

CHEMICAL AND MICROBIOLOGICAL PROPERTIES OF CHICKEN MEAT FROM THE INTENSIVE AND EXISTENT

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ABSTRACT:

With the development of poultry production in the last decade, the need for poultry products with high nutritional value has also increased. The knowledge that chicken meat contains high nutritional value has a great influence on its consumption. Chicken meat production is characterized by large, intensive, commercial production systems with modern technology and import hybrids. In intensive care, the technology of production is strictly defined in order to achieve production-specific results for individual chicken hybrids. Extensive producing of chickens is usually the activity in the yard that is run by the rural households for their own needs.

*Within this research the chemical and microbiological correctness of chicken meat was observed in the intensive and extensive production. The chemical content of water, fat, protein and ash was determined by chemical analysis on white and red meat samples. For the purpose of assessing the microbiological safety, there has been carried out microbiological analysis, in accordance with the requirements of the Microbiological Criteria for Food Regulations. The study included the determination of the presence of *Salmonella* spp., *Listeria monocytogenes*, *Enterobacteriaceae*, *Sulphite Reduction Clostridium*, *Coagulase Positive Staphylococcus*, *Sum of Aerobic Colonies*.*

The quality of meat differs between intense and extensive. The quality of meat is influenced by a number of factors, such as the quality of animal feed, feeding, accommodation, treatment of chickens, slaughter and many other factors.

1. INTRODUCTION

The production of poultry meat or fattening chickens intended for the production of poultry meat in most cases is based on intensive production on large farms or on family households. It means that there are two basic ways in the world of chicken meat production, which are industrial intensive fattening (floor system and battery-cage system) and extensive fattening. More recently, it has been increasingly mentioned, accepted and appearing of free/ecological fattening or more commonly known as the "free range" of chicken fattening. Intensive production (fattening) is in an integrated system of agro-food companies and contract production of individual producers, which is the most common case and agricultural enterprises or only with specialized producers of family agriculture. Intensive (conventional) fattening of chickens, in addition to fast growth and low food consumption per kilogram of increment are accompanied by negative events such as BMV syndrome (pale, soft and watery flesh), residues of various substances in meat (antibiotics, coccidiostats, pesticides) and poor care for welfare of animals [1].

Extensive fattening is still used in villages and in some suburban settlements and take place in two phases. In the first stage the chickens are kept closed for three to four weeks and in the second one they are held in open spaces sometimes in combination with drains. The fattening itself lasts longer than an intense one. Thus grown chickens have generally better organoleptic properties, a significantly higher proportion of linoleic and linolenic acid, and a lower proportion of oleic and palmitic acid. Generally, small flocks are bred with a maximum of one hundred individuals.

In the systematisation of extensive cultivation methods, the EU issued recommendations in 1991 which manufacturers must comply to so that meat from such production could be defined as chicken meat from a non-industrial growing system. Chickens must be fed during the fattening with mixtures containing at least 65 % of cereals. Feeding of animal origin is permitted only in the first weeks of life (after 4 weeks), in limited quantities although the recommendations are that these nutrients are to be completely omitted and replaced by nutrients of plant origin. All stimulating means of growth are forbidden and many preventive therapies also. Coccidiostats are only allowed to a certain age (up to 4 weeks). In the protection of animal health zoo-hygiene is a priority [2, 3]. About 70 % of the total fattened poultry comes from intense producers. Other 30 % production refers to the traditional, extensive way of keeping poultry, mostly for own consumption or, less, for the local market.

Chicken is a nutritious food with relatively low costs Mantilla et al. [4] and many desirable nutritional characteristics such as low lipid content and relatively high concentrations of polyunsaturated fatty acids which consumers consider as a positive and healthy aspect [5]. Chicken meat is a natural source of vitamins, minerals, healthy fats and proteins. It contains the following vitamins B12, B3, B6 and vitamin D as well as the following minerals iron and phosphorus that the human body cannot produce in sufficient quantities. It contains 20 to 24 % of protein of high biological value [6]. Chicken meat obtained by an organic or extensive system is considered more valuable in terms of qualitative compared to the meat grown in an intensive or conventional breeding system [7, 8]. Cholesterol content in meat is very important for consumers because it is considered as one of the risk factors for heart disease in humans [9]. In the research of Janječić [10], the content of cholesterol in 100 g of chicken meat with skin was 75 mg, chicken breast without skin 64 mg and chicken meat 63 mg. However, it is very fast-consuming food and its shelf life is relatively short even when it is in a refrigerator [4].

