

Meat quality and animal welfare: Religious and scientific perspectives

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19.1 Introduction

Farm animal welfare entails ensuring the well-being of the individual animal by preventing unnecessary animal suffering, ensuring a good quality of life and a humane death (Gregory, 1998; Grandin, 2010a,b). Animal welfare is only applicable to living animals because dead animals cannot suffer. Nonetheless, the manner, circumstance, and reason for animal death are subject to welfare concerns and could affect meat quality (Gregory, 2005; Anil, 2012). Slaughtering is regulated by strict policies, animal welfare, working conditions, and food hygiene and safety (Gregory, 1998; Farouk, 2013). The suitability of the commonly used methods is dependent on religious ideology, livestock species, consumer demands, the availability of facilities, and economic considerations (Anil, 2012; Farouk et al., 2014). Slaughter techniques, if not effectively and efficiently applied, could compromise animal welfare and operators' safety and can hinder meat quality and safety (Gregory, 1998; Farouk et al., 2014). Current slaughter methods are broadly categorized into two, namely conventional and religious slaughtering techniques. Conventional slaughter involves the application of stunning (electrical, gas, and mechanical) prior to neck, while religious slaughter involves the killing of animals by neck cut using a sharp knife in accordance to religious prescriptions (Anil, 2012; Farouk, 2013). Regardless of slaughter method, consumers generally demand for conventional meat quality attributes (Farouk et al., 2014; Sabow et al., 2016). Nonetheless, in addition to conventional quality, spiritual quality is important for those who consume meat from religiously slaughtered animals (Farouk et al., 2014). When applied correctly, stunning improves animal welfare (Gregory, 1998; Anil, 2012). However, stunning could have adverse effects on carcass and meat quality and could pose public health concerns. For instance, muscle spasm, changes in blood pressure, and convulsion associated with electrical stunning could

cause fracture and hemorrhages in vessels and muscle, which could result into carcass downgrading and low meat shelf-life in ruminants (Gregory, 1998; Anil, 2012; Sabow et al., 2017). Preslaughter gas stunning hastened postmortem glycolysis and reduced water holding capacity and meat redness in broiler chickens (Salwani et al., 2016). Mechanical stunning (penetrating and non-penetrative captive bolt) caused CNS embolism in the jugular blood of cattle (Anil and Harbour, 2001; Anil et al., 2002; Coore et al., 2004), thus causing public health concerns. Stunning methods that kill animal cause poor bleed out, which could predispose meat from such animals to oxidative and microbial deterioration (Nakyinsige et al., 2014; Sabow et al., 2016). While carcass and meat quality problems are seldom encountered in religious slaughter, animal welfare could be compromised if religious slaughter is not carefully applied (Anil, 2012; Farouk et al., 2014). Thus, there is a need to harmonize religious and temporal views on animal slaughtering in order to produce meat with greater conventional and spiritual qualities without compromising animal welfare (Farouk, 2013; Farouk et al., 2014). The principles of different slaughtering techniques, their implication on meat quality, and their compliance to religious and conventional animal welfare demands are the subjects of this chapter.

19.2 Relevance of animal welfare to meat quality and safety

Evidences for increased public concern about animal welfare are abound (Blokhuis et al., 2008; Anil, 2012). Animal welfare is increasingly regarded as an integral component of meat quality and safety (Farouk, 2013; Grandin, 2010a,b). The livestock industry is ethically accountable to the consumers on the way animals are managed, transported, and slaughtered, thus making animal welfare a potentially and significantly important component of meat quality (Gregory, 2005; Grandin, 2010a,b). The ability of the livestock industry to meet the consumers' demands for meat quality forms the basis of any efforts geared at achieving economic sustainability of livestock production (Zjalic et al., 2006). Because of the high level of awareness of animal welfare issues in the society, ensuring an acceptable level of animal welfare forms an integral part of meat production. Animal husbandry practices, transportation systems, stunning, and slaughter techniques constitute the major perils faced by meat animals during their life cycle (Gregory, 1998; Grandin, 2010a,b). These perils could lead to poor welfare and thus to poor meat quality (Bianchi et al., 2006; Nakyinsige et al., 2014; Sabow et al., 2017).

