

# **TEKNOFEST**

**AEROSPACE AND TECHNOLOGY FESTIVAL 2022**

**TECHNOLOGY FOR HUMANITY COMPETITION**

## **FINAL REPORT**

**Agricultural Technologies Competition**

**Team Name : Matric Warrior Of Maarif**

**Project Title:**

**Utilization of Eggshells in the Protection of  
Food**

**Application ID :**

**473687**

**Team Advisor: Zia Ullah Khan**

**Team members : Asadullah Nadeem**

**Zulqarnain**

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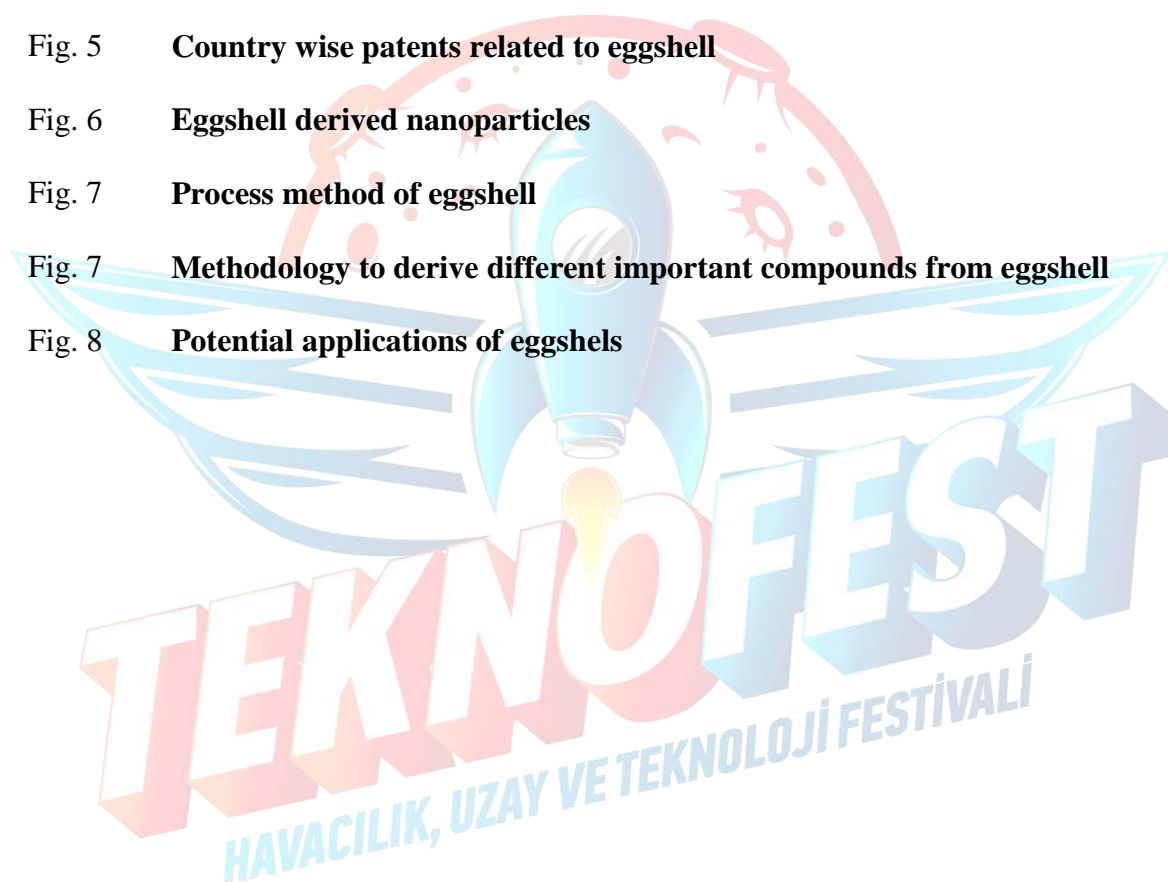
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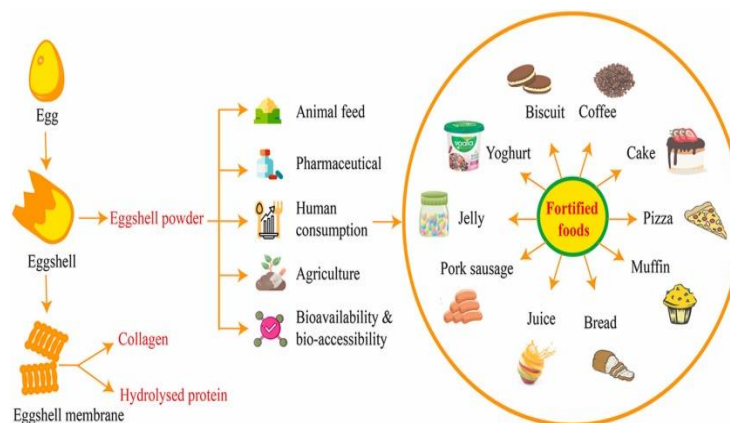
## 1. Project Summary

### **Problem:**

All over the globe millions of tons of food packaging items go to waste which enter the environment and are posing a great threat to the environment and the wilderness. Traditional food packaging is also an expensive method which demands millions of dollars. The transformation of waste products generated from agricultural processes into biocompatible materials, medical items and food packaging is a strategy that will increase the waste utilization. This technique has successfully changed the rather untransformed wastes products into highly beneficial products. Eggshell is considered as agricultural waste material and as useless and mostly discarded mostly because it is thought to be contributor to pollution. This waste has great potential for generating hydroxyapatite, a major biomaterial bone and teeth. The compounds derived from eggshell are used repairing bone tissues and their regeneration. Moreover, utilization of eggshell is perfectly environmentally friendly process. Eggshell based material has good chance of decreasing the cost of food packaging and processing with eco-friendly impact being biodegradable.

