STUDY ON THE TEMPERATURE REGIME IN INCUBATION OF MUSCOVY DUCK EGGS I. STUDY ON TEMPERATURE REGIME IN NATURAL HATCHED MUSCOVY DUCK EGGS

ПРОУЧВАНЕ ВЪРХУ ТЕМПЕРАТУРНИЯ РЕЖИМ ПРИ ИНКУБИРАНЕ НА ЯЙЦА ОТ МУСКУСНА ПАТИЦА (CAIRINA MOSCHATA) I. ПРОУЧВАНЕ ВЪРХУ ТЕМПЕРАТУРНИЯ РЕЖИМ ПРИ ЕСТЕСТВЕНО ЛЮПЕНЕ НА ЯЙЦА ОТ МУСКУСНА ПАТИЦА

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ABSTRACT

Study was carried out on the temperature regime on the surface of naturally hatched Muscovy duck eggs with the aim of its specifying during artificial incubation. Egg fertility and hatchability during the whole period of study were reported in the experimental hatches.

Depending on the period of the embryo development, on the ambient temperature and the egg position in the nest, the surface temperature of the naturally hatched Muscovy duck eggs varied between 35.78 and 38.87^{o} C.

The temperature increase of the upper egg surface after the 20th – 23st day of the embryonic development to 37.92 - 38.87^{o} C was due to the use of yolk fats by the embryos leading to the release of more heat.

As a result of the observations on the temperature regime of the surface of naturally hatched Muscovy duck eggs, we recommend that during artificial hatching of eggs from the same waterfowl species the following temperature should be maintained:

– until closing of the allantois - 37.6 – 37.8 ^{o} C.

– from closing of the allantois until the transfer into the hatchery - 37.2 – 37.5 ^{o}C.

– in the hatchery - 36.7 – 37.0 ^{o}C.

– water cooling of eggs by it twofold per day sprying with distilled water at 18–20°C, since 20th, instead of 8th or 16th day of embryonary development, or accomplish it in hatchery only.

KEY WORDS: Muscovy duck, temperature regime in natural incubation, incubation technology

DETAILED ABSTRACT

Проведено е проучване върху температурния режим на повърхността на естествено люпени яйца от Мускусна патица с оглед прецизирането му при тяхното изкуствено люпене (инкубиране). Отчетени са също оплодеността и люпимостта на яйцата в опитните люпила- общо за изследвания период.

Проучванията по настоящия труд са проведени с 18 птици от вида Мускусна патица (White variety) на първа репродуктивна година, при полово съотношение 1:5 (15 женски и 3 мъжки). Патиците се отглеждаха по конвенционален начин, при екстензивна система на производство.

От всяка мътачка бяха проучени по две насаждания: едно пролетно- при умерена и едно лятно- при висока атмосферна температура, като яйцата във всяко от проучваните люпила се маркираха (номерираха). Температурата по време на люпенето се измерваше непосредствено на повърхността на яйцето, с термосензорен електронен термометър, с точност ±0.03- 0.06°C. Замерваха се по три периферно и три централно разположени в гнездото яйца от люпило, в три пункта на всяко яйце - на повърхността непосредствено под мътачката, на повърхността, граничеща със съседно яйце и на повърхността, граничеща с дъното на гнездото. Измерванията се провеждаха през ден в периода от 1ви до 15ти и от 15ти до 30ти, и всеки ден от 30ти до 33ти ден от ембрионалното развитие.

В зависимост от периода на ембрионално развитие, околната температура и положението на яйцето в гнездото, температурата на повърхността на естествено люпени яйца от Мускусна патица варира между 35.78 и 38.87°C

Повишаването на температурата на повърхноста на яйцата след 20я – 23я ден от ембрионалното развитие до 37.92–38.87°C се дължи на използването от ембрионите на мазнините от жълтъка, което води до отделяне на повече топлина.

Стойностите на основните репродуктивни признаци са в рамките на характерните за вида Мускусна патица, цитирани от различни автори.

В резултат на извършените наблюдения върху температурния режим на повърхността на естествено люпени яйца от Мускусна патица, препоръчваме при изкуственото люпене (инкубиране) на яйца от този вид водоплаващи птици да се поддържа следната температура:

– до затваряне на алантоиса- 37.6 – 37.8 °C.

