THE INFLUENCE OF GARLIC POWDER AND INORGANIC COPPER IN CHICKEN FEED ON BREAST MEAT QUALITY

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Abstract — In this study the nutritive, and technological quality of chicken breast meat were analysed. Hubbard broiler chickens were used for investigations (n=200). There were four groups of samples, control group (C) chickens fed with standard mixture, experimental group I chickens fed with supplemented 2% of garlic powder in standard feed mixture, experimental group II chickens fed diet with 2% of garlic powder and 100 ppm of inorganic copper, and experimental group III chickens fed diet with 100 ppm inorganic copper. Fattening lasted 42 days. In the breast meat of the experimental group I significantly ($P < 0.05$) higher protein content and lower ($P < 0.05$) fat content, comparing to control (C), was determined. Cholesterol levels in breast meat of the experimental group I (46.1 mg/100g) and II (40.9 mg/100g) were significantly lower ($P < 0.05$) comparing to the control (60.1 mg/100g) group. The average technological quality of breast meat of all groups according to pH_k as the parameter and criteria for determining the quality of breast meat corresponds to PSE. The average technological quality of breast meat of control and experimental group I and II according to $colour_u$ (L^*) as the parameter and criteria for determining the quality of breast meat corresponds to "normal quality".

Key Words – breast meat quality, broiler diet, garlic, copper

I. INTRODUCTION

Meat quality depends on complex property of meat, influenced by multiple interacting factors including the conditions under which the meat is produced. Considering the already extensive knowledge of feed and meat quality, feeding seems to be the optimal tool in achievement of desired meat qualities [1].

Beside nutrients necessary for chickens growth and development, feed very often contains some medications used therapeutically in animal feed to improve the health and well-being of animals and to improve the production results in poultry industries [2]. In recent years, as alternatives for these synthetic growth promoters in animal feed, probiotics, prebiotics, organic acids and herbs, as well as essential oils have been investigated [3].

Garlic (*Allium sativum*) has been used as spice and folk medicine since antiquity, mostly because of its antibacterial, antifungal and antioxidant activities. Bioactive components of garlic, including several sulphur-containing compounds such as alliin, diallylsulfides and allicin, may partly account for some of these effects of garlic [3]. These components provide a characteristic flavor and well-known aroma, and also have hypocholesterolemic effect. Yeh and Liu [4] and Chowdhury [5] reported that components of garlic inhibit cholesterol and fatty acids synthesis in the liver, thus affecting the lower fat content in meat.

Copper as a biogenic element is essential for normal growth and development of chicken in required doses of about 4 ppm for chicks aged 0-8 weeks. The concentration of copper in certain feed is relatively high (10-20 ppm), and all the feeds that are used satisfy the physiological requirements of chicks for these micronutrients. High doses of copper (100 and 200 ppm) in broiler feed have growth promoting and bactericidal effect, similar to antibiotics [6] and, also it lowers fat and cholesterol content [7].

Because of its composition and properties of the basic ingredients poultry meat is defined as dietary. Its specificity is arising from richness in physiologically important components, their easy digestibility and a low energy value [8].

Chicken meat is low in fat and cholesterol and is usually considered healthier than other animal

protein sources, especially than red meats of mammalian origin [9].

The objective of this study was to determine the effects of garlic powder and inorganic copper supplementation in standard chicken feed on nutritive and technological quality of breast meat.

II. MATERIALS AND METHODS

The experiment was carried on 200 chickens, hybrid Hubbard. Chickens were divided in four groups control group (C) and experimental groups (I, II, III) and fed under the same conditions in the period of 42 days. Feed composition was the same for all four groups, based on corn, soya and sunflower, except added premixes. Experimental treatments were the following: (I) feed containing 2% garlic powder; (II) feed containing 2% garlic powder and 100 ppm inorganic Cu from $CuSO_4$; (III) feed containing 100 ppm inorganic Cu from $CuSO_4$. Feed and water supply was *ad libitum* applying floor stocking system**.** After growing and 12 h starving period, 50 chickens from each group were slaughtered and chilled by standard technological procedure. Breast meat was taken from each bird for the determination of nutritive and technological quality. Basic chemical composition of meat was estimated by determination of moisture [10], protein [11], free fat [12] and total ash [13] contents. Content of connective tissue was determined by multiplying hydroxyproline content by the factor 8 [14].

The cholesterol content of breast meat was determinate by High Performance Liquid Chromatography. Total cholesterol was extracted from lyophilized meat (dry matter), after saponification with saturated methanolic KOH, according to the procedure of Indyk [15] and extracted with hexan and isopropanol. Cholesterol was separated and quantified by an HPLC system (HP 1090-Hewlett-Packard, USA). Cholesterol determination was done by the following conditions: column Hypersil ODS, 5 μm; flow: 0.2 ml/min; Mobile phase: Metanol; diode array detector: 212/4 nm.

Technological quality was evaluated by determinations of pH_u, and $colour_u$. pH_u value was determined by portable pH meter ULTRA, type UX 390, with reinforced Ingold combined electrode for direct determination of pH in meat. Breast meat colour was determined on the fresh cross section 24 hour p.m. using Minolta Chroma Meter CR-400, and colour characteristics were presented in u CIE *L*a*b** system (lightness *L**, redness and greenness - *a**, yellowness and blueness - *b**).

