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EGGSHELL WASTE IS A CALCIUM SOURCE FOR LAYERS: REVIEW

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Abstract: The objective of this review paper is to evaluate the eggshell meal is a calcium source in layer diets. The increase in the price of feed ingredients has led to rise in feed cost which hinders further growth of feed industry. In layer production, feed calcium sources are also in the list of increasing feed cost. Now, eggshell meal is sold at relatively cheaper cost than shell grit and limestone. Body weight gain, egg production, egg weight, breaking strength, shell percentage and shell thickness did not differ significantly between different study treatment groups supplemented with eggshell, shell grit and oyster shell, respectively.
Keywords: Eggshell, Layer, Body weight, Egg production, Egg quality.

INTRODUCTION

Poultry is one of the fastest growing segments of the agricultural sector in India, with a poultry population of 489 million, producing 47 billion eggs per year ranks third highest among egg producing countries in world (Anon., 2009). Such a fast growth rate in poultry production leads to increase in demand and price for inputs like feed and feed ingredients. In layer production, feed calcium sources are also in the list of increasing feed cost. There are two major calcium sources commonly used, *viz*. limestone and oyster shell grit. Limestone often has the problem of high level of magnesium or sand and silica. Oyster shell grit is not available during fishing holiday period of the year. Hence, finding an alternative calcium source at relatively cheaper cost is need of the day.

There are three egg processing plants available in India, at present (Gole *et al*., 2008). In Tamil Nadu, M/s. SKM Egg products Export India Limited, Erode is manufacturing egg powder with the plant capacity of breaking 1.2 million eggs per day and has an output capacity of producing 5.5 tonnes eggshell meal per day, which is sold at relatively cheaper cost than shell grit and limestone.

Eggshell meal is a mixture of eggshell, shell membranes and a minor amount of egg counts obtained by drying the residue from the egg processing plant. Eggshell meal from the processing plant may have microbial contamination (Vandepopuliere *et al*., 1978). Hence, it

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needs to be processed either to reduce microbial load or to sterilize the product. Eggshell meal contains 37.3 per cent calcium, 0.12 per cent phosphorus, 0.41 per cent magnesium and 5.2 per cent of crude protein (Walton *et al*., 1973). Calcium and eggshell meal is readily utilized by birds and availability is equal to ground limestone (Vandepopuliere *et al*., 1975).

Substitution of eggshell meal for ground limestone and oyster shell gave comparable egg production (Arvat and Hinners, 1973) and was economically feasible (Vandepopuliere *et al*., 1978). Hence, the objective of the review article is to summarise the effect of eggshell meal as a calcium source in layer diets.

PRODUCTION PERFORMANCE

Body weight gain

The performance of layers when adding two types of eggshell meal in laying hen rations in comparison with ground limestone on full and restricted feeding programmes. The body weight gain was significantly ($P<0.01$) higher in layers when fed diet containing eggshell meal dried in tube type flash dryer than those fed diet containing eggshell meal dried in triple pass rotary dehydrator and ground limestone in full feeding programme but no significant difference between treatments on restricted feeding programme (Vandepopuliere *et al*., 1975). Muir *et al*. (1976) compared five different calcium sources in 3 per cent level (limestone, aragonite, oyster shell, clam shell and eggshell) in layer diet from 33 to 72 weeks of age and found that there was no significant difference on mean body weight among the treatments.

Eggshell meal was fed to laying hens as a dietary calcium source at the levels of 0 per cent, 1.75 per cent, 3.5 per cent, and 7 per cent of feed in place of ground limestone where there was no significant difference in the average final body weight between the treatments (Sim *et al*., 1983). There was no significant difference in body weight when different calcium sources such as seashell, limestone and oyster shell were fed to laying hens (Guinotte and Nys, 1991).

