INFLUENCE OF CONVENTIONAL AND ALTERNATIVE HUSBANDRY SYSTEMS ON THE POULTRY MEAT DIETETIC VALUE

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Abstract

This paper tries to equitably evaluate the way that husbandry technology influences the quality of the meat produced by chicken broilers, knowing that, from January 1, 2011, all E.U. countries must implement the law regulations related to the alternative husbandry systems recommended for aviculture practice. There were analyzed the conventional husbandry system–on permanent litter, in blind houses -group C and the alternative one–on permanent litter, in houses providing access to a grassy outer paddock -group A. The biological material consisted in meat samples taken from breast, wings, thighs and drumsticks of the investigated carcasses (70 carcasses-group C and 70 carcasses-group A). The samples have been analytically studied, in accordance with Weende schematics and for cholesterol content. Meat caloricity has been calculated and the data were statistically assessed through ANOVA single factor method. Caloricity was higher in group C samples (165.44-187.22 Kcal/100g), compared to those in group A (139.60-179.23 Kcal/100g). Meat cholesterol content varied between 65 mg-83 mg/100 g (lower values in the white meat). The meat issued from the chickens reared within the alternative system proved to have better dietetic features, knowing that its inner lipids content was also lower. Furthermore, the research will deepen, because the samples were taken from carcasses produced by different farmers.

Key words: broiler, alternative systems, caloricity, cholesterol, dietetic value

INTRODUCTION

Into the world and less in Romania, there were done studies related to the influence of husbandry system on the quality of poultry products and especially of the meat issued from chicken broilers. Thus, some papers reviewed the law enforcements related to poultry welfare. Moreover, in some European countries, there are some tasks books for the farmers that wish to do organic poultry farming [2, 5] and they refer to fowl accommodation, feeding, genotype choose and certain forbidden substances. Such advices were also comprised by some E.U. regulations [1, 7, 9] but for conventional production. Besides those technological aspects, other authors indicated that consumers preferences for buying and using chicken meat issued from organic or free-range farms was rather influenced by the gastronomic education they received (better flavor and texture of the meat, comparing to that produced in conventional farming) [3,4] and also by ethical reasons (animals welfare) [6, 10] than the inner nutritional quality of such products which is almost similar, no matter the used rearing systems for meat production.

Thus, within the context created by the enforcement of the European laws on poultry welfare, the Romanian farmers will be obliged to adapt their exploitations to the new technological systems. It is true that such alternatives mainly refer to the laying hens sector, but there are also advices fro broiler farming. It imposes to investigate the quality of animal products and especially of poultry products, knowing the consumers preferences for such affordable food [8]. As a compound of the quality, the nutritional value of poultry meat could be assessed through lab trials, through physical, chemical and mathematical methods. Through the results presented within this paper, the authors tried to realise an objective characterisation of the way in which the rearing technology (conventional or alternative-free range) affected the nutritional and dietetic quality of the chicken broilers meat.

MATERIAL AND METHOD

The biological material was represented by certain meat samples issued from “Cobb-500” chicken broilers, reared in private farms, under two different technological systems: deep litter rearing, in isolated halls and free-range rearing in familial exploitations, throughout 42 days period. 70 individuals of both genders were used for slaughtering and meat sampling, from each technological system. The samples were noticed conventionally, as related to their provenience, with: group C – meat issued from chickens reared in deep litter isolated system; group A – meat produced by chickens reared on permanent litter, with access to an external paddock – alternative free range system.

From every used carcass (70 in group C and 70 in group A), there were sampled 50 g of meat from each carcass cut: breast fillet, wings, thighs and shanks. Those samples were well labelled, refrigerated for 48 hours, then were weighted and minced and dehydrated at 60°C. The issued powder was used for analytical chemistry assessments, in order to evaluate meat content in certain nutrients, accordingly to the analytical standards recognised internationally (humidity-SR ISO 1442/1997, mineral substances -SR ISO 936: 1998, total nitrogen-SR ISO 937:2007, lipids-SR ISO 1443:2008, fatty acids and cholesterol-gas chromatography). The quantity of sampled material allowed us to run 10 analytic repetitions for each studied parameter. Meat dietetic value was evaluated, besides the cholesterol level and fatty acids ratio, through its caloricity, using the theoretical relation which is based on the quantity of gross energy spread by the burning of 1 g crude protein, crude fat and nitrogen free extract into a calorimeter (GE (Kcal/Kg)=5.70Kcal x n_gCP + 9.50Kcal x n_gCF + 4.2 Kcal x n_gNFE).

