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FREQUENCY OF OCCURRENCE OF PHYSICAL DEFECTS IN TURKEY POULTS*

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Abstract

The objective of this study was to determine poult quality in the first breeding season of turkeys. The study was conducted over a 24-week laying season of white broad-breasted Big 6 turkeys. Starting from the first week of laying, at three-week intervals, 504 eggs laid on the same day were weighed and the percentages of eggs weighing 70 to 100 g and more than 100 g were calculated. Results from the 21st week of laying season were not used due to failure of ventilation equipment. Each egg was visually inspected to determine the percentages of eggs with normal shell structure, rough-shelled eggs and eggs without shell pigmentation. Nine incubation cycles were carried out. Egg fertilization rates and hatch rates were determined. At the end of each incubation cycle, poults were weighed individually and divided into morphologically normal and morphologically defective. The latter were further subdivided into weak poults with poor motor skills, poults with abnormal feathers, eyes, legs and umbilicus, and poults with unabsorbed yolk sacs. Eggs with weight exceeding 100 g accounted for 17.9% and 46.6% of the analysed eggs at 12 and 24 weeks of the laying season, respectively. In week 12, eggs without shell pigmentation accounted for 8.3%. In week 24, the percentage of rough-shelled eggs was 6.7%. Most poults with physical defects hatched in weeks 1 and 3 of the laying period (65.67% and 76.84%, respectively). Weak poults with poor motor skills accounted for 0.2–2.5% of the examined birds. Wet feathers were noted in 0.9% to 4.1% of poults over the laying season. Leg abnormalities were observed in 6.5% to 7.8% of poults. Eye defects were encountered least frequently. In 41–70% of poults long black scabs were visible on their navels, and umbilical vessels were long. Unabsorbed yolk sacs were noted in 0.5% to 3.2% of poults.

Key words: egg weight, eggshell structure, poult quality

Turkeys are the second (after chickens) most popular poultry species in Poland. In 2011, 191 990 turkey hens were introduced into breeding farms, which means

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an increase in the population of these birds by 15.6% over 2010 (National Poultry Council – Chamber of Commerce in Warsaw, 2012). Poland is also an exporter of turkey eggs and poults. Turkey production continues to expand steadily, and good quality eggs and poults are in high demand.

Mass is an important indicator of egg quality. The optimum weight of turkey eggs is 75 g to 95 g, and the weight of eggs intended for incubation should range from 70 g to 100 g (Polish Standard PN-R-78564, 1998). Egg weight is determined by the age of layers, feeding regime, and the form and content of nutrients supplied by feed (Borzemska, 2005; Hybrid, 2008). Some nutritional and biological factors may alter the percentage of yolk, albumen and shell, and the energy value of eggs, thus reducing hatchability due to changes in nutrient reserves during embryogenesis (Nangsuay et al., 2011).

Egg weight is also determined genetically. Selection for high body weight contributes to an increase in egg weight during the breeding season. In turkeys, egg weight becomes more uniform in the second laying cycle (Nestor et al., 2008).

Intensively farmed laying hens (indoor housing, artificial lighting, artificial insemination) produce eggs of inferior quality (Mróz, 1998, 2010). Besides too high weight, other common defects of turkey eggs are shell abnormalities, including roughness and reduced pigmentation (Mróz, 1998). In flocks of medium-heavy and heavy turkeys, eggshell abnormalities are noted in 19–39% and 4–9% of eggs, respectively (Mróz, 1998; Mróz et al., 2007). Unlike in chickens, cracks on the inner surface of the eggshell are rare in turkeys (Mróz, 2010). Defective eggs, including broken, damaged and dirty eggs, and eggs laid outside the coop, have an estimated 3–15% share of all laid eggs (Hybrid, 2008; Mróz, 2010). Such eggs are more numerous if turkeys are kept in cages, as compared with deep litter (Hybrid, 2008). Egg quality is regularly monitored in poultry farms, because it has a significant effect on hatch rates and the quality of newly-hatched birds (Mróz, 1998).

Poult quality is determined by body weight at hatch, which makes up 65% to 74% of egg weight and increases with an increase in egg weight (Shanawany, 1987). The body weight of poults decreases by 4% to 6% during the first 12 hours after hatch, as a result of excreting meconium, urates and free water, and 36 hours after hatch it should not be lower than 48 g (Polish Standard PN-R-78566, 1998).

