DEVELOPMENT OF AN ANTACID TABLET FROM COBB BROILER CHICKEN EGGSHELLS

A Research Paper Presented To
The Faculty of
Philippine Science High School Western Visayas
Bito-on, Jaro, Iloilo City

In Partial Fulfillment
of the Requirements for
SCIENCE RESEARCH 2

by

Shanna Clarissa M. Losañes
Bea Rafaella S. Nufuar
Fourth Year – Photon

March 2012

APPROVAL SHEET

This research paper herein entitled

DEVELOPMENT OF AN ANTACID TABLET FROM COBB BROILER CHICKEN EGGSHELLS

Prepared and submitted by Shanna Clarissa M. Losañes and Bea Rafaella S. Nufuar in partial fulfillment of the requirements in Science Research II, has been examined and recommended for acceptance and approval.

ERIKA EUNICE P. SALVADOR
Science Research II Adviser

Approved by the members of the Research Committee on March 2012.

EDWARD C. ALBARACIN

MIALO C. LACADEN

ARIS C. LARRODER

HAROLD P. MEDIODIA

FLORDELIZA T. REMONDE

Accepted in partial fulfillment of the requirements in Science Research II.

EDGAR F. ALMERO, Ed.D.
OIC—Office of the Director

COBB BROILER CHICKEN EGGSHELLS AS ANTACID

Losañes S.C.M., Nufuar B.R.S

Philippine Science High School Western Visayas Campus, Bitoon, Jaro Iloilo City

shanna1995@yahoo.com, microbeateria@yahoo.com

ABTSRACT

In order to address the need of the poultry science community for further eggshell development al studies and to the problems of establishments circulated on eggshell disposal, the researchers developed an antacid from Cobb Broiler chicken eggshells by tablet compression. Moreover, with this development, the common problem of hyperacidity was given a tentative cure. The eggshells were transported from a hatchery in Iloilo City to the PSHS WVC Research Laboratory I and was studied. The eggshells were powdered and were tested for its percent $CaCO_3$. An antacid tablet was made using a handheld tablet maker. Percent $CaCO_3$ was determined by titration with EDTA. It was found out that the percent $CaCO_3$ of the eggshell and the eggshell antacid were 27.166% and 41.11% respectively. The dissolution time of the eggshell antacid suggests that it will dissolve slowly in a simulated stomach acid. The results suggest that eggshells could be made into antacids because of its calcium carbonate content but a more efficient way of making an antacid is needed.

Keywords: eggshells, antacids, calcium carbonate, dissolution time, hyperacidity

ACKNOWLEDGEMENTS

We would like to thank the following for helping us achieve our goal of finishing our research paper:

Ma'am Erika Salvador for advising us with wonderful advises.

Ma'am Lani Estilo for providing Chemicals and apparatuses that we used for our amazing data gathering.

Sir Rusty Balcoba for allowing us to do our research in the research lab and in the equipment room and for providing us with the equipment we needed for our data gathering.

Ma'am Virna Jane Navarro for allowing us to stay late so that we can do our data gathering.

Daphne Juanico for helping us start our research paper.

Shanna's parents for asking someone to collect eggshells from the Losanes Hatchery and for allowing Shanna to go to school every weekend.

The Creators of google for helping us search for more articles regarding our research.

Mark Zuckerberg for creating facebook, a place where we can chat and talk about our research.

Steve Jobs for not letting us use a typewriter to type our research paper but instead created Macbooks.

Smart for giving us a way to communicate with each other.

Manong Guard for letting us stay until 6:30PM because we have a permit.

God for giving us life and for guiding us as we do our research.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PLATES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

A. Background of the Study

The avian eggshell is the outer covering of the egg that retains albumen (Nakano et al 2003) and protects the contents of the egg against losses and environmental aggression (Pizzolante 2009). The eggshell is considered as the egg's first line of defense against bacterial contamination (Aeb.org 2004) and is essential for the propagation of all avian species (Nys et al C.R. Palevol 3 2004).

The hen eggshell represents 11% of the egg's total weight (Tsai et al 2005) and is composed of 94% calcium carbonate, 1% magnesium carbonate, 1% calcium phosphate and 4% organic substances (Rivera et al 1999, Tsai et al 2005). The organic substances found in the eggshells are composed mainly of proteins (Baker and Balch 1961) with small amounts of carbohydrates and lipids (Burley and Vahedra 1989, Nakano et al 2003). The major component of eggshell is calcium carbonate (Frier and Holanda 2000, Nys et al C.R. Palevol 3 2004, Tsai et al 2005). Other elements found in the eggshell are Calcium, Magnesium, Phosphorus, Sodium and Carbon (Abdel-Salam et al 2006).

Chicken eggshell is considered as a waste material from domestic sources such as hatcheries, homes and fast food joints (Croft 1999). The estimated quantity of eggshell waste to be disposed each year is between 10,000- 11,000 Tonnes in UK (Tocan 1999). Each year in Georgia, more than 37 million pounds of eggshells are directed to landfills (Colar 2005). In Mexico, the annual production is estimated as 7.0×10^{10} of units of eggs, approximately 480,000 tons of eggshells a year. The eggshell material is useless after the production of eggs and egg derivatives (Rivera and others 1999).

Antacids are drugs that neutralize part of the hydrochloric acid in the stomach. It is indicated in ulcer therapy, and other conditions on the prescribed antacid (www.tpub.com 2010). Antacids perform a neutralization reaction, such that they buffer gastric acid, raising the pH to reduce acidity in the stomach (servinghistory 2010). An

antacid is used in most hyperacidity conditions, including gastritis and dyspepsia (www.healthhype.com 2010). Antacids usually come in the form of a tablet.

This research is intended to make use of chicken eggshells that are of no use to consumers and producers, making it a cheaper antacid for the people that could not afford regular antacids and making eggshell disposal easier for producers and consumers alike.

B. Statement of the Problem

Can antacid tablets made of Cobb broiler chicken eggshell powder be used as an alternative to commercial antacid tablets?

C. Objectives

General Objective:

This study aims to develop an antacid tablet from Cobb broiler chicken eggshells.

Specific Objectives:

a. To determine the percent calcium carbonate in powdered Cobb Broiler chicken eggshells by titration
b. To make a 500mg antacid tablet with the use of Cobb Broiler chicken eggshells.
c. To measure and compare the percent $CaCO_3$ of the eggshell antacid and other commercial antacids by titration
d. To measure the time it takes for the eggshell antacid to dissolve in stimulated stomach acid

D. Hypothesis

There will be no significant difference between the $\%CaCO_3$ of the eggshell antacid and the commercial antacids.

E. Significance of the Study

Owners of hatcheries find it hard to dispose eggshells. A lot of eggs are consumed everyday in households all over the world. Most of the time only the egg yolk and egg white are used. The eggshells are left and thrown away (Nakano et al 2003).

Since eggshells are regarded as wastes, a tablet made of powdered eggshells will be more cost efficient than regular antacids on the market.

This research is intended to make use of chicken eggshells from hatcheries, poultries, houses and other establishments.

