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EFFECT OF TRANSPORT TO THE SLAUGHTERHOUSE ON STRESS INDICATORS AND MEAT QUALITY OF BROILER CHICKENS*

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Abstract

The aim of the study was to evaluate the effect of transport to the slaughterhouse on stress indicators as well as carcass and meat quality of 42-day-old chickens. Hubbard Flex broilers were assigned before slaughter to one of two groups: control (I) and experimental (II) with 10 birds per group (5 pullets and 5 cockerels). Prior to slaughter, chickens from group II were subjected to a 16-h feed withdrawal and 4-h procedure which included: 1-h loading, 2.5-h transport and 0.5-h unloading. Birds from group I were starved for 16 h and remained in the poultry house until slaughter. After killing by decapitation, blood was collected to determine the concentration of glucose, lactate, corticosterone and thyroid hormones (T_3 and T_4). pH_{15min} of breast and leg muscles was determined postmortem. This test has been repeated after 24-h cooling of carcasses, which were later subjected to simplified carcass analysis. The prepared muscles were evaluated for CIE L*a*b* colour, water holding capacity (Grau-Hamm), drip loss, thermal loss and shear force. The transport of chickens had no consistent effect on lower meat quality and placed a greater strain on the body of cockerels than pullets, as evidenced by twice higher corticosterone concentration in the blood of cockerels ($P \leq 0.05$) and more pronounced changes in the quality traits of cockerel meat. Of all stress indicators measured in the blood of the analysed chickens, triiodothyronine, lactates and glucose were correlated the most to meat quality traits. Monitoring stress levels by testing stress indicators in blood can help to improve preslaughter handling and poultry meat quality.

Key words: broilers, transport, preslaughter stress, meat quality

After a rather monotonous life broiler chickens suddenly undergo many treatments on the day of slaughter that affect their well being as well as the meat quality, often in a negative way (Savenije et al., 2002). Feed withdrawal, catching, loading, transport, unloading, shackling and stunning are standard procedures used before slaughter. Compromised welfare may be partly caused by exhaustion of the energy stores of the chickens, which cannot cope with difficulties they have never encountered before.

Environmental factors are nonspecific stimuli (stressors) that expose animals to stress (Selye, 1978). Pre-transport catching and crating alone increases blood corticosterone concentration (Kannan and Mench, 1996), which is regarded as one of the stress indicators in birds. Catching, crating and loading are the most frequent procedures to cause physical injury during preslaughter treatment. Transport is another pro-

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cedure regarded as a stressor (Kannan et al., 1997). According to Kania et al. (2001), the strongest stress responses are caused by stressors that are emotional (catching, mishandling, transport, fear) and polyetiological factors (concurrent noise, improper temperature, overfeeding, starvation, or no access to water).

During transport to the slaughterhouse, birds are often exposed to a number of stress factors that can affect meat quality such as improper temperature, adverse microclimate, vibration, motion, impacts, shocks, lack of feed and water, social disruption and noise.

The metabolic state of the animal at the time of slaughter determines the initial metabolic state of the muscle postmortem and, as a result, affects the final meat quality (Savenije et al., 2002).

The aim of the study was to evaluate the effect of transport to the slaughterhouse on stress indicators as well as carcass and meat quality in 42-day-old broilers.

Material and methods

Hubbard Flex broilers (n = 287) were kept on deep litter in the standard environmental conditions of a poultry house. All chickens were fed *ad libitum* complete starter, grower and finisher diets containing 21, 19 and 18.5% CP and 3075, 3200 and 3300 ME/kg, respectively. At the end of the rearing period, at the age of 42 days, 20 birds (10 cockerels and 10 pullets) with average body weight were selected for slaughter. Birds were randomly assigned to control (I) and experimental groups (II) with 10 birds per group in an equal sex ratio. Prior to slaughter, chickens from group II were subjected to a 16-h feed withdrawal and 4-h procedure which included: 1-h loading, 2.5-h transport and 0.5-h unloading. Birds were caught manually and placed in a transport crate at a density of 0.047 m^2 per broiler. The vehicle was loaded and unloaded manually. Birds from group I were starved for 16 h and remained in the poultry house until slaughter. After killing by decapitation, blood was collected to determine the concentration of glucose, lactate, corticosterone and thyroid hormones (T_3 and T_4). An Epol 20 analyser was employed to determine glucose concentrations using the oxidase method. Corticosterone levels were determined using enzyme-linked immunosorbent assay (Elisa). Plasma lactate was measured using colorimetric method. The serum levels of thyroid hormones: T_3 and T_4 were determined using microparticle enzyme immunoassay (MEIA) and fluorescence polarization immunoassay (FPIA), respectively.

