EVALUATION OF DRIED POULTRY MANURE IN LAYER RATIONS

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "EVALUATION OF DRIED POULTRY MANURE IN LAYER RATIONS" 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, fellowshi-, or other similar title, of any other University or Society.

Signature of the candidate:

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Place: Mannuthy

Date : 29-7-1978.

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I am dedicating this thesis to my eldest brother.

P.A. Peethambaran

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TABLE OF CONTENTS

INTRODUCTION

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The Indian Poultry Industry has made remarkable progress during the last fifteen years. The increase in the number of high yielding laying stock coupled with better nutritional and managemental techniques has resulted in higher and quicker returns from poultry industry. Today poultry farming is a commercially viable enterprise both for the rural and urban sectors.

Poultry have been reared in high density confinement housing systems during the last decade to produce meat and eggs more efficiently and economically than at any other time in the history of poultry production. The current level of annual egg production (9290 million) is however less than 10 per cent of the minimum potential demand of our people (Anon, 1977). The Nutrition Advisory Committee of the Government of India reported that India's annual demand for eggs exceeds 100,000 million (Anon, 1977) to meet the recommended minimum requirement of half an egg per person per day.

Feed is the major expense item in the production of eggs accounting for about 60-70 per cent of the total cost of production. Availability of balanced feed at reasonable cost is one of the essential pre-requisites for profitable poultry production. Further, the consumption of poultry products could be promoted when those products become available at competitive rates in comparison with other items of human diet. The purchasing power of our people is limited and is showing no tendency for spectacular improvement. Hence, cutting down the cost of production is a more feasible proposition for boosting the demand for poultry products.

The cereal gains which form an important source of energy in poultry rations are becoming scarce and costly as these are largely required for human consumption. If the present trend continues, some of the conventional ingredients of poultry rations may not be available at all for poultry feeding in the days to come. Poultry nutritionists are therefore in constant search for alternate feed sources to tide over such situations thereby reducing the cost of production.

Many of the agricultural by-products and industrial wastes have been tried as substitutes for conventional feed ingredients depending upon their availability and nutritive value. One such ingredient is poultry manure itself. Poultry manure has been considered as an efficient fertilizer for many years. However, its importance as a potential livestock/poultry feed was recognized only recently.

A layer farm of one thousand birds can produce manure well over 40 tonnes per year (Card and Nesheim, 1972). While considering the recycling of manure as a feed stuff, primarily it must be nutritious both in content and digestibility. Potential hazards from recycling animal wastes by feeding include pathogenic bacteria , fungi, harmful residues of pesticides, feed additives, hormones, minerals and drugs. The treatment processes of manure include mainly drying by heat. Heat sterilisation helps to reduce the number of pathogens to harmless proportions.

Research carried out in advanced countries have shown that dried poultry manure can be recycled after proper processing. This area has been little explored in our country. In an earlier study carried out in the department of Poultry Science, College of Veterinary and Animal Sciences, Mannuthy, it was shown that dried poultry manure could be used in broiler diets upto 10 per cent level without adversely affecting the broiler performance.

The present study aims to assess the usefulness of sun dried poultry manure as an ingredient in layer diets with reference to hen day egg production, feed efficiency, body weight maintenance and egg quality in terms of egg weight, albumen and yolk contents.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Preliminary studies on the feeding of poultry manure were essentially to determine the presence of "unidentified growth factors" in poultry droppings (Rubin *et al.*, 1946, Elam *et al.* 1954). Ichhponani and Lodhi (1976) reported that deep litter droppings are suitable for feeding ruminants, and caged layer droppings for poultry feeding. There is no evidence that recycling animal waste presents harmful effects to human health. It has also not altered the taste of meat, milk and eggs (Fontenot and Webb, 1975; Syrett, 1977).

The chemical composition of the dried poultry manure varies from sample to sample depending on the composition of the ration fed to the birds, feed spillage, age and physical status of the birds, fresh moisture content of the droppings, environmental temperature, method of storage, age of manure before drying, drying temperature and speed of drying (Manoukas *et al.*, 1964, Kubena *et al.*, 1973, Zindel, 1971; Syrett, 1977). Prawirokusumo and Bray (1975) indicated that the fermented dried manure had greater feeding value since essential amino acid synthesis and uric acid disappearance occured during fermentation process. Miller (1975) observed 90 per cent of the nitrogen in fermented poultry manure as true protein and only 10 per cent as non-protein nitrogen fractions.

Polidori et al. (1973) reported the crude protein content of dried poultry manure as 19.66 per cent, of which 59.7 per cent as true protein and 22.8 per cent as uric acid. Sadagopan and Sinha (1976) opined that on an average, dried poultry manure contained 28 per cent crude protein, out of which 10 to 11 per cent was true protein and the rest of nitrogen was mainly uric acid. Feldhofer et al. (1976) studied the amino acid content of poultry droppings and found that the proportion of hydroxy-proline, glycine, lysine and threonine were highfollowed by valine, aspartic acid and alanine, but low in methionine, phenyl-alanine, glutamic acid and leucine.

Flegal and Dorn (1971) recycled dehydrated poultry waste for 14 times and stated that there was a trend towards a slightly increased percentage of calcium and phosphorus in the voided faeces. Trakulchang and Balloun (1975 b) reported that as the number of recyclings increased calcium and magnesium contents of the excreta decreased linearly. They observed that increasing the DPW content in the ration significantly decreased the calcium, phosphorus, and iron in excreta. Mc Donald et al. (1975) suggested poultry manure as an excellent source of calcium having a calcium phosphorus ratio of about 3:1. Varghese and Flegal (1972) concluded that the levels of arsonic acid, mercury, copper and zinc were not appreciably altered in the tissues, eggs or faeces after 23 recyclings.

The use of raw poultry manure as a feed ingredient for chicken was considered to have two possible drawbacks: viz., absorption of nutrients from the intestinal tract may be altered by the uric acid content of the manure, and the production of riboflavin by intestinal coliform bacteria may be inhibited by uric acid (Bare et al., 1964; Lau and Wiseman, 1964). Ousterhout and Presser (1971) mixed fresh wet poultry faeces in layer ration and found that "wet mash" was readily consumed by hens but egg production was found to be normal in the initial stages and fell drastically thereafter. Sadagopan and Sinha (1976) observed that direct feeding of fresh manure was difficult due to the high moisture content. Chang and Flint (1975) suggested that the dehydration temperature for drying manure must be set at 260°C (500°F) or higher and the moisture content of the dried manure must be kept below 10 per cent to maintain the microbial count under one million per gram of dehydrated cage layer excreta.

