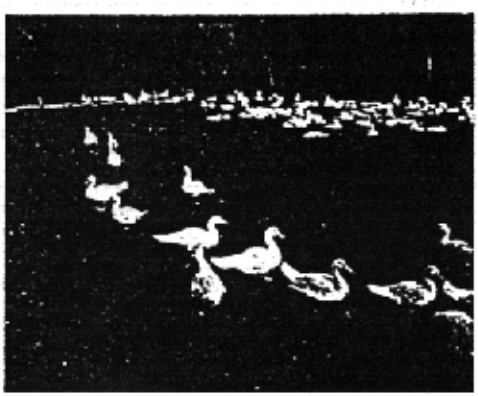
World`s Poultry Science Association

PROCEEDINGS

10th European Symposium on Waterfowl



March 26 - 31, 1995
Halle (Saale), Germany

EFFECT OF WARMING TREATMENTS DURING DUCK EGG STORAGE ON INCUBATION PERFORMANCE

Bagliacca M., Marzoni M., Paci G., Petrocelli C.
Dept. of Animal Production - Veterinary Faculty - University of Pisa
V.le Piagge, 2 56124 PISA ITALY

Abstract

A total of 3522 eggs were analysed to determine whether duration of egg storage and warming treatments during storage significantly effects incubation performance of Muscovy ducks. The eggs were collected and assigned randomly to one of the six storage treatments groups: 3, 7, or 14 days of storage, always below the physiological zero (18°C) and 3, 7, or 14 days of storage with a daily warming for half an hour at 37°C. Fresh egg weight was recorded. The eggs were placed on metallic egg flats and were daily turned during storage. Weight of each egg was measured after storage to determine amount of weight lost during storage. Mortality was highest in eggs that were stored for a longer period of time. Daily warmed eggs had significantly higher hatching rate at 7 days of pre-incubation storage than eggs stored always below the physiological zero. One of the reasons for the increased incidence of embryonic mortality in eggs that were stored for longer periods may be related to the increased egg weight loss during storage.

Key words: egg-hatchability; incubation; egg-storage; ducks

Introduction

It is well documented that egg storage reduces embryonic viability (hatchability of fertile eggs) (Proudfoot 1969; Decuypere et Michels 1992; Meijerhof 1992). Egg weight loss also increases as the number of days of storage is extended (Paci et al. 1991). Basal research indicates that during storage there is no discernible embryonic development and the embryo remain in a state of embryonic diapause when the eggs are held at temperatures below physiological zero (20°-21°C). However, embryonic development still occur during storage, although at a minimum rate and in a disproportionate way, and so such growth may contribute to the decline in viability as the storage period increases. In addition the stage of embryonic development determine the embryo viability, too (Lundy 1969; Mayes et al. 1984; Meijerhof 1992). The number of cells contained by the blastoderm before incubation depends from a lot of factor such as specie, strain, parental age, individual bird variation, egg weight, position of the egg in the sequence, type of the nest, egg collection pattern, ambient temperature and, for last but not in the least, it is influenced by the length, temperature, humidity, gaseous environment and orientation of the eggs in the storage period. Environment in the storage room determine the rate of survival of the original cells and the rate of replacing with the new cells (Petitte 1991). In East Asia, where duck's eggs are yet stored and artificially incubated by traditional methods, since the second century before Christ, the hatchery-man stores the duck's eggs at a temperature below or near to the physiological zero and, once a day, he heats eggs in the bright sun for a short period by simply placing them under the sun (Bagliacca 1991; Nguyen Thi Minh 1992; Nguyen song Hoan 1991; Liu Fuan 1985). This technology is not strange since copy the natural behaviour of the ducks which are used to remain on the nest for some time before the lay of each egg and gave good results when applied to long storage of Pekin ducks (Pingel et al. 1989). The hypothesis tested in this trial was that warming treatments during storage, which reproduce the natural behaviour of ducks, may increase embryo viability in eggs of Muscovy duck.

