EFFECT OF TIME OF OVIPOSITION ON EGG QUALITY IN EGG AND MEAT TYPE HENS*

E. Tůmová, Z. Ledvinka, M. Skřivan, M. Englmaierová, L. Zita

Czech University of Life Sciences, Faculty of Agrobiology, Food and Natural Resources, Department of Animal Husbandry, Prague, Czech Republic

Two experiments were carried out to investigate the effect of time of oviposition on egg quality characteristics in egg and meat type hens. In the experiment 1, egg type ISA Brown hens from 20 to 64 weeks of age were housed on litter (7 hen/m^2) and in the experiment 2, meat type Ross 308 hens at the age from 23 to 55 weeks (5.5 hen/m^2) were used. Eggs were collected daily at three-oviposition times 06:00, 10:00 and 14:00 h. Every four weeks, 90 eggs for each type (30 eggs for each oviposition time) were used for egg quality assessment. In egg type, time of oviposition had no significant effect on egg weight and eggshell quality characteristics except shell thickness. Morning eggs had greater shell thickness (0.398 mm) than afternoon eggs (0.390 mm). In meat type, the significantly ($P \leq 0.05$) heaviest eggs (64.17 g) were laid in the early morning (06:00 h) and the significantly ($P \leq 0.05$) highest shell percentage (10.92%) was in eggs laid in the afternoon (14:00 h). Cholesterol content was measured in egg type. There were no significant differences in time of oviposition but the lowest content was found out in eggs collected at 10:00 h (13.93 mg/g yolk).

hens; egg type; meat type; oviposition time; egg quality

INTRODUCTION

Time of oviposition plays a vital physiological role in determining eggshell quality because the amount of deposited shell is a linear function of time spent in the shell gland after plumping, and therefore thickness. Numerous studies indicated that eggs laid early in the morning were heavier than eggs laid during the later periods of the day (Choi et al., 1981; Arafa et al., 1982; Lee, Choi, 1985; Novo et al., 1997; Patterson, 1997). Zakaria et al. (2005) suggest that in their study were found out differences in egg weight among eggs from broiler breeders at different times of the day. Weights of early laid eggs were significantly greater than middle laid and the late laid eggs in the young flock, whereas late laid eggs were significantly smaller than early laid and middle laid eggs in the old flock. On the other hand, Ayorinde and Olagbuyiro (1991) concluded that egg weight was not significantly affected by different time of lay. Moreover, most of investigators revealed that eggs had better shell quality characteristics when laid in the afternoon than in the morning (Roland, Harms, 1974; Arafa et al., 1982; Lee, Choi, 1985; Oguike, 1995; Pavlovski et al., 2000). In contrast, Aksoy et al. (2001) indicated that shell weight was not affected by the collection time. Furthermore, yolk percentage slightly decreases (Tůmová, Ebeid, 2005; Tůmová et al., 2007) and the Haugh Units increase (Pavlovski et al., 2000; Tůmová, Ebeid, 2005).

It seems that genotype is a valuable aspect in time of oviposition. Lewis et al. (1995) revealed high differences between broiler breeder hens and egg type hens. These deviations were higher than those between white-egg and brown-egg hybrids. The time of lay in broiler breeder hens was 1 h later than in white-egg hens and 2.5 h in brown-egg hybrid (Lewis et al., 2001). Campo et al. (2007) stated that white eggs inclined to be laid in the afternoon, whereas brown eggs tended to be laid in the morning.

Lewis et al. (2007) show that birds transfered to 16-h or 17-h photoperiods had inferior rates of lay between 52 and 60 weeks of age to birds maintained on 11 h from 20 weeks. However, the 11-h birds laid more eggs on the floor and produced a large number of cracked and dirty eggs. In addition, they found that increases in photoperiod applied during the laying period do not compensate for age-related declines in egg production, and adversely affect rate of lay.

The objectives of the present study were to determine the effect of oviposition on egg quality characteristics and compare differences in egg and meat type of hens.

MATERIAL AND METHODS

Two experiments were carried out to investigate the effect time of oviposition on egg quality characteristics in two different types of hens, egg and meat. In the first experiment, 6500 egg type ISA Brown hens from 20 to 64 weeks of age were housed on deep litter (7 hen/m^2). The daily photoperiod consisted of 15 h of light and 9 h of darkness. The lights were turned on at 03:00 and switched off at 18:00 h. In the second experiment, meat type parents hens Ross 308 from 23 to 55 weeks of age were reared on deep litter (5.5 birds/m^2). There were 4100 hens and 500 cockerels in the house in male : female ratio 1 : 8.2. Birds were provided with feed and water ad libitum. Laying hens were fed by a commercial feed mixtures

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N1 (with 17.6% crude protein, 11.7 MJ of metabolizable energy) from 20 to 40 weeks of age and N2 (with 15.5% of crude protein, 11.5 MJ of metabolizable energy) from 41 to 64 weeks of age. Meat type hens got a commercial feed mixture NP (with 16.1 % of crude protein and 11.3 MJ of metabolizable energy). The calcium content was 3.5 %, resp. 2.9 % in feed mixture for the laying hens, resp. for the meat type hens.

