

STUDIES ON THE MEAT COMPOSITION IN CHICKENS INVADED WITH *EIMERIA TENELLA*

V. KOINARSKI AND A. PAVLOV

Faculty of Veterinary Medicine, Trakia University, Stara Zagora

Summary

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The studies were performed on forty, 3 weeks-old broiler chickens, divided into 2 groups. The chickens from the first group were infested with *Eimeria tenella* oocysts whereas the second group was left untreated (controls).

It was found out that in the meat of invaded chickens (breast and thigh muscle), a statistically significant increase in moisture content, decrease in fat content, higher manganese and lower iron content occurred. Therefore, the results of the studies showed that coccidiosis had an impact on the general as well as on the mineral composition of meat.

Key words: chickens, *Eimeria tenella*, meat composition

INTRODUCTION

Eimeriosis in chickens, etiologically related to *Eimeria tenella* is one of the commonest parasitic diseases in this avian species (Pellerdi, 1974; Fitzgerald, 1980). *E. tenella* is the most pathogenic coccidial species in our country (Koinarski et al., 1997). The death rate in infested birds could amount to 60-80% (Witlock et al., 1981; Chapman, 1984).

There are a number of reports evidencing the influence of *E. tenella* upon the body weight and blood biochemistry (Ruff et al., 1974; Muzurkiewicz and Staszemask, 1981; Angelov and Koinarski, 1997). The data related to the composition of meat obtained from invaded chickens are however contradictory (Stoll and Enigk, 1970; Ruff et al., 1981).

The aim of the present study was to follow out the influence of experimental *E. tenella* invasion on breast and thigh meat composition in broiler chickens.

MATERIALS AND METHODS

The studies were performed on 40 chickens at the age of 3 weeks. The birds were with equal body weight and divided into 2 groups of 20 chickens each. They were housed under conditions excluding a secondary *E. tenella* invasion. Both groups were fed a diet free of antibiotics or coccidiostatics.

The chickens from group I were experimentally invaded *per os* by $8 \cdot 10^4$ *E. tenella* oocysts. The second group was left untreated (controls).

Ten days after the invasion, all chickens were slaughtered by exsanguination according to the slaughtering technology for poultry. The carcasses were defeathered, eviscerated and the meat – chilled in a refrigerator at 5 °C.

Up to hour 24 after the slaughtering, the breasts and the thighs were separated.

After removal of skin and bones, the meat was minced, put into flasks and stored at – 18 °C until the analysis. The mineral composition was studied on a composite sample obtained by mixing breast and thigh musculature.

The following parameters were determined: moisture content – by drying at 105 °C to constant weight (BSS 5712-74, 1974); protein content – by the method of Kjeldahl (BSS 9374-82, 1982); fat content – by the method of Soxhlet (BSS 8549-74, 1974); ash content – by burning in an oven at 800 °C (BSS 9373-72, 1972), the mineral content – after dissolving the ash in hydrochloric acid and measuring with an atomic absorption spectrophotometer (Ibrishimov and Lalov, 1984).

Data were statistically analyzed by one way analysis of variance (ANOVA).

RESULTS AND DISCUSSION

The results of breast musculature analysis in healthy and invaded chickens are presented in Table 1. The moisture content was 75.81 g% in group I while in group II – 77.73 g%. The protein content was 18.43 g% and 17.63 g%, that of fat – 4.19 g% and 3.83 g%; the ash content – 1.43 g% and 1.33 g%, respectively. Significant differences ($p < 0.05$) between both groups were observed for moisture and fat content.

Similar results were obtained in the analysis of thigh meat (Table 2). The specimens from invaded birds showed higher moisture and lower fat and ash content and no significant change in the protein content.

Table 3 shows the results of the analysis of the mineral content of combined samples. The amounts of calcium, potassium and iron in the meat of infested birds were lower while those of phosphorus, manganese, sodium, zinc and magnesium – elevated. Statistically significant differences were observed only in manganese (increase by 0.75 ppm) in group I and the iron content (decrease by about 10%) in group I.

