



Recent Methods of Slaughtering and its Effect on Meat Safety and Hygiene

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The Third Gulf Conference on Halal Industry and its Services
13-15 May, 2014
Sheraton Hotel, State of Kuwait



أساليب الذبح الحديثة وأثرها على صحة وسلامة اللحوم

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أستاذ الأمراض المعدية والوبائيات (الطب البيطري)، قسم البحوث البيئية والصحية، معهد خادم الحرمين الشريفين لأبحاث الحج والعمرة، جامعة أم القرى، مكة المكرمة، المملكة العربية السعودية



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Overview



- **Definition of a good slaughter method**
- **The Halal (Islamic) slaughter:**
 - In holy Quran and Hadith
 - Procedure of the Halal slaughter
 - Effects on the animal and meat safety and hygiene
- **The recent (conventional) slaughter methods:**
 - Aims
 - Types
 - Adverse effects on the animal and meat safety and hygiene
- **Conclusions and recommendations**

Definition of good slaughter method

Generally, from the scientific point of view, several criteria define a good slaughter method:

- ✓ animals cannot be treated cruelly;
- ✓ animals cannot be unduly stressed;
- ✓ bleeding must be done as quickly and as complete as possible;
- ✓ carcass bruising must be minimal;
- ✓ slaughter must be hygienic, economic and safe for the operators * (Swatland, 2000).
- ✓ In addition, the humane conditions must be presented during pre-slaughter handling ** (Roça, 2002).

*Swatland, H.J. (2000): Slaughtering.

Internet: <http://www.bert.aps.uoguelph.ca/swatland/ch1.9.htm>. 2000. 10p.

** Roça, R.O. (2002): Humane slaughter of bovine. First Virtual Global Conference on Organic Beef Cattle Production September, 02 to October, 15 – 2002. 1-14.

1. The Halal (Islamic) slaughter

In holy Quran and Hadith, there are some orders followed by Muslims:

1.1. Mention the Name of ALLAH:

(فَكُلُوا مِمَّا ذُكِرَ اسْمُ اللَّهِ عَلَيْهِ إِنْ كُنْتُمْ بِآيَاتِهِ مُؤْمِنِينَ) [الأنعام:118]

(وَلَا تَأْكُلُوا مِمَّا لَمْ يُذْكَرِ اسْمُ اللَّهِ عَلَيْهِ وَإِنَّهُ لَفِسْقٌ وَإِنَّ الشَّيَاطِينَ لَيُوحُونَ إِلَىٰ أَوْلِيَائِهِمْ لِيُجَادِلُوكُمْ وَإِنْ أَطَعْتُمُوهُمْ إِنَّكُمْ لَمُشْرِكُونَ) (الأنعام 121)

1. The Halal (Islamic) slaughter

1.2. Only the Halal meat:

يقول الله تعالى: (حُرِّمَتْ عَلَيْكُمُ الْمَيْتَةُ وَالِدَمُّ وَلَحْمُ الْخِنْزِيرِ وَمَا أُهْلَ لِغَيْرِ اللَّهِ بِهِ وَالْمُنْخَفَقَةُ وَالْمَوْفُقُودَةُ وَالْمُتَرَدِّيَةُ وَالنَّطِيحَةُ وَمَا أَكَلَ السَّبُعُ إِلَّا مَا ذَكَّيْتُمْ وَمَا ذُبِحَ عَلَى النَّصَبِ وَأَنْ تَسْتَقْسِمُوا بِالْأَزْلَامِ ذَلِكُمْ فَسُقُ الْيَوْمَ يَبْسُ الدِّينَ كَفَرُوا مِنْ دِينِكُمْ فَلَا تَحْشَوْهُمْ وَاخْشَوْنَ الْيَوْمَ أَكْمَلْتُ لَكُمْ دِينَكُمْ وَأَتِمَمْتُ عَلَيْكُمْ نِعْمَتِي وَرَضِيْتُ لَكُمْ الْإِسْلَامَ دِينًا فَمَنِ اضْطُرَّ فِي مَخْمَصَةٍ غَيْرِ مُتَجَانِفٍ لِإِثْمٍ فَإِنَّ اللَّهَ غَفُورٌ رَحِيمٌ) [المائدة: 3]