In both houses, eggs were recorded, categorized and collected daily at three-oviposition times 06:00, 10:00 and 14:00 h. Every four weeks, 90 eggs for each type (30 eggs for each oviposition time) were used for egg quality assessment. Each egg was weighed and shell-breaking strength was determined by the device QC – SPA (TSS England). Albumen height and Haugh Units were evaluated by the device QCH (TSS England). Using the individual weight of each egg and the weight of its components, percent yolk, percent albumen and percent shell were determined. Yolks were separated without albumen for cholesterol analysis according to Ingr and Simeonovová (1983).

All data were analyzed by one-way ANOVA analysis of variance using SAS program. Duncan's multiple range tests is used to differentiate groups means.

RESULTS

In egg type hens time of oviposition had no significant effect on egg weight and most of egg quality characteristics (Table 1). Differences among collection time and egg weight were not significant but the heaviest eggs were collected at 10:00 and 14:00 h.

Time of oviposition had no significant effect on shell quality characteristics except shell thickness. In the morning (06:00 h) collection time, significantly ($P \leq 0.05$) higher shell thickness was observed, whereas thicker shells (0.398 mm) were found on eggs laid during the early morning hours when compared with eggs laid in the afternoon hours (0.390 mm).

As shown in Table 1, albumen quality characteristics were lower in eggs laid in the morning (06:00 h) and they are significantly increased at 10:00 and 14:00 h. The differences in Haugh Units between the last time of oviposition and the first one were 2.86 Haugh Units higher in eggs collected in the afternoon. No significant differences were detected in yolk percentage, yolk index and cholesterol content between eggs laid early in the morning and those laid late in the afternoon. However, collected eggs at 10:00 h had higher yolk index (48.03%) and lower cholesterol content (13.93 mg/g of yolk).

In the second experiment with meat type of hens, the time of oviposition had a significant effect on egg weight (Table 2). The heaviest eggs (64.17 g) were laid in the early morning (06:00 h) and the egg weight at 10:00 and 14:00 h were 62.84 g and 62.42 g, respectively.

Time of oviposition plays a very important role in determining eggshell quality. All egg shell quality characteristics, shell percentage, shell thickness and shell strength were significantly higher in the afternoon eggs, what is in contrast to the first experiment with egg type of hens where eggs laid in the morning had significantly higher shell thickness, while other characteristics were not influenced by oviposition.

There are opposite findings in both experiments for albumen characteristics. In contrast to egg type hens in eggs of meat type significant differences among albumen index, albumen height, Haugh Units and time of oviposition were not determined. Albumen quality characteristics were lower in eggs laid in the morning (06:00 h) and they increased at 10:00 and 14:00 h.

DISCUSSION

Based on the results of the present study, it can be concluded that in egg type, the heaviest eggs were laid later in the morning and in the afternoon. These results are not in accordance with the results of many other authors (Washburn, Potts, 1975; Choi et al., 1981; Arafa et al., 1982; Lee, Choi, 1985; Novo et al., 1997; Patterson, 1997; Pavlovski et al., 2000; Aksoy et al., 2001). They proved that afternoon eggs were lighter than morning eggs. Moreover, Choi et al. (1981) and Novo et al. (1997) showed that egg mass significantly declined with oviposition time. In addition Choi et al. (1981) reported that the heavier eggs laid early in the morning were mainly due to the greater percentage of the first eggs of the sequence in a clutch among those laid early in the morning. In our case, meat type hens laid the heaviest eggs in the morning, what is in agreement with the literature mentioned above. Zakaria et al. (2005) also attained to similar findings in broiler breeders.

Egg shell measurements are one of the most affected characteristics. We found out significant differences in all egg shell measurements in meat type hens. Higher shell quality was in eggs laid in the afternoon. However, in egg type, only shell thickness was significantly higher in eggs laid in the morning. These findings in egg type are not consistent with those of Roland, Harms (1974), Arafa et al, (1982), Lee, Choi (1985), Oguike (1995) and Pavlovski et al. (2000) who indicated that shell quality of eggs laid in the morning is not as good as that of those laid in the afternoon. On the other hand, Harms (1991) established that shell weight was the highest in the morning, declined until 12:45 hr and then increased thereafter. Aksoy et al. (2001) indicated that shell weight was not affected by the collection time. In egg type, there were stated the same results in yolk percentage as with Tůmová and Ebeid (2005) and Tůmová et al. (2007) and in the Haugh Units as with Pavlovski et al. (2000) and Tůmová and Ebeid (2005). Yolk percentage slightly decreased and Haugh Units increased, too.

