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THE EFFECT OF DIFFERENT 12-HOUR PRE-SLAUGHTER FASTING REGIMES ON SELECTED SLAUGHTER TRAITS HAEMATOLOGICAL PARAMETERS AND BLOOD MINERAL CONCENTRATIONS IN BROILER CHICKEN

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Abstract. The study aimed at determination of the effect of 12-hour fasting on the slaughter value and the level of haematological and mineral indices in the blood of broiler chickens. The study was conducted on 6-week-old Hybro commercial cross-bred chickens with an even sex ratio (1:1), divided into 3 groups, 40 individuals each. Group I had access to feed and water for the entire 12-hours experiment, group II was deprived of feed but had access to water, whereas group III was deprived of both food and water for the whole 12 hours. Blood was sampled at the same time as the slaughter, with the following parameters being assayed in the whole blood: haemoglobin level (Hb), haematocrite value (Ht) and K^+, Na^+, Cl^- concentration, whereas Ca, Mg, P contents was checked in the blood serum. The body weight of chickens was determined before and after fasting, whereas liver weight and breast muscle pH were checked after 15 minutes after slaughter. The conducted examination showed that chicken body and liver weights were significantly lower in the groups exposed to fasting. Feed and water deprivation in the examined birds did not affect the breast muscle pH after 15 minutes from the slaughter. The pH of breast muscles measured 15 minutes after slaughter was typical for good quality meat, which points to lack of disturbances in post-slaughter transformations in chicken breast muscles due to stress connected with a 12-hour fasting. The applied fasting induced a significant increase

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in the concentration of chlorine ions in blood. In case of magnesium, differences were found only between experimental groups. Its level in group III was the lowest, whereas in group II the highest compared to the other examined groups.

Key words: broiler chickens, pre-slaughter fasting, slaughter value, blood parametrs

INTRODUCTION

The time of feed and water deprivation in birds before their slaughter is most often 8–12 hours [Wabeck 1972, Bilgili 2002], although it can be extended in production practice even to 18 hours with the prolonged transport [Warris 1997].

According to Freeman et al. [1984], Knowles et al. [1995] and Warris et al. [1993, 1997], extension of the fasting time induces metabolic disorders in birds, a decrease in their body weight and a drop in glucose and total protein levels in the blood plasma, as well as disturbances in sodium balance and an increase in corticosterone level.

Majority of the published literature concern the influence of several or even several dozen of hours of fasting or fasting joined with transportation.

It is therefore interesting to determine whether different regimes of 12-hour pre-slaughter fasting affect loss of the body and liver mass, the pH_{15} of breast muscle, selected haematological parameters and blood mineral concentrations in broiler chickens.

MATERIAL AND METHODS

The study included Hybro commercial crossbred broiler chickens (with an even sex ratio 1:1), farm-fattened for 6 weeks according to the rearing technology intended for that type of birds.

During 12 hours before slaughter, the birds were marked and weighed, and then divided into 3 experimental groups:

- group I (control), consisted of 40 individuals with an access to both feed and water for the entire 12 hours of the experiment;
- group II (experimental), consisted of 40 individuals deprived of feed, but with continuous access to water;
- group III (experimental), consisted of 40 individuals without access to neither feed or water for the time of the experiment.

After 12 hours, the birds were transported to a Poultry Plant (the distance of transportation was 30 km and the waiting time for slaughter was 1 hour). Before the birds were slaughtered, they had been weighed again and then hung on the line

for slaughter. Blood was sampled at the same time as the slaughter, heparinised andessor send for analysis. Fifteen minutes post-slaughter, the breast muscle pH was measured with a px processor PM 600 pHmeter with an ESAqP-307 glass electrode, whereas the liver was weighed after completion of the entire technological processing.

During 2–3 hours from the time of blood sampling, concentrations of sodium, potassium and chlorine ions were assayed in the heparinised whole blood by means of AVL 9180 electrolyte analyser. Blood samples collected for coagulation (clotting) were centrifuged and the blood serum was separated, in which total calcium, phosphorus and magnesium contents were determined using BioMerieux reagent kits.

