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A Review on the Use of Eggshells as a Raw Material for Production of Calcium Preparation

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Abstract: *There are a lot of calcium supplements on the market, particularly those that include calcium carbonate, which is sadly not sufficiently absorbed by the body.*
The study examined the release kinetics of calcium in the form of calcium citrate and calcium carbonate from tablets made from modified eggshells. The release of calcium exhibited first-order kinetics. During the first half of the trial, 79.93% of the calcium in the form of calcium citrate was released from tablets made from modified eggshells; after three hours, this percentage reached around 100%. These values were 7 and 60% for the calcium carbonate-produced tablets, respectively. Calcium in the form of calcium citrate was released four times faster than calcium carbonate, with the half-time of calcium release from tablets containing calcium carbonate being t50% = 2.2 h and from tablets containing calcium citrate being t50% = 0.5 h. These findings may be related to the varying solubility of calcium salts

Keywords: Calcium supplement, Waste renewal, Eggshell, Calcium extraction, Health

I. INTRODUCTION

Calcium is supplied through dietary sources, as it constitutes 98% of the skeletal system and is one of the most fundamentally important and crucial nutrients for the human body (Muñoz-Garach et al., 2020). Its function is clear because it serves a vital structural role in our bodies. Additionally, data show that over the past 50 years, India's dietary calcium intake has decreased (Kadhim et al., 2020). Calcium is an essential element that is needed for blood coagulation, nerve conductivity, tooth and bone growth, and muscular contraction (Szymandera-Buszka et al., 2021). It is recommended to consume enough calcium,which is crucial for cardiovascular health and can avoid hypertension and preeclampsia (Arnold et al., 2021). Individuals are growing less focused on their consumption

Tonnes of eggshells are produced every day as biowaste all over the world. These are leftovers gatheredfrom the fast food and residential sectors.The disposal of eggshell trash adds to environmental contamination, and it also involves costs and site availability. The smell of eggshells attracts flies and isabrasive. Approximately 91% of the overall weight of the egg is made up of the eggshell, which makes up 11% of the total weight. This eggshell would be used in this study as a calcium supplement tablet forfemales in place of CIPCAL-500.

II. MATERIAL AND METHOD

We chose eggshells, which are widely accessible on the market and have a variety of uses as raw materials. Yet the amount of calcium carbonate in eggs varies depending on the species. Eggshells were gathered from fast food restaurants, homes, hotels, bakeries, and poultry farms, among other places. Due to the extensive use of eggs, a significant volume of eggshells were collected from various sources. The next step after collection was to boil and wash them under tap water. Six cups of purified water were usedto hold twelve egg shells. It was used to fry the cleaned eggshells for ten minutes. All of the shells were removed. After that, they were laid out on a baking sheet made of glass or stainless steel and left overnight to dry . Chemicals. The sources of calcium citrate (FZNP Biochefa; Ryszka et al. 2007, 2014), magnesium stearate (ChemMPol, Warsaw, Poland), inulin (Brenntag, Kędzierzyn-Koźle, Poland), potato starch (PEPEES), and inulin were all analytically pure and met quality standards. Wet granular calcium carbonate combined with inulin syrup was used to make synthetic calcium carbonate tablets. Granulate that was obtained was

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dried for 24 hours at 60°C. That kind of bulk was then tableted with the addition ofmagnesium stearate. Eggshells with their membranes were used to make calcium citrate tablets (Ovopol, Nowa Sól, Poland). Citric acid was added to eggshells before they were roasted for two hours at 120°C (Ryszka et al. 2007, 2014). After being combined with other chemicals, the obtained granulate was tableted. A rotatory tablet press equipped with thirty matrixes was used for tableting.

Fig. 1.1 CALCIUM CHLORIDE EXTRACTION

Since the proportion of calcium in different bird eggshells varies, we extracted calcium chloride from a variety of eggshells, including those from free-range and broiler chickens as well as ducks. The calcium chloride found in eggshells has good binding qualities. This was comparable to calcium chloride that is sold commercially.

efficiently employed in the food processing sector. When blanched, rambutan flesh can be added to solutions with 1% NaHSO3 and 0, 2.5, or 5% calcium chloride. The outcomes demonstrated that the pHand vitamin C content of the fruit flesh tend to drop when calcium chloride is added to the blanching solutions. However, the organoleptic scores for texture and color, total acids, and syrup strength (sugar content) all rose. The pH rose and the amount of vitamin C dropped during the two months of storage.

[22] This calcium chloride extraction method offers a way to repurpose the eggshells that are thrown away by employing the extract for a beneficial product, such a food processing help.

Figure 1.2. Arrangement for the extraction of calcium Trial and error work Calcium chloride

Fig:1. 2 SET UP FOR CALCIUM EXTRACTION

III. ISSUE OF WASTE MANAGEMENT IN INDIA

India's waste management problem India's waste production With an average annual growth rate of 4%, India generates close to 62 million tonnes of waste annually, of which less than 65% is collected and roughly 15%–18% is treated

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(Baulk et al. 2017). Three primary categories can be used to separate the garbage produced: dry (or recyclable waste), organic (all biodegradable waste), and biomedical (or sanitary and hazardous waste). Less than 60% of waste in India is collected from houses, and only 15% ofrubbish in cities is processed, despite the nation having a population twelve times larger than that of the United States (Baulk et al. 2017). About 9,400 metric tonnes of solid garbage are produced daily in the Mumbai Metropolitan Region (MMR), of which food waste is made up of various source of organic waste in urban population .

