

Quality of heavy-type turkey poults as related to the age of layers in the first laying season

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(Received August 18, 2008; accepted April 14, 2009)

During the first 24-week laying season nine incubation series (504 eggs in each) were carried out at three-week intervals. Major hatchability determinants were considered and assessed on 4536 eggs. Moreover, the body conformation of 3688 poults was evaluated based on motor activity, outward appearance of down, abdomen, eyes, legs and navel, and on the residues of the chorioallantoic membrane and the yolk sac. The scores for the overall quality of poults were expressed in a 100-point scale. Moreover, determined was body weight (g) and relative body weight (%) of poults. The results were evaluated statistically by a one-factorial analysis of variance. Mean values were compared by Duncan test.

Hatching rate ranged from 75.6% to 93.1%, and was lowest in turkey-hens aged 33 and 57 weeks. The body weight of poults increased from 59.1 g to 72.6 g over the laying season, reaching 63.4 to 71.0 g at peak hatchability. At that time the relative body weight of poults varied from 67.2 to 70.2%. Poults from eggs laid by hens aged 39 to 51 weeks reached the highest mean scores for quality – 95.2 to 96.8 points. The quality of poults hatched from eggs laid by hens aged 33, 36, 54 and 57 weeks was found to be significantly poorer.

KEY WORDS: body weight / conformation / hatchability / poults / turkey

The criteria for poult quality assessment proposed in Poland by Dziaczkowska [1980] have been adopted and are applied in practice until today. One of the main advantages of this approach is its high accuracy. However, it does not permit a

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comparison of different types of poults. Methods that enable to compare the body conformation of day-old poults could be employed in order to select the best breeding material. Unfortunately, no such methods have been developed in Poland so far, and professional literature provides scant information on evaluation of poult quality.

The quality of newly-hatched poults is of primary interest to hatchery managers. The outcomes of quality evaluation are determined by a variety of factors, including time that passed from hatching. Recently, Belgian, Dutch and Brazilian authors have developed a new method for chick quality assessing, in which the scores are converted into a 100-point scale [Tona *et al.* 2003] or a 10-point scale [Boerjan 2006]. The 100-point scale is recommended for evaluating the course of incubation and the body conformation of newly-hatched poults, while the 10-point scale should be applied to assess the quality of poults prior to sale. Tona *et al.* [2004] analysed fast-growing chickens and chickens carrying the dwarf gene. Chicks that received 100 points accounted for 24.87 to 25.86% of the tested population. The mean score ranged from 84.32 to 86.85 points, and was not affected by the growth rate of chicks during embryonic development. The above authors reported that the share of best-quality (100-point) chicks could further be increased to 48.04-62.28%, and that the average score could reach 92.04-96.59 points [Tona *et al.* 2002]. The overall quality of chicks was determined by the time of egg storage – more chicks of superior quality hatched from eggs stored for a shorter time. No reference data on poult quality assessing by points are available.

Body weight is another indicator of the overall quality of hatchlings. In turkey poults it ranges from 46.40 to 69.68 g, depending on the age of hens and egg weight [Siopes 1992, Applegate and Lilburn 1996, Mróz and Pudyszak 1997, Orłowska and Mróz 2006]. Egg weight increases throughout the laying season, which reduces hatchability and may affect poult quality. According to many authors, the relative body weight of poults should not exceed 70% of egg weight [Mróz and Pudyszak 1997, Mróz *et al.* 2007ab]. In a study by Shanawany [1987] it varied from 60.4 to 66.4%, but in heavy-type turkeys it may reach 68.30 to 69.45% [Mróz *et al.* 2007a].

The objective of this study was to determine the quality of heavy-type turkey poults as related to the age of layers over their first laying season.

