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Economic Evaluation of Magmeal for Quail Feed as a Remunerative Poultry Feed in India

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ABSTRACT

Background: Maggot meal, popularly magmeal is a core product consisting of dried defatted larvae that is ground into a high protein larvae meal. It is a potential alternative for fish replacement in the diet of quails.

Methods: A study on 240 Japanese quail birds from day old to six week of age was conducted at Poultry Research Station, Madhavaram Milk Colony, Chennai with magmeal supplementation during the year 2015-16. The birds were divided into four groups and each having with three replicates with 20 birds in each replicate. Group 1 (Control group) was fed basal diet (with 7% fish meal), group 2 was fed basal diet replacing 50% fish meal with magmeal, group 3 was fed basal diet replacing 75% fish meal with magmeal and group 4 was fed with Japanese quail basal diet replacing 100% fish meal with magmeal. Economic evaluation of magmeal at various levels of inclusion in Japanese quail diet was calculated.

Result: There was a sizeable reduction in the cost of production in all the treatment groups when compared to control group. It is concluded that feed containing magmeal was found to be cost effective than the feed containing fishmeal for the Japanese quails.

Key words: Japanese quail, Magmeal, Poultry feed.

INTRODUCTION

Magmeal is a core product consisting of dried defatted larvae that is ground into a high protein larvae meal. It has 48.73% protein content (Mohapatra *et al.,* 2020). The high crude lipid acts as protein sparer. It has a dark rich texture. It is a rich source of protein and limiting essential amino acids - arginine and methionine. Magmeal is found to be a rich source for both essential and non-essential amino acids (Mohapatra, 2020) which can be fed to poultry, pig and fish. In Japanese quails, dietary inclusion of magmeal replacing fishmeal at 100 per cent at six week of age enhanced the tryptic and lipase activity. It improved the morphology of small intestine in Japanese quails thereby facilitating improved digestion due to high crude protein in the magmeal. It had a positive impact on hematological parameters by improving the hemoglobin concentration at three weeks and total erythrocyte count at both three week and six week (Mohapatra *et al.,* 2020). It improved the serum albumin and globulin in Japanese quails. It influenced the total cholesterol concentration in Japanese quails. The significantly high increase in triiodothyronine hormone at both three and six weeks and thyroxine at three week due to the inclusion of magmeal improved the growth indices and metabolism with age in the Japanese quails by improving the body weight gain and feed consumption. This may be attributed to the fact that neutral odour and nutty flavour of magmeal contributed to the improving palatability thereby augmenting the nutritional impact for the quails. Magmeal did not negatively affect the feed efficiency and livability in Japanese quails and thus can be cost effective on large scale production (Mohapatra, 2016).

Japanese quail (*Coturnix coturnix japonica*) is a small sized, domesticated and disease resistant species well adapted to intensive poultry system in India. It has a tendency for faster growth rate, early sexual maturity, higher production, high laying prolificacy with shorter generation interval and short incubation period and therefore, is reared for egg and meat production by the poultry farmers of the country. Nutrition is the most important factor required to maintain health, faster growth rate and egg production. Animal protein sources play a major role for proper growth in grower birds. Protein deposition in the body of birds depends to a larger extent on the amino acid supply and therefore, on the quantity, the quality and biological value of dietary animal protein. Energy and protein in poultry diet are considered as conventional indicators for growth and feed efficiency of birds. Consequently, indicators of the carcass quality, especially the abdominal fat, are evaluated by the dietary protein requirements (Niu *et al.*, 2009). Increasing dietary animal protein levels are associated with increased abdominal fat percentage. They are stored as

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adipose tissues which are primarily as abdominal fats and have selective accumulative effects on wing muscles. Therefore, high protein diets result in the accumulation of fat in the carcass (Siregar *et al*., 1982). Protein sources are included in the diet of all organisms for proper growth and development. Fish meal containing about 60 per cent protein, is the good protein source in the poultry diet. However, due to overexploitation and burgeoning human population, fish availability is dwindling and there is a stiff competition for the same between man, animal and bird. This increase in demand has led to increased price of fish meal for poultry feed. In addition, the high feed costs can be attributed to scarcity and high cost of feed ingredients particularly animal protein supplements. The price of fish meal, the most guaranteed animal protein source has become prohibitive (Aneibo *et al*., 2008). Hence it becomes imperative to replace fish meal with other animal protein supplements. Thus, use of insect larvae as a protein source is an attractive possibility and a valuable commercial alternative.