Fifteen minutes postmortem, the initial acidity of muscle tissue from breast muscles (*pectoralis superficialis*) and leg muscles (*biceps femoris*) was determined. The pH test was repeated after 24-h cooling of carcasses at +4°C. Cooled carcasses were subjected to simplified carcass analysis. Carcass weight with and without giblets, weight of breast and leg muscles, weight of giblets (liver, gizzard and heart), weight of leg bones, abdominal fat and omental fat were determined. These data were used to estimate dressing percentage with and without giblets and to determine carcass tissue composition which were calculated on the basis of carcass weight with giblets. The prepared muscles were evaluated for technological parameters such as CIE L*a*b* colour (Minolta CR310), water holding capacity according to Grau and Hamm (1953),

drip loss, thermal loss and tenderness based on maximum shear force (Instron 5542 equipped with a Warner-Bratzler shearing device).

The results were analysed statistically using analysis of variance and Duncan's test. Pearson's linear correlation coefficients were also analysed to determine if the stress parameters studied are related to meat quality. SAS Enterprise Guide software (SAS Institute, 2006) was used for all statistical calculations.

Results

The mean body weight of 42-day-old Hubbard Flex broilers was 2180 g (SD = 366). Preslaughter handling resulted in a body weight loss of 92.5 g in experimental birds and 75 g in control birds. The highest body weight loss (117 g) was found in transported cockerels.

Preslaughter transport was found to have an effect on dressing percentage (Table 1). Control chickens had higher dressing percentage with giblets and birds transported to the slaughterhouse had a 0.97% lower dressing percentage ($P>0.05$). Significant differences in dressing percentage were found in cockerels (difference of 2.02%). Dressing percentage without giblets showed significant ($P\leq0.05$) differences between the experimental and control groups. No statistically significant differences were found in carcass quality between the two groups. Dissection results indicate that 1.42% poorer muscling of carcass breast was characteristic of the experimental birds. Lower differences were found for leg muscling, which was similar in both groups. Preslaughter transport reduced birds' fatness, being most evident in cockerels in which the amount of abdominal and omental fat was 0.43% lower in the experimental group ($P>0.05$). The carcasses of transported birds had a slightly higher proportion of giblets (by 0.23%) ($P>0.05$).

The breast muscles of birds subjected to 16-h preslaughter fasting were characterized by higher pH_{15min} compared to the muscles of chickens subjected to both fasting and transport (Table 2). The difference in the mean initial acidity of the muscles between the groups was significant ($P\leq0.05$) at 0.21 units. The greatest differences ($P\leq0.001$) were found in cockerels for the initial pH of breast muscles (0.4 units), while in pullets muscle pH was almost identical. Significant ($P\leq0.01$) differences of 0.35 units were also observed between control cockerels and pullets. The difference in breast muscle pH measured 15 min and 24 h postmortem was 0.27 units in the control birds compared to a pH decline of 0.01 units in the experimental birds. Differences in the pH_{24h} of breast muscles between the groups studied were small (0.05 units). No significant differences in breast muscle colour were observed with a tendency towards lower L* (lightness) value of breast muscles in birds from group II paralleled by lower redness and higher yellowness. The results also show that the use of 2.5-h preslaughter transport had no significant effect on the water holding capacity of muscles. Shear force of breast meat of cockerels from the experimental group increased significantly ($P\leq0.05$) by 3.63N. In group II, there was a tendency towards greater shear force of meat (by 1.3N on average) and greater thermal loss due to cooking (by 1.92%) in relation to the control chickens. In addition, birds from group II showed 0.53% better water holding capacity of breast muscles.

