

## THE EFFECT OF THE BROILER PARENTS AGE AND THE PERIOD OF EGG STORAGE ON INCUBATION INDICATORS

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### Abstract

The basic objective of this study was examination of the effect of age of broiler parents (PA) of Cobb Hybrid 500 and the period of storage of eggs i.e. egg age (EA) on the fertility of eggs and chicken hatching, as well as the embryo mortality of chickens (early, middle and late) during the incubation period. By the method of a random sample, in the three phases of the production cycle, i.e. for different age of broiler parents (PA25weeks, PA41weeks, and PA58weeks) and in the case of eggs stored for up to 7 days, and over 7 days (EA <7 and EA > 7), 1050 eggs per phase (total of 6300 eggs) were selected, in order to determine these reproductive indicators.

The age of broiler parents affected the fertility of eggs because there were the most fertile eggs in the middle of the production cycle (PA41 = 97.05%), then at the beginning (PA25 = 96.09%) and the least in the final stage (PA58 = 93.00) of flock breeding. The egg storage period had no effect on the fertility of eggs, while the age of broiler parents and egg storage period significantly affected the percentage of chicken generating, and thus the embryo mortality during incubation. The lowest total embryo mortality (13.05%), regardless of the storage period, was found in eggs originating from PA41, much higher 15.87% in eggs originating from PA58 and the highest 16.93% in eggs originating from PA25. In addition, extending the period of storage of eggs i.e. egg age (EA < 7 and EA > 7) resulted in the increase of the total embryonic mortality in all three phases of the production cycle.

**Key words:** *storage, parents, eggs, embryo, mortality.*

### Introduction

It is well known that the production technology of one-day old broiler chickens starts with breeding i.e. rearing of a certain heavy hybrid parent flock of hens and ends with artificial incubation of eggs produced for breeding (plantation). Observed as a whole, after oviposition (egg carrying), new-laid eggs are placed at the warehouse parent (mother) farm for a day or two, and then are transported by special vehicles with air conditioning to the chicken brooding house. They are re-stored and kept for a certain period of time before they are put in an incubator. Under optimal conditions, commercial hatcheries put in eggs after 3 to 5 days of storage by which the negative effects of egg storage are minimized to the hatching (feasibility) and the quality of day-old chickens. First of all, the highest percentage of chicken generating from a number of fertilized eggs (embryo mortality is reduced to a minimum) is achieved and quality and vital chickens are produced. However, the chicken breeding houses in some situations have to extend the duration of storage of eggs, because the duration of

storage of eggs in the chicken brooding house depends on the supply of hatching eggs, hatchery capacity, market demand and the price of day-old broiler chickens.

A remarkable number of researchers, such as Decuyper and Michels (1992), Reis and Soares (1993), Gustin (1994), Reis et al. (1997), Suarez et al. (1997), Elibol and Brake (2003), Altan et al. (2002), Tona et al. (2004), Miclea and Zahan (2006), Elibol and Brake (2006), Petek and Dikmen (2006), Schmidt et al. (2009), Reijrink (2010), Al-Bashan and Al-Harbi (2010) have found out that the age of broiler parents of different genotypes and age of eggs, i.e. the period of storage (keeping) eggs affect the incubation results, and therefore the fertility of eggs, i.e. the chickens' embryo mortality during incubation.

These authors, in a broader sense, submit that an extension of the period of storage of eggs, among other things, extends the incubation period, decreases the percentage of chicken hatching, reduces the quality of the chickens after hatching, which have negative impact on growth, feed conversion and mortality of broiler chickens during fattening. Although the negative effects of prolonged egg storage period are known to some extent, however, it is still not fully examined how age of eggs (storage period) affects the development of the embryo during the incubation period, and thus the number and percentage of high-quality day-old hatched out chickens.

According to this, the main objective of the study was to determine the effect of paragenetic factors on the results of incubation, particularly broiler parent age (PA) and the period of storage (keeping) of eggs i.e. egg age (EA). In fact, at different age of broiler parents of Cobb 500 hybrid (PA25weeks, PA41weeks, and PA58weeks) and at the eggs stored – old up to 7 (EA <7days) and more than 7 days (EA > 7), among other things, the number and percentage of fertility of eggs, chickens' hatching (out of the number of incubated and out of the number of fertilized eggs) as well as embryo mortality (early, middle and late mortality) during the incubation period have been determined.