Nesheim (1972), Young (1972), and Young and Nesheim (1972) stated that there was no effect on egg production or egg weight when DPW or wheat bran was added to a basal diet. The above workers concluded that DPW could be utilised upto 25 per cent of the layer diet without affecting egg production.

Flegal and Zindel (1969) incorporated dehydrated poultry waste (DPW) in layer rations at levels of 0, 10, 20, 40, and 40 per cent plus 4.5 per cent added animal fat and found that birds that received 10 per cent DPW laid the most eggs, while those fed 40 per cent DPW plus 4.5 per cent animal fat produced the least. However there was no statistical difference in egg production between the various levels of incorporation.

York et al. (1970) reported that egg production, shell thickness and egg weight were not affected by adding 0, 10, 20 and 30 per cent DPW in layer diets. But they found that the feed efficiency was inversely proportional to the amount of dehydrated poultry waste in the diet. They further observed that there was no deleterious effect on the quality of shell eggs as measured by Haugh units, storage weight loss, colour, odour and/or microbial content.

Cooper and Hughes (1976) incorporated poultry litter from laying pens at 0, 2, and 5 per cent levels in layer rations and found that there was no significant difference in fertility and hatchability among groups. Biely (1977) fed a basal ration with 0, 10 or 20 per cent dried poultry waste from one day of age to 44 weeks. At 34 and 39 weeks of age, hatching eggs were collected and found that there was no deleterious effect on hatchability by feeding DPW.

Maekawa et al. (1976) obtained greatest egg production with dried poultry waste at 10 or 15 per cent level, but with 10 per cent level, there was a higher proportion of soft shells. However, eggs did not differ in weight, density, yolk colour or firmness of white.

Galal et al. (1977) conducted experiments with laying hens by feeding 0, 5, 10, 15 and 20 per cent dried poultry waste in their feed. These authors concluded that egg production, egg weight and shell thickness did not vary significantly, but the control group consumed significantly less feed than any of the other groups. On a per dozen egg basis the hens fed 20 per cent DPW had the poorest feed conversion and produced the lightest coloured yolks and the control group laid eggs with darkest coloured yolks.

Lee and Bolton (1977) offered diets with 0, 10 or 20 per cent dried poultry manure to laying hens and found that the hen-housed laying performance of hens offered DPM diets were significantly better for number of eggs and total egg mass produced. The inclusion of DPM in the diets did not affect the albumen quality or the incidence of hair cracks, cracks or broken eggs, but shell weight and shell thickness were poorer.

Umeda et al. (1975) reported that when Leghorn hens had 7.5 or 15 per cent of DPW in their ration replacing wheat bran or defatted rice bran, there was no significant effect on feed intake. But with DPW replacing wheat bran, egg output was lower than that of hens given wheat or rice bran diets alone. Whereas, with DPW replacing rice bran in their feed there was no effect on egg yield but intake per hen was slightly higher than that of hens given no DPW. Feed efficiency was lower with DPW than either bran diet alone. None of those differences were significant. These authors also reported that DPW had no effect on Haugh units, egg shell thickness or strength, yolk colour or the odour of the eggs.

Polidori et al.(1973) studied the effect of replacing fish meal partly with dried poultry manure at 5, 7.5 or 10 per cent levels. They observed that total feed consumption and feed efficiency were significantly greater with the diets containing DPM. With 5 and 10 per cent poultry manure, eggs were significantly heavier than the other diets.

Blair and Lee (1973) observed improvement in egg production, feed efficiency and body weight when 9.7 per cent dried autoclaved poultry manure was added to a low protein layer diet. When DPW upto 21 per cent was added to amino acid deficient rations there was numerical enhancement of egg production and egg weight but feed conversion was depressed as levels of DPW increased in the diet (Rinehart et al., 1973).

Prasad et al. (1977) conducted a feeding trial employing autoclaved dried poultry manure (ADPM) at 0, 10, 15 and 20 per cent levels and the data on egg production showed a slight non-significant decrease incidental to the increase in the levels of ADPM from zero to 15 per cent. At 20 per cent level the egg production was significantly reduced and feed consumption at 15 and 20 per cent levels decreased. There was no significant influence on egg weight and feed efficiency by feeding autoclaved dried poultry manure.

Harnisch (1975) fed a basal wheat and soya ration, containing 0, 2.5 and 20 per cent of dried chicken excrement to pullets, one month before laying and hens in their second, third and fourth month of laying, for ten days each. Inspite of the fact that the diet containing 20 per cent dried excrement contained very high 'non-protein' nitrogen level, there was 30 to 50 per cent greater nitrogen retention in the hens and the egg yield was also quite good, about 73 to 83 per cent of that in the control group.

Studies by Waldroup and Hazen (1975) using 5, 10, 15, 20 or 25 per cent dried fermented or unfermented poultry droppings showed that egg production was reduced significantly with 20 or 25 per cent fermented and 10, 15 or 25 per cent unfermented droppings. Haugh units and feed consumption were increased and egg weight was not affected by the supplements.

Biely et al. (1972) reported that egg production, Haugh units and percentage of large eggs were slightly reduced by incorporation of poultry manure at 25 per cent level in the diet.

Trakulchang and Balloun (1975 a) supplemented DPW at 0, 12.5, and 25 per cent levels and recorded improved egg weights with higher levels of DPW in the diet, possibly because of the reduced rate of egg production of the flock. They also observed that diet containing 25 per cent DPW caused a significant reduction in feed efficiency and increased mortality.

MATERIALS AND METHODS

MATERIALS AND METHODS

A feeding trial of 168 days duration was undertaken in White Leghorn hens to study the feeding value of Dried poultry manure (DPM) at 0, 10, 15 and 20 per cent levels in layer rations.