– от затваряне на алантоиса до прехвърляне в люпилния шкаф- 37.2 – 37.5 °C.

– в люпилния шкаф- 36.7 – 37.0 °C.

– водното охлаждане на яйцата чрез двукратното им на ден пулверизиране с дестилирана вода с температура 18–20°C да става вместо от 8ми или 16ти ден – от 20ти ден на ембрионалното развитие, или да се извършва само в люпилния шкаф.

Ключови думи: Мускусна патица, температурен режим при естествено люпене, технология на инкубация.

INTRODUCTION

Despite the good results obtained in artificial hatching of Muscovy duck eggs in the last 10 – 20 years - Avanzi & Mori (1983) [1] - 81.8 to 83.4 %; Wang G., Xu L. (1989) [17] – 80.14 – 84.27 %; Raud, 1986 [14] (by Sauveur & De Carville, 1990) - 75-85 %; Pingel (1992) [13] – 80 % of hatchability, - some authors (Hodgetts & Tullett, 1991) [4] pointed out that hatchability of artificially incubated duck eggs was comparatively low. Specialists in that area tried to define the reasons in the insufficiently precision of some technological elements of the incubation process. For instance, the insufficient attention paid to the necessity of destroying the cuticle of the eggshell in the second half of incubation, (Serbul, 1986) [15], the prolonged true hatching in artificial incubation of eggs, (Harun, 2001) [3] and Nickolova (2003, 2004) [11], [12]. To our mind, the least but not last, the unsatisfactory hatchability of the eggs of that species was due to the insufficiently precise temperature regime in artificial hatching. The difficulties in maximal optimization of temperature in the incubation and hatchery were due to the high content of fats in the egg yolk of the Muscovy ducks, that led to the increased release of heat in the second half of incubation (Nickolova, 1999) [10].

Due to the above-mentioned reason, striving at bigger precision, a part of the researchers recommended different temperatures in the incubator depending on the period of embryonic development. For example, Serbul (1983) [16] and Serbul et al. (1986) [15] recommended a temperature of 37.8 – 38.0° C until allantois closure (13 – 16 day of incubation), 37.5 – 37.4° C after allantois closure (16 – 30 day of incubation) and 37.5 – 37.4° C in the hatchery (31 – 35 day of incubation). Korotkova (1985) [5] suggested that during the first three days the temperature should be maintained at 38.0° C, until the 7th day - 37.8° C, until allantois closure - 37.6° C and in the hatchery - 36.8 – 37° C. The rest of the researchers in that area support the idea of one and the same temperature until the transfer of the eggs for hatching: Kortlang (1985) [6] applied 37.3 ° C in the incubator and 36.9° C in the hatchery, Wang et al. (1988) [17] - 37.8° C and 36.5° C, respectively, Meltzer (1988) [9] - 37.5±0.2° C in the incubator, Sauveur & De

Carville (1990) [14] maintained a temperature of 37.6° C in the incubation cage and 37.2° C in the hatchery, while Bagliacca et al. (1991) [2] applied 37.8±0.2° C and 37.2° C±0.3° C, respectively.

The aim of the present study was to follow up the temperature regime on the Muscovy duck egg surface in natural hatching in order to specify it in their artificial incubation.

MATERIAL AND METHODS

Studies described in the present paper were carried out in 2004 with Muscovy duck (White variety) populations in the Training-and-Experimental site of the Agricultural University – Plovdiv. 18 fowls in their first reproduction year were used at sex ratio 1:5 (15 females and 3 males). The ducks were reared by the conventional method, at an extensive production system, in closed premises with windows, on a deep litter pen, at a density of 2.5 heads/$m^{2.}$ having an unlimited access to yards with solid pavement (1.5 heads/m^2) throughout the year. The fowls did not have an access to water ponds. The nests of semi-open type with the size of 45/45/60 cm were set along the dark side of the building. During the reproduction period the ducks were fed on combined forage based on cereals, soya and sunflower groats and additives containing 12 MJ of exchangeable energy and 16 % of crude protein.

