Compositional and Microbiological Particularities of Poultry Meat Obtained in a Free Range System Compared to the Intensive Growth System

Sorin Daniel DAN *, Alexandra TĂBĂRAN, Oana REGET, Darius CORDEA, Ionuț CORDIȘ, Marian MIHAIU

¹Department of Animal Production and Food Safety, University of Agricultural Sciences and Veterinary Medicine, Faculty of Veterinary Medicine, 3-5 Mănăştur Street, 400372, Cluj Napoca, Romania

*Corresponding author: sorindan@usamvcluj.ro

Bulletin UASVM Veterinary Medicine 72(2) / 2015,
Print ISSN 1843-5270; Electronic ISSN 1843-5378
DOI:10.15835/buasvmcn-vm: 11592

Abstract

Poultry meat is influenced by a series of factors, among the most important representatives being the breed, growth system and feeding regime used by farmers. In the last years there was a significant growth of poultry meat consumption, many of the consumers preferring the traditionally raised chickens, with a growth rate longer, without antibiotics added to feed. The aim of our study was to make a comparative research regarding the compositional particularities and the microbial degree of contamination in chickens grown in a traditional system compared to those raised in an intensive system. Poultry meat samples were collected during January-May 2015 period, from some supermarkets in our country, represented by breast muscles and leg muscles. The compositional parameters (proteins, fat, water and collagen) were determined through automatic method with the FoodScan analyzer and the microbiological parameters (Aerobic plate count, Enterobacteriaceae, *Salmonella* and *Campylobacter*) were established through classical methods. In the case of breast muscle obtained from poultry raised in a traditional system (free range) compared to the samples obtained from poultry bred in an intensive system, the protein values were 21.01 ± 0.22 g%, water 68.98 ± 0.39 g%, collagen 2.03 ± 0.10 g%, respectively 8.26 ± 0.47 g%. The total germ load at the poultry meat carcasses was in between 3.9 ± 0.54 and 4.85 ± 0.42 log CFU/cm², the *Enterobacteriaceae* load ranged from 0.9 ± 0.63 and 3.36 ± 0.48 log CFU/cm², without noticing significant differences between the two growth systems. There was no *Salmonella* and *Campylobacter* bacteria isolated. The results indicate significant differences in what concerns the compositional parameters, with higher values of proteins, water and collagen and lower levels of fat in the case of poultry grown in the traditional system compared to the intensive one.

Keywords: compositional and microbiological parameters, free range and intensive system, poultry meat

INTRODUCTION

The importance of poultry is the nutritional value they carry, poultry meat is much sought by consumers due its dietary and taste traits, the digestibility is higher the content is rich in protein and low in fat and also has low price market compared to meat produced from other animals. In recent years the production and consumption of poultry meat broilers, this type of poultry is slaughtered between the ages of 6-8 weeks (Ștețca and Dinea, 2006; Dinea,

2008). Also, both in our country and worldwide the economic interest for poultry production is materialized by applying intensive exploitation, with a pronounced industrial character. Poultry meat quality is influenced by a series of factors, among the most important representatives being the breed, growth system and feeding regime used by farmers (Bogosavljević-Bošković *et al.*, 2010; Kuźniacka *et al.*, 2014). In the last years there was a significant growth of poultry meat consumption, many of the consumers preferring the traditionally

raised chickens, with a growth rate longer, without antibiotics added to feed. Poultry by its physical properties and chemical components, constitute a favourable environment for microorganisms and reducing the level of contamination can only be achieved by following good work practices and hygiene (GMP, GHP) and HACCP (Bărzoi and Apostu, 2002; Mihaie and Rotaru, 2007). The aim of our research was to conduct a comparative study regarding the compositional features and the extent of microbial contamination of broilers reared in the traditional system compared to intensive farming system.

MATERIALS AND METHODS

For compositional and microbiological evaluation broilers reared intensively compared to the traditional growth 15 chicken carcasses from five batches ($n = 3$) were taken between January to May 2015 from each growth system. Samples were taken from a retail network of hypermarkets in Cluj County, where poultry is purchased from both farms and traditional intensive growth system. The compositional parameters (proteins, fat, water and collagen) were determined through automatic method with the FoodScan analyzer and the microbiological parameters (Aerobic plate count - SR ISO 4833/2003, Enterobacteriaceae - SR ISO 21528-2/2007, Salmonella - SR EN 6579/AC/2006 and Campylobacter - SR EN ISO 10272/2/2007) were established through classical methods. The results were statistically analyzed with Origin8.5 program.

RESULTS AND DISCUSSION

Comparative assessment of compositional parameters of broilers

The results for chicken legs, from the intensive breeding system in January-May, highlights the value of fat is 13.42 ± 0.67 g%, protein is 16.82 ± 0.60 g%, water of $66.48\% \pm 0.24$ g, and that of the collagen is 2.13 ± 0.09 g% (Fig. 1).

By making a comparison between the traditional and the intensive growth system was found that the average values of compositional parameters show higher value in respect of the traditional regarding proteins (18.68 ± 0.650 g%), water (67.42 ± 0.83 g%) and collagen (3.18 ± 0.31 g%) (Fig. 2).