Material and methods

The material comprised hatching eggs laid by heavy-type broad-breasted turkey-hens during their first 24-week long laying season. Prior to incubation the eggs were stored for 4 to 7 days and weighed accurate to ± 0.1 g. Nine incubation series, each of 504 eggs, were carried out at three-week intervals. A total of 4536 eggs were incubated. Egg hatchability was determined based on fertilization rate (i), hatching rate of fertilized eggs (ii) and number of eggs with live unhatched embryos (iii). Newly-hatched poults were evaluated within two hours after being taken out of the hatching unit. The body weight of poults was determined accurate to ± 0.1 g, and their

relative body weight was calculated according to the formula proposed by Bochno *et al.* [2001]:

$$\text{Relative body weight of a hatchling (\%)} = \frac{\text{body weight of a hatchling (g)}}{\text{average weight of eggs laid by hens at a specified age (g)}} \times 100\%$$

Body conformation of 3688 poults was assessed with a 100-point scale based on the scoring system proposed by Tona *et al.* [2003] for chicks. Detailed guide for body conformation scoring applied in the present study for poults is presented in Table 1.

Table 1. Scheme of the body conformation assessing of poults with a 100-point scale

Item	Description	Points
Motor activity	Correct standing position, the poult is able to move	6
	The poult remains huddled, sitting on its haunches, unable to get up on its feet	0
Down	Clean and dry	10
	Wet	8
	Soiled with feces or covered with albumen	0
Abdomen	Well-toned	12
	Hard	0
Eyes	Open, sparkling	16
	Squinted	8
	Closed	0
Legs	Straight shanks and toes	16
	Hyperemic	8
	Incorrect position of shanks and toes	0
Navel	Clean, closed, skin-colored	12
	Small scab, not sticking out of the down	8
	Scab sticking out of the down	6
	Navel area swollen and dirty	0
Chorioallantoic membrane	No residues of the membrane	12
	Short (0.5-1 cm) blood vessel	4
	Long blood vessel	0
Yolk sac	Absorbed into the body	16
	Residues of the yolk sac	0

The results were verified statistically by a one-factorial analysis of variance. Mean values were compared by Duncan's test.

Results and discussion

Egg fertilization rate was found to be high in all age groups of hens (Tab. 2), but it reached a peak ($P \leq 0.05$) in those aged 36 to 54 weeks. A lower egg fertilization rate was found at the beginning (week 33) and towards the end (week 57) of the laying

Table 2. Egg fertilization and hatchability as related to turkey-hens' age

Age of hens (weeks)		Fertilization rate (%)	Hatching rate of fertilized eggs (%)	Live unhatched embryos (%)
33	mean	93.7 ^{ab}	75.6 ^a	5.8 ^{ab}
	V	3.85	7.40	77.20
36	mean	97.6 ^b	84.8 ^{abc}	3.3 ^{abc}
	V	0.66	7.31	58.85
39	mean	97.8 ^b	88.6 ^{bc}	3.7 ^{abc}
	V	1.02	3.36	28.22
42	mean	98.0 ^b	93.1 ^c	0.8 ^c
	V	0.80	2.74	1.23
45	mean	96.4 ^b	88.9 ^{bc}	2.3 ^{abc}
	V	1.58	3.61	56.58
48	mean	96.0 ^{ab}	87.4 ^{bc}	3.1 ^{abc}
	V	2.95	5.97	44.52
51	mean	96.0 ^{ab}	80.3 ^{abc}	4.8 ^{abc}
	V	2.02	9.20	28.09
54	mean	96.8 ^b	83.4 ^{abc}	4.9 ^{abc}
	V	2.00	4.83	34.62
57	mean	91.7 ^a	78.8 ^{ab}	6.1 ^a
	V	3.21	7.32	34.65
33-57	mean	96.0	84.5	3.9
	V	2.86	8.20	62.60

ab... Within columns means bearing different superscripts differ significantly at $P \leq 0.05$.

V – variation coefficient.

season. The hatching rate of fertilized eggs was high (above 80%) between week 36 and 54 of hens' age, and lower in the other periods analysed (Tab. 2). The percentage of unhatched embryos was low in hens between week 36 and 48 of age, and high over the remaining weeks. The coefficients of variation were low for fertilization rate and hatching rate, and high for the number of unhatched embryos, which is considered typical [Orłowska and Mróz 2006, Mróz *et al.* 2007b].

