	6.970	5.180	18	7.947	5.298	20	6.777	4.066	13	9.005	8.312
9th week	17	8.361	5.902	8	8.271	12.406	14	8.280	7.097	10	8.274	9.928
Average feed efficiency.			4.850			6.070			4.369			5.296

TABLE - 12.

Table showing mean egg weight with ± S.E. (gm) per egg in different weeks and in different groups.

No.of week	Group I	Group II	Group III	Group IV
	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.
1st week	44.50 ± 4.87	48.58 ± 3.19	45.39 ± 3.11	44.11±4.17
2nd week	47.91 ± 2.12	50.02 ± 4.06	46.08 ± 4.96	44.06±3.99
3rd week	46.75 ± 3.93	49.08 ± 2.19	47.70 ± 5.23	49.09±3.78
4th week	47.98 ± 4.11	51.71 ± 3.73	47.75 ± 4.87	45.62±6.16
5th week	46.41 ± 6.60	49.73 ± 5.81	43.25 ± 4.76	49.77±5.78
6th week	51.42 ± 6.90	50.12 ± 7.76	49.46 ± 3.86	47.38 ±6.00
7th week	51.84 ± 5.76	51.59 ± 6.19	50.53 ± 4.36	46.60±4.93
8th week	51.19 ± 4.19	54.28 ± 2.91	49.47 ± 5.93	46.15±7.83
9th week	52.27 ± 6.96	47.50 ± 4.76	50.61 ± 6.86	44.65 ±6.63
Average egg weight.	48.92	50.29	47.80	46.34

TABLE - 13.

Table showing the analysis of variance for egg weight.

Sources of variation	df	M. S.
Between groups	3	163.29 NS
Within groups	532	68.36
Total:	535	

NS denotes non-significance.

No significant difference was observed in egg weight between the groups. It can be concluded that neither the mustard cake nor the Iodised salt exerted any influence on egg weight.

THYROID WEIGHT.

Thyroid weight was recorded for the purpose of determining the change in weight of thyroid of the laying birds due to the goitrogenic principles present in the mustard cake.

The details of thyroid weight are presented in Table 14.

As the data of the thyroid weight was erratic no definite conclusion can be drawn on the goitrogenic effect of mustard cake as well as the anti-goitrogenic effect of iodised salt.

TABLE - 14.

Table showing the weight of Thyroid (mg) per 100 gm of body weight.

Group I			Group II			Group III			Group IV		
Body weight of the bird in kg.	Total weight of thyroid	Weight of thyroid/ 100 gm body weight	Body weight of the bird in kg.	Total weight of thyroid	Weight of thyroid/ 100 gm body weight	Body weight of the bird in kg	Total weight of thyroid	Weight of thyroid/ 100 gm body weight	Body weight of the bird in kg	Total weight of thyroid	Weight of thyroid/ 100 gm body weight
1.380	138	10.00	1.000	128	12.80	1.025	76	7.41	1.030	113	10.96
1.190	92	7.73	1.555	66	5.71	0.805	106	13.82	2.105	198	9.40
1.200	84	7.00	0.925	103	11.13	1.020	75	7.35	1.320	122	9.24
1.240	130	10.40	1.470	98	6.66	1.450	115	7.24	1.550	103	6.64

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S U M M A R Y

S U M M A R Y

S U M M A R Y

Experiment on the effect of replacing the groundnut cake by mustard cake and counteracting the goitrogenic effect of mustard cake by Iodised salt was conducted in layers for a period of nine weeks.

The birds were divided into four groups of 14 each on the basis of their average egg production.

Accordingly four experimental rations were computed, two with groundnut cake (Group I and II) and two with mustard cake (Group III and IV). Iodised salt (KI) at the rate of 51.47 mg/100 kg of feed was incorporated in group II and IV.

The crude protein content and calculated ME of the four rations were 17.56, 17.56, 17.52 and 17.52 % and 2934, 2934, 2916 and 2916 Kcal/kg respectively.

The birds were reared in battery cages under similar environmental and managemental condition for 9 weeks.

Records for egg production, feed consumption, egg weight and thyroid weight was observed.

The highest number of eggs during the period of 9 weeks were produced in mustard cake group (200) which was followed by mustard cake plus iodised salt group (194). The lowest number of eggs were laid in the group containing groundnut cake plus iodised salt (164). No significant

difference in egg production between the four groups was observed.

Differences in feed consumption was also found insignificant between the four groups. However, the palatability of the ration with mustard cake (Group III) was quite satisfactory (91.76 gm per bird per day) when compared to the group I with groundnut cake (88.94. gm/ bird per day.

Birds in group II and IV (groundnut cake + iodised salt and mustard cake + iodised salt) ate slightly more (100.89 gm/bird/day and 102.82 gm/bird/day) in comparison to group I and III indicating the effect of iodised salt on metabolism.

The differences in feed efficiencies in terms of feed consumed per dozen of eggs was insignificant. However, the best efficiency was observed with mustard cake (group III) which was 4.369 kg/dozen of eggs.

Differences in egg weight between the groups was insignificant indicating that the cakes or the iodised salt did not have any influence on egg weight.

Goitrogenic effect of mustard cake and anti-goitrogenic effect of iodised salt was not clear in the present study.

The present study revealed that so far as egg production, feed consumption, feed efficiency and weight of eggs are concerned, mustard cake upto 20% can be safely replaced for groundnut cake in the ration for layers.

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