REPLACEMENT VALUE OF LIVER MEAL IN LAYER RATION

BY

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "REPLACEMENT VALUE OF LIVER MEAL IN LAYER RATION" 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.

Signature of the candidate:

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Place: Mannuthy

Date : 31-7-1981

CERTIFICATE

Certified that this thesis, entitled "REPLACEMENT VALUE OF LIVER MEAL IN LAYER RATION" is a record of research work done independently by Sri.P.Gangadharam under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to him.

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INTRODUCTION

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Feed is the major expense item involved in the production of eggs accounting for about 60-70 per cent of the total cost of production. The profitability of poultry production therefore is essentially based on the availability and cost of the feed ingredients. The fast developing poultry industry with the modernised scientific technology directly competes with human population for high quality foods such as animal proteins and other feed ingredients which are already in demand. If this condition persists,a time will come when atleast some of the ingredients may not become available for poultry feed formulation. Therefore, it has become necessary to explore alternate sources for conventional feed ingredients.

The major nutrient that dictates the cost of poultry feed is the protein sources. Animal protein sources are added not only to supply quality proteins in the diet but also because of the possible presence of unidentified factors atleast, in some of them which may improve growth and egg production.

The protein fraction is commonly supplied through vegetable protein and animal protein ingredients. Generally fish meal/unsalted dried fish is incorporated in the poultry feed as animal protein source. It is estimated that the requirement of fish meal for feed formulation is around 0.89 million tonnes and the availability at present is close to the requirement. However, with larger export potential for high grade fish meal the availability of fish and fish meal is becoming lesser leading to higher cost.

Extensive research has been done in developed countries and in India as well to ascertain the nutritive value of certain agro-industrial by-products like Algae protein (Scenedesmus acutus), meat meal,blood meal, silk worm pupae meal, feather meal and hatchery by-product meal (prepared from infertile eggs and dead germs) as a replacement product for fish meal/unsalted dried fish and has been shown that these products can be used as part of complete substitution for fish meal. Earlier experiments carried out at College of Veterinary and Animal Sciences,Mannuthy, have shown that the frog meal can replace fish meal twice by weight in the poultry rations for growth as well as for egg production. Even the dried bacterial biomass (Petkov et al.,1976),African giant snail (Achatina spp.) meal (Venugopalan et al.,1976) and poultry by-product meal (Akkilic,1977) have been tried as a substitute for fish meal in poultry rations.

The preparation of poultry rations with only plant proteins is also being attempted during the non-availability of fish meal and meat meal.

However, the majority of agro-industrial product tested so far as alternate source for fish or fish meal have limited application in as much as they are not commercially available in quantities sufficient to meet the demand. Liver meal, a by-product from pharmaceutical industry, has been made available in commercial scale in recent times.

Therefore, the present investigation was carried out to assess the efficacy of replacing unsalted dried fish with a commercial preparation, Prot-O-Liv (manufactured by Aries Agro-Vet Industries Pvt.Ltd.) in layer ration.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Research in economising poultry rations is directed mostly towards identifying methods of replacing animal protein sources as these constitute the major cost components in poultry rations. Further, fish meal which is the conventional animal protein ingredient in poultry rations is becoming scarce both in quantity and quality. Developing all protein rations, supplementing rations with amino acids and identifying alternate feed ingredients for animal protein sources are some of the aspects that are being investigated upon. The review highlights the observations made in this regard. Most researchers have attempted to work with growing chicks and broilers in as much as the biological importance of proteins being more during growth than during subsequent stages of life.

Sathe and Bose (1962) reported that although increased growth responses were obtained by the inclusion of terramycin feed supplement (TM-5) to an all-vegetable protein poultry ration, the addition of animal protein supplement such as fish meal, was, however, found necessary for economy of gain in weight, low mortality and better uniformity of the flock.

Fernandes (1960) fed White Leghorn day-old chicks with diets composed of 10 per cent fish meal, 10 per cent Pencillin mycelium residue, 10 per cent fish meal plus 5 per cent Pencillin mycelium residue and in another diet fish meal was substituted by 10 per cent liver meal residue. The results indicated that the diet containing dried liver residue performed most efficiently with respect to growth followed by Pencillin mycelium residue and fish meal. Further he suggested that the quantity of feed required for one pound gain was largest with fish meal diet and smallest with liver meal residue diet.

While replacing animal protein by plant protein in rations for fattening chickens, Legner (1968) included 6 per cent fish meal in one ration, the second had no fish meal but had 10 per cent each of dried fish solubles and dried whey, and the third had no animal protein. The author found that the group of chickens fed ration containing fish solubles and dried whey performed better in terms of average weight and feed efficiency both in pens and cages.

When the levels of 0 and 3.0 per cent fish meal; 0, 1.5 and 3.0 per cent partially delactosed whey and 0, 100 and 200 mg/ton of supplemental biotin was added in the broiler ration, the results derived was either the 3.0 per cent fish meal, 1.5 or 3.0 per cent partially delactosed whey or 100 and 200 mg/ton of supplemental biotin to a commercial type diet did not result in significant response in terms of body weight or feed efficiency (Damron et al.,1971).

Patel and Sayed (1973) found that Pencillin mycelium residue could replace 50 per cent groundnut cake or fish meal in broiler rations. Sethi and Virk (1977) noticed poor growth and reduced efficiency of feed utilization when fish meal was replaced by <u>Pencillium crustosum</u> protein in a starter diet.

Bankne (1974) claimed highest gains and best utilization of feed with most fish meal in fattening chickens. He suggested that 15 to 20 per cent of total protein should come from animal protein feeds. Contrary to this finding Ar'kov and Chesheva (1975) fed broiler chickens with maize, wheat, barley, sunflower oil meal, fish meal, dried milk, hydrolysed yeast, lucerne meal, calcium carbonate, sodium chloride, or the basal diet with sunflower meal replaced by mustard oil meal or with 50 per cent of the component of animal origin replaced with mustard oil meal; or the same diet as the third group to 30 days of age and then the reference diet with all the animal products substituted by mustard oil meal. The results indicated no significant difference between the four groups in weight gain, rate of feather growth, carcass yield or meat quality.