The increased moisture content in muscle cells and the accompanying increase in sodium levels in high degree of invasion (8.10^4 oocysts) was probably due to impaired function of K-Na ATPase. In this connection, the increased serum magnesium concentrations, observed in previous studies of ours must be emphasized (Angelov and Koinarski, 1997). It is known that magnesium cations could alter the conformation of the forementioned enzyme (Sirakova, 1998). Our results differ from those of Ruff et al. (1981) that reported no significant increase in the moisture content in chickens with coccidiosis.

Table 1. General composition of breast meat from healthy and *E. tenella* invaded chickens, g% (mean $\pm$ SEM)

Parameter	Controls (n=8)	Invaded (n=8)
Moisture	75.81 $\pm$ 0.75	77.73 $\pm$ 0.58*
Protein	18.46 $\pm$ 0.50	17.63 $\pm$ 0.34
Fat	4.19 $\pm$ 0.66	3.83 $\pm$ 0.32*
Ash	1.43 $\pm$ 0.10	1.33 $\pm$ 0.09

* $p < 0.05$ vs controls.

Table 2. General composition of thigh meat from healthy and *E. tenella* invaded chickens, g% (mean $\pm$ SEM)

Parameter	Controls (n=8)	Invaded (n=8)
Moisture	78.30 $\pm$ 0.99	80.66 $\pm$ 0.58*
Protein	17.07 $\pm$ 0.33	17.17 $\pm$ 0.64
Fat	4.21 $\pm$ 0.52	3.10 $\pm$ 0.46*
Ash	1.21 $\pm$ 0.10	1.03 $\pm$ 0.09

* p<0.05 vs controls.

Table 3. Mineral composition of meat from healthy and *E. tenella* invaded chickens, ppm (mean $\pm$ SEM)

Parameter	Controls (n=8)	Invaded (n=8)
Calcium	820 $\pm$ 9.08	804 $\pm$ 55.7
Phosphorus	7985 $\pm$ 217	8336 $\pm$ 190
Magnesium	986 $\pm$ 16.5	1055 $\pm$ 26
Potassium	14032 $\pm$ 273	13592 $\pm$ 231
Sodium	9185 $\pm$ 191	10018 $\pm$ 371
Iron	81.06 $\pm$ 0.85	73.73 $\pm$ 1.7*
Copper	5.06 $\pm$ 0.05	5.43 $\pm$ 0.22
Zinc	25.88 $\pm$ 1.24	29.32 $\pm$ 1.16
Manganese	2.14 $\pm$ 0.05	2.89 $\pm$ 0.11*

* p<0.05 vs controls.

The trend towards decrease in the protein content, particularly in white musculature in the course of the disease could be due to the impaired protein metabolism in infested birds as a consequence of the impaired liver function. Liver parenchyma lesions in *E. tenella* invaded chickens were reported by Lozanov (1980). The disturbed intestinal absorption as well as the lack of appetite in diseased birds could also have an impact on such changes.

The lack of statistically significant decrease in red meat protein content is intriguing taking into account the decreased

content of protein in the liver of *E. tenella* invaded chickens, observed in previous studies of ours (Koinarski et al., 1998).

The decrease in total lipids by 9% in breast meat and by more than 25% in thigh meat in invaded chickens could be probably due to lipid destruction related to the maintenance of the energy balance. An enhanced destruction of lipids and increase in serum lipid concentrations (lipaemia) are observed in *E. tenella* invaded turkeys (Koinarski, 1997) and chickens (Musaev and Ibrahimova, 1977).

The decreased iron content could result from haemorrhages in the intestinal mucosa, accompanying the disease as well as from the poorer absorption of iron through the damaged intestinal mucosa. According to Hovanski (1984), during its endogenous development, *E. tenella* acquire iron from the host for the synthesis of iron-containing enzymes. Turk and Stephens (1981) have not however observed any changes in serum iron in chickens invaded with *E. tenella*.

Manganese could be excreted through the intestinal mucosa, so the damaged intestinal wall was presumably a cause for its elevation.

In conclusion, it could be stated that *E. tenella* invasion has an influence the composition of the meat in challenged chickens, manifested by increased water content, decreased fat content and a trend towards decrease in the protein content.

The changes in the mineral content of meat are related to statistically significant decrease in iron levels and elevated manganese concentrations.

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Correspondence:

Assoc. Prof. V. Koinarski
Department of Microbiology, Infectious and Parasitic Diseases,
Faculty of Veterinary Medicine,
Trakia University, Stara Zagora, Bulgaria