The reproductive performance of turkeys has increased recently due to specialized and intensive breeding programmes and advanced insemination techniques [Faruga *et al.* 1996, Orłowska and Mróz 2006, Mróz *et al.* 2007b]. The hatching rate of fertilized eggs has exceeded 85%, reaching in some cases 90%, confirming earlier research results [Mróz *et al.* 2007ab]. Reduced hatchability is usually noted at the end, but it may also be observed at the beginning of the laying season (as in the present study) – Grimes *et al.* [2004]. Christensen *et al.* [1996] and Łeppek *et al.* [1999] reported a decrease in hatchability towards the end of the laying season by 6.4% and 3.8%, respectively. Mróz *et al.* [2007a, 2008] demonstrated that hatchability in turkeys depends on egg quality, and does not exceed 75% in eggs with poor shell surface pigmentation. According to French [1997], hatchability is determined by egg

weight; the highest hatching rate – 80.6% – was achieved for eggs weighing 85 to 89 g. The hatching rate of eggs weighing more than 95 g and less than 84 g was 67.8% and 78.9%, respectively. The relation between hatchability and egg weight was also shown in the present study. Reduced embryo viability observed in the group of older hens can be attributed to increased gas exchange through eggshell pores and a faster rate of embryo metabolism [Borzemska 1978, 2005, Christensen *et al.* 1996, Faruga *et al.* 1996]. A different pattern of protein metabolism during intensive growth is associated with a decreased concentration of thyroxine and increased activity of triiodothyronine. A lower glycogen content in the liver and heart of embryos was also noted over this period. Serum glucose concentrations decrease in the embryos as the hens grow older [Christensen *et al.* 1996].

The body weight of hatchlings remained within the normal range for turkeys throughout the laying season [Polish Standard 1998]. Poults that hatched from eggs laid by the oldest hens had the highest body weight (Tab. 3). At peak hatchability the body weight of poults reached 63.4 to 71.0 g. The relative body weight of poults from 67.2 to 70.2%, recorded in hens aged 39 to 48 weeks, seems to be optimum since it corresponds to the highest hatchability values. Variation in egg weight and poult weight was at an average level. Great variation in egg weight, indicative of the poor

Table 3. Body weight of poults as related to turkey-hens' age

Age of hens (weeks)		Egg weight (g)	Body weight (g)	Relative body weight (%)
33	mean	81.9 ^a	59.1 ^a	72.1 ^a
	V	6.58	7.35	10.03
36	mean	89.9 ^b	64.0 ^b	71.2 ^a
	V	6.74	7.87	11.06
39	mean	90.3 ^b	63.4 ^{ab}	70.2 ^{ab}
	V	7.14	9.00	6.70
42	mean	92.3 ^b	63.6 ^{abc}	68.9 ^b
	V	6.60	8.38	5.48
45	mean	94.0 ^c	64.5 ^{bc}	68.6 ^b
	V	6.79	8.28	7.02
48	mean	96.0 ^{cd}	64.5 ^c	67.2 ^b
	V	6.42	8.29	6.40
51	mean	97.4 ^d	71.0 ^c	72.8 ^a
	V	6.80	7.90	9.11
54	mean	97.9 ^d	65.7 ^d	67.1 ^b
	V	6.76	8.16	13.02
57	mean	101.4 ^e	72.6 ^f	71.5 ^a
	V	40.25	6.92	12.98
33-57	mean	93.5	65.3	69.8
	V	16.87	9.83	8.07

^{ab...} Within columns means bearing different superscripts differ significantly at $P \leq 0.05$.

V – variation coefficient.

biological value of eggs, was observed in the hens aged 57 weeks. The body weights of poults obtained in this study are greater than those of *Nicholas* poults reported by Siopes [1992] – 49.6 to 52.7 g at the beginning of the laying season and 59.9 to 61.0 g at the end – and comparable with the findings of Applegate and Lilburn [1996], Christensen *et al.* [1996] and Orłowska and Mróz [2006].

The highest percentage of poults without physical defects reached 57.9 and was found in hens aged 45 weeks (Tab. 4). The number of defect-free, healthy hatchlings was significantly lower early in the laying season. The highest share of poults that received 100 points ($P \leq 0.05$) came from eggs laid by hens aged 42 to 48 weeks, while the lowest – from eggs laid by 33-, 36- and 39-week-old hens. Poults from eggs laid by hens older than 39 weeks got high scores for body conformation, except for those that hatched from eggs laid by 54-week-old hens. However, the poor results of quality evaluation were in this case caused by an external factor independent of hens' age, *i.e.* equipment failure during incubation. The final score of poults with physical

