# EFFECTS OF PRE-INCUBATION STORAGE TIME OF OSTRICH EGGS ON THEIR INCUBATION AND HATCHING RESULTS

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**Abstract**:

The research was carried out in the "ANOC" ostrich farm in Patos/Albania, in order to determine the effects of storage period on the hatchability of 197 ostrich (Struthio camelus) eggs. One egg setting was monitored, through dividing the eggs into three groups according to their age, as following: 20-30, 10-20 and 1-10 days old, containing respectively 49, 80 and 68 eggs/group. During the hatching process, the respective parameters, such as: fecundity, embryonic mortality, weight egg loss and hatchability were recorded and monitored. After two weeks, the average weight loss of the all eggs resulted to be 0.5% more than the standard, referred as such, the instructions given by the Dutch company ***PAS REFORM***, producer of the ostrich eggs incubation and hatching machines. The reason of the high embryonic mortality (40.7%) mainly relates with the long pre-incubation storage time. Higher sterility (42.6%) might especially relate with the high temperature stress in the farm, considering the fact that the animals were just transferred from the Netherlands to Albania. The hatching rate (29.9%), compared to the total number of the set eggs is comparable with the same parameter achieved in the UK. Out of these results, it is concluded that: the shorter the egg storage time before the setting the better will the hatching results be.

**Keywords**: Egg weight loss, embryonic mortality, hatchability, ostrich, storage time.

## 1. Introduction

Ostrich production and management is still a new industry and experience, not only in Albania but in Europe as well. South Africa is the main well-known area for the biggest number of ostrich farms, but during the recent years the interest on the ostrich farming has been increasing world wide.

Since 2005, the ANOC (Albanian Netherlands Ostrich Company), a joint-venture between an Albanian broiler producer company and two Dutch partners, was established. ANOC started its activity based on a 110 breeders flock (parent stock) imported from the Netherlands in 2005, while since than the activity of the company has been gradually growing reaching at about 1000 fatteners at different ages and categories (from day-old chicks to finishers) today.

Interesting factors in the industrial ostrich production are the artificial incubation of eggs and the rearing of chicks to an age, usually 3 months, at which the birds can be considered independent and strong enough to be able to live as such [3, 5. 11, 18].

This study was performed, in order to analyze and find the highest priorities and the

most influential factors, effecting in the ostrich eggs' incubation issues not yet quite clear even in other countries [4], because of the limited studies related to them.

Because of the difficulties faced in bringing the existing hatchery into an acceptable function to hatch the first ostrich eggs in our country, and on the other side, the limited number of available hatching eggs, it became obligatory to set the collected eggs during a 30 days period of time.

The purpose of the study was evaluation of the incubation parameters depending on ostrich eggs' storage time. Many researches have reviewed the effects of storage time on the hatchability of ostrich eggs [1, 14, 20].

## 2. Material and Methods

Monitoring and evaluation process was carried out directly in the ostrich farm facilities. The hatching process technique was implemented according to the recommended technology, in the mean time the incubation's physical regime was monitored and evaluated.

The breeders were in the first reproduction season (the females 3 years old, while the males were 4 years old) and the male: female ratio was 3♀: 1♂. Breeders were kept in collective boxes of 16 animals (12 females + 4 males), in an open sided house.

The total eggs' storage time, before incubator set, ranged from 1-30 days. Eggs were turned automatically through a 90° (2 x 45°) angle every 4 hours. 197 eggs (marked with an identification number and laying date) were candled before having been set in the incubator and eggs' weights were recorded. After two weeks, all eggs were weighed and candled again, in order to find the exact weight loss and the size of the air cell, as the main factors that indicate the progress of the hatching process and especially the level of the relative humidity in the hatchery. Another candling was carried out in the 28-th day, in order to identify the infertile eggs, which were than removed from the incubator. An infertile or sterile egg, doesn't demonstrate any internal change, but it remains clear and without any evidence of embryo development. This is also the way of differentiating the sterile eggs from the dead embryos. The eggs were grouped according to their storage time, respectively: 20-30, 10–20 and 1–10 days old eggs, comprising each of them the corresponding number of eggs: 49, 80 and 68. Two parameters, such as the *embryonic mortality of fertile eggs* and *embryonic mortality of total eggs* were calculated. The second parameter includes the early embryonic mortality, which is difficult to be identified. Hatching was allowed to be as natural as possible, with the eggs being examined every 2-3 hours, to record the time of external piping and successful hatching. Some weak chicks were assisted in hatching. Hatchability was calculated for hatched eggs by dividing that number by the total eggs set or fertile eggs

[4]. Chicks were weighed after hatch and the incubation period was recorded. The following parameters were recorded:

- Egg weight loss;
- Number of sterile eggs in the 28-th day;
- Number of died embryos;
- Number of hatched eggs;

Results of this monitoring were statistically processed (ANOVA and Descriptive Analysis) and evaluated.