Two hatches of each hatcher were studied: a spring one at bland external temperature and a summer one – at high temperature, by marking (numbering) of the eggs in each of the examined nest. Temperature during hatching was measured immediately on the egg surface by a thermosensor electrone termometer with precision of ±0.03–0.06° C. Three marginally and three centrally positioned eggs in the nest were measured at three egg spots: at the surface immediately beneath the hatcher, at the surface attached to an adjacent egg and at the surface toughing the nest bottom. Measurements were taken every second day in the period from the 1st to 15th day, from the 15th to the 30th day and everyday from the 30th to 33rd day of the embryonic development.

Egg fertility and hatchability in the experimental hatches were also reported in total for the studied period.

RESULTS AND DISCUSSION

Depending on the period of embryonic development, the ambient temperature and the egg position in the nest, the surface temperature of naturally hatched Muscovy duck eggs varied between 35.78 and 38.87° C (Table 1). Until allantois closure (15th day of the embryonic development), in spring hatches, no significant differences between the temperatures of the equal surfaces of the central and marginal eggs in the nest, were detected.

At the same time in summer hatches such a difference was proven only between the temperatures of the upper surfaces of the central and marginal eggs ($p<0.05$). In the same incubation period the highest temperature was registered for the upper surface of the hatching eggs despite their position in the nest, more significant being the temperature differences of the upper and lower egg surface: $p<0.05$ for the central and $p<0.001$ for the marginal eggs. That regularity was observed during the three stages of the embryonic development at bland as well as at high external temperature for both central and marginal eggs. It was due to the close contact of the egg with the body of the duck hatcher. Variation was between 36.43 and 37.00° C in the first 15 days, between 35.66 and 37.97° C from the 15th to the 30th day and between 37.92 and 38.87° C in the last three days of hatching. The existence of although insignificant differences between the temperatures of the eggs situated immediately under the hatcher and those placed marginally in the nest was explained by the worse contact of the latter with its body. That characteristic was better manifested in hatches with more eggs because in that case the marginal eggs were still less covered by the duck.

After closing of allantois (15th – 30th day of the embryonic development) for the spring hatches the most significant proved to be the difference between the temperatures of the lower surfaces of the central and marginal eggs ($p<0.001$). Although smaller, the differences between the lateral ($p<0.01$) and the upper ($p<0.05$) surfaces of the eggs of different situation in the nest, were statistically significant. In summer hatches no significant differences were established between the temperatures of the three studied surfaces of central and marginal eggs in that stage of the embryonic development. Most probably that result was a consequence of the hatcher more frequent getting out of the nest under conditions of high external temperatures [12] and the increased heat release by the embryos at that development stage resulting from the use of fats in the yolk. The same regularity was also observed in the last three days of hatching: significant differences were established between the temperatures of the upper and the temperatures of the lower surfaces of the central and marginal eggs ($p<0.001$) only in the spring hatches (bland external temperatures).

Data in Table 1 show that in the spring, as well as in the summer hatches for both, the central and the marginal eggs in the nest, the surface temperature started to increase significantly after the 15th day of the embryonic development. In fact the increase was most obviously registered after 20th – 23st day of incubation and it was

Table 1. Temperature regime at the egg surface at natural incubation (°C)

	At bland external temperature			At high external temperature		
day of incubation	1 – 15 x±Sx	15 – 30 x±Sx	30 – 33 x±Sx	1 – 15 x±Sx	15 – 30 x±Sx	30 – 33 x±Sx
central eggs						
- upper surface	36.43±0.10	37.54± 0,15	38.18±0.02	37.00±0,08	37.97±0,08	38.87±0,09
temperature	c1 i1i2 I1	a1a2 C1 i1i3 J1	a1a2 A1 i2i3 I2	a1b1 C1 i1i2 I1	c1 i1i3 J1	a1a2 i2i3I2
- lateral surface	36.45±0.10	36.59 ±0,07	37.49±0.07	36.67±0,08	37.78±0,08	38.35±0,10
temperature	c2 i4	a1a3 B1 i5 I3	a2c1 i4i5 I4	b1a2 i4i5	i4i6 I3	a1 i5i6 I4
- lower surface	36.01±0.13	35.66 ±0,10	37.26±0.07	36.16±0,09	37.66±0,11	38.37±0,12
temperature	c1c2 i6k1	a2a3 A1 i7k1 I5	a1c1 A2 i6i7 I6	a1a2 i7i8	c1 i7i9 I5	a2 i8i9 I6
marginal eggs						
- upper surface	36.50±0.09	36.58±0,05	37.92±0.06	36.75±0,08	37,67±0,09	38.57± 0,10
temperature	a1 i8 K2	b1 C1 i9 I7	a3c2 A1 i8i9J2	a3c1 C1 i10i11K2	i10i12I7	i11i12J2
- lateral surface	36.38±0.12	36.12±0,13	37.62±0.11	36.53±0,07	37.55±0,09	38.12±0,11
temperature	c3 i10	b1c1 B1 i11 I8	a4c2 i10i11 J3	c1a4 i13i14	i13i15i8	i14i15 J3
- lower surface	35.78±0.16	36.48±0,09	36.64±0.10	36.03±0,08	37.39±0,10	38.19±0,08
temperature	a1c3 i12i13	c1 A1 i12 I9	a3a4 A2 i13 I10	a3a4 i16i17	i16i18I9	i17i18 I10

