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The effectiveness of short-term preheating of "Kobb 500" hatching eggs during their long-term storage

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Abstract. Creation of highly productive cross-countries, transition to nonconventional power supplies of a bird, sharp restriction of its vital space, constant accumulation of egg and meat efficiency has led to very essential changes in a structure and physical and chemical properties of eggs. It forces scientists and practitioners to make certain changes to requirements for quality of incubatory eggs, the modes of their storage and incubation. Influence of preincubatory storage of eggs on deductibility is a subject of long-term researches, but the modern theory doesn't offer any explanation of contradictory information which we have now. Bird's egg quickly loses the initial properties therefore can't maintain long-term having rummaged in development (the latent period) and in several days of storage becomes of little use for an incubation. The researches confirmed that creating conditions close to the natural process occurring in the nest due to the application of short-term heating of eggs during the storage period, can contribute to maintaining high hatchability at its longer storage. In conditions of forced storage, the short-term preheating of hatching egg to the optimum temperature allows to increase chick hatchability by reducing embryonic death and reducing the incubation time.

1. Introduction

Due to the dynamics of the market requirements of day-old chicks and the wide variety of commercial hatcheries, the storage of hatching eggs is often inevitable.

Although the detrimental effects of storage on hatchability and chick quality is known for a long time, hatchery managers aim to optimize the use of modern machines power, and minimize the transportation from farm to hatchery. In such a way effectiveness improves and expenses reduces. Although hatchery managers are well aware of the measures that can be taken to reduce losses, nevertheless, many people have difficulties in observation these measures in hatchery practice. However, losses due to long-term storage can be significantly reduced by the consistent application of these methods in planning of hatchery programs. Moreover, the recent studies reveal new aspects of what is happening inside egg during its storage. However, these changes in white of the egg determine the quality of hatching eggs in terms of its potential for the development of (healthy) chicken. The quality off egg is the highest on the day of laying while changes of viscosity of the white of the egg and in the pH level mainly occur during the next four days. However, the egg stored for 1-2 days has the best hatchability. Thus, this is the egg with a "conventionally optimal" quality of white of the egg. The results of recent studies show that the chick embryo itself initiates changes in characteristics of white of the egg, probably, optimizing the environment for incubation [1–3].

Despite this, the following measures provide a useful tool to reduce losses due to storage:



- The age of parent flock has an important influence on hatchability and quality of chickens. If possible, it is preferable to store eggs from a young parent flock, than eggs from old flocks, since the reduction of hatchability due to storage has a greater effect on the egg from old parent herd.
- The storage temperature. After egg laying temperature inside the egg drops sharply below physiological zero. It is the minimum temperature at which embryonic development occurs. However, the temperature below this level affects on other characteristics of egg, thus affecting on the quality of egg. When the storage of egg is expected to last for a maximum of three days, the temperature should be maintained between 18-21°C. If the storage period increases to 4-7 days, the egg should be stored at a temperature of 15-18°C. When the storage period is more than seven days, the recommended storage temperature of eggs is reduced to 10-12°C.
- The relative humidity. Despite the fact that the requirements for the optimum level of relative humidity maintenance are not so stringent as compared with temperature values, it is important to realize that egg can lose too much humidity if it was stored in low humidity conditions. Especially, the egg with thin or porous shells, usually from adult parent flock, is at risk of dehydration. The relative humidity during storage should be between 70-80 %.
- The turn of egg. The turn of egg can restore the hatchability level after pre-incubation storage. While earlier studies suggested that this method is applicable only after a long-term storage period, the recent research results show that the turn of eggs four times a day brings positive results already at the storage of eggs during seven days.
- The duration of incubation. In the stored egg, not only the embryonic development is delayed, but also the degree and rate of growth and development. Therefore, the duration of the incubation process should be extended by one hour for each storage day. For this purpose, the egg laying plans for incubation should be made taking into account the duration of its storage.
- The pre-incubation processing. Studies showed that preheating of eggs immediately prior to the start of incubation can reduce losses on the output as a result of storage. During the preheating period, the temperature of various components of egg becomes homogeneous before incubation begins, which leads to a more homogeneous early embryonic development.
- The incubation temperature. The latest results of studies using turkey eggs showed the positive effect of temperature increase during the first and the second weeks of incubation on hatchability of the stored egg.
- The position of egg. The positive effect of storing eggs with the pointy end up is known for a long time. Thus, the central position of egg-yolk (and therefore the embryo) is maintained during storage.
- The pre-heat therapy on the farm. The temporary heating of egg immediately after eggs laying before storage helps to reduce losses on the output due to storage [4].

Despite the fact that this issue is the subject of numerous reviews and studies, the mechanisms that cause a quality degradation of eggs as a result of storage are still not clear today. It is well known that the viscosity of egg white (height of egg white) decreases, and the pH level of egg white increases during storage. The feature of a breeding bird of "Kobb" is an excellent viability, a high output, and the output of hatching eggs that gives the company an advantage over competitors in 10-15 chicks for hen housed [5].

When the plans of the poultry factory "Akashevo" will be realized, the company will close the issue with the parent herd for their needs, as well as expand the opportunities of "Kobb Europe" to increase the supply of young breeder to Russian poultry farmers. The livestock of a one-time placement of chicken broilers "Kobb 500" in "Akashevo" will amount to 10.5 million heads.

