

Comparative Study of Calcium Carbonate Content in Different Chicken Eggshell

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ABSTRACT

An eggshell is the hard, outer covering of an egg. It consist mostly of calcium carbonate, a common form of calcium .The rest is made up of protein and other mineral. The composition off eggshell is approximately 98.2% CaCO_3 , 0.9% magnesium & 0.9% phosphate. In past decades, eggshell powder processed from hen eggs has been used as a natural calcium supplement .In this experiment, the comparative analysis of calcium carbonate content was carried out for selected eggshell of different kind of hen namely Naked chicken, Welsummer, Leghorn, hybrid chicken, Buckeye by using EDTA method. When calcium carbonate is treated with hydroxylamine hydrochloride and potassium thiocyanate solution, metal reduced to their lower oxidation state and form stable cyanide complexes, as KSCN act as masking agent ;other element present in traces do not interfere .Patton- reader's indicator helps to titrate calcium ion directly with pH values between 12 and 14. The results shows that highest calcium content is determined in eggshell of Hybrid chicken. Thus this study was designated to evaluated calcium carbonate content in diff kind of hen eggshell.

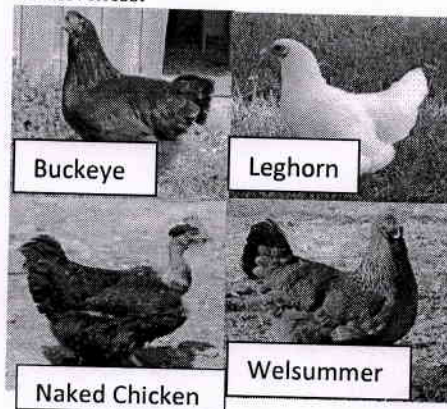
Keywords-EDTA, Eggshell, KOH, Patton – reedor's indicator.

1. Introduction

Eggshell is non-edible by-product with little saleable value but they may contain biologically active compounds (Nakano *et al.*, 2003) [6]. Calcium is the major component in an eggshell. .In this experiment, the comparative analysis of calcium carbonate content was carried out for selected eggshell of different kind of hen namely Naked chicken, Welsummer, Leghorn, hybrid chicken, Buckeyeg by using EDTA method. When calcium carbonate is treated with hydroxylamine hydrochloride and potassium thiocyanate solution, metal reduced their lower oxidation state and form stable cyanide complexes, as KSCN act as masking agent :other element present in traces do not interfere.Patton Reeder indicator helps to titrate calcium ion directly with pH values between 12 and 14 (S.Y.BSc. Handbook Himalaya pub) [1].

Eggshell calcium is the best natural source of calcium and it is about 90% absorbable, than limestone or coral sources. The whole medium eggshell makes about one teaspoon of powder. Birds lay hard-shelled eggs, most birds' eggs are incubated in nests and are often highly conspicuous, so their color serves as camouflage. However, the shells are porous enough to allow oxygen to enter the egg and carbon dioxide to leave. The shell and the albumen (egg white) protect and cushion the developing embryo. The albumen is

also a source of protein and water for the embryo (Adeyeye, 2009) [9]. Calcium is a vital component of a healthy diet and a mineral necessary for life, particularly in cell physiology where movement of the calcium ion in and out of the cytoplasm functions as a signal for many cellular processes. The amount of calcium in the body depends on the amount of calcium you get in your food. Eggshells are waste materials from hatcheries, homes and fast food industries and can be readily collected in plenty (Bain, 1997; Nys, 2004,) [9, 11]. Eggshell waste disposal contributes to environmental pollution. Challenges associated with disposal of eggshells include cost, availability of disposal sites, odour, flies and abrasiveness.





2. Materials and methods

2.1. Eggshell Sample

Eggs of local and hybrid hen were bought from the market and their shells were collected. These collected samples were compared and identified by using resources and based on the morphology of the egg.

2.2. Determination of CaCO₃ in an egg shell

The major component of eggshell is Calcium Carbonate (CaCO₃). This analysis will be done volumetrically by using a characteristic reaction of carbonate compounds, namely their reaction with acids. Calcium Carbonate (limestone) is very insoluble in pure water but will readily dissolve in acid.

