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Embryonated-Duck Egg (Balut) Incubator Utilizing Geothermal Surface Manifestation in Negros Oriental

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ABSTRACT

Direct utilization of geothermal energy from surface manifestations is gaining popularity and significant growth in recent years. Among the most common uses of low temperature resources are drying, greenhouse heating, and aquaculture. Most of these projects aim to answer the community's need for a much favorable technology in terms of efficiency, power consumption and economic considerations. The design and fabrication of an embryonated duck egg (*balut*) incubator that utilizes the heat from geothermal surface manifestation would be a big contribution to the local *balut* industry of the province of Negros Oriental. This incubator directly uses the geothermal source at Bulak, Dauin, Negros Oriental to incubate duck eggs into a *balut*, an exotic delicacy common in the Philippines. The use of this incubator, with some initial considerations, have the same efficiency as the existing electric-powered incubators but with significantly much lower maintenance cost having zero electric power consumption, that would eventually transform to economic gain.

1. INTRODUCTION

Direct use of geothermal energy dates back thousands of years. In the past, people used the heat from the earth for cooking, bathing and other activities involving heat. Presently, geothermal surface manifestations like hot springs are also considered as a useful resources for space heating, greenhouses, and other industrial process that needs heat. Among the many uses of this natural heat, agriculture applications are most common for it usually requires a much lower temperature.

Moreover, embryonated duck egg, what is locally known in the Philippines as *balut* is a very common delicacy in the country. It is duck's egg that was incubated for sixteen days, cooked and best served with vinegar as street food in places like Dauin where both local and tourist are fun of eating *balut*. The typical practice of incubating it is by the use of heat coming from incandescent light bulbs for twenty-four hours a day within the entire incubation period.

With the design of a *balut* incubator that would use the readily available hot spring in Bulak, Dauin as heat source would greatly help boost the income of the local *balut* industry in the town and neighboring places. The incubator will be heated solely by the hot water coming from the spring to replace the incandescent light bulbs that consumes much electricity.

2. METHODOLOGY

A sustainable type of incubator will be designed and fabricated. Its performance and reliability will be tested throughout the whole 16 days of egg incubation. In terms of functionality, the designed incubator has a similar principle to the geothermal dryers where the hot water through pipes will transfer heat by convection to the incubator to maintain desired temperature. In acquiring the reliability of the incubator, candling will be done three times; 7th, 11th, and 16th days. Through candling, embryos will be seen and therefore we can tell if the duck embryo is alive or dead.

2.1 Flow of Study

The development stages of the research, shown in Figure 1, consist of the step-by-step process diagram of activities are followed by the researcher in order to complete the project. The first step was to design conceptualization and design specification where researchers plan and gather data and information regarding on the project to be made. Next, determine the design considerations followed by the identification and selection of materials considering the following factors which are the; appropriateness of materials used, availability, and cost.

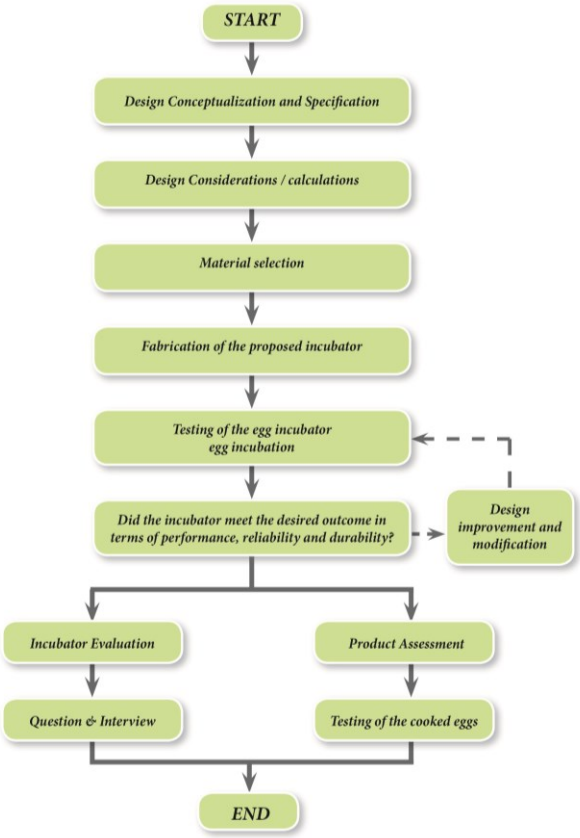

Figure 1: Flow chart of the research design.

Fabrication of the embryonated duck egg incubator that utilizes geothermal source would follow once the materials needed were identified and gathered, these includes assembly of parts, prior for the experimentation or incubation of the eggs. The reliability of the designed embryonated duck egg incubator will be evaluated, if not desirable as expected, the design would undergo improvements and modifications. The designed embryonated duck egg incubator evaluation and product assessment will commence after the modifications and improvements were made.

2.2 Location

The incubator will be mounted in a hot spring in Baranggay Bulak of the Municipality of Dauin in Southern Negros Oriental. Initial investigation, showed that the geothermal source has a temperature that ranges between 70°C to 78°C.

Dauin is a town at the foot of Mt. Talinis, an inactive volcano and home of the Palinpinon Geothermal Power Plant.

