

Elektrische Betäubung von Schlachtschweinen.

R. HOENDERKEN

Institut für Tierzucht "Schoonoord" - Zeist, die Niederlanden

In Experimenten wurde versucht, objektiv festzustellen, wieweit nach der elektrischen Betäubung *"das Bewusstsein so schnell wie möglich ausgeschaltet wird und wieweit Bewusstlosigkeit von genügend langer Zeit entsteht"*. Wenn dies nicht der Fall war, wurde versucht anzugeben, unter welchen Bedingungen dieser Ausgangspunkt erreicht konnte. Ebenfalls wurde untersucht, wie lange eine durch elektrische Betäubung hervorgerufene Bewusstlosigkeit anhielt. Diese letzten Daten können einen Hinweis geben, in welcher Zeit nach der Betäubung die Tiere entblutet werden müssen.

Die elektroencephalographische Untersuchung bei Schweinen bei verschiedenen elektrischen Betäubungsmethoden wurden beschrieben. In dem Versuchsplan sind alle Faktoren, die möglicherweise Einfluss auf die Betäubung haben, wie die Spannung, die Stromstärke, die Betäubungszeit und das richtige Anbringen der Elektroden der Betäubungszange während der Betäubung, eingebaut.

Auch wurde die EEG-Untersuchung nach elektrischer Betäubung mit konstanter Stromstärke (50 Hz, Wechselstrom) beschrieben. Das Ziel dieser Experimente war, eine statistisch zuverlässige Schätzung über die Stromstärke machen zu können, welche notwendig ist, um in minimal 90% der Fälle eine effektive Betäubung zu garantieren. Eine effektive Betäubung ist wie folgt definiert: Das Auftreten eines epileptischen Anfalls innerhalb einer Sekunde, ausgelöst durch elektrischen Strom.

Der Einfluss der Entblutung auf die Hirnaktivität wurde bestimmt. Gemessen wurde die Zeit zwischen dem Entblutungsstich und dem Verschwinden der Hirnaktivität infolge des Blutverlustes. Aus diesem Teil der Untersuchungen konnten auch einige Schlüsse für das Schächten gezogen werden.

Weiterhin wird diskutiert, auf welche Weise die Ergebnisse der vorliegenden Arbeit in der Praxis angewendet und kontrolliert werden können. Ebenfalls wird auf die Sicherheitsaspekte für das Bedienungspersonal eingegangen. Schliesslich sind noch die ersten Ergebnisse aus den Untersuchungen mit einer automatisierten elektrischen Betäubung von Schlachtschweinen angegeben.

Electrical stunning in pigs.

R. HOENDERKEN

Institute for Animal Husbandry "Schoonoord" - Zeist, the Netherlands

Investigations were initiated with the objective of determining if and how long after stunning *"the consciousness disappeared as fast as possible and a state of unconsciousness for a sufficient long period is realised"*. In those circumstances where this did not happen criteria are given for successful operational conditions. Furthermore the length of time evoked unconsciousness lasted, was investigated. This would give an indication about the limits of the bleeding time.

The effectiveness of several electrical stunning methods have been investigated using electro-encephalography to monitor the effects. The experimental equipment and procedures included all relevant factors such as voltage, current, time span of stunning and the location of the electrodes of the tongs during the stunning act.

Also experiments with EEG are described in which the stunning was effected with a constant current level (50 Hz of different magnitude). The aim was to determine (statistically) a current level which was required for at least a 90% effective stunning rate. Effective stunning was defined as follows: Electrical current applied and resulting in a generalised epileptic insult within one second.

The experiments on the relation between bleeding and brain activity are reported. Important in this respect was the determination of the time between the moment of sticking and the disappearance of brain function due to blood loss. From this part some conclusions were drawn in relation to the so-called "ritual slaughtering". Furthermore it is indicated how the experimental results might be applied in practice. Also appropriate control measures for guaranteeing the security of the stunning operator are discussed. In addition the first results obtained with properly modified automatic stunning equipment are given.

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L'étourdissement électrique de porcs.