The gathered data were statistically processed, to obtain the main estimators and to assess the significance of the differences between means, using the ANOVA Single Factor method.

RESULTS AND DISCUSSIONS

Those raw chemical components affecting meat caloricity are listed in tab. 1.

Thus, lipids proportion per 100 g meat varied within large limits, from a minimal of 1.25±0.04 g% (breast fillet), till 8.09±0.06g% (upper legs muscles). Statistical significant differences occurred for the same parameter ($\hat{F}>F\alpha0.05$ for 1;18 FD) between the two analyzed groups, respectively between thighs samples (8.09±0.06g%-group C vs. 7.45±0.17g%-group A) and for those sampled from the shanks (7.27±0.06g%-group C, compared with 6.93±0.20g%-group A). although the values in A group were lower, due to the higher energetic expenses of those birds, the uniformity of the assessed trait was better in the samples issued from C group (v=2.40-2.46%) than that calculated for group A (v=7.20-9.31%). Accommodation of the fowl into a isolated hall, under better controlled microclimate conditions and restrained movements contributed in the achievement of a better homogeneity level in the studied flocks.

Relatively to the protein meat content, the oscillations presented statistical significance between the analyzed groups. There also were found higher variation amplitudes for this trait, when the cut carcass parts were compared. Thus, for the meat issued from breast, total nitrogen content reached 23.35±0.20g% in C group, compared to 24.33±0.29g% in A group (significant statistic difference). Except for the samples of breast fillet (white meat), in those samples from wings and lower limbs, the total nitrogen content values were lower in group A, compared to fowl in group C. Thus, significant differences occurred for the protein content of wings meat (21.74±0.17g% in group C vs. 20.91±0.28g% in group A), respectively distinguished significant ($\hat{F}>F.\ \alpha\ 0.01$ for 1;18 FD), for the same trait in the drumsticks (18.51±0.43g% proteins in A group, compared to 20.23±0.40 g% proteins in C group). We estimate that the lower values in the meat produced by those chickens having access to outer paddock could be also due to a poorer feed assimilation, consequently to more intense and more often movements, as well as to thermoregulation efforts. That type of assimilation also led to the achievement of a lower value for body weight when fowl turned 42 days old, compared to the intensive technological system.

Table 1 Chemical compounds affecting caloricity of the meat issued from the intensive and free-range technological systems applie din broilers rearing

Carcass cut	Exp. group	Chemical compound affecting caloricity	$\overline{X} \pm s_{\bar{x}}$ (g/100g) (n=10)	V%	Min. (g/100g)	Max. (g/100g)
Breast	C	Lipids	1.25 ±0.04	9.47	1.12	1.45
		Total nitrogen matters	23.35^{a} ±0.20	2.69	22.65	24.33
		Nitrogen free extract	0.44 ±0.07	47.69	0.15	0.79
	A	Lipids	1.45 ±0.03	8.81	0.86	1.16
		Total nitrogen matters	24.33^{b} ±0.29	4.02	21.05	23.70
		Nitrogen free extract	0.79 ±0.02	14.29	0.36	0.51
Wings	C	Lipids	4.16 ±0.04	2.79	3.95	4.34
		Total nitrogen matters	21.74^{a} ±0.17	2.41	21.14	22.55
		Nitrogen free extract	0.46 ±0.01	7.81	0.41	0.53
	A	Lipids	3.98 ±0.06	4.52	3.74	4.27
		Total nitrogen matters	20.91^{b} ±0.28	4.20	19.89	22.19
		Nitrogen free extract	0.55 ±0.02	11.15	0.46	0.64
Thighs	C	Lipids	8.09^{a} ±0.06	2.40	7.91	8.52
		Total nitrogen matters	18.98 ±0.19	3.15	18.18	19.82
		Nitrogen free extract	0.51 ±0.05	33.26	0.36	0.79
	A	Lipids	7.45^{b} ±0.17	7.20	6.90	8.25
		Total nitrogen matters	18.76 ±0.35	5.88	16.24	19.87
		Nitrogen free extract	0.50 ±0.04	25.09	0.31	0.65
Shanks	C	Lipids	7.27^{a} ±0.06	2.64	6.93	7.62
		Total nitrogen matters	20.23^{a} ±0.40	6.32	17.40	21.80
		Nitrogen free extract	0.57 ±0.05	29.70	0.22	0.85
	A	Lipids	6.93^{b} ±0.20	9.31	6.31	8.25
		Total nitrogen matters	18.51^{c} ±0.43	7.31	16.89	21.32
		Nitrogen free extract	0.45 ±0.05	38.59	0.02	0.69