Fresh droppings from caged layers fed a standard ration was collected from the University Poultry Farm, Mannuthy and sun dried. The dried poultry manure was analysed for the contents of moisture, crude protein, crude fibre, ether extract, total ash, acid insoluble ash, calcium and phosphorus as described by the methods in A.O.A.C. (1970) and presented in Table 2. Four experimental rations were computed according to ISI (1977) (Table 3) and rations were analysed for chemical composition (A.O.A.C., 1970) (Table 4).

Forty single comb White Leghorn pullets of 25 weeks of age were used for the experiment. All the birds belonged to a single strain and hatch. At the commencement of the experiment these birds had attained sixty five per cent production. The birds were leg banded and weighed individually, allotted randomly to four groups of ten birds each and housed in individual wire cages. Each group was assigned an experimental diet randomly as outlined in Table 1. The allotment of birds to the different individual cages were also made at random. The battery laying cage was placed in a well ventilated and well lighted room.

Table 1.
Experimental design

Group	No. of birds	Experimental diets
I	10	Control diet (I)
II	10	10 per cent DPM (II)
III	10	15 per cent DPM (III)
IV	10	20 per cent DPM (IV)

Feed and water were provided *ad libitum* throughout the experimental period. Care was taken to keep the feed wastage minimum, by keeping the feed troughs not more than half-full. Standard managemental practices were followed for the whole period of the study. The experiment was carried out for six periods of 20 days each with effect from sixteenth December 1977 through first June, 1978.

The body weights of individual birds were recorded at the end of each 28-day period to study the pattern of body weight maintenance among different treatment groups.

Feed consumption of individual birds for each period was recorded. From this, average daily feed consumption per bird per period was arrived at. Daily egg production was recorded individually. Period-wise feed efficiency (kg feed/dozen eggs) for each group was calculated.

During the last three consecutive days of each 28-day period, all eggs from each group were weighed and average was worked out (Table 9). Three eggs from each group were collected at random and stored in a refrigerator for internal egg quality studies. On the next day these eggs were broken out and the shell, albumen, yolk were examined for obvious abnormalities and the weights were recorded. From the above data, the per cent composition of shell, albumen, and yolk were determined.

During the course of the experiment two birds belonging to the group fed 10 per cent DPM were found to be not laying from the third period onwards. Data pertaining to these birds were not used for statistical analysis from the third period onwards. At the close of the experiment these two birds were destroyed and on examination were found to be internal layers. No mortality was observed in any group during any of the periods under study.

Table 2. The chemical composition of the dried poultry manure (DPM) used in the experiment (D.M.basis)

Nutrient	Per cent
Dry matter	95.0
Crude protein (N x 6.25)	23.1
Crude fibre	16.6
Ether extract	2.7
N.F.E.	26.1
Total ash	31.5
Acid insoluble ash	17.4
Calcium	5.15
Phosphorus	2.20

The data collected during the course of the investigation were subjected to statistical analysis (Snedecor and Cochran, 1967). The economics of feeding dried poultry manure was evaluated based on the overall performance of the birds in the experiment.

Table 3. Composition of Experimental diets

Ingredients parts/100	Diets			
	I	II	III	IV
Yellow maize	40	40	40	40
Groundnut cake	17	14	12	10
Gingelly oil cake	5	5	5	5
Rice bran	22	12	7.5	2.5
Unsalted dried fish	10	10	10	10
Dried poultry manure	0	10	15	20
Mineral mixture*	2	2	2	2
Shell meal	2	2	2	2
Salt	0.5	0.5	0.5	0.5
Tallow	1.5	4.5	6	8
Total	100	100	100	100
Added per 100 kg of diet				
Vitamins AB_2D_3**(g)	20	20	20	20

* Mineral mixture - Poultrymin (Aries Agro-Vet Industries, Private Ltd.) 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.

** Vitamins - Vitablend AB_2D_3 (Glaxo laboratories, India Ltd.) contained 40,000 I.U. of Vit.A, 25 mg of Vitamin B_2, and 6000 I.U. of Vit.D_3 per g of vitablend AB_2D_3.

Table 4. The chemical composition of the experimental diets (in per cent) (D.M. basis).

	Diets			
	I	II	III	IV
Dry matter	94.5	92.7	91.8	91.8
Crude protein	17.6	18.4	18.2	17.3
Ether extract	7.2	8.1	9.8	8.9
Crude fibre	7.5	6.7	4.9	4.7
N.F.E.	50.2	48.1	51.4	52.2
Total ash	17.5	18.7	15.7	16.9
Acid insoluble ash	10.7	10.5	9.4	7.2
Calcium	2.46	3.03	2.83	2.97
Total phosphorus	1.59	1.68	1.69	1.84
Metabolizable energy* (K cals/kg)	2800	2900	2770	2780

* calculated

RESULTS

RESULTS

Egg production

The data on egg production are presented in Table 5 and is graphically represented in Fig 1. The mean per cent hen-day egg production was 64.76, 64.64, 70.12 and 61.13 for groups fed diets containing 0 (control), 10, 15 and 20 per cent Dried Poultry Manure (DPM) respectively. Statistical analysis of the data (Table 14) showed significant differences among diets and due to periods ($P \angle 0.01$). The egg production from birds fed 15 per cent DPM in their diet was found to be significantly higher than that fed control, 10 per cent ($P \angle 0.05$) and 20 per cent DPM ($P \angle 0.01$) in the diets. However the mean per cent hen-day egg production of the groups fed diets containing 0, 10 and 20 per cent DPM did not differ statistically.

The mean per cent hen-day egg production recorded during the first, second and third periods was comparable with that of the fourth period but was significantly higher than that observed during the fifth and sixth periods. The differences in mean per cent hen-day egg production during the initial three periods of the experiment were not significant.

The egg production during the fourth and fifth periods was comparable but, during the sixth period the production was significantly lower than the rest of the experimental periods.

Feed consumption

The mean daily feed consumption figures per bird per period for the different treatment groups are presented in Table 6. The average figures recorded was 98.9, 98.3, 101.3 and 98.5 g for groups fed diets containing 0, 10, 15 and 20 per cent DPM respectively. Statistical analysis of the data (table 14) indicated no difference among dietary treatments, nor among periods.