F. Scope and Delimitation

The eggshells will be taken from Losañes Hatchery, Brgy. Talanghawan, Sta. Barbara, Iloilo.

The antacid will be made in the Research Laboratory of Philippine Science High School using a handheld tablet press. Furthermore, the study will focus on developing an antacid for hyperacidity alone.

Commercial calcium carbonate antacids will be compared to the developed antacid for calcium content, basicity and dissolution time so that both will have almost similar components.

G. Definition of Terms

Basicity- The ability of an antacid to react based on the number of replaceable hydrogen atoms it contains (The American Heritage Medical Dictionary 2007).

Calcium carbonate ($CaCO_3$) antacid- A substance (calcium carbonate) that neutralizes antacid (The American Heritage Medical Dictionary 2007).

Cobb Broiler chicken- a type of chicken raised specifically for meat production (Damerow 1995).

Eggshell- the hard exterior covering of an egg (Merriam-webster 2010)

Hyperacidity- Abnormal high acidity in the stomach (The American Heritage Medical Dictionary 2007).

pH- a numerical measure of acidity or alkalinity of a solution, usually measured on a scale of 0 to 14. Neutral solutions (such as pure water) have a pH of 7, acidic solutions have a pH lower than 7, and alkaline solutions have a pH higher than 7. The letter pH stand for potential of Hydrogen, since pH is effectively a measure of the concentration of hydrogen ions (that is, protons) in a substance.

Tablet- a medicinal formulation made of a compressed powdered substance containing an active drug and diluents (Thefreedictionary 2011)

Titration- The process, operation or method of determining the concentration of a substance in solution by adding to it a standard reagent of known in carefully measured amounts until a reaction of definite and known proportion is completed as shown by a color change or by electrical measurement, and then calculating the unknown concentration (The American Heritage Medical Dictionary 2004).

CHAPTER 2
REVIEW OF RELATED LITERATURE

A. Eggshells

A.1. Description

The eggshell is a bio ceramic material in which the mineral calcium carbonate is intimately associated with an organic matrix (Ahmed et al 2005) composed of carbohydrates and lipids. The chicken eggshell comprises calcified shell and shell membranes that retain the albumen, regulates gas exchange between the embryo and the environment, prevents bacterial penetration and provides a source of nutrients for the developing embryo (Nakano et al).

The eggshell contains almost 95% inorganic compounds- most of which are Calcium Carbonate. It weighs about 5 grams and it contains 2.2 grams of calcium, which represents 38% of its weight (Galal 2010). Eggshell color in broiler breeders typically ranges from a light cream to a dark brown. Eggshell color is believed to be a sex-linked trait characteristic of the hen. There may be significant differences in shell color and thickness between breeds (Joseph et al 1999).

Calcium, magnesium and sodium are major inorganic constituents of the eggshell. Calcium distribution, however, is not homogenous throughput the eggshell thickness, its relative concentration increases from inside to outside (Abdel-Salam et al 2006).

The eggshell is a three-layered structure, namely the cuticle on the outer surface, a spongy calcareous layer and a mammillary layer (Tsai et al, 2005). It is noted by the same author that the by-product eggshell generated from food processing and manufacturing plants is inevitably composed of calcium carbonate and eggshell membrane.

Taking into account the sustainable utilization of eggshell and its intrinsic pore structure, the characterization of this biomaterial is very scarce in literature (Tsai et al 2005).

A.2. Disposal and Uses

Eggshell disposal is also a serious problem for egg processing industries due to stricter environmental regulation and high disposal costs (Rao et al 2006). Most of the eggshell wastes are disposed of for landfill without any pre-treatment (Tsai et al 2005). It is obvious that this approach is not a desirable practice in the view of odor from biodegradation; this renders the waste difficult to land (Amu et al 2005). The physical nature of the shell waste and the foul rotten odor produced when the material degrades renders the waste difficult to recycle to land (Amu 2005).

Occasionally, the eggshells are used as fertilizers or soil conditioners because of their high calcium, magnesium and phosphorus contents (Tsai et al 2006). Chicken eggshells were also used as a food additive but on a very modest scale (Schaafsma et al 2000).

The eggshell is currently used as a source of calcium for animal feeds and human health supplements for osteoporosis (Rao et al 2010). According to Daengprok et al (2009), it is found that eggshell is mainly used in calcium deficiency therapies in humans and animals for bone mineralization and growth. It is also used as an anti-tartar agent in toothpastes.

It is reported in literature that eggshell powder could be used for soil stabilization where very high subgrade performance is unnecessary. The low effect of the eggshell powder could be attributed to the presence of eggshell membrane that contains collagen, which reduced the binding effect of calcium and potassium that could increase soil cohesion (Amu et al 2005).

It is also used as a calcium source for preparing calcium salts like calcium citrate, calcium gluconate and calcium lactate.

According to Schaafsma and Pakan, the use of eggshell powder resulted in decreased pain and increased bone mineral densities in an elderly population with osteoporosis; a reduction in pain and an improvement of the physical well being of the post-menopausal women aged sixty-five to eighty-one years old was also reported by the participants (1999).

B. Hyperacidity

B.1 Background

Hyperacidity is a symptom, which has engaged the attention of many medical men. A study of literature reveals the confusion regarding the exact significance of this symptom. Hyperacidity is a demonstrable increase of acid over figures normally encountered (normal gastric acid pH is between 1.5-3.5). The concept of the term 'hyperacidity ' argues that this is a condition in which the normal neutralization process does not occur. This is possible either through excessive tonicity of the pyloric center or high tonicity of the stomach wall as a whole. It is, of course possible that an excessive amount of secretion over the needs of the ordinary stomach might present hyperacid figures (Rehfuss 1928).

It is a common condition wherein a person experiences some stomach discomfort after eating a meal, due to excessive production of acid during the process of digestion. It is also known as acid dyspepsia. It is experiences when the stomach secretes hydrochloric acid to destroy microorganisms ingested in the food but too much of it results to hyperacidity, which is often worsened as HCl acid triggers other acids to be secreted (wisegeek.com).

Aside from stomach pains, other common symptoms of hyperacidity include; heartburn, nausea, bloating and flatulence (ayushveda.com 2011).

B.2. Causes and Factors that trigger Hyperacidity

Hyperacidity can be functional (primary) or pathological (secondary). The causes of primary hyperacidity are: taking in too much spicy and fatty food, inadequate exercise or going to bed immediately after a heavy meal (www.homeopathictreatment4u 2011). Heavy smoking and stress can also result to hyperacidity (www.hpathy.com 2011). Some causes of hyperacidity are also idiopathic.

The causes of secondary hyperacidity are; stomach ulcers, acid reflux disease, stomach cancer (www.hopeopathictreatment4u.com 2011), reflux esophagitis and peptic ulcer (www.hpathy.com 2011).