In the heparinised blood samples, the level of haemoglobin (Hb) was determined by Drabkin's method, whereas the value of haematocrite index (Ht) by a traditional method using a haematocrite centrifuge [Pawelski 1990].

Using Statistica 10.0 computer software, mean values ($\bar{x}$) and standard deviations (SD) were calculated. In order to evaluate the effect of experimental factor, orthogonal single-factor analysis of variance was performed. The significance of differences between experimental groups was estimated using the Duncan's test.

RESULTS AND DISCUSSION

Average body weight of the broiler chickens before fasting was 2145 to 2306 g, while that before slaughter was 2069 to 2306 g. In group II, decrease in body weight amounted to 3.12%, while in group III to 3.63%, the difference between these two groups being significant at $P \leq 0.05$ (Table 1). The obtained values did not deviate from those reported by other authors [Contreras-Castillo et al. 2007]. The fasting of animals before slaughter should be conducted in such a way so that the alimentary tract is emptied without losses in their body weight. However, the value of these losses increases together with the extension of fasting time, from 0.18 to 0.51% per hour [Warris et al. 1999]. In research reports, an optimum time of bird fasting should be 8–12 hours [Wabeck 1972, Papa 1991], while losses in their body weight from 1.4 to 5% [Buhr et al. 1998, Savenije et al. 2002].

Also significant effect of fasting on the liver weight was observed in this study, which is confirmed by studies of other authors [Warris et al. 1988, 1993, Buhr et al. 1998, Trampel et al. 2005]. At the time when many stressors affect animals, with pre-slaughter fasting being one of them, adaptation of their organism to a changed situation is associated with energy expenditure, which is being drawn by bird organisms from liver glycogen breakdown [Warris et al. 1988, Klusek et al. 2004].

Feed and water deprivation in the examined birds did not affect the formation of breast muscle pH after 15 minutes from the slaughter (Table 1). Similar results were also obtained by Ngoka et al. 1982, Debut et al. 2003. The pH of breast muscles measured 15 minutes after slaughter amounted from 6.02 to 6.19 and was typical for good quality meat [Trojan and Niewiarowicz 1973, Niewiarowicz and Pikul 1979], not pointing to the appearance of disturbances in post-slaughter transformations in chicken breast muscles due to stress connected with a 12-hour fasting.

Despite the fact that no significant effect of fasting on the haemoglobin level in the blood of examined broiler chickens was recorded, a distinct increase in its value was observed however in the group of birds being deprived of feed (group II) and in the group being deprived of feed and water (group III) when compared to the control group (Table 2). The highest level of haemoglobin was observed in group III completely deprived of feed and water. Skorupińska et al. [1993] observed a decrease in the haemoglobin level during the first day of water deprivation in hens and its significant increase not until the second and the third day. Significant increase in the haemoglobin level due to fasting in calves was also observed by Baranow-Baranowski et al. [1986].

Deprivation of feed only did not practically affect the value of haematocrite index in the examined broiler chickens. This value was very similar to that obtained in the control group and amounted to 0.28. However, Soutyrine et al. [1998]

Table 1 . Slaughter performance traits in broiler chickens, $\bar{x}$, SD

Tabela 1. Cechy wartości rzeźnej kurcząt brojlerów, $\bar{x}$, SD

Traits Cechy	Group I Control Grupa I kontrolna		Group II No access to feed Grupa II pozbawiona paszy		Group III No access to feed and water Grupa III pozbawiona paszy i wody	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Body weight prior to 12-hour fasting, g Masa ciała przed 12-godzinnym głodzeniem, g	–	–	2247	551	2145	533
Body weight after to 12-hour fasting, g Masa ciała po 12-godzinnym głodzeniu, g	2306a	538	2179b	547	2069c	523
% body weight loss Straty masy ciała, %	0	0	3.12a	1.26	3.63b	1.02
Liver weight, g Masa wątroby, g	52.40a	15.77	41.75b	8.69	41.32b	8.48
pH_{15}	6.19	0.36	6.18	0.26	6.02	0.36

Letters a, b, c denote significant differences between experimental groups at $P \leq 0.05$.
Literami a, b, c zaznaczono istotne różnice pomiędzy grupami dla $P \leq 0{,}05$.

