Development of a Steam Powered Incubator with Solar Supported System

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Abstract. This research work deals with the development of incubator powered by steam generated from boiled water in which the inner components and micro – controller are powered by solar system. The eggs incubator is designed to be powered by steam source of energy. The materials selected for the fabrication of the incubator were, plywood, Aluminum foil, Gas cylinder and aluminum condenser pipe. The wood was coated with aluminum foil inside in order to prevent heat loss, the six electric bulbs were introduced to complement the heat when the major source was down and three (3) D.C fans of 1.3A rating each for uniform distribution and circulating of heat. All these components were controlled by an integrated micro-controller circuit by sensing and processing the data (Temperature and Humidity). The Temperature, Humidity and egg turning mechanism were controlled and regulated by configuring micro-controller based on the operating conditions of the incubator. The performance evaluation of the designed incubating machine was tested for the period of 18-28 days. The incubating temperature range of (37-39^{O}C) was maintained throughout the incubating period, and the relative humidity ranged from 45% to 60% was also maintained.

Keywords: Micro –Controller, Steam, Temperature, Incubating

1.0 Introduction

Livestock farming in an Agricultural sector plays an important role in Nigeria economic development by providing employment, income and production of meat, eggs, day-old chicks, poultry manure etc. for the Nigerian populace (Okeoma, 2003).

An incubator is an apparatus, which simulates the broody of bird by means of temperature, humidity and ventilation regulation, as well as turning of eggs for embryo development into chicks (Umar *et al*., 2016). An incubator is equipment which assists farmers to produce chicks from eggs without the consent of mother hen. The difference between natural and artificial incubation is the fact that in latter mother hen provides warmth by contact rather than surrounding the egg with warm air as it is in artificial incubation.

Study of the chicken egg and its development from the un-incubated stage to the emergence of the chick from the shell has been interesting. The developing chick in an egg is called an embryo, and a careful study of the different stages of embryonic development uncovered many interesting facts. Incubation of eggs shows the effects of heat, air, and moisture on hatchability. It shows how an egg is formed, their different parts and their functions, and how a chick embryo develops (Okeoma, 2003).

Temperature is the most important factor in incubation efficiency, the recommended temperature vary between 37.5 – 39.4^0 C (Ogunwade *et al*., 2015). Most of the failure recorded during hatching processes was majorly due to humidity not being set correctly, the ideal humidity should be varies between 50-55% for the first 18 days of incubation and for the last three days, about 65% (Ogunwade et al. 2015). The normal and standard atmospheric air is usually 20-21% oxygen.

2.0 Materials and Methods

This describes in detail the material selection and experimental procedure used in the experimental incubation of poultry eggs for 21 days (21) days after the hatching of the different eggs. The focus is on the vital role of the steam and microcontroller, which practically controls all devices in the incubator to provide the conditions for the incubation of poultry eggs.

The incubator is simple in the physical and economic nature of the use of materials. The heat is generated in the heat chamber by a controlled steam cylinder and distributed evenly throughout the incubator by the forced pressure flow through the use of centrifugal fans installed in strategic areas within the incubator. The relative humidity and uniform temperature conditions are maintained inside the incubation room by the microcontroller throughout the incubation period for poultry eggs.

3.0 Description of the cabinet incubator

A schematic diagram of the cabinet incubator consists of the following elements:

I. The cabinet is divided into three sections

ii. The egg trays and their rotating mechanism

iii. The charcoal pot and cylinder

iv. The microcontroller

v. Centrifugal fans and

vi. The battery

vii. Bulbs

viii. Sensors

The principle of operation of an incubator in this research work based on the transfer of heat generated from steam by boiling water in the cylinder heated to 100^0C, and the nub of the cylinder open and the steams started flowing through the Aluminum condenser pipe to the different cabinets while the battery supplies the microcontroller and the wiper engine that rotate the link to the eggs crate with electrical energy. Heat is generated in the incubator, which raises the temperature to 39°C and then the temperature sensor triggers the steam. The microcontroller also activates the humidifier to generate the required humidity of 55% and more.

The main function of radial fans is to ensure the circulation and uniform distribution of heat, humidity and fresh air in the incubator. The microcontroller also rotates the egg shells at different times in incubator per day.

The 3D sketch of the incubator was developed using the commercial software Pro E and Creo. This was used to develop a 2D orthographic projection of each part of the incubator. These orthographic projections were used as working drawings in the manufacture of the incubator. The developed 3D model is shown in Appendix A while the working drawings are shown in Appendix B

The egg tray provides sitting for the egg cartons are rotated every designed times per day by the action of a system activated by the microcontroller that consists of an electric motor (wiper Engine), and a link relation to the horizontal.

