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CHEMICAL COMPOSITION OF MEAT OF LAYING HENS IN ALTERNATIVE REARING SYSTEMS

Simeon Rakonjac[1], Snežana Bogosavljević-Bošković[1], Zdenka Škrbić[2], Lidija Perić[3], Vladimir Dosković[1], Veselin Petričević[2], Milun D. Petrović[1]

[1]University of Kragujevac, Faculty of Agronomy Čačak, Cara Dušana 34, Čačak, Serbia
[2]Institute for Animal Husbandry, Beograd-Zemun, Autoput 16, 11 080 Zemun, Serbia.
[3]University of Novi Sad, Faculty of Agriculture, D. Obradovica 8, Novi Sad, Serbia.
Corresponding author: Simeon Rakonjac, simcepb@yahoo.com
Original scientific paper

Abstract: The aim of this paper was to estimate the effect of rearing systems (floor and organic) on the chemical composition of meat of laying hens. The tested genotypes were Isa Brown hybrid and dual purpose breed New Hampshire. Based on the results of this research can be concluded that the rearing system, generally, did not caused statistically significant differences in any of the parameters examined chemical composition of meat. On the other hand, the breast meat - white meat and thigh and drumstick - dark meat of New Hampshire genotype had significantly higher fat content compared to the Isa Brown hybrid. It must be noted that in the breast meat reported significant interaction genotype x rearing system. The other parameters of the chemical composition of meat were not significantly different between reared genotypes.

Key words: laying hens, chemical composition, white meat, dark meat.

Introduction

In recent years more and more attention is paid to the functional role of food - its characteristic to improve the state of health consumers and prevent the occurrence of diseases associated with inadequate nutrition. For this reason, consumers are increasingly deciding to buy a product that is obtained in the "natural way" and for him are willing to pay a higher price, because they believe that such products are healthier and better.

For this reason, alternative rearing systems of poultry are increasingly the focus of science and practice. In Europe, already 44% of hens are raising in some of the non-cage rearing systems, and about 20% of individuals has access the outdoor *(Committee for the Common Organisation of Agricultural Markets, 2016).* In the UK almost 50% of the birds are raising in the rearing systems with an

outdoor, while in Switzerland for many years even prohibited the rearing of poultry in cages. Situation is somewhat different in the US, where only about 5.6% of hens are rearing out of the cage.

Many researchers have studied the quality of poultry meat from different rearing systems *(Latif et al., 1996; Holcman et al., 2003, Bogosavljevic-Boskovic et al., 2006, 2011a, 2011b, Dou et al., 2009, Souza et al., 2011).* However, most of these studies related to meat quality of broilers, while about the quality of the meat of laying hens have very little information. The reason for this is because this meat represents only a by-product, which is obtained at the end of the completed cycle of egg production and represents, above all, an important raw material for the meat industry. Although the value of meat worn hens does not exceed 10% of their value at beginning egg production *(Puchala et al., 2014),* it is assumed that even between 15% and 20% of the produced poultry meat represents meat of laying hens at the end of egg production.

For this reason, the aim of this study was to investigate the chemical composition of white and dark meat of different genotypes of laying hens from alternative rearing systems at the end of the production cycle.

Material and methods

A laying hens of two genotype: commercial hybrid Isa Brown and New Hampshire breed were used in this study. These two genotypes were housed in floor and an organic rearing systems. The experiment was arranged in 2x2 factorial design with two layer genotypes and two rearing systems (30 birds per group).

Stocking density in floor rearing system was 2.5 birds/m^2. Feeding program was designed according to requirements of laying hens in conventional production system (Table 1).

Organic groups had same stocking density as floor groups in houses, but each hen have and about 5m^2 pastured outdoor. Feeding program was designed according to the regulations for organic production, without additions of synthetic amino acids, vitamins and minerals, using mostly organic produced components (Table 1). Feed and drinking water for all four experimental groups was available on an *ad libitum* basis.

