INCUBATION YIELD AS A FUNCTION OF BROILER BREEDER AGE

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ABSTRACT

The factors involved in poultry egg incubation include breeder hen age, which may influence both the external and internal quality of eggs. In this context, this study sought to determine incubation yield among eggs from breeder hens at three ages. A total of 1,728 eggs were obtained from Cobb broiler breeders at three ages (26 weeks, 32 weeks, and 53 weeks) and incubated. At the end of the incubation process, eclosion, hatchability, the percentage of infertile eggs, the time of embryo mortality, and chick weight were all analyzed according to breeder hen age. Analysis of variance was applied to the results, and egg fertility was found to be associated with breeder age, since lower rates of eclosion were found in eggs from younger broiler breeders. Chick weight was also found to be influenced by breeder age, since eggs from older broiler breeders hatched into heavier chicks. However, neither mortality nor hatchability were found to be affected by breeder hen age.

Keywords: eclosion, hatchability, fertile eggs, mortality, chick weight

RENDIMENTO DE INCUBAÇÃO EM FUNÇÃO DA IDADE DA MATRIZ

RESUMO

Dentre os fatores relacionados para o sucesso da incubação está a idade da matriz, pois este pode influenciar na qualidade interna e externa do ovo. Nesse contexto, o trabalho teve como objetivo verificar o rendimento da incubação para ovos de três idades de matrizes em produção. Incubou-se um total de 1.728 ovos divididos em três idades de matrizes da linhagem Cobb: 26, 32 e 53 semanas. Ao final do processo de incubação, as variáveis analisadas foram: eclosão, eclodibilidade, porcentagem de inférteis, época da mortalidade e peso dos pintinhos nas três idades de matrizes. Os resultados foram submetidos a análise de variância e observou-se que a fertilidade é afetada pela idade da matriz, levando a menor eclosão para os ovos de matrizes mais jovens, e influencia também o peso dos pintinhos, pois os ovos das matrizes mais velhas proporcionaram pintinhos mais pesados. Entretanto, mortalidade e eclodibilidade não são afetadas pela idade da matriz.

Palavras-chave: eclosão, eclodibilidade, ovos férteis, mortalidade, peso dos pintinhos

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INTRODUÇÃO

Two important goals of broiler breeder production are to increase the eclosion rate of eggs and to generate healthy chicks. To achieve these goals, large percentages of fertile eggs must be obtained, and conditions must be created to maintain egg quality until the chicks hatch.

The factors associated with productive outcomes include breeder age, which is of substantial importance for achieving incubation success: it has been proven to be a pre-incubation factor that influences the internal and external quality of eggs (BARACHO et al., 2013; GARCIA et al., 2015; MENDES et al., 2014; TANURE, 2008). As flocks age, egg size increases and eggs undergo changes in shell thickness, as well as in pore quantity and diameter. There are subsequent decreases in gas conduction and negative effects on embryo metabolism, which may affect the activity of the enzymes involved in gluconeogenesis. These changes interfere in the embryo's concentration of blood glucose, as well as in the type and quantity of nutrients available for embryonic development (CAMARGO et al., 2015). Eggs laid by older broiler breeders also produce heavier chicks and tend to exhibit later eclosion relative to eggs laid by young breeders (LIMA et al., 2001).

Young breeders lay smaller eggs with a lower incubation yield, lower chick quality, and a lower rate of eclosion. These differences may be attributed to lower yolk concentrations in the egg, as the yolk is fundamental for embryo growth (MAIORKA et al., 2000).

Production by broiler breeders is commonly extended in accordance with the market, and may also be initiated earlier. For this reason, commercial hatcheries often include eggs laid by very young breeders (at the start of oviposition) and older breeders (at the end of oviposition). Thus, knowledge on the production outcomes of eggs laid by breeder hens of different ages is essential for improved management of egg hatcheries and will help to guarantee both the conditions necessary for embryonic development and maximized productivity.

In this context, the objective of this study was to assess the effects of broiler breeder age on variables such as eclosion, hatchability, the percentage of infertile eggs, mortality, and chick weight at the end of the incubation process.

MATERIALS AND METHODS

The experiment was conducted in a commercial poultry hatchery located in the city of Amparo, São Paulo State, Brazil, in March and April 2015. A total of 1,728 eggs from Cobb broiler breeders were raised under similar conditions. These eggs came from three breeder ages: 26 weeks of age, 32 weeks of age, and 53 weeks of age. They were divided into three experimental repetitions with 18 trays with 96 eggs each. Thus, each repetition used two trays of eggs from each breeder age group.

The experimental eggs were laid on the same day and randomly selected from breeders of each age group after unviable eggs (dirty eggs, cracked eggs, very small eggs, double-yolk eggs, broken eggs, and deformed eggs) were removed. Three identical multi-stage CMG 125e incubators (one for each repetition) were used (Casp, Ampario, São Paulo, Brazil). The eggs were held in the central region of each incubator and remained there for 19 days at a temperature of 37.2ºC (ALLCROFT, 1964) and at 60% humidity. The eggs were turned 45 degrees each hour to the right and left so that they would reach the ideal hatching position.