Poult quality is also affected by body conformation – poults with physical defects are culled from the flock. Some minor defects, such as wet feathers on the neck and a small black scab on the navel, disappear within a short time post-hatch and the poults can be considered as healthy (Borzemska, 2005). There are many reasons for physical defects in poultry. Umbilical abnormalities and unabsorbed yolk sac are associated with poor sanitary conditions, incorrect water vapour pressure in the incubator or the water content of eggs (Mauldin and Buhr, 1996). Too high incubation temperature may cause "black button" navels. Poults with "black button" navels are characterized by lower body weight, higher mortality and lower feed intake (Tona et al., 2004; Fasenko and O'Dea, 2008). Leg problems may be due to mycoplasma infections, gout and perosis as well as inappropriate lining material in egg hatching trays (Mauldin and Buhr, 1996). The relationship between the body conformation of turkeys and chickens and the breeding season remains an important consideration

since as many as 37% to 75% birds hatch with physical defects (Tona et al., 2003, 2004; Mróz and Orłowska, 2009).

Literature documenting the quality of poults hatched from artificially incubated eggs is scant, and poult quality is associated with egg quality and the age of laying hens, which prompted us to conduct the present study involving commercially raised turkeys in Poland. The quality of poults is a major concern for hatchery managers. The main goal of the farmer is high turkey weight. Factors that influence turkey flock performance, such as nutritional and environmental conditions, are well documented. Other less-well-understood factors, such as age of the hens, may affect embryonic life of the poult and thereafter the quality of the hatched chick and the growth potential posthatch. Tona et al. (2004) concluded that growth potential of chicks one day posthatch is partly linked to the incubating egg quality and other characteristics that can be linked to the physiological stage of hens (e.g. age). Knowledge of the degree to which hen's age affects chick quality can contribute to improving the profitability and the economic side of poultry production. Thus, the hypothesis was tested by measuring the frequency of occurrence of physical defects in the turkey poults during laying season to establish the influence of hen's age on these features.

The aim of this study was to determine poult quality in the first breeding season of turkeys.

Material and methods

The experimental materials comprised eggs of heavy-type broad-breasted white Big 6 turkeys. A total of 2000 females and 200 males were reared in an intensive deep litter system, in line with the relevant standards. Eggs were collected for analysis in weeks 1, 3, 6, 9, 12, 15, 18, 21 and 24 of the laying season, which corresponded to the development stages of hens (week 1 of the laying season = week 33 of age). Broken and misshapen eggs were eliminated. In each of the above weeks, 504 eggs laid on the same day (accounting for 25% to 50% of eggs laid on that day) were evaluated. The percentages of eggs weighing 70 to 100 g, less than 70 g and more than 100 g were calculated. The percentages of eggs with normal shell structure, rough-shelled eggs and eggs without shell pigmentation were determined by a previously described method (Mróz, 1998).

Before incubation, the eggs were stored for 7 days at ambient temperature of 15ºC, relative humidity of about 86%, and ventilation adjusted to the number of eggs. Nine incubation cycles were carried out in Petersime incubators, in accordance with the relevant guidelines. Egg fertilization rates and hatch rates were determined. At the end of each incubation cycle, poults were weighed individually with an accuracy of +0.5 g and divided into morphologically normal and morphologically defective. The latter were further subdivided into weak poults with poor motor skills, poults with abnormal feathers, eyes, legs and umbilicus, including poults with unabsorbed yolk sacs, using a previously developed key (Mróz and Orłowska, 2009). The methods for assessing these conditions are stated in Table 1. The number of examined poults varied from 357 to 460, depending on incubation success.