Bal'ezov <u>et al</u>.(1975) while replacing two-third or all of the fish meal in a reference diet with poultry waste meal and fodder yeast claimed no difference in growth in starters when compared to controls but was greater than that of controls in finishers. Bondari and Kazemi (1975) indicated that the proteins of cotton seed meal and sunflower seed meal could replace all of the animal proteins without any harmful effects on broiler growth.

Gruhn et al.(1975) while investigating the use of high protein wheat for broiler feeding found that supplementation with L-lysine and DL-methionine did not improve the feed conversion of the birds on soya bean meal-fish meal diets, whereas with the other experimental diets amino acid supplementation was found necessary to improve feed efficiency.

Opstvedt and Gjefsen (1975) stated that the breeder broiler hens given fish meal in their rations upto 2 per cent performed better than the hens given diets based on soyabean oil meal. They also observed that the egg weight increased significantly as the proportion of fish meal was increased in the ration.

In broilers complete replacement of fish meal with hydrolysed feathers depressed growth by about 100 g. Though 50 per cent replacement of fish meal gave same live weight gain, the feed eaten/kg gained was 2-5 per cent more (Bal'ozov et al.,1976 a) . On the same lines when 4.5

per cent of fish meal or half or all replaced by hydrolysed feathers during finishing period in broilers, dressing percentage was slightly lower in the birds with no fish meal (Bal'ozov et al.,1976 b).

Rao et al.(1976) formulated 3 types of broiler rations with either complete frog meal or 50 per cent fish meal and 50 per cent frog meal or only fish meal. The growth rate was significantly higher with the second ration when compared with the other two rations.

It was reported that the African giant snail (Achatina spp.) meal can be used at a level of 10 per cent in the starter mash without adding fish meal. The growth response was almost equivalent to that of birds fed ration containing fish meal (Venugopalan et al.,1976).

Akkilic (1977) prepared poultry by-product meal and replaced fish meal at 4, 8, 10 and 12 per cent level in broiler diets with the control of 12 per cent fish meal diet. He concluded that this poultry by-product meal can be satisfactorily used upto 12 per cent without interfering chick growth and feed consumption.

Ammenuddin (1977) tried to evaluate the effect of fish offal and trash fish meal in broiler rations. The rations containing fish offal meal showed a significant gain ($P<0.05$) in body weight and feed efficiency than trash fish meal and conventional fish meal. However, there was slight but insignificant improvement in body weights and feed efficiency of the birds fed trash fish meal than those fed the control diet.

It was shown that yeast produced from molasses can be used upto 5 to 10 per cent levels in broiler diets. It was also observed that it can be substituted for about one third of the soyabean meal and all of the fish meal provided that methionine and lysine are added at 0.5 per cent each (Daghir and Baki,1977).

Murarasu et al.(1977) observed higher body weight and feed efficiency in meat type chickens when protein hydrolysate from slaughter house was used to replace fish meal in their ration.

Srivastav et al.(1977) reviewing the use of all vegetable protein rations for broilers stated that all vegetable protein ration when supplemented with Vitamin B_{12} and synthetic amino acids namely, methionine and lysine could effectively substitute animal protein without deleterious effects on live weight gain and feed efficiency.

Reddy *et al.* (1978) did not notice much difference in feed consumption and feed efficiency with the reference diet containing 9 per cent fish meal and 4 per cent Algae protein (*Scenedesmus acutus*) with and without supplemental methionine in chick rations. Similarly Thirumalai *et al.* (1978) included solid fish silage in chick rations at 5 and 10 per cent levels instead of fish meal and concluded that it could be used upto 10 per cent economically in starter ration to replace all fish meal in terms of gain in weight.

To evaluate the performance of Silkworm Pupae Meal (SWPM) in broiler chicks Joshi *et al.* (1979) formulated a control ration containing 11 per cent fish meal and the experimental rations substituting 25, 50, 75 and 100 per cent fish meal with SWPM. Though SWPM potentially was found to be much superior source of protein than fish meal, body weight gains showed a significant decrease with each incremental level of dietary SWPM. However, feed efficiency data revealed that SWPM had insignificant effect upto 50 per cent replacement level.

Rao *et al.* (1979) while evaluating the nutritive value of Male Chick Meal (MCM) reported that when fish meal was substituted with MCM at 50, 75 or 100 per cent in broiler chick ration there was no significant difference in all the levels of inclusion. But numerically feed consumption was reduced with MCM diets and feed conversion ratio was comparable.

Day and Dilworth (1980) while reporting the nutritive value of fish meal and Pro-Pak (which was composed of meat meals, fish by-products, blood meal, feather meal, L-Lysine, DL-methionine, salt, limestone and a phosphate supplement) claimed that there were no detectable differences in nutritional quality of fish meal and Pro-Pak.

Dhaliwal et al. (1980) while assessing the use of housefly (Musca Domestica linnacus) Pupae meal in broiler mash observed that the average weight gain in the control ration with fish meal and 50 per cent fish meal replaced ration fed birds were non-significant (P/0.05). They further concluded that higher levels of substitution may be harmful due to higher crude fibre content (19.9 per cent) in housefly pupae meal.

The research reports of substitution of fish meal in layer ration is limited.

Ceballos and McGinnis (1970) while investigating the utilization of alfalfa and cereal grain protein by laying hens reported that the basal diet supplying protein solely from high protein wheat and alfalfa (without animal protein source) gave nearly similar egg production to that of diets containing animal protein ingredients. However, they observed that the egg weight in this group was around 2g less than the diets containing fish meal.

Johri (1971) stated that if care was taken to see that the lysine and methionine requirement of the birds are met, there could not be any deliterous effect on growth, egg production, fertility, internal egg quality and hatchability when the fish meal was substituted with groundnut cake or tilcake or a combination of both.

