INFLUENCE OF SEASON ON CHEMICAL COMPOSITION OF ALBUMEN, YOLK AND EGGSHELL FROM LAYER EGGS

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Abstract

In this paper was investigated influence of seasons on chemical composition of egg albumen, yolk and eggshell in eggs from laying hens. The reasons for this research were the higher summer temperatures in Republic of Macedonia which causing severe damages in production of eggs. Isa-Brown hybrid hens were tested in a poultry farm located in southern part of state where penetrate the Mediterranean climate and the summer temperatures reach a maximum of 35-41°C. The research was lasted 3 seasons (summer, autumn and winter) during which time were processed about 900 eggs and in 176 eggs was determined the impact of fixed factor on the chemical composition of albumen, yolk and shell (moisture and dry matter, crude ash, crude protein, crude fat and calcium carbonate). The obtained results were statistically processed by applying different models of Least Squares Means by [5]. Factor season has shown no statistically significant impact on chemical composition of albumen and yolk in any studied parameters. Although, there was a slightly lower percentage of crude protein in albumen and a higher percentage in yolk during the summer. In contrast, season had statistically significant ($p<0.01$) influence on the percentage of calcium carbonate in eggshell. The analyzed eggs collected during the summer months had a significantly lower (90.74) percentage of $CaCO_3$ in shell compared to eggs collected in autumn (92.01) and winter (93.86). That is a one of the reasons for poor quality of eggs in the summer seasons.

Key words: season, chemical composition, albumen, yolk, eggshell

INTRODUCTION

The season (especially summer with high temperatures) is one of many factor affecting productive and reproductive traits of layers. Seasonal variations directly and indirectly affect quality of eggs. Indirect impact is shown by reduction of consumed food during the high summer temperatures, which further affects decline of laying and mass of eggs. The direct impact of high temperatures is shown by decline of eggshell quality [13] [9] and [14] found that decline of consumed food during the summer was occurred within 1% reduction for every 1°C increased temperature when they occurred from 21-30°C and reduction of 4.6% in rapid rise of temperatures from 32-38°C. It is concluded that season and age, especially high summer temperatures and hens' older age have valuable influence on egg lower weight and quality (strength) of eggshell [7] [8]. High (above 25°C) environmental or shed temperatures may affect the feed (and therefore calcium) intake of the bird, thus resulting in a decreased availability of calcium for shell deposition [4]. [1] found that the egg quality of older hens was more severely affected by increased temperature than younger hens.

The aim this study, therefore, was to investigate the influence of seasons on chemical composition of all egg's components (albumen, yolk and eggshell) in eggs from laying hens.

MATERIAL AND METHODS

Isa-Brown hybrid hens from young (up to 45 weeks of age) and old (above 45 weeks of age) were tested in a poultry farm located in southern part of Macedonia where penetrate the Mediterranean climate and the summer temperatures reach a maximum of 35-41°C.

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The research was lasted 3 seasons (summer, autumn and winter) during which time were processed about 900 eggs and in 176 eggs was determined the impact of fixed factor (season) on the chemical composition of albumen, yolk and shell (moisture and dry matter, crude ash, crude protein, crude fat and calcium carbonate). The layers were stored in cage batteries and fed with mixtures which quality corresponded to the age of layers and the seasonal changes in order to factor diet does not influence on the quality of eggs. The mass of albumen, yolk and eggshell and their chemical analysis (determination of moisture and dry materials, crude ash, crude protein and BEM, crude fat in the yolk and percent of calcium carbonate in eggshell) were tested in this experiment. The determination of chemical composition of albumen, yolk and eggshell was done with already recognized methods for chemical analysis.

Obtained results were statistically processed by applying different models of Least Squares Means [5].

RESULTS AND DISCUSSIONS

Influence of season on the mass of egg components is shown in Table 1, where is given average results of measurements weight of yolk, albumen and eggshell in eggs collected in summer, autumn and winter period from two aging group of Isa-Brown hybrid.

Table 1 Influence of season on mass of egg components in g.

Season	Young layer			Old layer			Average		
	Yolk	Album.	Shell	Yolk	Album.	Shell	Yolk	Album.	Shell
Summer	16.13	37.05	8.21	16.41	36.38	8.26	16.27	36.71	8.23
Autumn	17.30	39.04	8.33	17.25	39.50	8.07	17.27	39.27	8.20
Winter	16.40	38.71	8.35	17.89	38.08	8.22	17.14	38.39	8.28

Data from above table shows change mass of egg components depending of the season. The highest average weight of yolk and albumen was concluded in autumn season, while average maximum eggshell was in winter months. The lowest average values of the measured mass of all egg components were in summer season, when temperature often exceeding 40 degree. In such conditions layers reduce feed intake, laying hens will try to overcome heat stress by panting [4]. However, this causes a decrease in the amount of carbon dioxide (CO_2) in the hens' blood, a condition known as respiratory alkalosis [4]. As egg shells are made up of 95% calcium carbonate ($CaCO_3$), this decrease in blood CO_2 levels combined with an increase in blood pH and a subsequent decrease in Ca^{2+} ions for shell formation leads to an increase in the number of thin or soft shelled eggs produced.

