ELECTRICAL STUNNING AND QUALITY OF CHICKEN CARCASS AND BREAST MEAT

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INTRODUCTION

Stunning is the operation aimed to render animals insensible during slaughtering procedures. Several techniques can be utilized for stu birds (KUENZEL & INGLING, 1977; GREGORY & WOTTON, 1987), but the most common is the waterbath stunner.
The efficiency of electrical stunning depends on the control of parameters like voltage, amperage, current frequency and immersion time recommendations of several researchers for optima conditions to obtain stunning (WABECK, 1988 and GREGORY & WILKINS, 1989a conflicting.
Five adverse effects are associated with high voltage stunning: 1)wing haemorrhages; 2)red skin conditions, including red wing-tips pygostyles; 3)poor plucking; 4)broken bones and 5)blood blemishes or blood coagules in breast muscle (GREGORY, 1989). GREGOR al. (1991) determined the effect of stunning current frequency on broilers and hens. When a sinusoidal AC was used, 50 Hz killed some o birds whereas at corresponding rms current 1500 Hz caused no ventricular fibrillation. Square wave DC at 50; 200 and 350 Hz did not pro any difference on carcass downgrading.
The present work aims to determine the effect of different stunning voltage and frequencies on chicken carcass and meat downgrading.

MATERIALS AND METHODS

Commercially Cobb bred reared, mixed-sex broilers, 45 days old were transported to a local slaughter plant. In each replicate 135 birds w selected to have live weights in the range 2,0-2,5 kg.
Fifteen birds were used in each treatment of two experiments ran consecutively. In a first experiment the birds were stunned at diffe voltages at 60 Hz, whereas in the second experiment four different frequencies at 40V were used during stunning. Ten seconds after stun the birds were automatically bled by a rotating knife. Bleeding was allowed for six minutes.
The birds were then packed into polyethylene bags and placed into insulated boxes filled with ice for transport to the laboratory. There were kept under refrigeration for 24 h when evaluations were conducted. For both experiments a control treatment of non-stunned birds used. Three replicates were carried out for each experiment at different times in the same season.
Experiment 1: Birds were stunned for 11 s in a water bath at 20, 40, 80 and 100 V at 60 Hz using a commercial stunner. Voltages w accuratly sett and measured by means of a laboratory voltimeter with a scale resolution of 10 V.
Experiment 2: Birds were stunned for 11s in a water bath at 40 V under frequencies of 200, 350, 500 and 1.000 Hz. For this purpos stunner was built that allowed variation of frequency from 0 to 1.100 Hz and of voltage from 0 to 100 V. The equipment generated a squ symetrical alternate bipolar wave for the accurate measurement of frequencies and an oscilloscope TEKTRONIC model 5103 N was used.
Blood Loss: The amount of blood lost over six minutes bleeding was determined by the difference of weight between the live and the b birds. Total blood volume of each broiler was estimated to be 7.5% of body weight (KOTULA & HELBACKA, 1966).
Carcass Grading: Carcass evaluation and grading was conducted according to the recommendations of GREGORY & WILKINS (1989 and GREGORY & WILKINS (1989b) using the following parameters: reddening of the wing tips, haemorrhages at the mid prime joing; blo spots at the breast portion, and broken bones. Cells with engorgement blood was established by observing the engorgement of the wings vein
Objective and Subjective Tenderness: The breast meat (eigty two fillets) kept at 2-3°C for 24h, wrapped in aluminium foil and cooked to internal temperature of 85°C according to the WORKING GROUP (1987). After cooling for 24h at 2°C samples from the right, were shear in an Instron equipment model TM-2318 using a Warner Braztler device. The left side of the breast was used for sensory analysis.

RESULTS AND DISCUSSION

Stunning Voltage and Bleeding Efficiency: Stunning voltage had a significant effect on blood loss. Stunning at 20 - 40V, whi corresponded to currents in the range of 20 - 50mA, resulted in significantly higher blood loss. Lowest blood loss (27,2%) was obtained w unstunned broilers. This value was not statiscally different from the 34,7% and 30,2% obtained by stunning at 80V and 100V respectivel which corresponded to currents in the range of 60-125mA (Table 1).
The most efficient stunning condition for blood loss, e.g. stunning at 40V resulted in 55,3% higher than the 35 - 50% reported by NEWELL SHAFFNER (1950) also higher than the 35 - 50% blood losses obtained by POTSUBAY & DUDUK (1966) . Under the conditions of th study only for currents above 50mA broilers presented symptons corresponding to end of respiration, retention of muscular tonus and death So it can be assumed that the reduction in blood loss for higher voltages was due to a higher incidence of birds with ventricular fibrillation. These results are in disagreement with those of PAPINAHO & FLETCHER (1995) who concluded that currents in the range of 0 - 200mA d not affect blood loss if bleeding last for 150s. In support of our results VEERKAMP & DE VRIES (1983) reported a reduction in blood los when voltages increased from 75 to 200V. They concluded that ventricular fibrillation induced by high voltage reduced bleeding. WEISE et (1988) argues that if bleeding is allowed for 180s total blood loss will not be affected by the ventricular fibrillation. Some of the disagreement might be explained by the breed used in different studies since KRANEN et al. (1996) found that blood loss was dependent on the stunning method and bird strain.
Stunning frequency and blood loss: Considering that 40V was the voltage that caused higher blood losses when stunning was conducted 60Hz, it was chosen to measure the influence of current frequency on bleeding.
Higher blood loss averaging 73,5% were observed when stunning at 1000Hz although not statistically different from the values obtained with treatments at 60 and 350Hz that resulted in average blood losses of 55.3% and 56.2% respectively (Table 2).

