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Review Paper

CHEMICAL CHARACTERIZATION OF EGG SHELL MEAL

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Introduction

The objective of this review paper is to evaluate the eggshell meal is a calcium source in layer diets. Studies on the evaluation of alternative sources of feed have been more concerned with energy and protein stuffs. Not much has been made on local alternative sources for the major mineral nutrients like calcium and phosphorus. The main sources of calcium are oyster shells, bone meal, limestone and di-calcium phosphate. It is essential in the formation of shells in eggs and also helps to regulate the passage of nutrients in and out of the cells. Dicalcium phosphate have been found to be major sources of calcium for livestock all over the world but are extremely costly following importation. Organic sources of calcium and phosphorus which are inexpensive and readily available except for the over dependence by the livestock industry include oyster shells and bone meal. Eggshell is highly rich in calcium (90%) with little percentage (less than 5%) of phosphorus; it is possible that optimum dietary level of calcium and phosphorus can be met using eggshell meal as a source. The aim of this article is therefore, to review the chemical composition of eggshell meal.

Calcium

The inorganic salts of hen's eggshell contained 98.43 per cent calcium carbonate (Romanoff and Romanoff, 1949). The calcium content of eggshell meal was 35.2 per cent (Walton and Cotterill, 1972). Walton et al., (1973) collected three different kinds of eggshell waste from egg breaking plants *viz*. eggshell waste as such, eggshell waste centrifuged and eggshell waste washed and analysed for their calcium content. The percentage calcium content of the eggshell waste as such, centrifuged sample and washed sample were 36.4, 36.7 and 37.3, respectively which showed minor variations.

The calcium content of eggshell meal dried in triple pass rotary dehydrator was 33.5 per cent and that dried in tube type flash dryer was 34.8 per cent (Vandepopuliere *et al*., 1975). However, Muir *et al*. (1976) reported that the calcium content of the eggshell was 34.8 per cent. The egg breaking plant shell waste dried in a triple pass rotary dehydrator and reported that the calcium content of eggshell waste was 36.3 per cent (Vandepopuliere *et al*., 1978).

The inorganic salts of hen's eggshell contained 97.25 per cent calcium carbonate (Majeed *et. al*., 1982). Sim *et al*. (1983) studied chemical composition of granular eggshell meal and found that the granular eggshell meal contained 36 per cent calcium. Chicken eggshell

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powder was assessed for its nutritive value in human nutrition, which contained 401±7.2 mg calcium per gram (Schaafsma *et al*., 2000).

Phosphorus

Hen's eggshell contained 0.73 per cent of tricalcium phosphate as inorganic salts (Romanoff and Romanoff, 1949). However, Walton and Cotterill (1972) reported that the phosphorus content of eggshell meal was 0.12 per cent. Walton *et al*. (1973) studied the phosphorus content of eggshell waste as such, centrifuged eggshell waste and washed eggshell waste and reported that they were 0.116 per cent, 0.104 per cent and 0.117 per cent, of phosphorus respectively. Similarly, Vandepopuliere *et al*. (1978) stated that the phosphorus content of eggshell meal was 0.11 per cent. But Majeed *et al*., (1982) reported 0.613 per cent of tricalcium phosphate in hen's eggshell.

Magnesium

The magnesium content in eggshell meal was 0.37 per cent (Walton and Cotterill, 1972). Walton *et al*. (1973) studied three different sources of eggshell waste that had magnesium content of 0.398 per cent for eggshell waste as such, 0.4 per cent for centrifuged eggshell waste and 0.407 per cent for washed eggshell waste. The inorganic salts of hen's eggshell contained 0.713 per cent of magnesium carbonate (Majeed *et al*., 1982).

Crude protein

The crude protein content of the eggshell meal was 8.1 per cent (Walton and Cotterill, 1972). The crude protein content of eggshell waste as such, centrifuged eggshell waste and washed eggshell waste were 7.56 per cent, 5.31 per cent and 5.15 per cent, respectively (Walton *et al*., 1973). The crude protein content of eggshell meal produced in triple pass rotary dehydrator was 7.5 per cent and in tube type flash dryer was 5.44 per cent. Muir *et al*. (1976) reported that the crude protein content of eggshell meal was 7.56 per cent. The crude protein content of eggshell meal dried in triple rotary dehydrator was 6.46 per cent (Vandepopuliere *et al*., 1978). Sim *et al*. (1983) studied the utilization of granular eggshell meal as a dietary calcium source for laying hens, which had 5.5 per cent crude protein.

In vitro calcium solubility

A solubility test with particulate seashell, limestone and oyster shell by dissolving them in 0.1 N HCl and found after 5 minutes were 34±12 per cent, 44±16 per cent and 47±16 per cent solubilized, respectively (Guinotte and Nys, 1991). Keshavarz and Scott (1993) fed two calcium source (pulverized limestone and pulverized oyster shell) of similar particle size with different *in vitro* solubility (47.0 per cent and 77.8 per cent, respectively) and found that

in vitro solubility differences of the calcium sources was significant ($P < 0.05$) but it had no effect on shell quality and bone mineralization.

Lichovnikova (2007) reported that the *in vitro* solubility of eggshell was 14 per cent which was found to be lower as compared to fine limestone (85 per cent), large limestone (49.5 per cent) or oyster shell (44 per cent). Safaa *et al*., (2008) studied the *in vitro* solubility of fine limestone, coarse limestone and oyster shell by dissolving 2.0 gram sample in 200 ml of 0.2N HCl for 15 minutes and found that they were 57.47 per cent, 33.48 per cent and 50.65 per cent, respectively.

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