### **Idea:**

We worked on the idea of using eggshells for the packaging and protection of food and use of eggshell derived compounds, which not just proved to be a cheap method but also an efficient mean of protecting food items. Conclusively globally on large scale, increased generation of eggs has also increased its wastage on a huge scale in the form of eggshells. This has led to a loss in calcium carbonate minerals and other important minerals constituted in the eggshell and their bio-available shape and beneficial for utilization human. Several research studies in this field have been done to use eggshell waste for agricultural, medical as well as for industrial based applications. Eggshell being a cheaper and easily available source of calcium, it is less laborious to derive calcium carbonate from it. Eggshell has higher bioavailability as compared to synthetic calcium and is also suitable for consumption by humans.. Hence, it can be used as eggshells can be employed for pharmaceutical industries and other purposes such as animal feed as well as for soil enhancers to increase fertility of soil. These actions will also decrease the generation of greenhouse gases by the dumping off eggshells in lands and landfills. It will also protect the environment. Conversely, it will also overcome the calcium deficiency. Addition to it, consuming the calcium from nature derived sources like eggshells will be beneficial as compared to chemical based sources with adverse effects.

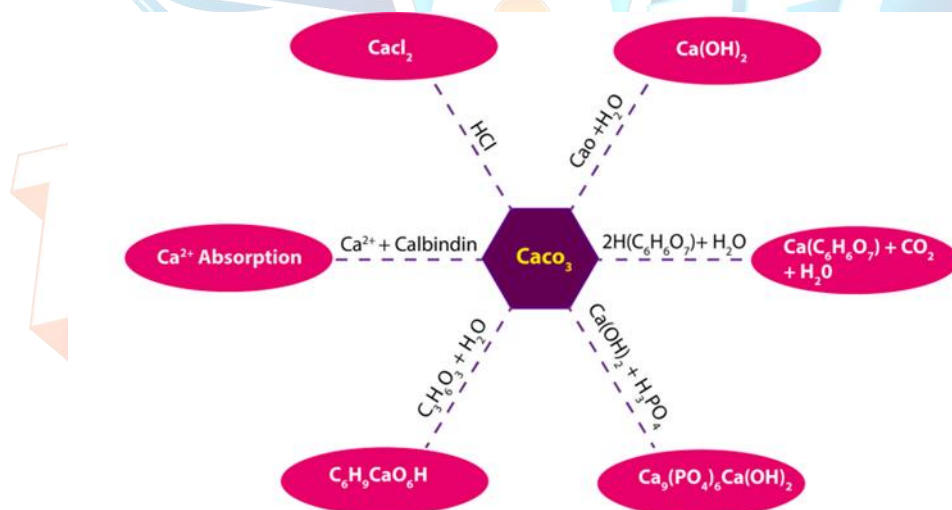


**Fig.1: Various proposed uses of eggshell**

## Project Idea Disclosure

### 1.1. Problem / Need to Produce Solutions

Eggshells contain a cuticle layer on the outermost side which is also known as eggshell bloom. Cuticle covering prevents the bacteria from penetrating inside the egg. We have studied that eggshells with thicker layers of cuticles are more efficient protectors. We can enhance this character of eggshell by depositing a thick layer of cuticle on the outside. This will prevent bacteria from entering the egg by 98%.

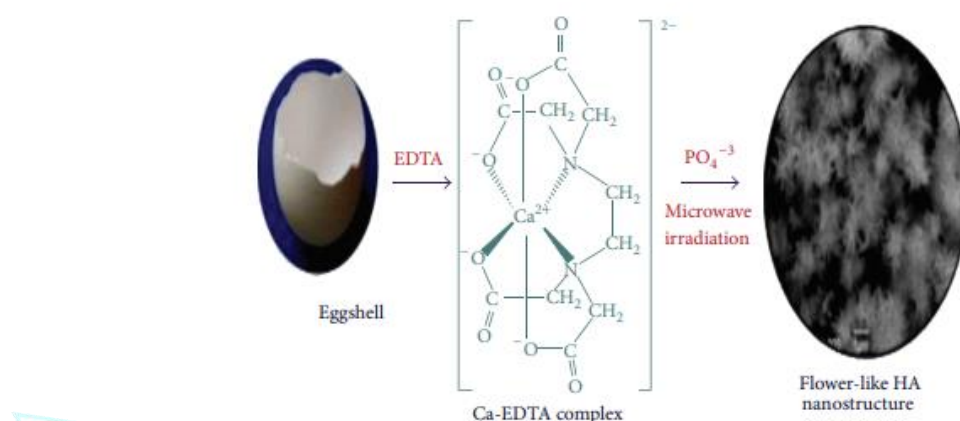


**Fig. 2: Egg shell derived compounds**

Eggshells are also known to prevent the ultraviolet radiations of the sun from entering the shell and damaging the embryo. Ultraviolet radiation may change the composition of foods.