Some of the factors that may trigger hyperacidity are:

- Prolonged intake of allopathic medicines
- Prolonged alcohol digestion
- Not taking meals on time
- Leaving long gaps before each meals (www.homeopathictreatment4u.com 2011)
- Too much intake of caffeinated drinks
- Excessive intake of sour foods that contain high acid content
- Spinal lesions (www.ayushveda.com 2011)

C. Antacids

C.1. Description

Antacids give relief by raising the pH of the stomach acid to 3 or 4. It does not neutralize stomach acid to a pH of 7. Most commercial antacids contain one or more of the following neutralizing agents: calcium carbonate, sodium bicarbonate or magnesium and aluminum salts (Prelab Procedures 2010).

Antacids may also come in different dosage forms such as tablets, capsules, injections, elixirs, and suspensions (Pharmaceutical Regulatory Authority 2008).

The chief reason for prescribing an antacid preparation is the neutralization of the hydrochloric acid in the stomach. Most antacid agents remain in the gastrointestinal system when they are taken to neutralize stomach acid, but some antacids that have the capability to ionize, and most are capable of changing the systemic pH of the blood by going into the bloodstream. The effect of this change in systemic pH is dangerous and undesirable (www.tpub.com).

Antacids may be used to reduce the symptoms of acid reflux which may cause heartburn or esophagitis (inflammation of the gullet), to relieve some symptoms caused by ulcers in the stomach and the duodenum and in other conditions, it is also helpful in neutralizing stomach acid for occasional bouts in dyspepsia

(www.patient.co.uk 2010). Antacids are the most widely used agents for treating GERD because patients with mild heartburn often self-medicate with these over-the-counter drugs and never seek treatment for their reflux symptoms. Because they act locally, antacids are considered first- line therapy for pregnant women who experience heartburn (Maton 2003).

D. Calcium Carbonate

D.1. Description

Calcium Carbonate (chemical formula: $CaCO_3$) is an important chemical compound used in industries and construction, health and dietaries, agriculture and wastewater treatments. It is estimated to be 4% of the earth's crust and is mostly found in rocks. It consists of one atom of calcium bonded to one atom of carbon and three atoms of oxygen. Common names for calcium carbonate are: limestone, calcite, aragonite, chalk and marble (www.wisegeek.com 2011). The appearance of calcium carbonate is that of a fine, white powder (www.trivenichemicals.com 2011). A characteristic of calcium carbonate is that it will fizz and release calcium dioxide upon contact with a strong acid. Calcium carbonate is noted to possess qualities such as fluorescence and triboluminescence (www.wisegeek.com 2011).

D.2. Calcium Carbonate Tablets

The most common active ingredient in antacids is calcium carbonate. (Prelab Discussion 2010). Most antacids such as calcium carbonate and magnesium hydroxide are water insoluble (Prince George's Community College: Further Explanations in the Chemistry World 2011).

Most antacids that contain some kind of carbonate that reacts with strong acid to make carbonic acid, H2CO3, which then dissociates to water and carbon dioxide gas; which is shown by the formulas below:

$$CaCO_3 + 2\,HCl\,(aq) \rightleftharpoons H_2CO_3\,(aq) + CaCl_2\,(aq)$$

$$CaCO_3 + 2\,HCl\,(aq) \rightleftharpoons H_2O\,(l) + CO_2\,(g) + CaCl_2\,(aq)$$

The tendency of antacids containing calcium salts and sodium bicarbonate cause hypocalcaemia, alkalosis and azotemia while magnesium salts tend to cause diarrhea and aluminum hydroxide gels on the other hand causes constipation (Piper and Fenton Date unknown). Antacids with sodium content are recommended for high blood pressure patients so as the antacids with calcium are recommended for patients with lithiasis, while magnesium containing antacids are not recommended in long term treatments of chronic gastritis because they may assist the production of colitis in chronic patients (Sales et al 2006).

Calcium carbonate antacids are effective acid neutralizers; these antacids also serve as a source of calcium, giving them a dual purpose. They are most commonly made in the form of chewable tablets, but swallowable or effervescent types can also be found. Tableted antacids are popular for occasional heartburn; they are handy to carry around, easy to take, and moderate in cost.

Calcium carbonate is the usual form of calcium used in these antacid tablets, and for a variety of good reasons: calcium carbonate is an effective neutralizing alkali, calcium carbonate is the most absorbable form of calcium supplement, and provides a highly concentrated, highly bioavailable source of elemental calcium to help prevent osteoporosis (www.specialminerals.com 2011).

D.3. Uses of $CaCO_3$ in the human body

These tablets generally contain binders and flavoring agents in addition to the weak base, so we cannot just assume that a bigger tablet is more effective. Instead, we can determine the exact number of moles of base in a tablet by reacting it with acid; this will be the tablet's acid neutralizing capacity (Acid-Neutralizing Capacity of Antacid Tablets 2010).

Calcium carbonate is made up of 40% calcium. It is also claimed to be the best calcium supplement on the market. It serves as a calcium supplement for osteoporosis and hypocalcaemia (Schaafsma 2000).

It is reported in literature that high intake of calcium carbonate in patients with chronic renal failure results in positive calcium balance and reduced gastrointestinal absorption of phosphate. Calcium carbonate has been shown to be effective in

controlling serum phosphorus (Martis et al 1989) and is said to be a good phosphate binder in patients undergoing kidney dialysis (James Cancer Hospital & Solove Research Institute 2003). Hypercalcemia, metastatic calcification and alkosis are the most cited side effects of calcium carbonate therapy limiting it to some patients undergoing medication.

According to an article of Stanley et al in 2004, the Ca2+ released after chewing of CaCO3 antacids may be partially responsible for the reduction of heartburn by significantly improving initiation of peristalsis and acid clearance.

Some allergic reactions one to calcium carbonate:

- Hives
- Difficulty in breathing
- Swelling of the face, tongue or throat
- Vomiting or nausea
- Constipation
- Dry mouth and increased thirst (www.drugs.com 2011)

E. Complexometric titration with EDTA

A titration is defined as a procedure for the quantitative analysis of a substance by means of an essentially complete reaction in solution with a reagent of known concentration (Prelab Procedures 2010). Complexation titration is a selective titration where in an acidic or basic titrant reacts with the titrand that is a base or an acid. The most common method for delivering titrant is a buret. A buret is a long, narrow tube with graduated markings, equipped with a stopcock for dispensing the titrant. The buret's small internal diameter provides a better-defined meniscus, making it easier to read the titrant's volume precisely.

Ethylenediaminetetraacetic acid, or EDTA, is an aminocarboxylic (weak) acid. EDTA is a Lewis acid with six binding sites—four negatively charged carboxylate

groups and two tertiary amino groups—that can donate six pairs of electrons to a metal ion.

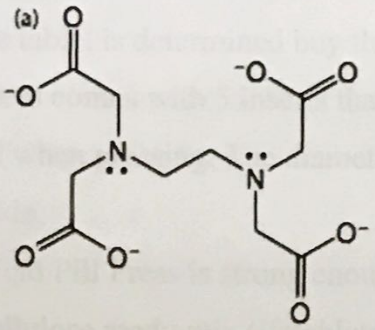

Fig 1. EDTA in its fully deprotonated form.