Materials and methods

Stocks and housing

Eggs weighing between 65 to 112g were collected from an Italian strain of Muscovy duck. The birds were housed in pens with a room temperature of 20°C and the photoperiod was 14 h light: 10 h dark with lights on at 07:00 h. The male:female ratio was 1:5 and ducks were 55 wk of age during egg collection period. Each deep litter rearing pen had 400 ducks and the eggs were laid on colony nests or on the litter. A typical layer diet containing 4.37% Ca, .69% P, 17% CP, and 2.685 Kcal ME/kg was fed *ad libitum* intake.

Experimental design and methodology of storage and incubation

The experiment involved 3522 eggs, collected over a 2 day period. Each day the eggs laid were gathered, placed with small end down on metallic egg flats, washed and fumigated. The second day all eggs were transported to the hatchery for the storage and divided randomly into six experimental

groups. Three of the six groups were stored at a constant temperature of 18±1°C, while the other three groups were stored at 18°C and daily warmed for half an hour to 37°C. Each experimental group of the two storage treatments were subjected to one of three different storage periods: 3, 7, or 14 days. All eggs were daily turned. The temperature of 18°C was chosen as it has been recommended that duck's eggs be stored at 16-18°C for storage less than 7 days and 11-12°C for storage longer than 7 days. Netherless in Vietnam the temperature is maintained not so far from the physiological zero (Bagliacca 1991; Nguyen Thi Minh 1992; Nguyen song Hoan 1991). All eggs were weighed prior to, and immediately after storage. Incubation was carried out in an automatic incubator with hourly turning of ±60°. The eggs were daily sprayed from the 10th to the 30th days, according to the technology used for ducks eggs (Bagliacca et al. 1989, 1991). Candling was done at the 10th and the 30th day of incubation and the infertile and with embryo dead eggs were broken and dead controlled by direct exam of th yolks.

Statistical analysis

The data were analysed using least squares analysis (Wilkinson, 1988). Source of variation were storage with or without daily warming (treatments 2) and storage length (days 3). Least squares means and standard deviations were calculated for loss of egg weight. The relationship between fertility, mortality, and hatchability with length of storage and treatments was analysed using log-linear models and the chi-square test of independence.

Results and discussion

With 3 days of storage, hatchability was not affected by treatments. With 7 days of storage the best results were obtained by daily warmed eggs and with 14 days of storage, hatchability decreased so greatly in both group (probably due to the relatively high temperature of storage chosen) that the best results obtained by daily warmed eggs did not differed significantly from the unwarmed eggs (table 1). Incidence of dead embryos followed the trend of hatched ducklings but with 14 days of storage a tendency to higher mortality rate and a significative higher fertility rate than in the eggs kept always below the physiological zero was observed in daily warmed eggs. Since longer storage determine very early mortality (by increasing the number of eggs which fault of restart cell division), most of the eggs classified as infertile to candling and to the following brochure and examination of the yolks were probably incorrectly assigned to the infertile group; it is advisable that they were not infertile but with embryos which faulted the restart of cell division (very early dead embryos). The daily warming, evidently allow to a higher number of eggs, than unwarmed eggs, to restart cell division; however the effect of the long storage time is not completely cancelled and some embryos, which succeeded in restarting growth, showed later a mortality resulting in a trend to higher incidence of dead embryos.

Weight loss during storage was always significantly higher in the eggs with periodic warming during storage than in the eggs stored at constant temperature. As it has been recommended that egg weight loss during storage should reach the maximum value of 1% (Oosterwoud 1987; Paci et al. 1991), the weight loss observed at 14 days is too high and may be the cause of the observed tendency to the increasing of embryo dead.

The results of the present research show that also in Muscovy duck the warming of the eggs during storage may reduce the negative effects of the storage time. For longer storage time, 14 days, the number or the temperature of the warming treatments must be reduced so to reduce the egg weight loss.

References

Bagliacca M. (1991) Thuc Hanh Ap Trung (Incubation of waterfowl eggs). Food and Agriculture Organisation of the United Nations Editor Hanoi, VIE/86/007: pp20.

Bagliacca M., Paci G., Marzoni M., Avanzi C.F. (1989) Tecnologia di incubazione nell'anatra muschiata: effetto della posizione e del raffreddamento delle uova durante l'incubazione. Zoot. nutr. Anim, 1989,15: 423.