The microprocessor had a digital screen that recorded the temperature and humidity of the incubator during the incubation of eggs. The microprocessor controls the radial fans that regulate the flow of hot air from the steam through the Aluminum condenser pipe to the incubation chamber, thus maintaining a uniform and uniform temperature requirement for the incubator. The microcontroller also was to sense or monitor the temperature and humidity to prevent overshooting and undershooting. It is important to measure the temperature and humidity of the incubation during the twenty-one day incubation period over an hour interval to facilitate comparison of the incubation efficiency of the eggs. Once the temperature rises than the require temperature or below it, the incorporated alarm start blowing to notify there is a problem, if its higher the aluminum condenser pipe pulls out and reduce the heat transfer.

The temperature at each cabinet is different due to (temperature gradient) that occurred as a result of condensation. Condensation is the process of a substance in a gaseous state transforming into a liquid state.

4.0 Result and Discussion

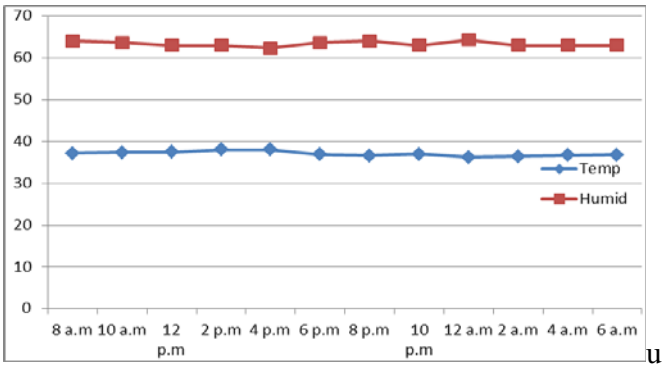
The objective of the project was to develop a steam powered incubator with the support of solar system, using materials that were readily available in the local market with the aim to increase the rate of chicks. The results obtained from the performance evaluation done on the developed incubator are the incubating temperature and humidity as well as the ambient temperature. The incubator was kept in a well-ventilated room for the testing. The incubator was left for five minutes for proper heat conduction into the incubator.

The temperature in the incubator was measured with thermometer and the heat generated via the steam was regulated until a temperature of $38^{O}C$ was achieved. Then, 20 fertile chicken eggs were set on the egg tray inside the incubator, although, the egg tray can accommodate 180 eggs. The eggs were turned at five hours intervals daily. In order to prevent high temperature,

.After the completion of incubation, the efficiency of the incubator was also determined based on the percentage hatchability.

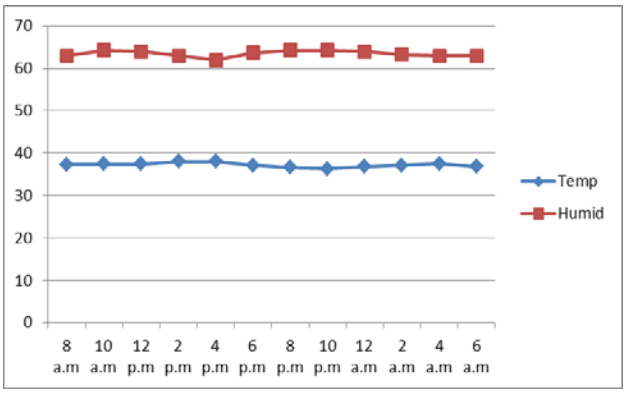
The below was first second day reading

Day 1



u

Day 2

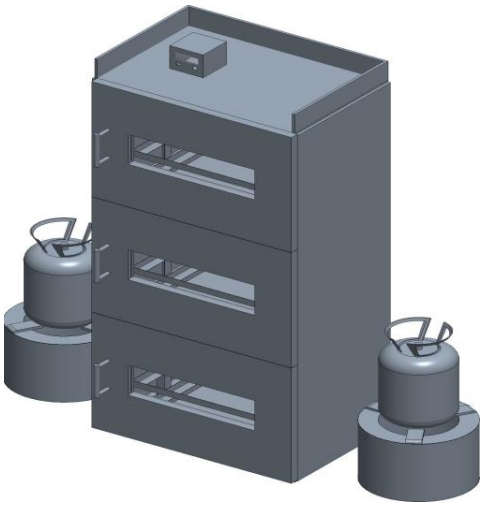


5.0 Conclusion

The foregoing exercise has demonstrated the possibility of incubation of eggs using steam powered energy and solar system support. The development of the steam powered with solar supported system incubators has established the possibility of using readily available materials to increase chicken production. The result was quietly okay, this shows that the system developed is efficient.

Recommendations

The further research should be on the mechanism that will be slot the cupper pipe in and withdraw whenever the temperature is higher and lower than the require temperature respectively.



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