R. HOENDERKEN

Institut de recherches zootechniques "Schoonoord" - Zeist, Pays-Bas

Le but de cette recherche était d'examiner dans quelle mesure l'étourdissement électrique du porc de boucherie répond aux impératifs fixés par la loi. On s'est efforcé de déterminer objectivement dans quelle mesure *"la conscience est relevée le plus vite possible et dans quelle mesure se produit une perte de conscience d'une durée suffisante"*. Dans les circonstances pendant lesquelles ceci ne se produit pas, on essayait de démontrer quelles conditions garantiraient les normes prescrits. Aussi on examinait combien de temps se prolongeait la perte de conscience stimulée par l'étourdissement électrique. Ceci pourrait être une indication de la période dans laquelle les animaux doivent être saignés.

On a décrit la recherche électro-encephalographique des porcs après plusieurs méthodes d'étourdissement électrique. Dans le projet d'essai sont mentionnés tous les facteurs d'observations, comme par exemple l'influence du placement des électrodes de la pince d'étourdissement pendant l'étourdissement.

On a aussi décrit la recherche électro-encephalographique des porcs après l'étourdissement électrique, avec une intensité constante du courant (à 50 Hz courant alternatif). Le but de ces expériences était de donner une estimation, statistiquement justifiée, de l'intensité du courant, qui est nécessaire pour garantir au moins 90% de cas d'étourdissement effectif. Il était donc nécessaire de définir ce que l'on comprend par étourdissement effectif dans le contexte de cette thèse. Cette définition est la suivante: provoquer chez cet animal en 1 seconde un mal épileptique généralisé à l'aide de courant électrique.

L'influence de la perte du sang du porc sur l'activité du cerveau était déterminée. On a examiné combien de temps il se passe entre le début de la saignée et le moment où la fonction du cerveau s'éteint par la suite de cette opération. En même temps on peut tirer des conclusions de cette partie de la recherche à l'égard de quelques aspects importants du soi-disant abattage rituel.

On a indiqué de quelle façon on peut appliquer cette méthode et moment se conformer aux résultats de recherche sur celle-ci. En même temps les aspects de sécurité pour les employés de l'abattoir sont traités. Enfin sont présentés les premiers résultats des expériences concernant l'automatisation de l'étourdissement électrique de porcs de boucherie.

Электрическое оглушение свиней.

Др. Р. ГУНДЕРКЕН

НИИ Животноводства "Схооноорд", г. Зейст, Голландия

Цель, которую исследованиями преследовали, состоялась в том, чтобы установить, если и через какой промежуток времени после оглушения "как можно скорее исчезнет сознание и наступит состояние потери сознания в течение достаточно долгого периода". Для тех случаев, когда это не произошло, были составлены критерии для эффективных обстоятельств.

В дальнейшем было произведено исследование продолжительности потери сознания, что в свою очередь могло бы послужить в качестве показателя ограничения времени кровоистечения.

У свиней были внедрены электро-энцефалографические технологии. Сначала приведено рассмотрение значения EEG данного вида исследования, а после того - описание хирургических методов, применяемых для вставки в череп электродов, записывающих результаты показаний установки оглушения.

Далее приведено описание экспериментов с записью EEG, в условиях которых оглушение было осуществлено при помощи силы тока постоянного значения (50 герц различной силы). Цель этих экспериментов состоялась в статистическом определении такой силы тока, которая является необходимой для получения эффективного оглушения по крайней мере на 90%. Целесообразное оглушение определяют как следует: применение такого электрического тока, следствием которого является всеобщий эпилептический инсульт в течение одной секунды.

Приведено сообщение об экспериментах, направленных на связь между кровоистечением и мозговой деятельностью. В этом отношении важное значение имеет определение необходимого - между мгновением укола и исчезновением мозговой деятельности вследствие потери крови - времени.

Из этого делают некоторые заключения, имеющие отношение к так называемому "ритуальному убое". Сверх того приводится сообщение о том, каким образом результаты приведенных опытов можно внедрить в практическую жизнь. Сюда относятся также контрольные мероприятия, являющиеся гарантией для безопасности занимающегося оглушением животных работника. Кроме того приведены первые результаты, полученные при помощи применения установок оглушения.