Table 2. Haematological parametrs and blood minerals concentrations in broiler chickens, $\bar{x}$, SD

Tabela 2. Zawartość składników hematologicznych i mineralnych w krwi kurcząt brojlerów, $\bar{x}$, SD

Traits Cechy	Group I Control Grupa I kontrolna		Group II No access to feed Grupa II pozbawiona paszy		Group III No access to feed and water Grupa III pozbawiona paszy i wody	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Haemoglobin, mmol · dcm^{-3} Hemoglobina, mmol · dcm^{-3}	7.31	1.84	7.79	2.89	7.81	2.19
Haematocrit Hematokryt	0.28	0.04	0.28	0.02	0.30	0.02
Ca, mmol · dcm^{-3}	2.34	0.45	2.46	0.56	2.59	0.35
P, mmol · dcm^{-3}	3.07	0.75	2.85	0.56	3.16	0.71
Mg, mmol · dcm^{-3}	1.06ab	0.10	1.11b	0.10	1.02a	0.07
K, mmol · dcm^{-3}	6.06	1.21	5.91	1.14	5.44	0.79
Na, mmol · dcm^{-3}	135.8	15.70	141.05	5.71	141.53	7.27
Cl, mmol · dcm^{-3}	101.10a	8.15	109.50c	4.85	110.17c	6.35

Letters a, b, c denote significant differences between experimental groups at $P \leq 0.05$.
Literami a, b, c zaznaczono istotne różnice pomiędzy grupami dla $P \leq 0{,}05$.

observed a significant increase in the haemtocrite index during an 8-hour fasting. In cased of the group of birds being deprived of both feed and water, a larger mean value of that index was recorded (0.30) when compared to other groups. An increase in the haematocrite value as affected by water restriction in young Astra L hybrid hens was observed by Skorupińska et al. [1993]. In the study by Baranow-Baranowski et al. [1986] conducted on calves, an increase in the haemtocrite index due to fasting was observed, too. Water restriction induces haemoconcentration, the picture of which is an increase in the haematocrite value, which is directly connected with a rise in the content of morphotic blood elements, also including erythrocytes.

Stress factors, such as high temperature or pre-slaughter stress, affect the level of mineral components in the blood of birds [Orowicz et al. 2004, Vecerek et al. 2002].

In the experiment under discussion, mean total calcium concentration in the blood serum of broiler chickens amounted from 2.34 to 2.59 mmol · dcm^{-3} (Table 2). Krasnodębska-Depta and Koncicki [2000] and Orowicz et al. [2004] recorded a lower calcium concentration in chicken blood serum when compared to that obtained in this study. The fasted birds were characterised by higher concentration of calcium in blood, although a difference between experimental groups was not confirmed statistically. Also Wójcik et al. [2009] observed a non-significant in-

crease in the calcium level in the blood of broiler chickens exposed to transport stress. Pre-slaughter fasting is a stress for chickens and, according to Fitko [1983] stress induces an increased secretion of thyroid gland hormones and contributes to the increase of calcium concentration in blood.

No effect of feed and water deprivation in birds on the content of inorganic phosphorus in the blood of broiler chickens examined was observed.

In case of the magnesium content in blood, significant differences were found between experimental groups only. The broiler chickens exposed to complete fasting were characterised by a lower mean magnesium level (1.02 mmol · dcm^{-3}) than those in the group provided only with water (1.11 mmol · dcm^{-3}).

The potassium concentration in the blood of broiler chickens provided with feed and water amounted on average to 6.06 mmol · dcm^{-3}. Similar values were obtained by Borges et al. [2004] for 44-day-old broiler chickens. Also Orowicz et al. [2004] reported a very similar level of that chemical element in chickens. Despite the lack of statistically significant differences in the fasted birds, a decrease in the potassium concentration was observed in experimental groups (5.91 and 5.44 mmol · dcm^{-3}, respectively in group II and group III) when compared to the control group (6.06 mmol · dcm^{-3}). Also Debut et al. [2005] observed a decrease in the content of potassium cations in broiler chickens exposed to thermal stress.

