CARDIAC ARREST STUNNING IN POULTRY

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SUMMARY

The voltages required to kill at least 90% of the birds by a 6-second passage through a water bath stunner were evaluated by the up and down method and the electrocardiogram to be as follows: layers 220 V/4-6 s, guinea fowl 250 V/4-6 s, ducks 208 V/3-4 s, geese 376 V/2-3 s, adult turkeys (toms) 210 V/2-4 s, (hens) 360 V/2-6 s. Voltage differences between turkey males and females are related to impedance variations. High voltage required for geese might have resulted from reduced time of exposure.

Thus 100 spent layers were culled in a waterbath stunner at 220 V with "standard" (6-7 s) or "prolonged" (10-12 s) exposure time. In all "standard" and half the other hens the legs were wetted.

Prolonged stunning time increased death rate by ca. 20% if the legs had been wetted. Prolongation of stunning exposure might thus help to raise killing efficiency but other stunning conditions must likewise be optimised.

INTRODUCTION

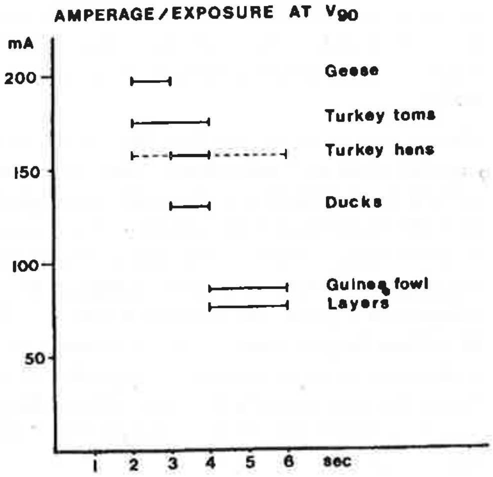
Stunning inducing heart fibrillation has been recommended for years as the most humane electrical method for the slaughter of poultry (Wormuth et al. 1981; Heath 1984; Gregory and Wotton 1985), but not until recently has it been approved by authorities, whether internally as in Germany or publicly as by the USDA (Childers, 1987). For broilers at least 150 V (Wormuth et al. 1981; Schütt-Abraham et al. 1987a) or 150 mA per bird are recommended for effective killing (Gregory and Wotton 1987). No sufficient data is known for other poultry species.

STUNNING EXPERIMENTS IN POULTRY OTHER THAN CHICKEN

In a series of experiments using the up and down method the voltages (sinus, 50 Hz) required to kill at least 90% of the birds submitted to a 6-second passage through a water bath stunner were determined for layers, guinea fowl,ducks, geese and (adult) turkeys. All birds were shackled backs first in accordance with behaviour observations in individually processed poultry (Wormuth et al. 1981) and immersed unto the base of their wings except for the oversized turkey toms which dipped in unto their mid breast region. The occurrence of heart fibrillation was confirmed by recording the electrocardiogram. (For a detailed description of the experimental design see Schütt-Abraham et al. 1987a, b).

Under these experimental conditions the voltages required to kill 90% of the stunned birds were determined to be 220 V for layers, 250 V for guinea fowl,360 V for turkey females, 210 V for turkey males, 208 V for ducks and 375 V for geese (Table 1). While layers and guinea fowl were always killed by currents exceeding 80 mA, the highest amperage survived by turkey hens was 130 mA, by turkey toms 160 mA, by ducks 165 mA and by geese 220 mA.

Figure 1



While the voltage differences between turkey sexes can be explained by impedance variations based on diameter and surface properties of the legs the high voltage required for geese could not. However, during the experiments it was noted that the time of exposure did not closely follow the passage duration but tended to decrease with increasing size and/or restlessness of the birds. While layers and guinea fowl made current contact for at least 4 seconds while passing the stunner for most other species this time was the maximum, with geese being exposed for only 2-3 seconds. From the data in Table 1 the amperage-time relation underlying the 90% killing level was roughly estimated as shown in Fig.1.

While the onset of an epileptiform fit is considered to be an all or not event which has to be triggered by reaching the threshold current within the first moments of exposure (Hoenderken 1979) the hazard of developing heart fibrillation is known to be modified by the duration of current flow (Kamphuis 1983). Provided the criteria for immediate initiation of an epileptiform fit are met it should thus be possible to stun effectively without having to raise the voltage above 250 V by simply prolonging the time of exposure. This would help to minimize the risk for the slaughter personnel, as in a water bath stunner the voltage is applied continuously.

OBSERVATIONS AT PROLONGED EXPOSURE

When our flock of 100 spent layers had to be culled we thus seized the opportunity for further observations. All birds were routinely submitted to 220 V in a water bath stunner while shackled sideways and dipping in unto the base of their wings. One third of the flock passed the stunner in standard time of 7 seconds after their legs had been wetted to improve shackle-bird contact(Group I). Another third was treated likewise except that the passage time was prolonged to 12 seconds (Group II). The remaining birds (Group III) differed from those in Group II only in that their legs remained dry

Sticking was carried out manually by an unilateral cut ca. 30 seconds after the onset of current flow and the birds were allowed to bleed for at least two minutes before further processing (scalding in a hot water tub, plucking on a rotating drum, evisceration and dressing by hand; processing operations not standardised).