2. MATERIAL AND METHOD OF WORK

Experimental research was conducted on chicken meat from intensive and extensive fattening. The samples marked as an intensive commercial production system were 6 chickens from retail randomly purchased. Extensive fattening of chickens is usually an activity in the courtyard carried out by rural households, their own breeding of chickens. The chickens were purchased and taken from the agricultural pharmacy "NUCA-MERC" in Coralici, brought home (60 pieces) for 5 days and placed in a box measuring 150 cm × 35 cm, covered with styrofoam to store heat of 32 ° C for seven days. For the first 15 days, they were fed by the starter mixture for small chickens and vitamins were added to the water. From 15 to 25 days, the starter mixture for larger chickens was taken (that is, the larger mixture of starter), 25 to 35 days they were fed with premix, and the other 7 days only with domestic wheat and corn without any additives. From 60 bred chickens, 6 samples for the determination of chemical and microbiological analyzes were taken by the random selection method. A total of 12 samples of chicken meat were analyzed (6 from intensive and 6 from extensive fattening).

Determination of water content in analyzed samples was carried out according to BAS EN ISO 662: 2017 method, determination of fat content by method BAS ISO 1443: 2007 and protein content (BAS ISO 937: 2007). Determination of total cholesterol in fat tissue was performed spectrophotometrically (Huang et al., 1961). Fat extraction was done using the Folch method [11]. Cholesterol produces sulphuric acid in an anhydrous environment of unsaturated hydrocarbons, halohrome blue green. Acetic anhydride extracts cholesterol, precipitates proteins and provides an anhydrous environment. Toxic metals Cd and Pb were determined by the method of atomic absorption spectrophotometry. Analytical Methods FP-3 Analysis of Meat and Meat Products (2000), Perkin Elmer AAnalyst-800

(flame and graphite technique). The instrument measures each standard, i.e. the sample, three times, performs measurement statistics, construct a calibration diagram and calculate the concentration of an unknown sample. Microbiological analysis in the analyzed samples was carried out in the laboratory of Public Institution „Veterinary Institute" BiHac.

3. RESULTS AND DISCUSSION

Chemical analysis of the samples of red and white meat tested determined the content of water, solids, fats, proteins and ash. The results of the research of chemical analyzes were presented in the form of tables in which the mean values and standard deviation of the intensive and extensive fattening of the chickens were given.

Table 1 Chemical analysis of chicken white meat from intensive and extensive fattening

SAMPLES (n=6)	Water content %		Fat content %		Protein content %		Dry matter %		Ash %	
	IF	EF	IF	EF	IF	EF	IF	EF	IF	EF
Sample 1	73.18	74.80	2.89	3.24	21.64	24.82	26.82	25.20	1.04	1.21
Sample 2	73.24	73.60	3.46	2.06	21.89	25.16	26.76	26.40	0.89	1.05
Sample 3	74.63	74.09	3.54	2.94	19.43	23.17	25.37	25.91	0.93	1.06
Sample 4	74.12	74.52	2.81	2.21	23.87	22.26	25.88	25.48	1.16	0.91
Sample 5	75.18	75.64	3.03	1.59	22.16	23.89	24.82	24.36	1.01	0.87
Sample 6	75.36	75.24	2.34	2.18	23.11	24.21	24.64	24.76	1.04	1.13
Mean value	74.28	74.64	3.01	2.37	22.02	23.92	25.71	25.35	1.01	1.04
STDEV	0.939	0.746	0.444	0.607	1.516	1.072	0.940	0.746	0.094	0.129

n = number of samples, IF = intensive fattening, EF = extensive fattening

Table 2 Chemical analysis of chicken red meat from intensive and extensive fattening

