

Chicken Eggshell as Calcium Supplement Tablet

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Abstract— Hen eggs are very nutritious ,economical and healthy food items but their shells are discarded as wastes from different sources like hotels, houses etc. In this study these discarded hen eggshells were collected. They were processed in several steps and a powder was obtained in final stage. This eggshell which is very rich in calcium content finds applications in many fields and here it was used as a calcium supplement for females. For making a comparison of the calcium content calcium carbonate obtained from different eggshells were characterized by Fourier Transform Infrared spectroscopy (FTIR). The data depicted the percentage of calcium carbonate in different eggshells. The purpose of this particular project was to study the use of eggshell in different applications like fertilizer, calcium supplement, etc.

Keywords: Calcium supplement, chicken eggshell

I. INTRODUCTION

Eggshells are generated as bio- waste around the globe everyday in tonnes. They are waste material collected from house and fast food industries .Eggshell waste disposal contribute to environment pollutionand also the disposal includes cost, availability of disposal sites. odour of eggshell provides site for flies and abrasiveness. Eggshell which constitutes about 11% of the total weight of the whole egg contains about 91% of CaCO_3 . In this study this eggshell would be used as a calcium supplement tablet for females as a substitute for CIPCAL-500.

II. MATERIALS

We used eggshell which are easily available in the market as a raw material and are being used in different applications. But eggs obtained from different birds contain varying percentage of calcium carbonate. Eggshell was collected from poultry farm, houses, hotels, bakeries, fast food industries etc. Collection of eggshells from these sources in a large amount was done, because of large scale usage of eggs.

After collection the next step was to clean them with tap water and boil them. 12 egg shells were taken in 6 cups of filtered water. The cleaned eggshells were cooked in it for 10 minutes The shells were drained out. Then they were spread out on glass or stainless steel baking sheet and dried overnight .In the morning, they were dried in oven at 200°C for about 10 minutes. After this, they were pulverized into a granular form by grinding in a mixer.



Fig 1.Eggshell powder

III. USES of EGGSHELL

Eggshell contains calcium carbonate in large percentage and trace amounts of other micro elements. Eggshell calcium carbonate is 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.[1]This can be used as fertilizer to treat blossom –end – rot (BER) plants and also as calcium supplement tablet for human beings. It can be used a calcium supplement for pets.It is used as a seedling starter.It is an excellent fertilizer.It can be also used up as a compost material.

IV. EXTRACTION OF CALCIUM CHLORIDE

Eggshells of different eggs of bird contain varying percentage of calcium content so, we extracted Calcium chloride from different egg shells like free range and broiler chicken eggshell, duck egg shell. The eggshell calcium chloride has good binding properties. This was comparable to the commercially available calcium chloride. This property of calcium chloride can be

effectively used in food processing industry. Rambutan flesh when blanched in solutions containing 1% NaHSO₃ added with 0; 2.5 and 5 percent calcium chloride . The results showed that the use of calcium chloride in the blanching solutions tend to decrease the pH and vitamin C content of the fruit flesh. On the other hand, the total acids, syrup strength (sugar concentration), and organoleptic scores for texture and color increased. During the two months storage the pH increased while the vitamin C content decreased. [22] This process of extracting calcium chloride provides a way out to use the discarded eggshells and using its extract in some useful application such as food processing aid.



Fig 2. Set up for calcium extraction

Experimental work

Extraction of calcium chloride was done using 4% (w/v) Hydrochloric Acid (HCl) solution for an extraction period of three hours. Ratio of eggshell to Hydrochloric acid (HCl) was 1:15 (w/v) .After hydrolysis, the residues were removed and solution was heated to 110–115°C until dried.

V. EGG SHELL as CALCIUM SUPPLEMENT for WOMEN

Importance of calcium

Calcium is a nutrient that is essential for strong bones. Ninety-nine per cent of your body's calcium is stored in human bones and teeth. The other one per cent of human body's calcium is found in blood. Blood calcium is necessary to support your body's critical functions such as controlling your blood pressure and maintaining your heartbeat.

The calcium in our bones makes up our bone bank. Throughout our lifetime, the calcium from the foods we eat is "deposited" in and "withdrawn" from our bone bank, depending on our body needs. When our calcium intake is too low to keep human blood calcium normal our body will "withdraw" the calcium it needs from our bones. Over time, if more calcium is taken out of our bones than is put in, the result may be thin, weak bones that may break more easily.[6]

Calcium requirement in pregnancy

Calcium supplementation is necessary in pregnancy for the following reasons:

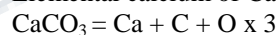
- ❖ Need is enhanced.
- ❖ Skeletal development of foetus
- ❖ Calcium prevents pregnancy complications.
- ❖ Calcium prevents pregnancy induced hypertension.
- ❖ More resorption from mother may sow initial seeds of osteoporosis and hence calcium should be supplemented to meet extra demand. [24]