Animal welfare plays a crucial role in the sustainability of animal agriculture by promoting the potentials and limiting the problems of animal production (Xiccato et al., 2002). Integrating sound animal welfare programs into livestock production could promote meat quality and guarantee a positive future trend for global trade in meat (Steinfeld et al., 2006). Animal welfare enables the livestock industry to provide animal protein to the people, promote trade, and forestall future problems. Improving the welfare of animals could reduce and/or eradicate the negative impacts

of disease outbreaks on farms (McInerney, 1998). Disease is unavoidably associated with economic loss. Disease-free livestock would maximize their potential productivity and provide safe food to consumers. Maintaining the welfare of farm animals could increase the profitability of animal production enterprise. The efforts put into disease prevention determine largely the potential risks and economic consequences of such disease (Broom, 1986). Preventing welfare problems is better for the animal and cheaper for the farmer than treating the problem. Good economics of livestock production is a balance between production costs and income. Thus, lowering direct and indirect costs associated with curing animal welfare-related diseases in livestock is an important strategy for increasing profitability. Improved animal welfare could limit carcass damage, transport stress, and death of animals (Gregory, 1998; McInerney, 1998). Poor animal welfare resulting in diseased stock could lead to the carcass downgrading (Gregory, 1998; Farouk et al., 2014).

Carcasses from diseased animals could be condemned or the diseased parts trimmed off, thereby causing a reduction in carcass yield and quality. Meat obtained from low quality carcasses (e.g., bruised or blood-splashed carcasses) has abnormal color, which may hinder the sales of such meat in value markets and such meat could possess a great hygiene risk for consumers (Gregory, 1998; Farouk et al., 2014). Poor animal welfare could predispose animals to preslaughter stress, which could reduce yield by lowering the water holding capacity and color stability of meat (Nakyinsige et al., 2014). Improving animal welfare could boost livestock productivity, which could help sustain local consumption and give room for exports. Animal welfare could enable a competitive advantage in agricultural trade in global animal products markets. Promoting animal welfare could sustain future food production and protect the environment.

19.3 Principles for slaughter of religiously accepted animals

Slaughtering refers to the killing and bleeding out of animals purposely for food (meat) (Agbeniga, 2012). Religious slaughter methods are those whose application is considered appropriate before meat is deemed consumable by the followers of the respective faiths. Halal and kosher methods practiced by Muslims and Jews, respectively, are the major commercially important religious slaughter techniques (Farouk et al., 2014). There are many similarities in the principles and practice of halal and kosher methods of slaughter. In both methods, particular attention is given to avoid unnecessary pain to animals in general and, in particular, in the course of slaughtering (Pozzi et al., 2015). The halal/kosher slaughter methods oblige that the two jugular veins, carotid arteries, trachea, and esophagus must be severed during exsanguination without decapitating the head during the process (Velarde et al., 2014). The purpose is to remove blood and consequently kill the animal through deflecting blood away from the brain to stop the delivery of oxygen. The expulsion

of blood from carcasses is a prerequisite for both kosher and halal meat production because it is considered an impurity that should not be consumed.

The basic requirements for the halal slaughter of animals defined by the GCC Member States and contained in Gulf standards Update (GSO 993/1998), Indonesia (MUIHAS 23103, 2012), Malaysia (MS 1500:2009), and The Islamic Food and Nutrition Council of America (Chaudry et al., 1997; Riaz and Chaudry, 2004) include the following:

- I. The animal should be alive at the time of slaughter; preslaughter treatment such as stunning must not result in the death of the animal before it is slaughtered. Stunned animals, if not slaughtered, must be able to make a full recovery
- II. Allah's (God) name and glorification must be uttered by the slaughterer at the time of the slaughter of each animal
- III. Effort should be made to slaughter the animal with one stroke using a very sharp knife
- IV. The slaughtering shall be carried out from the front side (towards the chest) and not from behind (towards the back)
- V. The head should not be severed from the neck during slaughter
- VI. Manipulating the carcass, such as skinning or cutting off the hocks, is not allowed to commence before the animal is completely dead.