### **Material and methods**

The experimental part of the research was carried out on poultry farm (producing eggs for breeding) and chicken brooding house AGREKS Ltd. Lower Zabari, Republic of Srpska - BiH. This farm, among other things, deals with the rearing and breeding of broiler parents of Cobb 500 hybrid, i.e. the production of breeding eggs and day-old chickens.

In order to determine the effect of age of broiler parents in different stages of the production cycle (start, middle and end), i.e. at 25 weeks old flock (PA25), 41 (PA41) and 58 weeks (SR58), and stored eggs (older eggs) up to 7 (EA <7) and over seven days (EA > 7) on the fertility of eggs and embryonic mortality of chickens during incubation, studies were carried out on a total of 6300 eggs. This means that six groups (treatments) of eggs were selected by the method of a random sample, i.e. 1050 eggs aged up to 7 days and 1,050 eggs kept over 7 days per each phase were incubated ( $1,050 \times 2 = 2100 \times 3 = 6300$  eggs).

All the eggs were kept in a storage room at the temperature of 15 ° C to 18 ° C and 75% to 85% relative humidity. All eggs are kept no longer than 14 days under the above mentioned microclimatic conditions.

A special attention is paid to the fertilized eggs and the eggs from which the chickens hatched out i.e. the eggs with dead embryo in the different stages of its development (early - to 7 days, intermediate from 8 to 17 days, and late from 18 to 21 days of incubation).

Due to limited space, the determined values of an average egg weight, i.e. day-old chickens are textually expressed in this paper, while the results on the fertilized eggs, chicken hatching out of the number of the eggs put in and the number of fertilized eggs, as well as embryo mortality presented in tables in absolute and relative values.

The results achieved are used to determine the effect of broiler parent age (PA), the time period of storage of eggs (egg age - EA) on the properties of the various categories of incubated eggs (fertile and unfertile eggs, the eggs from which chickens hatched, fertile eggs with dead embryo ) and hatched day-old broiler chickens.

Statistic data rendering was done by standard statistic methods (Hadživuković, 1973).

### Results and discussion

In the middle of the production cycle (PA41), the average weight of the eggs stored up to 7 days (EA<7) was 63.11 g, weight of a day-old chickens was 44.01 g, the relative share of chicken in egg weight was 69.73%. Age of broiler parents statistically significantly ( $P < 0.001$ ) affected the increase of egg weight and a day-old chickens' weight, while the percentage of chicken in egg weight was decreasing. In addition, extending the period of storage of eggs for more than 7 days, in all three phases of the production cycle, has caused the egg weight and the chicken percentage reduction, i.e. the relative share of chicken in egg weight decreased with the extension of the period of egg storage, especially in the initial (PA25) and final stage (PA58) of the production cycle and the differences were confirmed at the level of  $P < 0.001$ .

In addition to the effect of broiler parents' age and egg storage time on the egg weight, they had also a special effect on hatching of chickens, as it is evident from the data presented in Table 1.

Table 1. Fertilization of eggs and generating (hatchery) of chickens

Age of parent flock (PA)	Age of eggs (EA)	Total of incub. Eggs	Fertile eggs		Chickens hatched out	Chicken hatchery (%)	
			N	%		From inc. eggs	From fert. eggs
PA <sub>25</sub> weeks.	<7	1050	1018	96,95	855	81,43	83,99
	>7	1050	1000	95,24	822	78,29	82,20
	<i>Total</i>	<i>2100</i>	<i>2018</i>	<i>96,09</i>	<i>1677</i>	<i>79,90</i>	<i>83,10</i>
PA <sub>41</sub> weeks.	<7	1050	1023	97,43	920	87,62	89,93
	>7	1050	1015	96,67	852	81,14	83,94
	<i>Total</i>	<i>2100</i>	<i>2038</i>	<i>97,05</i>	<i>1772</i>	<i>84,38</i>	<i>86,95</i>
PA <sub>58</sub> weeks.	<7	1050	977	93,05	834	79,43	85,36
	>7	1050	976	92,95	806	76,76	82,58
	<i>Total</i>	<i>2100</i>	<i>1953</i>	<i>93,00</i>	<i>1640</i>	<i>78,09</i>	<i>83,97</i>