Scheideler (1998) compared eggshell meal from two egg breaker plants to various sources (limestone and oyster shell) and reported that there was no significant difference in body weight between any of the treatments. When fine limestone (LF), coarse limestone (LC) and oyster shell (OS) were fed in different combinations (T_1-100 per cent LF, T_2-60 per cent LF and 40 per cent LC and T_3-60 per cent LF and 40 per cent OS) as calcium source to laying hens, there was no significant difference in body weight gain between the treatments (Safaa *et al*., 2008).

Egg production

Eggshell meal, ground limestone and oyster shell were compared in a layer feeding trial at 3.7 per cent and 5.7 per cent calcium levels and there was no significant difference in hen day egg production between the different calcium sources (Arvat and Hinners, 1973). Vandepopuliere *et al*. (1973) incorporated eggshell meal in layer diet and reported that eggshell meal fed group had a hen day egg production of 55 per cent, which was comparable to 53.2 per cent in ground limestone fed group. Two types of eggshell meal (Type A dried in triple pass rotary dehydrator and type B dried in tube flash dryer) were evaluated in laying hen rations in comparison with ground limestone on full and restricted feeding programmes. There was a significantly ($P < 0.01$) higher egg production in groups fed with eggshell meal type A than groups fed with eggshell meal type B and ground limestone on full feeding programme and restricted feeding programme (Vandepopuliere *et al*., 1975).

Muir *et al*. (1976) compared limestone, aragonite, oyster shell, clam shell and eggshell in layer diet from 33 to 72 weeks of age and found that there was no significant difference between the treatments on hen housed egg production but the eggshell supplemented group had significantly ($P < 0.05$) lower hen day egg production than other treatments. Sim *et al*. (1983) replaced different levels of eggshell meal (0 per cent, 1.75 per cent, 3.5 per cent and 7.0 per cent) to limestone in early and late stage of egg production in hens and found no significant difference in early stage but in late stage there was a significant ($P<0.01$) increase in hen day egg production as level of eggshell meal increased in the diet. When different sources of calcium such as seashell, limestone and oyster shell were fed to laying hens there was no significant difference in hen day egg production between calcium sources (Guinotte and Nys, 1991).

Scheideler (1998) studied two sources of eggshell meal (I and II) from two egg breaker plants to limestone and oyster shell in first and third laying cycle. He reported that there was no significant difference between the treatments for egg production in the first laying cycle hens but egg production was decreased significantly ($P<0.05$) in eggshell meal II fed group than other two groups in third laying cycle. Ali (2003) reported that when layers were fed isocaloric and isonitrogenus diet having equal calcium and available phosphorus, the egg production performance was lowest in group fed 1.8 per cent dicalcium phosphate and 9.5 per cent eggshell meal and they produced more number of thinner eggs than those fed with bone meal, limestone and dicalcium phosphate at different levels. Fine limestone, coarse

limestone and oyster shell in different combinations were no significant difference in egg production between the treatments (Safaa *et al*., 2008).

EGG QUALITY CHARACTERISTICS

Egg weight

Eggshell meal and ground limestone as sources of calcium and had comparable egg weights of 65.7 g and 64.8 g, respectively (Vandepopuliere *et al*., 1973). When eggshell meal was compared with ground limestone on full and restricted feeding programmes, layers fed with eggshell meal had significantly ($P<0.01$) lower egg weight than ground limestone fed layers on limited feeding programme (Vandepopuliere *et al*., 1975).

Five different calcium sources (limestone, aragonite, oyster shell, clam shell and eggshell) in layer diet from 33 to 72 weeks of age and there was no significant difference in mean egg weight over the entire trial period among the treatments (Muir *et al*., 1976). The utilization of granular eggshell meal as a dietary calcium source for laying hens and there was no significant difference in egg weight of aged hens with different calcium sources (Sim *et al*., 1983). When different sources of calcium such as seashell, limestone and oyster shell were fed to laying hens there was no significant difference in egg weight between calcium sources (Guinotte and Nys, 1991).