It is the most common titrant for complexation titrations. It is a versatile titrant that can be used to analyze virtually all-metal ions. Although EDTA is the usual titrant when the titrand is a metal ion, it cannot be used to titrate anions.

Titrating with EDTA using murexide or Eriochrome Blue Black R as the indicator gives the concentration of Ca2+. The amount of EDTA used in the titration provides an indirect measure of the amount of Ca2+ in the original sample (Analytical Chemistry 2.0 2011).

F. Tablet Making Methods and Equipment

F.1. Tablet Press

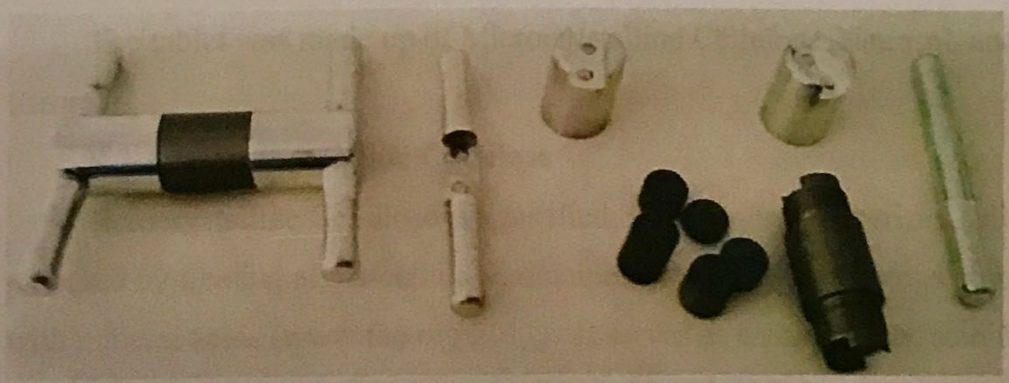

Figure 2. The handheld tablet press available from www.lfatabletpresses.co.uk.

The press is small and portable for enthusiasts who are interested in making and exploring tablet making procedures.

This press can produce tablets from 4mm (0.15 In) to 19mm (0.75 In) thick. The thickness of the tablet is determined buy the amount of powder added and the inserts used. The press comes with 5 inserts that allow you to adjust the pressure applied to the tablet when pressing. The diameter of the tablets produced by this press is 15mm (0.6 In) wide.

The Hand Held Pill Press is strong enough to bind tablets together using Microcrystalline Cellulose ready mix (lfatabletpresses.co.uk).

The hand held press uses direct compression as the method of tablet preparation. Other tableting methods include wet granulation, roller compaction and dry granulation. Direct compression is used to define the process by which tablets are compressed directly from the powder blends of active ingredient/s and suitable excipients. No pretreatment of the powder blends are involved. Direct compression is more prone to segregation due to the difference in densities of the excipients and the active ingredients present in the tablet. The dry state of the material during mixing may induce static charge and lead to segregation. This leads to problems like weight variation and content uniformity (Gohel ang Jogani 2005).

F.2. Tablet Press Pre-mix Composition

The tablet was made up of Microcrystalline Cellulose, Natrasol, and Magnesium Stearate.

F.2.1 Microcrystalline Cellulose

Microcrystalline Cellulose is a purified, partially depolymerized cellulose prepared by treating alpha-cellulose, obtained as a pulp from fibrous plant material, with mineral acids (www.fao.org 2011). It serves as an emulsifier, stabilizer, anticaking and dispersing agent and it has a pH of 5.50-7.5.

Microcrystalline Cellulose has proven to be stable, safe and physiologically inert.

Microcrystalline Cellulose revolutionized tableting because of its unique compressibility and carrying capacity. It exhibits excellent properties as an excipient for solid dosage forms. It compacts well under minimum compression pressures, has high binding capability, and creates tablets that are extremely hard, stable, yet disintegrate rapidly. Other advantages include low friability, inherent lubricity, and the highest dilution potential of all binders. These properties make Microcrystalline Cellulose particularly valuable as a filler and binder for formulations prepared by direct compression, though it also is used in wet or dry granulation and for spheronisation (www.nbent.com 2011, www.lfatabletpresses.co.uk 2011).

F.2.2 Natrasol

Natrasol or hydroxyethylcellulose is a non-ionic, water-soluble cellulose ether (www.ashland.com 2012). It readily dissolves in water to form viscous solutions; it also acts as a thickener, binder, stabilizer and suspending agent in solution. It is nonionic and is inert to all common aqueous organic solutions. It could be insolubilized by certain resins and reagents and is used in most drug products as an inert ingredient (www.signetchem.com 2012). The red color of the tablet filler is due to Natrasol Range. Natrasol's properties are sticky even when they are dry, it is a binds firmly with other tablet properties in dry conditions. Natrasol is inert and non-reactive. It works with all active ingredients without changing the effect or causing chemical reactions (www.lfatabletpresses.com 2012).

F.2.3 Magnesium stearate

Magnesium stearate, also known as octadecanoic acid, is a solid white powder at room temperature. It is an FDA-approved inactive ingredient commonly used in the pharmaceutical industry as a diluent for tablet and capsule manufacturing (www.drugs.com 2012). It is commonly used as a lubricant for tablets. Studies have shown that magnesium stearate may affect the release time of the active ingredients in

tablets but it does not lower the bioavailability of the tablet's ingredients (www.lfatabletpresses.co.uk 2012).

G. Neutralization Reaction

A neutralization reaction is a reaction of an acid and a base that results in an ionic compound and possibly water. When a base is added to an acid solution, the acid is said to be neutralized. The ionic compound that is a product of a neutralization reaction is called a salt. The salt formed in a neutralization reaction consists of cat-ions obtained from the base and anions obtained from the acid (www.cengage.com 2011).

Effective neutralization for hyperacidity can only be obtained in the majority of cases in the absence of side effects by a combination of antacids, either together or perhaps preferably in a routine with the patient, the maximum does not each being given that will not or statistically should not, produce complications.

The failure of the tablet to disintegrate rapidly with the consequent reduction of the surface area of the antacid tablet with which the acid can react with provides a less neutralizing effect of the tablet to patients. It is advised that the patients must chew or suck the tablet if therapeutic effect is to be obtained; crushing and chewing the tablet would increase neutralizing capacity (Barbara and Fenton Date unknown).

CHAPTER III
METHODOLOGY

A.1 Overview of the Study

This study aimed to develop an antacid tablet from eggshells. Cobb Broiler chicken eggshells were used in this study. The eggshells were randomly collected in the Losañes Hatchery. The eggshells were titrated using Complexemetric EDTA titration in order to get the calcium content. The eggshell powder was compressed with the use of a hand held tablet press was bought from www.lfatabletpresses.co.uk. The eggshell antacids were titrated in order to get the Ca^{2+} content. The calcium content of the eggshells, the eggshell antacid and the other commercial antacids were compared. Trials were performed thrice for accuracy.

A.2 Time and Place of Study

Sampling was done in the Losañes Hatchery, Barangay Talanghawan, Sta. Barbara, Iloilo City. The material preparation, laboratory work and tablet making were done at the Research Laboratory of Philippine Science High School Western Visayas.