ANOVA test results between two groups, for each carcass cut and analyzed parameter:

^{ab} significant differences ($\hat{F}$>Fα 0.05 for 1;18 DF);

^{ac} distinct significant differences ($\hat{F}$>Fα 0.01 for 1;18 DF).

Thus, it would be advisable to retain certain solution to balance such undesirable situations:

- a reassessment of the nutritional requirements for the chickens reared within the free-range system;
- usage of certain specially designed hybrids for such an alternative system;
- rearing of the broilers for more than 42 days if they benefit from access toward a n outer paddock, almost similarly to the French Label Rouge system.

N.F.E. values oscillated within normal limits for the studied samples.

The caloricity of the meat was given by its inner compounds (table 2).

Thus, greater values could be observed in group C for all anatomic carcass regions, compared to those calculated for group A samples, mainly due to the different fatty content. Minimal values were found in breast fillet (165.44±0.83 Kcal/100g in group C and 139.60±1.64 Kcal/100g in group A), while the highes ones issued from the thighs (179.76±1.70 Kcal/100 g in group A, respectively 187.22±1.21Kcal/100 g in group C). No statistical significance was recorded for the differences between groups.

Related to the meat dietetic value, its inner cholesterol content was assessed (table 2, fig. 2). Thus, greater values were observed in the red meat, compared to the white one. A comparison between husbandry versions revealed slight decrease of cholesterol levels in the muscles of chickens which beneficiated from access toward the outer paddock, over those exclusively kept inside the hall. Lowest cholesterol content was detected in breast meat (58mg%- group C, 56mg%- group A), while the maximal values occurred, again in the thighs meat (79mg%- group C and 75mg%-group A).

Table 2 Caloricity and cholesterol content of the meat issued from chicken broilers reared within the intensive and free-range technological systems

Carcass cut	Exp. group	Caloricity $\overline{X} \pm s_{\bar{x}}$ (Kcal/100g)		V%	Min. (Kcal/100g)	Max. (Kcal/100g)	Cholesterol content (mg/100g)
Breast	C	165,44	±0,83	1,78	143,50	150,39	58
	A	139,60	±1,64	3,72	131,46	145,88	56
Wings	C	187,22	±0,99	1,90	160,65	169,41	66
	A	159,29	±1,48	2,94	152,76	167,04	62
Thighs	C	187,22	±1,21	2,04	182,28	193,72	79
	A	179,76	±1,70	2,94	172,23	188,48	75
Shanks	C	186,78	±2,37	4,02	171,90	200,21	74
	A	173,23	±2,50	4,57	165,47	188,66	73

