

Welfare of slaughter animals and impact on meat quality*

Karabasil Neđeljko¹, Dimitrijević Mirjana¹, Milićević Dragan²

A b s t r a c t: Animal welfare is very important in the meat production chain. From the production on the farm to slaughtering, it is the main task of experts and other stakeholders included in the meat production, as well as their obligation, to respect the animal welfare, to treat animals in a humane manner, to spare them fear, suffering and pain. Since slaughterhouses represent unfamiliar environment for the animals, and therefore stressful environment, negative effects can be diminished by adequate handling of animals. Guarantee of proper animal treatment and subsequent meat quality is respecting of adequate regulations and continuous education of persons included in the chain of animal food.

Key words: welfare, quality, meat.

Introduction

Production of food is still one of the main human activities without which there is no survival of the human kind. In recent years, 40 % of human population is employed in agriculture, which is more than any other occupation. All cultivated plants and domestic animals are product of human technology. It is indisputable that modern agriculture has its drawbacks, some of them were severely criticized and cause fear in people. In addition to all shortcomings, agriculture is basis/foundation of the civilization as we know it. Cultivated plants and domesticated animals are foundation of the modern world.

One of the reasons influencing the decrease in meat consumption is concern of the consumers in regard to zoonoses, residues, contaminants, etc. So, incidence of bovine encefalopathy had significant impact on consumption of beef in countries where this disease was recorded (Gregory, 2000). Recently, there are discussions about other reasons for negative consumer attitude towards the meat consumption, associated with modern animal farming methods. Therefore, ethical dilemma and sense of resentment occur in part of consumers. Producers and suppliers of meat respond to the negative reactions of consum-

ers by marketing of meat prepared for use (heat treated, ready dishes). Reason for this is to disassociate meat for consumption and animal from which the meat comes from, to make this link less distinct and as distant possible (Baltić *et al.*, 2002; Baltić *et al.*, 2010; Fiddes, 1997). One of the measures undertaken by producers and suppliers is introduction of modern systems of production process control and control of the final products, as well as informing of consumers about those measures. In this way the level of consumer concern about the quality of foodstuffs is reduced (Gregory, 2000).

Standards and legislative regulations in the field of animal welfare

Consumer attitude towards the meat quality represents very important information for producers, because it has direct impact on profit. Quality is very difficult to define, but with numerous researches conducted in this field and adequate public awareness and information campaigns, the consumer opinion and attitude in regard to the meat quality and farming of animals and management of animals, can be improved over time (Baltić *et al.*, 2002; Baltić

*Plenary paper on International 56th Meat Industry Conference held from June 12-15th 2011. on Tara mountain;

*Plenarno predavanje na Međunarodnom 56. savetovanju industrije mesa, održanom od 12-15. juna 2011. godine na Tari.

¹Faculty of Veterinary Medicine of the Belgrade University, Bulevar oslobođenja 18, 11 000 Belgrade, Republic of Serbia;

²Institute of Meat Hygiene and Technology, Kačanskog 13, 11 000 Belgrade, Republic of Serbia.

et al., 2010a). In recent years, animal welfare has increasingly been in the sphere of interest of experts as well as the general public. Veterinarians are especially important since animal health is one of the most important animal welfare aspects (*Baltić et al.*, 2005). In addition to veterinarians, production managers, workers in the meat production chain, need to acquire knowledge and skills in the field of animal welfare, and special attention must be directed to the procedure of assessment of welfare conditions in regular production.

As the consequence of increasing concerns of consumers, but also state authorities, for the animal welfare, activities followed which lead to tightening of the legislation and introduction of standards which, in addition to legislation, should improve the execution of adequate conduct towards the animals. All standards are based on the fact that food business operators operate within the local legislation, however respecting internationally adopted rules. So, there are three implementation levels of different rules: a) Global - OIE (The World Organization for Animal Health) published animal welfare standards pertaining to slaughtering, transportation and killing of animals in disease control (*OIE*, 2010). These standards represent the minimum requirement for developed countries as well as developing countries; b) Regional – directive/regulation of European Union relating to animal welfare on the farm, in transportation and slaughtering (*Council Directive* 2001/88/EC; *Council Regulation* (EC) No 1099/2009); c) National legislation – each state has adopted own legislation in the field of animal welfare (*Defra*, 2010; „*Official journal of RS*“, No. 41/2009; *USDA*, 2010; *MAF*, 1996); and d) Internal standards of large corporations/associations/scientific societies (*FASS*, 2010; *National Pork Board*, 2008), which in some segments are even more severe in requirements than valid/applicable national regulations and/or OIE standards.

