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**MODERN TRENDS**  
**IN LIVESTOCK PRODUCTION**

# PROCEEDINGS



Belgrade, Serbia, 2 - 4 October, 2013

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## FACTORS OF IMPORTANCE FOR SUCCESSFUL ELECTRICAL STUNNING OF PIGS

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**Abstract:** There are regulations in European Union, as well as in our country, which require that animals during slaughter must be unconscious, must not feel a pain and in this state must remain until complete loss of brain function due to exsanguination. Electrical stunning effectiveness in pigs can be assessed through two critical points, and these are the percentage of animals that are effectively stunned at the first attempt and the percentage of animals that remain insensitive during slaughter procedure. In order to properly perform stunning procedure workers have to be careful, trained and competent. In addition, the equipment used for stunning should be in such a way designed and constructed, as well as regularly cleaned and calibrated to ensure optimal current flow and effective stunning of pigs. Proper stunning is important both for high standard of animal welfare and meat quality, and therefore it is important to perform stunning procedure in accordance with recommendations.

**Key words:** pig, electrical stunning, welfare, staff, equipment

### Introduction

In order to maintain a high standard of animal welfare during slaughter, Regulations of the EC require that animals must be unconscious, must not feel a pain and in this state must remain until complete loss of brain function due to exsanguination. The same requirements are set in our country where according to Regulation (*Anon, 2010*), animals must be stunned before slaughter in a manner that causes instantaneous loss of consciousness. Shackling and hoisting of stunned pigs do not cause anxiety, pain, suffering and stress (*Anon, 2004*). In addition, stress one minute prior to slaughter contributed to lower pH and higher temperature of meat 45 minutes after slaughter, as well as to a lower water holding capacity indicating low meat quality (*van der Wal, 1997*). In order to enhance animal welfare, it is necessary to monitor and assess stunning effectiveness using objective

measures (*Grandin, 2001; Grandin, 2010a; Grandin, 2010b*). Two critical points should be monitored during electrical stunning of pigs to assess animal welfare and success of stunning, and it is the percentage of animals that are effectively stunned at the first attempt and the percentage of animals that remain insensitive during slaughter procedure (*Grandin, 2010a*).

## **Effective stunning at the first attempt**

Pigs are usually stunned using current or gas. With current pigs can be only stunned if electrodes are placed on the head, or stunned and killed, if current first passes through the head, and then through the heart (*Grandin, 2010a*). When assessing the effectiveness of head-only electrical stunning, it is necessary to check whether electrodes are placed in the correct position on the head. The electrodes should be set in such a way that current spans the brain. Electrodes should be placed ***between eye and ear on both sides of the head or one on the top of the head and the other under the jaw*** (*Grandin, 2010b*). Electrodes should never be placed on the neck or elsewhere than recommended, because the current will bypass the brain and stunning will fail (*Grandin, 2010b*).

*Grandin (2001)* found that placing the tongs in the wrong location was a major cause of return to sensibility. The importance of correct placement of electrodes for efficient stunning suggested also results of *Lammens et al. (2006)* who found that 1,8% of pigs was not effectively stunned due to incorrect placement of stunning tongs. *Spencer and Veary (2010)* observed proper placement of stunning tongs in 35-98% cases in five slaughterhouses. In study of *Dokmanovic et al. (2012)* was found high incidence of incorrect placement of stunning tongs (55-83%) in two abattoirs, which indicated serious problems in stunning practice (Table 1) and could be the cause of high incidence of unsuccessful stunning at first attempt (48-89%). This high incidence of improper electrode placement was due to lack of pig restraint as well as due to lack of staff training. It is therefore important that staffs are regularly trained regarding stunning procedure in order to improve treatment and welfare of pigs. Furthermore, most of small slaughterhouses in Serbia doesn't have restrainers why the optimum position of the electrodes is virtually impossible to attain under practical conditions and the practice of repeat application of electrical stunning is common (*Spencer and Veary, 2010*). In this cases it is recommended to apply current first to the head, to induce insensibility, and then immediately after to the side of the animal, right behind the front leg, to stop the heart (*Vogel et al, 2010*). Applying a second current to the chest abolished rhythmic breathing, righting reflex, eye tracking, vocalization (squealing), and natural spontaneous blinking (*Vogel et al, 2010*). After the electrodes are placed in the proper position, the current can be applied. Applying energized electrodes