The analysis of samples taken from January to May, it was found that the average values of

compositional parameters of chicken legs are: fat 11.76 ± 0.42 g%, protein 18.68 ± 0.65 g%, water $67.42\% \pm 0.83$ g% and collagen 3.18 ± 0.31 g% (Fig. 2). It appears that in the traditional system the amount of fat is lower, the amount of protein, water and collagen are higher than intensive farming system ($p < 0.05$).

According to the results obtained from analyzing samples of chicken breast obtained in the intensive growth system, it was found that the average fat value is 9.53 ± 0.18 g%, protein 20.57 g% of which 1.66 g% collagen and water 68.65 g%, respectively ($p < 0.05$) (Fig. 3).

After statistical processing of the results obtained from January to May regarding chicken breast obtained from chickens reared in the traditional growth it was found that the average fat value was 8.26 ± 0.47 g%, protein 21.01 ± 0.22 g% of which the collagen was 2.03 ± 0.10 g% and water $68.98 \pm 0.39\%$ (Fig. 4). The analysis of the results obtained for chicken breast obtained from poultry reared in the traditional system found

Fig. 1. Compositional parameters values in poultry legs obtained from broilers raised in intensive system ($n=15$)

Fig. 2. Compositional parameters values in poultry legs obtained from broilers raised in traditional system ($n=15$)

higher mean values of proteins, collagen and water and lower in fat compared to samples obtained from the intensive system ($p < 0.05$). Higher values of collagen in samples from chickens reared in the traditional system is mainly due to higher slaughter age (> 65 days compared to 40-42 days for intensively reared chickens). These results are similar to those reported by Bogosavljević-Bošković *et al.* (2010, 2011) in comparative studies on the compositional quality of chicken meat produced in different of growth systems, intensive and free ground (traditional), which revealed higher values of proteins and low fat both in the legs and breast muscles.

Lower values of fat in poultry reared in the traditional system can be explained by their increased muscle activity, which leads to faster metabolism (Holcman *et al.*, 2003; Bogosavljević-Bošković *et al.*, 2006; Kuźniacka *et al.*, 2014). If in the amount of proteins, the authors mentioned showed similar values of 22.57 ± 0.14 g% for semi-intensive systems and 23.4 ± 0.18 g% for the traditional system, fat levels were much lower in the muscles of the chest, between 1.97 ± 2.7 and 0.13 ± 0.11 g% (Bogosavljević-Bošković *et al.*, 2010). These different values on average compositional values are influenced by many factors: race, sex, age, breeding system, type of feed used at the farms, including the slaughtering system.

Comparative evaluation of microbiological parameters of broilers

The total aerobic plate count (APC) from the surface of the intensive reared poultry carcasses was between $\log 4.01 \pm 0.41$ CFU/cm² in January and 4.65 ± 0.2 log CFU/cm² in May (Fig. 5). Similar values were revealed in the same period in the samples collected from poultry reared in the traditional system, with a minimum of 3.9 ± 0.43 log CFU/cm² in April and a maximum of 4.9 ± 0.54 log CFU/cm² in January ($p > 0.05$). These results regarding the level of contamination of poultry carcasses reared in different systems (intensive / extensive), due to similar conditions slaughter, given that all broilers were slaughtered in the same slaughterhouse.

Similar results were mentioned by Dan *et al.* (2008) in a study on the bacterial load from the surface of the broilers, which showed values between 4.19 and 5.12 log CFU/cm². According to a study by Thomas and McMeekin (1981), which

studied the total microbial load from the surface of broiler carcasses, they obtained a microbial load average only in samples taken from the chest and lower limbs of 8.5×10^3 CFU/6.25cm² respectively 1.1×10^4 CFU/6.25 cm².

Such relatively low levels in the study, revealed a good microbiological quality compared with the results obtained in our study, due to the fact that the cooling of the carcasses in the study by Thomas and McMeekin (1981), was at 2°C, while the temperature used for cooling in our studied the carcasses averaged around 4°C, which may explain the lower level of aerobic mesophilic germs. Higher levels of contamination were presented in a study made by Goksoy *et al.*, (2004) on the microbiological quality of broiler chicken carcasses processed in two abattoirs in Turkey, which revealed an average load level for aerobic mesophilic germs of 5.13 ± 0.48 log CFU/g.

