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ARTIFICIAL INCUBATION OF POULTRY EGGS - 3,000 YEARS OF HISTORY -

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INTRODUCTION

The development of the poultry industry over the years is absolutely remarkable and the evolution of artificial incubation is not less extraordinary. From Egyptian rudimentary incubators to the concept of single stage incubation using extremely sophisticated machines, three thousand years of continuous progress was achieved by understanding the incubation process and consequently developing efficient equipments. In this article, this very interesting history is summarized.

ANCIENT INCUBATORS

At around 3,000 years ago, the early Egyptian incubators consisted of a large mud brick building with a series of small rooms (ovens) located at each side of a central passageway. In the upper part of these "small incubation rooms", there were shelves for burning straw, camel manure or charcoal in order to provide radiant heat to the eggs below. Vents were located in the roof of these chambers and they allowed smoke and fumes from the fires to escape and also provided some light. The entrance to each incubator room from the passageway was through a small manhole.

Thousands of eggs were placed on the floor of each incubator room and they were turned twice a day. Temperature control was achieved by controlling the strength of the fire, the opening of the manholes and by regular openings of vents in the roof of the ovens and passageway. Humidity was controlled by spreading moist jute over the eggs when necessary.

In this rudimentary incubation system, the temperature, humidity and ventilation were checked and controlled without using measuring devices like thermometers. It was done by having the hatchery manager and the hatchery workers actually living inside of the building. By living there, they would soon learn to judge the humidity, temperature and air freshness using their own feelings and their sense of touch. In other words, they were able to detect any deviation from the standard. It is recorded, for example, that they used to test the temperature of the egg by holding it against their eye lid, the most sensitive part of the body for judging temperature.

Aristotle, the Greek philosopher, writing about poultry at around 400BC, describes a similar method to Egyptian incubators, but the necessary heat to the eggs was provided by burying them in piles of decomposing manure.

Artificial incubation of eggs was also practiced in China as early as 246 BC and this method eventually spread through South East Asia. As in Egypt, a heavy walled, insulated mud brick building was used and inside of it, there were a series of mud brick ovens heated by charcoal fire. Similarly to the Egyptians, the temperature of the eggs was measured against the eyelid of the operator.

The Chinese utilized the concept of heat transfer. After the chick embryos developed, they started to produce increasing amounts of heat and consequently they did not need added heat. By mixing bags of older eggs with the newer ones, this animal heat helped to warm the new incoming eggs. At 16 days, fowl eggs were removed to another hatching area in the building, where they were just covered with a blanket and allowed to hatch from 19 to 21 days.

THE DEVELOPMENT OF MODERN INCUBATORS

By the mid 1600's, Egyptian experts were brought to Europe to build and operate an Egyptian type hatchery, but they were not successful and the project was abandoned. Probably, this failure was due to the adverse climate conditions during the winter time in Europe in contrast with the warm and fairly constant temperature in Egypt which helped to make their method successful.

After the failure of the introduction of the Egyptian incubators in Europe, the objective became to develop more sophisticated mechanical machines. In 1750, a French scientist, de Beaumur, published "*The art of hatching and bringing up domestic fowls of all kinds, at any time of the year, either by means of hotbeds or that of common fire*". This author used fermentation to heat the incubator as well as a rudimentary type of thermometer.

Over the following 100 years, more experimental incubators were produced, some using hot water, some heated by charcoal and others by steam. However, very few of these machines were successful as they were unable to regulate the range of temperature within the narrow range which was required.

In the second half of 19th century, the advent of thermostats to regulate temperature accurately allowed the development of more efficient incubators. From this point on, several models of small machines were developed and sold mainly to small poultry producers.

In the first decades of 20th century, there was the development of the new concept of incubators in United States. Electric "forced-draught" machines revolutionized the production of day-old chicks not only in the hatchability but also in the quality of the chicks. These large "forced-draught" incubators allowed massive production of chicks with very much less labour resulting in reduction of production costs. The commercial poultry industry as it is known today was on its way.

From 1960 onwards, the progress of the poultry industry was extremely rapid throughout the world and two outstanding changes occurred. One was the increasing size of poultry operations, with huge flocks being reared in a single shed and consequently, the capacity of the incubators had to be increased to support this growth. The second great advance was related to the technology. Since then, hatcheries have become a great technological site with electronic controls to regulate the temperature within 0.1°C of variation, automatic humidifiers to control the moisture, eggs are turned automatically 24 times a day, alarm systems alert for any problem in the machines, all necessary information is provided in a digital display outside of the machines and, furthermore, the complete operation can be monitored and controlled through central computerized system.

The 21st century has seen the development of even more sophisticated technologies to improve the monitoring and controlling of the incubation environment. Systems for automatic measurement of carbon dioxide, weight loss from eggs and even the temperature of the eggs *in situ* have been developed and these data are used to control heating, cooling, humidification and ventilation of the machines. This constant evolution of the hatchery equipments is part of the most dynamic and efficient animal industry in the world.

CONCLUSION

Since Egyptians started the process of artificial incubation of eggs, its principles were established and they consisted of providing a warm and humid environment for the eggs and turning them periodically. It is interesting to note that, after three thousand years, the modern machines work basically in the same way. Furthermore, the success of those rudimentary incubators did depend on the workers who lived inside of the incubators. Nowadays, highly sophisticated machines with automatic control of all vital parameters are used, but the success of the whole process still relies on the people who work at the hatcheries. In other words, the hatchery manager and its team do make all the difference.

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