SAMPLES (n=6)	Water content %		Fat content %		Protein content %		Dry matter %		Ash %	
	IF	EF	IF	EF	IF	EF	IF	EF	IF	EF
Sample 1	74.86	74.57	3.14	3.59	19.14	22.23	25.14	25.43	0.84	0.65
Sample 2	71.28	73.19	3.10	2.43	17.88	20.73	28.72	26.81	0.96	0.73
Sample 3	75.24	73.11	4.68	2.33	22.15	21.77	24.76	26.89	0.67	0.82
Sample 4	76.09	73.06	4.39	2.36	21.64	22.84	23.91	26.94	0.89	1.05
Sample 5	73.11	75.24	4.16	3.87	21.18	21.19	26.89	24.76	0.56	0.98
Sample 6	74.28	73,26	3.34	3.99	21.76	21.78	25.72	26.74	0.83	0.94
Mean value	74.14	73.74	3.80	3.09	20.63	21.76	25.86	26.26	0.79	0.86
STDEV	1.719	0.930	0.691	0.801	1.714	0.744	1.720	0.931	0.148	0.154

In previous studies Kralik et al. [12] and Galonja [13] it was found that the water content of white meat ranges from 74.06 % to 75.01 %, fats from 0.21 % to 0.75 % protein from 23.33 % to 24.09 % and ash from 1.13 % to 1.24 %. Red meat contained 75.99 to 76.32 % of water, 2.62 to 3.25 % of fat, and 19.93 to 20.03 % of protein and from 1.09 to 1.10 % of ash. These values are approximate to our results. Determination of total cholesterol of red and white chicken was done on a spectrophotometer. White meat shows a lower value of cholesterol content than it was found in red one. Also, chicken meat from extensive breeding shows lower values than intensive one. Samples of white meat of

intensive fattening had higher total cholesterol content and the mean value was 87.21 mg/100 g compared to the sample of the chickens of extensive fattening with a mean value of 61.99 mg/100 g. In samples of red meat of intensive fattening chickens, the total cholesterol content was 103.07 mg/100g, and in the red meat sample 91.12 mg/100g. Duraisamy et al. [14] brought up data of average cholesterol values in the control group and for white meat it was 77.33 mg/100 g and for red one 95, 43 mg/100 g. Honkel and Armeth [15] estimated the value of cholesterol content in breast musculature 43.40 mg/100 g, and in hock and thigh musculature 84.00 mg/100 g. In the study of Janječić [10], the cholesterol content of meat broilers with skin was 75 mg/100 g, white meat without skin 64 mg/100 g and hen meat 63 mg/100 g. The content of cholesterol in turkey meat with skin was 74 mg/100 g, and without skin 60 mg/100 g.

Determination of toxic cadmium metal (Cd) and lead (Pb) was done on six samples and average values of cadmium (Cd) in red meat of chickens of intensive fattening was 0.010 mg/kg, and in the red meat sample 0,007 mg/kg. In the sample of white meat of intense fattening, the value of cadmium (Cd) was 0.006 mg/kg, and in the extensive fattening sample of 0.003 mg/kg. The content of lead (Pb) in red meat of intensive fattening chickens was 0.008 mg/kg, and in the extensive fattening sample was 0.004 mg/kg. In the samples of white meat of intensive fattening, the content of lead (Pb) was 0.008 mg/kg, and in the sample of chickens with an extensive fattening was 0.006 mg/kg. According to Mariam, et al. [16] the chicken meat contains cadmium (Cd) 0.31 mg/kg and lead (Pb) 3.15 mg/kg. Dogan, et al. [17] emphasize the values of trace metal content in meat taken from stomach parts, ranging from 0.25 to 6.09 µg/kg cadmium (Cd) and 0.01 to 0.40, mg/kg lead (Pb). The same authors state that the values of lead (Pb) in chicken meat were more than they were recommended as legal for human consumption. According to the Rulebook on maximum permitted quantities for certain contaminants in food "Official Gazette of B&H", Ser. 68/14 [18], the allowed lead value (Pb) for meat is 0.10 mg/kg and cadmium (Cd) 0.050 mg/kg. The results of the microbiological analysis performed on chicken meat samples are shown in Table 3. The analyzes were done on six samples per fattening. Our results for extensive fattening samples are in accordance with the Rulebook "Official Gazette of B&H", Ser.13/94 [19], according to which the tested samples must not contain the examined microorganisms in determined quantities according to the Rulebook. For samples of intensive bulk purchased in retail, one sample was positive for *Salmonella* spp. n the examined samples of chicken meat of the intense fattening the values of Enterobacteriaceae and the collection of aerobic colonies were larger than at the extensive fattening, which is to be expected because the samples were purchased in retail.