Table 1. Assessment of different parameters for determining poult quality

Parameters	Assessment
Activity	Activity is assessed by laying the poult on its back to determine how quickly it returned to its feet. A quick spring back onto its feet was regarded as good, but trailing back onto its feet or remaining on its back was assessed as weak.
Feathers	The poult body was examined for dryness and cleanness. It was regarded as normal if dry and clean, but not good if wet or dirty.
Eyes	The poult eyes were observed. The state of brightness and wideness of the gape of the eyelids were estimated.
Legs	The poult was put on its feet to determine if it remained upright well. The toes were examined for their conformation. If the poult remained upright with difficulty, articulations of the knees were examined to detect sings of inflammation or redness or both.
Navel area	Navel and surrounding areas were examined for the presence of scab and blood vessels. If the scab and blood vessels were visible, the size of scab and blood vessels was determined.
Remaining yolk	Observation of the navel area allowed estimation of the presence of any remaining yolk sac.

The weight of eggs and poults was analysed statistically by one-way analysis of variance (ANOVA), and mean values were verified by Duncan's test. The remaining data are presented as percentages.

Results

Over the laying season, average egg weight increased by 19.5 g, and exceeded the permissible value in week 24 (101.4 g) (Polish Standard PN-R-78564, 1998). During the first nine weeks, the percentage of eggs with optimal and acceptable weight ranged from 90.1% to 100%, and it decreased substantially over successive weeks (Table 2). Eggs lighter than 70 g were not noted. The number of eggs heavier than 100 g was increasing until the end of flock use.

The percentage of eggs with normal shells ranged from 87.9% to 96.8%. The highest number of eggs without shell pigmentation was observed in week 12 of the laying season. In the second half of the laying season the percentage of eggs without shell pigmentation increased compared to the first half of the laying season. The percentage of eggs without shell pigmentation ranged from about 4% to over 5%. The number of rough-shelled eggs increased considerably towards the end of the breeding season (Fig. 1).

Egg hatchability was typical of heavy-type turkeys. Egg fertilization rates exceeded 90% at the beginning of the breeding season. Hatch rates were highest in weeks 6 and 9 and lowest in weeks 1 and 24 (Table 2).

Table 2. Quality characteristics of eggs and poults

Item	Statistical measures	Laying weeks									
		1	3	6	9	12	15	18	21	24	1–24
Average egg weight (g)	x	81.9 a	89.9 b	90.3 b	92.3 b	94.0 c	96.0 cd	97.4 d	97.9 d	101.4 e	93.5
	V	5.40	6.02	6.41	6.09	6.39	6.14	6.62	6.65	14.39	7.10
Eggs weighing 70 g to 100 g (%)	x	100.0	94.8	94.2	90.1	82.1	75.6	63.3	55.8	53.4	78.8
	V	-	-	-	-	-	-	-	-	-	-
Egg hatchability (%):											
egg fertilization rates	x	93.7	97.6	97.8	98.0	96.4	96.0	96.0	96.8	91.7	96.0
	V	-	-	-	-	-	-	-	-	-	-
hatch rates	x	75.5	84.8	88.6	93.1	88.9	87.4	80.3	83.4	78.8	84.5
	V	-	-	-	-	-	-	-	-	-	-
Body weight of poults (g):											
average	x	59.1 a	64.0 b	63.4 ab	63.6 abc	64.5 bc	64.5 c	71.0 d	-	72.6 e	65.3
	V	4.37	5.06	5.70	5.34	5.35	5.35	5.61	-	5.01	5.22
with normal body conformation*	x	59.2	64.3	64.1	63.2	64.4	66.1	70.4	-	72.1	65.6
	V	4.32	4.43	4.81	4.36	4.57	4.56	5.42	-	4.90	4.65
with physical defects*	x	59.0	63.8	63.0	64.0	65.0	66.2	71.3	-	72.6	65.3
	V	4.31	5.10	5.92	5.63	5.92	5.10	5.70	-	7.04	5.55
Poults with anatomical abnormalities (%)	x	65.7	76.8	62.1	50.7	42.1	47.5	54.6	-	53.2	56.5
	V	-	-	-	-	-	-	-	-	-	-

a, b, c, d, e – values in rows with different letters differ significantly ($P \leq 0.05$).
* – values for the body weight of poults with normal body conformation and with physical defects did not differ significantly in laying weeks.