Table 1. Evaluation of carcass quality of broiler chickens ($\bar{x} \pm SD$)

Item (%)	Group					
	I – control			II – experimental		
	♂	♀	$\bar{x}$	♂	♀	$\bar{x}$
Carcass weight loss	1.23±0.38	1.68±0.73	1.46±0.60	1.54±0.20	1.75±0.43	1.65±0.33
Dressing percentage with giblets	79.89±0.98 A	79.62±1.40	79.76±1.15	77.91±0.83 B	79.68±1.29	78.79±1.38
Dressing percentage without giblets	76.58±1.12 a	76.25±1.50	76.41±1.26 a	74.52±1.07 b	75.99±1.18	75.26±1.31 b
Breast muscles	24.08±1.50	24.45±2.73	24.26±2.08	22.40±1.85	23.27±1.82	22.84±1.79
Leg muscles	19.01±0.31	19.06±1.34	19.03±0.92	19.56±0.47	18.63±0.97	19.09±0.87
Giblets	4.23±0.42	4.25±0.31	4.24±0.35	4.33±0.42	4.60±0.16	4.47±0.33
Liver	2.68±0.32	2.56±0.28	2.62±0.29	2.54±0.18	2.75±0.21	2.65±0.21
Gizzard	0.92±0.14	1.07±0.06	0.99±0.13	1.09±0.24	1.17±0.11	1.13±0.18
Heart	0.63±0.09	0.62±0.08	0.63±0.08	0.70±0.10	0.68±0.07	0.69±0.08
Leg bones	5.29±0.20	4.95±0.57	5.12±0.44	6.01±0.35	4.41±1.12	5.21±1.15
Abdominal fat	2.91±1.02	2.62±1.34	2.76±1.13	2.48±0.71	2.67±0.61	2.57±0.63

a, b – values in rows with different letters differ significantly ($P \leq 0.05$).
A, B – as above for $P \leq 0.01$.

Table 2. Evaluation of breast muscle quality of broiler chickens ($\bar{x} \pm SD$)

Item	Group					
	I – control			II – experimental		
	♂	♀	$\bar{x}$	♂	♀	$\bar{x}$
pH_{15min}	6.54±0.21 **AX**	6.19±0.14 Y	6.36±0.25 a	6.14±0.05 **B**	6.16±0.12	6.15±0.09 b
pH_{24h}	6.12±0.09	6.06±0.08	6.09±0.09	6.18±0.19	6.10±0.10	6.14±0.15
L*	54.56±3.54	56.36±1.36	55.46±2.70	54.94±1.87	55.35±2.14	55.14±1.91
a*	9.63±0.94	9.68±1.14	9.66±0.98	8.97±1.16	9.49±0.47	9.23±0.88
b*	9.52±2.02	10.95±1.37	10.23±1.79	10.63±1.02	11.26±0.66	10.95±0.88
Drip loss (%)	0.34±0.04	0.45±0.17	0.40±0.13	0.41±0.06	0.44±0.26	0.43±0.18
Thermal loss (%)	16.85±1.18	18.24±2.06	17.55±1.75	19.08±4.23	19.86±2.11	19.47±3.18
Water holding capacity (%)	14.61±3.10	13.75±0.55	14.18±2.15	12.60±4.00	14.71±2.05	13.65±3.20
Shear force (N)	18.43±1.07 a	19.34±2.35	18.89±1.79	22.06±2.26 bx	18.32±2.82 y	20.19±3.11

a, b; x, y – values in rows with different letters differ significantly ($P \leq 0.05$).
X, Y – as above for $P \leq 0.01$.
A, **B** – as above for $P \leq 0.001$.