Electrical stunning of pigs for slaughter

R. HOENDERKEN

Research Institute for Animal Husbandry "Schoonoord", Zeist, The Netherlands

Introduction

The practical application of electrical stunning of pigs for slaughter in most countries is regulated by law. It is required that unconsciousness is evoked immediately, unnecessary animal suffering is prevented, and that the safety of the stunning equipment operator is guaranteed. During recent investigations (HOENDERKEN, 1978) doubts have arisen about whether the regulations met the aim of the law.

The goal of these investigations was to assess objectively to what degree these requirements were met and how different usual stunning methods were in practice. Experiments were set up with the objective of determining if and how long after stunning the consciousness disappeared and the unconsciousness period lasted.

Material and methods

The effectiveness of several electrical stunning methods were investigated using electro-encephalographic equipment to monitor the effects. The electrodes for recording the electro-encephalogram (EEG) were surgically inserted in the skull of the pig to make contact with the dura mater. The stunning experiments took place approximately 18 hours after surgery. The experimental equipment and procedures included most relevant factors which are present in practice in the countries of the EC (VON MICKWITZ and LEACH, 1977), such as voltage, current, time span of stunning and the location of the electrodes during the stunning act. Furthermore other factors were added, such as the type of stunning tongs and the condition of the skin (dry or wet). All these factors were investigated at different levels (multifactorial experiments). The investigated levels were:

- A. Voltage : 1) 70 volt 2) 180 volt
3) 300 volt 4) 600 volt
- B. Type of stunning tongs : 1) pair of tongs with sharp electrodes
2) pair of tongs with eroded electrodes
3) single handed tongs
- C. Location of the electrodes : 1) ear-ear 2) ear-eye
3) nape of neck-bridge of nose 4) eye-heart
- D. Stunning time in seconds : 1) 5 seconds 2) 1 second
- E. Skin of the pig : 1) dry 2) wet

After these investigations it was necessary to do experiments, also with EEG recording, in which the stunning was affected with a constant current level (50 hertz of different magnitude). These current levels make it possible to determine what percentage of the pigs were effectively stunned in practice by recording the current in use during the stunning.

Main results of the experiments

- 1) After stunning experiments with 70 volts, generally there was not effective stunning (table 1).

		ear-ear		eye-ear	
		70 V	180 V	70 V	180 V
1st stunning	1 sec.	00	75	00	100
	5 sec.	13	75	50	100
2nd stunning	1 sec.	00	88	00	100
	5 sec.	25	75	75	100

Table 1. Percentage stunned animals per combination of voltage, location of the electrodes and time of application, separately for the first and second stunning, for 64 pigs.

- 2) After stunning experiments with 180 volts, effective stunning was generally possible, when the electrodes of the stunning tongs were located eye-ear. When the location was ear-ear at 180 volts (usually in practice) the stunning was not always effective (table 1 and 2).

stunning was not always effective (table 1 and 2).										
location electrodes		condition	1st stunning				1st + 2nd + 3rd stunning			
ear-ear		skin electrodes	%	$\bar{x}$	s_x	n	%	$\bar{x}$	s_x	n
	dry	eroded	75	1.14	0.16	12	71	1.20	0.20	21
		sharp	75	1.02	0.14	12	75	1.06	0.17	24
	wet	eroded	100	1.16	0.11	12	100	1.25	0.18	24
		sharp	73	1.20	0.24	11	76	1.24	0.23	24
	average		81	1.13		47	81	1.19		93
	dry	eroded	92	1.02	0.31	12	91	0.98	0.28	23
		sharp	100	0.84	0.17	11	95	0.85	0.19	21
	wet	eroded	100	0.96	0.17	12	96	1.02	0.19	23
sharp		100	0.98	0.25	12	100	1.02	0.25	22	
average		98	0.95		47	95	0.97		89	

Table 2. Overall results of the experiments conducted with 180 volts equipment under variable conditions (% = percentage stunned animals, $\bar{x}$ = mean amperage after 0.5 seconds, s_x = standard deviation of the average amperage and n = number of animals).

