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THE EFFECTS OF MINERAL ADSORBENTS ADDED TO BROILERS DIET ON BREAST MEAT QUALITY

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The aim of these investigations was to determine the influence of mineral adsorbents "Minazel" and "Minazel Plus" added into broiler diet, on the carcass quality and nutritional, technological and sensory properties of breast meat.

The examination was done on Cobb 500 provenience divided into 4 groups: control group C (fed without addition of mineral adsorbent), experimental group E I (0.5% of Minazel), experimental group E II (0.2% of Minazel Plus), experimental group E III (0.3% of Minazel Plus).

The results showed that the broilers fed with the addition of mineral adsorbents, had a higher ($P < 0.01$) mass of chilled carcass "ready to grill" and breast mass, than the broilers of the control group.

Based on the parameters and criteria for defining the quality of chicken breast meat (pH_u and L^) it can be concluded that meat of all groups had in average "normal" quality. According to the results of sensory analyzed roasted breast meat, meat of experimental groups had preferable smell and tenderness.*

KEY WORDS: broilers, mineral adsorbents, meat quality

INTRODUCTION

Modern poultry production is the fastest method to obtain quality products of animal origin for human consumption. Optimal and healthy feed is essential for reaching full genetic potential and improving health and productivity of broilers. The use of new technologies in biotechnology is the solution for a bigger production of foods and feeds. Basic orientations for that are new technological procedures that are aimed at improving the nutritive value of foods and feeds, as well as the valorization of primary agricultural production (1).

Performances of broilers during fattening, slaughter characteristics, and meat quality are governed by the pre-mortal and post-mortal factors. It is considered that the diet, as a

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pre-mortal factor, has a dominant impact (more than 30%) on the quality of carcasses and meat (2,3).

One of the most important goals of broiler diet is to obtain the biggest live weight in the shortest period, with a high proportion of muscles (especially the most valuable: breast and drumstick) and minimum proportion of bones in the carcass, as well as good productive performances such as low feed conversion ratio. Also, the quality of the carcass and meat can be assessed by a large number of criteria for evaluation of sensory, morphological, physical, chemical, health, and technological properties (4).

The presence of mycotoxins in feed mixtures is a worldwide problem. Their alimentary ingestion can cause intoxications of many animals in one herd (5). Besides, mycotoxin residues in the animal products can cause intoxications in humans (6).

There are various methods of feed decontamination. The use of mineral adsorbents, as an inactivator of mycotoxins, has been mentioned more frequently in recent times. Mycotoxin adsorbents of mineral origin, based on natural zeolites with a high content of clinoptilite can be effective agents for the absorption of most of the toxic matter in feed (7, 8, 9).

The addition of zeolites to poultry feed contaminated with different mycotoxins can effectively reduce and prevent pathomorphological changes of target tissues. Also, there is a significant reduction of residues in edible tissues of meat and eggs. Furthermore, the application of zeolites in the poultry feed has certain positive effects on the production results, diminishing mortality, ensuring good health conditions, and improving the quality of meat and eggs (10, 11).

The aim of this research was to compare the influence of different types and levels of mineral adsorbents added into the broilers diet on the carcass and nutritional, technological and sensory quality of breast meat.

EXPERIMENTAL

Cobb 500 hybrids of both sexes were used for the investigations. Broilers (n=400) were divided in four groups, control (C) and experimental (EI, EII and EIII) and fed under the same conditions in the period of 42 days. The feed composition was the same for all four groups, based on corn, soya and wheat, except for the addition of mineral adsorbents. Experimental treatments were as follows: EI feed contained 0.5% Min-a-Zel; EII feed contained 0.2% Min-a-Zel plus; EIII feed contained 0.3% Min-a-Zel plus. Feed and water supply was *ad libitum*, applying floor stocking system.

Min-a-Zel is a product obtained from natural zeolite (clinoptilites), with good balance of calcium, sodium and potassium. Min-a-Zel plus is obtained by modification of zeolites using the organic cations (7). Both products are manufactured in the Institute for Technology of Nuclear and Other Mineral Raw Materials in Belgrade.