Table 3. Evaluation of thigh muscle quality of broiler chickens ($\bar{x} \pm SD$)

Item	Group					
	I – control			II – experimental		
	♂	♀	$\bar{x}$	♂	♀	$\bar{x}$
pH_{15min}	6.52±0.11 a	6.42±0.12	6.47±0.12	6.41±0.19 b	6.40±0.13	6.40±0.16
pH_{24h}	6.37±0.08 a	6.34±0.05	6.36±0.07	6.53±0.08 b	6.36±0.18	6.45±0.16
L*	46.86±1.21	47.42±1.64	47.14±1.39	47.06±2.07	46.14±2.40	46.60±2.17
a*	15.30±0.52	15.18±0.74	15.24±0.61	15.55±0.81	15.25±1.26	15.40±1.01
b*	9.13±0.84	8.72±0.63	8.92±0.73	8.91±0.83	8.20±0.60	8.56±0.77
Drip loss (%)	0.28±0.18	0.23±0.03	0.26±0.12	0.17±0.04	0.26±0.09	0.22±0.08
Thermal loss (%)	24.21±4.20	24.61±1.65	24.41±3.02	22.58±2.91	25.21±2.64	23.90±2.96
Water holding capacity (%)	11.20±2.57	9.60±3.17	10.40±2.84	8.74±1.95	11.52±2.59	10.13±2.61

a, b – values in rows with different letters differ significantly ($P \leq 0.05$).

Table 4. Blood biochemical indices of broiler chickens ($\bar{x} \pm SD$)

Item	Group					
	I – control			II – experimental		
	♂	♀	$\bar{x}$	♂	♀	$\bar{x}$
T_3 (ng/ml)	0.66±0.09	0.84±0.08	0.75±0.12	0.68±0.19	0.74±0.25	0.71±0.21
T_4 (µg/dl)	1.92±0.26	1.71±0.38	1.81±0.33	1.94±0.13	1.97±0.31	1.96±0.23
Corticosterone (ng/ml)	4.84±0.80 a	4.60±2.14	4.72±1.53	7.52±1.79 bx	3.58±1.30 y	5.55±2.55
Lactate (mmol/l)	7.86±1.57	6.68±1.32	7.27±1.50	6.58±0.61	7.22±2.45	6.90±1.71
Glucose (mg/dl)	256.65±22.61	236.17±21.22	246.41±23.32	230.39±12.44	232.88±16.53	231.64±13.85

a, b; x, y – values in rows with different letters differ significantly ($P \leq 0.05$).

No significant differences were found in mean pH values of leg muscles measured 15 min and 24 h postmortem between the groups (Table 3). Significant ($P \leq 0.05$) differences were found for pH of leg muscles from experimental cockerels, in which pH_{15min} was lower by 0.11 units and pH_{24h} higher by 0.16 units compared to the control group. In pullets, slight differences in muscle pH were observed between the groups. The difference in pH of breast muscles measured 15 min and 24 h postmortem was 0.11 units in the control birds. No such changes were observed in group II. There were some non-significant differences in leg muscle colour between the groups studied. L* (lightness) value of breast muscles from experimental birds tended to decrease together with lower yellowness (b*) and higher redness (a*). Transport slightly improved the technological suitability of leg muscles, contributing to more favourable water holding capacity of meat (by 0.27% on average) and lower thermal losses during cooking (by 0.51% on average) in relation to the control group. These quality changes tended to be greater in cockerels, in which water holding capacity of muscles differed by 2.46% and thermal loss by 1.63% ($P>0.05$) between the experimental and control groups.

The response of the chickens to preslaughter handling was evaluated from the biochemical blood parameters. No significant differences in the blood concentration of thyroid hormones were found (Table 4). In cockerels from both groups, the concentration of triiodothyronine (T_3) and thyroxine (T_4) was practically the same, and in transported pullets T_3 decreased slightly by 0.1 ng/ml and T_4 increased by 0.25 µg/dl. After the application of the treatment factor, serum corticosterone level increased ($P \leq 0.05$) significantly in cockerels by 2.68 ng/ml. In addition, sex differentiated corticosterone levels because there were significant ($P \leq 0.05$) differences (by 3.94 ng/ml) in the serum concentration of corticosterone. There was also a tendency towards lower mean concentration of lactate and glucose in the blood of transported birds, with greater differences between the cockerels from both groups.

