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GOOSE EGGS HATCHING TECHNIQUE IMPROVEMENT WITH THE USE OF PRE-INCUBATION

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Abstract. Based on the available literature it can be concluded that pre-incubation has only been used to prolong the hatching ability of eggs stored for a longer period of time. The following research used pre-incubation as a method aiming at increasing the hatchability rates. Pre-incubation was conducted immediately prior to the proper date of incubation. White Koluda® goose eggs ($n = 7263$) were used in this research. Eggs were divided into 3 groups and warmed to the temperature of 37.8°C. In both experimental groups the differences in hatchability rates of eggs and hatching of goslings were not statistically significant ($P \leq 0.05$). However, while comparing the control group with those in which pre-incubation had been conducted, a higher percentage of fertilized eggs and a lower percentage of dead embryos were observed in groups that had been warmed. Moreover, a higher percentage of hatchability was observed in pre-incubated groups, which matters in large-scale production and enables a more efficient production of goslings. A positive effect of the process of pre-incubation on the synchronization of hatching was also observed. In the pre-incubated groups, goslings hatched simultaneously, which suggests full synchronization of the process of hatching. Pre-incubation as an additional treatment during incubation can result in an increase in the hatchability rates of eggs and hatching of goslings, which seems to be justified in case of this species due to low hatchability rates.

Key words: pre-incubation, hatchability, synchronization, goose

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INTRODUCTION

One of the major factors influencing the performance of poultry production is the technique of clutching and hatching of goslings. Over the years, the perfect eggs' incubation technology of different species of poultry was developed. Those works focused mainly on the study of diverse clutching environment and technical treatments, which allowed to distinguish a number of factors affecting the hatchability of eggs. Undoubtedly, one of the most important factors influencing the development of the embryo is the temperature. By the early twentieth century it was found that temperature changes in the egg incubator significantly affect the efficiency of the incubation process, determining the proper development of goslings. The temperature also affects the postembryonic development of birds, thus determining the body weight and the survivability [Kosin 1956, Bohren et al. 1961, Kraszewska-Domańska and Pawluczuk 1977, Christine et al. 1979]. Other studies suggest that the improvement of clutching and hatching of eggs can occur not only as a result of the appropriate adjustment of temperature in the egg incubator, but also by the application of suitable temperature during the storage of eggs – pre-incubation [Eiby et al. 2008, Reijrink et al. 2010].

In the previous studies, pre-incubation was only used to extend the hatching ability of eggs stored for a period exceeding 7 days [Meijerhof 1992]. Irreversible morphological changes, and thus the decrease in the quality of eggs lead to the reduction of hatching rate and the quality of goslings [Adamski 2008]. The hatching improvement with the use of the pre-incubation is related with the fact that the total development of hypoblast happens in the warmed eggs, which effectively protects the embryo against the negative impact of the microenvironment [Fasenko et al. 2001]. In addition, warming the stored eggs increases the amount of CO2 produced by the embryo, which contributes to the reduction of the drop in the pH of the egg (8.2) for the appropriate development of the embryo [Benton and Brake 1996, Fasenko et al. 2001, Reijrink et al. 2010].

The improvement of the incubation technique of eggs seems to be justified due to the unsatisfactory results of clutching and hatching of goslings. The hatchability of goose eggs stands at 60–70% [Rosinski and Bednarczyk 1996, KRD-ING 2013]. In order to reduce the losses, we should improve the technique of incubation, introduce changes in the technology and conduct further studies to improve the clutching and hatching results of goslings. One of the examples of increasing the efficiency of gosling production is the pre-incubation of eggs [Eiby et al. 2008]. The aim of this study was to determine the effect of warming the goose eggs on the results of clutching and hatching of goslings.

MATERIAL AND METHODS

The study was conducted on hatching eggs of the White Koluda® goose in the Poultry Hatchery Unit. The geese came from the parental set W33 × W11, which were obtained from the brood farm in Kołuda Wielka. The egg laying ability of the assessed parental set amounted to 37% at the peak of production, and the average fertilization throughout the period was 81.2%. The research material consisted of 7269 eggs. The eggs allotted to research were obtained randomly in three periods: at the beginning (volume I – n = 840 eggs), at the top (volume II – n = 1634 eggs), and at the end of the laying ability (volume III – n = 4795). Each egg volume was divided into three groups. In total, the control group (I) consisted of 2723 eggs, which were not warmed. The eggs assigned to group II – 2254 pcs. were warmed once for six hours. The eggs in group III (2292 pcs.) were warmed for six hours through two consecutive days before the beginning of hatching.