Free-radical as well as photochemical reactions can digest the proteins, damage the antioxidants, oxidize the lipids, make changes to the color and substance, and produce undesirable flavorings and odorous substances. Now we are working on methods to apply this technology practically in food packaging.



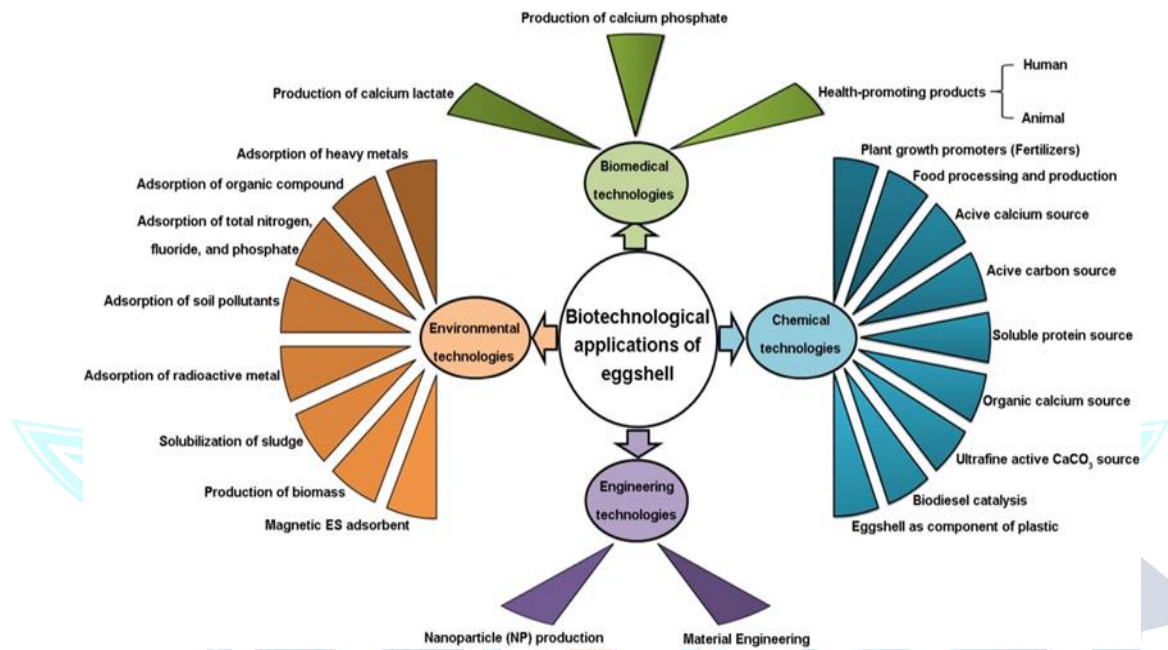
**Fig. 3:** Structure of eggshell

## 1.2. Indigenous and Originality Side

The idea was devised by students and project will be driven by the students of MAARIF Foundation. The idea typically belongs to students and manufacturing and construction will be done by students with supervisors' assistance. The citations are also given in the end. Agricultural waste material utilization has enabled the contributions in many parts of life from its use in feedstock in the synthesis of different biobased products and its subsequent use as renewable based energy source. It has potential to be used as has the potential of decreasing pollution level and environmental effect exerts by dependence on chemical based products. Its employs as a biomaterial in biomedical applications has increased value to its utilization. Eggshell is obtained chickens and other birds as well. Eggshell is a good source of calcium as carbonates and oxides that is good sources of hydroxyapatite. Although these eggshells are not only the first natural source for the formation of hydroxyapatite, it provides a cheap and a renewable and sustainable source of biological HAp.

Both of these hydroxyapatite and nanohydroxyapatite are generated from eggshells. The products are proven by chemical analysis techniques and they do same function with hydroxyapatite. They are biocompatible with mechanical strength as well as durability to

carry out the needed function. This development related to eggshell agricultural waste has enabled a significant contribution in the generation of biomaterials used in medical applications. It will help us in providing better solutions to problems encountered as a result of damage and injuries related with bones and teeth with less medical cost and eco-friendly impact.

