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Review Article

Benefit of Egg Shell as Calcium Source in Egg Production and Bone Development

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Abstract

The external covering of egg is called eggshell. Chicken eggshell is composed of calcified egg shell as well as shell membrane. Its total weight is 10-11 % as compared to whole egg weight. Eggshell is an important structure for two reasons. Firstly, it act as an embryonic chamber during development of chick, secondly it act as a container and provide protection to the contents of egg and a unique container for the market egg. Despite its remarkable properties it is very often discarded from homes, restaurants, farms and factories. This review article aims to summarize the recent reports utilizing eggshell as calcium source in chicks, stressing the need to use a egg shell as a calcium source instead to use other sources. Hen eggshell is chemically composed of 65.6 % water, 11.8 % proteins, 11% fat and 11.7 % Ash. The shell consists of 97% calcium carbonate, and this is provided to the hen in the diet. However, the chemical must be broken down in the digestive system and then re-synthesized in the shell gland to form the shell. The shell of egg is the best sources of calcium then other sources like limestone. Calcium has an important role in formation of hard eggshell in hens. The calcium played a role in eggs quality as well as bone mineralization. Deficiency of calcium leads to minimize bone strength, egg weight and egg production.

Keywords: Eggshell; laying hens; calcium; bone development; egg production; eggshell quality & eggshell thickness.

INTRODUCTION

Feed is the most key constituent of cost production in poultry farms.Therefore, investigators are continuously focusing for methods to reduce feed cost period improving poultry production [1]. Most key sources of protein as well as income are poultry [2]. Eggs are calculated as perfect protein [3]. The shell of egg is waste product from homes, restaurants, farms and factories [4]. Extenuation of food left-over is a step toward achieving global environmental goals [5]. The waste disposal shell of egg take part in environmental pollution [6]. So, reuse of eggshell as supplement in concrete is superior solution to decrease environmental problem [7].

The shell of egg is the best sources of calcium other then sources like limestone [8]. The shell supply actual shape to egg as well as also conserved useful nutrients inside egg. Chicken eggshell is composed of calcified egg shell as well as shell membrane. Its total weight is 10-11 % as compared to whole egg weight. Shell membrane is composed of inner as well as outer membranes.Inner membrane become uncalcified and outer membrane set off mineralized [9]. Both shell membranes have almost thickness 100 micrometer. These membranes help to prevent insight of bacteria. Eggshell membrane is a fibrous structure. It is very essential for development of eggshell. Eggshell membranes are composed of 10 percent collagens which are most important proteins and provide support to bones, teeth and other body tissues [10]. Eggshell contains organic matter that includes proteins, lipids and carbohydrates [11]. Eggshell is also consist of uronic acid, nitrogen, sialic acid and amino acids. True shell contain that palisade layer, cuticle and mammillary layer [12]. Eggshell cuticle is wrapping outside of eggshell. Its inner side is calcified and outer side is non-calcified [13]. Cuticle eggshell is stop dehydration of internal egg components [14].

Egg shell contained protein expected membranes suppress in egg shell. Hen eggshell is chemically composed of 65.6 % water, 11.8 % proteins, 11% fat and 11.7 % Ash. Eggshell powder is chemically composed of 21.2 % C, 0.93 % MgO, 76.9

% CaO, 0.42 % P2O5, 0.02 % Fe2O3 and 0.11 % Na2O. The shell of egg is composed of almost 98.2 percent calcium carbonate (380 mg Ca per gram). So, it is possible egg shell meal in hen's diet provide the best calcium. 0.3 % phosphorus is also present in egg shell at low level but it is very useful for replenishing hen's bone. It is very important to keep away from hypophosphatemia. 0.2 % magnesium is also present in hen eggshell which have effect on preserve eggshell quality. Shell calcium fulfilled is 28.2 to 41.2 % as well as phosphorus fulfilled is 0.102 % [15]. Calcium has an important role in formation of hard eggshell in hens. Calcium has chief role in control muscle spasms in hens. Calcium is a big ingredient of bone where calcium presence almost 99 percent. Calcium is helpful for interior egg quality [16].

Table 1: Nutritional composition of chicken egg shell [42]

Nutritional composition of chicken egg shell	
Nutrition	**% weight**
Water	29-35
CaCO3	90,9
Calcium	35,1-36,4
Phosphorus/ Vitamin D	0,12/41
Magnesium/ Vitamin A	0,37-0,40/270
Protein	1,4-4
Fat/ Vitamin E	0,1-0,2/0.5
Ash/ Proline	89,9-91,1/ 0,54-0,62
Potassium	0,10-0,13
Sulphur	0,9-0,19
Cholesterol	185

Quality of an eggshell is chief factor for production of egg because egg breakage gives rise to economic losses. Shell quality includes that shape, soundness and color of shell. It is also very important for food safety of egg. Quality of egg shell is determined by age, genotype and housing system as well as also by stability feeding with adequate phosphorus, calcium and trace minerals [12]. Laying hens required high concentration of calcium sources for the eggshell quality and bone health [17]. In the digestive system calcium has played an important role in the formation of eggshell quality [18]. The breaking strength of egg shell revealed to be for better indicator for its quality. Lowering of eggshell % due to reduction in eggshell thickness [19]. Calcium absorption rate is associated to require for calcium shell accumulation. Eggshell strength becomes increased due to eggshell thickness [20]. Koreleski and Swiatkiewicz (2004) indicated that thickness of eggshell was increased by feeding 60-80 percent large limestone. Eggshell required calcium for maintaining of good shell quality and almost 50-60 percent calcium makes egg strong. By adding more digestible calcium improved the eggshell quality. By adding extra vitamin D provide further improvement in eggshell quality [21].