2.3 Design

The design of the embryonated duck egg incubator was based on the common electric incubator, but with considerations to the temperature of the source and the desired temperature to be maintained for incubation. Figure 2 shows a three-dimensional illustration of the incubator. At the top part of the incubator are four air vents, that will be manually opened when the inside temperature of the incubator goes more than the desired temperature. Angle bars with meshed wires were used for the making of the trays to make it more durable and stable with the presence of the eggs. Steel angle bars were also used and riveted to construct the frame. Copper tubes were used where the hot water will pass through. Insulators were installed in between the frame and the casing. A glass window was also present to see the inside of the incubator during the incubation period.

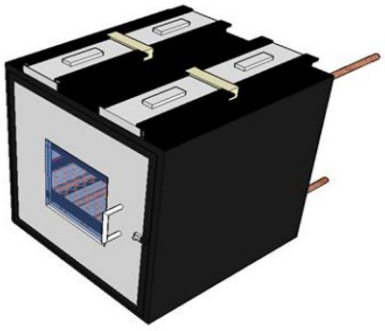

Figure 2: The Balut Incubator

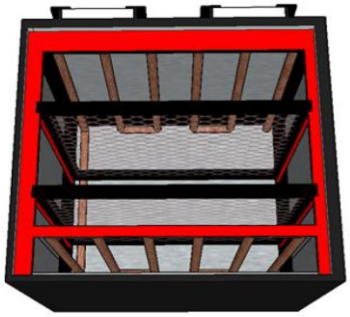

Figure 3: Inside view of the Balut Incubator

2.4 Egg handling and Assessment

The testing of the embryonated duck eggs incubator that utilize geothermal heat source includes the collection of the duck eggs. Thirty duck eggs were used during the testing. The temperature was monitored and maintained inside the incubator. The procedures for the experiment of the embryonated duck egg incubator will be shown in a form of flow chart in Figure 4.

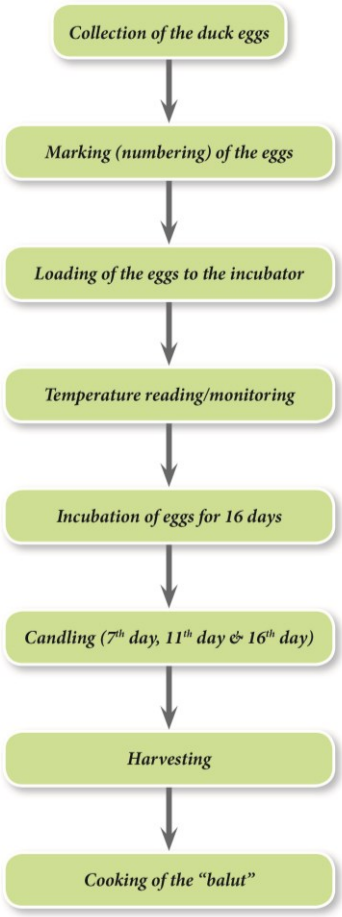

Figure 4: Egg handling process

3. RESULTS & ANALYSIS

3.1. Candling

In order to determine the reliability of the incubator, candling of the duck eggs was done. The first candling will be done in the 7th incubation day of the eggs. During the first candling of the eggs, it shows how many embryos were developing in the first 7 days. Egg #10, #11 and #16 shows the characteristics of an undeveloped embryo. These eggs that have the characteristics of the dead embryo will only be proven in the next candling since the embryo is too small to determine if it is really dead or not.

The second candling was performed in the 11th incubation day of the eggs. During the second candling of the eggs, those eggs with the characteristics of the undeveloped embryo were proven to be dead (egg #10, #11 and #16). These eggs will then be harvested as "*pinoy*" (undeveloped Balut). Eggs having the characteristics of the developed eggs were also proven to be alive, since the embryo shows progress during the second candling.

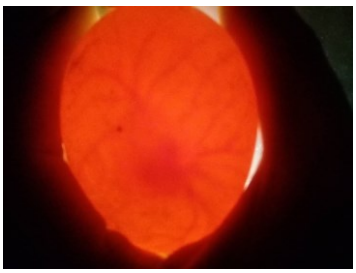

Figure 5: One of the eggs during the second candling.

Third candling of eggs was performed in the 16th incubation day, it is the final candling before they are harvested. At this stage, the eggs will be at the most developed point of the embryo during the incubation period of 16 days in total. 27 out of the 30 eggs were developed into a “Balut”.

3.2 Factors that Affect the Incubator

Weather and ambient temperature, though not much, affects the temperature inside the incubator. Since the incubator was situated on an open field during the testing, the weather conditions on the outside will affect the inside temperature of the incubator. During hot and sunny day, the temperature increases while during cold night or during rainy days, the temperature drops inside the incubator. But generally, the change in temperature inside the incubator did not affect the incubation of the eggs.

Figure 6: Temperature monitoring.

4. CONCLUSION AND RECOMMENDATION

Based on the testing and results, the factors that can affect the functionality of the incubator are the weather and ambient temperature, temperature at the specific time of the day and the environment where the incubator was installed. After testing and evaluation of the embryonated duck eggs incubator, the researchers therefore come up with the following conclusions:

1. The considerations needed for the fabrication of the embryonated duck eggs incubator that utilizes geothermal source were the geothermal source as well as the ambient temperature.

2. In case of sudden increase of source temperature, air vent shall be used to maintain desired temperature inside the incubator

3. By candling we can determine the developed or the undeveloped embryo of the eggs. As recorded, 10% of the total number of eggs did not developed and the remaining 90% of the eggs were harvested after the incubation period of 16 days.

4. A well-insulated incubator can manage to maintain its required range of temperature.

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