In table 2a and 2b are given results of an examination of chemical parameters of albumen, yolk and eggshell influenced by season (summer, autumn and winter). Factor season has shown no statistically significant impact on chemical composition of albumen and yolk in any studied parameters. Although, there was a slightly lower percentage of moisture, dry matter and crude protein in albumen and lower percentage of crude fat in yolk, during the summer.

In contrast, season had statistically significant ($p<0.01$) influence on the percentage of calcium carbonate in eggshell. The analyzed eggs collected during the summer months had a significantly lower (90.74) percentage of $CaCO_3$ in shell compared to eggs collected in autumn (92.01) and winter (93.86). That is a one of the reasons for poor quality of eggs in the summer seasons.

Table 2a Influence of seasons on chemical parameters of albumen, yolk and eggshell

Fix fac	n	MA		MO		DM		OM		CP	
		LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE
Albumen											
μ	176	38.25	0.122	88.39	0.003	11.61	0.003	11.18	0.012	9.63	0.034
1	57	38.01	0.231	88.38	0.006	11.60	0.006	11.16	0.023	9.56	0.064
2	60	38.64	0.236	88.40	0.006	11.62	0.006	11.19	0.024	9.67	0.065
3	69	38.11	0.223	88.39	0.006	11.61	0.006	11.17	0.022	9.67	0.061
Fexp		1.95		3.25		2.25		0.35		0.93	
Yolk											
μ	176	16.87	0.123	48.68	0.280	51.28	0.004	49.69	0.004	15.32	0.028
1	57	16.58	0.266	48.60	0.060	51.29	0.008	49.68	0.008	15.41	0.059
2	60	16.97	0.242	48.70	0.054	51.28	0.007	49.69	0.007	15.32	0.054
3	69	17.05	0.244	48.75	0.055	51.28	0.007	49.69	0.007	15.24	0.054
Fexp		0.73		1.38		0.47		0.67		1.84	
Eggshell											
μ	176	8.21	0.036	-	-	-	-	-	-	-	-
1	57	8.17	0.085	-	-	-	-	-	-	-	-
2	60	8.22	0.073	-	-	-	-	-	-	-	-
3	69	8.23	0.071	-	-	-	-	-	-	-	-
Fexp		0.14		-		-		-		-	

1 – summer, 2 – autumn, 3 – winter; MA – Mass, g; MO – Moisture, %; DM – Dry matters, %; OM – Organic matters, %; CP – Crude proteins

Table 2b Influence of seasons on chemical parameters of albumen, yolk and eggshell

Fixed factor	n	CF		BEM		CA		$CaCO_3$	
		LSM	SE	LSM	SE	LSM	SE	LSM	SE
Albumen									
μ	176	-	-	1.58	0.010	0.43	0.003	-	-
1	57	-	-	1.58	0.021	0.42	0.006	-	-
2	60	-	-	1.54	0.024	0.41	0.006	-	-
3	69	-	-	1.59	0.027	0.44	0.007	-	-
Fexp		-		0.98		3.69		-	
Yolk									
μ	176	28.84	0.017	5.50	0.030	1.60	0.004	-	-
1	57	28.81	0.037	5.58	0.065	1.59	0.080	-	-
2	60	28.79	0.033	5.44	0.058	1.60	0.071	-	-
3	69	28.91	0.033	5.47	0.059	1.61	0.072	-	-
Fexp		3.24		1.07		1.07		-	
Eggshell									
μ	176	-	-	-	-	-	-	92.21	0.195
1	57	-	-	-	-	-	-	90.74	0.436
2	60	-	-	-	-	-	-	92.01	0.391
3	69	-	-	-	-	-	-	93.86	0.357
Fexp		-		-		-		15.63**	

1 – summer, 2 – autumn, 3 – winter; CF –Crude fats, %; BEM – BEM, %; CA – Crude ash, %; $CaCO_3$ - Calcium carbonate, %; p<0,05)*, (p<0,01**

These results are in accord with those obtained in the research of the authors [8]. The reduction in egg quality parameters recorded in our experiment is in agreement with [12], [10] and [2] who reported that, exposure of Japanese quails and laying hens to high ambient temperatures caused reduction in reproductive activities and egg quality respectively. The reduction in reproductive performance associated with heat stress is a well-known phenomenon in domestic birds [3]. This is probably due to the direct debilitating effect of high ambient temperature on ovarian function in the birds

[11]. A possible mechanism for the reduction of ovarian function might be the reduction in blood flow to the ovary; a differential ovarian blood flow pattern was found in hens exposed to high ambient temperatures [6].

CONCLUSIONS

Based on the obtained results can be implicated following conclusions:

- Factor season has shown no statistically significant impact on chemical composition of albumen and yolk in any studied parameters. Although, there was a slightly lower percentage of crude protein in albumen and higher percentage in yolk during the summer.
- In contrast, season had statistically significant ($p<0.01$) influence on the percentage of calcium carbonate in eggshell. The analyzed eggs collected during the summer months had a significantly lower (90.74) percentage of $CaCO_3$ in shell compared to eggs collected in autumn (92.01) and winter (93.86). That is a one of the reasons for poor quality of eggs in the summer seasons.
- As a general conclusion should be noted that the high temperatures provoke heat stress which produce damage in eggshell quality. This negative effect can be soothed by various supplementations in drinking water or feed (vitamin C, vitamin E, potassium chloride, ammonium chloride, potassium sulphate and sodium bicarbonate).

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