2.3. Procedure-

Clean the collected eggshells with water and dry them in an oven. Use a mortar and pestle to grind the eggshells into a powder. Add 5 cm³ of conc. HCl to a 250 cm³ beaker containing accurately weighed 0.4 g sample powder. Partially cover it with a watch glass and heat on a sand bath to evaporate it nearly to dryness. Repeat acid treatment once again and cool the residue. Extract it with about 25-30cm³ of distilled water and boil for 10 minutes. Filter the solution through a Whatmann filter paper No.41 and collect the filtrate in a 250 cm³ standard measuring flask. Wash the residue 3-4 times with distilled water and collect all the washing in the same measuring flask. Dilute the solution collected to 250 cm³ with distilled water. This is stock solution. Pipette out 25 cm³ of the stock solution in a conical flask. Add 2 test tube of distilled water to it, add 10 cm³ of 8MKOH solution to it. Shake vigorously, then add 3 cm³ of 1%KSCN solution and 3 cm³ 1% hydroxylamine solution to it. Allow it stand for 3 min. Add 5-6 drops or pinch of 1% Patton reader's indicator to it. Shake well. Titrate it against 0.05M EDTA solution from the burette. End point will be from wine red to blue color. This reading corresponds to amount of only calcium ion. (B).

Color before titration Color change after titration

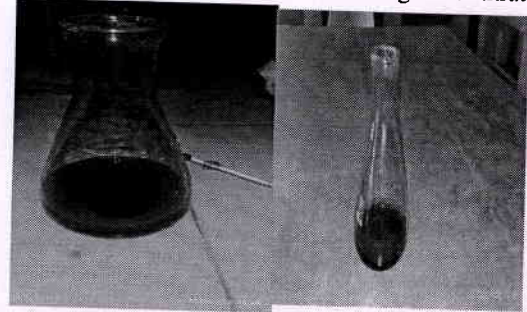
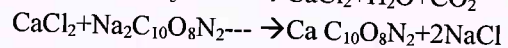


Fig-1

Fig-2

Reactions:-



3. Result and discussion-

The eggshell is a highly specialized mineralized structure, which provides protection against physical damage and penetration by microorganisms. The egg shell consists of the inner and outer shell membranes, the true shell and the cuticle. The crystalline layer of the shell, which is responsible for its mechanical strength, consists of more than 90% calcium in the form of calcium carbonate. Calcium is absorbed from the feed in the intestine. Provided that sufficient calcium (3.8-4.2%) is present in the feed, the process of calcium uptake, deposition and excretion is regulated by vitamin D3 and its metabolites. Increased or decreased calcium level in birds might be depending upon their habitat. In case of domestic birds, they are fed with supplementary feed. This may be the reason for the difference in the calcium content in birds' egg shell. This may increase the quality of egg shell.

Eggshells can be utilized for various purposes that minimize their effect on environmental pollution. Eggshells present healthy, balanced calcium due to its trace amounts of other minerals and is probably the best natural source of calcium (Adeyeye, 2009) [9]. One whole medium sized eggshell makes about one teaspoon of powder, which yields about 750-800 mgs of elemental calcium plus other micro elements. Eggshell powder has been reported to increase bone mineral density in people and animals with osteoporosis (Kingori, 2011) [5, 6].

Calculations-

25 cm³ of the solution required Bcm³ of 0.05M EDTA solution.

250 cm³ of the solution required 10B cm³ of 0.05M EDTA solution.

100 cm³ of 1M EDTA = 40.08 g of calcium
= 100 gram of CaCO₃.

10B cm³ of 0.05M EDTA solution
= 40.08*10B*0.05/100
= x₁ g of calcium
= -----B-----(1)

100*10*B*0.05/1000=x₂ of CaCO₃

% of CaCO₃ = x₂ *100/wt. of CaCO₃

According to experimental analysis of eggshell sample of Hybrid chicken has highest value of calcium and percentage CaCO₃ found 98.19%.Meanwhile low value of CaCO₃ found in Naked chicken and percentage CaCO₃ is 91.18%. Correct order of percentage of calcium carbonate in egg shell is

Hybrid chicken 98.19% > Leghorn, Buckeye = 97.17% > welsummer 94.68% > Naked chicken 91.18%

Table 1- Weight and percentage of calcium carbonate in different chicken eggshell samples