MATERIALS AND METHODS

An extensive study was conducted on Japanese quail birds (*Coturnix coturnix japonica)* to evaluate the effect of magmeal supplementation on intestinal physiology and morphological changes and hematobiochemical changes during the period 2015-16. Economic evaluation of magmeal at various levels of inclusion in Japanese quail diet was also calculated. A total of 240 birds from day old to 6 weeks of age were maintained in equicaloric and equinitrogenous dietary regime at Poultry Research Station, Madhavaram Milk Colony, Chennai. The birds were fed with quail brooder and finisher mash with varying proportion of fishmeal and magmeal prepared at Central Feed Technology Unit, Kattupakkam.

Preparation of magmeal

Maggots were cultured in the Department of Veterinary Parasitology, Madras Veterinary College, Chennai by the floatation method of harvesting of housefly larvae from manure of laying chickens. It involved flooding of the manure with excess water, thus making the larvae float for their easy removal, washing them in clean water three times until there was no remnant of manure, after which they were dewatered (Akpodiete *et al*., 1997). Magmeal was prepared by incubating (60°C for 24 hours in hot air oven) and powdering of the incubated maggots in the Department of Veterinary Physiology, Madras Veterinary College, Chennai (Fig 1 and 2). The proximate analysis of the prepared magmeal was analyzed by Animal Feed Analytical and Quality Assurance Laboratory, Veterinary College and Research Institute, Namakkal, Tamil Nadu (Table 1). The magmeal was incorporated into the quail diet.

The amino acid composition of magmeal was determined by high pressure liquid chromatography in Sri Nathella Sampathu Chetty Clinical Laboratory (Unit of Sankara Nethralaya Medical Research Foundation), Chennai. The amino acid level (nmoles/ml) in magmeal is presented in Table 2a and 2b. The analysis by high pressure liquid chromatography revealed that the highest essential amino acid levels in magmeal were of threonine (55 nmoles/ml) and arginine (49 nmoles/ml) followed by valine (47 nmoles/ml) whereas glycine (80 nmoles/ml), glutamic acid (78 nmoles/ml) and serine (53 nmoles/ml) had the highest non - essential amino acid level in magmeal (Fig 3).

Experimental design

A total of 240 birds maintained at Poultry Research Station, Madhavaram Milk Colony, Chennai were divided into four groups as follows:

Group 1 (Control group)

Japanese quail basal diet (with 7% fish meal).

Group 2

Japanese quail basal diet replacing 50% fish meal with magmeal.

Group 3

Japanese quail basal diet replacing 75% fish meal with magmeal.

Table 1: Proximate analysis of magmeal.

Component	Percentage
Moisture	10.68
Crude protein	48.73
Crude fat	4.28
Ether extract	26.64
Total ash	4.65
Calcium	0.30
Phosphorus	0.63
Nitrogen free extract	5.02
Gross energy	5643 kcal/kg

Table 2a: Essential amino acid level in magmeal.

Essential amino acids	Level (nmoles/ml)
Threonine	55
Arginine	49
Valine	47
Lysine	39
Leucine	35
Phenylalanine	28
Isoleucine	18
Histidine	16
Methionine	5

Table 2b: Non-essential amino acid level in magmeal.

Non-essential amino acids	Level (nmoles/ml)
Glycine	80
Glutamic acid	78
Serine	53
Tyrosine	14
Alanine	4
Aspartic acid	1

Group 4

Japanese quail basal diet replacing 100% fish meal with magmeal were given to 60 birds (20 birds in 3 replicates) in each group and were fed up to 6 weeks.

Feed formulation for Japanese quails

The birds were fed with quail brooder (Table 3) and finisher mash (Table 4) with different combination of fishmeal and magmeal which was prepared at Central Feed Technology Unit, Kattupakkam.