A.3 Materials and Equipment

Materials

- Eggshells
- EDTA Crystals
- $MgCl_2$ (Magnesium Chloride)
- $NaCl_2$ (Sodium Chloride)
- Murexide
- 12M HCl
- NaOH (Sodium Hydroxide)
- Distilled Water
- Commercial Calcium Carbonate Antacid Tablets

Equipment

- Burette
- Iron Stand
- Iron ring
- Iron clamp
- Burette clamp

- Electronic Balance
- Mortar and pestle
- Volumetric flasks
- Beakers
- Graduated cylinders
- Erlenmeyer flasks
- Wash bottle
- Watch glass
- Funnel
- Hand held Press
- Stirring rod
- Oven

B.1 Preparation of Equipment and Materials

Sample containers and glass equipment were sterilized and dried before and after use. Chemicals, reagents, and other materials were requested from the PSHSWVC-SRA. The handheld press was ordered from www.lfatabletpresses.co.uk.

B.2 Collection of Eggshells

One kilo of Cobb Broiler Eggshells was collected from the Losañes Hatchery in Brgy. Talanghawan, Sta. Barbara, Iloilo. Eggshells were transported to the PSHS-WVC Research Laboratory for analysis. One-fourth kilo of eggshells was de-membranized by hand and cleaned with distilled water. Eggshells were air dried and crushed with the use of mortar and pestle. The eggshell powder was sterilized in an oven at 115°C for fifteen minutes. The eggshell powder was cooled and was transferred into a clean covered container.

B.3 Eggshell Analysis

B.3.1 Analyte Preparation

Adapted from A. Hughes 2004, this method uses a thirty milligrams eggshell powder sample that was weighed with a digital balance and was transferred into a two hundred fifty mL beaker. Twenty-five milliliters of distilled water and twenty drops of twelve molal HCl were added slowly to the beaker with constant stirring. The beaker was covered with watch glass. The reaction was allowed to proceed when almost all of the eggshell powder had dissolved. The solution was heated with a

hotplate found in the Equipment Room of PSHS-WVC. The solution was allowed to boil and was transferred to a 250mL volumetric flask with the use of a funnel, the solution was then diluted to 250mL. This is the Ca^{2+} solution.

B.3.2 Preparation of Titrant

Three thousand eight hundred milligrams of EDTA dehydrate of disodium salt and 10 milligrams $MgCl_2$ was dissolved in 1L of distilled water in a large beaker using a stirring rod. The solution was stored overnight in a cleaned, tightly capped, 1.5L soft drink container.

B.3.3 Standardization of Titrant

Fifteen milliliters of standard grade $CaCO_3$ solution was measured into a 250 mL Erlenmeyer flask. The $CaCO_3$ solution was added with 75mL distilled water and 10mL of 1M sodium hydroxide. One-eighth of a teaspoon of murexide ground (100mg indicator mixed with 20g of analytical grade sodium chloride) was added until the solution turned pink. Using the EDTA titrant, the solution was titrated until the color changed from pink to purple. The process was done in triplicate to ensure accuracy.

B.3.3.1 Preparation of $CaCO_3$ solution

One gram of dry calcium carbonate was dissolved in 25mL 1M HCl and was diluted in a beaker at exactly 1L.

B.3.4 Titration

Twenty-five milliliters of the Ca^{2+} solution was transferred into three Erlenmeyer flasks. Twenty-five milliliters of distilled water and 5mL NaOH were added to each of the three flasks. One-eighth teaspoon of murexide ground was added to one flask. The initial color of the solution was pink after the addition of the indicator. After titration, the solution turned into a purple color. The burette was then read and the results were recorded.

The formula $M_1V_1=M_2V_2$ was used to calculate the concentration of the EDTA solution.

B.4 Antacid Tablet making

B.4.1 Preparation of tablet powders

The eggshell powder was sieved to ensure that fine particles would compose the active ingredient of the tablet. Five hundred milligrams of the sieved eggshell powder was kept in folded filter paper and was labeled '0.5g Eggshell powder'. It was assumed that the eggshell powder was composed of 33% $CaCl_2$.

Five hundred milligrams of the tablet filler was weighed using a digital balance. The weighed powder was kept in folded filter paper and was not labeled. There were ten sets of weighed eggshell powder and tablet filler.

B.4.2 Making the Tablet

Five hundred milligrams of eggshell powder and five hundred milligrams of tablet filler was mixed in a watch glass with the use of a stirring rod.

The two of the biggest dies of the tablet press were put in one end of the uncapped tablet press. One researcher held them by hand. The other researcher capped the end held by the first researcher, and then the tablet mix was poured into one end of the tablet press with the use of a makeshift funnel with the use of paper. Three more dies were added then the cap was tightened. The press's handles were attached and were twisted. The made tablet was taken out of the press with the use of one handle.

B.5 Determining the basicity of Antacid

B.5.1 Titration

The method used was adapted from chemistry.ucsc.edu. Three eggshell antacid tablets were weighed. One of the antacid tablets was crushed with the use of a mortar and pestle. Three hundred milligrams of eggshell antacid powder was weighed and was transferred to a 250mL beaker. Twenty-five milliliters of distilled water and 20 drops of 12M HCl were added to the beaker. The beaker was covered with watch glass. The solution was allowed to be boiled after most of the bubbles disappeared. After the solution was boiled, the solution was transferred in a 250mL volumetric flask and was diluted.

Three Erlenmeyer flasks were prepared and were filled with 25mL diluted eggshell powder solution, 25mL distilled water and 5mL NaOH. The solution turned

transparent and clear after NaOH was added. One-eighth teaspoon of murexide ground was added to one flask containing one solution. The color of the solution changed from a transparent faint yellow to a pink color. The solution was then titrated. The solution color changed from pink to purple. This method was performed thrice for accuracy.

The formula $M_1V_1=M_2V_2$ was used to calculate the concentration of Calcium in the crushed eggshell antacid tablet.

B.6. Dissolution time

B.6.1 Preparation of Simulated Stomach Acid

The method used was formulated according to the United States Pharmacopeia. Two grams of Sodium Chloride and 7ml of 1M HCl was dissolved. The solution was added with sufficient water until it reaches 1000mL. The addition of pepsin (purified) was omitted because of finding none in close area proximity.

B.6.2 Determination of Eggshell Antacid Tablet's dissolution time

Two hundred fifty milliliters of simulated stomach acid was each distributed to three 300mL beakers. In the three beakers, three eggshell antacids will be dropped. The time will be recorded until the full antacid tablet is dissolved. Three cellular phone timers were used.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study is to utilize chicken eggshells from hatcheries, poultries and other establishments as an ingredient of a Calcium Carbonate antacid tablet. This study aimed to determine the percent calcium carbonate of Cobb Broiler Chicken eggshells. The eggshells were ground and were made into tablets together with a mixture of Natrosol, magnesium stearate and microcrystalline cellulose. The ground eggshells and the eggshell antacid were titrated with the use of EDTA. The antacid tablets made from eggshells were then tested for their dissolution time. Each set up was replicated three times.