Science and scientific information which we obtain as the result of different experimental investigations, measure/quantify the effect of different situations and environment conditions on animals, from the aspect of the animals, and ethics shows us how to treat the animals. Corresponding standards in this field help us to realize good production practice, and legislative regulations show us how to treat the animals. Fighters for animal rights often pose a dilemma that the idea itself of animals being reared only to be killed for our purposes, is cruel/brutal. However, death relates to the quantity of life (duration) more than to the quality. Welfare primarily concerns the quality of life. Even though in certain situations death can have impact on welfare as

indicator of previously poor condition of the animal, it is not an aspect of the welfare. The question is raised when is the death relevant from the welfare aspect? - In all situations when death of an animal occurs as the outcome of our poor practice, housing conditions, neglect, etc., such as high mortality of animals due to poor housing conditions, way of dying and applied slaughtering procedure, etc. In general, people want to avoid the poor quality of living and to have as long possible life span (quantity). This aspect (quantity of life) in the issue of animal welfare, from the ethical point differs from the demand relating to quality of life.

Assessment of animal welfare is aimed at evaluation of the condition of the animal as consequence of our actions (housing conditions, neglect, poor construction of the equipment and facilities where animals are housed, etc.). In the chain of meat production there are many steps in the process, and main steps in production of animals farmed for meat production, as following: rearing of animals on farms, transportation from farm to livestock market or slaughterhouse, transportation from the livestock market to slaughterhouse, stay of animals in slaughterhouse and slaughtering operations. In addition, there are numerous between steps which additionally complicate the welfare conditions, so it is necessary to realize the essence of the problem and it is preferable to have as few possible handling steps with animals. On the other hand, if you don't want to endanger animal welfare, then you should not keep it, rear it, transport it, stun or kill it, because every link in the production chain leads to some kind of threat to animals. There are always problems or they occur from the aspect of our relation, conditions which we provide for the animals, however, what we can do is to reduce the negative effects in the process of production of meat.

Good and poor manufacturing practice

Outcomes of poor production/manufacturing practice are numerous and create problems in production chain, and some of the examples are: percentage of tortured animals, injured animals, animals with bruises and wounds, percentage of animals which have not been successfully stunned in the first attempt, etc. All of these examples are consequence of applied procedure and poor manufacturing practice in handling of animals (*Grandin*, 2010). One of the examples of poor practice can also be when large number of animals slip/fall during handling. Reason can be poor construction and quality of floor, if it is slippery and not adequate for animals, or in

excessive use of electric stick causing the panic in animals (Gregory, 2007). If after applied stunning procedure animal still doesn't lose consciousness, this can be consequence of several factors such as poor maintaining of the equipment, also in cases when animal is upset, it is more difficult to place the stunning equipment on correct position, untrained staff, as well as poor construction of the stunning pen (Grandin, 1998).

In order to ensure the minimum requirement, some of the procedures such as use of force, striking and pulling of animals, especially tied and consciousness animals, are prohibited, whether by reference standards or applicable legislation. In OIE standard, relating to animal slaughtering, it is stated that such practice cannot be used under any conditions (OIE, 2010). Therefore, they are described and discussed for a reason, and unfortunately it is the possibility that some of these practices can be implemented by staff which lacks knowledge and training in the field of animal behaviour and sense of pain, as well as inadequate management support. In order to avoid misunderstandings and different interpretations of procedures which refer to fulfilling of animal welfare requirements, it is necessary to emphasize situations and procedures which are stressful and painful to the animals, and therefore are not appropriate to be applied in practice.