After the end of the one-year production cycle, six animals per group (total 24 layers) were randomly selected. After a fasting period of 12 hours, selected animals were slaughtered. After slaughtering, samples of white (breast muscle) and dark meat (leg muscle) were collected. In these samples were conducted following examination:

- Dry matter content - standard ISO 1442/1998;
- Total ash content - standard ISO 936/1999;
- Nitrogen content - standard ISO 937/1992, and the protein

content is determined by the formula: SP (%) = N (%) x 6.25;
- Free fat content - standard ISO 1444/1998;

Analysis of the results obtained was based on the parameters of descriptive statistics and using an appropriate model analysis of variance to test the significance of differences *(Stat Soft Inc Statistica For Windows, Version 7.0. (2006): Computer program manual Tulsa).*

Table 1. Chemical composition of complete feed mixtures for feeding of laying hens

Chemical composition	Floor system	Organic system
Dry matter	88.38	89.82
Crude protein	16.79	16.82
Fat	5.15	4.31
Cellulose	4.82	4.29
Ash	12.52	12.68
BEM	49.10	51.90
Ca	3.72	3.43
Total P	0.71	0.81
Na	0.17	0.18
Lysine	0.79	0.80
Methionine + cysteine	0.68	0.48
Methabolizable energy	11.5 MJ	11.3 MJ

Results and Discussion

Tables 2 and 3 shows the results of testing the chemical composition of breast meat (white meat) and the drumsticks and thigh meat (dark meat) laying hens at the end of the production cycle. These results clearly showed that the rearing system had not significant effect ($p \geq 0.05$) of any of the parameters examined chemical composition of dark or white meat.

On the other hand, the effect of genotype was significant ($p \leq 0.05$) on the fat content of the white and dark meat. Generally speaking, New Hampshire hens had higher fat content in the muscle of the breast (0.92%) compared with Isa Brown hybrid (0.69%). However, in this case occurred and significant interaction genotype x rearing system ($p \leq 0.05$), so that the breast meat organically raised New Hampshire hens had significantly higher ($p \leq 0.05$) fat content (1.07%) of the other three experimental groups - Isa Brown organic 0.61%, Isa Brown floor 0.77%, New Hampshire floor 0.78%, which mutually were not significantly different ($p \geq 0.05$). New Hampshire birds also had significantly higher fat content in the meat of thighs and drumsticks ($p \leq 0.05$) in relation to the Isa Brown hybrid (3.61%: 2.52%). Genotype had not a statistically significant effect ($p \geq 0.05$) on the other

chemical parameters of egg quality (dry matter content, ash content, protein content).

Table 2. Chemical composition of breast meat of laying hens

		Dry matter (%)	Ash (%)	Protein (%)	Fats (%)
Rearing system					
Floor		26.85 ± 0.64	1.03 ± 0.06	25.04 ± 0.62	0.77 ± 0.21
Organic		26.61 ± 0.68	1.08 ± 0.04	24.69 ± 0.75	0.84 ± 0.28
Genotype					
Isa Brown		26.53 ± 0.61	1.04 ± 0.05	24.79 ± 0.59	0.69 ± 0.13 [b]
New Hampshire		26.93 ± 0.67	1.07 ± 0.06	24.94 ± 0.81	0.92 ± 0.28 [a]
Rearing system x Genotype					
Floor	Isa Brown	26.67 ± 0.73	1.02 ± 0.05	24.87 ± 0.68	0.77 ± 0.10 [b]
	New Hampshire	27.03 ± 0.53	1.05 ± 0.07	25.20 ± 0.56	0.78 ± 0.29 [b]
Organic	Isa Brown	26.39 ± 0.47	1.06 ± 0.04	24.71 ± 0.52	0.61 ± 0.10 [b]
	New Hampshire	26.84 ± 0.82	1.09 ± 0.05	24.68 ± 0.99	1.07 ± 0.19 [a]
ANOVA					
Rearing system		ns	ns	ns	ns
Genotype		ns	ns	ns	*
Rearing system x Genotype		ns	ns	ns	*

a-b Values within column with no common superscript are significantly different ($p \leq 0.05$). *$p \leq 0.05$

The absence of significant differences in the chemical composition of meat hens raised in different rearing systems in our study is in accordance with results that, admittedly did for broiler chickens, announced *Latif et al. (1996), Holcman et al. (2003), Dou et al. (2009), Souza et al., (2011).* Namely, these authors in their research have not determined significant differences in the chemical composition of meat of broilers reared in rearing systems with outdoor and without it.