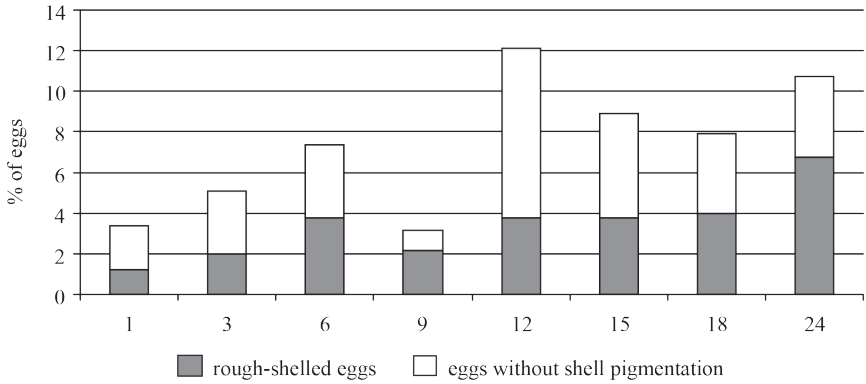

Figure 1. Percentage of eggs with shell defects

The average body weight of poults increased by 13.5 g throughout the breeding season. The highest increase in the body weight of poults, by 4.9 g, was observed at the beginning of laying (between weeks 1 and 3). Until week 18, the body weight of poults remained at a similar level (Table 2). The average body weight of poults was significantly higher ($P<0.05$) between weeks 18 and 24 of the laying season, compared with the remaining time periods. There were errors in the technique of incubation in the 21st week of lay. In week 21, the body weight of poults was lower than in the previous weeks due to inadequate ventilation. Therefore, the results concerning the weight of poults and chick body defects were not used in the discussion. The body weights of poults with physical defects and poults with normal body conformation did not differ significantly (Table 2).