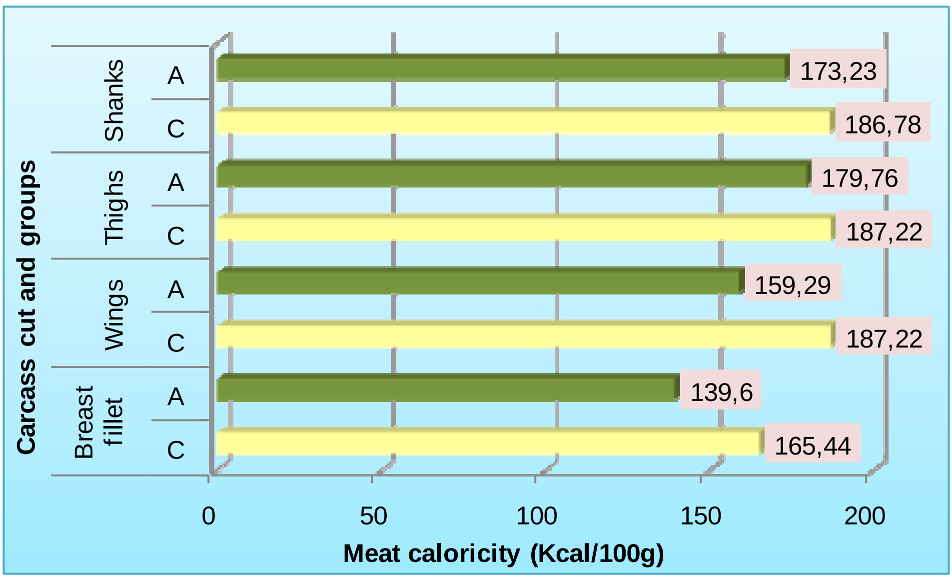

Fig. 1 – Caloricity of the meat issued from chicken broilers reared within the intensive and the free-range technological systems

Concerning the fatty acids in the meat, a balance closed to 1:1:1 was found in the breast and wings meat between the saturated, monounsaturated and polyunsaturated ones. The slightly increased level of ω-3 polyunsaturated fatty acids should be noticed in the samples taken from the free-range chickens. However the data acquired up to this moment are not sufficient to submit an absolute conclusion, because they should be double verified within an experiment, in order to better regulate the environmental factors and especially those related to feeding, knowing that the diet directly affects the lipids profile in the meat.

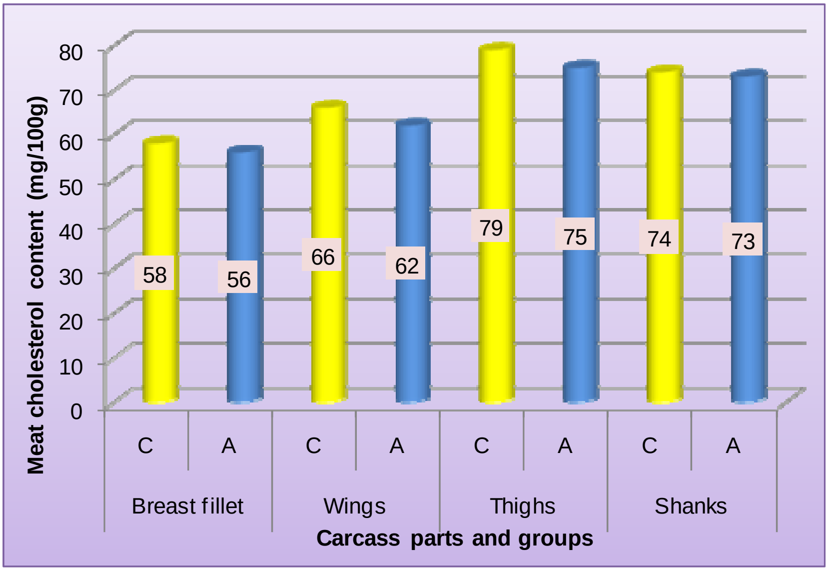

Fig. 2 – Meat inner cholesterol content in the chicken broilers reared within the intensive and the free-range technological systems

CONCLUSIONS

Significant differences were identified for the chemical composition of the white and red meat samples, as well as for each husbandry technology apart.

Lower caloricity and cholesterol values occurred for the chickens produced within the alternative free range system and also for the white meat samples (breast fillet), compared to the red meat (lower limbs).

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