RESULTS AND DISCUSSION

The feed cost of the ingredients and production cost (per kilogram live body weight) of dietary supplementation of magmeal by replacing in the Japanese quail brooder and finisher mash is presented in the Table 5 and 6 respectively.

The cost of quail brooder mash per kilogram for groups G_1, G_2, G_3 and G_4 were Rs. 27.85, Rs. 25.13, Rs. 25.81 and Rs. 25.01. The cost of quail finisher mash per kilogram for groups G_1, G_2, G_3 and G_4 were Rs. 24.38, Rs. 23.32, Rs. 22.58 and Rs. 21.78, respectively. The costs of production per kilogram live weights were Rs. 118.23, Rs. 94.43, Rs. 83.93 and Rs. 77.59, respectively. The data pertaining to economic evaluation of magmeal in terms of feed cost is mainly influenced by the inclusion level of magmeal in the diet. By considering the labour, time and operational expenses involved in the production of magmeal, the cost of magmeal incorporated in the experimental diet was approximately worked out as Rs. 10 per kilogram. The feed production cost (Rs. /kg) gradually reduced as the inclusion level of magmeal increased by replacing the fish meal (Table 6). Accordingly the feed efficiency was improved (significant reduction in the value of feed conversion ratio) when higher level of magmeal was incorporated in groups G_2, G_3 and G_4. In Japanese quail production, feed cost and

Fig 1: A handful of maggots.

Fig 2: Magmeal

Table 3: Quail brooder mash (in kg).

Composition	G_1	G_2	G_3	G_4
Maize	10.000	10.916	9.000	8.840
Maggot meal	0.000	0.700	1.060	1.400
De-oiled rice bran	0.296	0.000	1.475	1.715
Soyabean meal	6.320	6.240	6.100	6.020
Calcite	0.121	0.160	0.220	0.260
Dicalcium phosphate	0.200	0.200	0.200	0.200
Oil	1.159	0.580	1.080	1.020
Mineral mixture poultry	0.400	0.400	0.400	0.400
Dry fish	1.400	0.700	0.360	0.000
Salt	0.030	0.030	0.030	0.030
AB_2D_3K	0.002	0.002	0.002	0.002
Ultracil TCF	0.010	0.010	0.010	0.010
Cosmodot	0.010	0.010	0.010	0.010
Vetroliv	0.010	0.010	0.010	0.010
d-l-Methionine	0.009	0.009	0.010	0.010
Ultra B_{12}	0.002	0.002	0.002	0.002
Perivac plus	0.004	0.004	0.004	0.004
Choline	0.020	0.020	0.020	0.020
Spectra DFM	0.002	0.002	0.002	0.002
Larvanil	0.005	0.005	0.005	0.005
Total	20.000	20.000	20.000	20.000

Table 4: Quail finisher mash (in kg).

Composition	G_1	G_2	G_3	G_4
Maize	15.000	14.880	14.580	14.100
Maggot meal	0.000	1.050	1.590	2.100
De-oiled rice bran	1.128	0.948	1.248	1.788
Soyabean meal	9.480	9.780	9.690	9.570
Sun flower de-oiled cake	1.500	1.500	1.500	1.500
Dicalcium phosphate	0.300	0.300	0.300	0.300
Calcite	0.150	0.150	0.210	0.300
Mineral mixture poultry	0.150	0.150	0.150	0.150
Dry fish	2.100	1.050	0.540	0.000
Salt	0.045	0.045	0.045	0.045
AB_2D_3K	0.003	0.003	0.003	0.003
Ultravit M	0.075	0.075	0.075	0.075
Ultracil TCF	0.030	0.030	0.030	0.030
Cosmodot	0.015	0.015	0.015	0.015
Vetroliv	0.009	0.009	0.009	0.009
d-l-Methionine	0.015	0.015	0.015	0.015
Total	30.000	30.000	30.000	30.000

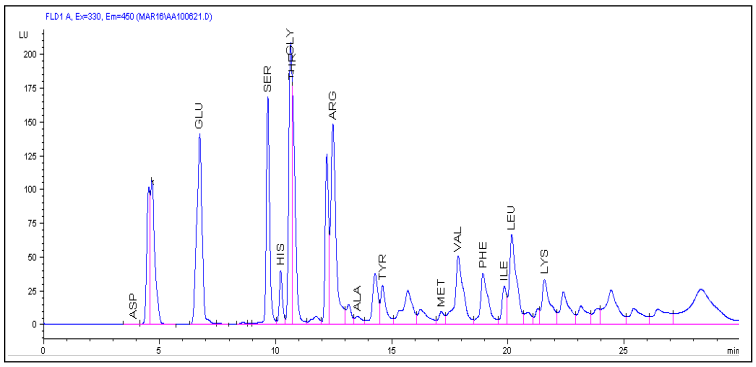

Fig 3: Amino acid composition of magmeal.

