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**PhD DISSERTATION ABSTRACT**

**„Contribution on the improvement of hens eggs  
artificial incubation performances, through the  
adjustment of certain technological factors”**

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## **PhD DISSERTATION ABSTRACT**

Despite all scientific progress made in the artificial incubation area of expertise we find ourselves still facing a great number of ambiguities and unknown matters, all generating numerous contradictions.

A particularly important aspect to be considered is the fact that specialists have not yet fully comprehended the morphological, biochemical and physiological alterations occurring during embryonic development. The border between these causes is sometimes infinitely small and only after we have discovered what exactly interferes with the embryonic development process can we claim to have understood the phenomenon called “incubation”.

According to various works in the bibliography, successful results have been obtained while artificially incubating eggs, especially in point of incubational technique (devices equipped with advanced control features) and physical incubational parameters.

Also, a great amount of success has been noted in what concerns the biosecurity of the hatcheries; however studies remain to be conducted in order to determine exactly how effective the current disinfection and fungicide substances really are. Tests must be taken in order to establish the optimal dosage of substances used and to determine how and when these doses should be administered and, of course, what their remanence is.

Also, adjustments are necessary for the physical parameters of egg preincubation. Data present in the works consulted for the making of this thesis vary from one reference to another in terms of air temperature and relative humidity and in what concerns the preincubation time. Also, there are further contradictions concerning both the incubation physical parameters during the stages of embryonic development and the sequence of these stages.

In a similar way, we cannot talk about a unity in opinions in what concerns the physical parameters (air temperature and relative humidity) whose status should be taken into account both in the spaces where the eggs are transferred and sorted and in those where the hatched chicken are temporarily placed.

This particular thesis means to shed some light and come with certain clarifications in the matters mentioned above.

After conducting a number of two series of experiments (which have been specified in the general test schedule) some performance improvements were noticed in incubating hen eggs originating from adult heavy breed parents. The following conditions were fulfilled in order for the experiments to be successful:

- new disinfectants and fungicide substances were used to ensure the biosecurity of the hatcheries;
- the physical parameters of hen eggs preincubation were optimized;
- the physical parameters of incubation by stages of embryonic development were optimized;
- the physical parameters in the spaces where the eggs are transferred and sorted and in those where the hatched chicken are temporarily placed were optimized.

The research within the first series of tests was conducted on 4 egg lots divided as follows: one control lot (Lc) and three experimental lots (L1exp ÷ L3exp).

Basically, the experimental factors focused on the modifications occurring during the most important stages of the artificial incubation technological process: preincubation, incubation, egg transfer in the hatchery, hatched chicken sorting and temporary placement.

The experiments were conducted at the S.C. „AVICOLA” S.A. Slobozia hatchery, in a 1177, 42 m<sup>2</sup> hall which contains 12 incubators (9 – I.V.60 M and 3 – I.V.60) working at a capacity of 655.776 eggs per series of incubation and 6 hatcheries (Pas Reform - H2-19) with a capacity of 115.200 eggs per hatching series.

The eggs necessary for the two series of tests came from the parents of the trade meat hen hybrid „ROSS-308”, bred on farm 1 RRG Amara, property of S.C. „AVICOLA” S.A. Slobozia.

The lot used for the first series of tests was aged 41-42 weeks at the time of harvesting. The research was conducted on a total of 20248 eggs divided into 4 lots, respectively Lc = 5010; L1 exp. = 5062; L2exp. = 5094 and L3exp. = 5082.

The modifications of the embryony development process were the following:

**1. During the stage of mechanical cleaning of the egg's mineral shell (with a cotton cloth dipped in a Virkon'S solution , concentration 0,2%):**

Lc: no

L<sub>1</sub> exp.: no

L<sub>2</sub> exp.: no

L<sub>3</sub> exp.: yes

**2. During egg preincubation stage:**

<b>- working temperature:</b>	<b>- relative air humidity:</b>	<b>- duration:</b>
Lc: +26 ÷ +28°C	Lc: 60-65%	Lc: 12 hours
L <sub>1</sub> exp.: +28 ÷ +30°C	L <sub>1</sub> exp.: 65-70%	L <sub>1</sub> exp.: 10 hours
L <sub>2</sub> exp.: +30 ÷ +32°C	L <sub>2</sub> exp.: 70-75%	L <sub>2</sub> exp.: 8 hours
L <sub>3</sub> exp.: +32 ÷ +34°C	L <sub>3</sub> exp.: 75-80%	L <sub>3</sub> exp.: 6 hours