Table 4. Results of poults quality assessing with a 100-point scale as related to turkey-hens' age

Age of hens (weeks)		Assessment with a 100-point scale		
		poults without defects (pooled)	all poults (points)	poults with physical defects (points)
33	mean	34.3 ^{ab}	93.7 ^b	90.6 ^b
	V	18.47	7.78	7.84
36	mean	23.2 ^a	92.5 ^a	90.2 ^b
	V	21.63	6.33	5.22
39	mean	37.9 ^{ab}	95.2 ^c	92.5 ^c
	V	15.87	5.28	4.74
42	mean	49.3 ^{bc}	95.8 ^{cd}	92.1 ^c
	V	19.53	5.29	4.73
45	mean	57.9 ^c	96.8 ^d	92.7 ^c
	V	5.80	4.55	4.12
48	mean	52.5 ^c	96.3 ^{cd}	92.3 ^c
	V	10.05	5.00	4.49
51	mean	45.4 ^{bc}	96.3 ^{cd}	93.2 ^c
	V	6.21	4.53	4.00
54	mean	44.0 ^{bc}	93.7 ^b	88.9 ^{a*}
	V	43.50	7.47	6.42
57	mean	46.8 ^{bc}	96.1 ^{cd}	92.6 ^c
	V	5.60	5.13	4.86
33-57	mean	43.5	95.1	91.6
	V	28.31	5.95	5.44

ab... Within columns means bearing different superscripts differ significantly at $P \leq 0.05$.

V – variation coefficient.

*Hatchery failure.

deformities was on average by 3.5 points lower (Tab. 4), compared to poults without such defects. Available literature provides data on quality assessment by points only with respect to chicks [Tona *et al.* 2002, 2003, 2004]. Those data are similar to the present results, but a direct comparison between two different bird species is not possible. Earlier findings by Applegate and Lilburn [1999] as well as the results of this study indicate that poults coming from eggs laid by young hens (aged 34 weeks) are the weakest.

The results presented here show that poult classification by points may be a new way to estimate the quality of poults at a specified laying season. When pooled, all tested poults received 95.1 points for overall quality, whereas poults whose body conformation was imperfect got 91.6 points. Hens aged 39 to 48 weeks were characterized by the best reproductive performance, which was reflected by the highest egg fertilization rate, the highest hatching rate of fertilized eggs and the greatest percentage of poults with the highest (100 points) scores for quality (57.9%). The body weight of poults increased from 59.1 g to 72.6 g over a 24-week laying season, reaching 63.4 to 70.1 g at peak hatchability. At that time the relative body weight of poults varied from 67.2 to 70.2%.

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Jakość indycząt typu ciężkiego w pierwszym sezonie nieśności zależnie od wieku niosek

Streszczenie

Celem pracy była ocena jakości indycząt wylęzonych z jaj znoszonych w pierwszym sezonie nieśności przez nioski w różnym wieku.

Indyczęta pochodziły z dziewięciu legów, prowadzonych co trzy tygodnie w 24-tygodniowym sezonie nieśnym. Ustalono podstawowe wskaźniki wylęgowości. Budowę indycząt oceniono na podstawie aktywności ruchowej, wyglądu puchu, brzucha, oczu, nóg, pępka, pozostałości kosmówko-omocznici i woreczka żółtkowego. Wyniki wyrażono w skali 100-punktowej. Określono masę ciała (g) i względną masę ciała (%) indycząt. Wyniki opracowano za pomocą jednoczynnikowej analizy wariancji, a średnie porównano testem Duncana.

Wskaźniki wylęgu wahały się od 75,6% do 93,1%, a najsłabsze były w 33 i 57 tygodniu życia niosek. Masa ciała indycząt wzrosła z 59,1g do 72,6 g w sezonie nieśnym, a w okresie najwyższej wylęgowości wynosiła od 63,4 do 71,0 g. Względną masę ciała indycząt na poziomie 67,2-70,2% odnotowano w okresie najwyższej zdolności wylęgowej jaj. Najwyższe średnie oceny – 95,2-96,8 pkt. – uzyskały indyczęta wylęzione z jaj zniesionych przez nioski będące w wieku 39-51 tygodni. Jakość indycząt z 33, 36, 54 i 57 tygodnia życia niosek była istotnie gorsza.