After growing and 12 h of starving period, 8 broilers from each group were slaughtered by standard technological procedure and chilled as carcass "ready to grill" (12). Cutting and deboning of breast was applied in order to determine the nutritive, technological and sensory quality of meat. Basic chemical composition of breast meat was estimated by the determination of moisture (13), protein (14), free fat (15), and total ash (16) contents. The technological quality was evaluated by the determinations of pH_u, and colour_u. The

pH_u value was determined using a portable pH meter ULTRA, type UX 390, with reinforced Ingold combined electrode for direct measurement. Breast meat colour was determined on the fresh cross-section 24 hour p.m. using Minolta Chroma Meter CR-400, and the colour characteristics were presented in CIE *L*a*b** system (lightness *L**, redness *a**, yellowness *b**) (17). The samples (breast meat) were roasted in a convection air oven at 175°C for 45 min, cooled to room temperature for 1 h and then analyzed for sensory characteristics. The cooking loss was evaluated by comparing the weight before and after roasting of breast meat. Five trained panellists, experienced in the sensory evaluation of various meat products were employed. Sensory evaluation (smell, taste, tenderness and juiciness) was carried out according to the point system of analytical descriptive test using a scale from 1 to 7 (1-unacceptable, 7-optimal).

The statistical parameters calculated for the obtained data were: means (*X*) and standard deviation (Sd). Analysis of variance (Duncan test) was used to test the hypothesis about differences among the obtained results. The software package STATISTICA 8.0 (18) was used for the analysis.

RESULTS AND DISCUSSION

Mean values of chilled carcass mass, main parts – breast and breast meat of control and experimental groups of broilers are presented in Table 1.

Table 1. Mass of chilled “ready to grill” carcass, main parts – breast and breast meat of control and experimental groups

Group	Chilled carcass mass (g)	Breast mass (g)	Breast meat mass (g)
C	1180 ^{ab} ±56	391.4 ^{bA} ±31.7	274.0 ^{aA} ±27.5
E I	1484 ^{dc} ±47	470.3 ^{ab} ±46.3	329.8 ^{bb} ±48.0
E II	1286 ^{bA} ±37	438.4 ^{aA,B} ±23.2	289.2 ^{aAB} ±26.6
E III	1352 ^{cA} ±50	439.5 ^{aAB} ±39.9	301.6 ^{abAB} ±28.9

^{A,B,C} – means within the column with different superscripts differ ($p < 0.01$)

^{a,b,c,d} – means within the column with different superscripts differ ($p < 0.05$)

The significantly ($P < 0.01$) higher mass of chilled “ready to grill” carcass was in experimental groups (fed with added mineral adsorbents) than in the control group.

In accordance with the literature data about fattening performances of broilers, it is evident that the broilers from the EI group achieved very good results for this provenience Cobb (19). It should be noted that the broilers that were fed a diet with the addition of natural zeolite, clinoptilites (Min-a-Zel 0.5%) had higher breast and breast meat mass than the broilers from the control group (20) and statistical differences were observed between the mean values ($P < 0.01$).

The results of basic chemical composition of breast meat of control and experimental groups are shown in Table 2.

Table 2. Basic chemical composition of breast meat of control and experimental groups

Group	Moisture (%)	Protein (%) ^{ns}	Free fat (%)	Total ash (%) ^{ns}
C	73.73 ^{aA} ±0.23	22.61±0.45	2.10 ^{cC} ±0.02	1.23±0.02
E I	74.36 ^{bB} ±0.12	22.42 ±0.76	1.91 ^{bB} ±0.06	1.21 ±0.02
E II	73.83 ^{aAB} ±0.83	22.10 ±0.64	2.79 ^{aA} ±0.11	1.20 ±0.09
E III	74.04 ^{abAB} ±0.24	22.02 ±0.56	2.72 ^{aA} ±0.08	1.19 ±0.07

^{A,B,C} – means within the column with different superscripts differ (p<0.01)

^{a,b,c} – means within the column with different superscripts differ (p<0.05)