Data was recorded and the results were computed. The obtained results from three trials were then compared.

A. Results

Table 1.1 Standardized EDTA Molarities for three trials with standard deviation.

Trial	Molarity
1	0.0295M
2	0.0299M
3	0.0299M
Average	0.0298 ± 0.000230 M

Using the Equation $M_1V_1=M_2V_2$, results show that the Concentration of the EDTA solution made was 0.0298M this will be used in the succeeding titrations.

Table 1.2 Mass and percent calcium carbonate in Eggshells by titration with standard deviation.

Trial	Mass $CaCO_3$	Percent $CaCO_3$
1	0.0922g	30.7%
2	0.0774g	25.8%
3	0.0749g	25.0%
Average	0.0815 ± 0.00935g	27.2 ± 3.08599 %

Table 1.3 Mass and percent calcium carbonate in the Eggshell Antacid Tablets by titration with standard deviation

Trial	Mass $CaCO_3$	Percent $CaCO_3$
1	0.13g	43.3%
2	0.12g	40.0%
3	0.12g	40.0%
Average	0.125 ± 0.00577 g	41.1 ± 1.90526%

Results in the dissolution time test indicate that eggshell antacid tablets dissolve slowly. After a span of 3 days only a portion of the eggshell antacid tablets have dissolved in 1M Hydrochloric acid.

B. Discussion

The results show that the $\%CaCO_3$ in the eggshell antacids is much higher than the obtained $CaCO_3$ percentage found in eggshells. This may be caused by the color of the shell, the particle size of the eggshells before titration and the non-homogenous distribution of calcium in the eggshell (Abdel-Salam 2006).

The result obtained makes the eggshell antacid a comparable antacid tablet to Tums. In one experiment by Mattson and Saunders in 2003, it was found out that Tums- one of the leading calcium carbonate in the market is composed of 41-43%

calcium carbonate. The result of the $\%CaCO_3$ obtained by the eggshell antacid is 41.11% a number that is between the brackets of calcium carbonate composition in Tums.

The results regarding the eggshell composition might vary because of the non-homogenous calcium distribution on the eggshell thickness reported by Abdel-Salam in 2006. The eggshell color is a sex-linked characteristic of the hen and is usually dependent on how much calcium carbonate the shell contains. The whiter the shell, the more calcium carbonate it contains (Joseph et al 1999). The shell of the Cobb Broiler chicken that was used in this study is brown in color.

The results in dissolution time determination proved that eggshells couldn't be fully digested with the stomach pH of 1M HCl. The filler dissolves in an ample amount of time and yet the powdered eggshells remain intact and float in the water surface. The set up was timed for three days in the hope of making the eggshells still digestible. A study by Nakano and others in 2003 was then concluded right stating that avian eggshells are non-edible, non-digestible byproducts.

The results of this study suggest that the eggshell antacids are comparable to the antacids available on the market with regards to it's percent calcium carbonate; however, the results obtained from this study regarding the Cobb Broiler Chicken Eggshell Antacids' dissolution times suggests that it could not be digested by the stomach, thus, the powdered eggshell from this breed of chickens could not be made into antacids.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This study developed an antacid tablet from Cobb Broiler chicken eggshell powder. This study measured the %$CaCO_3$ present in the eggshells and in the antacid tablets after adding a mixture of Natrosol, magnesium stearate and microcrystalline cellulose as filler. This study also measured the dissolution time of the eggshell antacid tablets.

A. Summary of Findings

1. The results of the eggshell titration proved that Cobb broiler chicken eggshells could be a good source of calcium. Approximately thirty percent of a Cobb Broiler chicken eggshell is composed of calcium.
2. The results of the eggshell antacid solution titration proved that an eggshell antacid is comparable to commercial $CaCO_3$ antacids.
3. The results of the eggshell antacid tablet dissolution time indicate that the stomach could not easily digest eggshells and is therefore not an efficient medicine to cure hyperacidity.

B. Conclusions

The results of the study suggest that eggshells may be a good source of calcium for the body or a good active ingredient for antacids because of their neutralization reaction. into these products because it can not be digested even if it is
powdered. However, a more efficient preparation method must be employed to make the eggshells easily digestible or that the calcium in the eggshells should be converted to a different form.

C. Recommendations

In order to expand the scope of this study, the researchers suggest that:

1. Make use of other chicken breed's eggshells.

2. Use methods that would exhibit a more stomach-like environment and would exhibit hyperacidity.
3. Use a different method and equipment in tablet making.
4. Determine other parameters like tablet strength, expiry date and others.
5. Use a more technological method in determining calcium content of an eggshell.

Literature Cited

Amu O, Fajobi A, Oke B. "Effect of Eggshell Powder on the Stabilizing Potential on an Expansive Clay Soil". Research Journal of Agriculture and Biological Sciences. 2005; 1(1). 80-84.

Antacids [Internet]. [Updated 2010]. Servinghistory.; [cited 29 Jul 10]. Antacid: Mechanism of Action; p.1 Available from: http://www.servinghistory.com/topics/antacid::sub::Mechanism_Of_Action

Egshells [Internet]. [Updated 2010]. Wilder B; [cited 19 Jul 10]; Calcium made from eggshells; p.1 Available from: http://www.healingnaturallybybee.com/articles/supp2.php.

Industry partnership finds alternative uses for eggshell waste [Internet]. [Updated October 2005]. Gatech.edu [cited Aug 29] p. 1. Available from: http://www.whistle.gatech.edu/archives/05/oct/24/eggwaste.shtml

Lux G, Waldherr P, Schmack B, Rosch W. "Long-term effect of calcium carbonate containing antacids on basally and peptone-stimulated hydrochloric acid secretion". Fortschr Med. 1979; 97(37), 1641-1644.

Radwan L, Fathi M, Galal A, El-Dein A. "Mechanical and Ultrastructural Properties in Two Egyptian Native Breeds of Chicken".International Journal of Poultry Science. 2010; 9(1). 77-81.

Rubino A, Margres J, inventors; Armour Pharmaceutical Company, assignee. Antacid Tablets. US Patent 4,115,553. September 19, 1978. 6 p.

Schaafsma A. "Short term effects of a chicken egg shell powder enriched dairy based products on bone mineral density in persons with osteoporosis or osteopenia". Bratisl Lek Listy. 1999;100(12).651-656

Schaafsma A, Pakan I, Hofstede G, Muskiet F, Van Der Veer E, De Vries P. "Mineral, Amino Acid, and Hormonal Composition of Chicken Eggshell Powder and Evaluation of its Use in Human Nutrition". Poultry Science. 2000; 79. 1833-1838.

Stanley S, Ahmed T, Zubaidi S, Riley S, Akbarali H, Mellow M, Miner P. "Calcium Carbonate Antacids Alter Esophageal Motility in Heartburn Sufferers". Digestive Diseases and Sciences. 2004; 49(11/12). 1862-1867.