Scheideler (1998) compared dried eggshell products from two egg breaker plants to limestone and oyster shell and reported that there was no significant difference in egg weight between treatments. Ali (2003) fed eggshell meal, bone meal, dicalcium phosphate and limestone as calcium source in four different combinations and found that there was no significant difference between the treatment groups in egg weight. A non significant difference in egg weight between the treatments fed with combinations of fine limestone, coarse limestone and oyster shell (Safaa *et al*., 2008).

Breaking strength

Eggshell meal was compared as pulverized eggshell and crushed eggshell meal against oyster shell, pulverized limestone and limestone grit in a layer feeding trial and reported that the breaking strength of eggs from oyster shell, pulverized eggshell and limestone grit fed groups were significantly ($P<0.01$) stronger than other treatment groups (Meyer *et al*., 1973).

Vandepopuliere *et al*. (1973) incorporated eggshell meal in layer diet and found that eggshell meal fed group had a breaking strength of 2.936 kg, which is comparable to ground

limestone fed group, which had a breaking strength of 2.923 kg. When eggshell meal was compared with ground limestone on full and restricted feeding programmes, there was no significant difference in breaking strength between the treatments (Vandepopuliere *et al*., 1975). Froning and Bergquist (1990) studied an extruded eggshell product in comparison with limestone and found no significant difference in breaking strength between the treatments. Guinotte and Nys (1991) investigated different sources of calcium such as seashell, limestone and oyster shell in laying hens and found that there was no significant difference in breaking strength between calcium sources.

Shell percentage

The utilization of granular eggshell meal as a dietary calcium source for laying hens to ground limestone and no significant difference in shell weight between the treatments in early and late stages of production (Sim *et al*., 1983). When different sources of calcium such as seashell, limestone and oyster shell were fed to laying hens, there was no significant difference in shell weight between calcium sources (Guinotte and Nys, 1991).

Scheideler (1998) compared eggshell meal to limestone and oyster shell and reported a non significant difference in wet shell percentage between treatments. Lichovnikova (2007) reported that when four different sources of calcium (eggshell, fine limestone, large limestone and oyster shell) were fed to laying hens in various combinations for 2 weeks between 56 and 57 weeks of age, the shell weight ratio of eggshell:limestone (68:32) group was significantly ($P<0.001$) lower from other treatment groups.

When combinations of fine limestone, coarse limestone and oyster shell were fed to laying hens, there was no significant difference in shell weight percentage between the treatments (Safaa *et al*., 2008).

Shell thickness

Arvat and Hinners (1973) fed eggshell meal, ground limestone and oyster shell to layers and found that there was no significant difference in shell thickness between the calcium sources. When eggshell meal was compared with ground limestone on full and restricted feeding programmes, there was no significant difference in shell thickness between treatments on full and restricted feeding programmes (Vandepopuliere *et al*., 1975).

Muir *et al*. (1976) compared limestone, aragonite, oyster shell, clam shell and eggshell in layer diet from 33 to 72 weeks of age and found that there was no significant difference in egg shell thickness among the treatments within each sampling age. Lichovnikova (2007) fed eggshell, fine limestone, large limestone and oyster shell in various combinations to laying

hens for 2 weeks between 56 and 57 weeks of age and found significantly (P<0.01) lower shell thickness in eggshell:limestone (68:32) fed group than other treatment groups. A non significant difference in eggshell thickness between the groups fed with combinations of fine limestone, coarse limestone and oyster shell (Safaa *et al*., 2008).

CONCLUSION

Fast growth rate in poultry production leads to increase in demand and price for inputs like feed and feed ingredients. The increase in the price of feed ingredients has led to rise in feed cost which hinders further growth of feed industry. In layer production, feed calcium sources are also in the list of increasing feed cost. Now, eggshell meal is sold at relatively cheaper cost than shell grit and limestone. Accordingly the information available on eggshell waste as source of calcium for layers has to be extensively reviewed. Body weight gain, egg production, egg weight, breaking strength, shell percentage and shell thickness did not differ significantly between different study treatments.

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