## 3. Results and Discussion

### *3.1 Eggs' weight loss*

In the following tables, the egg weight at the moment of setting and two weeks after the setting is displayed (as they were grouped according to their age in the storing room).

**Table 1** Egg weight loss during the incubation process

| *Parameters* | *Group 1* | *Group 2* | *Group 3* | **Average** |
|---|---|---|---|---|
| Number of set eggs | 49 | 80 | 68 | |
| Storage period | 20-30 | 10-20 | 1-10 | |
| Initial egg weight (M±SD) | 1587.13±135.86 | 1572.84±146.08 | 1562.13±136.67 | 1572.55±140.06 |
| Egg weight after two weeks of incubation (M±SD) | 1509.88±117.07 | 1491.99±126.05 | 1473.98±126.32 | 1489.86±124.14 |
| **Egg weight expressed as a percentage of initial egg weight** | 95.13 | 94.86 | 94.36 | 94.74 |

As it can be seen from the table 1, in both weightings, although the eggs of the first group are heavier, the differences between the three groups are not significant.

All the eggs under the incubation have shown an average weight loss of 5.3%, or 0.5% more than the standard norm, referred as such, the instructions given by the Dutch company ***PAS REFORM***, producer of the ostrich eggs hatchery.

Being much bigger than the eggs of other species, the ostrich eggs have a bigger evaporation; this is the reason why it is necessary to keep the relative humidity at a lower level, to allow the evaporation from the eggs, in such way that it can lose about 11-15% of its initial weight until the end of the incubation period [11]. Eggs, that lose less than 10% or more than 20% of their initial weight are less likely to hatch [4,5], while if the weight loss is excessive, the embryo dies of dehydration [15, 19, 20].

**Table 2:** Comparison of the hatched chick weight with the egg's weight in the day of set

| *Parameters* | *M* | **SD** |
|---|---|---|
| Initial egg weight | 1572.55 | 140.06 |
| Hatched-Chick weight | 902.83 | 73.99 |
| **Chick weight expressed as a percentage of initial egg weight** | 57.4 | |

These results comply with those of [20], who reported that chick weight as a percentage of initial egg weight averaged 63.6% and ranged from 56-69%.

*3.2 Sterile Eggs*

From the Table 3, high level of egg sterility (42.6%) relates with several factors, where the main two ones are: adaptation and the temperature stress in the new environment.

According to [2], because of the handling stress (transportation, moving from one house to another one, etc) and/or the high environmental temperatures, the insemination might not be effective. High temperatures were found to be a reason of lower male fertility [7]. According to the different sources of literature, infertility rate varies widely, from 22.2% in the United Kingdom to 42% in USA [5, 10]. According to [14], the rate of infertility for the eggs stored for 19 days was 20%, while according to [16] for the eggs stored during 8-28 days, it was 36%.

*3.3 Embryonic mortality*

The effect of storage time on embryonic mortality is presented in Table3. A high rate of embryonic mortality was evidenced, using two parameters as reference: embryonic mortality referring to the total number of fertile eggs, which is in the level of 40.7 %, and the embryonic mortality in comparison with the total number of the set eggs, which is in the level of 23.4%. According to [14] these parameters were respectively 20.8 % and 16.7 %. Embryonic mortality peaks during the first and last few days of incubation with few losses occurring during the middle period of incubation (3, 4, 12). Early embryonic mortality has been associated with delayed egg collection, high storage temperature, infected eggs, while mid embryonic mortality has been associated with inadequate egg turning and inappropriate eggs' handling [2]. Late embryonic mortality is related to inadequate ventilation and fluctuating incubation temperature, high level of humidity in the in the hatching machine and mal-positions of the head [9. 17].

*3.4 Hatched eggs*

Hatchability denotes the percentage of fertile eggs that hatch successfully following an incubation period. As it can be seen in the table 3, the hatching rate of the eggs is relatively low, but anyhow comparable with the same parameters in some countries where the ostrich is reared. Various hatchability rates have been noted the world over, ranging from 27-67% and so on average bellow those founding wild ostriches [1, 6]. These results seem to be better than the ones of [14], according to which the eggs stored for a period of 28 days had a hatching rate of 49.55% over the fertile eggs.

In this study, it was concluded that the low hatchability rate, relates with the problems within the incubation process (high rates of infertility and high embryonic

mortality). Prolonged storage period reduced hatchability [5]. According to [8], the most effective storage period was less than 15 d to maintain hatchability for ostrich eggs when incubated at 36.5 to 37.0 °C with 25% RH. Reports suggest that prolonged pre-incubation storage of over 14 days and high breeder stocking density have a negative effect on hatchability (5, 13, 8).