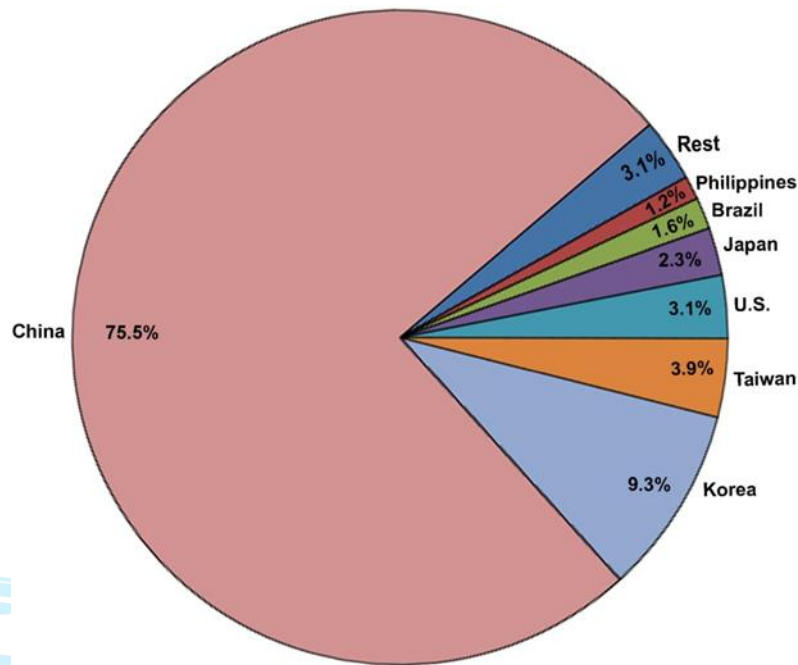


**Fig. 4:** Various biotechnological products from eggshell

### 1.3. Audience

A wide range of customers can be targeted from household users to factories. The product being cheap and ease of availability, it is easy to use and raw material is also available at low cost. We can target a massive proportion of people belonging to various communities. On household level it can be used to store food for a short time. It can also have potentially great applications on commercial level. Industrialists can use it for food packaging. It can be used as a seed starter instead of using traditional plastic seed starters. Pharmaceutical companies can use eggshells for the packaging of medicines. It can also be used to transport food to astronauts in the space. Eggshells can be used to natural

repellent of insects in a field as crushed egg shells keep insects away due to their sharp edges. They are considered a popular choice as an organic pest control.

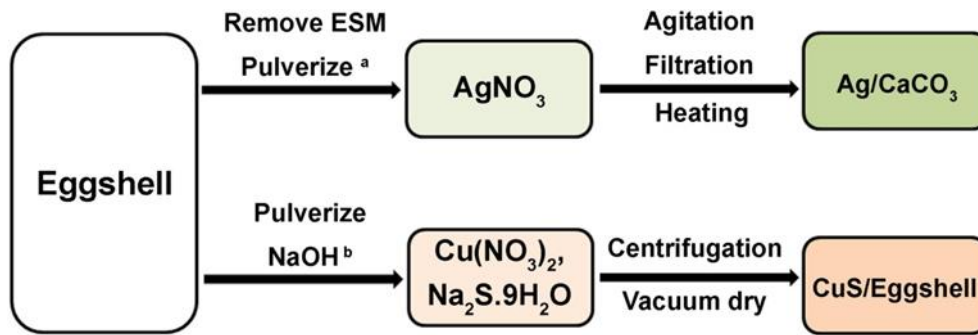


**Fig. 5:** Country wise patents related to eggshell

## 2. Method to Use

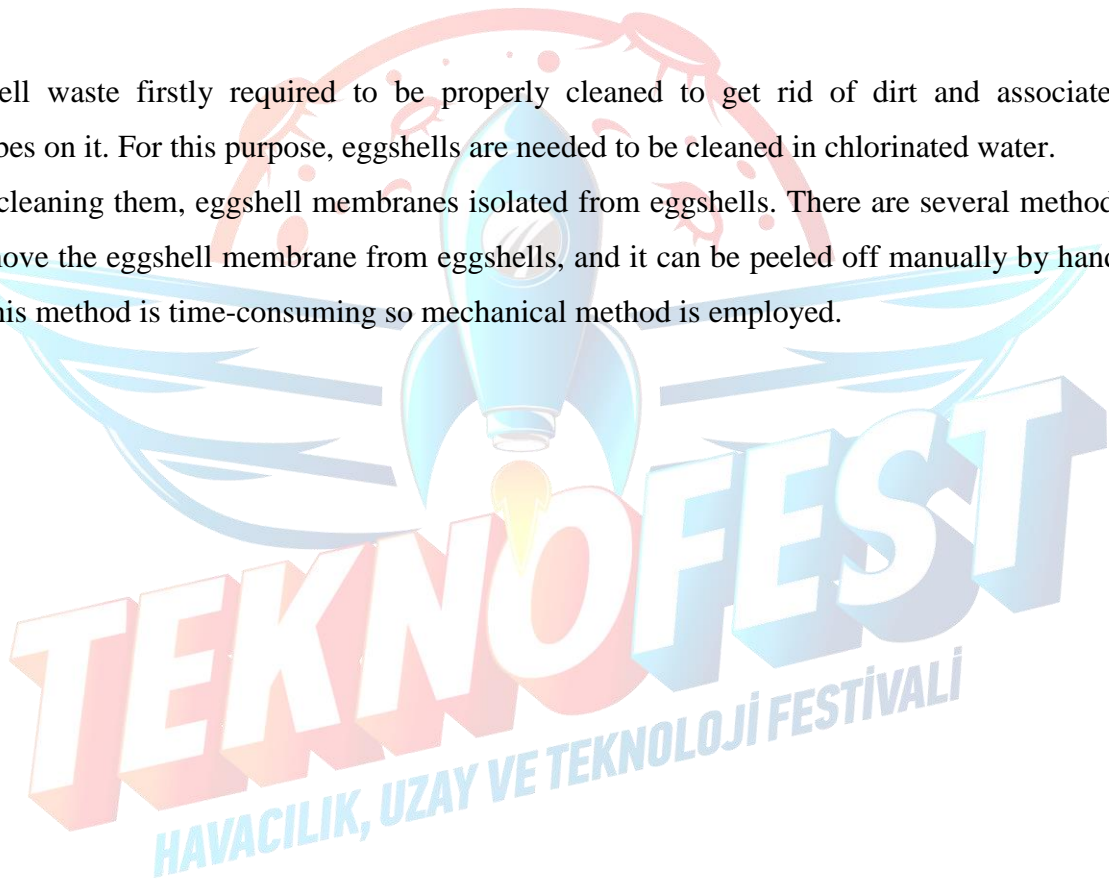
Eggshells are also known to prevent the ultraviolet radiations of the sun from entering the shell and damaging the embryo. Ultraviolet radiation may change the composition of foods. Free-radical as well as photochemical reactions can digest the proteins, damage the antioxidants, oxidize the lipids, make changes to the color and substance, and produce undesirable flavorings and odorous substances. Now we are working on methods to apply this technology practically in food packaging.