What is an Antacid? [Internet]. [Updated 1992 Jan]. Cramer T. [cited 29 Jul 10]. p. 1 Available

from: http://findarticles.com/p/articles/mi_m1370/is_n1_v26/ai_11808454/

Yang H, Wang Z, Lu J. "Study on the relationship between eggshell colors and egg quality as well as shell ultrastructure in Yangzhou chicken". African Journal of Biotechnology. 2009; 8(12). 2898-2902.

Prabakaran K, Balamurugan A, Rajeswari S. "Development of calcium phosphate based apatite from hen's eggshell." Bull. Mater. Sci. 2005; 28(2). 115-119.

APPENDIX A

Raw Data

Standardization of EDTA			
Standard	Mass of $CaCO_3$= 1g Vol 1M HCl= 25mL Vol Distilled Water= 1L $CaCO_3$ MW= 100.87 g/mol		
EDTA	Mass EDTA crystals= 3.8g Mass $MgCl_2$= 0.1g Vol Distilled water= 1L		
	Trial 1	**Trial 2**	**Trial 3**
Vol Aliquots	25mL	25mL	25mL
Vol 1M NaOH added	10mL	10mL	10mL
Vol Distilled water added	75mL	75mL	75mL
Indicator	Murexide	Murexide	Murexide
Initial Buret Reading	0mL	0mL	0mL
Final Buret Reading	8.4mL	8.3mL	8.3mL
Molarity of EDTA	0.0295M	0.0299M	0.0299M
Average Molarity of EDTA	0.0298M		

Eggshell Titration			
Analyte	Mass Eggshells= 0.300g Vol 12M HCl= 20 drops Vol Distilled Water= 250mL		
	Trial 1	**Trial 2**	**Trial 3**
Vol Aliquots	25mL	25mL	25mL
Vol 1M NaOH	10mL	10mL	10mL
Vol Distilled Water	25mL	25mL	25mL
Indicator	Murexide	Murexide	Murexide
Initial Buret Reading	0mL	0mL	0mL
Final Buret Reading	3.1mL	2.6mL	2.5mL
Mass $CaCO_3$ in Eggshells	0.0922 g	0.0774g	0.0749g
Average Mass $CaCO_3$ in Eggshells	0.0815g		
%$CaCO_3$ in Eggshells	27.166%		

Eggshell Antacid Titration			
Analyte	Mass Antacid= 0.300g Vol 12M HCl= 20 drops Vol Distilled Water= 250mL		
	Trial 1	**Trial 2**	**Trial 3**
Vol Aliquots	25mL	25mL	25mL
Vol 1M NaOH	10mL	10mL	10mL
Vol Distilled Water	25mL	25mL	25mL
Indicator	Murexide	Murexide	Murexide
Initial Buret Reading	0mL	0mL	0mL
Final Buret Reading	4.4mL	4.2mL	4.5mL
Mass $CaCO_3$ in the Antacid	0.13g	0.12g	0.12g
Average Mass $CaCO_3$ in the Antacid	0.125g		
%$CaCO_3$ in the Antacid	42%		