The results show large differences between egg and meat type in the effect of oviposition on egg quality. For instance, egg weight was the highest in the morning in

Table 1. Effect of oviposition time on egg quality characteristics in egg type of hens

Characteristic	Time of oviposition (h)			Significance
	06:00	10:00	14:00	
Egg weight (g)	62.16	63.27	63.07	NS
Shell strength (N)	47.50	46.94	46.30	NS
Shell deformation (mm)	0.317	0.322	0.310	NS
Shell thickness (mm)	0.398[a]	0.392[b]	0.390[b]	*
Shell (%)	10.37	10.42	10.33	NS
Egg shape index (%)	76.68	76.43	76.08	NS
Albumen height (mm)	5.51[b]	5.85[a]	5.86[a]	**
Albumen (%)	61.91	61.89	61.94	NS
Albumen index (%)	6.86[b]	7.40[a]	7.46[a]	*
Haugh Units	69.99[b]	72.35[a]	72.85[a]	*
Yolk height (mm)	18.50[a]	18.60[a]	18.25[b]	**
Yolk (%)	26.43	26.37	26.00	NS
Yolk index (%)	47.40	48.03	48.01	NS
Cholesterol (mg/g yolk)	14.42	13.93	14.19	NS

[a,b] Means followed by different letters in the same row are significantly different; [NS] not significant; [*] $P \leq 0.05$; [**] $P \leq 0.01$

Table 2. Effect of oviposition time on egg quality characteristics in meat type of hens

Characteristic	Time of oviposition (h)			Significance
	06:00	10:00	14:00	
Egg weight (g)	64.17[a]	62.84[b]	62.42[b]	*
Shell strength (N)	40.34[a]	40.54[a]	38.36[b]	*
Shell thickness (mm)	0.34[b]	0.34[b]	0.35[a]	*
Shell (%)	10.45[b]	10.62[b]	10.92[a]	*
Egg shape index (%)	75.91	75.71	76.02	NS
Albumen (%)	58.81	58.43	58.19	NS
Albumen index (%)	7.51	7.57	7.32	NS
Haugh Units	72.17	73.4	72.25	NS
Yolk (%)	30.73	31.09	30.89	NS
Yolk index (%)	45.24	45.15	44.76	NS

[a,b] Means followed by different letters in the same row are significantly different; [NS] not significant; [*] $P \leq 0.05$

meat type, whereas in egg type at 10:00. Similar findings were in egg shell quality. There were higher characteristics in the morning in egg type but in meat type in the afternoon. The same contrast results were ascertained in Haugh Units and in yolk index. It seems that these differences are influenced by genotype and methods of breeding.

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TŮMOVÁ, E. – LEDVINKA, Z. – SKŘIVAN, M. – ENGLMAIEROVÁ, M. – ZITA, L. (Česká zemědělská univerzita, Fakulta agrobiologie, potravinových a přírodních zdrojů, katedra speciální zootechniky, Praha, Česká republika):

Vliv doby snesení na kvalitu vajec slepic nosného a masného typu.

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Vliv doby snesení na ukazatele kvality vajec od nosného a masného typu slepic byl stanovován na základě dvou pokusů. V prvním pokusu byly nosnice ISA Brown od 20. do 64. týdne věku ustájeny na podestýlce (7 slepic/m^2) a druhý byl realizován s masným typem slepic Ross 308 ve věku od 23 do 55 týdnů (5,5 slepic/m^2). Vejce byla sbírána denně v časech 06:00, 10:00 a 14:00 hodin v intervalu čtyř týdnů. Pro zjištění kvality vajec bylo použito 90 kusů vajec od každého typu (30 vajec z každého času sběru). Doba snesení vejce neměla u nosného typu průkazný vliv na hmotnost a ukazatele kvality skořápky kromě tloušťky skořápky. Vejce snesená ráno měla silnější skořápku (0,398 mm) než vejce snesená odpoledne (0,390 mm). Slepice masného typu snášela prokazatelně ($P \leq 0,05$) těžší vejce (64,17 g) časně ráno (06:00 hodin) a naopak signifikantně ($P \leq 0,05$) vyšší podíl skořápky (10,92 %) měla vejce snesená odpoledne (14:00 hodin). U vajec slepic nosného typu byl stanovován obsah cholesterolu. I když nebyly zjištěny průkazné rozdíly mezi různými časy sběru, nejnižší obsah měla vejce sebraná v 10:00 hodin (13,93 mg/g žloutku).

slepice; nosný typ; masný typ; doba snesení; kvalita vajec

Contact Address:

Prof. Ing. Eva Tůmová, CSc., Česká zemědělská univerzita v Praze, Fakulta agrobiologie, potravinových a přírodních zdrojů, katedra speciální zootechniky, Kamýcká 129, 165 21 Praha 6-Suchdol, Česká republika, tel.: + 420 224 383 048, e-mail: tumova@af.czu.cz