(electrodes that direct electric current) on animal's body cause electric shocks and vocalizations in pigs. Such a practice, so-called "hot wanding", compromises animal welfare and is related to higher occurrence of blood splashes in meat. Hot wanding and vocalization during stunning was observed in 24-85% of pigs (*Dokmanovic et al., 2012*), which according to *Grandin (2010b)* indicated serious problems in stunning practice. In addition, electric tongs should hold firm on animal's body, since the interruptions of current application weaken its effect. Also, every time when current applies that leads to muscle contractions and blood splashes in meat (*Grandin, 2010b*).

Among proper electrode placement, it is necessary to pay attention to voltage, amperage and frequency of current at the time of stunning. According to the *Anon (2010)*, amperage and duration of stunning must be such as to ensure that animal instantaneously loses consciousness and remains unconscious until the occurrence of death. In order to induce instantaneous and painless loss of consciousness, it is necessary that amperage strong enough spans the brain and induces *grand mal* epileptic seizure. If insufficient amperage spans the brain, the animal will feel pain, electric shock or symptoms of a heart attack, and at the same time can be paralyzed (*Grandin, 2010b*). For these reasons, it is recommended that the amperage for pigs weighing approximately 100 kg is at least 1.25 amps, and for heavier pigs 2.0 amps or more (*Anon, 2007*). Therefore, it is necessary to sort pigs with similar live weight into groups and to regulate amperage according to live weight. Importance of amperage for successful stunning was determined by *Vegh et al. (2010)* who found that effective stunning in 88.3% cases was significantly related to amperage but not to other parameters such as voltage and duration of stunning. *Dokmanovic et al. (2012)* found that failure to stun was related to low current amperage (1.3 A), despite the fact that many pigs weighed more than 150 kg that required stronger amperage. The defined value of current amperage becomes achieved within the first second of application, and then it is necessary to apply 1-3 seconds more, in order to achieve effective stunning (*Grandin, 2010b*). *Dokmanovic et al. (2012)* observed that application of current lasted too long in one slaughterhouse (11.48 seconds) which could result in burns, blood splashes and lower pork quality. *Mikus et al. (2011)* found that application of electric current for at least 15 seconds in slaughterhouses instead of recommended 3 seconds was related to insufficient education of workers.

There must be sufficient voltage during electrical stunning to deliver the recommended minimum amperage. For pigs the recommended minimum voltage is 250 volts to insure insensibility (*Troeger, 1999*).

Today are very frequent stunning devices operating at 800 Hz, resulting in a better meat quality, reduced incidence of blood splashes and broken backs (*Grandin, 2010b*). *Berghaus and Troeger (1998)* evaluated animal welfare

implications of higher frequency (500 or 800 Hz) electrical stunning in comparison to “normal” (50 Hz) stunning and concluded that all stunning frequencies tested (50, 500, 800 Hz) caused an effective stun within a minimum current flow time (1.3 ampere constant) of 0.3 seconds. All tested stunning frequencies were in conformance with animal welfare demands. One disadvantage of stunning with too high frequencies is that the pigs regain sensibility more quickly than pigs stunned using frequencies of 50 to 60 cycles (*Anil and McKinstry, 1992*).

As was previously stated, in order to properly perform stunning procedure workers have to be careful, trained and competent. The equipment used for stunning should be in such a way designed, constructed and maintained as well as regularly cleaned and calibrated to ensure optimal current flow and effective stunning of pigs (*Anon, 2007*). Furthermore, electrodes must be cleaned frequently to insure that a good electrical connection occurs between stunner and animal.

## **Insensitivity during slaughter procedure**

Properly stunned animals are not conscious and do not feel stimulations while hanging on the rail. A sign that pig is effectively stunned is occurrence of *grand mal* epileptic seizures that consists first of tonic, and then clonic convulsions (*McKinstry and Anil, 2004*). During epileptic seizure raise levels of neurotransmitters glutamate and aspartate, which lead to excessive neuron excitation when animal is not aware and sensitive to pain. Tonic muscle contractions last 10-15 seconds, when it is recommended to bleed the animal, and then start clonic spasms of extremities, in the form of walking, kicking or paddling, which last about 30 seconds (*McKinstry and Anil, 2004*).