**Table 3:** Sterility, embryonic mortality and hatchability percentage of eggs stored up to 30 days

| ***Hatching parameters*** | **Indicators** |
|---|---|
| No. of eggs set | 197 |
| Head of hatched chicks | 59 |
| Hatched chicks of total eggs (%) | 29.9 |
| Hatched chicks of fertile eggs (%) | 52.2 |
| No. of sterile eggs | 84 |
| Sterile eggs of total eggs (%) | 42.6 |
| No. of embryonic death | 46 |
| Embryonic mortality of total eggs (%) | 23.4 |
| Embryonic mortality of fertile eggs (%) | 40.7 |
| No. of broken eggs | 8 |
| Broken eggs of total eggs (%) | 4.1 |

## 4. Conclusions

Pre-incubation storage time didn't show any significant influence on the evaporation level until the first two weeks of incubation, but storage time and egg weight, affect egg weight loss and hatchability. Sterility seems to be unaffected by the pre-incubation storage time of ostrich eggs, but of ostrich adaptation and the high temperature stress in the new environment. Long term storage of eggs before the set resulted to early embryonic mortality, which was evidenced through the third candling process (after four weeks of incubation). High rates of sterility (42.6%) and a long storage period (up to 30 days) without appropriate conditions have contributed to lower hatchability. Although chick weight expressed as a percentage of initial egg weight was optimal.

## 6. References


1. Badley A: **Boosting ostrich productivity through better egg hatchability**. *A report for a rural industries Research and Development Corporation*, 1998 98 (17).
2. Blessing.D: **Veterinary problems of the ostrich *(Struthio Camelus)* up to 12 weeks of age**. Doctorate Thesis, presented at the Department of Veterinary Pathology of Utrecht University, The Netherlands, 1998, 7–13.
3. Deeming and Ayres: **Factors affecting the rate of growth of ostrich chicks in captivity.** *The veterinary Record*, 1994, (135): 617-622.
4. Deeming et al: **Observation of the commercial production of ostrich in the UK**. *The veterinary Record*. 1993, (132): 627-631.
5. Deeming, D.C: **Factors affecting hatchability during commercial incubation of ostrich (Struthio camelus) eggs**. *British Poultry Science*, 1995, (36): 51-65.
6. Deeming D C: **Production, fertility and hatchability of ostrich (Struthio Camelus) eggs on a farm in United Kingdom**. *Anim. Sci*. 1996. (63): 329-336.

7. Dijkman.E: **Incubation and neonatal disorders in ostriches.** *Publication of Survey Results on incubation problems and chick mortality in Zimbabwe*, 1996, 31-37.

8. Dzoma B M: **Some Factors Affecting Fertility and Hatchability in the Farmed Ostrich: A Review.** *Journal of Animal and Veterinary Advances*. 2010, 9 (2): 229-239

9. Hassan SM, Siam AA, Mady ME, Cartwright AL: **Egg storage period and weight effects on hatchability of ostrich (Struthio camelus) eggs**. *Poultry Science.* 2005, 84 (12):1908-1912

10. Hicks: **Ostrich reproduction**. *In M.E Fowler (Ed), Zoo and Wild Animal Medicine, Current Therapy* 1993, (3): 203-206.

11. Ley et al: **Mortality of chicks and decreased fertility and hatchability of eggs from a captive breeding pair of ostriches.** *Journal of the American veterinary medical Association,* 1986, (189): 556-563.

12. Madeiros: **Incubation trouble shooting – causes of poor incubation/hatching results**. *Paper presented at the 4-th annual European Ostrich Association Conference at Hengelo, Netherlands*. 1996, 5-9

13. Meijerhof R: **Pre-incubation holding of hatching eggs.** *World's Poultry Sci. J*. 1992, (48): 57-68.

14. Nahm K H.: **Effects of storage and weight loss during incubation on the hatchability of ostrich eggs (Struthio Camuelus).** Poultry Science, 2001, 80:1667-1670.

15. Rahn Et Al: **How the bird eggs breathe**. *Scientific American*, 1979, 240; 46.

16. Saengsophon Anucha: **Effect storage time on hatchability of ostrich eggs.** Proceedings of 30th anniversary agricultural exhibition of King's Mongkut Institute of Technology Ladkrabang on 24-25 June, 1999, Bangkok (Thailand), 24-25 Jun 1999, 483-487

17. Stewart: **Hatcher management in Ostrich production**. *In M.E Fowler (Ed), Zoo and Wild Animal Medicine, Current Therapy* 1993, (3): 206-211.

18. Shivaprasad H**: Neonatal mortality in ostriches: an overview of possible causes.** *Proceedings of the Association of Avian Veterinarians.* 1993, 282-285.

19. Tullet, Deeming: R**elationship between eggshell porosity and oxygen consumption of embryo in domestic fowl.** Comparative Biochemistry and Physiology, 1992, 72A, 529-533.

20. Wilson,H.R and A R Eldred: **Effect of egg storage on hatchability and weight loss of ostrich eggs.** 1997 Applied poultry research 6: 216-220.