APPENDIX B

Plates

Plate 1: Collected Cobb Broiler chicken eggshells

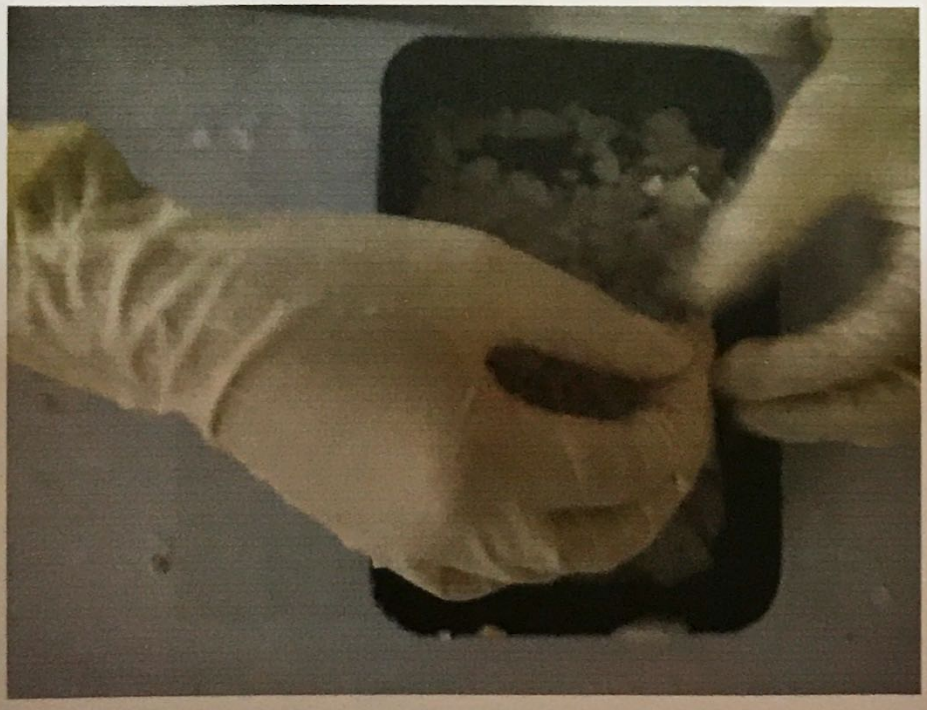

Plate 2: Cleaning and Grinding of eggshells

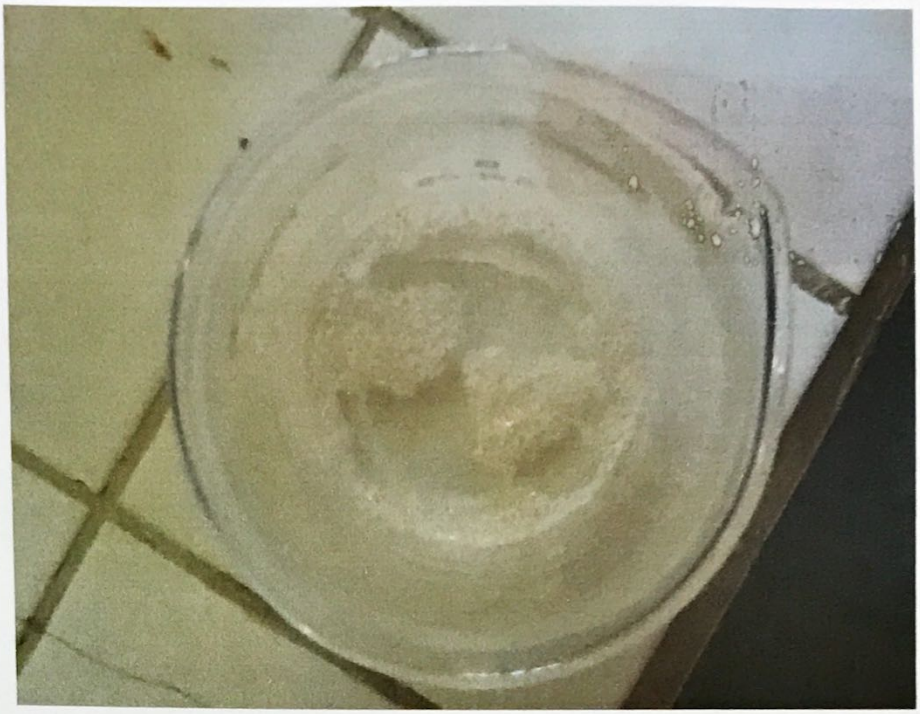

Plate 3: Dissolved eggshells

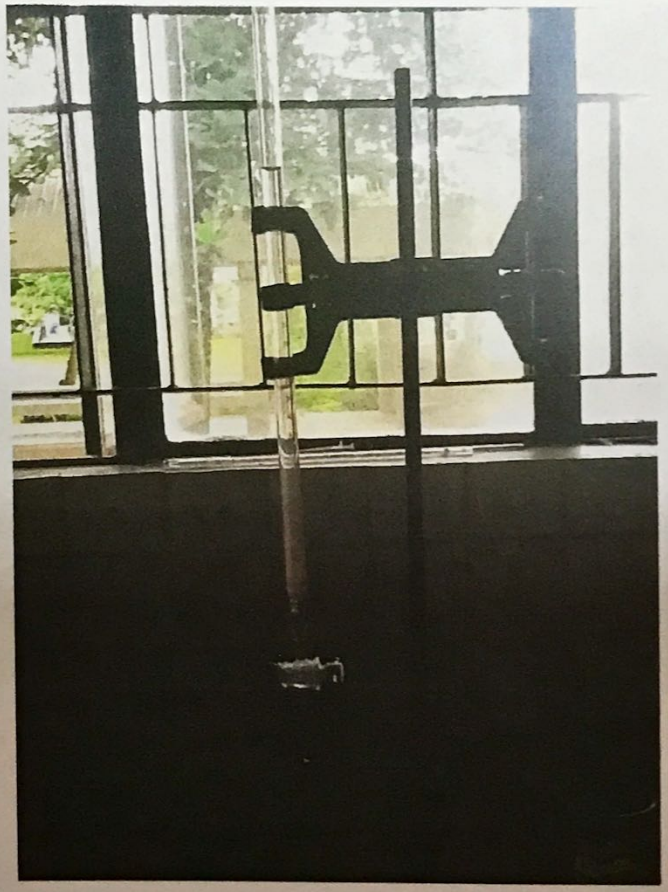

Plate 4: Titration setup

Plate 5: Tablet making

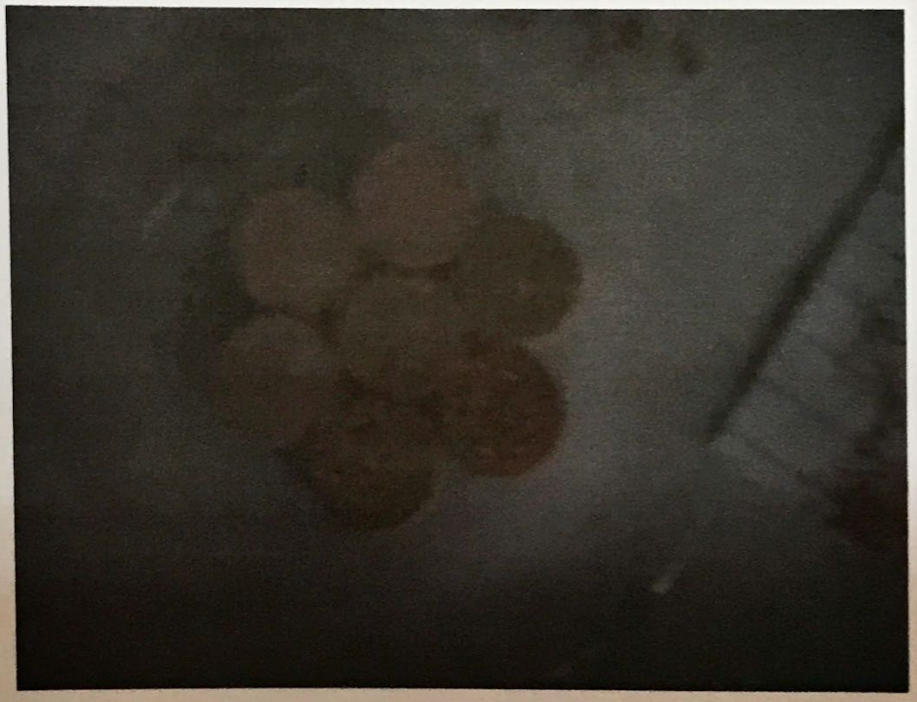

Plate 6: Tablets

Plate 7: Dissolution time setup

APPENDIX C

Sample Calculation

Standardization of EDTA:

Given:

Standard:	Mass of $CaCO_3$= 1g
	Vol 1M HCl= 25mL
	Vol Distilled Water= 1L
	$CaCO_3$ MW= 100.87 g/mol
Vol Aliquots:	25mL
Initial Buret Reading	0mL
Final Buret Reading	8.4mL

Solution:

$$1g\,CaCO_3 \text{ x } \frac{mol}{100.087g} = 0.0099913\,mol\,CaCO_3$$

Diluted to give a:

$$\frac{0.0099913mol}{1L} = 0.0099913\,solution\,of\,CaCO_3$$

25 mL aliquot was taken

$$25mL \text{ x } \frac{0.0099913mol}{1000mL} = 2.496\text{x}10^{-4}\,moles\,CaCO_3\,in\,aliquot$$

Using the equation: $m_1v_1 = m_2v_2$

$$MEDTA = \frac{1000mL \text{ x } 2.496\text{x}10^{-4}\,moles\,CaCO_3\,in\,aliquot}{8.4mL}$$

$$MEDTA = 0.0297\,M$$

Titration:

Given:

Analyte	Mass Eggshells= 0.300g
	Vol 12M HCl= 20 drops
	Vol Distilled Water= 250mL
Initial Buret Reading	0mL
Final Buret Reading	3.1mL
MEDTA	0.0297M

Solution:

$$\frac{0.0297\,MEDTA\,(3.1mL)}{1000mL} = MCaCO_3$$

$$M\,CaCO_3 = 9.207\mathbf{x}10^{-5}M\;in\;aliquot$$

$$\frac{9.207\mathbf{x}10^{-5}M\;in\;aliquot\;\mathbf{x}\;1000mL}{25mL} = 0.00368\;M\,CaCO_3$$

$$0.00368\;M\,CaCO_3\,\mathbf{x}\,0.25L = 0.0009207\;mol\,CaCO_3$$

$$0.0009207\;mol\,CaCO_3\,\mathbf{x}100.87\frac{g}{mol} = Mass\;CaCO_3$$

$$Mass\;CaCO_3 = 0.09215g\;CaCO_3$$

$$percent\,CaCO_3 = \frac{0.09215g\,CaCO_3}{0.3g\;eggshells}\mathbf{x}\;100$$

$$percent\,CaCO_3 = 30.7\;percent$$