

# The effects of hen's age and egg storage time on the frequency of occurrence of physical defects in turkey poults

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**ABSTRACT** The aim of this study was to determine the effect of the interaction between hen's age and egg storage time on the frequency of occurrence and type of physical defects in turkey poults. The experimental materials comprised 6,048 eggs laid by BUT 6 turkey hens at 32, 38, 46, and 51 wk of age (1,512 eggs per week), which were randomly divided into 4 groups (378 eggs per group) and stored for different periods of time, i.e., 7, 10, 13, and 17 D. After incubation, poults were

evaluated individually. Egg weight and the hatch-weight of poults increased with hen's age ( $P < 0.001$ ). The relative body weight of poults, expressed as a percentage of egg weight, was highest in the group of the youngest hens (70.6%). Prolonged egg storage before incubation contributed to an increase in the percentage of poults with physical abnormalities ( $P < 0.001$ ). Umbilical abnormalities were most common regardless of the week of the laying season and egg storage time.

**Key words:** Turkey, hen's age, egg storage, poults quality

2019 Poultry Science 98:7097–7100  
<http://dx.doi.org/10.3382/ps/pez481>

## INTRODUCTION

In poultry production, hatching eggs have to be stored for prolonged periods in response to seasonal variations in demand for turkey poults. According to Fasenko et al. (2002), egg storage longer than 1 wk negatively affects hatchability due to metabolic changes in the embryo. The cited authors demonstrated that the metabolism of embryos from eggs stored for 15 D proceeded at a slower rate than the metabolism of embryos from eggs stored for 4 D. Interestingly, there were some embryos from long-term stored eggs whose development was equal to that of the embryos from short-term stored eggs (Fasenko, 2007). Oblakowa et al. (2008) found that prolonged egg storage before incubation can contribute to an increased incidence of structural deformities in poults. The incidence of physical defects is generally highest in poults hatched from eggs laid in the first 2 to 3 wk of the laying season (Mróz and Orłowska, 2009). It is known that the physical, morphological, and mechanical characteristics of eggs play an important role in the processes of embryo development and hatching (Mróz and Orłowska, 2009; Anandh et al., 2012; Ghane et al., 2015). Previous research failed to specify whether

the storage time of eggs laid by turkey hens at different ages exerts an identical influence on poults quality. Therefore, the objective of this study was to determine the effect of the interaction between hen's age and egg storage time on the frequency of occurrence of physical defects in turkey poults.

## MATERIALS AND METHODS

The experimental materials comprised eggs laid by BUT 6 turkey hens that were raised in accordance with the recommendations of Aviagen Turkeys (2015). The hens started laying eggs at 30 wk of age. At 32, 38, 46, and 51 wk of hen's age, 1,512 eggs laid on 1 or 2 consecutive days (a total of 6,048 eggs) were collected randomly and marked. At each sampling date, the eggs were randomly divided into 4 groups (378 eggs per group) and were stored for different periods of time, i.e., 7, 10, 13, and 17 D. All eggs were stored at a temperature of 15°C and relative air humidity of 86%. After storage, the eggs were incubated for 27 D and 12 to 16 h in Petersime P13 incubators, in accordance with the relevant technological standards. After incubation, poults were weighed and evaluated using the method proposed by Mróz et al. (2013).

The results were processed statistically by two-way ANOVA. The significance of differences between mean values was determined by Duncan's test.

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Received July 3, 2018.

Accepted August 2, 2019.

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**Table 1.** Egg weight, the hatch-weight of poults, the relative body weight of poults, and the percentage of poults with physical defects (means and SEM).

Specification		Egg weight (g)	Hatch-weight of poults (g)	Relative body weight of poults (%)	Poults with physical defects (%)
Hen's age (weeks)	32	87.40 <sup>a</sup>	61.68 <sup>a</sup>	70.6 <sup>a</sup>	36.09 <sup>a</sup>
	38	94.22 <sup>b</sup>	64.20 <sup>b</sup>	68.1 <sup>b</sup>	38.15 <sup>a</sup>
	46	97.45 <sup>c</sup>	67.91 <sup>c</sup>	69.7 <sup>b,c</sup>	51.11 <sup>b</sup>
	51	98.05 <sup>c</sup>	67.62 <sup>c</sup>	69.1 <sup>b,c</sup>	49.01 <sup>b</sup>
Egg storage period (days)	7	94.40	63.82 <sup>a</sup>	67.6 <sup>a</sup>	37.02 <sup>a</sup>
	10	94.30	65.65 <sup>b</sup>	67.5 <sup>a</sup>	37.35 <sup>a</sup>
	13	94.90	65.76 <sup>b</sup>	69.3 <sup>b</sup>	46.01 <sup>b</sup>
	17	94.28	66.18 <sup>b</sup>	70.2 <sup>b</sup>	52.66 <sup>c</sup>
SEM		0.099	0.451	0.041	0.053
		<i>P</i> -value			
Hen's age (A)		<0.001	<0.001	<0.001	<0.001
Egg storage period (P)		0.167	<0.001	<0.001	<0.001
Interaction (A x P)		0.069	0.066	0.069	0.071

<sup>a-c</sup>values in columns followed by different letters differ significantly.