Feed Efficiency (kg feed/dozen eggs)

Data on periodwise feed efficiency for the dietary treatments are presented in Table 7. The mean feed efficiency figures were 1.85, 1.84, 1.74 and 1.97 for groups fed diets I, II, III and IV respectively. Statistical analysis of the data (Table 14) showed significant differences among diets ($P \angle 0.05$) and among periods ($P \angle 0.01$). The feed efficiency in the group fed 15 per cent DPM was found to be significantly better than that fed 20 per cent DPM ($P \angle 0.01$) in the diet. However, the feed efficiency of the groups fed diets containing 10, 15 and 20 per cent DPM was comparable with that of the control group. Also the feed efficiency at levels of 10 and 15 per cent, 10 and 20 per cent DDM in the diets were comparable.

Among periods, the feed efficiency during the first five periods did not differ statistically. The feed efficiency during the sixth period was found to be significantly poorer than the rest of the experimental periods ($P \angle 0.05$).

Body weight

The periodwise average gain or loss in weight of each group is given in Table 8. The differences in weight loss due to different diets as well as periods were not statistically significant (Table 13).

Egg weight

The average egg weights for the different dietary treatments are given in Table 9. There were significant differences among treatments ($P \angle 0.05$) and among periods ($P \angle 0.01$) (Table 15). The mean egg weight recorded in the group fed 10 per cent DDM was found to be significantly lower than that fed 15 per cent ($P \angle 0.01$) and 20 per cent DDM ($P \angle 0.05$). However, the average weight of eggs laid by hens fed different levels of DDM was comparable with that of the control.

The mean egg weight registered during the first period was found to be significantly lower than that during the rest of the experimental periods ($P \angle 0.01$). The average weight recorded during the second period was comparable with that of third and fourth period but was significantly different from that of fifth and sixth period. The egg weight during the third period was significantly lower than that during the subsequent periods. Whereas the egg weight during fourth and fifth period was significantly lower than that of the sixth period. The mean egg weight recorded during the sixth period was the maximum obtained in this study and was significantly higher than the rest of the experimental periods.

Internal Egg Quality

Per cent Albumen.

The mean values of per cent albumen were 62.04, 61.80, 61.66 and 62.01 for groups I to IV respectively (Table 10). Statistical analysis of the data revealed no significant difference due to dietary treatments, but was significant due to the experimental periods ($P \angle 0.01$) (Table 15). The average per cent albumen during the first period was found to be significantly higher than that during the rest of the experimental periods. However, the albumen per cent during the periods from second through six remained more or less constant and did not differ statistically. (Table 10).

Per cent Yolk.

The mean per cent yolk of eggs laid by hens under different dietary treatments were 26.13, 26.06, 26.31, 25.71 for the groups I to IV respectively (Table 11). There was no significant difference in yolk percentage due to diets but differed statistically between periods ($P \angle 0.01$) (Table 15). The mean per cent yolk during the first period worked out to be significantly lower than that during the rest of the experimental periods. There was a progressive increase in yolk percentage after the first period. The mean per cent yolk during the periods second, third and fourth did not differ statistically, so also the figures during periods fourth, fifth and sixth. But the mean per cent yolk during the last two periods were found to be significantly higher than that during the first three periods of the study.

Per cent Shell.

The mean values of per cent shell of the eggs laid by the hens in the four treatment groups were 11.66, 12.14, 12.03 and 12.28 respectively (Table 12). Statistical analysis of the data revealed no significant difference due to experimental diets but showed significant difference due to periods ($P < 0.01$) (Table 15). The mean per cent shell recorded was found to be the highest during the first period. Thereafter shell percentage exhibited a progressive decrease and was the lowest during the sixth period. The mean per cent shell during the first period was comparable with that of second period but was significantly higher than that of the subsequent periods. The shell percentage during the second period was comparable with that of the third period but was significantly higher than that of the fourth, fifth and sixth periods. The mean per cent shell during the last three period did not differ statistically. The shell percentage recorded during the third period was comparable with that of the fourth and fifth periods but was significantly higher than that of the sixth period.

No obvious abnormalities of shell, albumen and yolk were observed in any groups fed experimental diets. Yolk colour was found to be more or less uniform in all eggs studied.

Livability

No mortality was observed in any of the experimental groups during the entire period of the study.

Economic aspect of feeding DPM

Cost of feed per kg worked out to Rs 1.71, 1.74, 1.75 and 1.77; and feed cost per dozen eggs Rs 3.16, 3.20, 3.05 and 3.49 for diets containing 0, 10, 15 and 20 per cent levels of DPM respectively (Table 16).

