

## Assessment of unconsciousness during slaughter without stunning in lambs

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### Abstract

The aim of this study was to assess brain activity in lambs during slaughter without stunning and its correlation with heart rate (HR) and the absence of physiological reflexes. The index of consciousness (IoC-view<sup>®</sup>) assesses consciousness by an algorithm that analyses the EEG and gives an index from 0 (unconscious) to 100 (conscious). Eight lambs (Merino breed) of 20 to 25 kg live weight were individually restrained in a stretcher and three skin electrodes were placed at the level of the frontal bone. The electrodes were connected to the IoC-view<sup>®</sup>. Two additional electrodes were placed on the chest and the HR was transferred to a watch monitor. Recording time started 2 min prior to sticking to obtain the basal IoC and HR value of each animal. During bleeding, presence of corneal reflex and rhythmic breathing were recorded every 10 s until brain death. Rhythmic breathing disappeared at an average time of 44 ( $\pm$  4.2) s after sticking, ranging between 30 and 60 s. The corneal reflex disappeared at 116 ( $\pm$  11.01) s, ranging between 80 and 160 s after sticking. Changes in the brain activity occurred between 22 to 82 s after sticking (52 [ $\pm$  20.2] s). In five out of six animals the HR increased (177 [ $\pm$  22.7] beats min<sup>-1</sup>) compared to basal values (139 [ $\pm$  8.4] beats min<sup>-1</sup>) at 115 ( $\pm$  97.5) s after sticking. Both brain activity and physiological reflexes revealed that when bleeding is performed, through a transverse incision across the neck without stunning, the onset of unconsciousness could last 1 min which impaired animal welfare. This prolonged consciousness compared to other authors' findings may be attributable to inefficient bleeding when lambs are slaughtered without head restraint.

**Keywords:** animal welfare, consciousness, EEG, lambs, neck sticking, religious slaughter

### Introduction

Stunning prior to slaughter is a legal requirement in the EU to induce unconsciousness and insensibility either immediately or sequentially, so that sticking can be performed without avoidable fear, anxiety, pain, suffering and distress (Council Regulation EC No 1099/2009). For this purpose, the stunning procedure should induce unconsciousness in the animal without pain and has to be prolonged until brain death by exsanguination. However, the OIE recommendations (OIE 2009), and the USA (USDA 2010) and the EU legislations (Regulation EC No 1099/2009) exempt religious slaughter from stunning. During halal and shechita slaughter the animals are restrained and bled through a transverse incision across the neck, severing the skin, muscles, trachea, oesophagus, carotid arteries, jugular veins and major nerves. The bleeding requires some time to provoke brain death. In sheep, after neck cutting, the time to loss of consciousness ranges from 14 to 298 s (Gregory & Wotton 1984). In addition, the cuts involve substantial tissue damage in areas well supplied with nociceptors (Kavaliers 1989). One EEG study developed in calves revealed that ventral-neck incision is associated with noxious stimulation that is expected to be painful prior to loss of consciousness (Mellor *et al* 2009). In sheep, there have been no direct EEG studies, however,

based on the physiological similarities between sheep and cattle, it is reasonable to suppose that the neck cut in non-stunned sheep causes pain (Hemsworth *et al* 2009). Furthermore, during bleeding, animals may feel also anxiety, pain, distress and other suffering (EFSA 2004). Thus, there is concern about the extent of time that lambs are conscious or able to perceive pain, anxiety and distress after neck cutting (von Holleben *et al* 2010). One of the most reliable methods of assessing the state of consciousness is monitoring the brain activity by recording the EEG (Raj *et al* 1997; Rodriguez *et al* 2008). The index of consciousness<sup>®</sup> (IoC, IoC-view<sup>®</sup>, Morpheus Medical, Spain) is a monitor based on wireless technology that assesses brain activity in non-restrained animals. The IoC analyses the raw EEG giving a unitless scale from 0 (null brain activity) to 99 (awake) (Revuelta *et al* 2008). The IoC-view<sup>®</sup> monitor is currently used in human patients (Revuelta *et al* 2008), rabbits (Silva *et al* 2011) and pigs (Lluch *et al* 2011). The recommended IoC for surgical anaesthesia is under 60 whereas an IoC under 40 would suggest deep unconsciousness (Revuelta *et al* 2008). In commercial conditions, the state of consciousness tends to be assessed by means of the presence of some physiological reflexes (von Holleben *et al* 2010), such as the corneal reflex and rhythmic

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## **Table of Contents Slaughter Without Stunning And Food Labeling Briefing Note**

1. Understanding the eBook Slaughter Without Stunning And Food Labeling Briefing Note
  - The Rise of Digital Reading Slaughter Without Stunning And Food Labeling Briefing Note
  - Advantages of eBooks Over Traditional Books
2. Identifying Slaughter Without Stunning And Food Labeling Briefing Note
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Slaughter Without Stunning And Food Labeling Briefing Note
  - User-Friendly Interface
4. Exploring eBook Recommendations from Slaughter Without Stunning And Food Labeling Briefing Note
  - Personalized Recommendations
  - Slaughter Without Stunning And Food Labeling Briefing Note User Reviews and Ratings
  - Slaughter Without Stunning And Food Labeling Briefing Note and Bestseller Lists
5. Accessing Slaughter Without Stunning And Food Labeling Briefing Note Free and Paid eBooks
  - Slaughter Without Stunning And Food Labeling Briefing Note Public Domain eBooks
  - Slaughter Without Stunning And Food Labeling Briefing Note eBook Subscription Services
  - Slaughter Without Stunning And Food Labeling Briefing Note Budget-Friendly Options

6. Navigating Slaughter Without Stunning And Food Labeling Briefing Note eBook Formats
  - ePub, PDF, MOBI, and More
  - Slaughter Without Stunning And Food Labeling Briefing Note Compatibility with Devices
  - Slaughter Without Stunning And Food Labeling Briefing Note Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Slaughter Without Stunning And Food Labeling Briefing Note
  - Highlighting and Note-Taking Slaughter Without Stunning And Food Labeling Briefing Note
  - Interactive Elements Slaughter Without Stunning And Food Labeling Briefing Note
8. Staying Engaged with Slaughter Without Stunning And Food Labeling Briefing Note
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Slaughter Without Stunning And Food Labeling Briefing Note
9. Balancing eBooks and Physical Books Slaughter Without Stunning And Food Labeling Briefing Note
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Slaughter Without Stunning And Food Labeling Briefing Note
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Slaughter Without Stunning And Food Labeling Briefing Note
  - Setting Reading Goals Slaughter Without Stunning And Food Labeling Briefing Note
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Slaughter Without Stunning And Food Labeling Briefing Note
  - Fact-Checking eBook Content of Slaughter Without Stunning And Food Labeling Briefing Note
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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