وقال جل من قائل: (قُلْ لَا أَجِدُ فِي مَا أُوحِيَ إِلَيَّ مُحَرَّمًا عَلَى طَاعِمٍ يَطْعَمُهُ إِلَّا أَنْ يَكُونَ مَيْتَةً أَوْ دَمًا مَسْفُوحًا أَوْ لَحْمَ خِنْزِيرٍ فَإِنَّهُ رَجْسٌ أَوْ فَسَقًا أَهْلَ لِغَيْرِ اللَّهِ بِهِ فَمَنِ اضْطُرَّ غَيْرَ بَاغٍ وَلَا عَادٍ فَإِنَّ رَبَّكَ غَفُورٌ رَحِيمٌ) [الأنعام: 145].

1. The Halal (Islamic) slaughter

1.3. The animal should be rested and Sharp knife should be used:

قال صلى الله عليه وسلم: " إن الله كتب الإحسان على كل شيء فإذا قتلتم فأحسنوا القتلة، وإذا ذبحتم فأحسنوا الذبحة، وليحد أحدكم شفرته وليرح ذبيحته" (من سنن ابن ماجة، كتاب الذبائح، باب إذا ذبحتم فأحسنوا الذبحة (2170)، والترمذي في كتاب الديات وباب ما جاء في دية الجنين (1409)).

1. The Halal (Islamic) slaughter

1.4. Prevent Pain and Agony for Animals before Slaughtering

1.5. Accessibility of Animals to Drinking Water before Slaughtering

1.6. Avoid Slaughtering Animals in the Sight of Others

1. The Halal (Islamic) slaughter

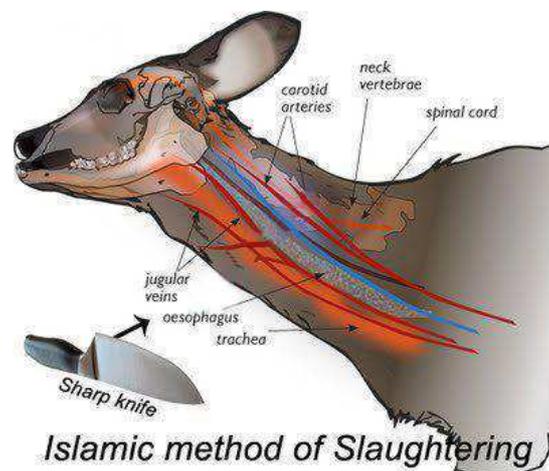
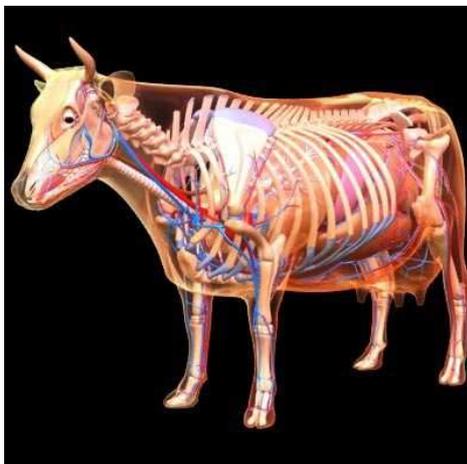
1.7. Horizontal cutting all of the vessels of the throat

The Sunnah halal method of slaughter is → to drain all of the impure blood from the body of the animal → by cutting all of the vessels of the throat including the carotid arteries, trachea, esophagus, and the jugular veins.