Bagliacca M., Paci G., Marzoni M., Avanzi C.F. (1991) Tecnologia di incubazione delle uova degli anatidi. Atti Convegno CNR: Allevamenti delle Piccole Specie, Roma: 95-107.

Decuypere E., Michels H. (1992) Incubation temperature as a management tool: a review. World's Poultry Science Journal 48 (1): 28-38.

Liu Fuan (1985) The parched rice incubation technique for hatching duck eggs. In: Duck production science and world practice. Eds. Farrell D.J. and Stapleton P., Univ. of New England: pp:178-182.

Lundy H. (1969) A Review of the effects of temperature, humidity, turning and gaseous environment in the incubator on the hatchability of the hen's egg. In: The Fertility and Hatchability of Hen's egg. Eds. Carter T.C. and Freeman B.M., Edimburg: pp. 143-176.

Mayes F.J., Takeballi M.A. (1984) Storage of the eggs of the fowl (Gallus domesticus) before incubation: a review. World's Poultry Science Journal 40 (2): 131-140.
Meijerhof R. (1992) Pre-incubation holding of hatching eggs. World's Poultry Science Journal 48 (1): 57-68.
Nguyen Song Hoan (1991) Personal comunication.
Nguyen Thi Minh (1992) Incubation of duck egg by traditional methods are applied in Vietnam and hatching results. Proc. 9th Internat. Symposium on Waterfowl, Pisa (Italy): 124-126.
Oosterwoud A. (1987) Effect of egg handling on egg quality. In: Egg quality - current problems and recent advances. Eds. Wells R.G. and Belyavin C.G., Butterworths, London: pp:283-291.
Paci G., Marzoni M., Bagliacca M., Avanzi C.F. (1991) Some aspects of duck egg quality. Proc of the 4th Europ. Symp. on the Quality of Eggs and Eggs Products, Dorwerth (Nederlands): 169-176.
Petitte J.N. (1991) Variability in preincubation embryo development in domestic fowl. 1. Effects of nest holding time and method of egg storage. Poultry Science 70: 1876-1881.
Pingel H., Schneider K.H., Vagt A. (1989) Untersuchungen uber Moglichkeiten der Langzeitlagerung von Enterbruteiern. Archiv fur Tierzucht 32(1): 39-49.
Proudfoot F.G. (1969) Handling and Storage of hatching eggs. In: The Fertility and Hatchability of Hen's egg. Eds. Carter T.C. and Freeman B.M., Edimburg: pp. 125-142.
Wilkinson L. (1988) SYSTAT: The System for Statistics. SYSTAT Inc. Evanston, IL (USA).

Research supported by M.U.R.S.T.

Table 1 - Effect of daily warming and storage-length on hatching results

infertile eggs

TREATMENT		STORAGE - LENGTH						TOTAL	
		3 days		7 days		14 days			
CONTROL	n.	34	a	57	a	151	b	242	
	%	6.97	NS	9.12	B	23.5	B	13.8	B
DAILY WARMING	n.	27	a	37	a	99	b	163	
	%	5.59	NS	5.85	A	15.2	A	9.24	A
TOTAL	n.	61		94		250		405	
		6.28	a	7.48	a	19.32	b	11.5	

dead embryos

TREATMENT		STORAGE - LENGTH						TOTAL	
		4 days		7 days		14 days			
CONTROL	n.	88	a	222	b	264	b	574	
	%	18.0	NS	35.5	B	40.9	NS	32.7	NS
DAILY WARMING	n.	108	a	184	b	298	c	590	
	%	22.4	NS	29.1	A	45.9	NS	33.4	NS
TOTAL	n.	196		406		562		1164	
		20.2	a	32.3	b	43.4	c	33.0	

hatched ducklings

TREATMENT		STORAGE - LENGTH						TOTAL	
		4 days		7 days		14 days			
CONTROL	n.	366	c	346	b	229	a	941	
	%	75.0	NS	55.4	A	35.6	NS	53.6	A
DAILY WARMING	n.	348	a	411	b	253	c	1012	
	%	72.1	NS	65.3	B	38.9	NS	57.3	B
TOTAL	n.	714		757		482		1953	
		73.5	c	60.2	b	37.25	a	55.5	

note: values with different letters in a column (A, B) or row (a,b,c) are significantly different (P<.05)