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on hatchability and chick quality is known for a long time, hatchery managers aim to optimize the use of modern machines power, and minimize the transportation from farm to hatchery. In such a way effectiveness improves and expenses reduces. Although hatchery managers are well aware of the measures that can be taken to reduce losses, nevertheless, many people have difficulties in observation these measures in hatchery practice. However, losses due to long-term storage can be significantly reduced by the consistent application of these methods in the planning of hatchery programs. Moreover, recent studies reveal new aspects of what is happening inside the egg during its storage.

Despite the fact that this issue is the subject of numerous reviews and studies, the mechanisms that cause a quality degradation of eggs as a result of storage are still not clear today. It is well known that the viscosity of egg white (height of egg white) decreases; and the pH level of egg white increases during storage.

The main task of the pedigree reproducer is to obtain a quality hatching egg for obtaining the maximum number of healthy chickens. Since the storage of hatching eggs is an essential and determining factor influencing on hatchability and chick quality; it is necessary to keep the hatching egg under optimal conditions from the moment of prelaying and to the hatchery.

On long storage the hatchability of hatching eggs decreases. Every day of egg storage for more than three days reduces hatchability by 0.7-1% and requires one hour of additional incubation, and also the percentage of embryonic death increases, and live embryos tend to slower development and slower withdrawal.

Today there is a fairly effective method to reduce the negative effects of long-term storage of eggs. The research conducted in Holland have proved that preheating of hatching eggs for 3 or 6 hours at the temperature of 100 °F (37.8 °C) allows to increase the hatchability of eggs (by 9-11%) through the reduction of early and late embryonic mortality, which is a consequence of long-term storage (14 days), and reduce the percentage of weak Chicks [6].

2. Experimental part

The aim of the studies was to increase the hatchability of hatching eggs due to preheating during its long-term storage.

In order to solve the task, the experiment was conducted in the pedigree reproducer of the LLC "Poultry farm "Akashevskaya", the Mari El Republic. For this purpose the hatching eggs from the parent plot in the amount of 9600 pieces were used. The whole egg was stored at the temperature of +16 °C. The eggs prepared for incubation were divided into three groups: the first - the number of eggs - 2400 pieces, the egg without preheating; the second - the number of eggs - 4800 pieces, was preheated 2 times with an interval of 5 days; the third - the number of eggs - 2400 pieces, was preheated 2 times with an interval of 5 days. The keeping period of all hatching eggs is 13 days.

The method of the preheating of eggs was on the following. Trucks with eggs from the storage chamber were placed in a preheated to 100 °F incubation machine. The egg was there within two hours after the temperature reached 100 °F. Then, the trucks with eggs were in the incubation corridor for one hour. After, the eggs were placed in the storage chamber.

3. Results and considerations

After the hatching all chickens were counted by a counter. Counter data on the number of chickens is: 4215, 2097 and 2045. Then all eggs that were not deduced in the output trays were calculated and the data on them were corrected, which are presented in table 1. However, the differences in percentages remained the same: 87.8%, 87.4% and 85.2%, if do not take into account the done adjustment of chicken number.

150 eggs from each group of eggs were selected and opened at random (Table 2).

The main difference in hatchability is due mainly to mortality in the last stage of incubation (late mortality and live chicken in the shell). The quality of chickens of all three groups was normal: active and with a good navel. The egg shell in the output boxes was clean, it indicates the correct hatching

time of chickens (output window in accordance). A large number of chickens with acrania of brain can be caused by high fever in the first days of incubation.

Table 1. The key figures of hatchery egg hatchability.

Pickup data	Q-ty of eggs	Date of pre-heating	Received chickens		Sorted out chickens		Not hatched (egg)	
			Q-ty	%	Q-ty	%	Q-ty	%
May 14, 15	4800	May 18 and 23	4251 *	88.6	13	0.3	536	11.2
May 14, 15	2400	May 20 and 25	2108 *	87.8	13	0.5	279	11.6
May 14, 15	2400	No heating	2060 *	85.8	15	0.6	325	13.5

*It is corrected taking into account not removed egg in output trays.

It should also be noted that in all three groups there was a fairly large number of infected eggs (about 3% of the stuffed egg).

Table 2. The fertility key figures of the hatching eggs.

Q-ty of eggs	Date of pre-heating	Clear	Rate of mortality			Live in shell	Acrania	Infection (black rot)	Egg breakage - check
			early	mid-incubation	late				
150	May 18 and 23	43	59	3	11	4	7	21	2
150	May 20 and 25	41	59	1	13	3	8	24	1
150	No heating	21	76	1	17	10	6	17	2

There is reason to believe that short-term heating of eggs helps the survival of cells that die during prolonged storage of eggs. There is also a suggestion that the heating promotes the development of embryo to the stage of more effective resilience to the impacts of storage.

4. Conclusion

The optimization of storage conditions of eggs before incubation is mainly about measures that maximally inhibit the process of biological ageing of egg. However, the use of these techniques in incubation practice is effective only when they are performed from the first day of storage. Based on the foregoing, a detailed study of the processes that occur in egg during its aging, as well as the study of the influence of different gas environments during the storage of eggs in its physico-chemical, biological and incubation indices will help establish the most optimal conditions for storing eggs of modern bird crosses.

Thus, based on the conducted studies, it is possible to make an informed conclusion that the use of short-term heating of hatching eggs has a number of advantages:

- reduction of embryonic death cases at an early stage of incubation;
- reduction of incubation time;
- increase of incubation egg hatchability during prolonged storage.

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