A significant effect of genotype on the chemical composition of the meat of laying hens, in our case, on the fat content is in accordance with the conclusions expressed by the *Sirri et al. (2010),* which indicated the genotype as a major factor that affect the quality and chemical composition of poultry meat in non-industrial rearing systems. In our research, meat of New Hampshire genotype had generally a higher fat content and in the breasts and in the legs compared with Isa Brown hybrid. This is in accordance with the results published by *Puchala et al. (2014),*

who founded that this genotype has a tendency to accumulation of fat in the meat, because they found a significantly higher fat content in breast meat (1.61%), and in the meat of thighs and drumsticks (7.71%), compared to the other three genotypes: Greenleg Partridge, Rhode Island Red and Barred Rock. It must be noted that these contents of fat were significantly higher than in our experiment, what these authors and confirmed by the comments that were obtained content of fat had twice the size of their available results of other authors. On the other hand, the protein content in the meat of thighs and drumsticks New Hampshire genotype in the aforementioned study (19.56%) was lower than our results (21.66%), while the protein content of the breast meat was similar (24.89% : 24.94%). It is important to point out that in their study there were no significant differences in the content of protein in dark meat among the genotypes, while the white meat emerged statistically significant difference ($p \leq 0.05$).

Table 3. Chemical composition of drumsticks and thigh meat of laying hens

		Dry matter (%)	Ash (%)	Protein (%)	Fats (%)
Rearing system					
Floor		26.15 ±1.43	1.04 ± 0.06	22.00 ± 1.16	3.09 ± 0.85
Organic		25.74 ± 1.12	1.02 ± 0.06	21.73 ± 0.59	3.04 ± 1.01
Genotype					
Isa Brown		25.60 ± 1.47	1.02 ± 0.04	22.07 ± 1.05	2.52 ± 0.69 [b]
New Hampshire		26.28 ± 0.99	1.05 ± 0.06	21.66 ± 0.74	3.61 ± 0.78 [a]
Rearing system x Genotype					
Floor	Isa Brown	26.10 ± 1.74	1.04 ± 0.02	22.42 ± 1.32	2.64 ± 0.81 [bc]
	New Hampshire	26.19 ± 1.22	1.05 ± 0.08	21.59 ± 0.89	3.55 ± 0.66 [ab]
Organic	Isa Brown	25.10 ± 1.07	1.00 ± 0.03	21.73 ± 0.62	2.40 ± 0.61 [c]
	New Hampshire	26.37 ± 0.80	1.05 ± 0.05	21.73 ± 0.62	3.68 ± 0.95 [a]
ANOVA					
Rearing system		ns	ns	ns	ns
Genotype		ns	ns	ns	*
Rearing system x Genotype		ns	ns	ns	ns

a-b Values within column with no common superscript are significantly different ($p \leq 0.05$). * $p \leq 0.05$

Rizzi and Chiericato (2010), according to our results, founded a crucial influence genotype of laying hens on the fat content of breast and thighs. However,

in the same study, these authors reported a significant effect of genotype on the protein content of the meat, which was not confirmed in our experiment.

Conclusion

Based on the results of this research, can be concluded that the rearing system, generally speaking, did not affected statistically significant differences in any of the examined parameters chemical composition of meat. On the other hand, New Hampshire genotype had significantly higher fat content compared to the Isa Brown hybrid and in the breast meat - white meat and in thigh and drumstick - dark meat. It must be noted that in the breast meat appeared significant interaction genotype x rearing system. The other parameters of the chemical composition of meat were not significantly different between reared genotypes.

Hemijski sastav mesa kokoši nosilja iz alternativnih sistema gajenja

Simeon Rakonjac, Snežana Bogosavljević-Bošković, Zdenka Škrbić, Lidija Perić, Vladimir Dosković, Veselin Petričević, Milun D.Petrović

Rezime

Cilj ovog rada je bio da se ispita uticaj sistema gajenja na hemijski sastav mesa kokoši nosilja iz alternativnih sistema gajenja: podnog i organskog. Ispitivani genotipovi su bili linijski hibrid Isa Brown i rasa kombinovanih proizvodnih sposobnosti New Hampshire.

Na osnovu rezultata ovih istraživanja može se zaključiti da sistem gajenja, generalno posmatrano, nije uzrokovao značajne razlike ni u jednom od ispitivanih parametara hemijskog sastava mesa. Sa druge strane, i meso grudi - belo meso i meso bataka i karabataka - tamno meso, New Hampshire genotipa je imalo značajno veći sadržaj masti u odnosu na Isa Brown hibrid, s tim što se mora napomenuti da se kod mesa grudi, javila i značajna interakcija sistem gajenja x genotip. Ostali ispitivani parametri hemijskog sastava mesa nisu se značajno razlikovali između ispitivanih genotipova.

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