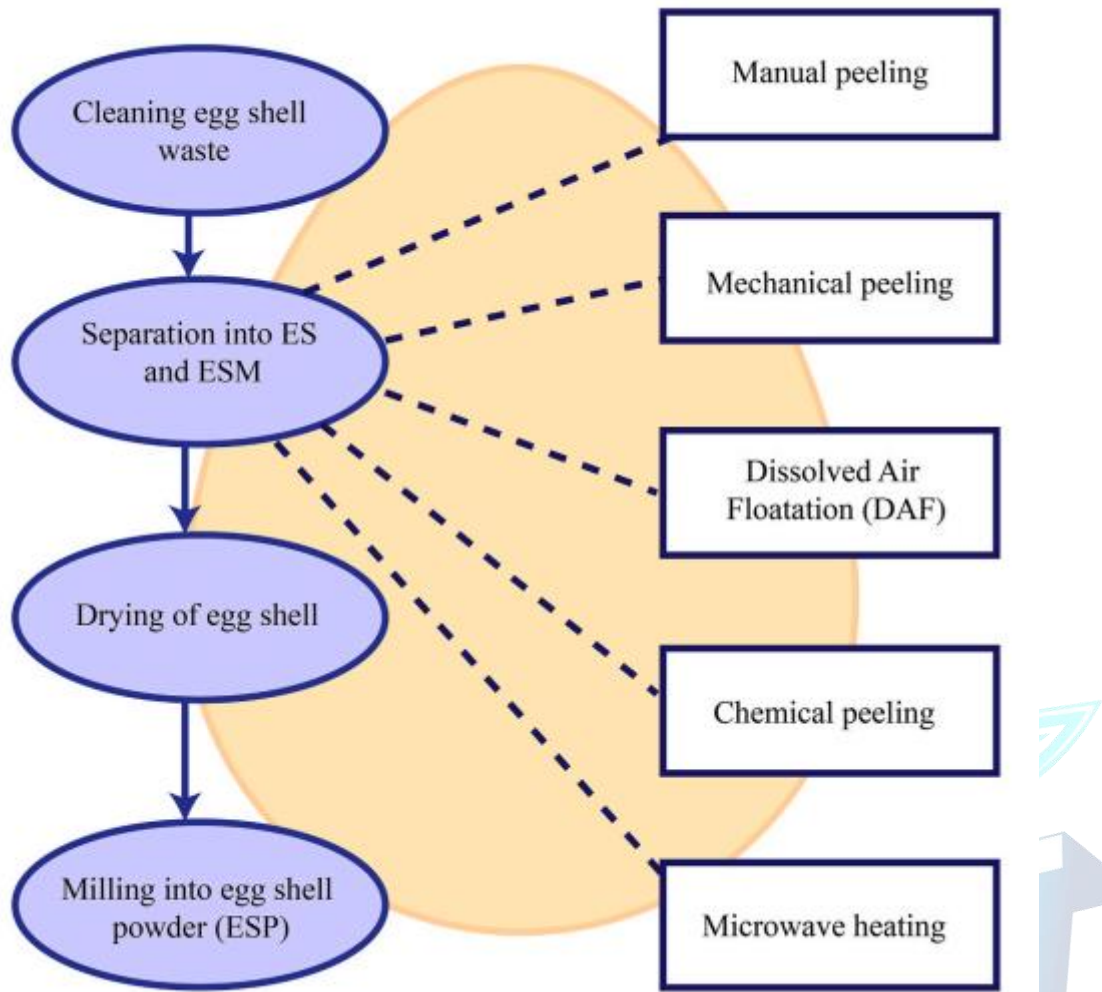




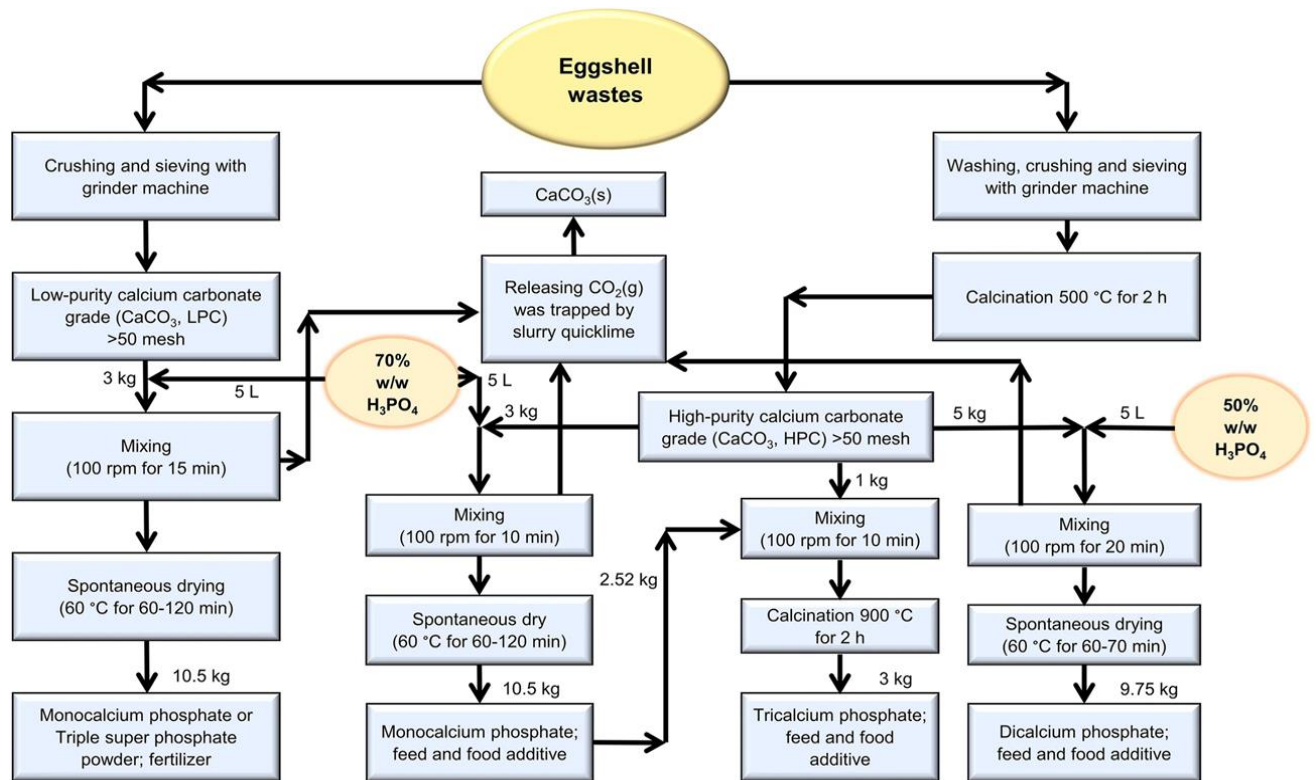
**Fig. 6:** Eggshell derived nanoparticles

Eggshell waste firstly required to be properly cleaned to get rid of dirt and associated microbes on it. For this purpose, eggshells are needed to be cleaned in chlorinated water. After cleaning them, eggshell membranes isolated from eggshells. There are several methods to remove the eggshell membrane from eggshells, and it can be peeled off manually by hand. But, this method is time-consuming so mechanical method is employed.





**Fig. 7:** Process method of eggshell



**Fig. 8:** Methodology to derive different important compounds from eggshell

### 3. Project Calendar

| Process                         | Date          |
|---------------------------------|---------------|
| Project idea                    | 20 March 2022 |
| Submission of project idea      | 30 March 2022 |
| Initial description report      | 2 April 2022  |
| Initial construction of project | 30 March 2022 |
| Optimization of project         | 10 April 2022 |
| Preparation of working model    | 15 April 2022 |
| Preparation of final report     | 13 May 2022   |
| Stock of Eggshells              | 14 May 2022   |
| Processing of eggshell          | 15 May 2022   |
| Utilization of product          | 20 May 2022   |

## **Application of project:**

### **1. Food storage:**

Egg shells can be used for storage of food in storage houses for their temporary stay over there. They are capable of preventing food spoilage and pathogens from turning the food item stale.