The analysis of Pearson's linear correlation coefficients (r), which was performed to find a relationship between stress parameters and meat quality showed several significant relationships. In the control chickens, there was a marked ($P \leq 0.05$) negative correlation between blood triiodothyronine (T_3) concentration and pH_{15min} of breast and leg muscles ($r = -0.7569$ and $r = -0.7547$, respectively). A strong positive relationship ($P \leq 0.05$) was also found between initial pH of breast muscles and blood lactate concentration in both experimental ($r = 0.7413$) and control birds ($r = 0.6408$). What is more, the correlation results indicate a significant negative relationship ($r = -0.7379$) between shear force of breast muscles and blood lactate levels in chickens from group II ($P \leq 0.05$). In addition, a clear ($P \leq 0.05$) positive correlation was found between the a* value of leg muscles from transported birds and blood glucose levels ($r = 0.6795$).

Discussion

Fear associated with unfamiliar noise, vibration and violent shocks experienced by birds during transit is a stronger stressor than starving that lasts longer (Kannan

et al., 1997). Biochemical blood parameters such as thyroid hormones and corticosterone levels and lactate and glucose concentrations are useful in evaluation of poultry responses to stress factors.

In the present study, experimental chickens were characterized, on average, by a 0.83 ng/ml higher discharge of corticosterone compared to the control group, but significant ($P \leq 0.05$) differences in this parameter were only found for cockerels. Likewise, Nijdam et al. (2005) reported higher blood corticosterone levels in transported birds. Lower blood corticosterone levels are generally indicative of lower stress levels (Kannan et al., 1997). Stress factors associated with preslaughter handling placed a greater strain on the body of cockerels, as evidenced by twice higher corticosterone concentrations in cockerels ($P \leq 0.05$).

Like in our study, Nijdam et al. (2005) showed no effect of transporting starved chickens on changes in blood T_3 concentrations. The same authors reported a significant decrease in thyroxine (T_4) levels in 49-day-old broilers that were both starved and transported before slaughter. Our study failed to confirm the effect of transport on significant changes in blood glucose and lactate concentrations in the birds studied. The lack of such differences in chickens subjected to preslaughter transport was also observed by Savenije et al. (2002). Reduced plasma glucose concentration in transported broilers was reported by Carlise et al. (1998), who attributed it to a depletion of liver glycogen stores due to the body's increased glucose requirement.

The present study did not show a significant effect of the treatment factor on carcass quality. The transport only had a detrimental effect on the dressing percentage of experimental birds and decreased it by 1.15% ($P \leq 0.05$). In cockerels, the differences in dressing percentage between both groups were significantly higher than in pullets. Lower carcass dressing percentage was due to body weight loss during transport. Lower live weight (by 3.4%) was observed in birds that were only starved, and birds that were starved and transported before slaughter had 4.2% lower body weight. Nijdam et al. (2005) also reported greater live weight loss in starved and transported broilers compared to chickens that were only starved for the same amount of time.

Meat quality is defined as a combination of many factors, of which colour and texture are particularly important for consumers. These traits can be shaped by short-term preslaughter factors such as fasting and transport (Lyon et al., 2004). However, preslaughter stress can cause unwanted changes in meat quality by changing muscle metabolism before and after slaughter.

Our study showed that the pH of breast muscles measured 15 min and 24 h after the slaughter of starved birds differed by 0.27 units. In the group of fasted and transported birds, the pH only decreased by 0.01 units. In this case, glycolysis was completed when pH value was higher (6.14 on average). This could be due to the depletion of glycogen stores in live animals as a result of long-term preslaughter stress. An altered rate of postmortem changes and the resulting meat defects are unfavourable consequences of antemortem stress (Owens and Sams, 2000). For leg muscles, pH value was found to increase by 0.05 units in the experimental group. According to Warris et al. (1993), chicken transport has an inconsistent effect on glycogen concentration as it reduces the ultimate pH of breast muscles while increasing the pH of leg muscles.

The rate of postmortem glycolysis and the ultimate pH of meat influence meat quality (Schrerus, 2000). It is well known that muscle pH determines physicochemical properties of meat such as colour, water holding capacity, thermal drip and tenderness of heat-treated meat (Połtowicz, 2000; Le Bihan-Duval, 2004). Our study shows that the higher pH_{24h} of muscles from transported chickens improved their water holding capacity but had a negative effect on tenderness of breast muscles ($P>0.05$). No significant changes were found in muscle colour as a result of bird transport. Similar results were obtained by Debut et al. (2003), who showed no significant differences in the colour of breast muscles from chickens transported prior to slaughter. Owens and Sams (2000) reported that a 3-h transport of turkeys had an effect on the quality of meat, which was characterized by higher pH and darker colour.