^{ns} – not statistically significant (p>0.05)

The moisture content for group C (73.73%) was significantly lower (P<0.01) compared to the group EI (74.36%). Moreover, it can be seen that the protein content (22.61%) was not significantly higher (P>0.05) in breast meat of the control group comparing to the experimental groups (22.02-22.42%). The content of free fat in the breast meat was the lowest (1.91%) in the group EI, and significantly lower (P<0.01) comparing to the control group C (2.10%), group EII (2.79%) and group EIII (2.72%). The free fat content in EII and EIII groups was significantly higher (P < 0.05) compared to the control group. The total ash content in breast meat among groups was in the range from 1.19% to 1.23%, and the difference of the values was not statistically significant (P>0.05).

The breast meat of broilers fed with the addition of “Mina-a-zel” had a lower fat (P<0.01) content compared to the control group. The results are consistent with those obtained by Ristić et al. (3), Radović et al. (21), and Jakanović et al. (22), who reported that chicken meat contains more protein (22-23%) than other types of meat and less fat (1-5%), so it can be considered as a dietetic food.

Table 3 lists the pH values and colour characteristics ($L^*a^*b^*$) of breast meat from the control and experimental groups of broilers.

Table 3. pH values and colour characteristics ($L^*a^*b^*$) of breast meat of the control and experimental groups

Group	pH	L^* ^{ns}	a^* ^{ns}	b^* ^{ns}
C	5.86 ^b ±0.06	56.82 ±1.33	5.17±1.36	13.25 ±1.48
E-I	5.78 ^{ab} ±0.09	56.20 ±2.47	5.55±1.60	14.39 ±2.50
E-II	5.76 ^a ±0.05	55.02 ±1.54	5.61 ±2.02	13.40 ±2.29
E-III	5.83 ^b ±0.07	54.86±2.08	5.25 ±1.28	13.35 ±2.02

^{a,b} – means within the column with different superscripts differ (p<0.05)

^{ns} – not statistically significant (p>0.05)

The determination of technological properties of breast meat (Table 3) showed that the pH_u value measured for the experimental groups was between 5.76-5.83, and for the control group it was 5.86. Based on the pH_u value as a quality parameter and taking the quality criterion 5.7 < pH_u < 6.1 (2, 3), the breast meat of all groups was of "normal" quality.

From the results shown in Table 3 it can be seen that the colour of breast meat of control group was lighter ($L^* = 56.82$) compared to the colour of experimental groups ($L^* = 54.86-56.20$), but this difference was not significant ($P > 0.05$).

Based on the lightness parameter (L^*) and criteria for PSE chicken meat quality ($L^* > 57$) (23, 24), normal quality of meat was assessed in both control and experimental groups. Furthermore, the redness value (a^*) was lower in broiler breast meat of the control group (5.17) than in the experimental groups (5.25-5.61). At the same time, the broilers fed with the addition of mineral adsorbents had a higher yellowness value (b^*) than the breast meat of the control group. However, these differences are not statistically significant ($P > 0.05$).

The results of the sensory evaluation and cooking loss of roasted breast meat samples of the control and three experimental groups are presented in Table 4.

The cooking loss of roasted breast meat of the control group (29.76%) was higher than that observed for the broilers fed with the addition of mineral adsorbents (25.65%-28.30%). The biggest cooking loss, which was statistically significant ($P < 0.01$), was recorded for the group C (29.76%), while that observed for the group EIII, was the lowest (25.65%). The cooking loss of roasted breast for group EI was statistically higher ($P < 0.05$) than that for the group EIII.