Sentek (1975a) observed the egg production as 54.28, 55.60, 53.70 with 4 per cent fish meal, or complete soyabean oil meal or soyabean oil meal and ground field beans respectively when the methionine and Vitamin B_{12} were adjusted as equal to the values in the diet as fish meal. Similarly Sentek (1975 b) replaced fish meal by increasing the proportion of soyabean meal and yeast in a layer ration and observed that replacing fish meal with soyabean meal and yeast had poorer egg production but supplementation of this ration with 0.5 per cent methionine surpassed the ration containing fish meal.

Waldroup and Hazen (1975) observed that the rate of egg production of hens receiving upto 15 per cent yeast derived from high purity alkane fractions was equal or superior to that of hens fed either all vegetable corn-soyabean meal diet or diet containing 5 per cent Peruvian fish meal. But no statistical significance could be observed among treatment groups in efficiency of feed utilization, expressed as grams of feed per egg or for egg quality factors like egg size or albumen quality.

Zohari (1975) while replacing some of the fish meal without changing crude protein content of the rations incorporated hatchery by-product meal at 3.6, 7.25, 10.5 or 14.5 per cent observed significantly lesser egg production with 7.25 or 14.5 per cent hatchery waste and poorer feed conversion with 7.25 per cent. But the egg weight was not affected.

Damian <u>et al.</u> (1976) fed layers with diets containing animal proteins and without animal proteins and found that there was no significant difference in egg production between the diets. Similarly Schubert and Gruhn (1976) fed layers with diets composed of grains, high protein wheat, high protein wheat diet supplemented with lysine and methionine or a diet containing 3 per cent fish meal with no amino acid supplementation. They observed that vegetable protein diets with no amino acid supplement produced smallest and fewest eggs and used largest quantity of feed per 100g egg weight. But supplementation of this ration with lysine and methionine improved these parameters. Egg production in relation to feed consumption changed little by replacing half of the fish meal with wheat, if 3 per cent fish meal was given during the grower period.

Nair *et al.* (1976) found insignificant difference with respect to egg production and feed efficiency ratio when the fish meal was replaced with fish silage at 50 and 100 per cent substitution.

Rahman and Nakkadi (1976) fed five rations to Fayoumi hens containing 10 per cent fish meal, 2 per cent ammonium nitrate, 1.5 per cent urea, 2.5 per cent ammonium chloride and 22 per cent decorticated cotton seed meal. The highest egg production was noticed in the rations with fish meal and decorticated cotton seed meal. Further, these workers suggested that enough cotton seed meal could be used when fish meal was expensive and that use of higher levels of non-protein nitrogen was not advisable.

Natarajan *et al.* (1978) compared 10 per cent fish meal ration and ration without fish meal in layers. Results indicated that the hen-housed production, feed efficiency and mortality on rations with and without fish meal were

58 and 53 per cent; 2.05 and 2.24 kg/dozen eggs, 5.8 and 25 per cent respectively.

MATERIALS AND METHODS

MATERIALS AND METHODS

An experiment was conducted at the University Poultry Farm, Department of Poultry Science, Mannuthy, to study the replacement value of liver meal, an animal protein supplement (Prot-O-Liv) manufactured by Aries Agro-Vet Industries Pvt.Ltd. as a substitute in place of unsalted dried fish.

One hundred and fifty single comb White Leghorn pullets of 24 weeks of age were used for the experiment. All the birds belonged to a single strain and hatch. The birds were wing badged, weighed individually and were alloted randomly to fifteen groups of ten birds each. In the experimental diets liver meal replaced unsalted dried fish at five levels, i.e., 0, 25, 50, 75 and 100 per cent. Thus there were five dietary treatments with three replicates each as presented in Table 1. The allotment of dietary regimen and the replicates were also made at random.

The liver meal and the unsalted dried fish utilized in the experiment were analysed for their proximate chemical composition as outlined in A.O.A.C.(1970) and is presented in Table 2. Five experimental layer rations as set out in Table 3.were computed according to ISI (1977). The rations were analysed for proximate chemical composition (A.O.A.C., 1970) and the values obtained are presented in Table 4. All the diets were isocaloric and isonitrogenous.

Feed and water were provided _ad libitum_ throughout the experimental period. Normal managemental practices were carried out for the whole period of study. Care was exercised to keep the feed wastage minimum. The experiment was carried out for four 28-day periods from twenty fifth January,1981 to sixteenth May,1981. At the completion of the experiment the birds were 280 days of age.

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 replicate birds for each period was recorded. From this data, mean feed efficiency both in terms of egg number and egg weight were arrived at.

Daily egg production was recorded replicate wise and the hen-day and hen housed production replicate wise and period wise were calculated. Period wise feed efficiency (kg feed/dozen eggs) for each treatment group was also calculated.

In order to estimate difference if any, in egg quality due to dietary regimen in terms of Haugh Unit score and shell thickness, internal egg quality assessment was carried out during each 28-day period. For this purpose three eggs from each replicate during the last three consecutive days were collected at random. On the same day these eggs were weighed individually, broken out and the height of the thick albumen was recorded by using the Ame's Micrometer. The Haugh unit was arrived at using these values. Shell thickness was determined by the use of Ame's shell thickness gauge.

All the eggs from each pen were weighed during the last three consecutive days of each 28 days period and the average was worked out for deriving egg mass values.

