

EFFECT OF OVERSTUNNING ON BLEEDING DEGREE OF BROILER CHICKEN MEAT

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SUMMARY

A number of researchers consider the usage of increased electric current parameters for stunning to be one of the ways of optimizing preslaughter immobilization of poultry. However information about the influence of stunning regimes on poultry meat quality and processing properties is limited and contradictory.

One of the objects of this investigation was to study the effect of stunning on bleeding degree of broiler chicken carcasses and the effect of bleeding degree on carcass appearance and poultry meat colour.

Bleeding degree of broiler chicken carcasses was determined by weight method, meat colour was determined by organoleptic method and with the help of instruments. Pathologoanatomical examination of poultry carcasses was carried out.

Differences in appearance of overstunned and stunned under production conditions carcasses were not observed. It was proved that carcass appearance (skin colour) can indicate the tendency of the residual blood changes and can not be indicative of meat colour because of colour defects which are concealed by skin (muscle hyperemia), it is the result of an individual live organism response to electric stunning.

Reliable evaluation method of poultry carcass bleeding degree is quantitative determination of heme pigment in poultry meat. It was found that pigment concentration in the meat of overstunned and stunned under production conditions poultry is within the limits for thoroughly bled out meat.

INTRODUCTION

The importance of optimizing poultry preslaughter immobilization increases in relation to the intensification of poultry processing, the immobilization provides proper automated slaughter. It is difficult to optimize electrical stunning through water at commercial frequency which is a widely adopted practice in poultry processing, because of individual variability of poultry sensitivity to electric current. As production experience show carcass quality problems arise when inadequately stunned, poorly immobilized birds are processed. During bleeding damages in the form of fractures haemorrhages occur as a result of convulsive muscle contractions. According to Schneider et al (1985) downgrading can reach 5%. The automated slaughter of poorly immobilized birds is difficult, due to improper cut bleeding worsens, wings are often damaged (Wesley, 1986). Large amount of blood in a scalding tank during scalding results in excessive foaming and the wetting property of scalding water decreases. Poor quality of carcass processing increases the load on purification works, valuable raw material for feed meal production is lost.

A number of researchers consider the increase of electrical stunning parameters to be one of the ways of optimizing the process of broiler slaughtering. The problem of inadequate immobilization disappears when electric current of 40 mA is used and it causes the fibrillations of heart ventricles (Wormuth et al., 1982). From the point of view of poultry welfare the advantages of slaughter with pre-slaughter electrical stunning at high frequency are obvious: the threshold values of electric current which cause cardiac arrest and anaesthetic effect coincide in fact. However there is a possibility of worsening bleeding procedure because of cardiac arrest, though there is information (Heath et al., 1981; Wormuth et al., 1981; Griffiths 1983, 1985) that heart arrest during bleeding doesn't have any negative effect on the quality of end product.

The purpose of our investigations was to study the effect of stunning at high voltage on bleeding degree of broiler carcasses.

The experiment was carried out with 3000 broiler chickens (Cross 6) at the age of 56 days, their carcasses were processed on a conveyor line. Electrical stunning parameters (70-190 V, 4s, 40-90 mA) were controlled, the degree of stunning was determined according to the scheme of Schneider et al. (1985): 1 - weak stunning, 2 - optimum stunning, 3 - strong stunning with lethal outcome (overstunning). The bleeding degree was determined by the blood quantity bled out during 180 s (per cent of live weight). Visual evaluation of carcass colour was scored on a universal scale, colour intensity and total pigment of muscular tissue was determined by a modified Homsey method on "Specord-40", grading by quality was conducted in compliance with the standard currently in force. Pathologoanatomical post mortem examination was carried out after defeathering. Histological sections were stained with hematoxylineosine to reveal tissue structure and formed blood elements (erythrocytes).

The analysis of the efficiency of broiler electrical stunning carried out according to existing technology (70-80 V, 50 Hz, 4 s) has shown that 10-14% of total number of birds were weakly stunned and 20-25% of birds were strongly stunned. The strength of electrical current passing through each carcass didn't depend on live weight (1375-2040) and was at an average of 45 mA (40-50 mA). With voltage increase the number of weakly stunned birds drastically decreased and overstunning reached 100% at 190 V. Current strength changed within the limits from 80 to 90 mA.

The difference in bloodloss in relation to a stunning degree amounted to 0.2% (80 V - 3.6%, 190 V - 3.4%) and was statistically significant ($p < 0,001$). There was practically no difference in market quality and processed quality of poultry carcasses, downgrading was not discovered. Significant differences in the colour of muscular tissue were absent. The heme pigment concentration in the muscles of overstunned and optimally stunned broilers was within the value limits for thoroughly bled out meat (Table 1).