## RESULTS AND DISCUSSION

As shown in Table 1, egg weight and the hatch-weight of poults increased with hen's age ( $P < 0.001$ ). The relative body weight of poults, expressed as a percentage of egg weight, was highest in the group of the youngest hens (70.6%,  $P < 0.001$ ). The relative body weight of poults hatched from eggs stored for the shortest period of time before incubation was approximately 2 percentage points lower, compared with the remaining groups ( $P < 0.001$ ). In a study by Mróz et al. (2013), the number of poults with structural deformities was higher in eggs laid in week 3 of the laying season than in week 12, but it remained stable to the end of the laying season. Ghane et al. (2015) demonstrated that changes in egg weight are not linear and occur predominantly in early- and mid-cycle eggs, and that the most significant differences are related to the albumen and yolk ratios, which in turn significantly impact the chemical composition of eggs, especially between early- and mid-lay eggs. In the present study, the percentage of poults with physical defects was also significantly ( $P < 0.001$ ) higher when the eggs were laid by younger hens (32 and 38 wk of age) compared with older ones (46 and 51 wk of age), thus indicating that poults quality is correlated with hen's age. Such a relationship was also noted by Ghane et al. (2015). According to Wineland et al. (2010) and Yalcin et al. (2012), the incubation profile should be adjusted for the age of the flock and egg size, as it directly impacts poults performance. Large eggs hatch better when the incubation temperature is reduced during the second half of incubation (Anandh et al., 2012) because larger embryos produce more metabolic heat, particularly during the later stages of development (Wineland et al., 2010). According to Mróz et al. (2004), extending the egg storage period from 7 to 10 D increased the number of poults with birth defects. In the current experiment, the frequency of occurrence of physical defects in poults was similar when eggs were stored

for 7 and 10 D before incubation, but the percentage of poults with structural deformities increased significantly ( $P < 0.001$ ) when eggs were stored for 13 or 17 D. No interaction was found between the experimental factors.

Umbilical abnormalities were the most common physical defect in the analyzed poults (Table 2). The percentage of poults with poor motor activity was affected by both hen's age ( $P \leq 0.001$ ) and egg storage time ( $P = 0.032$ ), and it was highest in hens aged 32 wk (0.92%,  $P \leq 0.05$ ) and in eggs stored for 17 D (1.19%,  $P \leq 0.05$ ). The number of weak poults was relatively low when compared with in an earlier study by Mróz et al. (2004) where it reached 2.3% and 10.1% in eggs stored for 9 and 12 D, respectively. Similarly to our findings, other authors also observed that the number of poults with poor motor skills increased with hen's age (to 7.6% in week 24 of the laying season, Orłowska and Mróz, 2006).

The number of poults with wet and dirty down feathers was highest in hens aged 38 wk (2.48%) and in eggs stored for 13 and 17 D (1.43% to 1.57%). The number of poults with this defect was relatively low in our experiment, compared with that reported by other authors (8.2 to 13.3%, Mróz et al., 2004).

Hen's age had no influence on the incidence of eye abnormalities, which was affected only by egg storage time ( $P \leq 0.001$ ). The percentage of poults with this defect was higher in eggs stored for 13 and 17 D (0.38% to 0.42%). The highest percentage of poults with leg deformities hatched from eggs laid by hens at 32 wk of age (2.4%,  $P \leq 0.05$ ), and from eggs stored for 10 and 17 D (1.05 and 1.4%). In previous studies, poults with leg abnormalities accounted for 4.3 to 4.6% (Mróz et al. 2004), or even for 6.5 to 7.9% of all poults hatched (Mróz et al., 2013). In this experiment, the incidence of the above defects was low, which points to appropriate incubation conditions and good hygiene practices in the parent flock.