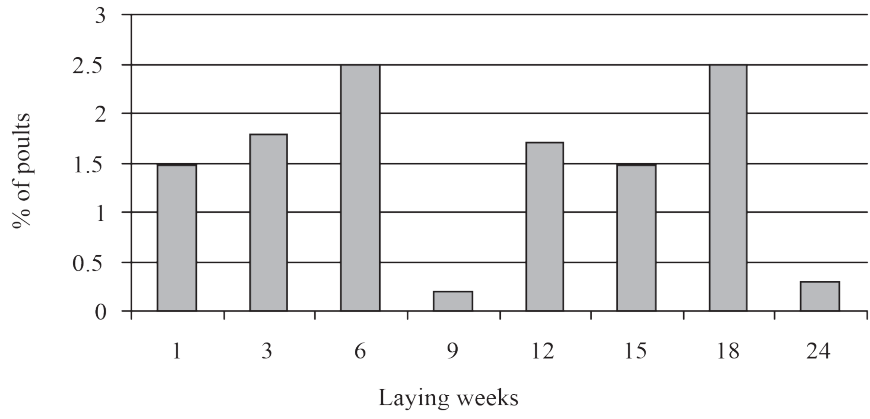

Figure 2. Poults with poor motor skills

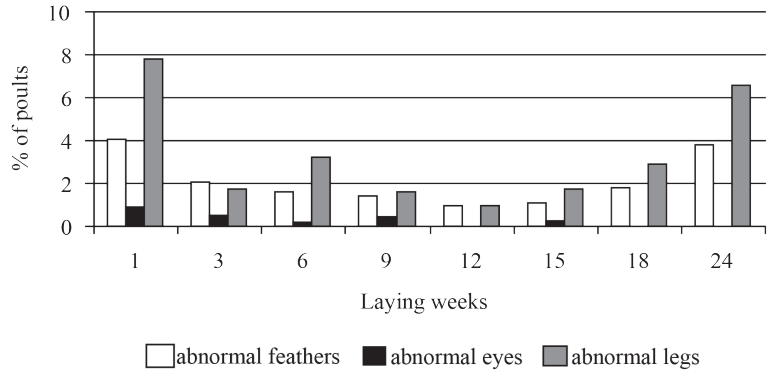

Figure 3. Percentage of eggs with shell defects

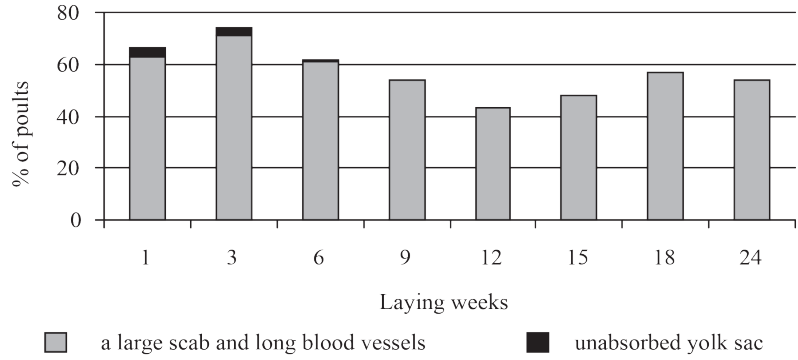

Figure 4. Percentage of eggs with shell defects

Most poults with physical defects hatched in weeks 1 and 3 of the laying season (Table 2). Weak poults with poor motor skills had a low share of the evaluated birds (Fig. 2). They must have hatched early, from the smallest eggs. The percentage of poults with wet down did not exceed 4.0% over the laying season (Fig. 3). Eye defects were observed over certain periods of time only (Fig. 3). Leg problems, including crooked toes and congested shanks, were encountered most frequently in weeks 1 and 24 of the laying season (Fig. 3). The most common defects, noted in 40% to 70% of poults (Fig. 4), were a black scab (>3 mm in diameter) on the navel and an uncut umbilical vessel (>10 mm in length). Unabsorbed yolk sacs were found in a small number of poults, at the beginning of the laying season (Fig. 4).

Discussion

An increase in egg weight in the first laying season is characteristic of turkeys, and it may reach 7 g to 24 g depending on the results of selective breeding for in-

creased body weight of hens (Lilburn and Antonelli, 2012; Hybrid, 2008). Such an increase in egg weight was also observed in Big 6 turkeys in the present study. As the flock became older egg weight increased and fertility decreased (Mather and Laughlin, 1979). A similar relationship was observed in our experiment. Our findings support previous research (Mróz, 1998, 2010) which showed that the number of eggs with shell defects is lower in heavy-type turkeys than in turkeys of other types. We are not able to explain the cause of the largest percentage of eggs without shell pigmentation in week 12 of laying. As the cause of the loss of pigment on the shell, Borzemska (2005) lists avian influenza (especially in turkeys), and poisoning with nicarbazin, ochratoxin A and other mycotoxins.

An increase in the body weight of hatchlings during the breeding season has been observed in different poultry species (Shanawany, 1987). Tona et al. (2004) reported higher average chick hatching weight from eggs of older hens. A similar relationship was observed among turkey day-old chicks in this experiment. Shanawany (1987) concluded that a 5 g increase in mass of eggs has increased body weight of turkey poults by 3–4 g. An increase in the body weight of poults results from an increase in egg weight, which was also confirmed in the current study. Taking into account body weight loss during the first 24 hours of life of poults (4–6%), the average body weight of day-old Big 6 poults was estimated to be 55–69 g. Different values are given in the Polish Standard PN-R-78566 (1998) which, however, does not account for the type and age of laying hens.

The occurrence of physical defects in the body depends on many factors, including prolonged storage of eggs, inadequate incubation conditions, and the age of the hens. In this experiment the percentage of turkey poults with physical defects of the body was slightly higher at the beginning of the laying season compared to the last few weeks of laying, but there were no significant statistical differences. Tona et al. (2004) reported 97.73% of chicks with normal body conformation from younger hens (35 weeks old) and 93.67% from older hens (45 weeks old). The dependence observed by Tona et al. (2004) is probably due to the impact of the second experimental factor, which was extended storage period of eggs. The percentage of turkey poults with anatomical abnormalities ranged from 42.1% to 76.8%. High percentage of turkey poults with anatomical abnormalities throughout the laying period can be explained by the fact that the assessment was carried out in the early hours of hatching through visual and subjective evaluation. Some minor defects disappear within a short time post-hatch and the poults are considered as healthy (Borzemska, 2005). Not all the poults with physical defects were unsuitable for breeding. The average percentage of poults not suitable for breeding throughout the laying period was 1.46%. Up to 3 week of lay there were no turkey chicks not suitable for breeding, and the highest percentage of poults that are not suitable for breeding (5.22%) occurred in the last week of lay.