Regenstein et al. (2003) described the basic requirements for kosher slaughter. Acceptable animals are slaughtered according to Jewish law by a specially trained religious slaughter man ("shochet") using a special knife ("chalef") that is extremely sharp with a very straight blade at least twice the diameter of the neck of the animal to be slaughtered. Prior to slaughter, the shochet make a blessing asking forgiveness for taking a life. The shochet checks the chalef before and after the slaughter of each animal and the cut on the animal's neck after each slaughter to make sure it was done correctly. Some of the critical considerations during the slaughter include: the cutting of the neck must be made without interruption, delay, or pausing; no pressing down of the knife so that only the sharpness of the blade cuts; the knife must not be burrowed, but rather must be exposed and visible from the beginning to the end of the cutting; slaughter must be within the limits within which the knife may be applied—from the large ring in the windpipe to the top of the upper lobe of the lung when it is inflated, and corresponding to the length of the pharynx; and the esophagus or the trachea should not be torn during the shechita incision (Anon, 2013). If any problem occurs with the knife or the cut, the animal is rendered treife or not kosher (Regenstein et al., 2003).

19.4 Scientific concerns about the welfare of religiously slaughtered animals

The 1958 Humane slaughter act and its revision of 1972 require that animals be rendered unconscious by stunning or stun killing before exsanguination. Nonetheless, the law permits religious slaughter as prescribed by Jewish and Islamic religious teachings (Sabow et al., 2016). Religious slaughter without stunning has been a central issue at the heart of animal welfare debates as it is perceived to cause undue pain

and distress during the lengthy neck cut-death interval. In Europe, slaughter without stunning has been banned in some countries, for example, Denmark, Netherlands, Norway, Sweden, and Switzerland. Concerns about religious slaughter without stunning focus on whether there is preslaughter stress (Ndou et al., 2011), whether the neck incision is painful (Gregory et al., 2010), and whether sensibility or consciousness is lost quickly enough following exsanguination by neck cutting or sticking (Anil, 2012).

There are concerns that, in some countries, slaughter plants use very stressful methods of restraint such as shackling and hoisting fully conscious animals with one rear leg. Stressful or painful methods of restraint cause injuries and may mask the animal's reactions to the throat cut (Grandin and Regenstein, 1994). In religious slaughter, Anil et al. (2006) reported that pain and distress were observed in cattle during neck cut and the period after slaughter prior to loss of brain activity. Gregory (2008) argued that when animals are slaughtered without stunning, some take long to lose brain function and die and recommended the use of precut electrical stunning or alternatively postcut captive bolt stunning to lessen the stress on animals slaughtered in rotating restrainers. Unpublished data collected by Hayes (2012) showed that some cattle harvested through the kosher method remained conscious for up to 200 s following the throat cut. Gregory et al. (2012) evaluated animal welfare of cattle slaughtered with or without stunning and reported occlusive false aneurysms formed as early as 7 s following the halal neck cut, which could lead to continuous consciousness through failure to bleed out properly. They recommended that one way of controlling the risk of occlusive false aneurysms is to perform either precut or postcut stunning. Johnson et al. (2012) demonstrated that slaughter by ventral-neck incision without stunning is associated with pain in the period between the slaughter and subsequent loss of consciousness. Another important animal welfare concern is aspiration of blood into lungs while the animal is still conscious following slaughter without stunning (Grandin, 2010a,b). Gregory et al. (2009) examined bovine stunning with sticking and found that the non-stunned animals continue to breathe during the early part of bleeding, while the stunned animals were not. The authors (Gregory et al., 2009) concluded that animals that were slaughtered without stunning do not lose consciousness rapidly while blood is present in their respiratory tract and may suffer airway irritation caused by the blood. The findings of Agbeniga and Webb (2013) also showed that the occurrence of blood in the trachea and blood splash in the lungs was significantly higher in cattle slaughtered with kosher method compared to those subjected to pneumatic captive bolt stunning.

19.5 Strategies to improve the welfare of religiously acceptable slaughter techniques

The World Organization for Animal Health (OIE), the European Union (EU), and the United States Department of Agriculture (USA), all permit slaughter without stunning to allow Jews and Muslims practice their religious beliefs. To improve animal welfare,

some religious authorities have accepted stunning either immediately before or immediately after the throat cut. [Grandin \(2010a,b\)](#) recommends the following to improve animal welfare during slaughter without stunning:

19.5.1 Restrain the animal in a comfortable, upright position

Animals to be slaughtered must be restrained using an appropriate equipment in order to spare them any avoidable pain, agitation, injury, or contusions ([Lambooj et al., 2012](#)). [Grandin \(2013\)](#) recommended that, in order to reduce stress in animals to be slaughtered, the restraint devices should be nonslip, should possess pressure-limiting devices, moving parts should move steadily, and the concept of optimum pressure must be used. In terms of the welfare ranking of restraint devices, [Grandin \(2013\)](#) ranked the ones that held animals in an upright position as excellent for conscious animals. [Grandin \(2010a,b\)](#) indicated that restraining the animal in a comfortable, upright position using a modified American Society for the Prevention of Cruelty to Animals (ASPCA) pen ([Fig. 19.1](#)) before and during slaughter was less stressful than shackling, inverting, or hoisting. A previous study by [Dunn \(1990\)](#) showed that stress responses such as cortisol levels and hematocrit values of cattle subjected to religious slaughter with the Weinberg pen, in which the animal is inverted, were significantly higher than those of cattle slaughtered in the ASPCA pen, in which the animal was standing. Additionally, the average time spent in the Weinberg pen was eight times longer than the time spent in the ASPCA pen.

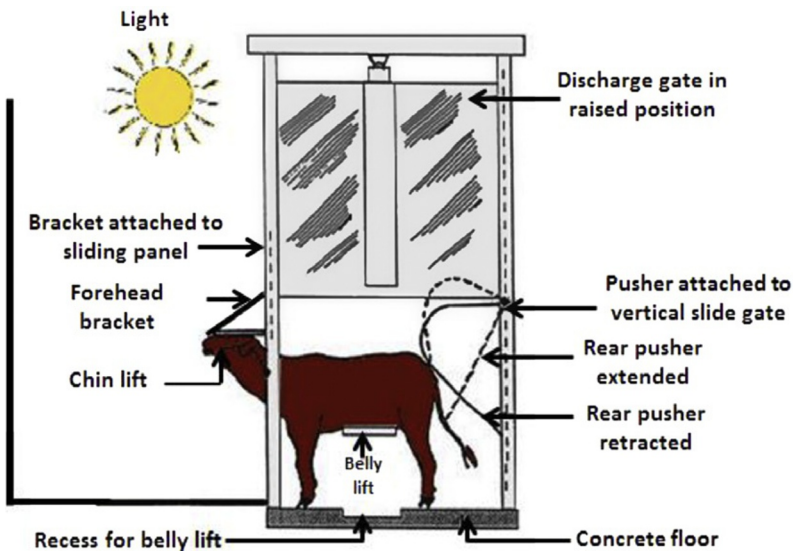


Fig. 19.1 A modified American Society for the Prevention of Cruelty to Animals pen ([Grandin and Regenstein, 1994](#)).

19.5.2 Religiously slaughtered animals must be unconscious before removal from the restrainer

According to [Grandin \(2010a,b\)](#), the animal must be insensible and unconscious before it is removed from the restraint box or restrainer and hung on the rail, as this will not cause unnecessary pain. An animal showing signs of sensibility when hung on the rail is a failed audit.

19.5.3 Use a very sharp knife that is twice the width of the neck

The knife design and the cutting procedure seemed to be critical in preventing the animal from reacting to the cut as a quick flow of blood and loss of consciousness immediately ([Helmut, 2010](#); [Grandin, 1994](#)). Sharpness of the knife and performing a complete uninterrupted cut could influence other factors such as vasoconstriction, clotting, ballooning known also as carotid occlusion, or false aneurisms ([Anil, 2012](#)). Furthermore, [Pozzi et al. \(2015\)](#) reported that the length of the knife should be twice the width of the animal's neck, which means about 20–22 cm for poultry, 45–48 cm for a veal calf, and 55–60 cm for adult cattle. Such a knife can be easily drawn across the neck without having the tips at either end enter the open wound causing needless pain. [Grandin \(2010a,b\)](#) stated that knives that are too short where the tip gouges into the neck will often cause violent struggling.