In addition to complete bleeding of flowing blood, there are numerous benefits of severing all the blood vessels of the throat including

- increased shelf life;
- absence of bacteria;
- and make a slaughter with no pain (Halal advocates of America, 2011a).

1. The Halal (Islamic) slaughter



Animal anatomy and The Islamic method of slaughter

1. The Halal (Islamic) slaughter

1.8. Avoid Complete Cutting of Animal's Head during Bleeding

- ✓ Prevention of the neck separation during the Islamic slaughter is very important → to maintain the connection of the brain to the rest of the body via the spinal cord → in order to send **nerve signals and hormonal alerts** which are necessary → to complete the bleeding process → **to remove all of the liquid blood from carcasses.**

1. The Halal (Islamic) slaughter

1.9. Procedure of the Halal slaughter*

1.9.1. In case of Manual slaughter

- ✓ The animal to be slaughtered has to be an animal that **is Halal.**
- ✓ The animal to be slaughtered shall be **alive or deemed to be an alive at the time of slaughter.**
- ✓ The slaughtering procedure should not cause torture to animals and should be done with **animal welfare/rights consideration.**
- ✓ The slaughterer shall be a **Muslim** who is mentally sound and fully understands the fundamental rules and conditions related to the slaughter of animals.
- ✓ If animals have arrived from long distance, they should first be allowed **to rest before slaughtering.**
- ✓ The animal may be slaughtered, after having been **laid on its left side facing Kiblah** (the direction of Makkah Al-Mukaramah).
- ✓ At the time of slaughtering the animals, the slaughterer shall utter **“BISMILLAH WALLAHUAKBAR”**

*The Organisation of the Islamic Conference (OIC)

1. The Halal (Islamic) slaughter

1.9. Procedure of the Halal slaughter

1.9.1. In case of Manual slaughter

- ✓ Slaughtering shall be done **only once to each animal**. The “sawing action” of the slaughtering is permitted as long as the slaughtering knife shall **not be lifted off the animal during the slaughter**.
- ✓ The act of Halal slaughter shall begin with an incision on the neck at some point just below the glottis (Adam’s apple) and after the glottis for long necked animals.
- ✓ The slaughter act shall sever the trachea (halqum), oesophagus (mari) and both the **carotid arteries and jugular veins (wadajain)** to hasten the bleeding and death of the animals.
- ✓ The bleeding shall be **spontaneous and complete**. The bleeding time must be **not less than 2.5 minute** to insure fully bleeding.
- ✓ Slaughterer should grab the head by left hand, stretching it down tightly and shall cut the throat by a **sharp slaughtering knife** held in the right hand. The sharp edge of knife which used for slaughter should be **not less than 12 cm**.

1. The Halal (Islamic) slaughter

1.9. Procedure of the Halal slaughter

1.9.2. In case of the Mechanical Slaughter

- ✓ The operator of the mechanical knife shall be a **Muslim**.
- ✓ The slaughterer shall recite **“BISMILLAH WALLAHUAKBAR”** prior to switching on the mechanical knife and shall not leave the slaughter area.
- ✓ To **restart the operation** he or another Muslim slaughterer shall **recite “BISMILLAH WALLAHUAKBAR”** before switching on the line and mechanical knife.
- ✓ The knife used shall be of single blade type and shall be sharp.
- ✓ The slaughter act shall sever the trachea (halqum), oesophagus (mari) and both **the carotid arteries and jugular veins (wadajain)** to hasten the bleeding and death of the animals
- ✓ The slaughterer is required to check that **each poultry is properly slaughtered**.
- ✓ A backup slaughterer with knife shall be ready to check any neck not cut well during mechanical slaughtering and **rapidly cut it manually**.
- ✓ Bleeding period shall be minimum **60 seconds** but during winter this period shall be increased by 5-10 seconds.