Proper nutrition is key element for maintaining of hen health. The milled eggshell is used in stabilizing materials like soil improving [4]. Calcium as well as phosphorus are vital mineral nutrients. They were much important for eggshell and bone formation [22]. Hens feed by dietary calcium produced eggs such had alike egg quality. Calcium sources such as egg shell, limestone, gypsum and oyster shell are compulsory for egg quality and bone formation [23]. Limestone and oyster shell also provide 38 % calcium in the form of calcium carbonate [24]. Different calcium sources had notable effect on egg weight and egg production. Use of eggshell as well as oyster shell in poultry as calcium source give the same egg production [25]. Use of eggshell waste designate that have economic advantage above other calcium source [45]. Egg shell is richer in calcium as compared to others like bone meal [1].

The calcium which has particle size played a role in eggs quality as well as bone mineralization [18]. When hens are not feeding consume then large particle size was beneficial [26]. In 1998 Scheideler indicated that particle proportions of eggshells was participated to consumption of calcium along hens. In laying hen'seggshell calcium source is highly accessible to hold up egg productionbut large fragment calcium rising to keep up egg shell quality [27]. If the calcium have large particle then they were stay in gizzard for a longer time and solubility of calcium become increased [28]. Although, literature suggesting better performance in hens with eggshell of various particle size [27]. Saunders-Blades et al suggested that decreased bone reabsorption and have useful effect on production quality as well as bird health by feeding large particle [29]. Recently, in 2007 Lichovnikova suggested that diet mixture accommodate two-thirds big sizedfragments of calcium source used to enhance eggshell quality mainly in old hens. Disinfected egg shell is a acceptable calcium source for handed down in deposit diet. The material which is used in diet was a granular size. Granular nature gave best results as compared to other particle size. Mashed egg shells have not good results while granular egg shells. The existence of piece of calcium in diet was great chief for hens in the course of high production else low production [30].

Uses of eggshells for the development of hens	
Used for what purpose	**Scientists**
Used of eggshell with magnesium and vitamin D3 have positive effect on bone mineral density	Schaafsma *et al.*, (2002) [44]
Used of bird shell to get balanced mineral in diet	King'ori.(2011)
Used of ground eggshell to know gonadal performance (ovarian traits and ovarian follicles)	N. Gongruttananun. (2011)
Used of egg shell and oyster shell to know egg shell strength	R. Meyer *et al*., (1973)
Used of dried eggshell to know egg quality & Ca digestibility	Schiedeler, S. E. (1998)
Used of eggshell and oyster shell to know egg production	Olgun *et al*., (2015) [43]
Used of ground eggshell to know hatching performance	N. Gongruttananun. (2011)
Used of eggshell and bone meal to know haematology of layers (RBCs, Hb and WBCs)	Uchele *et al*., (2020)

For balancing excessive rate of egg manufacturing hens required calcium [31]. Calcium deficiency can conduct to untypical skeletal development. It may lead to rickets in flourished chick. Deficiency of calcium leads to minimize bone strength, egg weight and egg production [32]. To reduce the risk of pathogen infections, the shell of egg must be dried at high temperature [33]. In 1945 Gutteridge and Pratt were conducted previous study related to use of eggshell as Ca source for hens. They found almost 2.22 percent shell of egg was essential in diet. Egg shell meal was obtainable in abundant. Egg shell diet were almost cheaper other then sources. When the egg formation is not occurred then only 40 percent calcium is absorbed from dietary source [34]. Hens have not potential to absorb adequately bone calcium to keep high calcium level in blood. But during the deposition of egg shell hens absorbed dietary calcium at faster rate and maintained the higher calcium level in blood [35]. In hen's solvability of calcium are also effects the ability to make use of it, bone quality and eggshell [29].

Egg shell membrane is frequently utilized as a generating agent in synthesis of nano particles [5]. Squeeze out eggshell plus membranes which used in layer diets as calcium sources without unfavourable effects on egg making [36]. In 2008 Lichovníková and Zeman suggested that utilization of calcium rate in eggshell was elevated in cage system contrast with floor system [37]. In hens diet eggshell meal gave best results as well as did not any unfavourable effects on limitation studies [38]. Results from currently study confirm dried egg shells used calcium source in diets without deleterious effects on egg production and egg weight. In 2007 Lichovnikova describe that different amount of egg shell had notably expand egg weight. In other words Lichovnikova indicated that hens not undergo effect on feed eating when give the different amount of egg shell like calcium source. Even though crushed eggshell was easily digested, but it was insufficient to increase eggshell quality. All performance framework were not seriously affected [30]. The treatment of dietary calcium did not effect on egg quality excluding egg weight [39]. The shell of egg has helpful effect on weight of eggshell despite the fact that eggshell thickness was not notably affected. Some researchers indicated that extruded eggshell have no deleterious effects on feed conversion, egg weight and egg production [33]. The results help earlier reports of further inquirer (Froning and Bergquist, 1990; Scheideler, 1998), during eggshells feeding to hens as calcium source have not detrimental effects on feed consumption, bone weight and egg production [40]. No effect of nutritive treatment was establish for egg weight, egg production, egg shell weight, bone weight and bone strength [41].

CONCLUSION

This review article aims to summarize the recent reports utilizing eggshell as calcium source in chicks, stressing the need to use a egg shell as a calcium source instead to use other sources. The shell of egg is the best sources of calcium then other sources like limestone. The shell of egg has helpful effect on weight of eggshell despite the fact that eggshell thickness was not notably affected. No effect of nutritive treatment was establish for egg weight, egg production, egg shell weight, bone weight and bone strength.

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