After incubation, the eggs were taken to the in ovo vaccination station. In this room, the eggs were vaccinated and transferred from the incubation trays to the hatcher drawers. Next, the eggs were placed in Casp hatchers (Casp, Ampario, São Paulo, Brazil), where they remained for two days at a temperature of approximately 36ºC and a relative humidity of 65%.

Once hatched, the chicks from each breeder age group were counted and then weighed on a SF-400 digital scale. The eggs from which no chicks hatched were also counted, and the eggs were then broken to determine the reason no chicks had hatched. The reasons determined were infertile eggs and embryo mortality between 0 and 7 days, 8 and 14 days, 15 and 18 days, or 19 and 21 days of embryonic development.

Eclosion and hatchability were calculated as in the study by ROSA & ÁVILA (2000). Eclosion was defined as the number of hatched chicks divided by the number of incubated eggs, the quotient of which was multiplied by 100. Hatchability was defined as the number of hatched chicks divided by the number of fertile incubated eggs, the quotient of which was also multiplied by 100.

Eclosion, hatchability, infertility, mortality, and chick weight were evaluated using the analysis of variance at a 95% confidence interval. In cases of statistically significant differences, the means were compared using Tukey's test at a 5% significance level.

RESULTS AND DISCUSSION

As shown in Table 1, the mean statistical locations and mean spreads of the different variables can be compared as a function of breeder age. The location measurements (mean, first quartile [Q1], median and third quartile [Q3]) provide a general overview of the data, while the variance measurements (standard deviation and coefficient of variation) quantify the range of the results and their spread around the mean and median.

Table 1. Descriptive statistics and test of comparison among broiler breeder ages to variables eclosion, hatchability, infertility, mortality and chick weight.

Variable	Breeder Age (Weeks)	Mean	Standard Deviation	Coefficient of Variation (%)	Q1	Median	Q3
Eclosion (%)	26	80 .03 b	5 .20	6 .50	75 .52	79 .69	83 .85
	32	86 .11 a	3 .71	4 .31	83 .07	85 .42	89 .32
	53	84 .20 ab	2 .83	3 .36	81 .25	84 .38	86 .20
Hatchability (%)	26	87 .94 a	4 .02	4 .57	84 .55	87 .00	92 .51
	32	89 .35 a	2 .68	2 .99	87 .40	88 .69	92 .39
	53	87 .26 a	3 .40	3 .90	85 .03	85 .57	90 .20
Infertility (%)	26	0 .09 a	0 .03	33 .97	0 .07	0 .09	0 .12
	32	0 .04 b	0 .02	56 .42	0 .01	0 .05	0 .05
	53	0 .03 b	0 .02	58 .99	0 .02	0 .04	0 .05
Mortality (%)	26	0 .12 a	0 .04	33 .34	0 .07	0 .13	0 .15
	32	0 .11 a	0 .03	25 .12	0 .08	0 .11	0 .13
	53	0 .13 a	0 .03	26 .70	0 .10	0 .14	0 .15
Weight (g)	26	35 .74 c	1 .02	2 .84	34 .91	35 .73	36 .54
	32	41 .21 b	0 .75	1 .81	40 .45	41 .42	41 .84
	53	46 .55 a	1 .60	3 .43	45 .36	46 .25	48 .34

Different letters indicate significant difference between the ages in the Tukey test at 5% of significance.

A significant difference in eclosion rates was found between the breeder ages. There was a more substantial increase in statistical location in eggs from 32-week-old breeders. In terms of variance, the spread of the eclosion results was greater among 26-week-old breeders; the range was lower in the other age groups. This result is consistent with the findings reported by TANURE (2008), in which the best rates of eclosion were obtained among eggs from 32-week-old breeders. This value dropped among 53-week-old breeders to such an extent that it did not differ from eggs from 26-week-old breeders. According to SUAREZ et al. (1997), eggs from young breeders exhibit lower incubation yields, which results in lower rates of eclosion. These results occur due to the higher infertility of eggs from young breeders. However, not all cases of low eclosion are associated with infertility. Eggs laid by young breeder hens have a low potential for eclosion and hatchability due to their thicker shells and denser albumen, both of which hinder humidity loss and gas exchange during incubation (ROCHA, 2008; NAZARENO et al., 2014). According to BARBOSA et al. (2015), older breeders exhibit worsened eggshell quality, which, in turns, causes dehydration and low hatchability. HODGETTS (1985) reported that, to incubate eggs from older breeder hens, an increase in incubation humidity must be considered in order to avoid excessive dehydration of the eggs. It is important to note that, because of differences in eggshells between eggs laid by young breeder hens and those laid by old breeder hens, humidity must be adjusted based on hen age (BARBOSA et al., 2015). This study found that eggs from 32-week-old to 53-week-old breeders did not differ significantly in rates of eclosion or hatchability; however, several other researchers (ELIBOL & BRAKE, 2002; ZACARIA et al., 2005) have concluded that eggs from middle-aged breeder hens (31 to 39 weeks of age) exhibited better rates of eclosion and hatchability than eggs from older hens (53 to 63 weeks of age).