Table 1. Experimental design

Dietary treatments	No.of replicates	No.of birds per replidate	Per cent substitution of unsalted dried fish
I (Control)	3	10	0
II	3	10	25
III	3	10	50
IV	3	10	75
V	3	10	100

Table 2. Per cent chemical composition of the liver meal and unsalted dried fish used in the experiment (D.M.basis)

Nutrient	Liver meal	Unsalted dried fish
Dry matter	90.2	87.4
Crude protein (N x 6.25)	59.5	35.4
Crude fibre	0.6	0.2
Ether extract	1.8	12.1
N.F.E.	11.0	9.1
Total ash	17.3	30.6
Acid insoluble ash	5.5	12.3
Calcium	0.90	5.30
Phosphorous	0.40	3.20

Table 3. Per cent composition of experimental diets

Ingredients	Diets				
	I	II	III	IV	V
Groundnut cake (Expeller)	25	24	22	21	19
Tapioca	15	15	15	15	15
Soyafortified bulgar wheat	30	34	40	44	49
Rice bran	15	12	8	5	2
Unsalted dried fish	10	7.5	5.0	2.5	-
Prot-O-Liv (Liver meal)	-	2.5	5.0	7.5	10
Mineral mixture*	2.5	2.5	2.5	2.5	2.5
Shell grit	2.0	2.0	2.0	2.0	2.0
Common salt	0.5	0.5	0.5	0.5	0.5
Added per 100 kg of diet					
Rovimix (g)**	30	30	30	30	30
Neftin 200(g)***	25	25	25	25	25

*Poultrymin - mineral mixture (Aries Agro-Vet Industries Pvt.Ltd.) containing 32 per cent calcium, 6 per cent phosphorous, 0.27 per cent manganese, 100 ppm.copper and 1000 ppm.Iron.

** Rovimix AB_2D_3- (Roche Products Limited) containing 40,000 IU of Vitamin A, 20 mg of Vitamin B_2 and 5,000 IU of Vitamin D_3 per gram.

***Neftin 200-(Smith Kline & French (India) Ltd.) containing Veterinary Furazolidone B.Vet.C.20 per cent w/w.

Table 4. Per cent chemical composition of the experimental diets (D.M.basis)

	Diets				
	I	II	III	IV	V
Dry matter	92.1	91.9	91.8	91.8	91.6
Crude protein (N x 6.25)	18.4	18.5	18.6	18.4	18.6
Ether extract	3.8	3.7	2.0	1.8	1.9
Crude fibre	5.6	5.3	4.2	3.4	3.2
N.F.E.	50.3	53.4	55.9	58.4	59.3
Total ash	14.0	11.0	11.1	9.8	8.6
Acid insoluble ash	5.4	3.8	2.4	2.4	1.0
Calcium*	2.6	2.2	2.4	2.0	2.3
Phosphorous	1.1	1.0	0.9	0.9	0.7
Metabolizable energy** (K cals/kg)	2715	2710	2711	2706	2702
Lysine %**	1.03	0.93	0.82	0.73	0.62
Methionine %**	0.45	0.66	0.76	0.86	0.96

* Shell grit was provided separately <u>ad libitum</u> in hoppers

** Calculated values

RESULTS

RESULTS

Hen-housed egg production

The data on per cent hen-housed egg production are presented in Table 5. The per cent hen-housed egg production of the first period ranged from 8.69 to 16.55. The mean per cent hen-housed egg production was 51.25, 48.25, 49.41, 48.51 and 43.93 for groups fed diets in which liver meal substituted unsalted dried fish at 0, 25, 50, 75 and 100 per cent (dietary treatments I, II, III, IV and V) respectively. Statistical analysis of the data (Table 6) showed significant differences among periods ($P<0.01$). However, the differences in hen-housed egg production among different dietary treatments were not significant.

Hen-day egg production

The mean per cent hen-day egg production was 51.25, 49.78, 49.41, 48.51 and 47.18 for the groups fed diets I, II, III, IV and V respectively (Table 7). The highest per cent hen-day egg production was obtained with diet I and the lowest with diet V. However, the statistical analysis of the data (Table 8) revealed non-significant difference among the different dietary regimens.

Feed efficiency (kg feed/dozen eggs)

The data on periodwise feed efficiency(kg feed/dozen eggs)

Table 5. Mean per cent hen-housed egg production of birds fed different dietary treatments

Dietary treatments	28-day periods				Mean for dietary treatments
	1	2	3	4	
I	16.55±4.48	57.98±3.12	69.16±1.72	61.31±3.53	51.25±1.88
II	8.69±1.37	51.43±4.56	69.05±2.19	64.64±3.72	48.25±1.93
III	13.93±2.92	61.55±3.17	65.59±0.78	56.55±2.52	49.41±1.59
IV	14.64±1.61	66.91±4.09	60.00±3.12	52.50±5.61	48.51±2.37
V	15.95±5.57	57.14±8.26	52.02±6.63	50.59±6.24	43.93±2.50
Mean for periods	13.95±1.55	59.00±2.34	63.17±2.19	57.12±2.22	48.31±1.49

Table 6. ANOVA on per cent hen-housed egg production

Source	df	SS	MSS	F
Treatments	4	349.21	87.30	1.31^{ns}
Replications	2	25452.99	12726.50	
Periods	3	23896.66	7965.55	119.28**
Treatments x Periods	12	1207.12	100.59	1.79^{ns}
Error	38	2131.82	56.10	

** Significant ($P<0.01$)
ns non significant

Table 7. Mean per cent hen-day egg production of birds fed different dietary treatments

Dietary treatments	28-day periods				Mean for dietary treatments
	1	2	3	4	
I	16.55±4.48	57.98±3.12	69.16±1.72	61.31±3.53	51.25±1.88
II	8.69±1.37	52.03±4.41	71.63±3.60	66.77±1.77	49.78±1.33
III	13.93±2.92	61.55±3.17	65.59±0.78	56.55±2.52	49.41±1.59
IV	14.64±1.61	66.91±4.10	60.00±3.12	52.50±5.61	48.51±2.37
V	15.99±5.54	59.53±7.14	57.33±3.82	55.87±3.27	47.18±1.81
Mean for periods	13.96±1.54	59.60±2.17	64.74±1.80	58.60±1.39	49.22±1.38

Table 8. ANOVA on per cent hen-day egg production

Source	df	SS	MSS	F
Treatments	4	109.47	27.37	0.28^{ns}
Replications	2	26473.86	13236.93	
Periods	3	25200.90	8400.30	86.63**
Treatments x periods	12	1163.48	96.96	2.22*
Error	38	1657.96	43.63	

* Significant ($P < 0.05$)
** Significant ($P < 0.01$)
ns non significant

for the experimental diets are presented in Table 9. The mean feed efficiency was 3.99, 5.30, 4.23, 4.05 and 4.04 for groups fed diets I, II, III, IV and V respectively. The statistical analysis of the data (Table 10) revealed that differences among dietary treatments were not significant but that among periods were highly significant ($P < 0.01$).