**Table 2.** Percentage of poults with physical defects.

Specification	Physical defects (%)							Late-hatched poults, unsuitable for rearing
	Poor motor activity	Wet and dirty down feathers	Eye abnormalities	Leg abnormalities	Unabsorbed yolk sac	*Umbilical abnormalities		
Hen's age (weeks)	32	0.92 <sup>a</sup>	0.53 <sup>c</sup>	0.19	2.39 <sup>a</sup>	0.83 <sup>b</sup>	25.06 <sup>b</sup>	6.17 <sup>a</sup>
	38	0.50 <sup>b</sup>	2.48 <sup>a</sup>	0.26	0.26 <sup>b</sup>	0.97 <sup>b</sup>	25.25 <sup>b</sup>	8.43 <sup>a,b</sup>
	46	0.62 <sup>b</sup>	1.26 <sup>a</sup>	0.19	0.43 <sup>b</sup>	1.63 <sup>a</sup>	36.00 <sup>a</sup>	10.98 <sup>b</sup>
	51	0.73 <sup>b</sup>	1.13 <sup>b</sup>	0.25	0.50 <sup>b</sup>	1.45 <sup>a</sup>	26.75 <sup>b</sup>	18.20 <sup>c</sup>
Egg storage period (days)	7	0.76 <sup>a</sup>	1.33 <sup>a</sup>	0.09 <sup>a</sup>	0.65 <sup>a</sup>	1.31 <sup>a</sup>	24.62 <sup>a</sup>	8.26 <sup>a</sup>
	10	0.40 <sup>a</sup>	1.05 <sup>b</sup>	0.00 <sup>a</sup>	1.05 <sup>b</sup>	1.45 <sup>a</sup>	24.00 <sup>a</sup>	9.40 <sup>a</sup>
	13	0.43 <sup>a</sup>	1.57 <sup>a</sup>	0.38 <sup>b</sup>	0.48 <sup>a</sup>	1.20 <sup>a</sup>	29.25 <sup>a</sup>	12.70 <sup>b</sup>
	17	1.19 <sup>b</sup>	1.43 <sup>a</sup>	0.42 <sup>b</sup>	1.39 <sup>b</sup>	0.92 <sup>b</sup>	35.19 <sup>b</sup>	12.12 <sup>b</sup>
SEM		0.009	0.025	0.003	0.002	0.003	0.116	0.119
				<i>P</i> -value				
Hen's age (A)	<0.001	<0.001	0.082	0.045	0.009	0.042	0.043	0.043
Egg storage period (P)	0.032	<0.001	<0.001	0.039	0.037	0.043	0.029	0.029
Interaction (A × P)	0.071	0.066	0.074	0.062	0.077	0.068	0.062	0.062

\*umbilical abnormalities: a large black scab on the navel and/or a long umbilical vessel that has not receded.

<sup>a-c</sup>values in columns followed by different letters differ significantly.

In the current study, a higher percentage of poults with unabsorbed yolk sacs was noted toward the end of the laying season, in weeks 45 and 51 of hen's age (1.63 and 1.45%, respectively), whereas prolonged egg storage before incubation had no effect on the frequency of occurrence of this defect. In another study (Mróz et al., 2013), the percentage of poults with unabsorbed yolk sacs was around 3.3%.

The highest percentage of poults with defects in the navel area (36%) hatched from eggs laid by hens at 46 wk of age. In the remaining age groups, poults with umbilical disorders accounted for 25.06 to 26.75% of all poults hatched. Such defects slow down the growth of intestinal villi and decrease body weight gains in the first week of birds' life (Kawalilak et al., 2010). The second most commonly encountered problem was delayed hatch which made the poults unsuitable for rearing. The incidence of delayed hatch increased with hen's age (from 6.17 to 18.2%). Prolonged egg storage to 13 or 17 D, significantly ( $P = 0.029$ ) increased the percentage of late-hatched poults. Orłowska and Mróz (2006) also demonstrated that the percentage of late-hatched poults was higher in older hens, even when eggs were stored for only 7 D before incubation. The frequency of occurrence of the remaining defects analyzed in this study was below 2% (Table 2). The experimental factors exerted varied effects on the incidence of birth defects in poults. No interaction between hen's age and egg storage time was found for any of the analyzed defects. According to Ghane et al. (2015), eggs differ significantly in their physical (weight and yolk percentage) and chemical characteristics throughout the laying season, which could be the main factor affecting the survival rate of embryos in both pre- and post-hatch periods. If the whole egg moisture content increases (physical), the moisture content of yolk may be lower because eggs laid in late stages have larger yolks that can be more condensed with solids and have higher ratios of proteins, fat and carbohydrates (Ghane et al., 2015;

Galic et al., 2018). The results of this study and the findings of other authors indicate that the incidence of physical defects in poults is affected by hen's age rather than egg storage time. Thus, the information on hen's age is needed to determine the optimal storage time for hatching eggs.

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