Fig. 1. PER CENT HEN-DAY EGG PRODUCTION AS INFLUENCED BY THE DIFFERENT DIETS

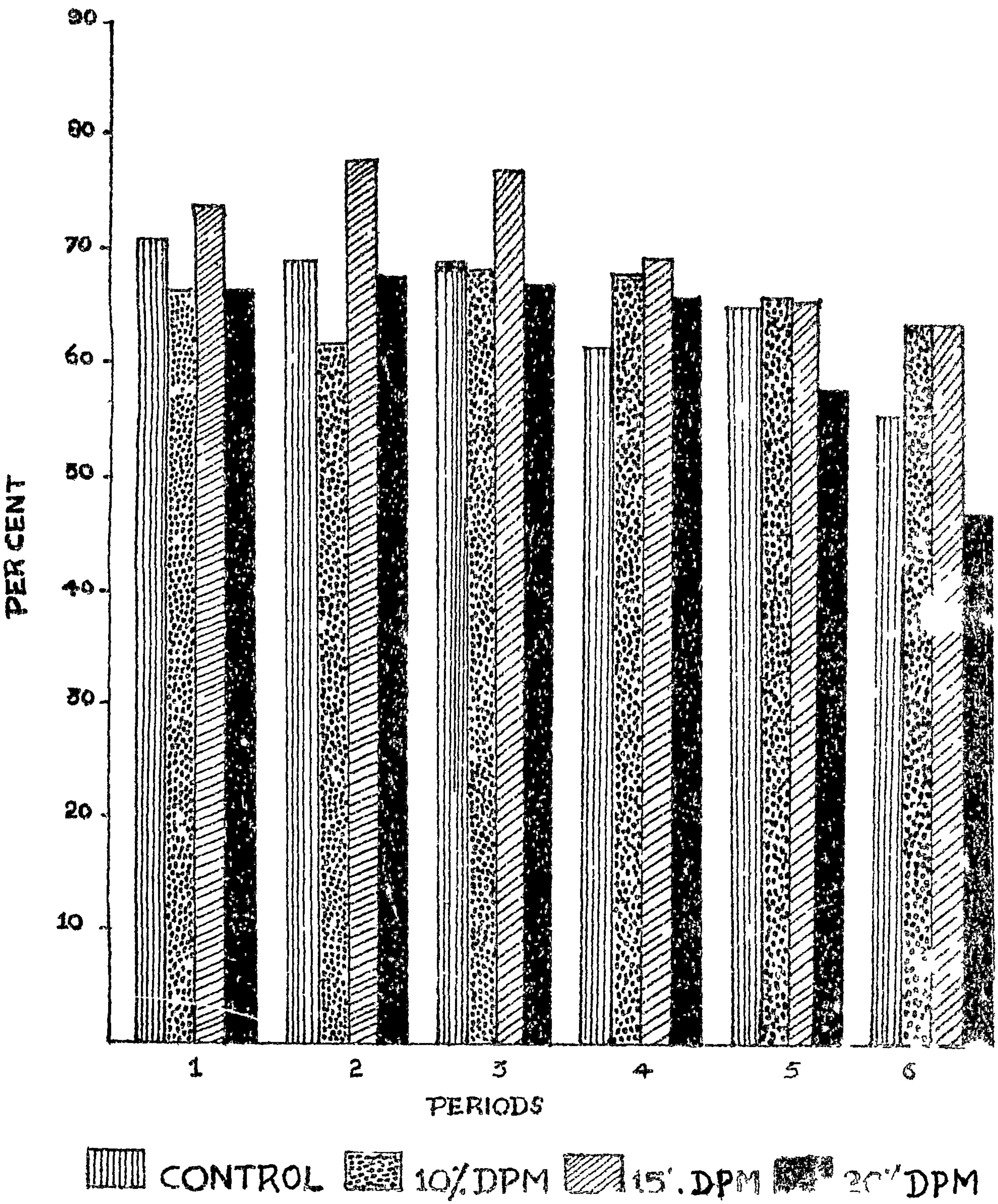

Table 5. Hen-day egg production as influenced by the different diets

Diets	Periods						Mean for diets
	1	2	3	4	5	6	
I	70.36	69.64	69.29	61.43	63.21	54.64	64.76^{a}
II	65.36	61.77	67-86	66.07	64.29	62.50	64.64^{a}
III	72.06	7 .79	75.36	69.29	63.93	62.50	70.12^{b}
IV	65.36	66.07	65.71	64.29	57.86	47.50	61.13^{a}
Mean for periods	68.49^{a}	68.57^{a}	69.56^{a}	65.27^{ab}	62.32^{b}	56.79^{c}	

Means carrying at least one similar superscript did not differ significantly

C.D. for diets = 4.30 ($P < 0.05$)

C.D. for periods = 5.26 ($P < 0.05$).

Table 6. Mean daily feed consumption per bird (g) as influenced by the different diets

Diets	Periods						Mean for diets (ns)
	1	2	3	4	5	6	
I	101.5	101.9	97.5	92.2	96.1	104.4	98.9
II	95.5	91.5	97.2	97.0	102.6	106.2	98.3
III	100.9	102.4	109.1	102.9	89.2	103.4	101.3
IV	98.4	98.6	101.3	97.9	92.0	102.7	98.5
Mean for periods[ns]	99.1	98.6	101.3	97.5	95.0	104.2	

ns : not significant

Table 7. Feed efficiency (kg feed/dozen eggs) as influenced by different dietary treatments

Diets	Periods						Mean for Diets
	1	2	3	4	5	6	
I	1.73	1.76	1.69	1.80	1.82	2.29	1.85[ab]
II	1.75	1.85	1.72	1.77	1.92	2.04	1.84[ab]
III	1.66	1.69	1.74	1.78	1.67	1.98	1.74[a]
IV	1.81	1.79	1.95	1.83	1.91	2.60	1.97[b]
Means for periods	1.74[a]	1.75[a]	1.75[a]	1.80[a]	1.83[a]	2.23[b]	

Means carrying at least one similar superscript did not differ significantly.

L.S.D. for diets = 0.138 ($P < 0.05$)

L.S.D. for periods = 0.169 ($P < 0.05$)

Table 8. Pattern of body weight maintenance of pullets as influenced by the different diets

Diets	Average initial body wt. (g)	Gain/loss in weight (g) Periods						Average final body wt. (g)	Mean for diets*
		1	2	3	4	5	6		
I	1330	-40	25	-35	-50	20	-5	1245	-14.2
II	1230	10	-15	15	-50	10	-20	1180	-8.3
III	1335	-50	65	40	-25	-35	-10	1270	-10.8
IV	1320	-15	-10	10	-70	-55	35	1215	-17.5
Mean* for periods	1304	-23.8	-16.3	7.5	-48.8	-27.5	0	1228	

* Not significant

Table 9. Average egg weight (g) as influenced by the different experimental diets

Diets	Periods						Mean for diets
	1	2	3	4	5	6	
I	45.37	48.55	48.41	50.15	50.13	52.20	49.14[ab]
II	43.54	47.59	47.91	49.42	49.59	52.18	49.37[a]
III	46.35	49.98	49.15	50.06	50.41	52.27	49.74[b]
IV	46.32	48.55	48.17	48.85	51.32	52.13	49.22[b]
Mean for periods	45.45[a]	48.67[bc]	48.41[b]	49.62[cd]	50.36[d]	52.20[e]	

Means carrying at least one similar superscript did not differ significantly.

C.D. for diets = 0.79 ($P < 0.05$)

C.D. for periods = 0.98 ($P < 0.05$)

Table 1[illegible]. Per cent albumin as influenced by the experimental diets

Diets	Periods						Mean for diets
	1	2	3	4	5	6	
I	62.88	61.89	62.34	62.75	60.61	61.75	62.04[a]
II	63.33	61.94	60.84	61.38	61.62	61.67	61.80[a]
III	62.51	61.31	61.99	62.01	60.06	61.27	61.66[a]
IV	63.50	61.67	62.67	61.09	61.88	61.26	62.01[a]
Mean for periods	63.06[a]	61.70[b]	61.96[b]	61.81[b]	61.24[b]	61.49[b]	

Means carrying at least one similar superscript did not differ significantly.