Table 2 - Effect of daily warming and storage-length on egg weight loss

TREATMENT		STORAGE - LENGTH						TOTAL	
		3 days		7 days		14 days			
CONTROL	n.	354		612		610		1576	
	%	.17	a	.48	b	.84	c	.50	
	g	.143	A	.396	A	.688	A	.409	A
	s.dev.	.104		.111		.216		.264	
DAILY WARMING	n.	352		612		612		1576	
	%	.32	a	.72	b	1.56	c	.87	
	g	.267	B	.593	B	1.286	B	.715	B
	s.dev.	.091		.217		.313		.480	
TOTAL	n.	706		1224		1222		3152	
	%	.25	a	.60	b	1.20	c	.68	
	g	.205		.495		.199		.562	
	s.dev.	.115		.199		.403		.042	

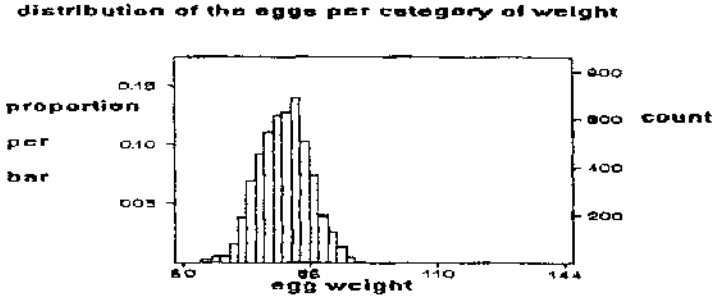
note: values with different letters in a column (A, B) or row (a,b,c) are significantly different (P<.05)

Do you investigate egg weight effect on hatching results?

Yes, in the first approach to the statistical analysis we controlled if there were interactions between the weight of the eggs and the different experimental treatments. We did not analyse the variable "egg weight" as a continuous variable even if the distribution of the weights was continuous (see the picture) and surely the effect of daily warming is a continuous phenomena but we choose to insert in the statistical model three different categories of weight (lighter than 74 grams, between 74 and 90 grams, and heavier than 90 grams). The reason of this choose was that only the eggs within this big category 74 - 90 grams are incubated in commercial duck hatcheries. All the eggs bearing to the lighter and the heavier categories are commonly discarded.

The results of this preliminary statistical analysis:

- confirmed the big reduction of hatchability of the eggs bearing to the heavier category, which justify their discharge in commercial hatcheries (P<.01).
- Did not show any significative reduction of hatchability in the eggs bearing to the lighter category, which might be incubated with good results. Of course by accepting lighter ducklings!
- Showed that there was no trend to interactions between the experimental treatments and the categories of egg weight so that we eliminated the egg weight categories in the final statistical model.



Why it is necessary to turn duck eggs 120° during incubation and storage?

The incubators used and made in Italy turn the eggs ±60° while the most incubators made all over the world are able to turn the eggs only ±45°. Apparently there is no advantage in a higher angle of turning. However I want to remember that Serboul, at the 7th European Poultry Conference in Paris (1986), observed an improvement of hatchability in duck eggs incubated in horizontal position in respect to the eggs incubated in vertical position in an incubator which turned the eggs only ±45°. In later experiments with incubators which turned the eggs ±60°, in which we always obtained very good hatching results (for a review see Bagliacca et al. 1991), we did not observe any improvement of hatching by the use of the horizontal position, which surely reduces the capacity of incubators.

Regarding the technology of turning during storage, the action of the force of gravity upon the embryo take evidence only for long storage times. The phenomenon however is a continuous phenomenon and even if the effect on hatchability can be statistically showed only for long storage times its action can determine little reduction of hatchability also with 7 and 14 days of storage.

The reason because also during storing the eggs were turned ±60° is related to the fact that in the present research we located the automatic mechanical device of an old broken Italian incubator in the storage room.

References

Bagliacca M., Paci G., Marzoni Fecia di Cossato M. (1991) Tecnologia di incubazione delle uova degli anatidi. Atti Convegno CNR: Allevamenti delle Piccole Specie, Roma: 95-107.

Serbul V.P. (1986) Improving Muscovy duck eggs incubation technique. Proc.7th European Poultry Conference, Paris, 819-823.