Calcium requirement to prevent osteoporosis

Osteoporosis poses a significant public health issue, causing significant morbidity and mortality. Calcium and vitamin D utilization in the optimization of bone health is often overlooked by patients and health care providers. In addition, the optimal standard of care for osteoporosis should encompass adequate calcium and vitamin D intake. Dietary intake or supplementation with calcium and vitamin D will be reviewed, including recent recommendations for increased vitamin D intake. Compliance to calcium and vitamin D therapy is paramount for effective prevention of osteoporotic fractures.[25]The best way to meet the daily dietary requirement is through the intake of high calcium containing foods. Dairy products are the best sources of calcium due to their high elemental calcium content, high absorptive rate, and relative low cost.

Elemental Calcium

Elemental calcium of Calcium carbonate(CaCO₃)



Substituting their atomic weights,
 = 40 + 12 + 16 x 3= 100

% of elemental calcium = 40/100 x 100= 40 %

Hence, Elemental Calcium for CaCO₃ is **40 %**

Calcium Carbonate content in eggshells

Eggshell was ground, and a mass of 0.1 gram was transferred to an Erlenmeyer flask. It was treated with known volume of hydrochloric acid and agitated for three minutes. It was then titrated using phenolphthalein indicator against sodium hydroxide.

Sr. No.	Type of eggshell	Mass of eggshell	Vol of HCl	Vol of NaOH	Percentage of CaCO ₃

1.	Free range	0.1	7	5.3	85
2.	Duck eggshell	0.1	5	3.8	70

compared with calcium carbonate extracted from broiler chicken eggshell.

VI. GRAPHICAL INTERPRETATION

From FTIR test we can easily conclude that eggshells of different birds contain calcium carbonate in varying percentage. The chicken eggshells like free range and broiler contain large quantity or percentage of calcium carbonate.

Table 1. Calcium Carbonate content in eggshells

Elemental Calcium Detection

Elemental calcium was detected in the eggshells using the Inductively Coupled Plasma- Mass Spectroscopy (ICP-MS) instrument. Theoretically elemental calcium in calcium carbonate is 40%. Free range chicken eggshell, Broiler chicken eggshell and Duck eggshell calcium was tested using ICP-MS instrument.

Sr.	Type of eggshell	Percentage of calcium
1.	Free range chicken eggshell	36
2.	Broiler chicken eggshell	38
3.	Duck eggshell	35

Table 2. Elemental Calcium content in eggshells

General method of Calcium carbonate extraction from oyster shell

The mussel and oyster shells are heated in an oven at 200 °C for 1 hour. This results in embrittlement of the shells more and after this they are subjected to milling in a high-speed planetary mill with a porcelain jar and alumina balls for 15 minutes with water. The powders are heated again to 500 °C and maintained for 2 hours and to undo the clusters a new milling is performed without water for 1 minute. The powders are characterized by particle size distribution analyses and chemical composition using a laser diffraction analyzer.[3]

CIPCAL-500 (oyster shell) calcium supplement tablets were taken for analysing calcium carbonate content by FTIR analysis. The weight of one tablet was 1.25 gm. Then the results of calcium carbonate from CIPCAL-500 was

From FTIR test of CIPCAL-500 we can conclude that the calcium carbonate extraction from oyster shell is tedious and costly, whereas chicken egg shell with equivalent amount of calcium carbonate is easily obtained and is also very economical. So, we can get a cheaper substitute as calcium carbonate supplement.

Wavelength in cm-1	Length
715	Weak
877	strong
1430	Very strong
1785	Very weak
2530	Very weak

Table 3. IR absorption peaks for calcium carbonate

VII. CALCIUM SUPPLEMENT TABLETS

As CIPCAL-500 and broiler chicken egg shell FTIR results were comparable, so an attempt was taken to make calcium carbonate supplement tablets out of broiler chicken egg shell powder.

The powder was compounded, sieved followed by granulation. It was then dried in oven at 120°C for two hours. After this the powder was fed to tablet making machine and different sized tablets were made.

The CIPCAL -500 and broiler chicken egg shell tablets were tested using calcium dissolution tester. Here the temperature maintained was 37°C and pH was maintained similar to human body pH by providing bath of 0.1N HCl.

Both the tablets were placed in cuvette and kept in acid water bath and then subjected to dissolution at a speed of 100 rpm.



Fig 3. Calcium Dissolution apparatus

calcium carbonate content is nearly 85 % .This can be used very effectively in various applications.