The following parameters were observed and recorded: behaviour during and after stunning and bleeding, corneal re flex and respiration, death rate (ventricular fibrillation confirmed by electrocardiogram) and occurrence of bruises. As previously reported for layers the time of exposure differed only slightly from the passage duration and resulted in 6-7 seconds for Group III resp. 10-12 seconds for Groups I and II.

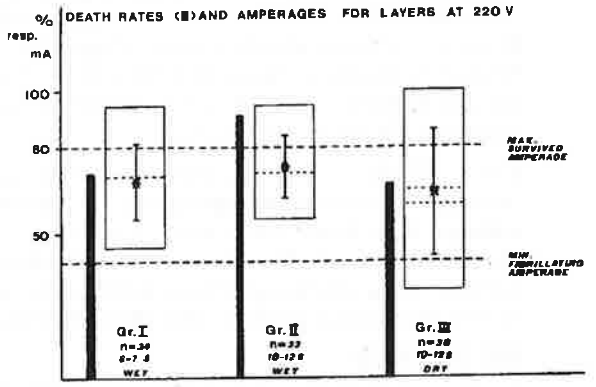
As expected (see Fig.2) the amperages were highest in Group II which combined wetted legs and prolonged exposure (X = 73 mA;s = 11 mA), followed by Group I with wetted legs and standard exposure (1 = 68 mA; s = 13 mA) and Group III with untreated legs and prolonged exposure (X = 64 mA; s = 22 mA).

Death rates were similar in the latter two groups with 71% in Group I and 67% in Group III. Most successful in triggering heart fibrillation proved to be the combination of wet legs and prolonged exposure as 91% of the birds in Group II were killed. Thus under otherwise similar conditions prolongation of exposure time as well as wetting the legs increased the death rate by ca. 20%. By wetting the legs not only a notable increase in amperage means, but also a distinct reduction in amperage variation could be achieved.

In accordance with previous observations heart fibrillation occurred from as little as 40 mA on while the maximum amperage survived by a layer was 80 mA.

None of the birds expressed the classical triad of an epileptiform fit: after cessation of the tonic spasms the hens just went limp. Without recording the electroencephalogram it could not be determined whether the clonic phase was actually missing or just its motoric analogy suppressed.

Figure 2.



Layers killed during stunning could readily be distinguished from survivors within 35 seconds after the onset of current flow. If at this time neither corneal reflexes nor respiratory movements were present it was safe to assume that the birds had developed ventricular fibrillation. The absence of hypoxemic spasms during bleeding provided further confirmation.

A similar connection between the rate of heart fibrillation and the percentage of chicken not reacting to touching the cornea ca. 45 seconds after the onset of current flow was previously reported for broilers by Weise et al. (1987). Thus the corneal reflex, although an invalid criterion for recognizing the state of consciousness after electrical stunning, 40-45 seconds after the onset of current flow may be used as indicator for the killing efficiency of the stunning process which can easily be evaluated at the slaughter line.

Hematomas the size of a cherry were found in the wing joints of only 6 out of 67 inspected carcasses, and in 3 of these cases were restricted to one side. Reddening of wing tips was not observed.

Table 1
Estimated voltage for killing 90% of the birds (V_{90}) during a 6-second passage of a water bath stunner

Species	Exposure time (sec)	V_{90} (v)	Calculated Impedance at V_{90} (kΩ) $\bar{x}$/s	Calculated Amperage at V_{90}	Maximal survived Amperage (mA)
Layers (1,3-2,3 kg) (n=63)	4-6	220	2.9/0.8	76	80
Guinea-fowl (1,2-2,3 kg) (n=68)	4-6	ca.250	2.9/1.4	86	80
Turkey hens (6,4-10,3 kg) (n=68)	ø 3-4	ca.360	2.3/0.9	157	130
Turkey toms (14,2-25,0 kg) (n=69)	2-4	210	1.2/0.3	175	160
Ducks (2,0-3,2 kg) (n=70)	3-4	208	1.6/0.3	130	165
Geese (4,3-6,7 kg) (n=69)	2-3	375	1.9/0.5	197	220

Because of the non-standardized manual processing procedures these data have to be treated with caution. However, if blood retention in the wings of electrocuted birds were mainly responsible for this kind of hematoma we would have expected a far greater percentage of carcasses affected by this bruise.

From all these observations was concluded that prolongation of stunning exposure might help to keep the voltages in a Water bath stunner at levels not overly hazardous for man. However, other stunning conditions will likewise have to be optimised. Further research in this field is planned for poultry other than chicken.

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