19.5.4 Score the interval from the cut to loss of consciousness

Cattle take longer to lose sensibility after slaughter without stunning compared to sheep ([Blackmore, 1984](#)). Sheep lose sensibility within an average time of 2–14 s with good cutting technique ([Blackmore, 1984](#)). In cattle, some animals may require over a minute to lose sensibility ([Gregory et al., 2010](#)). The use of careful technique will shorten the time required for cattle to collapse (lose posture and no longer be able to stand) after the cut. Collapse is the initial indicator of onset of insensibility ([Von Holleben et al., 2010](#)). When poor technique was used, only 68% of the cattle collapsed within 30 s and good technique increased the percentage of cattle that collapsed within 30 s to over 90% ([Grandin, 2010a,b](#)). Cattle will lose sensibility more quickly if they enter the restraint box calmly and are cut immediately after the head is restrained with swift knife stroke ([Grandin, 1994](#)). Releasing body and head restraints immediately after the cut also facilitates more rapid collapse ([Grandin, 2010a,b](#)). Moreover, using a high neck cut reduces time to final collapse frequency of animals that have a prolonged time to unconsciousness and could lessen such suffering ([Gibson et al., 2015](#)). The cut must be made at a ventral position of the neck near the lower jaw and it should not reach the spine. [Grandin \(1994\)](#) reported that if a rapid deep cut is performed close to the jawbone (high neck cut position), 95% of cattle rapidly collapsed. Additionally, [Gregory et al. \(2012\)](#) reported that severing the neck at the first cervical vertebra position as compared to the conventional second and fourth cervical vertebra reduced false aneurysm development, thereby lessening the risk of arrested exsanguination. It is well-recognized that there is increased branching

of the common carotid arteries at the high neck cut position (trachea rings ≤ 2) and it is proposed that this prevents or minimizes retraction of the carotid within the connective tissue sheath, thereby reducing the likelihood of false aneurysm formation (Gibson et al., 2015).

19.6 Similarities and differences between religious and scientific perspectives on slaughtering, animal welfare, and meat quality

In order to understand the similarities and differences between religious and scientific perspectives on slaughtering, animal welfare, and meat quality, it is important to first understand the meaning of these three terms in both perspectives. In scientific terms, slaughter means killing animals specifically for meat. From the religious perspective, slaughter means killing animals, which is equivalent to the scientific meaning of exsanguination; a method of euthanasia to ensure death of an animal through an incision made on the throat to sever all blood vessels. Sensory and motor nerves are also severed. In modern meat production, whether animals are stunned or not, exsanguination must be done to drain excess blood from the carcass purposely to improve meat safety. The scientific interpretation of animal welfare is given by World Organization for Animal Health (Office International des Epizooties—OIE), which indicates that an animal's welfare is good if the animal is healthy, comfortable, well nourished, safe, able to express innate behavior, and not suffering from unpleasant states such as pain, fear, or distress (OIE, 2010). The OIE meaning is further detailed by The Farm Animal Welfare Council (FAWC)'s Five Freedoms; (i) Freedom from thirst, hunger, and malnutrition, (ii) Freedom from discomfort, (iii) Freedom from pain, injury, and disease, (iv) Freedom to express normal behavior, and (v) Freedom from fear and distress (Farm Animal Welfare Council, 1993). In the religious sense, animal welfare is about treating animals humanely and reducing their pain. Lastly, meat quality is defined as those traits the consumer perceives as desirable which include both visual and sensory traits, credence traits of safety, health, and more intangible traits such as "clean" and "green" or welfare status of the production system (Warner et al., 2010). This includes both functional and conformance quality. In the religious perspective, meat quality is only considered after fulfilling the conformance quality, that is, must fulfill all the prerequisites prescribed in the given faith. Commonly, the meat production process must meet the Halal or Kosher requirements in line with the dietary guidelines of Muslims and Jews, respectively.

19.7 Religious and scientific perspectives on slaughtering

The Humane Slaughter Act dictates that animals be rendered rapidly unconscious before being shackled or exsanguinated. This rapid unconsciousness is achieved through stunning. There are currently three main methods of stunning, namely mechanical, electrical, and gas stunning. Another method of slaughter according to

Humane Slaughter Act is the religious or ritual slaughter. Ritual slaughter involves exsanguination without prior rendering the animal unconscious. The method is believed to be humane as it uses a very sharp knife to rapidly bleed and kill the animal. Ritual slaughter also involves severing the vagus nerve that conveys neurons to the brain (Nakyinsige et al., 2013a,b). Studies on the humaneness of ritual slaughter have given varying results. Earlier assessment of time to brain failure or evoked activity using electroencephalogram (EEG) or electrocorticogram (ECG) showed that animals slaughtered without stunning promptly lost brain function (Gregory and Wotton, 1984; Schulze et al., 1978), implying that the method is not painful, while others reported delayed loss of consciousness (Gregory et al., 2010; Newhook and Blackmore, 1982) implying pain to animals. Pain is one such stressor that serves as an awareness of potential tissue damage and if it is so severe that the animal can no longer cope with it to maintain homeostasis, it becomes distress and the animal's well-being is compromised; thus, understanding animals' physiology, psychology, and behavior is important for scientists to make educated assessments of animals' well-being (Backus et al., 2014).

