AN EVALUATION OF HIGH VOLTAGE STUNNING OF PIGS IN A RESTRAINER

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INTRODUCTION

THE FIRST proprietary system to be installed in Northern Ireland for restraining pigs during electrical stunning was introduced in 1974. The equipment was designed for bacon weight pigs (c. 90 kg live weight) at a maximum killing rate of 240/hr. The factory has a hollow sticking knife arrangement for collecting blood for edible purposes. A number of problems listed below arose on commissioning.

1. It was difficult to get pigs to move along the runway, which was 15 m long; some would lie down and others got their head under the pig in front.

2. The stunner operator, standing at ground level, also controlled the rate at which pigs were discharged from the restrainer. The movement of the restrainer conveyor tended to be erratic and pigs frequently emerged in pairs.

3. Stunning with conventional single-handed tongs at 65-95V x 50 Hz did not appear to give satisfactory anaesthetisation, so hampering blood collection.

The designs of the runway, restrainer and stunning apparatus were studied with a view to improving the existing layout and designing a satisfactory restrainer/stunning arrangement.

EXPERIMENTAL

Development of a high voltage stunner

INITIALLY an "Electro-Sting" high voltage stunner (Electronics Unlimited, Memphis) was evaluated. The design was such that the pig had to be restrained during stunning in order to maintain physical contact between the electrodes and the animal (Fig. 1A). To facilitate the operator, a stand was provided 1m high and a foot switch to control the entry and exit of pigs into and out of the restrainer. The holding bars on top of the restrainer had to be lowered to prevent pigs jumping on top of the leading animals and also to present a level pig for stunning. The original stunner operated at 300V with an application time of 3 sec. By experimentation, this was reduced to 240V at c. 600 mA with an application time of 6 sec. After stunning the pigs appeared to be relaxed, comparable to pigs after CO_2 anaesthetisation. The difficulty was that the regulations in Northern Ireland require a maximum voltage of 125V (Anon. 1945). Other conditions were that all conductors must be insulated and given mechanical protection, to ensure complete safety. In consultation, the following modifications were agreed and a new system was constructed.

1. A "double wound" (non-earthed) transformer was incorporated.
2. The control gear - timer, variable transformer, fuses and warning lights - was assembled in a watertight enclosure.
3. The applicator had 2 switches to prevent accidental actuation and also a warning light, adjacent to the electrode, to indicate a live circuit.
4. The applicator was provided with a spring balancer.
5. An enclosure surrounding the top of the restrainer was also provided.

A new apparatus was constructed to the following specification:-

CONTROL BOX	Output voltage.	Fully adjustable between 0-300 volts via double wound (non-earthed) transformer.
	Output current.	2000 mA max. limiting by means of trip switch with reset facility.
	Pulse duration.	Adjustable between 0-10 sec by means of an electronic timer with relay interlock.
	Output meters.	Fascia mounted ammeter and voltmeter.
	Power supply.	230-240V, 50 Hz.
	Enclosure.	Weatherproof resinglass with front access lockable door and meter sighting window.
	Warning light.	To indicate power (a) to control box and (b) to applicator.
APPLICATOR	Electrode spacing.	400 mm.
	Handle.	Moulded handgrip with trigger switch for one hand and push button switch for other hand.
	Warning light.	Pulse duration warning lamp incorporated in applicator.
	Cable.	4 m heavy duty rubber covered cable to control box.

Modifications to the conveyor

THE LENGTH of the runway was reduced to 8 m. A rail 25 mm outside diameter was fitted along the centre of the runway approximately 175 mm from the runway floor, to prevent pigs lying down or getting their heads under the one in front. Modifications to the runway floor leading to the restrainer included holding-down bars to

prevent pigs climbing on top of each other immediately prior to stunning (Fig. 1B). The setting of the restrainer conveyor was as shown in Fig. 1C.