The effect of chicken transport was most noticeable in the quality of cockerel muscles. Significant ($P\leq0.001$) differences were observed in the initial acidity of breast muscles between the experimental and control groups. The treatment factor had an effect on the shear force of the analysed muscles, with a significant ($P\leq0.05$) deterioration in the tenderness of these muscles. In addition, there was a tendency towards better water holding capacity and increased drip loss and thermal loss of breast meat from transported cockerels. Unlike breast muscles, the leg muscles of the analysed chickens were characterized by lower exudation of meat juices during storage and lower cooking loss compared to the control cockerels ($P>0.05$).

Our results showed several significant ($P\leq0.05$) relationships between biochemical blood parameters and meat quality in chickens. A negative correlation was found between the blood triiodothyronine concentration (T_3) and acidity of leg muscles measured 15 min postmortem in experimental chickens. Statistical analysis revealed that blood lactate concentration was positively correlated ($P\leq0.05$) with the acidity of breast muscles measured 15 min postmortem in both the experimental and control group of chickens. In a study on the *longissimus* muscle of pigs exposed to preslaughter stress, Hambrecht et al. (2004) showed a high and negative correlation between blood lactate concentration and muscle pH measured 30 min postmortem. In our study, we also found a negative correlation between blood lactate concentration and shear force of breast muscles from transported chickens, as well as a positive correlation between the a* value of leg muscles from transported chickens and glucose concentration of blood collected before slaughter. Also Akşit et al. (2006), who investigated the effect of heat stress on meat quality in broiler chickens showed that stress parameters are related to meat quality traits and, like in our study, confirmed a positive correlation between blood glucose level and the colour of meat from the analysed birds.

The present results suggest that chicken transport does not have a consistently detrimental effect on meat quality. Transport as a stress factor occurring during preslaughter handling placed a greater strain on the body of cockerels than pullets, as evidenced by over twice higher corticosterone concentration in the blood of cockerels from the experimental group ($P\leq0.05$) and more pronounced changes in the quality traits of their meat. Our findings confirm the considerable role of metabolic processes in the quality traits of meat from broiler chickens. Of all stress indicators measured in the blood of the analysed chickens, triiodothyronine, lactates and glucose were cor-

related the most to meat quality traits. Monitoring stress levels by testing stress indicators in blood can help to improve preslaughter handling and poultry meat quality.

References

Akşit M., Yalçin S., Özkan S., Metin K., Özdemir D. (2006). Effect of temperature during rearing and crating on stress parameters and meat quality of broilers. Poultry Sci., 85: 1867–1874.

Carlise A.J., Mitchell M.A., Hunter R.R., Duggan J.A., Randall J.M. (1998). Physiological responses of broiler chickens to the vibrations experienced during road transportation. Br. Poultry Sci., 39 (5), Suppl., 1: 48–60.

Debut M., Berri C., Baeza E., Sellier N., Arnould C., Guemene D., Jehl N., Boutten B., Jego Y., Beaumont C., Le Bihan-Duval E. (2003). Variation of chicken technological meat quality in relation to genotype and preslaughter stress condition. Poultry Sci., 82: 1829–1838.

Grau R., Hamm R. (1953). Eine einfache Methode zur Bestimmung der Wasserbindung im Muskel. Naturwiss, 40, p. 29.

Hambrecht E., Essen J.J., Nooijen R.I.J., Ducro B.J., Smits C.H.M., den Hartog L.A., Verstegen M.W.A. (2004). Preslaughter stress and muscle energy largely determine pork quality at two commercial processing plants. J. Anim. Sci., 82: 1401–1409.

Kania B.F., Matczuk J., Cieciera M. (2001). Neurofarmakologiczne podstawy łagodzenia stresu. Med. Wet., 57 (10): 719–722.

Kannan G., Mench J.A. (1996). Influence of different handling methods and crating periods on plasma corticosterone levels in broilers. Br. Poultry Sci., 37 (5): 21–31.