1. The Halal (Islamic) slaughter

1.10. Effects of the halal slaughter on the animal and meat safety and hygiene:

1.10.1. No Pain during Slaughtering

Cutting of the carotid arteries during Halal slaughter:

- ➔ stop the blood supply to the brain;
- ➔ disrupts the centers of sense in the brain;
- ➔ make the animal unconscious at once
- ➔ no pain sensation (no pain in Islamic slaughter).

1. The Halal (Islamic) slaughter

1.10. Effects of the halal slaughter on the animal and meat safety and hygiene:

1.10.2. Complete drainage of blood

- Cutting of the blood vessels of the throat ➔ facilitate the drain all of the impure blood from the animal body in a short time.
- Leaving the spinal cord intact ➔ allow for convulsions that result from the contraction of the muscles in response to the lack of oxygen in the brain cells ➔ this will allow for the maximum drainage of blood.
- ✓ Based on scientific evidences, natural bleeding time in domestic animals is about 3-6 minutes and during this period, **40% - 60% of blood volume exits from the body. The rest of the blood remains mostly in viscera and vessels***. al. (2014).
- ✓ When bleeding is properly done, which is necessary for good conservation, **about 60% of the total blood amount is removed, and the remaining blood is retained in the muscles (10%), and viscera (20 - 25%)***.

*Hajimohammadi B., Ehrampoush M.H. & Behrooz Hajimohammadi (2014): Theories About Effects of Islamic Slaughter Laws on Meat Hygiene. Health Scope.; 2(4):e14376.

**Piske, D. (1982): Aproveitamento de sangue de abate para alimentação humana. I. Uma revisão. Boletim do Instituto de Tecnologia de Alimentos, Campinas, v.19. n.3, p.253-308, 1982.

**Hedrick, H.B., Aberle, E.D., Forrest, J.C., Judge, M.D., Merkel, R.A. (1994): Principles of meat science. 3.ed., DUBUQUE:Kendal/Hunt Publ. Co., 354p.

1. The Halal (Islamic) slaughter

1.10.3. Improving of meat safety and hygiene

- The Halal slaughter allow for the maximum drainage of blood, → carrying away in part the waste and micro-organisms, → thereby improving:
 - the meat's taste,
 - shelf-life and
 - healthiness (ISNA Halal Certification Agency, 2010).
- Because of absence of the stress, in the Islamic slaughter, → keeping the glycogen content of animal muscles → and subsequent normal glycolysis process → and formation of lactic acid post slaughtering which → keep the meat pH within the normal ultimate values → this provides:
 - unfavorable medium for the growth of bacteria,
 - increase shelf-life,
 - keep the colour of the meat bright red and
 - make the meat tasteful.

1. The Halal (Islamic) slaughter

1.10.4. Protect human beings (consumers) from infectious diseases

The importance of Islamic slaughter is to facilitate the blood flow from the animal body, as blood represents suitable enrichment medium for growth and multiplication of microorganisms, therefore **its complete removal from the slaughtered animal is vital to protect the consumers from infectious diseases.**

2. The recent (conventional) slaughter methods (Stunning)

2.1. Definition of humane slaughter

In the **developed countries**, there is an increasing demand for processes called **humane slaughter**, aiming at reducing unnecessary suffering of the slaughtered animal*.

Humane slaughter can be defined as a set of technical and scientific procedures which guarantee animal welfare from loading at the farm up to bleeding in the slaughter plant**.

*Cortise, M.L. (1994): Slaughterhouses and humane treatment. Revue Scientifique et Technique Office International des Epizooties, v.13, n.1, p.171-193.

*Picchi, V. & Ajzentel, A. (1993): Abate bovino segundo o ritual judaico. Revista Nacional da Carne, São Paulo, v.18, n.202, p.53-57.

**Roça, R.O. (2002): Humane slaughter of bovine. First Virtual Global Conference on Organic Beef Cattle Production September, 02 to October,15 – 2002. 1-14.