Table 3 Results of the microbiological analysis of chicken meat from intensive and extensive fattening

ANALYSIS PARAMETERS (n= 6)	Quantity of sample	MDK	Analysis results	
			intensive	extensive
<i>Salmonella</i> spp. BAS EN ISO 6579-1: 2018	In 25 g	n.n.	One positive sample	n.n.
<i>Listeria monocytogenes</i> BAS EN ISO 11290-1: 2018	In 25 g	n.n.	n.n.	n.n.
<i>Enterobacteriaceae</i> BAS EN ISO 21528-2: 2018	cfu/g	m=10 0	<20	<10
<i>Sulphate-reducing clostridie</i> BAS ISO 15213: 2008	cfu/g	m=10	<10	<10
COAGULATE OF POSITIVE <i>Staphylococcae</i>	cfu/g	M=10	<10	<10

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BAS EN ISO 6888-1:2005; BAS EN ISO 6888-1/A1:2005				
SUM OF AEROBIC COLONIES BAS EN ISO 4833-1: 2014	cfu/g	M=10 000	<30	<10

cfu – colony forming units, MDK - maximum permissible concentration, n – number of elementary units that make up the sample, m – limit value - results are considered as satisfactory if all values obtained are less than or equal to values “m”, M – the maximum permissible value over which the results are considered as unsatisfactory, n.n. – the absence of microorganisms in the sample, n – number of samples per fattening.

Missohou, [20] conducted research on poultry meat collected from poultry farms near Mbeubeuss landfill site in Niayes (Senegal). The results of the microbiological analysis of the samples were not satisfactory. *E. coli* was 3%, about 1% of staphylococci and 7% of *Salmonella* spp. It was about the quality of meat whose samples were analyzed from poultry located on a farm near the landfill site. Also, the chickens were added drinking water that was not satisfactory to microbiological quality.

In their researches Hadžiosmanović et al. [21], they examined 66 chicken breast samples: *Salmonella* spp., *Listeria monocytogenes*, *S. aureus*, Enterobacteriaceae, sulphite-induced clostridia and total number of bacteria. In terms of microbiological quality and the findings of microorganisms in the samples of fresh meat of chickens, the presence of *Salmonella* spp was significant. about 10.60 %, *S. aureus* 30.30%, *Listeria monocytogenes* 3.03 %, and Enterobacteriaceae 34.84 %.

In the research Sencic et al. [1] chicken meat from organic farming compared to that from conventional fattening had a very significant ($p < 0.01$) higher protein content and very significant ($p < 0.01$) lower content of water, fats and ashes. Kim et al. [22], however, did not find significant differences with respect to the content of water, protein and fat, but they found significantly ($p < 0.05$) more ash in the breast muscle of chickens from organic farming.

4. CONCLUSION

Poultry production has undergone great progress over the past 20 years, and hence increased consumption of chicken meat. Poultry meat takes a special place in food consumption. Several factors have a significant influence on the quality of chicken meat: the way of breeding, the type of food, the temperature of the environment, the transport of animals, the ways of stunning before slaughter, the process with the carcasses during and after slaughter, storage conditions.

Our research indicates a better quality of chicken meat from extensive fattening. According to our research, higher fat and cholesterol content was found in samples of intensive fattening chickens compared to extensive fattening. The protein content was higher in samples of extensive fat.

Our results for extensive fattening samples are in accordance with the Rulebook (“Official Gazette of RB&H“ Ser.13/94), according to which the tested samples must not contain the examined microorganisms in certain quantities according to the Rulebook. For samples of intensive bulk purchased in retail, one sample was positive for *Salmonella* spp. In the samples of chicken meat of intense fattening value of Enterobacteriaceae and the collection of aerobic colonies were larger than extensive fattening, which is to be expected because the samples were purchased in retail and the manner of storage and transportation could have been affected by the presence of these bacteria.

5. LITERATURE

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