Whereas Sechita for the Jews does not accept stunning at all, halal slaughter for Muslims accepts pneumatic stunning in bigger animals like cattle and buffalos, head-only electrical stunning in smaller species like sheep, goats and deer, and water bath stunning for poultry (Nakyinsige et al., 2013a,b). The methods must, however, meet religious requirements shown in Table 19.1. High frequency head to body electrical stunning and postcut stunning (Farouk et al., 2014) are also being forwarded for consideration before halal slaughter.

Thus, the main difference between the scientific and religious perspective on slaughter lies in the application of stunning as a means to improve animal welfare during slaughter and its omission in the former and later, respectively. Important to note, however, is the fact that, in both, there is zero tolerance to inhumane treatment of animals during slaughter. For instance, Islam teaches that animals are to be slaughtered according to the mindful and attentive way taught by the prophet Muhammad (peace be upon him) as indicated in the following hadith:

Allah calls for mercy in everything, so be merciful when you kill and when you slaughter; sharpen your blade to relieve its pain.

19.8 Religious and scientific perspectives on animal welfare

Attention to animal welfare varies significantly around the world, with the EU having the strictest laws, while Asia, Africa, and Latin America have less stringent laws and regulations (Backus et al., 2014). These animal welfare laws and regulations are mainly related to humane slaughter and transportation of animals with the least attention given to handling of animals in farms and stockyards. Transportation of animals is regulated in terms of duration, stocking density, drinking, and feeding on the journey

Table 19.1 Sharia requirements for pre-halal slaughter stunning

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| <ul style="list-style-type: none"> (i) The method used should be reversible stunning and should not kill or cause permanent physical injury to the animal (ii) The person who is responsible for the stunning operation (operation, control and monitoring) should be trained in its use and should preferably be a Muslim (iii) The Muslim halal checker should verify that the stunning operation is conducted according to the approved methods (iv) The animal to be slaughtered should be alive or deemed to be alive at the time of slaughter (v) If the animal is found dead due to the stunning procedure, the slaughter man should identify and remove it from the halal system (vi) The phrase <i>Bismillah Allahu Akbar</i> must be invoked by a muslim slaughter man immediately before slaughtering (vii) The bleeding should be spontaneous and complete (viii) Scalding of poultry and carcass dressing of ruminants should only begin after the animal has been deemed dead from bleeding (ix) The equipment or tools used should only be dedicated to stunning halal animals and should never be used for stunning animals which are considered haram by Shariah law (x) If the equipment that were once used for haram animals are to be converted to use in the stunning of halal animals, they (equipment) should be ritually cleansed. The procedure should be supervised and verified by a competent Islamic authority (xi) The premises for stunning of halal animals should be physically segregated from other premises that deal with haram animals |
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Source: Nakyinsige, K., Che Man, Y.B., Aghwan, Z.A., Zulkifli, I., Goh, Y.M., Abu Bakar, F., Al-Kahtani, H.A., Sazili, A.Q., 2013. Stunning and animal welfare from Islamic and scientific perspectives. *Meat Sci.* 95 (2), 352–361; Nakyinsige, K., Sazili, A.Q., Aghwan, Z.A., Zulkifli, I., Goh, Y.M., Fatimah, A.B., 2013. Changes in blood constituents of rabbits subjected to transportation under hot, humid tropical conditions. *Asian-Austral J. Anim. Sci.* 26(6), 874–878.

and ventilation. The dimensions for the different species are based on scientific studies. Although it does not give deliberate guidelines on dimensions, religion teaches about animal welfare and respect for all creatures. This is evidenced in the Holy Quran:

And there is no creature on [or within] the earth or bird that flies with its wings except [that they are] communities like you.

Al An-am, 6: 38

and hadith:

Whoever is kind to the creatures of God, is kind to himself.

(Masri, 1989)

Islam emphasizes humane treatment of animals throughout the meat production chain. It mandates giving animals feed and water before slaughter. According to [Masri \(1989\)](#), prophet Muhammad (peace be upon him) once saw a man denying a satiating measure of water to a sheep he intended to slaughter and he gave the man

a beating with his lash and told him: *Go, water it properly at the time of its death, you knave!* The use of a sharp knife to quickly sever the four vessels in the neck is greatly emphasized, yet it is not allowed to sharpen the knife in front of the animal or to slaughter any animal in front of others of the same kind. Logically, this is aimed at preventing animals from distress.