2. The recent (conventional) slaughter methods (Stunning)

2.2. Aims of the stunning

- The law in Europe requires that all animals and birds must undergo pre-slaughtering process (i.e. stunning) **to render them unconscious before they slaughter***.
- Stunning consists in **putting the animal in an unconscious state which must last until bleeding****.

*SanteV., Le Pottier G., Astruc T., Mouchoniere, M. and Fernandez X. (2000): Effect of Stunning Current Frequency on Carcass Downgrading and Meat Quality of Turkey. Poultry Science 79:1208–1214.

**Gil, J.I. & Durao, J.C. (1985): Manual de inspeção sanitária de carnes. Lisboa: Fundação Calouste Gulbenkian, 1985. 563p.

2. The recent (conventional) slaughter methods (Stunning)

2.3. Types of stunning

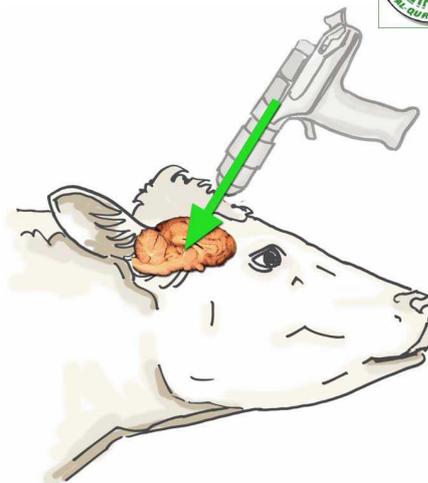
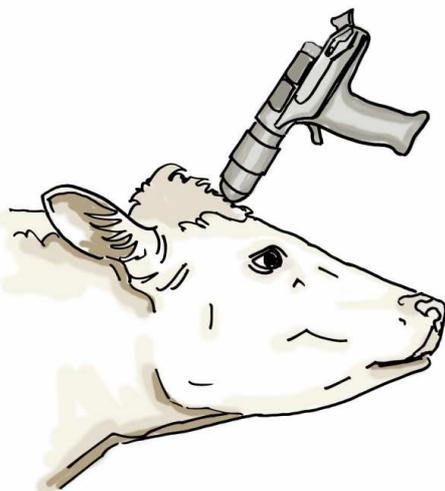
The stunning instruments or methods which can be used are:

- mallet,
- cash knocker,
- firearm-gunshot,
- pneumatic-powered stunners,
- pneumatic-powered air injections stunners,
- cartridge-fired captive bolt stunners,
- cutting of the medulla,
- electro-narcosis, and
- chemical processes.
- Slaughter can also be made by jugulation (Kasher or kosher method), without previous stunning*.

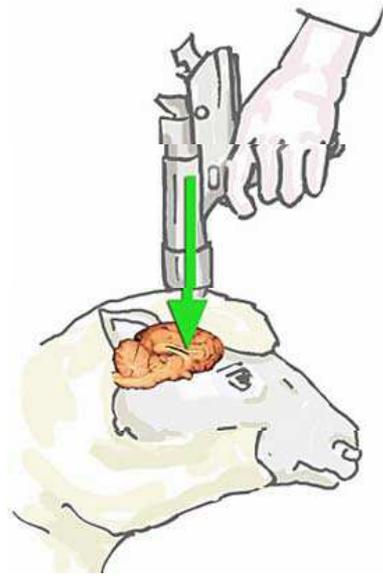
*Roça, R.O. (2002): Humane slaughter of bovine. First Virtual Global Conference on Organic Beef Cattle Production September, 02 to October,15 – 2002. 1-14.



Non-penetrating guns deliver a blow on the skull damaging the cortex, midbrain and brain stem



Penetrating guns fire the bolt into the brain through the cortex, midbrain and brain stem



**Captive bolt shooting in sheep
(Ideal shooting position in sheep)**

Stunning in cattle



2. The recent (conventional) slaughter methods (Stunning)

2.4. Adverse effects of stunning on meat safety and hygiene

All stunning methods have disadvantages relating to quality, public health as well as possible misstuns*.