In the current study, hatchability differed only slightly between breeder ages in terms of statistical location, and the range was large at all ages. At none of the three ages studied did hatchability reach the levels indicated in the Cobb manual. This result may be due to the fact that the eggs were held in multi-stage incubators. This type of machine holds eggs from broiler breeders of different ages, as was the case in the experiment in question. Though these eggs required the same incubation period, they required different temperatures (ALMEIDA et al., 2006), since eggs from older breeder hens require lower incubation temperatures than eggs from younger hens (VALLE, 2008). Furthermore, the machine needs to be opened two or three times per week to receive new egg loads, a step which changes the temperature during the incubation period (MORO, 2007). The use of multiple-stage incubators in the experiment may have been a determining factor in higher embryo mortality and the consequent lower rates of hatchability than expected for fertile eggs from the breeding line used herein.

The largest percentage of infertile eggs was found among eggs from the youngest breeders (26 weeks of age); there was no significant difference between the eggs from breeders at 32 weeks of age and those from breeders at 53 weeks of age. However, these results are not consistent with those of other studies. According to ULMER-FRANCO et al. (2010), infertility increases as the breeder flock ages. In a study by SILVA et al. (2016), eggs from younger breeders were found to exhibit higher rates of fertility than eggs from older hens. TANURE (2008) also found that eggs from 57-week-old breeders exhibited lower fertility than eggs from 32-week-old breeders. Meanwhile, BARBOSA et al. (2013) found that eggs from 63-week-old breeders exhibited higher infertility than eggs from 33-week-old breeders.

The rate of embryo mortality among fertile eggs during the incubation process was compared between the age groups, and there was little difference in terms of statistical location. In addition, all of the ages exhibited a high range in rates of embryo mortality. The average rate of embryo mortality over the course of the experiment was found to be at approximately 12%. These results are consistent with those reported by FRANCISCO (2011) and by BARBOSA et al. (2013), who also found no difference in mortality rates between the breeder age groups they evaluated. A higher concentration of mortality was found in the first week of incubation, since approximately 60% of the embryo mortality cases occurred between 0 and 7 days of incubation. This mortality rate did not differ significantly between the breeder age groups. These results differed from those obtained by FRANCISCO (2011), who reported the highest rates of embryo mortality between 8 and 18 days of incubation. SCHMIDT et al. (2002) and REIJRINK et al. (2010) report that preincubation warming reduces early embryo mortality. The rapid increases in temperature that the eggs experience when they are placed in the incubator may be associated with the concentration of early embryo mortality during this period. Multi-stage incubators do not regulate temperature based on the stage of embryonic development, and eggs with younger embryos are warmed by the heat produced by eggs with embryos in more advanced stages of development (GONZALES & CESÁRIO, 2003). Therefore, when the experimental eggs were held in the multi-stage incubator, they may have been overheated if the temperature was not adequate for their stage of development.

When chick weight was compared based on breeder age, there was a significant difference in location measurements and a low spread, regardless of age. The results presented herein show that chicks that hatched from eggs laid by 26-week-old breeder hens weighed less than the chicks that hatched from eggs laid by 32-week-old breeders; the experiment also revealed that the heaviest chicks hatched from 53-week-old breeders. Similar results were found by BARBOSA et al. (2013), TANURE (2008), and ALMEIDA et al. (2006). According to Joseph and Moran Jr. (2005), chick weight at eclosion is, on average, 66% of initial egg weight. This variable may also be influenced by breeder age (SANTANA et al., 2013). Thus, egg weight increases as breeders age, and chick weight is associated more directly with the weight of its egg and indirectly with breeder age (BRUZUAL et al., 2000).

Table 1 presents the results of Tukey's test for the variables at the three ages studied herein. The different letters reflect significant differences between the measurements of the variables.

Tukey's test revealed statistically significant differences between rates of eclosion obtained at the three different ages; however, there were no differences in hatchability rates when the analysis of variance was applied. The infertility results did not differ significantly between eggs from 32-week-old breeders and eggs from 53-week-old breeders; however, eggs from 26-week-old breeders were more infertile. The statistical tests found no significant differences in mortality rates between the breeder ages. In the comparisons of chick weight by breeder age, weight was found to differ at each age considered herein; the older the breeder hen, the heaver the chick. These tendencies are consistent with the findings reported by TANURE (2008), who confirmed that breeder hen age directly affects egg weight, and also that heaver eggs result in heavier chicks.

CONCLUSIONS

As the results of this study show, egg fertility is affected by broiler breeder age, since lower rates of eclosion were found in eggs from younger breeders. Broiler breeder age also affects chick weight, since eggs from older breeders hatched into heavier chicks. However, neither mortality nor hatchability are affected by breeder hen age.

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