Preslaughter handling and situations put animals at great risk of fear and they perceive such odors, sights, and sounds as signals of danger. In response to these stimuli, several changes occur within the sympathetic-adrenomedullary system, with the liberation of catecholamines to the bloodstream (Nakyinsige et al., 2014). Scientists thus measure catecholamines as an indicator of animal welfare. There is a religious conviction that, when Allah's name is mentioned with sincerity at the moment of slaughter, the animal is dispatched as painlessly (Farouk et al., 2014).

It is thus essential to acknowledge that, from both the scientific and religious perspectives, there is mutual agreement that animal welfare is important for production of wholesome of meat and humane treatment is an animal right.

19.9 Religious and scientific perspectives on meat quality

In the scientific perspective, meat quality is considered in terms of such quality characteristics as pH, color, tenderness, water holding capacity, and absence of such defects as DFD, PSE, skin discoloration, bruising, blood splash (ecchymosis), hemorrhages, and broken bones. However, in the religious perspective, these conventional quality properties only supplement *spiritual quality* that is attained by following religious prescriptions for producing religiously accepted meat.

Such retail companies as grocery stores, restaurants, and food service companies that sell meat and meat products to Muslims and Jews have specific requirements for standards during slaughtering, processing/manufacturing, packaging, warehousing, distribution, retail display, and/or serving. Each of these companies often seeks certification from a credible religious authority as assurance to its clients who want to uphold the tenets of their religion that the company's products are verified and therefore authentic. Religious followers have been known to consider halal or kosher certification as main purchase criterion before even national and international quality certification, expiry date, nutritional information, and price. The strictness with which this is followed is determined by geographic location, cultural differences, and different ethical, moral, or religious standards. Never the less, exporting countries must fulfill all the standards set by the importing country.

There is a great variation in denoting meat quality from the scientific and religious perspectives. Scientifically, meat quality is based on intrinsic and extrinsic factors that influence the appearance, eating, technological, nutritional, health, and safety indices of meat. Eating quality is dependent on tenderness, juiciness, and flavor; appearance is dependent on color and marbling; technological quality is influenced by protein solubility, the ability of the solubilized proteins to bind water and fat, and water holding capacity; health/nutritional quality is influenced by meat composition, while pH, antioxidant content, and microbial load are important considerations for meat safety.

These chemical and physical characteristics of meat determine the conventional consumer's appeal, acceptability, purchase, utility, and ultimately the value of meat.

On the contrary, from the religious perspective, meat quality is considered in terms of divine acceptability of animal species, slaughter method, and religion of the slaughterer. To verify these three conditions, large scale or cottage meat production involves hiring a certified slaughter man whose activities are also supervised by the certifying authority. For Muslims, any meat worthy of consumption must fulfill the conditions stipulated in the Holy Quran;

They ask you (O Muhammad S.A.W) what is lawful for them (as food). Say: "Lawful unto you are At-Tayibat [all kind of Halal (lawful-good) foods which Allah has made lawful (meat of slaughtered eatable animals ...).

Surah al Maidah 5:3

What is unacceptable is also mentioned:

He has forbidden you only the Maytatah (dead animals), and blood, and the flesh of swine, and that which is slaughtered as a sacrifice for others than Allah (or has been slaughtered for idols, etc., on which Allah's name has not been mentioned while slaughtering.

(Al- Baqarah 2: 173)

The slaughter of meat for Muslims must also fulfill the conditions given in [Table 19.2](#).

Additionally, meat consumed by Muslims must not only be halal (authorized, permitted, allowed, approved, sanctioned, legitimate, lawful, legal, or licit) but also thoyyiban (wholesome), which denotes quality, safety, healthiness, hygiene, and welfare. This is also a Quranic teaching;

Table 19.2 Prerequisites for slaughter of halal meat

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| <ul style="list-style-type: none"> (i) The animal must be alive at the time of slaughter, preslaughter treatment stunning inclusive must not result in animals' death prior to exsanguination, and stunned animals, if not exsanguinated, must be able to regain a full recovery (ii) Allah's (God) name and glorification (<i>Bismillahi Allahu Akbar</i>) must be uttered by the slaughter man at the time of the slaughter of each individual animal (iii) Preferably, the animal should be slaughtered with a single stroke using a very sharp knife (iv) The slaughtering should be carried out from the front side (towards the chest) and not from behind (towards the back) (v) The carotid artery, jugular vein, trachea, and esophagus should be severed (vi) The head must not be severed from the neck during slaughter (vii) Carcass dressing or scalding must never commence until the animal is completely dead |
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O mankind! Eat of that which is lawful and wholesome in the earth, and follow not the footsteps of the devil. Lo! he is an open enemy for you.