The data from table 1 show that the age of broiler parents affected the fertility of eggs stored up to 7 and over 7 days. Highest fertility, out of the number of incubated eggs, was in the middle of the production cycle (PA41 = 97.05%), then in the initial phase (PA25 = 96.09%) and the lowest (93.00% PA58) in the final stage of the productive cycle of the breeding of the parental flock. However, the age of broiler parents and egg storage period had a significant effect on the percentage of chicken hatching, especially on embryonic mortality during incubation. The best hatching of chickens out of the number of incubated i.e. fertilized eggs was at PA41 (84.38% and 86.95%), then at PA25 (79.90% and 83.10%) and the worst at PA58 (78.09% and 83.97%). In addition to this, prolonging the period of egg storage negatively affected the percentage of hatching of chickens in all three phases of the production cycle.

From the above we can see that the age of broiler parents affected the fertility of eggs and chicken hatching, and the age of the egg (storage period) affected the percentage of the chicken generating (hatching) and their quality (vitality). Similar tests were carried out by Tona et al. (2004), Petek and Dikmen (2006) for broiler parents of different age and of different time periods of breeding egg storage. Tona et al. (2004) had a higher percentage of

generating for about 4% (88.36% - 84.65%) in case of seven-days old eggs originating from broiler parents of Cobb hybrid, which were 35 weeks old, compared to the parent flock, which was 45 weeks old. In both age groups of broiler parents, incubated fresh eggs had a statistically significantly lower percentage of chicken hatching from 7 days old eggs. Petek and Dikmen (2006) concluded that together with extending the storage period of eggs, at the same broiler parents' age (37 weeks), the percentage of the generating of chickens, out of the number of fertilized eggs, drastically decreases. Thus, chicken generating from the number of fertile eggs, kept for 5 days, was 97.78%, and from the eggs stored for 15 days only 61.82%. Reis and Soares (1993), Schmidt et al. (2009) came to the similar conclusion. These authors state that with the prolongation of the period of storage of eggs, no matter how old parent flock is, the percentage of chicken generating significantly reduces. Schmidt et al. (2009) found that the percentage of the number of hatching chickens out of the number of fertilized eggs reduces from 93.83% (2 days old eggs) to only 74.13% in case of eggs stored for 14 days.

The established embryo mortality (early - up to 7 days; middle - from 7 to 17 days and late - from 18 to 21 days of incubation) in different stages of the production cycle, i.e. the broiler parents' age (PA25, PA41 and PA58) is shown in Table 2.

Table 2. Early, middle and late embryo mortality during incubation

Parent age (PA)	Egg age (EA)	Embryo mortality							
		Early		Middle		Late		Total	
		n	%	n	%	n	%	n	%
PA <sub>25weeks.</sub>	<7	71	6,97	17	1,67	75	7,37	163	16,01
	>7	80	8,00	31	3,10	67	6,70	178	17,80
	<i>Total</i>	<i>151</i>	<i>7,48</i>	<i>48</i>	<i>2,38</i>	<i>142</i>	<i>7,04</i>	<i>341</i>	<i>16,90</i>
PA <sub>41weeks.</sub>	<7	44	4,30	24	2,35	35	3,42	103	10,07
	>7	58	5,71	33	3,25	72	7,09	163	16,06
	<i>Total</i>	<i>102</i>	<i>5,00</i>	<i>57</i>	<i>2,80</i>	<i>107</i>	<i>5,25</i>	<i>266</i>	<i>13,05</i>
PA <sub>58weeks.</sub>	<7	42	4,30	39	3,99	62	6,35	143	14,64
	>7	59	6,04	45	4,61	66	6,76	170	17,42
	<i>Total</i>	<i>101</i>	<i>5,17</i>	<i>84</i>	<i>4,30</i>	<i>128</i>	<i>6,55</i>	<i>313</i>	<i>16,03</i>