Kannan G., Heath J.L., Wabeck C.J., Souza M.C.P., Howe J.C., Mench J.A. (1997). Effect of crating and transport on stress and meat quality characteristics in broilers. Poultry Sci., 76: 523–529.

Le Bihan-Duval E. (2004). Genetic variability within and between breeds of poultry technological meat quality. World Poultry Sci. J., 60: 331–340.

Lyon B.G., Smith D.P., Lyon C.E., Savage E.M. (2004). Effect of diet and feed withdrawal on the sensory descriptive and instrumental profiles of broiler breast fillets. Poultry Sci., 83: 275–281.

Nijdam E., Delezie E., Lambooij E., Nabuurs M.J.A., Decuypere E., Stegeman J.A. (2005). Feed withdrawal of broilers before transport changes plasma hormone and metabolite concentrations. Poultry Sci., 84: 1146–1152.

Owens C.M., Sams A.R. (2000). The influence of transportation on turkey meat quality. Poultry Sci., 79: 1204–1207.

Połtowicz K. (2000). Wpływ początkowego poziomu pH mięśni piersiowych na wybrane wskaźniki jakości mięsa kurcząt brojlerów należących do trzech genotypów. Rocz. Nauk. Zoot. Supl., 8: 161–165.

Savenije B., Lambooij E., Gerritzen M.A., Venema K., Korf J. (2002). Effect of feed deprivation and transport on preslaughter blood metabolites, early postmortem muscle metabolites and meat quality. Poultry Sci., 81: 699–708.

Schrerus F.J.G. (2000). Post-mortem changes in chicken muscle. World Poultry Sci. J., 56 (4): 319–346.

Selye H. (1978). Stress without distress. PIW, Warszawa.

Warris P.D., Kestin S.C., Brown S.N., Knowles T.G., Wilkins L.J., Edwards J.E., Austin S.D., Nicol C.J. (1993). The depletion of glycogen stores and indices of dehydration in transported broilers. Br. Vet. J., 149 (4): 391–398.

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Wpływ transportu do rzeźni na wskaźniki stresu i jakość mięsa kurcząt brojlerów

STRESZCZENIE

Celem badań była ocena wpływu transportu do rzeźni na wskaźniki stresu oraz jakość tuszki i mięsa 42-dniowych kurcząt. Badaniami objęto brojlery Hubar Flex przydzielone przed ubojem do dwóch grup: kontrolnej (I) i doświadczalnej (II) po 10 szt. w każdej (5 kurek i 5 kogutków). Kurczęta z grupy II przed ubojem zostały poddane 16-godzinnemu głodzeniu oraz 4-godzinnemu postępowaniu obejmującemu: 1-godzinny załadunek, 2,5-godzinny transport oraz 0,5-godzinny rozładunek. Ptaki grupy I były 16 godzin głodzone i do momentu uboju przebywały w kurniku. Przy uboju dokonanego metodą dekapitacji pobrano od kurcząt krew w celu oznaczenia glukozy, mleczanów, kortykosteronu oraz hormonów tarczycy (T_3 i T_4). Po uboju określono pH_{15min} mięśni piersiowych i nóg. Badanie to zostało powtórzone po 24-godzinnym schłodzeniu tuszek, które następnie poddano uproszczonej analizie rzeźnej. Wypreparowane mięśnie oceniono pod względem: barwy CIE L*a*b*, wodochłonności (Grau-Hamm), wycieku swobodnego, strat termicznych oraz siły cięcia. Transport kurcząt nie wpłynął jednoznacznie na obniżenie jakości mięsa i stanowił większe obciążenie organizmu kogutków niż kurek, gdyż wykazano dwukrotnie wyższe stężenie kortykosteronu we krwi kogutów ($P \leq 0,05$) oraz wyraźniejsze zmiany cech jakości ich mięsa. Ze wszystkich wskaźników stresu mierzonych we krwi badanych kurcząt trójjodotyronina, mleczany oraz glukoza były najsilniej skorelowane z cechami jakości mięsa. Monitoring poziomu stresu przez badanie tych wskaźników we krwi może pomóc w usprawnieniu obrotu przedubojowego i w poprawie jakości mięsa drobiowego.