Sr. nos	Egg samples	End point(B) CBR in cm ³	Wt. of CaCO ₃ in grams	% calcium carbonate in egg shell.
1	Naked chicken	18.2	0.3647 g	91.18%
2	Welsummer	18.9	0.3787 g	94.68%
3	Leghorn	19.4	0.3887 g	97.17%
4	Hybrid chicken	19.6	0.3924 g	98.19%
5	Buckeye	19.40	0.3887 g	97.17%

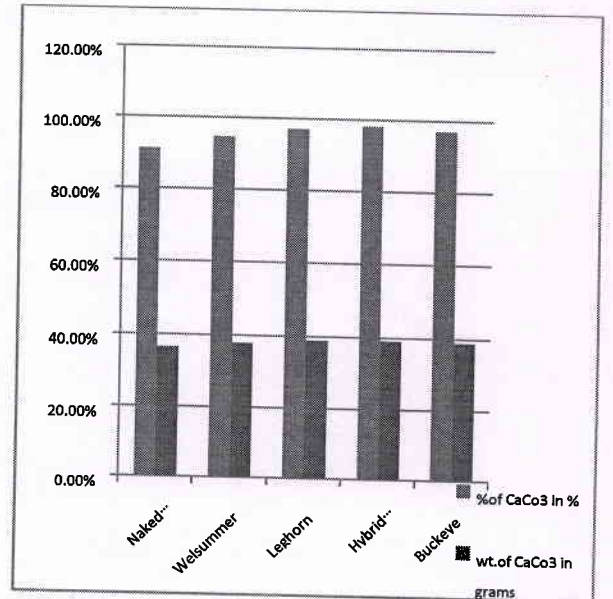


Fig-3 weight and percentage calcium carbonate present in eggshell samples.

4. Conclusion-

From results it is concluded that this titration is sample & most accurate method to determine the amount of calcium carbonate present in given sample powder as it gives sharp end point at completion of reaction. In this titration, used EDTA is an excellence complexing agent, quite cheap & easily available. Calcium dietary supplement is administrated for good shell formation and good skeleton development in young birds, during the breeding season to prevent egg binding. . Increased or decreased calcium level in birds might be depending upon their habitat. In case of domestic birds, they are fed with supplementary feed. This may be the reason for the difference in the calcium content in birds' egg shell. This may increase the quality of egg shell. According to experimental analysis of eggshell sample Hybrid Chicken has highest value of chicken and percentage CaCO₃ found 98.19%.Meanwhile low value of CaCO₃ found in Naked chicken and percentage CaCO₃ is 91.18%.

References-

- 1) S.Y.BSc Handbook Himalaya publication 23rd edition 2015 (ISBN 978-93-5202-716-3).
- 2) MSc Part -1 Handbook Himalaya publication 7th edition 2015 (Internet).
- 3). Gaonkar M, Chakraborty AP. Application of Eggshell as Fertilizer and Calcium Supplement Tablet. *International Journal of Innovative Research in Science, Engineering and Technology*. 2016; 5(3)-3525
- 4) Hunton P. Research on eggshell structure and quality: Hunton P. Research on eggshell structure and quality: *an overview. Brazilian Journal of Poultry Science* 2005; 7:67-71
- 5) Kingori AM. A Review of the uses of Poultry Eggshell and Shell Membranes. *International Journal of Poultry Science*. 2011; 10(11):908-912.
- 6). Nakano T, Ikawa NI, Ozimek L. *Chemical Composition of Chicken Eggshell and Shell Membranes. Journal of Poultry Science*. 2003; 3:510-514.
- 7). Nys Y, Gautron J, Garcia-Ruiz JM, Hincke MT. Avian eggshell mineralization: biochemical and functional characterization of matrix protein. *Comptes Rendus Palevol*. 2004; 3:549-562.
- 8) *International journal of zoology studies* 2018; 3:2455-7269
- 9) Adeyeye EI. *Comparative study on the characteristics of Egg Shells of some birds species. Bull. Chem. Soc. Ethiop* 2009; 23(2)159-166
- 10) Amu OO, Fajobi AB, Oke BO. *Effect of eggshell powder on the stabilizing potential of lime on an expensive clay soil. Res. J Agric & Soil Sci*. 2005; 1:80-84
- 11) Bain M. *Interpretation of eggshell strength. In: Solomon S.E (Ed): Egg and Eggshell Quality. Manson publishing Ltd., London, UK, 1997; pp131-141*
- 12) Bee .W. *How to make calcium from egg shells. www.linnaturallybybee.com*. 2011.