Feed efficiency (kg feed/kg eggs)

During the period I the feed efficiency(kg feed/kg eggs) was poor ranging from 14.91 to 25.35 and from there on it was similar in all the groups varying from 2.84 to 4.89. The overall mean feed efficiency among different dietary regimen were 6.99, 9.33, 7.50, 7.12 and 7.21 for the diets I to V respectively as presented in Table 11. The statistical analysis of the data (Table 12) indicated no difference among diets but showed significant difference among periods ($P < 0.01$).

Body weight maintenance

The body weight of birds fed diets I to V recorded initially and at the end of each period are presented in Table 13. The initial body weight ranged from 1.24 to 1.27 kg and the final body weight at the end of the experiment ranged from 1.28 to 1.39 kg. However, statistical analysis (Table 14) showed no significant difference due to dietary treatments but differences were significant among periods (P<0.01).

Egg mass

The mean egg mass data are presented in Table 15. The mean egg mass during the different periods ranged from 1.13 to 9.60 kgs. Statistical analysis revealed significant differences due to periods (P<0.01) but not due to dietary treatments (Table 16).

Egg weight

Mean egg weight values were fairly similar during the whole periods of the experiment. The mean egg weights were 47.61, 48.09, 47.35, 47.50 and 47.20 g for the experimental diets I to V respectively as presented in Table 17. Statistical analysis of the data (Table 18) showed non significant differences among diets as well as periods.

Haugh unit score

The mean Haugh unit score were 88, 89, 87, 87 and 86 for dietary treatments I to V respectively (Table 19). There was no significant difference in Haugh unit scores due to diets (Table 20) but these were significant between periods (P<0.05).

Shell thickness

The mean values of shell thickness of the eggs broken

Table 9. Mean feed efficiency (kg feed/dozen eggs) of birds fed different dietary treatments

Dietary treatments	28-day periods				Mean for dietary treatments
	1	2	3	4	
I	8.59±1.66	2.67±0.09	2.13±0.20	2.59±0.23	3.99±0.48
II	14.27±2.10	2.78±0.16	1.68±0.19	2.46±0.14	5.30±0.37
III	9.81±1.47	2.29±0.13	2.06±0.16	2.78±0.17	4.23±0.41
IV	8.63±1.22	2.20±0.13	2.40±0.23	2.98±0.27	4.05±0.52
V	9.45±3.12	1.90±0.16	1.98±0.87	2.94±0.22	4.04±0.47
Mean for periods	10.15±0.95	2.37±0.10	2.05±0.09	2.73±0.09	4.33±0.30

Table 10. ANOVA on feed efficiency (kg feed/dozen eggs)

Source	df	SS	MSS	F
Treatments	4	13.60	3.40	1.20^{ns}
Replications	2	770.39	385.20	
Periods	3	705.63	235.21	82.96**
Treatments x Periods	12	51.16	4.26	1.79^{ns}
Error	38	90.58	2.38	

** Significant ($P \leq 0.01$)

ns non significant

Table 11. Mean feed efficiency (kg feed/kg eggs) of birds fed different dietary treatments

Dietary treatments	28-day periods				Mean for dietary treatments
	1	2	3	4	
I	14.91±2.74	4.78±0.29	3.73±0.42	4.54±0.46	6.99±0.68
II	25.35±3.11	4.86±0.25	2.84±0.31	4.27±0.34	9.33±0.58
III	17.48±2.84	3.98±0.23	3.67±0.28	4.85±0.23	7.50±0.48
IV	15.34±2.28	3.97±0.30	4.18±0.38	4.50±0.59	7.12±0.77
V	17.07±5.87	3.36±0.26	3.53±0.16	4.89±0.37	7.21±0.61
Mean for periods	18.03±1.70	4.19±0.18	3.59±0.17	4.61±0.17	7.58±0.41

Table 12. ANOVA on feed efficiency (kg feed/kg eggs)

Source	df	SS	MSS	F
Treatments	4	44.99	11.25	0.97 ns
Replications	2	2396.46	1198.23	
Periods	3	2172.47	724.16	62.51**
Treatments x Periods	12	178.99	14.25	1.42 ns
Error	38	400.17	10.53	

** Significant ($P \leq 0.01$)

ns non significant

Table 13. Mean body weight (kg) of birds fed different dietary treatments

Dietary treatments	28-day periods				
	0	1	2	3	4
I	1.25±0.02	1.50±0.01	1.48±0.05	1.41±0.07	1.34±0.08
II	1.24±0.01	1.53±0.02	1.53±0.03	1.48±0.04	1.39±0.03
III	1.24±0.03	1.50±0.02	1.47±0.01	1.38±0.01	1.28±0.03
IV	1.27±0.02	1.58±0.02	1.50±0.03	1.40±0.05	1.32±0.06
V	1.25±0.02	1.54±0.03	1.49±0.01	1.40±0.04	1.32±0.04

Table 14. ANOVA on body weight

Source	df	SS	MS	F
Treatments	4	3.15	0.79	2.19^{ns}
Replications	2	87.59	43.80	
Periods	4	81.41	20.35	56.53**
Treatments x Periods	16	3.03	0.19	0.45^{ns}
Error	48	20.01	0.42	

** Significant ($P \leq 0.01$)
ns non significant

out from the hens of five treatment groups I to V were 0.333, 0.338, 0.339, 0.342 and 0.341 mm respectively as shown in Table 21. Statistical analysis of the data (Table 22) revealed non significant difference due to diets as well as periods.