Decreased blood volume being observed with the increase of haematocrite index induces an intensified secretion of aldosterone by the suprarenal cortex. Aldosterone, on the other hand, induces an increased excretion of potassium by kidneys [Oberleithner 2004], which may explain a distinct decrease in the concentration of K ions in the group of birds exposed to complete fasting.

The sodium concentration increased together with a decrease in the content of potassium ions, amounting from 135.8 to 141.53 mmol · dcm^{-3} (Table 2). Higher values of sodium concentration in chicken blood were reported by Borges et al. [2004] and Orowicz et al. [2004].

Significant effect of fasting on the concentration of chloride ions (Cl^-) in the blood of examined birds was found. The lowest mean concentration of chloride ions in blood, amounting to 101.1 mmol · dcm^{-3}, was observed in the control group. The mean content of chloride ions in the broiler chickens deprived of access to feed only amounted to 109.50 mmol · dcm^{-3}, whereas the birds being exposed to total fasting were characterised by a higher mean concentration of chlorine ions, amounting to 110.17 mmol · dcm^{-3}. Increase in the concentration of chloride ions in the blood of birds of group III could have been induced by haemoconcentration due to water restriction [Vogel et al. 2011].

CONCLUSION

The conducted study showed that chicken body and liver weights were significantly lower in the groups exposed to fasting. The applied fasting induced a significant increase in the concentration of chlorine ions in blood. In case of magnesium, differences were found between experimental groups only. When comparing all groups of the examined broiler chickens, it was found that concentration of that chemical element in group III was the lowest, while in group II the highest, which indicates that feed and water deprivation in broiler chickens before slaughter significantly affected a decrease in the magnesium content in their blood serum.

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WPŁYW WARIANTÓW 12-GODZINNEJ GŁODÓWKI PRZEDUBOJOWEJ NA WYBRANE CECHY WARTOŚCI RZEŹNEJ ORAZ WSKAŹNIKI HEMATOLOGICZNE I MINERALNE KRWI KURCZĄT BROJLERÓW

Streszczenie. W badaniach określono wpływ 12-godzinnego czasu głodzenia na wartość rzeźną, kwasowość mięśni oraz poziom wskaźników hematologicznych i mineralnych we krwi kurcząt brojlerów. Badania przeprowadzono na 6-tygodniowych mieszańcach towarowych Hybro z równym udziałem płci 1:1, podzielonych na 3 grupy po 40 osobników, przy czym grupa I miała dostęp do paszy i wody przez cały czas 12-godzinnego eksperymentu; grupa II pozbawiona była paszy, ale miała swobodny dostęp do wody w czasie 12-godzinnego eksperymentu; grupa III nie miała dostępu ani do paszy ani do wody w czasie 12-godzinnego eksperymentu. Jednocześnie z ubojem pobrano krew. W krwi pełnej oznaczono stężenia: hemoglobiny (Hb), wskaźnika hematokrytowego i jonów K^+, Na^+, Cl^-, natomiast w surowicy krwi oznaczono zawartość: Ca, Mg, P. Określono masę ciała kurcząt przed i po głodzeniu, masę wątroby oraz pH mięśni piersiowych w czasie 15 minut po uboju. Przeprowadzone badania wykazały, że masa ciała kurcząt i wątroby była istotnie niższa w grupach poddanych głodzeniu. Pozbawianie ptaków paszy i wody nie miało wpływu na kształtowanie się odczynu mięśni piersiowych po 15 minutach od uboju. Odczyn mięśni mierzony 15 minut po uboju, był charakterystyczny dla mięsa dobrej jakości i nie wskazywał na pojawienie się zaburzeń w przemianach poubojowych w mięśniach kurcząt, na skutek stresu związanego z dwunastogodzinnym głodzeniem. Zastosowane głodzenie spowodowało istotny wzrost stężenia jonów chloru we krwi. W przypadku magnezu stwierdzono różnice tylko między grupami doświadczalnymi. W grupie III jego poziom był najniższy, a w grupie II najwyższy w porównaniu do pozostałych badanych grup.

Słowa kluczowe: kurczęta brojlery, głodzenie przedubojowe, cechy wartości rzeźnej, parametry krwi

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