HatchTech
INCUBATION TECHNOLOGY

Technical Information

Storage of the Avian Embryo
Storage before Artificial Incubation

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Due to variable market demands for day old chicks in the poultry industry it is common that hatching eggs are stored before incubation starts. Eggs are stored at the breeder farm before they are transported to the hatchery. After arrival at the hatchery, it normally takes a few days before the eggs are set in the incubators.

At both locations eggs are stored in a storage room, where the temperature and relative humidity is controlled. If the storage period is less than 7 days a storage temperature of 16 to 18°C is advised and if the storage period is longer, a temperature of 10-12°C is mostly recommended. To prevent water loss from the eggs, the relative humidity in the storage room is kept between 70 and 80%. Despite of the climate regulation in the storage room it is commonly known that hatchability declines if the storage period is longer than 7 days (Becker, 1964). On the other hand it is also known that early embryonic mortality increases if eggs are set on day of oviposition. A short storage period of 3 to 4 days seems to be necessary for a good hatchability (Decuypere et al., 2001).

In practice, longer storage periods are sometimes unavoidable. It is common known that eggs of young breeder flocks are better suitable for prolonged storage periods than eggs of older breeder flocks, because albumen quality in eggs of younger breeder flocks is higher.

In nature, storage periods of more than 7 days are common as well, because a hen starts incubation when all eggs of a clutch are laid. Nevertheless the detrimental effects of prolonged storage perods in nature seem to be less than in artificial incubation. Consequently an interesting question is: what is the difference between storage in nature and storage before artificial incubation?

Storage in nature

Storage of eggs in nature seems to be simple. The eggs are laid in a nest and there is no regulation of temperature or relative humidity. Once a day the hen comes to the nest and lays an egg. While the egg is laid the other eggs in the nest are warmed for a short period. If a clutch of eggs is ended incubation starts.

What happens in the egg during storage?

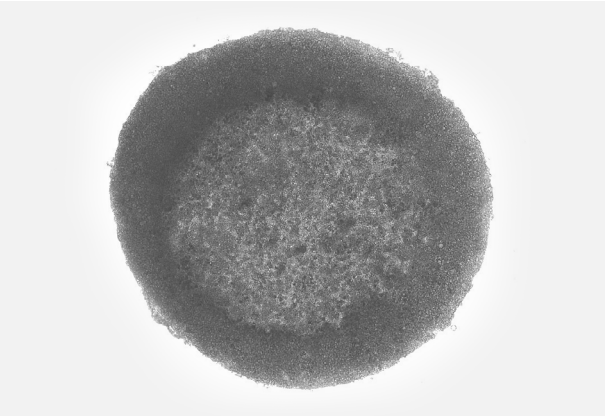
After oviposition, an egg cools down to ambient temperature and an air cell is formed due to evaporation of water through pores in the shell. Carbon dioxide is released from the egg, resulting in an increase in albumen pH from 7.6 at oviposition to a pH of 9 to 9.5 within 4 days of storage and a decrease in albumen height (Lapao et al.,1999). The yolk remains slightly acid during storage, at a pH around 6.5 (Bakst & Holm, 2003). The loss of carbon dioxide to the environment and thus changes in albumen pH and albumen height is dependent on length of storage period, storage temperature, transport of carbon dioxide thought the albumen, conductance of the eggshell and eggshell membranes and the concentration of the carbon dioxide outside the egg (Meijerhof, 1994). One of the positive effects of the increase in albumen pH is the protection of the embryo against a bacterial invasion. Due to the relatively high increase of albumen pH during storage, a pH difference arises between yolk and albumen. This difference might be necessary to facilitate certain transport functions across the albumen and yolk to and from the embryo (Benton & Brake, 1996). A decrease in albumen height is necessary to meet the oxygen requirements of the embryo during storage and early incubation. Thus, a change in albumen quality during storage seem to be necessary to protect and support embryo development.

The advise to decrease the storage temperature if the storage period increases, is to slow down the loss of carbon dioxide from the egg and to slow down the development of the embryo. Excessive loss of water during long-term storage has generally been reported to be detrimental for hatchability (Walsh et al., 1995). The reason for this is not totally clear. By controlling the temperature and relative humidity in the storage room the processes in the egg are slowed down, but

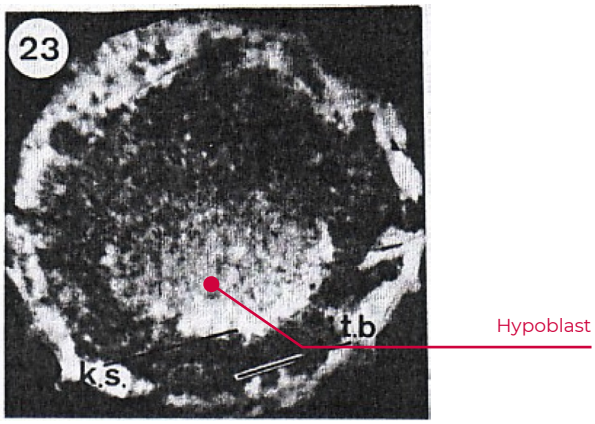
probably not enough to maintain embryo quality after prolonged storage periods. There must be an other factor that is important to maintain embryo quality.

Since the beginning of the 20st century it is known that a decline in hatchability of avian eggs caused by prolonged storage periods can be reduced by pre-storage incubation. In nature the hen also incubates the eggs every time she lays another egg.

Results of studies done by Fasenko et al. (2001) and Lourens (2001) showed that hatchability of broiler breeder eggs stored for 14 days was significantly better after 6 hours of pre-storage incubation than without pre-storage incubation. Lourens (2001) also showed an increase in chick quality. Fasenko et al. (2001) and Lourens (2001) suggested that there is an optimum in the length of the prestorage incubation period of fresh laid eggs. After 6 hours of pre-storage incubation, the embryos had formed the hypoblast (an extra cell layer) completely. It can be hypothesized that an embryo with a higher number of cells is more resistant against a prolonged storage period, because although cell death occurs, more viable cells are available for normal growth and development at the start of the incubation process. Another advantage of the hypoblast stage of development might be that it is a quiescent developmental period. If an embryo is stored at a very active period of development the chance to damage the cells might be higher.



Developmental stage of the embryo at oviposition



Developmental stage of the embryo after 6 hours of preincubation storage

In conclusion, temperature and relative humidity are not the only factors that need to be controlled during long-term storage. The developmental stage of the embryo also seems to be important in order to maximize embryo development, hatchability and chick quality.

Since October 2005 Wageningen University in the Netherlands started a PhD project in cooperation with HatchTech Incubation Technology and Hybro on the subject of storage and early incubation of the chicken embryo. HatchTech also developed a special version of their innovative incubator especially for pre-storage incubation at the breeder farms. The fundamental knowledge and practical experience will help to reduce the negative effect of storage on embryo development, hatchability and chick quality.

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