In an application these broiler chicken egg shell powder was used up to make tablets which were tested for equivalency against CIPCAL-500 calcium supplement tablets. The FTIR analysis results were comparable and also the source, availability and manufacturing of calcium carbonate tablets using chicken egg shell is much easier as compared to the oyster shell which is the main source of CIPCAL-500 tablets.

So it can be concluded that chicken egg shell cannot be just considered as a waste and can be effectively used for many applications.

REFERENCES

- 1) Butcher G.D., Miles R. Concept of eggshell quality, Veterinary Medicine 1990; 69.
- 2) Nakano T., Ikawa N.I., Ozimek L. Chemical composition of chicken eggshell and shell membranes, Journal of Poultry Science 2003; 3: 510–4p.
- 3) Hamster M.R.R., Santos Balzer P., Becker D. Characterization of calcium carbonate obtained from oyster and mussel shells and incorporation in polypropylene, Journal of Material Research 2012; 15(2).
- 4) Onoda H., Nakanishi H. Preparation of calcium phosphate with oyster shells, Journal of Scientific Research. 2012; 3(2).
- 5) Miller F.A., Wilkins C.H. Infrared spectra and characteristic frequencies of inorganic ions, American Chemical Society Publication 1952; 24.
- 6) Rovenský J., Stancíková M., Masaryk P., et al. Eggshell calcium in the prevention and treatment of osteoporosis, International Journal of Clinical Pharmacological Research 2003; 23(2–3) : 83–92p.
- 7) Lozano R., Joseph J.M., Kline B.J. Temperature, pH and agitation rate as dissolution test discriminators of zofenopril calcium tablets, Journal of Pharmaceutical and Biomedical Analysis 1994; 12(2).
- 8) Kingori A.M. A review of the uses of poultry eggshell and shell membranes, Int Journal of Poultry Science 2011; 10(11): 908–12p.
- 9) Lide D.R., ed., CRC Handbook of Chemistry and Physics. 75th Ed., Boca Raton, FL: CRC Press; 1994, 9–79p.

Sr. No.	Type	Weight in gms	Dissoluti on time in seconds
1.	CIPCAL-500	0.6	50
2.	Chicken egg shell	0.6	50

Table 4: Calcium Dissolution Time



Fig 4. Chicken egg shell tablets

VIII. CONCLUSION

We can conclude that broiler chicken egg shell has rich amount of elemental calcium nearly 38% and the

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- 10) Easterwood G.W. Calcium's role in plant nutrition, Fluid Journal. 2002; 10(1): 16–9p.
- 11) E.O Jatto, I.O Asia , E.E Egbon , J.O Otutu , M.E Chukwuedo , C.J Ewansiha, Treatment Of Waste Water From Food Industry Using Snail Shell, Acaedmia Arena,2010;2(1)
- 12) Burley, R.W. and V. Vadehra, 1989. The eggshell and shell membranes: Properties and synthesis. In: The avian egg chemistry and biology, John Wiley, NewYork, pp: 25-64.
- 13) Benefits of eating oyster,Cultured Palates Newsletter,21 January,2013.
- 14) Kaitlyn Boettcher, Are snails born with shells? Mental_floss,February,15,2013.
- 15) Snail Anatomy-Snail Facts and Information, Bioexpedition Publications.
- 16) Robert Nordsieck, Snails and Slugs(Gastropoda) - The Living World of Molluscs,
- 17) Arianne Bazilio and Jacob Weinrich, The Easy Guide to: Inductively Coupled Plasma Mass Spectrometry (ICP-MS),December-2012.
- 18) Elizabeth Shanor, Lab Report Example, April 25,2005.
- 19) R. M. Silverstein, G. C. Bassler, T. C. Morrill, Spectrometric Identification of OrganicCompounds, 4th ed., New York: Wiley, 1981, 166.
- 20) Bee, W., 2011. How to make calcium from egg shells.,www. Healing naturally by Bee. Downloaded from internet on 30/09/2011.
- 21) Aprianita N., Soemijati, Ketaren S. , A study on the effect of blanching in calcium chloride solutions and the use of varying syrup strength in the canning of rambutan (*Nephelium lappaceum* L.) flesh, Journal of Institut Pertanian Bogor Fakultas Mekanisasi dan Teknologi Hasil Pertanian. Bulletin Penelitian,2012.
- 22) Wunwiboon Garnjanagoonchorn andAlongkot Changpuak, Preparation and Partial Characterization of Eggshell Calcium Chloride, International Journal of Food Properties,Volume 10,Issue 3,2007.
- 23) John A.Sunycz, The use of calcium and vitamin D in the management of osteoporosis, Journal of Therapeutics and Clinical Risk Management, 2008 Aug; 4(4): 827–836.
- 24) Ray Sahelian, Calcium supplement health benefit and side effects, risk of overdosage or excess intake.
- 25) Summer Fanous,8 Fast Facts about Calcium.