### **2. Increase shelf life of food items:**

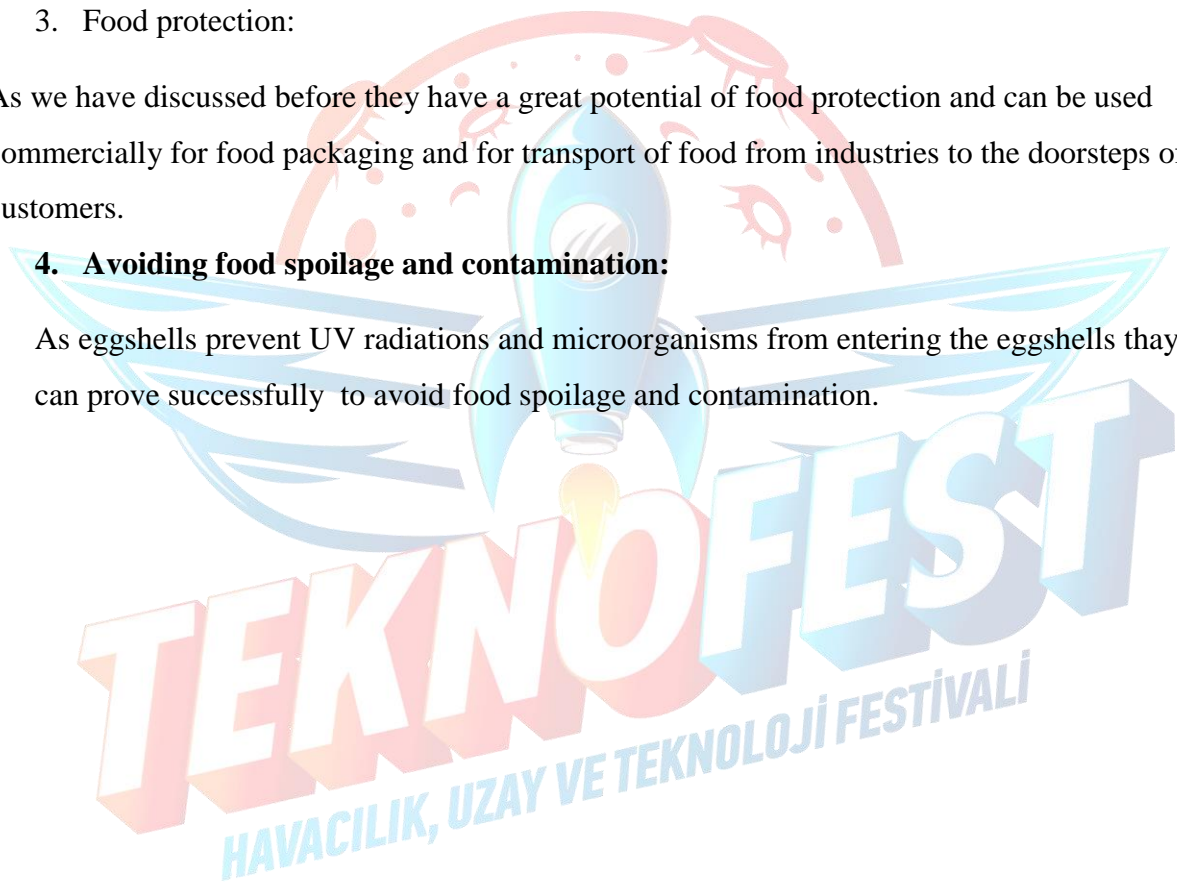
Eggshells are capable of increasing the shelf life of the food as it prevents UV radiations of sun to enter the shell and also prevent microorganisms from entering it.

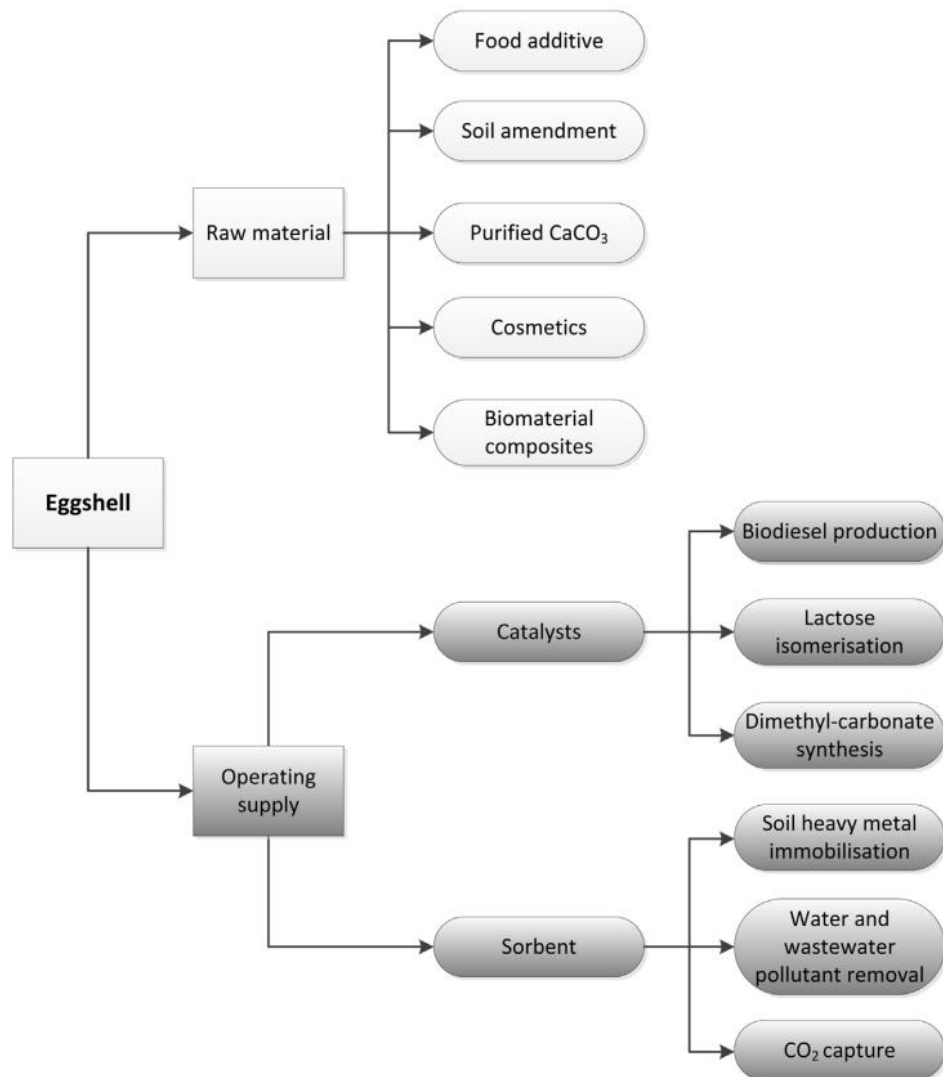
### **3. Food protection:**

As we have discussed before they have a great potential of food protection and can be used commercially for food packaging and for transport of food from industries to the doorsteps of customers.