L.S.D. for period = 0.37 ($P < 0.05$)

Table 11. Per cent yolk as influenced by the experimental diets

Diets	Periods						Mean for diets
	1	2	3	4	5	6	
I	24.23	26.02	25.84	26.52	28.13	27.11	26.31[a]
II	23.27	25.20	27.08	26.86	26.57	27.38	26.06[a]
III	24.38	26.58	26.15	26.11	27.31	27.32	26.31[a]
IV	23.97	25.61	24.94	26.50	26.55	26.68	25.71[a]
Mean for periods	23.96[a]	25.85[b]	26.00[bc]	26.50[bcd]	27.14[d]	27.12[d]	

Means carrying at least one similar superscript did not differ significantly.

L.S.D. for periods = 0.87 ($P < 0.05$)

Table 12. Per cent shell as influenced by the experimental diets

Diets	Periods						Mean for diets
	1	2	3	4	5	6	
I	12.89	12.09	11.82	10.73	11.26	11.14	11.66[a]
II	13.40	12.86	12.08	11.76	11.81	10.95	12.14[a]
III	13.11	12.11	11.86	11.83	11.83	11.41	12.03[a]
IV	12.53	12.72	12.39	12.41	11.57	12.06	12.28[a]
Mean for periods	12.98[a]	12.45[ab]	12.04[bc]	11.70[cd]	11.62[cd]	11.39[d]	

Means carrying at least one similar superscript did not differ significantly.

C.D. for periods = 0.584 ($P \angle 0.05$)

Table 13. Analysis of variance for the body weight maintenance for the different treatments and periods

Periods	Source of variation	df	SS	MS	F
1	Due to treatments	3	21687.50	7229.17	1.14^{ns}
	Error	36	227500.00	6319.44	
	Total	39	249187.50		
2	Due to treatments	3	40197.50	13399.17	1.58^{ns}
	Error	36	304340.00	8453.89	
	Total	39	344537.50		
3	Due to treatments	3	29131.58	9710.53	1.78^{ns}
	Error	34	185000.00	5441.19	
	Total	37	214131.58		
4	Due to treatments	3	10184.21	3394.74	0.67^{ns}
	Error	34	172300.00	5067.65	
	Total	37	182484.21		
5	Due to treatments	3	74289.47	24763.16	2.78^{ns}
	Error	34	302800.00	8905.88	
	Total	37	377089.47		
6	Due to treatments	3	16657.89	5552.63	0.87^{ns}
	Error	34	217800.00	6405.88	
	Total	37	234457.89		

ns = non significant

Table 14. Analysis of variance for the different characters studied among layers

Factor	Source of variation	df	SS	MSS	F
1. Hen-day egg Production	Due to diets	3	247.63	82.54	6.77**
	Due to periods	5	480.74	96.15	7.88**
	Error	15	182.94	12.20	
	Total	23	911.31		
2. Feed consumption	Due to diets	3	34.79	11.60	0.54ns
	Due to periods	5	200.58	40.12	1.87ns
	Error	15	321.68	21.45	
	Total	23	557.05		
3. Feed Efficiency	Due to diets	3	0.1545	0.0515	4.1200*
	Due to periods	5	0.7143	0.1429	11.4320**
	Error	15	0.1871	0.0125	
	Total	23	1.0559		

** Significant ($P \angle 0.01$)

* Significant ($P \angle 0.05$)

ns non significant

Table 15. Analysis of variance for the various egg quality factors studied

Factor	Source of variation	df	SS	MSS	F
1. Egg weight	Due to diets	3	5.71	1.90	4.52*
	Due to periods	5	101.85	20.37	43.50**
	Error	15	6.36	0.42	
	Total	23	113.92		
2. Per cent Albumen	Due to diets	3	0.59	0.20	0.59 ns
	Due to periods	5	7.94	1.59	4.68**
	Error	15	5.07	0.34	
	Total	23	13.60		
3. Per cent Yolk	Due to diets	3	1.45	0.48	1.45 ns
	Due to periods	5	27.70	5.54	16.79**
	Error	15	4.90	0.33	
	Total	23	34.05		
4. Per cent Shell	Due to diets	3	1.29	0.43	2.87 ns
	Due to periods	5	7.08	1.40	9.33**
	Error	15	2.28	0.15	
	Total	23	10.57		

* significant ($P < 0.05$)

** significant ($P < 0.01$)

ns non significant

Table 16. Summary of results showing overall performance of birds during the entire experimental period (160 days)

Factor	Experimental diets			
	I (control)	II (10% DPM)	III (15% DPM)	IV (20% DPM)
Average hen-day egg production (%)	64.76	64.64	70.12	61.13
Average daily feed consumption per bird (g)	98.9	99.3	101.3	98.5
Averaged feed efficiency (kg)	1.85	1.84	1.74	1.97
Average initial body weight (kg)	1.330	1.230	1.335	1.320
Average final body weight (kg)	1.245	1.180	1.270	1.215
Average egg weight (g)	49.14	48.37	49.74	49.22
Per cent albumen	62.04	61.80	61.66	62.01
Per cent yolk	26.13	26.06	26.31	25.71
Per cent shell	11.65	12.14	12.03	12.28
*Feed cost per kg (Rs)	1.71	1.74	1.75	1.77
Feed cost per dozen eggs (Rs)	3.16	3.20	3.05	3.49

* Cost of Dried Poultry Manure = Rs 200/tonne.

DISCUSSION

DISCUSSION

Egg production

From a perusal of the results presented in Table 5 it can be seen that the birds fed ration containing 15 per cent DPM showed the highest rate of egg production ($P < 0.05$) when compared to those maintained on rations containing 0, 10 and 20 per cent DPM. Though there was no significant difference in egg production between the control group and that fed 10 per cent DPM, the production was found to decrease when DPM in the ration was increased to a level of 20 per cent. The significantly low rate of egg production ($P < 0.01$) at 20 per cent level compared to that at 15 per cent level clearly indicates that the latter level (15 per cent) is the optimum for efficient egg production.