TABLE 1: Effect of stunning degree on muscular tissue colour and heme pigment concentration

Type of muscular tissue	Voltage (V)	Muscle colour (arbitrary units)	Pigment concentration (mg %)
Breast muscle	80	25.36 ± 1.03	65.36 ± 1.28
	190	25.32 ± 1.02	63.09 ± 5.59
Thigh muscle	80	63.65 ± 2.61	208.68 ± 5.16
	190	62.68 ± 6.43	194.26 ± 7.13

During the examination of the organs and tissues of over-stunned poultry (190 V) pathological changes in the cardiovascular system were found, these changes are characteristic of electric shock with lethal outcome, namely blood accumulation in the veins of systemic and pulmonic blood circulations. Inside the blood vessels there were blood clots. The mesenteric vein was filled with blood unevenly, so called pulsating zones were formed. Blood accumulation in the neck veins was characteristic.

Irrespective of the degree of stunning blood accumulation in large blood vessels of wings and lower limbs was observed in many cases. On the histological sections of thigh muscular tissue one could see capillary network filled with blood, mainly with erythrocytes; colouring of erythrocytes by hematoxylineosine was observed along the veins in the perivascular space.

As the result of the increase of blood vessel wall permeability erythrocytes penetrate into the interfibre space of muscular tissue which is darker in colour or has a multitude of small haemorrhages along the blood vessels, it depends on the intensity of the process. Thigh muscles are hyperemized to a greater degree because they have more developed network of blood vessels in comparison to low-functional breast muscles.

Damaging effect of electric current depends more on a live organism physiological condition at the moment of stunning than on the strength of electric current. After a long transportation period birds are tired, their excitability threshold of the central nervous system is lowered, and optimum stunning conditions lead to a lethal outcome more often than in less tired poultry. The number of strongly stunned birds increases to 5.5% (Table 2).

The meat of tired birds is darker and contains 1.2-1.5 times more heme pigment ($p < 0.001$). Bloodloss decrease amounts to 0.2-0.5% significantly ($p < 0.01$). The decrease of bloodloss and colour intensity increase in tired birds was observed after optimum stunning and after strong stunning (Table 3).

TABLE 2: Stunning efficiency in relation to the distance of broiler transportation to slaughterhouse.

Distance of transportation (km)	Number of birds (%)		
	weakly stunned	optimally stunned	overstunned
Up to 1.5	14.5 ± 1.2	65.5 ± 7.5	20.0 ± 3.0
More than 25	10.8 ± 0.9	63.7 ± 7.3	25.5 ± 7.8

TABLE 3: Effect of stunning degree on bloodloss and pigment quantity in poultry meat in relation to the distance of broiler transportation to slaughterhouse*

Distance of transportation (km)	Voltage (V)	Heme pigment concentration in thigh muscle (mg %)	Bloodloss (%)
Up to 1.5	80	186.0 ± 4.51 a	3.96 ± 0.11 a
	190	164.0 ± 5.08 a	3.61 ± 0.10 ab
More than 25	80	231.37 ± 5.82 b	3.71 ± 0.18 ab
	190	224.30 ± 9.19 b	3.42 ± 0.17 ab

*Values in the same column which are marked by different letters differ significantly ($p < 0.01$)

After the visual evaluation of the bleeding degree of tired after transportation birds it was found that large blood vessels in wings and lower limbs were filled with blood. Thigh muscles were strongly hyperemized, the meat had no market quality. Wing damage of such carcasses in defeathering machine was accompanied by formation of haemorrhages of different degree of severity up to those requiring trimming.

Thus overstunning (strong stunning) of poultry is connected with variety of individual sensitivity of birds to electric current effect and with physiological condition of birds. Optimally stunned and overstunned broiler carcasses have no particular differences in processing quality, it agrees with the data provided by Griffiths et al (1983, 1985) and Heath et al (1983). Different bleeding degrees didn't influence the quantity of residual blood in muscular tissue and carcass appearance.

Altogether strong stunning provides superior in quality automated slaughter. Calmness of birds during bleeding decreases the possibility of wing breakage and of getting live birds into scalding tanks due to improper dissection of the main blood vessels. Moreover the feathers of overstunned birds get soiled to a lesser degree during bleeding, therefore the scalding tanks are less polluted with blood.

The residual blood in large blood vessels of a carcass and the hyperemized muscle tissue can be classified as latent defects of electrical stunning, both optimum and strong especially in tired birds. Processing of such poultry requires high standard of the production operations following slaughter.

The results of our study give us reasons to believe that bleeding degree of broiler carcasses (muscular tissue) doesn't depend on the stunning degree. Bleeding defects (blood retention in the large blood vessels) which may cause downgrading cannot be considered as a result of over stunning. Their origin is related to characteristic biological effect of electric current on a bird organism and depends on its physiological condition. Preslaughter factors the stress nature of which has been shown earlier (

,1978; Shumkov et al, 1978) (catching, loading, unloading, transportation etc.) cause weakening of a live organism and strengthen damaging effect of electrical current itself, regardless of the stunning degree.

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