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- 3) Only the 300 volt and 600 volt apparatus was able to guarantee effective stunning under most indicated conditions.
- 4) During the stunning experiments under comparable conditions (voltage, type of electrodes of the stunning tongs, stunning time and skin condition), the level of the current was quite variable. In table 2 are the results shown with the 180 volt experiments (0.84 ± 0.17 till 1.20 ± 0.24 ampere).
- 5) The location of the electrodes and the current level used, determined whether the stunning was effective or not (table 1 and 2).
- 6) The minimal time span of unconsciousness after an effective stunning was 32 seconds ($\bar{x} = 66$ seconds, $s_x = 14$ seconds; $n = 328$). Therefore it is obligatory that effectively stunned pigs have to be stuck within 30 seconds after the beginning of the stunning act in order to prevent a come back (HOENDERKEN, 1978).
These results made it necessary to do thresholds experiments with a constant current stunning equipment. The experiments were done under standardized factors (location of electrodes ear-ear and stunning time 1 second). The main result of this experiment was:
- 7) The current level which guarantees an immediately effective stunning in at least 90% of the pigs is 1.07 ampere; the 95% confidence interval for the current level lies between 0.95 and 1.20 ampere (fig. 1 and 2).
- 8) The recording of the current levels (recorded in 19 slaughterhouses) showed that 70 or 180 volt equipment used in several abattoirs could not guarantee an immediate effective stunning (fig. 3).

How to apply the experimental results in practice

The investigations showed that the minimal level of the amperage, 0.5 or 1 second after the beginning of the stunning, is the essential point in effective stunning, not the voltage. When the level of the current, measured 0.5 seconds after the beginning of stunning was at least 1.25 ampere and the location of the electrodes of the stunning tongs was as good as ear-ear, it resulted in a 98 % effective stunning rate of the pigs (refer to fig. 2). To reach this minimal current level of 1.25 ampere a voltage of minimal 240 - 300 volts is necessary (refer to fig. 3).

NB: essential frequency of the current is 50 hertz. The optimal frequency of stimulation for an effective stunning is between 25 and 60 hertz, higher frequencies (100 hertz or over) appear less suitable for the production of long-lasting effective stunnings (AJMONE MARSAN, 1972; CROFT, 1952; BROWN, 1974; VAN DER WAL, 1976; HOENDERKEN, 1978b).

The most important points for the (veterinary) authorities to control the stunning in practice are:

- 1) control of the current during the stunning (HOENDERKEN, 1978),
- 2) control of the location of the electrodes during the stunning,
- 3) control of the time span between the beginning of the stunning and the sticking (HOENDERKEN, 1978).

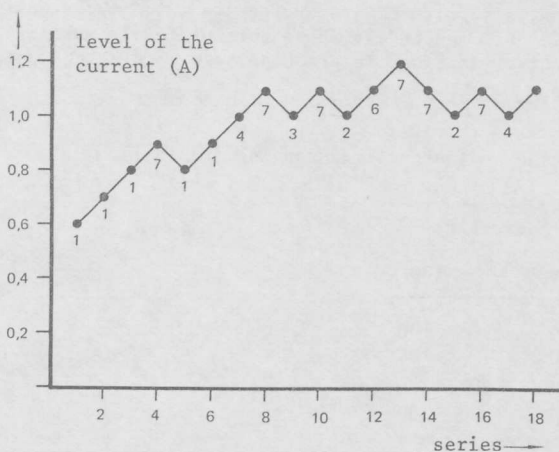


Fig. 1. The sequence of the constant current experiments ($n = 68$) with different levels per series of maximal 7 pigs; the number of successful stunnings per series is given at every point.