Table 4. Cooking loss and sensory evaluation of breast meat of the control and experimental groups

Group	Cooking loss (%)	Odour ^{ns}	Taste	Juiciness	Tenderness
C	29.76 ^{ab} ± 2.38	6.40 ± 0.00	6.40 ^{cb} ± 0.00	6.10 ^{ab} ± 0.35	6.38 ^a ± 0.44
E I	28.30 ^{aAB} ± 3.80	6.55 ± 0.19	5.65 ^{bA} ± 0.17	6.10 ^{ab} ± 0.00	6.80 ^b ± 0.20
E II	27.86 ^{abAB} ± 1.59	6.50 ± 0.00	5.45 ^{aA} ± 0.25	5.80 ^a ± 0.19	6.48 ^{ab} ± 0.26
E III	25.65 ^{bA} ± 1.40	6.60 ± 0.00	5.50 ^{abA} ± 0.00	6.18 ^b ± 0.24	6.55 ^{ab} ± 0.19

^{A,B} – means within the column with different superscripts differ ($p < 0.01$)

^{a,b,c} – means within the column with different superscripts differ ($p < 0.05$)

^{ns} – not statistically significant ($p > 0.05$)

The odour of roasted breast meat of the control and experimental groups (EI, EII and EIII) was in average evaluated as “excellent” (6.40-6.60) (Table 4). On the other hand, the taste of breast meat of the experimental groups was averagely evaluated as “very good” (5.45-5.65), and the samples of breast meat of the control group had significantly ($P < 0.01$) better marks for this attribute (6.40). The most important sensory properties for meat quality are juiciness and tenderness. These two attributes are closely related: for more tender meat, juices are released more quickly by chewing, and the juicy sensation of the meat is greater. The juiciness of breast meat of the groups C, EI and EIII was marked “excellent” (6.10-6.18), comparing to the juiciness of breast meat of the group EII (5.80), with no statistically significant differences between obtained values ($P > 0.01$). However, the values for the group EIII were statistically ($P < 0.05$) higher than for EII. The tenderness of breast meat of the experimental group EI was evaluated as optimal (6.80) and significantly better ($P < 0.05$) than the tenderness (6.38) of breast meat of the control group.

CONCLUSION

Mineral adsorbents can be successfully used as additives in the diet for broilers in the aim of improving the quality of the carcass and meat.

The diet with mineral adsorbents resulted in an increased weight of chilled carcass, breast and breast meat.

The results of basic chemical composition confirm that broiler breast meat contains more protein (22.02-22.61%) than other types of meat and less fat (1.91 - 2.79%), so it can be considered as a dietetic food.

Additionally, it was found that the technological quality of breast meat of the control and experimental groups, according to the parameters and criteria for quality estimation (pH_u , L^*) correspond in average to „normal“ meat quality. The cooking loss of roasted breast meat of the experimental groups was lower compared to that of the control group. According to the results of sensory analyses, the odour and tenderness of roasted breast meat of the experimental groups were better than the odour and tenderness of the control group.

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УТИЦАЈ МИНЕРАЛНИХ АДСОРБЕНТАТА ДОДАТИХ У ХРАНУ ЗА БРОЈЛЕРЕ НА КВАЛИТЕТ МЕСА ГРУДИ

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Циљ овог рада је да се испита да ли су минерални адсорбенти, “Миназел” и “Миназел Плус”, додати у храну за тов бројлера, имали утицај на квалитет меса груди бројлера. Испитивања су обављена на 400 бројлера хибридне линије Cobb 500, подељених у 4 групе: контролна група К (храна без додатог минералног адсорбента), експериментална група Е I (0,5% Миназела), експериментална група Е II (0,2% Миназела Плус) и експериментална група Е III (0,3% Миназела Плус).

Резултати испитивања показују да бројлери храњени храном са додатком минералних адсорбената имају статистички значајно ($P < 0,01$) већу масу најквалитетнијег дела трупа бројлера, груди, као и већи удео меса у грудима у односу на контролну групу.

На основу параметара и критеријума за дефинисање квалитета меса груди бројлера (pH_k и боја L^*) може се закључити да је месо свих група просечно “нормалног” квалитета. Резултати сензорне анализе указују да је топлотно обрађено месо груди експерименталних група оптималног мириса и мекоће.

Резултати добијени у овом раду указују да се употребом адсорбената микотоксина у исхрани бројлера остварује вишеструки бенефит у производњи пилећег меса.

Кључне речи: минерални адсорбенти, бројлери, квалитет меса

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