The intendent eggs for hatching came from parental geese, which were in the 2nd and 3rd laying season. The research material was collected daily for 3 days. The eggs were disinfected and stored for 3 days in the temperature from 10 to 12°C at 70% of relative humidity. Two days before the beginning of hatching, the eggs were warmed in the egg incubators in accordance with the assumption. The geese eggs were warmed in the egg incubator, where the temperature in the incubator's chamber amounted to 37.8°C with 55% of humidity. During warming of the eggs, they were mechanically rotated every hour by 180°. After pre-incubation the eggs were subjected to the proper incubation in accordance with the hatching techniques developed in the hatchery unit, adjusted to the used devices. The pre-incubation treatment and the proper incubation were conducted in the laying chambers of JARTOM company under the license of Pas Reform.

In the hatchery unit, applies the high circulation (egg cart) system. The air temperature in the egg incubator was 37.8°C with 57% of humidity, while in the hatchery chamber, respectively 37.0°C and 75% of humidity. The hatching took 31 days. The eggs were screened in 2 periods: in the 7th and 27th day of clutching. After conducting the biological analysis, each egg rejected after screening was cut in order to identify the clean and dead eggs. After the hatching, the following was recorded: fertilization, the number of dead embryos and healthy, crippled and weak goslings. Additionally, the time of goslings hatching was observed. The first goslings' selection was made in 62nd hour after hatching, counting from the time of transferring the eggs to the hatchery chamber, next the action was repeated after 6th and 10th hour. In each of the stage, the goslings were counted.

The collected data were statistically analyzed by calculating the clutching and hatching rate of goslings, relative changes of positioning (SEM), the values of differences between the groups were verified by the Tukey's test.

RESULTS

The test results are shown in Tables 1 and 2. The fertilization of eggs in all analyzed groups was low. Comparing the control group with groups in which the pre-incubation was conducted (Tables 1 and 2) it was concluded that the highest fertilization (82.8%) was found in eggs warmed twice (II). The percentage of fertilized eggs in the control group (I) was 79.3%, and in comparison with the eggs warmed once it was lower by 3.1 and 3.5% from the eggs pre-incubated twice (III).

Table 1. Goose eggs hatching results

Tabela 1. Wyniki lęgu jaj gęsi

Group Grupa		Features – Cechy			
		Number of set eggs, pcs Liczba jaj nałożonych, szt.	Fertilization, % Zapłodnienie, %	Dead embryos from eggs, % Zarodki zamarłe z jaj, %	
				set nałożonych	fertilized zapłodnionych
I	$\bar{x}$	2723	79.3	13.0	17.1
	SEM	494	5.7	1.5	3.5
II	$\bar{x}$	2254	82.4	10.9	13.4
	SEM	359	5.4	1.3	2.4
III	$\bar{x}$	2292	82.8	11.2	13.8
	SEM	355	4.7	1.3	2.0
Total Łącznie	$\bar{x}$	2269	81.5	11.7	14.8
	SEM	206	2.7	0.8	1.5

Table 2. Goslings hatching indicators

Tabela 2. Wyniki wylęgu piskląt

Group Grupa		Features – Cechy					
		Goslings not hatched, % Pisklęta nie wyklute z jaj, %		Crippled and weak goslings, % Pisklęta kalekie i słabe z jaj, %		Healthy goslings, % Pisklęta zdrowe z jaj, %	
		set nałożonych	fertilized zapłodnionych	set nałożonych	fertilized zapłodnionych	set nałożonych	fertilized zapłodnionych
I	$\bar{x}$	6.0	7.7	0.2	0.3	60.1	75.0
	SEM	0.1	0.5	0.1	0.2	7.3	4.1
II	$\bar{x}$	4.5	5.6	0.2	0.3	66.8	79.8
	SEM	0.6	1.1	0.1	0.2	6.3	3.1
III	$\bar{x}$	5.6	6.5	0.2	0.2	65.8	80.0
	SEM	0.7	0.9	0.1	0.1	5.5	2.0
Total Łącznie	$\bar{x}$	5.4	6.6	0.2	0.3	64.2	78.2
	SEM	0.3	0.5	0.1	0.1	3.4	1.8

The lowest percentage of dead embryos both from the set eggs and from the fertilized ones was present in the group in which the eggs were pre-warmed once for 6 hours (group II). The highest death rate was present in the eggs with no pre-incubation. The percentage of dead embryos from the fertilized eggs (group II) was lower by 3.7% from the eggs not subjected to pre-incubation. Comparing group II and III, there was little difference to the number of dead embryos.

