

A NEW DEVICE WITH MEASUREMENT AND SIGNALLING OF ELECTRIC CHARGE FOR STUNNING PIGS

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SUMMARY

The new prototype stunning instrument equipped with the hand tongs, digital measurement and signalling of electric output charge for stunning pigs was developed. Some experiments carried out in a slaughterhouse showed specified advantages of this device comparing with conventional equipment, particularly in high improvement of the effect of stunning and work safety.

Introduction

In Polish meat industry only electrical stunning of pigs is applied. Almost in all slaughterhouses (even in big ones) the conventional equipment with hand tongs is used and the animals mostly are not immobilized during the stunning process. Only in a few large plants the restrainers for transport and immobilizing of pigs are installed but mostly without any automatic stunning systems. According to Polish safety regulations, that were obligatory till the end of 1992, only stunning voltages not higher than 80 V (frequency of 50 Hz) were permitted. As it is well known the really effective stunning of pigs with those voltages is mostly impossible. The new regulations that came into force in 1993 allow using the voltages up to 250 V, 50 Hz for pig stunning with hand tongs i.e. just as in majority of EU countries. However the technical requirements regarding stunning instruments were considerably increased.

From experimental studies of different authors (Troeger, 1990), (Troeger and Woltersdorf, 1990) is known that to achieve the proper stunning effect and good meat quality in the pig the sufficient electric current intensity and stunning time are needed. The quotient of both values gives the electric charge which in its optimum value should amount about 15 C (1 C = 1 coulomb = 1 As). According to Ohm's law by given voltage the stunning current should vary with animal body resistance measured between the tongs electrodes. The resistance depends on relatively many factors as e.g. pig weight and dimensions, skin wetness, positioning and pressing of tongs (electric contact). On the other hand by conventional equipment the stunning time is defined subjectively ("by guess") by the personnel. Therefore the conventional methods do not secure the most favourable effect of pig stunning. The objective of the project described in this paper was to build a new instrument that allows to optimize stunning process by use of measurement and signalling of electric charge.

Materials and methods

In the first part of work a number of measurements of current intensity and animal body resistance during the stunning of pigs with the hand tongs using different voltages with mains frequency of 50 Hz were carried. Rectangular serrated electrodes were applied correctly on both sides of head at the base of the ears. In experiment made in slaughterhouse 3 groups (A,B,C) of randomly selected pigs of White Race each of 27 animals were used. The skin of the animals was moistened. The hand tongs were connected to the experimental device equipped with transformer with adjustable output voltage from 100 to 600 V, voltmeter, ammeter and time relay. The stunning times of 5 - 12 s were used (shorter times for higher voltages and inversely). The animals in 3 groups with weight of 85 - 165 kg (A), 85 - 139 kg (B) and 87 - 151 kg (C) were stunned by output voltage settings of 100 V, 300 V and 600 V respectively. During the stunning each pig the actual output voltage (U_s) and stunning current intensity (I) were measured that enabled to evaluate the electrical resistance between electrodes R_s .

In the second part of work the new stunning instrument (prototype) was used. Fig. 1 shows the simplified circuit

diagram of the device. The main separating transformer Tr1 provides the stunning voltage of 250 V, 50 Hz and the second transformer Tr2 with rectifier circuit - constant measuring and control voltage of 12 V. The calibrated resistor R has two functions: first in the moment of seizing pig head with tongs when it acts in the circuit measuring the resistance between electrodes using measuring voltage 12 V in order to automatic switching on the stunning voltage. The next function is to measure the output current intensity during stunning. This value is currently multiplied by time value in microprocessor unit MU with accuracy of about 1 C. The result is displayed as electric charge in coulombs with digital display unit D. The required charge value is adjustable in range of 0 - 20 C. As soon as a right charge value is achieved a short bell signal is provided. Then the stunning process should be stopped by the personnel. The removal of tongs from the pig body causes an automatic switching off. The digital display is then automatically reset to null and the next stunning process is possible to start.

In the second experiment 3 groups ("5", "10" and "15") of randomly selected pigs of White Race each of 20 animals were used. The weight of pigs was within 85 - 132 kg. The pigs were stunned in similar conditions as previously with hand tongs connected to the new stunning instrument using 3 settings of electric charge : 5 C (group "5"), 10 C (group "10") and 15 C (group "15"). Each time the resulting time of stunning process (up to bell signal) was measured. Moreover the movements of pigs after stunning were observed and the loss and regain of consciousness by pigs was visually estimated.

Results and discussion

The results of the measurements made in the first experiment are following (the ranges of parameters were mentioned): in group A (100 V) $U_s = 90 - 95$ V, $I_s = 0.3 - 0.6$ A, $R_s = 150 - 318$ ohm, in group B (200 V) $U_s = 270 - 290$ V, $I_s = 1.1 - 1.5$ A, $R_s = 104 - 290$ ohm, in group C (600 V) $U_s = 420 - 550$ V, $I_s = 1.8 - 3.5$ A, $R_s = 120 - 300$ ohm.

These results show that the resistance between electrodes varies in the range of 100 - 320 ohm i.e. very strongly even by correct tongs positioning. In consequence of this by constant voltage the stunning current varies similarly. It makes the correct and uniform stunning of all animals using conventional devices (without measuring instruments) almost impossible to achieve in industrial conditions, particularly in Poland where relatively big variability of pig weight is still observed.

Observations made in the second experiment showed that by given electric charge all pigs are approximately similarly stunned. In group "5" the stunning time varied within 3 - 5 s and the stunning effects mostly were found insufficient (strong motor activity after stunning). In group "10" actual stunning time was in range 7 - 10 s and the stunning effect was considerably better but the loss of consciousness by pigs remained no longer than about 30 s. Charge setting of 15 C in group "15" (resulting stunning time 9 - 14 s) was found as optimum for the majority of stunned pigs that confirms the results obtained by another authors (Troeger and Woltersdorf, 1990). In this case the most of animals were acceptable quiet during about 1 min after stunning ends that gives more time to the beginning of bleeding process.

The experiments showed that the new stunning instrument is very safe comparing to conventional equipment. Accidental touch of electrodes with two hands by the personnel does not cause the automatic switching on the stunning voltage thanks to correct selecting of operation threshold. It seems that the stunning instrument with measurement and signalling of electric charge is a better solution than instrument keeping the constant current intensity during the stunning process (Troeger and Woltersdorf, 1990). In the last case there is a danger of excessive voltage growth by poor electric contact between the electrodes and animal skin (or insufficient stunning when the restriction of voltage growth would be applied).

Conclusion

The new stunning device with measurement and signalling of electric charge is more efficient comparing to conventional equipment. Application of the instrument improves considerably the effect of stunning, especially in respect of uniformity process and also improves the work safety. Further detailed research using this device including problems of meat quality are planned. Also production of these instruments will be started this year.

References

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