2.4.1. Severe pain due to stunning

- In electroencephalographic reactions in beef cattle, it was found that the animals subjected to penetrative mechanical stun had the lowest alpha and beta wave intensity immediately post-stunning, and at 30 seconds after throat cut compared to both low power non-penetrative mechanical stun and high power non-penetrative mechanical stun animals. This could possibly be explained by the animals' awareness of pain or other stressful factors attributed to the slaughtering procedure.
- Also, the presence of large intervals of higher frequency alpha and beta brain waves, which usually occur in conscious animals, suggest stressful conditions related to postslaughter pain**.

*Knight, A.C. and Anil., M.H., (2003): EC Accompanying Measure QLK2-CT-2002 30531 UK.

**Meat technology update (2011): Effect of slaughter method on animal welfare and meat quality. http://www.meatupdate.csiro.au/data/MEAT_TECHNOLOGY_UPDATE_11-1.pdf

2. The recent (conventional) slaughter methods (Stunning)

2.4. Adverse effects of stunning on meat safety and hygiene

2.4.2. Incomplete drainage of blood

- ❖ Stunning may lead to death of the animal → no bleeding after slaughter.
- ❖ Damage of the brain or CNS, convulsions of the muscles and suffocation which are resulting from shutting, electrical shock and the gas stunning respectively → are hindering the bleeding process after slaughtering.
- ❖ As in the conventional slaughter methods, if the head is cut completely while bleeding is not finished yet, heartthrob and blood flow will be stopped. Thus, blood dose not exit thoroughly condition occurred, called imperfect bleeding of carcass*.

*Lahucky, R., Palanska, O., Mojto, J., Zaujec, K. & Huba J. (1998): Effect of preslaughter handling on muscle glycogen level and selected meat quality traits in beef. Meat Sci.; 50(3):389–93.

*Hajimohammadi B., Ehrampoush M.H. & Behrooz Hajimohammadi (2014): Theories About Effects of Islamic Slaughter Laws on Meat Hygiene. Health Scope.; 2(4):e14376.



The difference in the bleeding process (amount and flow of the blood) in Islamic and conventional slaughter methods



2. The recent (conventional) slaughter methods (Stunning)

2.4. Adverse effects of stunning on meat safety and hygiene

2.4.3. Making the meat perishable

- ❑ If animals are stressed immediately prior to slaughter → the muscle glycogen is released into the blood stream and, → after slaughter, is rapidly broken down to lactic acid while the carcass is still warm → this high level of acidity → causes a partial breakdown of muscle structure which results in → **pale, soft and exudative meat (termed PSE).**
- ❑ Long-term stress before slaughter → uses up the glycogen so that less lactic acid is formed after slaughter → resulting in an abnormal muscle condition in which → it remains dark purplish-red on exposure to air instead of a bright red colour → this is termed **dark, firm and dry (DFD) meat.**
- ❑ **The low acidity → favours rapid bacterial growth → the meat spoils quickly***

Meat texture and colour (Chambers and Grandin, 2001):

- (a) Normal meat;**
- (b) Pale Soft and Exudative (PSE) meat;**
- (c) Dark Firm and Dry (DFD) meat**



(c)