**3. During preincubation:**

<b>- fumigation:</b>	<b>- biological control I:</b>	<b>- biological control II:</b>
Lc: no	Lc: no	Lc: at transfer time, in the setter room;
L <sub>1</sub> exp.: continuous	L <sub>1</sub> exp.: inside the devices, at the eight day of the incubation process;	L <sub>1</sub> exp.: at transfer time, in the transfer room;
L <sub>2</sub> exp.: continuous, except for the period of time between the hours 12-72 from the innitial egg placement inside the devices;	L <sub>2</sub> exp.: outside the devices, at the eight day of the incubation process;	L <sub>2</sub> exp.: at transfer time, in the transfer room;
L <sub>3</sub> exp.: everytime a new series of eggs was placed in the devices (every three days)	L <sub>3</sub> exp.: inside the devices, at the eight day of the incubation process;	L <sub>3</sub> exp.: at transfer time, in the transfer room;

**4. During transfer:**

<b>- working temperature:</b>	<b>- relative air humidity:</b>	<b>- transfer duration:</b>
Lc: +26 ÷ +28°C	Lc: 55-60%	Lc: 15-20 minutes
L <sub>1</sub> exp.: +28 ÷ +30°C	L <sub>1</sub> exp.: 60-65%	L <sub>1</sub> exp.: 10 minutes
L <sub>2</sub> exp.: +30 ÷ +32°C	L <sub>2</sub> exp.: 65-70%	L <sub>2</sub> exp.: 10 minutes
L <sub>3</sub> exp.: +32 ÷ +34°C	L <sub>3</sub> exp.: 70-75%	L <sub>3</sub> exp.: 10 minutes

**5. During sorting:**

<b>- working temperature:</b>	<b>- relative air humidity:</b>
Lc: +26°C	Lc: 55-60%
L <sub>1</sub> exp.: +28°C	L <sub>1</sub> exp.: 60-65%
L <sub>2</sub> exp.: +30°C	L <sub>2</sub> exp.: 65-70%
L <sub>3</sub> exp.: +32°C	L <sub>3</sub> exp.: 70-75%

**6. Inside the temporary storage room for hatched chicken:**

<b>- working temperature:</b>	<b>- relative air humidity:</b>
Lc: +26°C	Lc: 55-60%
L <sub>1</sub> exp.: +28°C	L <sub>1</sub> exp.: 60-65%
L <sub>2</sub> exp.: +30°C	L <sub>2</sub> exp.: 65-70%
L <sub>3</sub> exp.: +32°C	L <sub>3</sub> exp.: 70-75%

**The following indicators were monitorized:**

**A. During egg incubation and hatching:**

- egg weight dynamics; at the time of their placement inside the devices; at the first mirage and at transfer; the microbial charge on the mineral shell of the eggs before and after every sanitary operation performed (fumigation, mechanical cleaning); the number of eggs containing normally developed embryos, at the first and second mirages; the number of eggs carrying dead embryos, at the first and second mirages; the number of clear (unfertilized) eggs, at the first and second mirages; egg fertility percentage; hatchability percentage; hatching percentage; the weight of the hatched chicken; the dynamics of the incubation physical parameters; working temperature, relative air humidity; ventilation; eggs turning-over, the economic efficiency of the experimental incubation processes.

**B. During the process of breeding the chicken resulting from the studied eggs:**

- the dynamics of the microclimate from the halls in which the chicken are bred (environmental temperature, relative air humidity, ventilation, noxa agents); the dynamics of the chicken's weight gain, by means of weekly individual weighing performed on the control lots; food quality; feeding process; lot losses and their causes; the economic efficiency of breeding the chicken who hatched from the eggs on which the tests were performed; qualitative and quantitative meat production.

From a total of 20248 eggs placed in the incubators 17060 chicken hatched, respectively  $L_c = 4160$  heads;  $L_{1exp.} = 4290$  heads;  $L_{2exp.} = 4360$  heads and  $L_{3exp.} = 4250$  heads.

The chicken were bred at "Avicola" Slobozia's 3PC – Bora farm, in halls equipped with BP-4 batteries until they reached 42 days of age, afterwhich they were slaughtered at the company's Poultry Slaughterhouse.

The second series of tests was conducted on the same experimental lots ( $L_c$  and  $L_{1exp.} \div L_{3exp.}$ ). This time new sanitation measures were added to the process but only for the lots  $L_{2exp.}$  and  $L_{3exp.}$ . They consisted of washing, disinfection and fungicide measures in four stages, as follows:

- *stage 1*: the eggs were washed with foamless detergent at  $+35^\circ \text{C}$  for 1 minute;
- *stage 2*: the eggs were rinsed at  $+38^\circ \text{C}$  for 1 minute;
- *stage 3*: the eggs were disinfected by use of original methods; thus, lot  $L_{2exp.}$  was disinfected at  $+40^\circ \text{C}$  with a Cloramine solution of 4‰ concentration; lot  $L_{3exp.}$  was disinfected at  $+40^\circ \text{C}$  with a Virkon's solution of 0,2% concentration, for 2 minutes;
- *stage 4*: the fungicide measures were taken using a „Bromosept 50” solution of 0,06% concentration, at  $+42^\circ \text{C}$ , for 2 minutes (lot  $L_{2exp.}$ ) and 15 minutes (lot  $L_{3exp.}$ ).