Enterobacteriaceae load on the surface of poultry carcasses raised in intensive system presented values between 0.72 ± 0.44 log CFU/

Fig. 3. Compositional parameters values in poultry breast obtained from broilers raised in intensive system (n=15)

Fig. 4. Compositional parameters values in poultry breast obtained from broilers raised in traditional system (n=15)

cm² in January and between 2.73±0.48 log CFU/cm² in May (Fig. 6). After statistical processing of the results obtained in the period between January and May, taken from retail network that sell poultry raised in traditional growth system in approved farms the Enterobacteriaceae load was between 0.81±0.34 log CFU/cm² in January and 3.36±0.48 log CFU/cm² in May. Higher levels of contamination were mentioned by Whyte *et al.* (2004) of 3.50±0.39 log CFU/cm². Similarly, Göksoy *et al.* (2004), in a study conducted in two poultry slaughterhouses in Turkey, revealed enterobacteria load was 3.81 ± 0.07 log CFU/cm², in the first slaughterhouse and 3.91±0.28 log CFU/cm² in the case of the second

From the results highlighted above, we can say that while the processing of the carcasses was performed in strict compliance with hygiene standards in the technological integrity, the microbial load values are low (Ayres *et al.*, 1980; Cousin, 2000). A comparative analysis of the values

obtained for samples from the traditional growth system, which although showed slightly higher values to intensive breeding system, no significant differences were found ($p>0.05$).

CONCLUSION

The average values of compositional parameters from legs, breast muscles obtained in the traditional system present significant differences compared to the intensive growth system. In the poultry meat samples grown in a traditional system, significantly lower fat values were found, while proteins, water and collagen showed higher values. There were no significant differences in terms of the microbiological parameters, fulfilling hygiene criteria during the technological process given the number of slaughtered poultry under the same conditions. Bacteria belonging to *Salmonella* and *Campylobacter* genus were not isolated from any of the samples.

Fig. 5. Total plate count at the surface of poultry carcasses raised in intensive system (n=3)

Fig. 6. Enterobacteriaceae count at the surface of poultry carcasses raised in intensive system (n=3)

REFERENCES

1. Ayres JC, Mundt JO, Sandine WE (1980). Prevention of Food Spoilage. In : Microbiology of Foods, WH Freeman and Compan, San Francisco.
2. Bărzoi D, Apostu S (2002). Microbiologia produselor alimentare. Risoprint, Cluj- Napoca.
3. Bogosavljević-Bošković S, Kurćubić V, Petrović MD, Radović V (2006). The Effect of Sex and Rearing System on Carcass Composition and Cut Yields of Broiler Chickens. Czech J Anim Sci 51:31-38.
4. Bogosavljević-Bošković S, Mitrović S, Djoković R, Dosković V, Djermanović V (2010). Chemical composition of chicken meat produced in extensive indoor and free-range systems. Afr J Biotechnol 53:9069-9075.
5. Bogosavljević-Bošković S, Pavlovski Z, Petrović M, Dosković V, Rakonjac S (2011). The effect of rearing system and length of fattening period on selected parameters of broiler meat quality. Arch Geflügelk 75:158-163.
6. Cousin MA (2000). Pseudomonas. In : RK Robinson, CA Batt, PD Patel (Eds). Encyclopedia of Food Microbiology, III, Academic Press, San Diego, California, 1864- 1867.
7. Dan SD, Mihaiu M, Rotaru O, Dalea I (2008). Microbiological hazard evaluation represented by the psychrotrophic germs from the level of avian carcasses. Buletin USAMV Veterinary Medicine 65(2):240-245.
8. Dinea M (2008). Creșterea păsărilor; Risoprint, Cluj Napoca, 359-375.
9. Goksoy EO, Kirkan S, Kok F (2004). Microbiological Quality of Broiler Carcasses During Processing in Two Slaughterhouse in Turkey. Poultry Science 83:1427-1432.
10. Holcman A, Vadjnal R, Žlender B, Stibilj V (2003). Chemical composition of chicken meat from free-range and extensive indoor rearing. Arch Geflügelk 67(3):120-124.
11. Kuźniacka J, Adamski M, Czarnecki R, Banaszak M (2014). Results of Rearing Broiler Chickens Under Various Systems, Journal of Agricultural Science 6(4):19-25.
12. Mihaiu M, Rotaru O (2007). Igiena alimentelor și sănătatea publică - Lapte, ouă, miere, procesarea și conservarea alimentelor, Risoprint, Cluj Napoca.
13. Ștețca Gh, Dinea M (2006). Tehnologia prelucrării și valorificării produselor avicole, Risoprint, Cluj Napoca, 77.
14. Thomas CJ, McMeekin TA (1981). Spoilage of Chicken Skin at 2°C: Electron Microscopic Study. Applied and Environmental Microbiology 41(2):492-503.
15. Whyte P, McGill K, Monahan C, Collins JD (2004). The effect of sampling time on the levels of micro-organisms recovered from broiler carcasses in a commercial slaughter plant. Food Microbiology 21:59-65.
16. *** Regulamentul (CE) nr. 2073 (2005). Criteriile microbiologice pentru produsele alimentare.
17. *** SR ISO 4833/2003. Metoda orizontală pentru enumerarea microorganismelor. Tehnica de numărare la 30°C.
18. *** SR ISO 21528-2/2007. Metoda orizontală pentru enumerarea germenilor din familia Enterobacteriaceae.
19. ***SR EN 6579/AC/2006. Metoda orizontală pentru detectarea bacteriilor din genul *Salmonella*.
20. *** SR EN ISO 10272/2/2007. Metoda orizontală pentru izolarea și identificarea *Campylobacter* spp.