Observed as a whole, the data in Table 2 show that the embryonic mortality during incubation was affected by broiler parent age as well as by the length of egg storage (keeping). Namely, the lowest embryo mortality (13.05%), regardless of the period of storage of eggs, was found in eggs originating from 41 weeks old broiler parents (PA41), much higher 16.03% at the end of rearing of flock (PA58) and the highest 16.90% in the initial stage of the production cycle (PA25). In addition, in all three phases of production, the extension of egg storage for more than 7 days resulted in increased embryonic mortality during incubation. The biggest difference (5.99%) was found in the case of eggs originating from 41 weeks old broiler parents i.e. total embryonic mortality in eggs that were stored for up to 7 days, was 10.07%, and in the case of the eggs kept for longer than 7 days, it was 16.06%. In the case of eggs laid at the beginning and in the end of the production cycle, the storage period had a minor effect on embryo mortality (the differences were smaller), but in these production stages the total embryo mortality was higher.

Observed by the production cycle phases (broiler parent age - PA), from the data shown in Table 2, it could be further seen that the early embryo mortality ranged from 5.71% (PA41) and 7.52 (PA25), intermediate between 2.38% (PA25) and 4.20% (PA58), and late embryonic mortality between 5.25% (PA41) and 7.03% (PA25). At all stages of the production cycle, with extending the storage period of eggs, early, middle and late embryonic mortality increased, except for PA25 where the late embryonic mortality was lower in eggs stored for more than 7 days (6.70%) than in the incubated eggs kept to 7 days (7.36%).

These issues, i.e. determination of the effect of storage time of eggs originating from broiler parents of different age on the results of incubation, especially on embryonic mortality were dealt by Reis and Soares, 1993; Gustin, 1994; Reis et al., 1997, Suarez et al., 1997, Elibol and Brake, 2006; Miclea and Zahan, 2006, Schmidt et al, 2009; Al-Bashan and Al-Harbi, 2010.

Reis and Soares (1993) have also found that with the ageing of the broiler parents of hybrid Cobb 500 the embryo mortality increases, too, during incubation, but it was significantly lower than the embryonic mortality shown in our study. Thus, the total embryonic mortality in eggs originating from 33 weeks old parents was the lowest (2.46%), slightly higher (4.84%) at 43 weeks old flock, and the highest at the end of the production cycle - 7.19%. Similarly, Reis et al. (1997) found embryo mortality of 7.9% at the incubation of eggs originating from flock aged between 32 and 34 weeks, and at the flock aged between 48 and 50 weeks it was 8.5%. Suarez et al. (1997) found the highest embryo mortality at the youngest flock (29 weeks old) and it was 10.2%, then at the oldest flock (52 weeks) 8.8%, and the lowest (5.8%) at the eggs originating from 41 weeks old broiler parents. Compared to our results, these authors have found similar or lower total embryo mortality during incubation of eggs stored for up to seven days originating from parent flock of different age.

Similar to our studies, Elibol and Brake (2006) incubated eggs originating from broiler parents of different age (37, 41, 59 and 63 weeks) and determined early, middle and late, and therefore the total embryo mortality. Unlike our studies, these authors have found the lowest total embryo mortality (8.33%) at eggs originating from the youngest flock (37 weeks), then at 41 weeks old flock (9.50%), and significantly higher at 59 weeks old flock (12.28%), i.e. at 63 weeks old flock (12.64%). However, observed as a whole, total embryo mortality was quite similar to our results (Table 2). The same authors state that the early and middle embryonic mortality increases with the increase of broiler parents' age, while late mortality was lowest (3.85%) at 41 weeks old flock, slightly higher (4.06%) at 37 weeks old flock, the highest (5.26%) at 59 weeks old broiler parents. As a support to that observation Al-Bashan and Al-Harbi (2010) found, in their researches, the early and late embryonic mortality during incubation of eggs originating from broiler parents of different age (24, 30, 35, 40, 45, 50, 55, 60 and 65 weeks). The lowest embryo mortality (early - 2.7% and late - 2.9%), was determined with parents aged 45 weeks, and then it gradually increased, and at the end of the production cycle, the early embryonic mortality was 6.2% and the late one was 5.6%.

In fact, the results of these authors are similar to ours, i.e. the lowest embryo mortality (early, middle and late) was mainly established at the eggs that are produced in the middle of the production cycle during the rearing of broiler parents and increased with age. In fact, the early, middle and late embryonic mortality during incubation at eggs kept (stored) up to 7 days was somewhat higher in our study at the different age of broiler parents but it showed a similar trend of increase i.e. decrease.