The eggs necessary for the testing also came from the parents of the trade meat hen hybrid „ROSS-308”, bred on farm 1 RRG. Amara, property of S.C. „AVICOLA” S.A. Slobozia.

The hen which provided the eggs were 30 weeks old. The experiment was conducted on 1200 eggs divided into 4 lots, respectively  $L_c = 300$  eggs;  $L1_{exp.} = 300$  eggs;  $L2_{exp.} = 300$  eggs and  $L3_{exp.} = 300$  eggs.

1072 chicken hatched from the 1200 incubated eggs, as follows:  $L_c = 265$  heads.;  $L1_{exp.} = 276$  heads.;  $L2_{exp.} = 263$  heads. and  $L3_{exp.} = 268$  heads.

The chicken were bred at “Avicola” Slobozia’s 5PC – Gh. Doja farm, until they reached 42 days of age, after which they were slaughtered at the company’s Poultry Slaughterhouse.

As the **first series of experiences** was finalized the following outcomes were recorded:

- the microbial charge present on the mineral egg shells decreased from the quantity initially recorded by 83,74% at the control lot  $L_c$ , 80,88 % at the lot  $L1_{exp.}$ , by 78,74% at  $L2_{exp.}$  and by 71,96% at  $L3_{exp.}$ ;

- for all experimental lots, the weight losses recorded varied within the limits mentioned in the manuals (12,30% - 12,46%). Statistically, no significant differences were noticed between the lots that made the object of this study;

- due to the fact that all eggs came from parents belonging to the same poultry lot, the medium number of unfertilized eggs varied within close limitations, between 7,42% - 8,98%;

- in comparison with the control lot ( $L_c$ ), the number of deceased embryos belonging to the experimental lots ( $L1_{exp.}$ ÷ $L3_{exp.}$ ), that were discovered during the two mirages, was smaller : 4,39% -  $L1_{exp.}$ , 4,06% -  $L2_{exp.}$  and 4,51% -  $L3_{exp.}$ , as opposed to 6,51% - the control lot  $L_c$ ;

- the number of the fully developed embryos was higher within the experimental lots ( $L1_{exp.}$ ÷ $L3_{exp.}$ ), as opposed to the control lot ( $L_c$ ); the percentages were the following: 86,49% - 88,09% at  $L1_{exp.}$ ÷ $L3_{exp.}$ , compared with 85,99% -  $L_c$ ;

- our research also shows that the highest fertility rate was recorded within the control lot  $L_c$  (92,55%), compared to 91,05% - 92,14% within the experimental lots  $L1_{exp.}$ ÷ $L3_{exp.}$ ;

- the analysis of the incubation process has shown that egg hatchability was higher among the experimental egg lots  $L1_{exp.}$ ÷ $L3_{exp.}$  by 2,62% - 3,58% in comparison with the control lot ( $L_c$ ) and egg hatching by 0,83% - 3,10%;

- the difference between the weight of the studied eggs and that of the chicken resulting from them after hatching was normal: 21,28-22,21 g, this being the case of all lots;

- the implementation of the new processes was all in all successful. The best economic results were recorded among the experimental lots, L2exp. in particular (4,59% compared to the control lot Lc);

- in what concerns the hatched chicken's weight dynamics, the experimental lots, at 42 days of age, recorded a weight gain higher by 2,08% - 4,96% than the control lot. However, at the same age, the weight of the chicken belonging to lot L3exp. was by 3,42% smaller compared to that of the chicken in Lc. If we take into account the growth speed, the daily medium growth (DMG) recorded at the end of the experiment was higher in the experimental lots, L1exp. and L2exp. than in the control lot Lc, by 2,49% - 10,10%. L3exp. recorded negative values compared to Lc;

- fodder intake/day/recipe and all throughout the experiences was higher in case of lot L1exp. compared to Lc. It has, however, been directly proportional to the body weight gain; the experimental lots L2exp. and L3exp. have eaten less than Lc by 2,12% - 9,32%. Nevertheless, the food conversion index in what concerns L1exp. and L2exp. has outgrown Lc by 3,34% - 7,94%. In what concerns the conversion index of the experimental lot L3exp. statistics have shown a percentage higher by 3,25% than the same index measured for Lc;

- poultry losses varied between 2,36% - 3,58% of the total; these values are normal; the most significant losses occurred due to technopathy and heat induced stress;

- the breeding of all chicken hatched from the tested eggs has proven to be very effective as all experimental lots have generated profits as follows: L1exp. and L2exp. have outgrown the control lot Lc by 2,65% - 3,84%, and L3exp. by 1,94%. In this latter case the efficiency proved somewhat smaller than of the other experimental lots;

- slaughter efficiency was rated within normal values for all experimental lots (77,92% - 79,12%): L1exp. and L2exp. have shown superiority compared to Lc by 1,16% - 1,65%, whereas L3exp. was outgrown by 0,78% by the control lot.