No obvious abnormalities of shell, albumen or yolk were observed in any groups fed experimental diets. Yolk colour was found to be more or less uniform in all eggs broken out for egg quality studies.

Livability

The mortality data of birds under experimentation are presented period wise in Table 23. In all the dietary treatments only five birds died during the entire experimental period.

Economics

The cost of liver meal and unsalted dried fish at the time of experimentation were Rs.3.60 and Rs.1.41 per kg respectively. The cost of diets in which liver meal replaced unsalted dried fish at 0, 25, 50, 75 and 100 per cent were Rs.1.65, 1.73, 1.81, 1.89 and 1.96 respectively.

Table 15. Mean egg mass (kg) as influenced by different dietary treatments

Dietary treatments	28-day periods				Mean for dietary treatments
	1	2	3	4	
I	2.20±0.57	7.60±0.47	9.30±0.40	8.22±0.67	6.83±0.26
II	1.13±0.16	6.88±0.66	9.60±0.28	8.76±0.73	6.59±0.27
III	1.85±0.42	8.26±0.48	8.59±0.10	7.55±0.26	6.56±0.16
IV	1.93±0.22	8.67±0.60	8.05±0.40	7.19±0.82	6.46±0.29
V	2.10±0.75	7.55±0.11	6.77±0.74	6.83±0.80	5.82±0.28
Mean for periods	1.84±0.21	7.79±0.31	8.46±0.32	7.71±0.32	6.45±0.18

Table 16. ANOVA on egg mass (kg)

Source	df	SS	MSS	F
Treatments	4	697.43	174.36	1.35^{ns}
Replications	2	46064.86	23032.43	
Periods	3	43030.38	14343.46	110.67**
Treatments x Periods	12	2337.06	194.75	1.78^{ns}
Error	38	4143.45	109.04	

** Significant ($P < 0.01$)
ns non significant

Table 17. Mean egg weight (g) as influenced by different dietary treatments

Dietary treatments	28-day periods				Mean for dietary treatments
	1	2	3	4	
I	47.77±0.82	46.88±2.27	48.00±1.29	47.76±1.60	47.61±1.26
II	46.73±1.11	47.70±0.67	49.69±0.16	48.23±1.33	48.09±1.15
III	46.99±0.89	47.89±0.32	46.80±0.25	47.71±0.65	47.35±0.81
IV	47.01±0.87	46.27±0.81	47.93±0.69	48.79±0.49	47.50±0.70
V	46.57±0.64	47.19±0.51	46.73±0.99	48.30±0.36	47.20±0.60
Mean for periods	47.01±0.35	47.19±0.46	47.83±0.42	48.16±0.40	47.55±0.62

Table 18. ANOVA on Egg weight

Source	df	SS	MSS	F
Treatments	4	5.51	1.38	0.51 ns
Replications	2	40.39	20.19	
Periods	3	13.07	4.36	1.62 ns
Treatments x Periods	12	21.81	1.82	0.61 ns
Error	38	112.83	2.97	

ns non significant

Table 19. Mean Haugh unit score of eggs as influenced by different dietary treatments

Dietary treatments	28-day periods				Mean for dietary treatments
	1	2	3	4	
I	92±1.00	88±1.20	85±0.88	87±0.58	88±0.76
II	90±1.15	87±3.18	87±1.76	87±1.73	88±1.32
III	90±1.53	88±1.76	85±0.88	86±2.40	87±1.55
IV	89±1.67	88±0.88	87±0.58	84±2.96	87±1.72
V	87±1.45	89±1.76	85±1.45	84±1.53	86±1.24
Mean for periods	90±0.64	88±0.75	86±0.51	86±0.86	88±0.92

Table 20. ANOVA on Haugh unit score

Source	df	SS	MSS	F
Treatments	4	15.50	3.87	0.49^{ns}
Replications	2	258.33	129.16	
Periods	3	178.33	59.44	7.48**
Treatments x Periods	12	64.50	5.38	0.61^{ns}
Error	38	332.67	8.75	

** Significant ($P<0.01$)
ns non significant

Table 21. Mean shell thickness (mm) as influenced by different dietary treatments

Dietary treatments	28-day period				Mean for dietary treatments
	1	2	3	4	
I	0.334±0.001	0.322±0.006	0.341±0.008	0.336±0.007	0.333±0.008
II	0.332±0.004	0.338±0.002	0.334±0.007	0.349±0.006	0.338±0.008
III	0.349±0.006	0.326±0.005	0.348±0.003	0.333±0.005	0.339±0.007
IV	0.334±0.006	0.329±0.008	0.349±0.004	0.356±0.008	0.342±0.009
V	0.352±0.014	0.330±0.008	0.348±0.002	0.333±0.008	0.341±0.009
Mean for periods	0.340±0.004	0.330±0.002	0.343±0.003	0.341±0.004	0.339±0.006

Table 22. ANOVA on shell thickness

Source	df	SS	MSS	F
Treatments	4	5.12	1.28	0.54^{ns}
Replications	2	54.04	27.02	
Periods	3	20.67	6.89	2.89^{ns}
Treatments x Periods	12	28.26	2.38	3.17**
Error	38	28.60	0.75	

** Significant ($P<0.01$)
ns non significant

Table 23. Details of periodwise mortality among birds fed different dietary treatments

Dietary treatments	Start of the experiment	28-day period				End of the experiment
		1	2	3	4	
I	30	-	-	-	-	30
II	30	-	1	-	-	29
III	30	-	-	-	-	30
IV	30	-	-	-	-	30
V	30	1	2	-	1	26

DISCUSSION

DISCUSSION

Hen-housed egg production

From the results presented in Table 5 it can be seen that the birds fed rations in which 25, 50, 75 and 100 per cent of unsalted dried fish was replaced by liver meal had fairly similar performance in respect of per cent hen-housed egg production when compared to the birds fed ration that had unsalted dried fish only. The per cent hen-housed egg production was numerically higher in the group I, followed by dietary treatments III, IV, II and V in that order. But the differences were not statistically significant. Nair _et al._ (1976) reported non significant difference with respect to egg production when the fish meal was replaced by fish silage at 50 and 100 per cent substitution level. Natarajan _et al._ (1978) working with White Leghorn layers have obtained 58 and 53 per cent hen-housed production with groups fed 10 per cent fish meal and without fish meal respectively.