Percentage of poults with poor motor skills did not exceed 2.5%. The absence of the linear distribution of the percentage of the poults with poor motor skills throughout the reproductive period may prove the lack of relationship with the age of hens.

Mather and Laughlin (1979) studied the interaction between parental age and early embryonic development from storage eggs. In 14 day storage eggs hen's age

influenced the numbers of abnormalities, which reached between 22.6% and 27.7% in very young and old birds, but remained between 9.7% and 18.0% in the middle period of reproduction. A similar increase in the distribution of poults with abnormal feathers, eyes, legs and unabsorbed yolk sac occurred in the first weeks of laying season and in the recent weeks.

According to Borzemska (2005) the most common defect of chicks hatched from artificially incubated eggs is an unabsorbed yolk sac, which was not the case in our study where the highest number of poults showed the signs of premature hatching. Problems with blood resorption from the blood vessels of the chorioallantois led to scab formation. Uncut umbilical vessels were also indicative of hatching acceleration. Such abnormalities have also been reported in other meat-type poultry species. A properly healed navel is an indicator of good quality and health of newly-hatched birds, and it affects their survival and growth. Poults and chickens with black scab navels are characterized by considerably higher mortality rates (Borzemska, 2005; Fasenko and O'Dea, 2008; Mróz, 2010) and are at risk of *E. coli* infections (Rosario et al., 2004). Similarly as in other poultry species, more physical defects are noted in turkeys at the beginning and towards the end of laying (Boerjan, 2006). An increased incidence of leg abnormalities in hatchlings can be related to a fast growth rate of embryos and improper nutrition of laying hens (Mauldin and Buhr, 1996; Borzemska, 2005).

The results of the present study show that heavy-type turkey hens started to lay eggs heavier than 100 g already in week 3 of the laying season and the number of eggs weighing more than 100 g increased with hen age. The number of eggs with shell defects remained low, and it was highest in week 12. The majority of morphologically defective poults hatched at the beginning of the breeding season. Throughout the laying season, the highest number of poults showed the signs of premature hatching. Other pathologies were rarely encountered.

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Częstotliwość występowania wad budowy piskląt indyczych

STRESZCZENIE

Celem podjętych badań była analiza jakości piskląt w pierwszym sezonie reprodukcyjnym indyków. Badania prowadzono w 24-tygodniowym sezonie nieśnym indyków białych szerokopierśnych Big 6. Poczynając od 1. tygodnia nieśności indyków co 3 tygodnie ważono 504 jaja z jednego dnia i określano procentowy udział jaj o masie od 70 do 100 g i >100 g. Każde zważone jajo poddano wizualnej ocenie powierzchni skorupy, określając procentowy udział jaj ze skorupą zbudowaną prawidłowo, ziarnistą i bez pigmentu. Wykonano dziewięć lęgów, określając procent zapłodnienia i wylęgu z jaj zapłodnionych. Po zakończeniu każdego lęgu pisklęta ważono indywidualnie i dzielono na prawidłowo zbudowane i z wadami morfologicznymi ciała. W grupie piskląt z wadami wyróżniono indyczęta słabe ruchowo, z wadami upierzenia, oczu, nóg, pępka i z niewciągniętym woreczkiem żółtkowym. Liczba jaj o masie >100 g wzrastała i w 12. tygodniu nieśności wynosiła 17,9%, a w 24. tygodniu 46,6%. W 12. tygodniu nieśności wzrósł udział jaj bez pigmentu w skorupie do 8,3%, a w 21. i 24. tygodniu udział jaj ze skorupą ziarnistą do 6,7%. Z jaj w 1. i 3. tygodniu nieśności wykluło się najwięcej indyczął z wadami budowy ciała, odpowiednio 65,7% i 76,8%. Pisklęta słabe, nieaktywne ruchowo stanowiły 0,2–2,5% badanych indyczął. Puch mokry odnotowano u 0,9–4,1% indyczął. Wady budowy nóg stwierdzono u 6,5 do 7,8% indyczął. Najrzadszą cechą patologiczną była wada oczu indyczął. U 41–70% indyczął stwierdzono czarny strup na pępku i długie naczynie pępowinowe. Niewciągnięte woreczki żółtkowe stwierdzono u 0,5 do 3,2% indyczął.