The better performance of birds fed ration containing 15 per cent DPM could be due to the higher feed consumption coupled with more efficient utilisation of the nutrients present in the ration. The comparatively lower crude fibre content of the ration containing 15 per cent DPM than that of 0 and 10 per cent levels might be a contributory factor to the higher efficiency of feed utilisation. The higher fat content of the ration may also be a factor which helps for the increased efficiency of metabolizable energy utilisation for egg production. Carew and Hill (1964) reported that addition of corn oil, Soybean oil or beef tallow increased the metabolic efficiency of energy utilisation in the case of chickens. With equicaloric diets increase in the fat component decreases the heat increment resulting in fewer calories of heat loss and relatively more available calories for production (Maynard and Loosli, 1969). The higher egg production obtained by feeding 15 per cent DPM in the ration might possibly be due to the balanced associative effect of DPM with other ingredients in the ration. It can be assumed that the synergetic effect of nutrients present in the ground nut cake, fish meal and dried poultry manure was exploited fully at 15 per cent level of DPM incorporation.

The limited capacity of birds in utilizing non-protein nitrogen (NPN) substances as a source of protein at higher levels can be attributed for the decreased egg production at 20 per cent level of DPM incorporation. The higher uric acid content in the diet is believed to act as a gut irritant thereby reducing the absorption of nutrients (Bare et al. 1964). Inspite of the fact that the diet containing 20 per cent DPM had low crude fibre content, the egg production in that group was low. The higher uric acid content of the ration might have interfered with the absorption of nutrients especially amino acids methionine and lysine which are critical for egg production. Hence a very high concentration of DPM in layer rations can not be recommended. However, in the present study the nutrient utilisation by the group fed DPM at 20 per cent level appeared fairly good as the performance of this group was not greatly different from that of the control. The layer ration containing 20 per cent DPM might prove better if supplemented with critical amino acids. However, this aspect was not explored in the present investigation.

The results obtained in this study are in agreement with the reports of Maekawa et al. (1976) who obtained better egg production with DPW at 10 or 15 per cent levels, and in contrast with the reports of Umeda et al. (1975), Waldroup and Hazen, (1975) and Prasad et al.(1977) . The contrasting results obtained by various workers may be attributed to the differences in composition of dried poultry manure used for the experiments, as the manure processing techniques and composition of the rations varied widely.

The experimental birds had attained a production rate of 65 per cent at the commencement of the trial. Although the peak production in different dietary treatments varied, there was gradual decline in the rate of production in all groups after peaking as is expected in pullet year of production.

Feed consumption

Though there was no significant difference in feed consumption among various dietary treatments, the birds fed ration containing 15 per cent DPM consumed comparatively higher amounts of feed. This is in agreement with the report of Umeda et al. (1975) who observed slightly higher intake of ration containing DPM than that of hens given no DPM in the ration. The average daily feed intake on the different dietary regimes ranged from 93.3 to 101.3 g. At 20 per cent level the feed consumption was almost similar to that at 10 per cent level indicating that DPM at higher levels did not exert any effect on feed intake.

The average feed consumption of the different experimental groups during the periods were not significantly different. Eventhough the climatic conditions did not exert any significant effect on feed consumption the natural trend of lower feed consumption with higher atmospheric temperature was evident during the fourth and fifth periods when these periods coincided with the summer months.

Feed Efficiency

The maximum feed efficiency was obtained for the group fed diet containing 15 per cent DPM and the least by the group fed diet containing 20 per cent DPM, the difference being statistically significant ($P \angle 0.01$). Galal *et al.* (1977) also observed poorest feed conversion at 20 per cent level of DPM in the diet. However, the feed efficiency of the groups fed diets containing 10, 15 and 20 per cent levels of DPM was comparable with that of the control. The variation in the feed efficiency of the groups fed different diets can be attributed to the variations in egg production rates. It is also seen from Table 7 that the mean feed efficiency for different groups ranged from 1.74 to 1.97 which is considered to be an optimum figure for birds fed and managed under ideal conditions. The relatively low feed efficiency figures recorded by the different groups during the sixth period of the study can be attributed to the decline in rate of production which is a normal phenomenon in birds after the peak production.

Body weight

From the data presented in Table 8 it can be seen that the average final body weights for all the groups were lower than the respective average initial weights.

The weight losses were more or less uniform with all the four groups. The average initial body weights of the different groups ranged from 1230 to 1330 g whereas the average final body weights ranged from 1180 to 1270 g. The average weight of the group fed diet containing 10 per cent DPM was low when compared to those of the other groups at the commencement and close of the trial.

Egg weight

It can be seen from the results (Table 9) that the mean weights of the eggs produced by the birds fed diets containing 0, 10, 15 and 20 per cent DPM were 49.14, 48.37, 49.74 and 49.22 g respectively. Significant difference in egg weight was seen between groups fed 10 and 15 per cent ($P < 0.01$); so also between 10 and 20 per cent DPM in the diets ($P < 0.05$). The lower egg weights recorded by the birds fed 10 per cent DPM in their diet can be attributed to the lower initial body weights of birds in that group, rather than to the effect of DPM in the diet. Johansson and Rendel (1968) reported a positive correlation between the initial body weight and egg weight of domestic chicken. It may be also noted that the uniformly low egg weights for all the groups fed different diets might be due to the smaller body size of the birds used in this study.

The mean egg weight of the four groups was lowest during the first period and was found to increase progressively, the maximum being obtained during the sixth period of the study. The increase in egg weight with advancement of lay is a natural phenomenon during the pullet year of production (Romanoff and Romanoff, 1949). Stadelman and Cotteril (1973) reported that the age of hens had more effect on egg size smaller eggs being laid at the start of their laying cycle. Johanson and Rendel (1959) stated that egg weights were lower at the commencement of lay but increased steadily for about seven or eight months. It can be inferred from the results that the incorporation of DPM had no deleterious effect on egg weight even at a higher level of 20 per cent. York et al.(1970), Waldroup and Hazen (1975); and Galal et al.(1977) also reported that egg weight was not affected by adding DPM in layer diets.

Internal egg quality

Per cent albumen.