IV. CALCIUM CONTAIN IN HOUSEHOLD WASTE

The amount of calcium in home garbage Thiamine, vitamin B12, and vitamin C had the greatest nutrient losses (130–160 nutrient days/capita/year, respectively). Proteins, dietary energy, and carbohydrates lost eighty-eight, fifty-nine, and fifty-three nutrient days/capita/year, respectively. In the UK, underconsumed nutrients were also associated with significant losses: dairy and poultry (27%) and calcium (wasted through baked products, 27%). Dietary fibre (31 and 29%, respectively) and fresh greens/vegetables (40%) and baked goods (18%) were found to be the main causes of food folate waste. Numerous nutritional studies carried out in the United Kingdom reveal that certain subgroups within the population express worries about their consumption of micronutrients, including calcium, iron, and vitamin D

The ESs's nutritional profile:

Calf ES and shell membrane make up the chicken ES. It weighs between 10 and 11% less overall than the entire egg. Water makes about 2% of the ES's composition, with 98% dry matter. Conversely, just 5%of the dry matter is made up of crude protein, whereas 93% of it is made up of ash. The membrane of the egg is a fibrous structure. It is necessary for ES to flourish (Chen et al., 2021). Chemically speaking, an ES from a hen has 11.8% protein, 11% fat, 65.6% water, and 11.7% ash. According to Wang et al. (2017)and Bello, the chemical makeup of ES powder includes 21.2% carbon, 0.93% magnesium oxide, 76.9% calcium oxide, 0.42% porosity, 0.02% iron oxide, and 0.11 percent sodium oxide.

V. IMPORTANCE OF CALCIUM IN HUMAN AND HUMAN ACTIVITY

NLM offers access to scientific publications as a library. A database's inclusion does not indicate that NLM or the National Institutes of Health support or agree with its contents. Find out more: PMC Notice of Copyright | PMC Disclaimer Environ Sci Pollut Res Int. 2021; 28(34): 46985–46998; springeropen logo. 16 July 2021, published online; doi: 10.1007/s11356-021-15158-w PMID: 34269980; PMCID: PMC8384791 An overview of the process of removing calcium supplements from eggshells to prevent waste production and long-term calcium insufficiency Akshita Singh, Kannan Natarajan, Subbalaxmi Selvaraj, and Nachiket Kelkarmatching writer Details about the author Article highlights Details about licenses and copyrights Disclaimer from PMC Related Data Availability of Data Declarative Visit the Abstract page. When a multitude of problems arise, the chance that one will become the solution to another is slim to none.

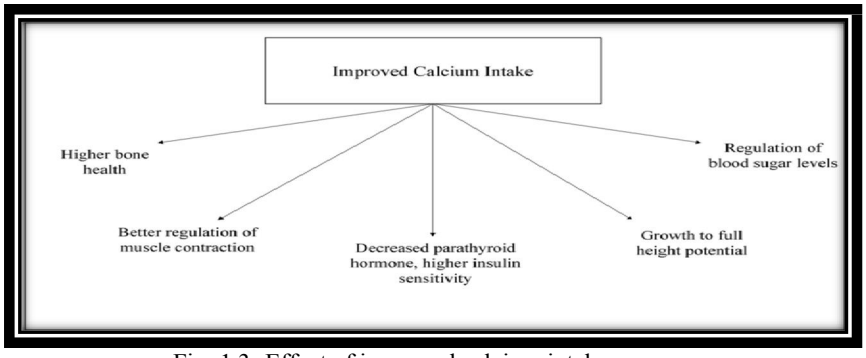

Fig :1.3 -Effect of improved calcium intake

VI. RESULT AND DISCUSSION

The purpose of extracting calcium citrate from chicken eggshells was multifaceted. First and foremost, it involved removing microbiological contamination from raw materials. Eating raw eggs and their shells increases the risk of

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contracting Salmonella enteritidis. Research indicates that the increased bacterial growth of raw material (up to 90 × 105 CFU/g) affects the powder made from eggshells that have not been treated with any bacteria-inactivating agents (such as heat or microwaves) (Hassan 2015). Our ownsynthesis, carried out at a specific temperature of 120°C for two hours, successfully prevented bacterial growth and ensured sufficient raw material sterility (Ryszka et al. 2007, 2014). Second, there was a distinction in calcium citrate and calcium carbonate's availability. Several clinical investigations have demonstrated that calcium citrate is more readily available .

VII. CONCLUSION

In this review, we have looked into the statistics of the waste management issue in India and highlighted the nutritional value lost in the process. Reports about global egg and eggshell production were studied. Thus, a major waste generation and environmental problem was identified due to levels of generation of eggshells and their waste management. (The calcium deficiency in the population and the collected data pertaining to various states were also analyzed in the report.) Calcium contents present in multiple household wastes were mentioned. An in-depth survey of calcium levels across the globe pointed to the fact that calcium deficiency-related diseases have been plaguing all but a few regions. As the benefits of using eggshells outweighed the rest, the study narrowed down on the different extraction methods of eggshells as an attempt to realize its economic viability towards the production of an adequate calcium supplement. Multiple studies, as mentioned, have shown eggshells to possess significant nutritional value which is currently a reservoir of calcium that is not being tapped into. Eggshell waste generation has grown rapidly and will continue to grow further. Due to the menace of overfilled landfills and improper disposal of eggshells, this waste material can have a significant effect on the surrounding as well as contributions to a higher presence of rats and other pestilence. Thus, a twofold solution, which combats not just the issue of waste generation but also one of chronic deficiency, is the need of the hour. This review has tried to correlate the problem of an increasing eggshell waste generation rate, in spite of having significant bioavailable calcium and the fact that while such high amounts of nutritional value calcium go to waste, countries continue to battle chronic calcium deficiencies at alarmingly high rates.

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