The best hatching rates were obtained in group II, and the lowest in the control group (I). The highest percentage of goslings not hatched from the set eggs (6.0%) and fertilized (7.7%) was found in the control group (I). This result was higher by 1.5% from the not hatched goslings from the set eggs and by 2.0% from the fertilized eggs from the results obtained in group II. The difference between group II (4.5%) and III (5.6%) in not hatched goslings was about 1%. The smallest number of crippled and weak goslings was observed in group II. In separate groups the difference in the amount of crippled and weak goslings was small.

The highest percentage of healthy gosling was obtained in eggs warmed once for 6 hours (group II) 66.8% from the set eggs and 79.8% from the fertilized eggs. On the number of healthy goslings in the group warmed once (II) had an impact the percentage of fertilization (82.4%) and the lowest percentage of dead embryos (10.9%) in the first days of hatching. The worst results were obtained in group I, the hatching rate from the set and fertilized eggs amounted to 60.1 and 75%. The differences between the warmed groups were small, group III 65.8%, and the group II 66.8% of healthy goslings from the set eggs. Both in group II and III, similar rates of hatched healthy goslings were obtained from the fertilized eggs (respectively 79.8 and 80.0%).

The use of pre-incubation positively influenced on the time of the hatching of goslings. It was noted that in group II and II, the process of hatching was limited only to one stage, in the 30th day of clutching obtained 91% of goslings, and the rest of goslings were hatched 6 hours later (9%). In group I, where no pre-incubation was used, the process of hatching was spread over time. In the first stage, 70% of goslings was obtained, six hours later – 22%, and after further four hours – 8%.

DISCUSSION

Eggs, depending on the date of their collection, characterizes their hatching difference. With the end of the laying abilities, the biological value of eggs is reduced [Adamski 2008]. In our study, the highest amount of eggs was obtained in the last laying period, which reduced the rate of fertilization and the overall hatching results. The reason for the decline of the fertilization rate is the reduced activity of males, observed especially at the end of the laying period, the tendency

of ganders' monogamy and environmental factors. Apart from the laying phase, the height of the fertilization rate is determined also by the sex ratio, the age of birds assigned for breeding, the nutrition and maintenance of birds [Pakulski et al. 2003].

In the pre-incubated groups, a smaller rate of dead embryos was observed in the first stage of hatching in comparison with the control group. Similar results were obtained in the studies in which the pre-incubation was used as a treatment extending the laying abilities during the longer period of storage. The egg warming during the storage to the temperature of incubation 37.8°C for 3 and 6 hours resulted in a decrease in the percentage of dead embryos in the first incubation phase [Reijrink et al. 2010].

In general, in the analyzed groups the average value of the gosling hatching rate was low. The mean values of this rate amounted to 78.2% of the fertilized eggs and 64.2% of the set ones. In the Paskulska's et al. studies [2003], the hatching results of goslings of the set eggs were lower and amounted to 61.1%. Not much larger percentage of gosling hatching from the set eggs was presented in the results of the assessment of the value in use of poultry [KRD-IG 2013], where it amounted to 62.2%. The results presented in the literature slightly differ from the results obtained in our own studies. It should be noted that the number of the obtained healthy goslings depends on many environmental and genetic factors [Świerczewska 2008]. The increased number of goslings in groups in which the egg warming was used proves to have a positive impact of the pre-incubation on the effectiveness of hatching. The increase of the hatching rate after using the egg warming confirms the studies conducted by Ruiz and Lunam [2002]. In the studies, the largest percentage of goslings was obtained in the group were before the storage, the pre-incubation was used. The improvement of hatching from pre-incubated eggs was also obtained in the studies of Fasenko et al. [2001]. Where the percentage of gosling hatching was increased from 70.5 (the control group) to 79.0% (the pre-incubated group). On the other hand, Tzschentke and Halle [2009] by warming the eggs in the last three days of incubation (for 2 hours till 38.2–38.40°C), improved the hatching results by 1.5% in comparison with the control group.