All data are presented as mean values. Analysis of variance (Duncan test) was used to test the hypothesis about differences among obtained results. The software package STATISTICA 8.0 [16] was used for analysis.

III. RESULTS AND DISCUSSION

Results of proximate composition of breast meat (Table 1) showed that the moisture content in group II (73.79%) was significantly ($P < 0.05$) lower compared to group I (74.46%). From the data in the same table it can be seen that the protein content of 22.86% in group I was significantly ($P < 0.05$) higher than the protein content in the control group C (21.63%).

Table 1 Nutritive and technological characteristics of chicken breast meat of control and experimental groups

Characteristic	Group			
	C	I	II	III
Moisture content (%)	74.41^{ab}	74.46^{a}	73.79^{b}	73.86^{ab}
Protein (%)	21.63^{b}	22.86^{a}	22.01^{ab}	21.82^{ab}
Free fat (%)	3.41^{a}	1.52^{c}	3.02^{ab}	2.61^{abc}
Total ash (%)	1.15	1.15	1.17	1.16
Connective tissue protein (%)	0.35^{a}	0.33^{ab}	0.32^{b}	0.32^{b}
Cholesterol (mg/100g)	60.1^{a}	46.1^{bc}	40.9^{c}	52.3^{ab}
pH ^{ns}	5.59	5.61	5.62	5.56
L^{*} ^{ns}	52.61	51.79	52.01	53.02

$^{a.\,b}$ different letters in the row $P < 0.05$
^{ns} difference not significant $P > 0.05$

The total ash content in breast meat within groups was in the range from 1.15% to 1.17%. Content of free fat in the breast meat was the

lowest (1.52%) in group I and significantly lower ($P < 0.05$) comparing to control group (highest content of free fat 3.41%) and group II (3.02%). The free fat content in II and III groups was lower ($P > 0.05$) compared with control group.

Kim et al [17]. reported that garlic added in feed increased the protein and reduced fat content in drumstick meat, and also, it reduced cholesterol levels and significantly ($P < 0.05$) increase unsaturated fatty acids content in drumstick meat compared to the control group. The amount of fat is different in different anatomical parts of broiler chickens, and is the smallest (2.8 g/100g) in breast meat.

It is significant that the chicken meat has a lower total fat content and higher content of mono-and polyunsaturated fatty acids than other meat [18]. The content of connective tissue protein in the breast meat of groups II and III was 0.32%, and significantly ($P < 0.05$) was lower than in the control group (0.35%).

The results confirm the well-known view that chicken meat contains more protein, the least connective tissue protein comparing to other types of meat (beef and pork) and less fat (1-5%), so that can be considered as dietetic food [9,18,19].The same table shows that the highest cholesterol content (60.1 mg/100 g) was found for the breast meat of the control group and it was significantly ($P < 0.05$) higher than the content of 46.1 mg/100 g for group I, and 40.9 mg/100 g for group II.

Cholesterol content of group III was 52.3 mg/100 g and was lower than in control group, but the difference was not significant ($P > 0.05$). Results of the present study are in agreement with results of other authors, [20] Songsang et al. [21] indicating that increased amounts of garlic in broilers feed from 0.7% to 1.3%, decrease the cholesterol content of breast meat from 46.83 mg/100g to 40.24 mg/100g. Added inorganic copper (200 mg/kg) in broilers feed has stimulating effect and lowers cholesterol content in plasma by 12% and in meat by 20-25% [22].

Results of technological properties of breast meat (Table 1) revealed that the muscles of group I had the highest average pH_u 5.61, while the muscles of the group III had the lowest average pH_u 5.56. The differences in the pH_u values among groups were not significant ($P > 0.05$). Average pH_u of muscles of all analysed groups indicated altered meat quality. According to pH_u values as parameters and criteria for determining the meat quality, PSE (pale, soft, exudative) quality is when $pH_u < 5.8$, and "normal" quality is if $pH_u > 5.8$ [23]. Averagely the lightest muscles were for experimental group III with the lightness (L^*) of 53.02, while the darkest were muscles of the experimental group I (51.79). The differences in lightness of the analysed breast muscles were not significant ($P > 0.05$). According to lightness L^* as a parameter and the criteria by which the PSE quality is (+): $L^* > 52$ and (-): $L^* < 49$, [24] chicken breast meat of control and III group, was on average PSE quality, while chicken breast meat of groups I and II was "normal" quality.

IV. CONCLUSION

The results obtained in this investigation showed that the addition of garlic powder and inorganic copper in broilers diet affected the quality of meat. In the breast meat of the group I (2% garlic powder) significantly ($P < 0.05$) higher protein content (22.86%) and lower ($P < 0.05$) fat content (1.52%), comparing to control group (21.63%; 3.41%), was determined. The relative content of connective tissue protein in the breast meat of II and III group were significantly lower ($P < 0.05$) than in the control group C. Cholesterol level in breast meat of the experimental group III (100 ppm inorganic Cu) was numerically lower ($P > 0.05$), while cholesterol levels in groups I (2% garlic powder) and II (2% garlic powder and 100 ppm inorganic Cu) were significantly lower ($P < 0.05$) comparing to the control group.

The average technological quality of breast meat of experimental group I, II and C according to $colour_u$ *(L*)* as the parameter and criteria for determining the quality of breast meat

corresponds to "normal quality". Breast meat of experimental group III corresponds, on average, to a slightly lower quality.

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