If we were to draw a conclusion for the **first series of tests** we can say that the incubation technologies we have experimented with, while processing the experimental lots L1exp. and L2exp., have determined superior results compared to the ones used for L3exp. and the control lot Lc.

For the **second series of tests** the final conclusions were drawn:

- as a result of the two step fumigation process performed on the control lot Lc and the experimental lot L3exp., the microbial charge initially present on the mineral egg shell decreased by 52,39% - Lc and 60,32% - L3exp;

- the experimental lots L2exp. and L3exp. underwent a supplementary disinfection and anti fungus treatment; the outcomes were the following: germ and fungus count decreased

by 97,44% (TGN) and 91,67 (TFN) for the L2exp. and by 97,30% (TGN) and 85,72% (TFN) for L3exp. After the second fumigation the microbial charge on the mineral egg shell was reduced to 0;

- at all experimental lots the weight loss registered during the incubation process were in normal limits (12,07% - 13,63%). Statistically, significant differences were noticed between Lc-L2 exp. and Lc-L3 exp.

- due to the fact that all eggs came from parents belonging to the same poultry lot, the medium number of unfertilized eggs varied within 4,67% – 6,67 % for all experimental lots;

- the number of dead embryos discovered during the two mirages was smaller within the experimental lots (L1exp. ÷ L3exp.) in comparison to the control lot (Lc). The losses were of 2,0% of the total count – L1exp., 3,67% - L2exp, 4,67% - L3exp., as opposed to 5,0% recorded for the control lot Lc;

- the number of normally developed embryos from the experimental lots L2exp. and L3exp. (89,67%) was outgrown by the results of the count performed on the control lot Lc (90,33%). L1exp. embryonic development was 94,0% successful;

- our research has shown that the best egg fertility was noticed within the experimental lot L1exp. (96,0%), followed by L3exp. with 94,33% and L2exp. with 93,33%;

- incubation process analysis shows that egg hatchability was higher in the case of the experimental lots as compared to the control lot Lc. Egg hatching, however, recorded higher percentages for L1exp. (3,38%) and L3 exp.(0,74%) in comparison to the control lot Lc, and a lower percentage (1,13%) at the count performed on the experimental lot L2exp.;

- the difference between the weight of the eggs studied and that of the chicken that hatched from these eggs ranged within normal limits(17,57-18,66g.);

- the implementation of the new processes was all in all successful. The best economic results were recorded among the experimental lot L1exp. in particular (22,33% compared to the control lot Lc); the experimental lots L2exp. and L3exp. proved less profitable because of the costly extra measures taken in their cases - disinfection and anti fungus treatment - during incubation. The profit in these cases was 0,46% – 15,64 % smaller than that of the control lot Lc.

- in what concerns the hatched chicken's weight dynamics, the experimental lots, at 42 days of age, recorded a weight gain higher by 3,75% – 8,86 % than the control lot. If we take into account the growth speed , the daily medium growth (DMG) recorded at the end of the experiment was higher in the experimantal lots (3,63% – 8,89%) in comparison to the control lot Lc;



- fodder intake/day/recipe and all throughout the experiences was smaller by 2,95% - 3,33% in case of the experimental lots compared to Lc. It has, however, been directly proportional to the body weight gain; The food conversion index for the experimental lots L1exp. ÷ L3exp. has outgrown that of the control lot Lc by 6,79% - 12,99%;
- poultry losses varied between 2,61% – 5,79% of the total; these values are normal; the most significant losses occurred due to heat induced stress;
- slaughter efficiency was rated within normal values for all experimental lots (77,36% – 79,57%); L1exp. and L3exp. have shown superiority compared to Lc by 1,43 – 2,85 ;
- the breeding of all chicken hatched from the tested eggs has proven to be very effective as all experimental lots have generated profits. The best economic results were noted for the experimental lots (L1exp. ÷ L3exp.). Profits, in their cases, have outgrown those of the control lot Lc by 21,20% – 39,96 %.

The incubation technologies we have experimented with, while processing the experimental lots L1exp. ÷ L3exp, have determined superior results compared to the ones used for the control lot Lc. We especially recommend the technologies used within the incubation processes of the eggs belonging to the experimental lots L2exp. and L3exp. These new approaches should be considered in the future for heavy breed hen eggs artificial incubation.