In the groups in which the eggs were warmed, the goslings hatched simultaneously, so the hatching process was synchronized, which positively affected the quality of the goslings. The studies of Ruiz and Lunam [2002] confirms that temperature adjustment can either shorten or prolong the process of gosling hatching. Extending the time of the hatching process, negatively affects the goslings' health. In the extended clutching, the goslings hatched earlier stay in the hatching chamber for too long, while for the rest it is more difficult to exit the eggshell. This leads to excessive dehydration, weakness and damage to the leg joints in all of the

goslings [Malec 2004]. In addition, the goslings hatched later are characterized by lighter body weight. This difference may persist up to the fourth week of life [Hager and Beane 1983]. There is a number of factors affecting the duration of the gosling hatching process. According to Malec [2004], the egg weight, as well as its size, significantly affects the length of the clutching period. Therefore, in the case of the goose eggs incubation, it is difficult to achieve the synchronization. The weight of the hatching eggs eligible for incubation is in the range from 130 to 220 g, which significantly makes it difficult to adjust all the hatching parameters and obtain the hatching synchronization. The differences in the weight of eggs in reproductive geese result from the reproductive period of laying geese, which lasts 4 years. Another factor affecting the duration of incubation is sex, which was confirmed in the studies on chicken eggs. It has been proved that females hatch earlier than males [Burke 1992].

CONCLUSIONS

The pre-incubation effects the hatching indicators of White Koluda® goose. The best clutching and hatching indicators were obtained in the group in which the eggs were warmed once. The pre-incubated eggs were characterized by lower mortality of embryos during the incubation period. The goslings in the warmed groups were characterized by synchronized hatching process. In the light of the conducted studies for the poultry practice, it can be recommended to improve the technology of clutching and hatching of the eggs, consisting of a single, 6-hour egg warming, before the beginning of the proper incubation process, which undoubtedly increases the efficiency of the gosling production.

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DOSKONALENIE TECHNOLOGII LĘGU JAJ GĘSICH Z ZASTOSOWANIEM PREINKUBACJI

Streszczenie. Na podstawie dostępnego piśmiennictwa można wnosić, że preinkubacja była wykorzystywana jedynie w celach przedłużenia zdolności wylęgowej jaj składowanych przez dłuższy okres czasu. W przeprowadzonym doświadczeniu preinkubacje zastosowano jako czynnik polepszenia wskaźników wylęgowych. Przeprowadzono ją bezpośrednio przed właściwym terminem inkubacji. W badaniu wykorzystano jaja ($n = 7269$) gęsi Białej Kołudzkiej®, które podzielono na 3 grupy i podgrzewano w temperaturze 37,8°C. W obu grupach doświadczalnych różnice we wskaźnikach lęgu jaj i wylęgu piskląt nie były istotne statystycznie ($P \geq 0,05$). Jednakże, porównując grupę kontrolną z grupami w których przeprowadzono preinkubację stwierdzono większy odsetek jaj zapłodnionych i mniejszy odsetek zarodków zamarłych w grupach podgrzewanych. Dodatkowo w grupach preinkubowanych odnotowano wyższy wskaźnik wylęgowości, co w produkcji wielkotowarowej ma znaczenie i pozwala na uzyskanie większej ilości piskląt gęsich. W doświadczeniu wskazano również na pozytywny wpływ zabiegu preinkubacji na synchronizację lęgu. W grupach preinkubowanych pisklęta wykluwały sie jednocześnie, co świadczyło o pełnej synchronizacji procesu wylęgu. Preinkubacja jako dodatkowy zabieg w czasie inkubacji może prowadzić do wzrostu wskaźników lęgu jaj i wylęgu piskląt gęsich, co wydaje się być uzasadnione w przypadku tego gatunku z uwagi na niskie wskaźniki wylęgowości.

Słowa kluczowe: preinkubacja, wylęgowość, synchronizacja, gęś

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