Signs that an animal becomes aware and sensitive to pain are: 1) the rhythmic breathing (if ribs make at least two respiratory movements), 2) vocalization while hanging on the bleed rail, 3) spontaneous blinking, 4) the righting reflex, where the animal is trying to lift its head; 5) sensitivity to a pin prick on the nose (*Grandin, 2011b*). The occurrence of one or more signs of returning to consciousness after stunning is unacceptable from the point of animal welfare and none of the procedures should started before animals become re-stunned. After it is determined that the animal is effectively stunned, it can be slaughtered. According to Anon (2010), bleeding should be performed as soon as possible after stunning and should be rapid, profuse and complete to prevent that animal regain consciousness. Pigs are usually bled by cutting the *truncus brachiocephalicus*. The pigs should be bled upto 15 seconds after stunning (*Anon, 2004*). This value is determined on the basis of experimental studies where first signs of sensitivity occur after 38 seconds (corneal reflex after  $37 \pm 12$  seconds, rhythmic breathing after  $44 \pm 8$  seconds and the righting reflex after  $59 \pm 15$  seconds of stunning) (*McKinstry and Anil, 2004*).

and that the brain loses its function after 14 to 23 seconds of bleeding (*Gregory and Wotton, 1986*). In addition, this practice reduces the incidence of blood splashes in meat, because cutting the blood vessels reduces high blood pressure, which is caused by applied current. Problems with too long stun to stick interval were observed by *Dokmanovic et al. (2012)* and *Mikus et al. (2011)* who found that slaughter was on average performed after 72.48 and 69 seconds, respectively. These too long stunning to bleeding interval lead to regaining of sensibility and ***consciousness in pigs***.

In the study of *Dokmanovic et al. (2012)* was found high incidences of reflexes that ***indicated return of consciousness***, 89% of pigs showed natural blinking, 9% rhythmic breathing, 61% righting reflex and 19% of pigs vocalized after stunning. This situation resulted from the incorrect placement of electrodes, insufficient amperage and too long interval from stunning to bleeding. Also insufficient amperage, insufficient duration of stunning, improper placement of stunning tongs and too long interval from stunning to bleeding was reason for unsuccessful stunning of 15.6% of pigs (*Anil and McKinstry, 1992*). In all these cases it is necessary to re-stun pigs as soon as possible in order to ensure animal welfare.

## **Conclusion**

In order to safe animal welfare as well as meat quality, it is important to perform stunning procedure in accordance with recommendations. The most common problems during stunning in our slaughterhouses are incorrect placement of stunning tongs, insufficient amperage and too long interval from stunning to bleeding. Therefore, staff training is necessary regarding stunning procedure in order to improve treatment and welfare of pigs. Furthermore, all stunning equipment should be maintained in good working conditions for achieving efficient stunning.

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## Činioci od značaja za uspešnost omamljivanja

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### Rezime

U Evropskoj Uniji kao i u našoj zemlji postoje zakonske odredbe koje nalažu da životinje u toku klanja moraju biti nesvesne, ne smeju osećati bol i u takvom stanju moraju ostati dok ne nastane potpun gubitak moždanih funkcija zbog iskrvarenja. Tokom omamljivanja svinja strujom postoje dve kritične tačke za praćenje uspešnosti omamljivanja, a to je procenat životinja koje su efikasno omamljene pri prvom pokušaju i procenat životinja koje ostaju neosetljive tokom celog postupka klanja. Za uspešno omamljivanje neophodno je da radnici budu pažljivi, dobro obučeni i da pravilno izvode postupak omamljivanja. Osim toga, oprema koja se koristi za omamljivanje treba da bude tako projektovana, izgrađena, održavana, čišćena i redovno kalibrisana kako bi se osigurao optimalan protok struje i efikasno omamljivanje. Postupak omamljivanja utiče na dobrobit životinja, ali i na kvalitet mesa, stoga treba ovaj postupak izvoditi u skladu sa preporukama.

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