(Al- Baqarah 2: 168)

The other ritual slaughter method, Shechita (Jewish or Kosher), is based on Biblical teachings described in the Old Testament where God instructed Moses and the Israelites to refrain from consumption of blood of slaughtered animals;

Every moving thing that is alive shall be food for you; I give all to you, as I gave the green plant. Only you shall not eat flesh with its life, that is, its blood.

(Genesis 9:3–4)

However, you may slaughter and eat meat within any of your gates, whatever you desire, according to the blessing of the LORD your God which He has given you; the unclean and the clean may eat of it, as of the gazelle and the deer. Only you shall not eat the blood; you are to pour it out on the ground like water.

(Deuteronomy 12:15–16)

So when any man from the sons of Israel, or from the aliens who sojourn among them, in hunting catches a beast or a bird which may be eaten, he shall pour out its blood and cover it with earth. For as for the life of all flesh, its blood is identified with its life. Therefore I said to the sons of Israel, You are not to eat the blood of any flesh, for the life of all flesh is its blood; whoever eats it shall be cut off.

(Leviticus 17:14)

To attain the spiritual quality taught in the above verses, the animal is slaughtered and the meat prepared according to rabbinical laws as indicated in [Table 19.3](#).

Following slaughter, the meat is then subjected to koshering as because blood, including all the removable residual blood in the meat is not permitted to those who consume kosher meat ([Regenstein et al., 2003](#)). A Jewish Inspector examines the carcass and may reject certain parts (treifa) and defects such as hemorrhages. Subsequent to this inspection, the meat is “porged” to remove veins or any other forbidden tissues such as blood, certain fats known as chailev, and the sciatic nerve (usually both hind legs are removed). Lastly, some meat cuts are salted to remove blood before marketing ([Anil, 2012](#)).

From the scientific perspective, the koshering process has tremendous effects on the meat quality since it removes some myoglobin and other sarcoplasmic proteins due to use water for soaking and salt for blood removal. The removal of heme proteins will have significant effects on color, flavor of the product ([Torres et al., 1988](#)).

Of all food products, meat is the most regulated religiously. Meeting religious quality requirements is so important for halal and kosher adherents that meat, which has graded well conventionally, yet failed to meet the minimum requirements of religious commandments during its entire production chain, would be considered spiritually worthless ([Farouk et al., 2014](#)). On the contrary, those basing on scientific knowledge

Table 19.3 Conditions for production of kosher meat

- (i) An approved and trained slaughter man (Shocet) who must be a person of recognized high moral character and consistent religious practice and must have obtained a license from the Rabbinical Commission and the local authority
- (ii) Using a very sharp special knife that is often examined for its sharpness after each cut and must be 16 in. long in case of cattle (chalaf)
- (iii) A Rabbi makes a transverse cut across the neck
- (iv) Koshering must be done

Source: Modified from Regenstein, J.M., Chaudry, M.M., Regenstein, C.E., 2003. The kosher and halal food laws. *Comp. Rev. Food Sci. Food Safety* 2 (3), 111–127.

to support stunning before exsanguination posit that meat produced without stunning animals is of low quality and reach such an extent of even demanding food labeling to clearly identify such meat. Nonetheless, there is an ever increasing perception from Muslims, Jews and some other that halal and kosher meat is wholesome and healthy (Cohen et al., 2002; Nakyinsige et al., 2012).

19.10 Conclusion

Promoting animal welfare is the key to the sustainability and economic viability of the production of meat with high spiritual and conventional qualities. Meat quality would be enhanced if livestock production and slaughtering systems are managed in a way that ensures delivery of high welfare potential. Religious slaughter improved meat quality, but could compromise animal welfare. Conversely, preslaughter stunning can improve animal welfare, but could have detrimental effects on carcass and meat qualities. These justify the harmonization of scientific and religious views on slaughtering to sustain the production of wholesome meat while maintaining animal welfare.

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