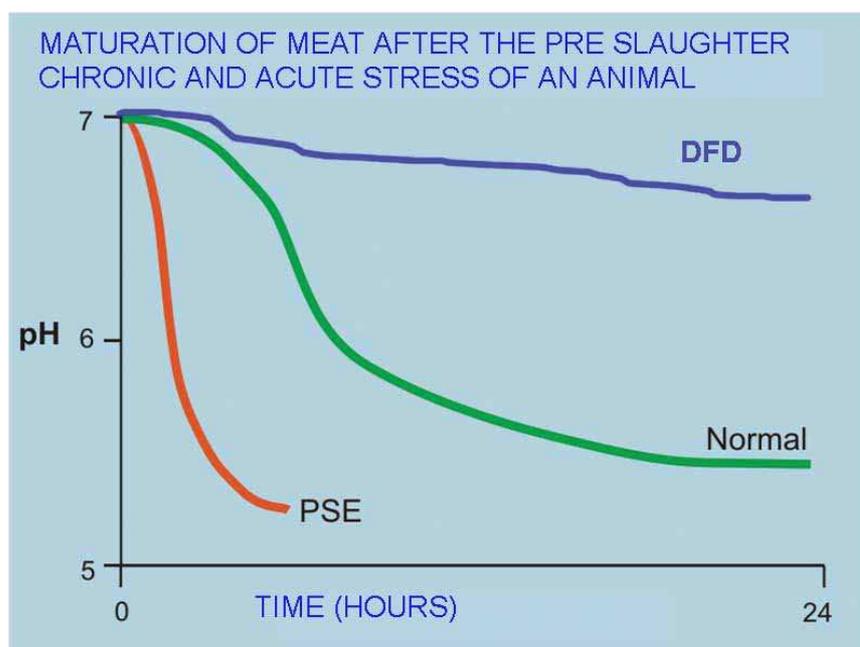


(b)



(a)

Chambers, P.G. and Grandin, T. (2001): Guidelines for humane handling, transport and slaughter of livestock. G. Heinz and T. Srisuvan (Eds.). http://www.fao.org/fileadmin/user_upload/animalwelfare/guidelines%20humane%20handling%20transport%20slaughter.pdf.



- "وليد أحكم شفرته وليرح ذبيحته" → the meat pH within the normal ultimate values → bright red colour
- Long-term stress before slaughter → dark, firm and dry (DFD) meat.
- Acute stress immediately prior to slaughter → pale, soft and exudative meat (PSE).

2. The recent (conventional) slaughter methods (Stunning)

2.4. Adverse effects of stunning on meat safety and hygiene

2.4.4. Stunned-meat act as source of infectious diseases for consumers

- incomplete drainage of blood (imperfect bleeding of carcass) in stunned meat → create a suitable media for proliferations of harmful micro-organisms → and subsequently facilitate the transmission of bacterial zoonotic infectious diseases to the consumers.
- In addition to haematogenous contamination of edible tissues with CNS material (prion diseases), other public health concerns may also be associated with penetrating Captive bolt (PCB) methods. For example, cross- or airborne contamination of the stunning gun operator (Prendergast et al, 2004; Daly et al, 2001).

Daly, D.J., Prendergast, D.M., Sheridan, J.J., Blair, I.S., McDowell, D.A. (2001): Use of a marker organism to model the spread of central nervous system tissue in cattle and the abattoir environment during commercial stunning and carcass dressing. *Applied and Environmental Microbiology* 68, 791-798.

Prendergast, D.M., Sheridan, J.A., Daly, D.J., McDowell, D.A., Blair, I.S. (2004): The use of a marked strain of pseudomonas fluorescence to model the spread of brain tissue to the musculature of cattle after shooting with a captive bolt gun. *J. Applied Microbiology* 96,437-446.

2. The recent (conventional) slaughter methods (Stunning)

2.4. Adverse effects of stunning on meat safety and hygiene

2.4.5. The use of mallet as a slaughter method caused severe lesion of the bone tissue, with depression of the affected region. It produces a cranial-encephalic contusion, and not concussion*.

2.4.6. The cash-knocker leads to diffusive brain lesion or injury caused by sudden blow and changes in the intra-cerebral pressure, resulting in a rotational deformation of the brain, with consequent lack of motor coordination**.

2.4.7. Excessive convulsions after electrical stunning in cattle need to be managed both to protect operators and facilitate high throughputs***.