The mean per cent albumen of eggs laid by birds fed the experimental diets did not differ markedly indicating that incorporation of DPM in the rations had no effect on the albumen percentage of eggs. With all the four experimental diets, the eggs obtained during the first period had significantly more albumen than for those laid during the subsequent periods, when almost uniform albumen percentages were obtained. Romanoff and Romanoff (1949) reported that higher percentage of albumen will be present in pullet eggs than in those of older birds and it remains more or less constant after few months of lay.

Per cent yolk.

There was no significant difference in the percentage of yolk in eggs laid by hens fed different experimental diets indicating that incorporation of DPM in poultry rations di not exert any influence on the yolk percentage. With all the diets the mean per cent yolk was significantly lower during the first period when compared to the subsequent periods. The size of yolk was found to increase gradually with advancement of lay following the normal trend. This is in agreement with the report of Romanoff and Romanoff (1949) who also observed lower percentage of yolk in pullet eggs and gradual increase with advancement of lay.

Per cent shell.

The results from the present study showed no significant difference in per cent shell of eggs laid by birds fed different diets suggesting that DPM did not influence the shell percentage. There was no incidence of soft shells in any of the groups fed diets containing DPM as against the report of Kaekawa et al. (1977) who obtained higher proportion of soft shells at 10 per cent level of PPM. With all the diets the mean percentage of shell was significantly higher during the first period when compared to subsequent periods. After four months of lay the shell percentage was found to decrease, a normal phenomenon resulting from the advancement of lay. Ewing (1963) reported that maximum shell thickness was obtained during the early periods of lay.

No abnormalities in shell, albumen or yolk could be detected in the eggs produced by birds fed the experimental diets. As against the report of Galal et al. (1977) the yolk colour was found to be more or less uniform in all eggs produced by birds fed the different diets suggesting that PPM did not exert any influence on egg yolk colour. This finding is in agreement with the report of Umeda et al. (1975) and Maekawa et al. (1976).

Livability

In contrast to the report of Trakulchang and Balloun (1975 a), no mortality was observed in this study. A complete absence of mortality in any of the experimental groups clearly indicates that sun dried poultry manure did not exert any deleterious effect on the nutritional status or on the physiological well being of the birds.

The present study tends to suggest that sun drying can be adopted as a safe method of processing poultry manure before incorporation in poultry rations, provided the droppings are collected from healthy stock under standard managemental conditions and properly stored before use.

Economics

It can be seen from the Table 16 that the cost of feed per dozen eggs was the lowest (Rs 3.08) in the group fed 15 per cent DPM in the diet when compared to the other groups, the costs being Rs 3.16, 3.20 and 3.49 for the diets containing 0, 10 and 20 per cent DPM respectively. The higher cost of feed for the diets containing DPM was evidently due to the incorporation of animal fat (tallow) at higher levels to make these diets isocaloric.

A critical evaluation of the overall results (Table 16) obtained during the course of the present investigation, essentially from an economic point of view, indicates that properly collected, processed and stored poultry manure can be safely and profitably incorporated at a level of 15 per cent in the rations of laying hens.

Further studies to identify the factors responsible for the depression in egg production at 20 per cent level of DPM incorporation and methods to eliminate these factors or to ameliorate the ill effects produced by those factors are warranted.

SUMMARY

SUMMARY

A feeding trial of 168 days duration, divided into six periods of 28 days each, was carried out during December, 1977 through June, 1978 using forty single comb White Leghorn hens maintained in individual wire cages. The birds were divided into four groups of ten each and the groups I, II, III and IV were fed diets containing 0, 10, 15 and 20 per cent levels of dried poultry manure (DPM) respectively.

Hen-day egg production, feed consumption, feed efficiency, pattern of body weight maintenance, egg quality traits such as egg weight, per cent shell, per cent albumen and per cent yolk and livability of birds were studied and the data were analysed statistically. The following conclusions were drawn at the close of the experiment.

There was significant improvement in egg production ($P < 0.05$) when dried poultry manure was included at 15 per cent level in the layer ration. The egg production registered by the birds fed rations containing 10 and 20 per cent of DPM were comparable with that of the control diet.

The feed consumption was not affected by the DPM incorporation at different levels studied.

Feed efficiency was found to be significantly better at 15 per cent level than that at 20 per cent level ($P < 0.01$) but, at 10, 15 and 20 per cent levels of DPM inclusion feed efficiency was found to be comparable with that of the control.

The pattern of body weight maintenance of the birds was not affected by the DPM incorporation even upto 20 per cent level in the diet.

The egg weight was significantly lower ($P < 0.05$) in the 10 per cent DPM fed group than the other groups fed 15 and 20 per cent DPM in the diet. This lowered egg weight could be due to the lower body weight of the birds in that group.

Egg quality traits such as per cent shell, per cent albumen and per cent yolk were not affected by the presence of DPM in the diets.

Livability of hens was not affected by feeding sun dried poultry manure as indicated by the absence of any mortality among the birds.

In the light of above findings it was concluded that sun dried poultry manure could be safely incorporated upto 15 per cent level partially replacing groundnut cake and rice bran in layer rations without adversely affecting the laying characteristics and this level proved to be more beneficial and economic.

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ABSTRACT

EVALUATION OF DRIED POULTRY MANURE IN LAYER RATIONS

By

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ABSTRACT OF A THESIS
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1978

ABSTRACT

Forty single comb White Leghorn pullets aged 25 weeks were divided into four groups of 10 birds each and the groups were on diets containing 0 (control), 10, 15 and 20 per cent dried poultry manure for 168 days. The entire period of study was divided into six periods of 28 days each. The results of this study revealed that the incorporation of dried poultry manure at 15 per cent level was better than 0, 10 and 20 per cent levels in terms of hen-day egg production, feed efficiency and egg weight. The feed consumption, pattern of body weight maintenance and livability of birds were not affected by the different dietary treatments. However, the feed efficiency was found to be significantly better at 15 per cent level of incorporation than that at 20 per cent level. Egg weight was significantly depressed at 10 per cent level than 15 and 20 per cent levels of DPM in the diet. Per cent shell, per cent albumen and per cent yolk showed no appreciable differences attributable to the inclusion of DPM at different levels in layer rations. Based on the overall performance of the birds fed 15 per cent dried poultry manure in the diet it was concluded that this level excelled the 0, 10 and 20 per cent levels of DPM incorporation and proved to be more beneficial and economic.