Table 1 - Blood loss and stunning voltages

Voltage (V)	Electric current (mA)	Blood loss (%)
20	20 - 29	49.6^{ab}
40	30 - 50	55.3^{a}
80	60 - 98	34.7^{bc}
100	70 - 125	30.2^{c}
No stunning	-	27.2^{c}

N = 30 birds/treatment.
a, b, c Means in the same row within treatment with different superscrpts differ (P<0.05).

Table2 - Frequency fo stunning at 40V and bloos loss.

Frequency (Hz)	Blood loss (%)
60	55.3^{ab}
200	43.5^{bc}
350	56.2^{ab}
500	44.2^{bc}
1000	73.1^{a}
No stunning	27.3^{c}

N = 30 birds/treatment.
a, b, c Means in the same row within treatment with different superscrpts differ (P<0.05).

The lowest average blood loss of 27.3% was obtained with unstunned birds. It was observed that there was a large variability in the blood loss values within the same treatment, showing the effects of other factor on bleeding rather than current frequency and voltage.
According to GREGORY et al. (1991) the use of high frequencies foster the start of bleeding, but actual values of blood loss as a function of frequency was not found in the literature. HILLEBRAND et al. (1996) reported that stunning using 200Hz currents resulted in less hemorrhages in the carcass than when using 50Hz but they did not give figures for blood loss. GREGORY et al. (1991) quoted that manufacturers of high frequency stunners claim better bleeding but did not mention blood loss values.
Some of the defects appeared to be affected by increasing the stunning voltage (80V, 100V) at 60Hz. These included reddening, engorged wing veins, superficial and deep haemorrhages in the breast muscle and broken bone like clavicle. However, the lowest incidence of defects was found for the 1000Hz/40V stunning condition and that the only defect was engorgement veins in 33,3% of the carcass. Unstunning resulted also in a carcass with few defects, only red wind tips, engorged wing vein and haemorrhages in superficial breast meat (Table 3).
Objective and Subjective Tenderness: The shear value showed that stunning at 1000Hz,40V had positive influence on the tenderness of the breast meat, because there was significative diference (P<0.05) when compared to control samples which were not stunned. Sensory analyses (tenderness) showed that stunning at 1000Hz/40V had a positive effect on the tenderness of the chicken breast meat. However, there was no significant difference in tenderness of the breast meat from treatment and untreated birds.

CONCLUSION

The use of high frequencies at 1000Hz and 350Hz/40V produced higher efficiency in the bleeding. However, there was no difference of treatment of 60Hz/40V. Some of the defects increased as the stunning current increased to 60Hz. Also affected the incidence of breast muscle haemorrhages and broken bones in the collar region. On the other hand, stunning at higher current frequencies at 1000Hz/40V result in fewer defects and had significant effects objective tenderness.

Table 3. - Effects of stunning voltage and frequency on carcass downgradings in broilers

Treatment	Reddening (%)				engorgement wing veins	broken bones (%)		Haemorrhages (%) in breast muscle	
Hz, V	Red wing tip	Red pygostyles	at humerus radius joint	Breast muscle		coracoid	clavicle	superficial	deep
60, 20	--	--	--	--	33.3	-	-	6.7	6.7
60, 40	--	6.7	6.7	--	60.0	-	6.7	6.7	13.3
60, 80	20.	13.3	20.0	13.3	73.3	6.7	20.0	13.3	6.7
60, 100	26.7	--	20.0	--	86.7	-	13.3	20.0	26.7
200, 40	20.0	--	6.7	--	40.0	-	-	-	-
350, 40	13.3	--	--	--	40.0	-	6.7	-	6.7
500, 40	6.7	--	6.7	--	53.3	-	-	-	-
1000, 40	--	--	--	--	33.3	-	-	-	-
No stunning	20.0	--	--	--	33.3	-	-	-	-

N= 15 birds/treatment

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