The drive motors were accommodated under the restrainer. Whilst this could be inconvenient for maintenance, their reposition facilitated the stunning operation. A roller conveyor was also installed for the shackling operation.

Assessment of blood splashing

THE DEGREE of haemorrhaging, assessed by a subjective method, was examined in the lungs of pigs stunned by 5 methods currently in use in Northern Ireland. The lungs were evaluated visually on removal from the carcase and classified into 1 of 3 arbitrary categories:-

1. No evidence of or slight haemorrhaging in one lung.
2. Slight haemorrhaging in both lungs or severe in one.
3. Severe haemorrhaging in both lungs.

RESULTS AND DISCUSSION

TO DATE two installations have operated on a total of $\frac{3}{4}$M pigs. Maintenance of the restrainers has been confined to replacement of the conveyor slats and an occasional rewind of the electric motor.

In one instance water entered the stunner control box, causing earth leakage. This was detected by observing that the pig behind the one being stunned was also receiving a shock. It has been found that the voltmeter and ammeter should be kept switched off except for testing, as their life is otherwise limited. The copper electrodes in contact with the pig have to be replaced periodically. Generally the system has been most reliable and well received by the operatives, particularly those carrying out blood collection.

It has been known for some time that various stunning methods can give rise to "blood splashing" in the meat of slaughter animals. This is due to the rupture of capillaries and blood vessels caused by the dramatic and substantial increase in blood pressure at and immediately following the stunning procedure. The detection and evaluation of this condition in meat can be difficult and economically prohibitive. The examination of the degree of haemorrhaging in the lungs has shown it to be directly related to muscle blood splashing (Blomquist, 1958). Such an evaluation, although indirect, has many advantages, mainly that dissection is unnecessary and that large numbers of animals can be assessed easily. The results are given in Table 1.

The anaesthetising of pigs with carbon dioxide using either the "Oval tunnel" or the "Compact" system gave the lowest incidence of lung haemorrhages. Of the three systems of electrical stunning examined, the system described above was superior in that the incidence of "severe" lung haemorrhaging was 3.5% as compared to 13.6% (97V; 1700 Hz) or 20.6% (80-125V; 50 Hz), although it was not as good as either of the CO_2 methods.

Table 1. Incidence of haemorrhaging in the lungs of pigs stunned by different methods

Method of stunning	No. of factories	Total no. of pigs examined	Incidence (%) of lung haemorrhaging in categories* 1 None	2 Slight	3 Severe
80-125V; 50 Hz	4	1048	48.4	31.0	20.6
97V; 1700 Hz	1	228	64.9	21.5	13.6
240V; 50 Hz	2	283	67.2	29.3	3.5
Carbon dioxide "Oval tunnel"	2	410	85.4	13.7	1.0
Carbon dioxide "Compact" system	1	500	90.6	9.2	0.2

* 1, No evidence of or slight haemorrhaging in one lung.
2, Slight haemorrhaging in both or severe in one.
3, Severe haemorrhaging in both lungs.

However, it must be added that although "blood splashing" is not common in the musculature of pigs slaughtered in Northern Ireland, it can be concluded that the new system will lessen the incidence.

CONCLUSIONS

THE ADVANTAGES of the system described above may be summarised as follows:-

1. Ease of stunning.
2. All pigs receive the same stunning treatment.
3. After stunning the pigs are completely relaxed, which facilitates (a) shackling, (b) sticking, particularly if blood is being collected for edible purposes.
4. There was a lower incidence of blood splashing using this method.

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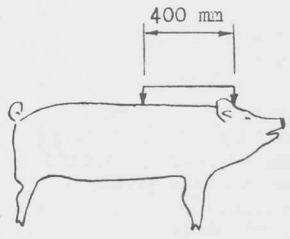

Fig. 1A. STUNNING LOCATION

Fig. 1B. GENERAL LAYOUT OF RESTRAINER AND STUNNER

Fig. 1C. RESTRAINER SETTING