The fairly equal performance of birds on the diets point out effective utilization of the proteins available in the liver meal for egg production. Except for the first period, similar rate of egg production was observed in all other periods. The numerically lower hen-housed production at 100 per cent substitution could be due to lower ether extract in that particular diet. It could be seen from Table 4 that as the substitution level increased the percentage of ether extractives in the diets decreased. This decreasing fat content of the different experimental diets may be a factor which leads to decreased efficiency of utilization of metabolizable energy for egg production as the substitution level is increased resulting in poorer egg production. Maynard and Loosli (1969) opined that with the 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.

The statistically non significant difference in the per cent hen-housed production clearly indicates that the liver meal could replace 100 per cent unsalted dried fish in layer ration without detrimental effect on egg production.

Hen-day egg production

It could be seen from the Table 7 that the mean per cent hen-day egg production follows fairly the same trend of hen-housed production. However, the hen-day production is higher in group II and V when compared to the hen-housed egg production recorded to these groups. This is because one bird died in group II and four birds died in group V during the experimental period.

Feed efficiency (kg feed/dozen eggs)

The maximum feed efficiency (kg feed/dozen eggs) was obtained for the group fed diet containing 10 per cent unsalted dried fish i.e. 3.99 followed by 4.04, 4.05, 4.23 and 5.03 for the groups V, IV, III and II respectively. Eventhough numerical difference are observed statistically it was seen that difference among the dietary treatments are not significant. Waldroup and Hazen (1975) also reported similar non significant differences between treatment groups in efficiency of feed utilization expressed as grams of feed per egg while studying the efficacy of diets containing either all vegetable corn-soyabean meal diet or 5 per cent Peruvian fish meal diet. Nair _et al._ (1976) also reported non significant difference in feed efficiency ratio when the fish meal was replaced with fish silage at 50 and 100 per cent substitution.

It is also seen from Table 9 that the mean feed efficiency figures for all the dietary treatment groups being higher when compared to the optimum figure for birds fed and managed under ideal conditions. This could be attributed to the fact that the pullets started laying during the first period and that feed efficiency as a consequence was poorer in all the groups. The feed efficiency during first period ranged from 8.59 to 14.27 among diets. But from the second period the feed efficiency varied from 1.68 to 2.98. In view of the shorter experimental period the effect of poorer feed efficiency recorded during the first period had substantially shifted the overall feed efficiency mean for all the groups. None the less, the apparent differences in feed efficiency among dietary treatm nts were not statistically significant.

Feed efficiency (kg feed/kg eggs)

Eventhough the feed efficiency in terms of kg feed/ dozen eggs or kg feed/kg eggs bears the same meaning with slight variation, this has been studied to assess if at all there exists any influence among diets on egg weight. It was found that the egg weight among different diets remained fairly uniform; so also egg production and feed consumed by birds. The feed efficiency calculated in terms of egg weight also projected similar trend as that of feed efficiency calculated based on egg number.

Body weight

The initial body weight of the birds among different dietary treatments ranged from 1240g to 1270g and final body weights from 1280g to 1390g. Further it could be seen from the Table 13 that final body weights for all the groups were higher than the respective average initial weights. The body weights were significantly different between ($P<0.01$) periods which is a normal phenomena. The lowest and the highest average final weights were observed in the groups III and II respectively. But the differences were non-significant due to different diets. The results of the present study thus reveal that the nutrient availability among the different dietary treatments is sufficient to meet the requirement of the birds.

Egg mass

Since there was no difference in egg weights among different groups the total egg mass (kg) also followed similar pattern. The egg mass as could be seen from Table 15 was not influenced by the dietary treatments.

Egg weight

From the results (Table 17) it can be seen that the mean weights of eggs produced by the birds fed diets in which 0, 25, 50, 75 and 100 per cent of unsalted dried fish was replaced by liver meal were 47.61, 48.09, 47.35, 47.50 and 47.20 g respectively. The statistical analysis pertaining to the mean egg weights of the different groups revealed no differences among diets as well as among periods (Table 18). The results obtained in this study is in accordance with the observations made by Waldroup and Hazen (1975) and Zohari (1975). In view of the similar egg weights obtained with all the experimental diets it may be stated that substitution of fish one hundred per cent with liver meal has no deleterious effect on the egg weight.

Haugh unit score

The Haugh unit score is one of the dependable measures of egg quality. Haugh unit score recorded in this experiment are presented in Table 19. It was found that there was no significant difference among periods as well as among diets in respect of Haugh unit score.

The Haugh unit score of eggs obtained from all the diets ranged from 86 to 88 which is considered as superior quality. This non significant difference between dietary treatments with regard to albumen quality observed in the present study agrees with the report of Waldroup and Hazen (1975).

Shell thickness

The mean shell thickness of egg belonging to different dietary treatments varied from 0.333 to 0.342 mm (Table 21). Eventhough the per cent calcium available in all the diets were below the requirement for laying hens, the normal shell thickness could have attained due to feeding shell grit *ad libitum* in separate hoppers. The statistical analysis of shell thickness indicated non significant differences between different diets as well as periods.

Livability

The mortality rate was 3.3 and 13.3 per cent for groups II and V respectively while there was no mortality in other groups. Among the birds that died, three were due to prolapse of the oviduct and the others due to non-specific causes. No nutritional deficiency diseases were encountered in the experimental birds.