Table 5: Raw material cost of the feed ingredients utilized for the preparation of the Japanese quail brooder mash and finisher mash.

Composition	Cost of the ingredients (Rs/kg)
Maize	14.6
Maggot meal	10
De-oiled rice bran	13
Soyabean meal	37
Sunflower Deoiled cake	21
Calcite	7.5
Dicalcium phosphate	36
Oil	72
Mineral mixture poultry	35
Dry fish	38
Salt	6
AB_2D_3K	800
Ultracil TCF	22
Ultravit M	71
Cosmodot	218
Vetroliv	120
d-l-Methionine	360
Ultra B_{12}	43
Perivac plus	546
Choline	80
Spectra DFM	600
Larvanil	181

Table 6: Economic evaluation of maggot meal at various levels of inclusion in Japanese quail diet for Indian rural market.

Group	Cost of feed per kilogram (Rs./kg) Brooder mash	Finisher mash	Production cost (Rs/kg live weight)
G_1	27.85	24.38	118.23
G_2	25.13	23.32	94.43
G_3	25.81	22.58	83.93
G_4	25.01	21.78	77.59

Cost of medicine = Re 1/kg live body weight.

Chick cost = Rs 6 per number of chicks.

feed efficiency are the most contributing factors in the determination of production cost. This was visualized from the data worked out for production cost. The production cost was worked out as the cost to produce one kilogram of live Japanese quail at six week by incorporating various cost components such as the cost of day-old Japanese quail chick (Rs. 6 per chick), cost of the feed and cost of medicine (Re 1 per kilogram live weight produced). As there was an improvement in the production performance parameters such as live body weight, feed efficiency, it brought down the cost and production from Rs. 118.23 in G_1 to Rs. 77.59 in G_4 (while replacing fish meal with magmeal from 0 per cent to 100 per cent). There was a huge reduction in the cost of production in groups G_2, G_3 and G_4 when compared to control group G_1 (Table 6). This improvement in performance parameters might be due to the unidentified growth factors present in magmeal and more bioavailability of nutrients present in magmeal. Thus, feed containing magmeal was found to be cheaper than the feed containing fishmeal for the Japanese quails. Thus it can be adopted by the farmers as it was found to be cost effective.

CONCLUSION

Magmeal aptly evolves an economic animal protein source for replacement of fish meal to quail ration. Thus, it emerges as a definite and great option when compared to the traditional meat meal which is fed to the Japanese quails and other poultry species. Therefore, culture of abattoir waste and fly larvae create sustainable animal feed in form of magmeal. It also combats the menace of high fly population which encourages a sustainable and cleaner environment. It is a nutritive animal feed. Fish meal, however, is a finite resource which cannot be produced in sufficient quantities but its rising cost is another cause of concern for the farmers and breeders. Research into alternatives to fish meal is now an international research priority and is the focus of current poultry nutrition research. This latest approach of the use of magmeal as an alternative source of animal protein in the diet of Japanese quails in the rural markets of India demonstrated that magmeal can establish itself to the physiological adaptability of quails and other poultry birds

keeping in view of the United Nation's 3R policy- Reduce, Recycle and Reuse. Hence it is very crucial to incorporate magmeal as an alternative to reduce the feeding cost and to make its culture a viable and attractive venture. The inclusion of magmeal can possibly lead to increase in poultry production and consequent economic affordability to the much-needed animal protein. Thus, a commercial and sustainable magmeal production is a befitting solution to the existing protein meat need. Magmeal can not only help in solid waste management strategy but also can act as another feed source *via* conversion of abattoir and other plant wastes for birds.

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