Differences were significant at: a - $p<0.001$; b - $p<0.01$; c - $p<0.05$ – between different surfaces in the same periods of embryonic development at the central and the marginal eggs.
A- $p<0.001$, B- $p<0.01$, C- $p<0.05$ – between same surfaces of central and the marginal eggs in the same periods of embryonic development.
i- $p<0.001$, j- $p<0.01$, k,- $p<0.05$ – between same surfaces at different periods of embryonic development at the central and the marginal eggs.
I- $p<0.001$, J- $p<0.01$, K- $p<0.05$ – between same surfaces and same periods of embryonic development at different external temperatures.

Table 2. Reproductive capacity of Muscovy Ducks

Indices	
Fertility, %	96.87
Hatchability of fertile eggs, %	95.48
Embr. mortality 1 – 10 day, %	2.01
Embr. mortality 10 – 26 day, %	1.51
Embr. mortality 26 – 32day, %	1.00
Duration of embr. developm., days	32. 40
Duration of hatching, days	1.50
Egg weight, g	80.42±0.11
Duckling weight, g	54.6±0.12
Duckling weight, %	67.53±0.14

the biggest in its final stage, i.e. 30th – 33rd day ($p<0.001$). That was explained by the fact that since the 20th – 23th day of their development the Muscovy duck embryos fed mainly on fats, as a result of which more heat was generated in their organisms [7, 8, 11]. The significantly higher fat content in the yolk of Muscovy duck eggs [10] in comparison with hen eggs increased the need of their more intensive cooling after the 16th day of incubation [11]. That problem was solved in naturally hatched Muscovy duck eggs, as we had mentioned before [12], by the more frequent getting out of the duck hatcher and its longer absence from the nest especially in the hot summer months.

To our mind the existence of statistically significant differences between the egg temperatures in the spring and summer hatches at almost all the stages of the embryonic development was due to the probability of taking the higher egg temperatures immediately before their being agitated by the hatcher or immediately before its getting out of the nest. At the same time it was possible that the cooler eggs had been at periphery of the nest just before getting to a central position and their temperature being taken immediately after their agitation by the hatcher. The high summer temperatures were the second reason.

The values of the major reproductive characteristics presented in Table 2 were in the frames of the typical ones for the Muscovy duck species cited by various authors.

CONCLUSIONS

Depending on the period of the embryonic development, the ambient temperature and the egg position in the nest, the surface temperature of naturally hatched Muscovy duck eggs varied between 35.78 and 38.87° C.

The temperature increase of the egg surface after the 20th – 23st day of the embryonic development to 37.92 - 38.87° C was due to the use of yolk fats by the embryos leading to the release of more heat.

As a result of the observations carried out on the temperature regime of the surface of naturally hatched Muscovy duck eggs, we recommend that the following temperatures should be maintained in artificial incubation of eggs from that waterfowl species:

– until allantois closure – 37.6-37.8 ° C.

– from closing of allantois until the transfer in the hatchery – 37.2-37.5 ° C.

– in the hatchery – 36.7-37.0 ° C.

– water cooling of eggs by it twofold per day sprying with distilled water at 18–20°C, since 20th, instead of 8th

or 16th day of embryonary development, or accomplish it in hatchery only.

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