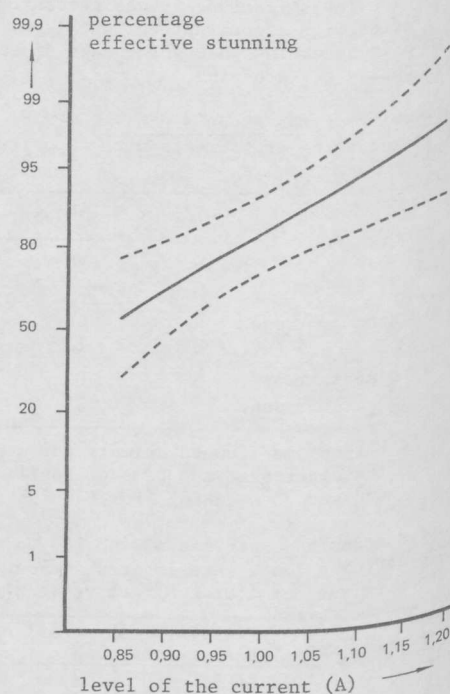


Fig. 2. Probitanalyse of the relation between the percentage effective stunnings and the level of the current, and the 95 % probability levels.

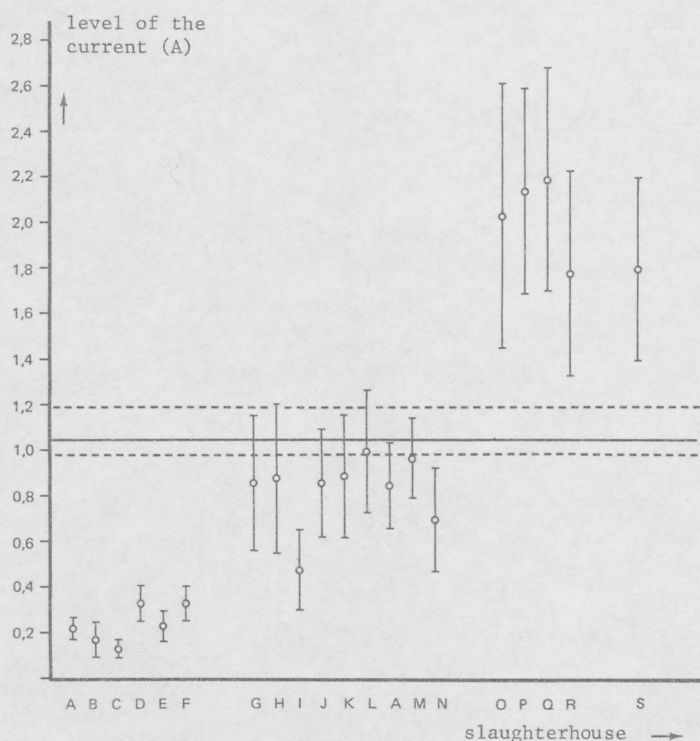


Fig. 3. The average current, measured 0.5 seconds after stunning at 20 slaughter-houses. Each point represents all the pigs stunned at one slaughter-house. The solid horizontal line represents the 90 % level of effective stunning and the broken lines represent the 95 % probability level (refer to Figure 2).
Slaughter-house A-F = 70 volt; G-N = 180 volt
O-R = 300 volt; S = 525 volt.

Literature

- AJMONE MARSAN, C., 1972. Focal electrical stimulation. In: *Experimental Models of Epilepsy*. Ed. by D.P. Purpura, J.K. Penry, D. Tower, D.M. Woodbury and R. Walter. Amsterdam, North-Holland Publishing Company.
- BROWN, S., 1974. An assessment of abattoir slaughtering techniques. Diss. Salford.
- CROFT, P.G., 1952a. The effects of electrical stimulation of the brain on the perception of pain. *J.Mental Sci.* 42:421-426.
- HOENDERKEN, R., 1978. Elektrische bedwelming van slachtvarkens, diss. Utrecht.
- HOENDERKEN, R., 1978b. Electrical stunning of slaughter pigs, Why (in press).
- MICKWITZ, G. VON and T. LEACH. Review of pre-slaughter stunning in the E.C.; Commission of the European Communities, Information on Agricultural no. 30, Brussels and Luxembourg, 1977.
- WAL, P.G. VAN DER, 1976. Bedwelming van slachtvarkens: Chemisch-fysiologische en vleeskwaliteitsaspecten. Diss. Utrecht, 1976.