In the review, Decuypere and Michels (1992) emphasize that apart from the age of parent flock, storage period affects the fertility of eggs i.e. chickens hatching, and thus the embryo mortality during incubation. Petek and Dikmen (2006), in their researches, found lower total embryo mortality - 9.52% (early - 5.10%, medium - 0.68% and late - 3.74%) at eggs stored for 5 days and significantly higher at eggs kept for 15 days, even 37.98% (early - 12.27%, medium - 8.11% and late - 17.60%). Similarly, Schmidt et al (2009) concluded that with extending the period of storage of eggs from 2 to 14 days the total embryo mortality increases from 7.05% to as much as 26.39% at broiler parents aged between 36 and 39 weeks. More specifically, total embryonic mortality at eggs kept up to 7 days (2, 4 and 6 days) was 9.52%, and at the eggs kept for longer than 7 days (8, 10, 12 and 14 days) it was 22.01%. The results of the above mentioned authors are substantially in agreement with our results i.e. that extending the period of storage of eggs increase the embryonic mortality of chickens.

The above mentioned indicates that at the optimal period of storage of eggs (2 - 6 days), no special procedures are needed, except for providing the proper temperature, relative humidity and ventilation of incubator. However, if the eggs are stored (kept) for a longer period of time, it is necessary to take appropriate actions, such as turning eggs during storage, pre-heating the eggs, placing the eggs in a plastic bag, installing nitrogen gas equipment i.e. providing quality air with optimal oxygen content and so on (Gustin, 1994; Altan et al., 2002; Reijrink, 2010).

### Conclusion

The aim of this research was to determine the effect of age of broiler parents in different stages of the production cycle (beginning - PA25weeks, medium - PA41weeks and final - PA58weeks) and time of storage, i.e. age of eggs (EA <7days and EA > 7 days) on the embryonic development of chickens and the results of incubation. Based on the results achieved in terms of fertility of eggs and chickens' hatching i.e. embryo mortality, by the stages of the production cycle and the different time periods of storage of eggs, the following can be stated:

Egg storage period (EA) had no effect on their fertility, while the highest fertility of eggs, regardless of egg storage period, was established in middle of the production cycle (PA41 - 97.05%), then in the early phase (PA25-96.09%) and lowest at the end of breeding parent flock (SR58E - 93.00%). It was similar at the number of chickens' hatching out of the number of incubated i.e. fertilized eggs. In the case of PA41 chicken generating amounted to 84.38% (from the eggs put in) and 86.95% (from fertilized eggs), in the case of PA25 it was 79.90% and 83, 10%, and at PA58 it was 78,09% and 83.97%. In every age of the parent flock, the percentage of chicken hatching out of the number of put in and the number of fertilized eggs was higher in a shorter period of storage of eggs (EA <7). Depending on the stage of the production cycle (PA), the effect of egg storage period (EA < 7 and EA > 7) on the percentage of chicken generating was different. At PA41EA <7 and PA41EA > 7) the biggest difference was identified - 6.48% (of incubated eggs) i.e. - 5.99% (from fertilized eggs), and then at PA25EA<7 and PA25EA> 7 - 3.14% and 1.79%, and at PA58SEA<7 PA58EA > 7 - 2,64% and 3,02%.

The age of broiler parents and egg storage period affected the embryo mortality (early, middle and late) during the incubation period. Namely, the lowest total embryo mortality (13.05%), regardless of the storage period, was found in eggs originating from PA41, much higher 15.87% in PA58 and the highest 16.93% in PA25. In addition, extending the period of storage of eggs resulted in the increase of the total embryonic mortality in all three phases of the production cycle. Regarding the stages i.e. the age of broiler parents (PA), early embryonic mortality ranged from 5.71% (PA41) and 7.52% (PA25), intermediate between 2.38% (SR25) and 4.20% (SR58) and late mortality between 5.25% (PA41) and 7.03% (PA25). By extending the storage of eggs (SJ <7 and SJ > 7), at all stages of the production cycle, early, middle and late embryonic mortality increased, except for the PA25. So the late embryonic mortality at PA25EA > 7 was 6.70%, and PA25EA <7 was 7.36%.

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