Economics

The lowest cost of the ration was for the unsubstituted ration (Diet I) (Rs.1.65/kg) and the highest cost was for the ration (Diet V) in which 100 per cent unsalted dried fish was replaced by liver meal (Rs.1.96/kg). The cost of ration showed an increasing trend as the level of substitution increased. This is mainly due to two factors. Firstly on an equal weight basis liver meal is costlier than unsalted dried fish. In addition, the rations in which liver meal was incorporated,was done at the expense of ground nut cake a protein ingredient that is cheaper among vegetable protein sources.

In the light of the fact that egg production is fairly uniform in all the dietary treatments the higher cost of the ration as a consequence of incorporation of liver meal had resulted in higher cost of production. Thus, substitution of unsalted dried fish with liver meal had not shown any economic benefit, though nutritionally sound. Therefore, it may be concluded that liver meal could form an alternate animal protein source in layer ration only in times when either unsalted dried fish and/or ground nut cake are costlier or unavailable.

SUMMARY

SUMMARY

An experiment was conducted at the University Poultry Farm, Department of Poultry Science, Mannuthy, to assess the replacement value of liver meal, an animal protein supplement (Prot-O-Liv) manufactured by Aries Agro-Vet Industries Pvt.Ltd. as a substitute in place of unsalted dried fish in layer ration. The experimental period of 112 days duration from January,1981 through May,1981 was divided into four periods of 28-days each.

One hundred and fifty single comb White Leghorn pullets were distributed to five dietary treatments with each treatment having three replicaters of 10 birds each. The dietary treatments consisted of 0, 25, 50, 75 and 100 per cent replacement of unsalted dried fish with liver meal. All the diets were formulated according to ISI(1977) and were isocaloric and isonitrogenous.

Hen-housed egg production, hen-day egg production, feed efficiency both in terms of kg feed/dozen eggs and kg feed/kg eggs, pattern of body weight maintenance, egg mass (kg), egg quality traits such as egg weight, Haugh unit score and egg shell thickness and livability of birds were studied and the data were analysed statistically. The summary of results obtained in the present study are presented in Table 24. The results indicated the following:

Table 24. Summary of results showing overall performance of birds during the entire experimental period

Factor	Experimental diets				
	I	II	III	IV	V
Mean hen-housed egg production (%)	51.25±1.88	48.25±1.93	49.41±1.59	48.51±2.37	43.93±2.50
Mean hen-day egg production (%)	51.25±1.88	49.78±1.33	49.41±1.59	48.51±2.37	47.18±1.81
Mean feed efficiency (kg feed/dozen eggs)	3.99±0.48	5.30±0.37	4.23±0.41	4.05±0.52	4.04±0.47
Mean feed efficiency (kg feed/kg eggs)	6.99±0.68	9.33±0.58	7.50±0.48	7.12±0.77	7.21±0.61
Mean initial body weight (kg)	1.25±0.02	1.24±0.01	1.24±0.03	1.27±0.02	1.25±0.02
Mean final body weight (kg)	1.34±0.08	1.39±0.03	1.28±0.03	1.32±0.06	1.32±0.04
Mean egg mass (kg)	6.83±0.26	6.59±0.27	6.56±0.16	6.46±0.29	5.82±0.28
Mean egg weight (g)	47.61±1.26	48.09±1.15	47.35±0.81	47.50±0.70	47.20±0.60
Mean Haugh unit score	88±0.76	88±1.32	87±1.55	87±1.72	86±1.24
Mean shell thickness (mm)	0.333±0.008	0.338±0.008	0.339±0.007	0.342±0.009	0.341±0.009
Mortality rate (%)	-	3.30	-	-	13.30
Feed cost per kg (Rs)	1.65	1.73	1.81	1.89	1.96

1) The egg production from birds fed five experimental rations were fairly similar indicating that liver meal can replace unsalted dried fish even upto 100 per cent without impairing egg production.

2) The body weight of the birds was not affected adversely by any of the five dietary treatments.

3) The egg weight recorded did not show any statistically significant difference among the experimental diets.

4) The feed efficiency calculated both in terms of egg number and egg weight were not statistically different among dietary groups.

5) The replacement of unsalted dried fish with liver meal had no deleterious effect on the major egg quality traits such as Haugh unit score and shell thickness.

6) The dietary treatments had no specific influence on the livability of layers.

7) Rations formulated with liver meal at any level of replacement was higher in cost and the magnitude increase in cost being in relation to the level of replacement.

In the light of the above findings it can be safely concluded that liver meal can be used as an alternate source of animal protein in layer ration in the place of unsalted dried fish without detrimental effect on egg production and other related parameters. However, the present day higher cost of liver meal has placed limitations of its use on economic considerations.

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REPLACEMENT VALUE OF LIVER MEAL IN LAYER RATION

BY

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ABSTRACT

An experiment to evaluate the nutritional and economic impact of replacing unsalted dried fish with liver meal in layer ration was conducted using single comb White Leghorn pullets. Five diets with 0, 25, 50, 75 and 100 per cent replacement of unsalted dried fish with liver meal were tried over four 28-day periods.

The per cent hen-housed egg production recorded for the five dietary treatments were 51.25, 48.25, 49.41, 48.51 and 43.93 respectively for diets in which 0, 25, 50, 75 and 100 per cent unsalted dried fish was replaced by liver meal. The per cent egg production both in terms of hen-housed and hen-day as well asfeed efficiency, livability and egg quality traits such as egg weight, Haugh unit score and egg shell thickness were not statistically different among dietary treatments. However, the cost of rations showed an increasing trend depending upon the level of substitution with liver meal, least being for the ration in which unsalted dried fish was not substituted (Rs.1.65/kg) and highest being in the ration where 100 per cent unsalted dried fish was replaced with liver meal (Rs.1.96/kg.).

It was concluded that liver meal can be used to replace the entire quantity of unsalted dried fish in layer ration without any detrimental effects on major egg production parameters. However, the higher cost of liver meal puts limitation on its use in poultry rations.