*Roça,R.O. (1999): Abate humanitário: o ritual kasher e os métodos de insensibilização de bovinos. Botucatu: FCA/UNESP, 1999. 232p. Tese (Livre-docência em Tecnologia dos Produtos de Origem Animal) - Universidade Estadual Paulista.

**Bager F., Shaw, F.D., Tavener, A., et al. (1990): Comparison of EEG and ECoG for detecting cerebrocortical activity during slaughter calves. *Meat Science*, Oxon, v.27, n.3, p.211-225.

**Leach, T.M. (1985): Pre-slaughter stunning. In: LAWRIE, R., ed. *Developments in meat science - 3*. London: Elsevier Appl. Sci. Publ. p.51-87.

***Velarde, A.; Ruiz-de-la-Torre, J. L.; Rosello, C.; Fabrega, E.; Diestre, A.; Manteca, X. (2002): Assessment of return to consciousness after electrical stunning in lambs. *Animal Welfare* 11, 333 -341.

2. The recent (conventional) slaughter methods (Stunning)

2.4. Adverse effects of stunning on meat safety and hygiene

2.4.8. The use of firearms is considered as a **high-risk operation in slaughter plants***.

2.4.9. The use of captive bolt stunners (pneumatic or cartridge-fired) **causes lesions of the central nervous system, spreading of CNS tissues throughout the animal organs****.

2.4.10. The use of pneumatic-powered air injections stunners which considered as an effective method for cattle slaughter, It produces **severe brain laceration *****.

2.4.11. Gas killing methods may be used to kill on site poultry, and young animals. The gaseous euthanasing method **should guarantee that the animal is dead at the end of the exposure******.

*Leach, T.M. (1985): Pre-slaughter stunning. In: LAWRIE, R., ed. Developments in meat science - 3. London: Elsevier Appl. Sci. Publ. p.51-87.

**Schmidt, G.R., Hossner, K.L., Yemm, R.S., et al. (1999b): An enzyme-linked immunosorbent assay for glial fibrillary acidic protein as an indicator of the presence of brain or spinal cord in meat. Journal of Food Protection, Desmonines, v. 62, n.4, p.394-397.

***Roça, R.O. (1999): Abate humanitário: o ritual kasher e os métodos de insensibilização de bovinos. Botucatu: FCA/UNESP, 1999. 232p. Tese (Livre-docência em Tecnologia dos Produtos de Origem Animal) - Universidade Estadual Paulista.

****European Food Safety Authority (2004): "Welfare Aspects of Animal Stunning and killing Methods" Scientific Report of the Scientific Panel for Animal Health and Welfare on a request from the Commission related to welfare aspects of animal stunning and killing methods.



Conclusion



1. The **best method of slaughter is the Halal Islamic method** which consists of a horizontal cut on the throat of the animal and severing all four vessels of the throat in addition to trachea and oesophagus, without any type of pre-slaughter stunning, in order **to remove all the impure blood from the animal**. This is the only method which ensures that the meat slaughtered **is lawful for Muslims of all schools of thought to consume and the method which removes all doubts**.
1. The Halal method of slaughter has been the best way to slaughter in the past and will continue to be the best way to slaughter in the future. As it characterized by **no pain sensation; complete drainage of liquid blood from the carcass; increased shelf life; absence of bacteria as well as improved meat safety and hygiene** in comparison to all conventional (stunning) slaughter methods.



Conclusion



3. At the time the Halal slaughter **protect the human beings from infectious diseases**; the stunned meat represents a dangerous source of zoonotic bacterial diseases and incurable prion diseases for consumers.
4. The use of any type of pre-slaughter stunning **makes the meat not lawful (not Halal) for Muslims**.
5. All stunning methods **have disadvantages relating to animal welfare, meat safety and hygiene, and public health**, as well as the stunned animal may die before slaughtering.
6. Further studies and researches are recommended to educate non-Muslims people **to apply the Islamic Halal method of slaughter and stop causing extra pain to the animal through stunning**.



الحمد لله رب العالمين