### **4. Avoiding food spoilage and contamination:**

As eggshells prevent UV radiations and microorganisms from entering the eggshells they can prove successfully to avoid food spoilage and contamination.





**Fig. 9:** Potential applications of eggshells

### Estimated cost (\$)

As raw materials are easily available and we have calculated the estimated cost of 10\$ per 20 kg of eggshell being processed. Majorly cost will be related to packaging materials and labor. Moreover we will also have to cleanse the eggshells before their use as they may contain pathogens and bacteria etc. In packaging of food preservatives will be used and have a minor expenditure.



## RISKS:

This model is not perfect. There is a risk factor of food spoilage if even a small hole is present in the model. Moreover the temperature needs to be maintained within the shell so that food items don't turn stale. However, it is needed to maintain the flavor and texture based condition of fortified products because of poor solubility and mouthfeel of calcium. Also, the incorporation of eggshell powder should be done post sterilization to avoid contamination of food from *salmonella* or pest, or other dangerous pathogens.

Risk factors include the fragility of egg shell. The model is completely perfect but eggshell can be broken easily. The shell of a hen's egg weighs only about one-fifth of an ounce, and it's made from calcium carbonate that's just over one-hundredth of an inch thick. In perfect conditions, that thin layer allows an egg standing on end to bear a 130 pound weight without breaking. But the problem is that a sudden minor force can cause the eggshell to shatter into pieces. Shell quality can be improved by providing the nutrients needed for the hen to build her bone reserves of calcium and make good shells: Feed a third to half of the calcium as large particles that are approximately ½ cm in size.

## References:

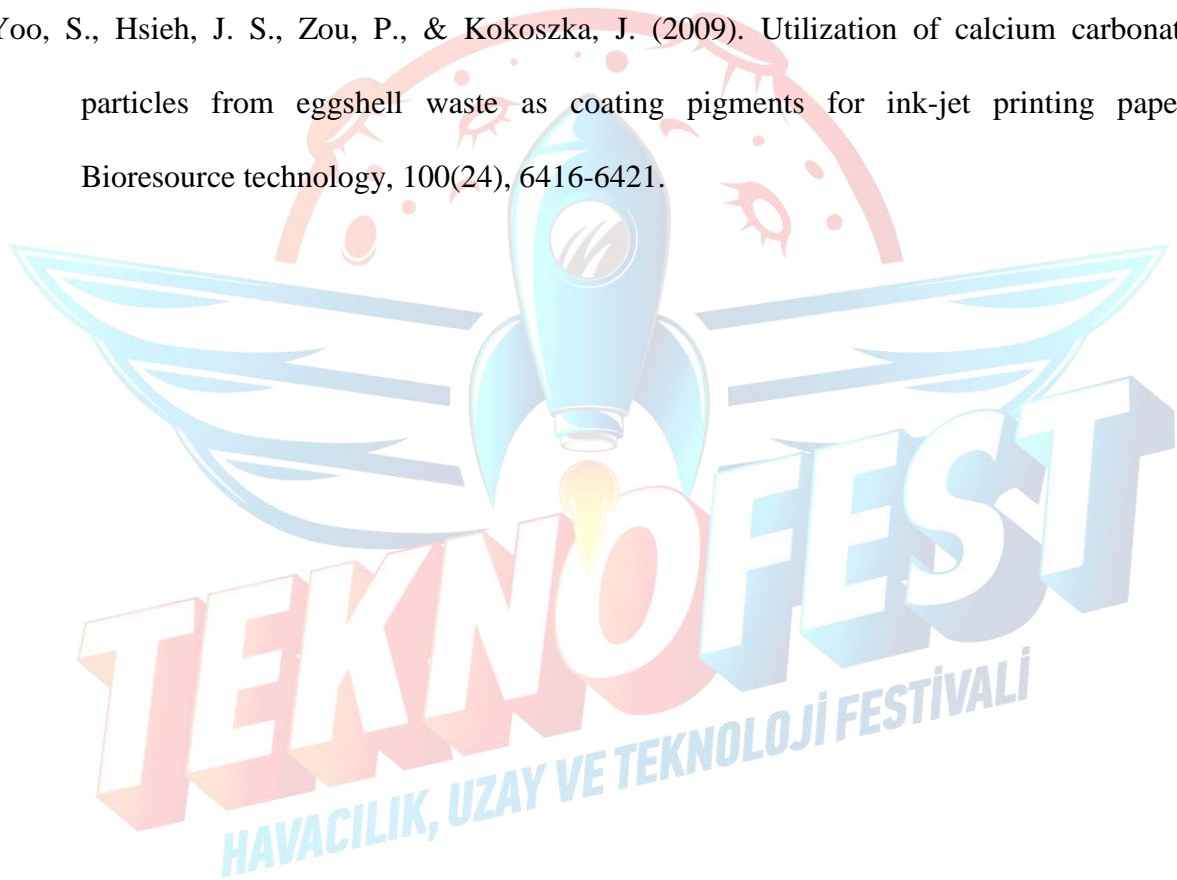
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