When speaking of space or equipment requirements, one should be cautious, because if we define how the equipment should look like, then we will prevent development of new methods and equipment from the scientific side (Troeger, 2009.). Majority of problems which relate to equipment can be assessed through outcome of the operation for which it is used. In case of stunning, efficiency of the equipment used can, among other things, be monitored through percentage of animals stunned from the first attempt. However, for some details it is necessary to have some specifications, such as minimum amper voltage value necessary for electric stunning, speed of the stunning wedge used in mechanical stunning and of course the minimum space that has to be provided for the animal in stunning pen (OIE, 2010.; Gregory, 2007). The fact that animals in transport must be provided adequate area/space in the transportation vehicle is often forgotten, and this is one of the major elements which are considered when welfare conditions are assessed (Ritter et al., 2006.; Ritter et al., 2007), because as a consequence of over loaded vehicle, injuries, bruises, and in worst case scenario deaths, can occur. Deaths during transportation represent objective indicator of the severity and level of suffering of animals. Based on this statement, from the aspect of animal welfare

and consumer demands, the mortality percentage of over 0% cannot be accepted, but in the practice, deaths during transport happen in all animal species. Percentage of animals that died varies in different producers and transporters. Significantly lower mortality percentage occurs in pigs which come from farms with good manufacturing practice compared to farms with poorer farming and rearing conditions (Fitzgerald et al., 2009.).

Animal welfare and quality of meat

Path of the animal from the farm to the slaughter house has numerous obstacles with which the animal is faced: handling and contact with the human/operator, transportation, different conditions and environment to which the animal is not used, deprivation of food and water, changes in the social structure, separation and/or mixing of animals (Ferguson and Warner, 2008; Ristić, 2009.). As consequence of above mentioned, animals can experience fear, dehydration, hunger, intensive physical stress and activity, fatigue and injuries. Inability of the animals to overcome the stress factors of the environment can additionally complicate and emphasize the consequences.

As a consequence of transportation, in all animal species, certain loss in body weight occurs, mainly due to loss of water, process of sweating, respiration and urine and faeces excretion. Factors influencing the loss of body weight are the condition of the animal, if the transportation vehicle is overloaded, season and climatic factors (heats or very humid and cold weather) and duration of the transportation. Loss of body weight occurs as consequence of food and water deprivation before slaughtering and it is most obvious in the first 12 h. From the aspect of animal welfare, bigger problem is the potential rehydration of animals upon their arrival to the slaughterhouse. In the livestock depot there should be water available for animals and different systems of water distribution. In some researches it was registered that animals, although they have access to water, refuse to drink it. Reason for this can be limited access or unfamiliar system of water supply to animals in the new environment. This is especially problem in calves and young cattle (Gregory, 2003; Jacob et al., 2006).

Bruises are defined as traumatic injuries without skin penetration with damages to blood vessels of the injured region, with extravasation of the surrounding tissue. Fattened animals are more susceptible to these injuries, also animals reared in chronically stressful conditions. Injuries of this type are most often occurring in cattle in the following regions: (a)

legs, thighs and loins (approximately 31 %); (b) in region of scapula and shoulder (approximately 36 %); (c) rib region (approximately 13 %); (d) and 20 % of injuries of other body regions. In sheep, bruises occur due to rough treatment of animals, when they are pulled by the wool or legs, in triage, sorting, weighing, loading, unloading, etc. when producer establishes that this problem occurs, it is necessary to determine the origin of the injury, if it was inflicted in the slaughterhouse or earlier in the production chain. If injuries occur in the slaughterhouse, the changes will be obvious and visible on animals from various producers. If the problem is not associated with the slaughterhouse, then by tracing the origin of the injured animals the farm/producer or transporter in question can be determined. Trauma injuries most often occur as consequence of overloaded vehicle, and the other reason is rough treatment of animals (Whytes *et al.*, 1985; Grandin, 2010). However, trauma injuries in cattle can occur on the body/carcass any moment before bleeding

Stress is response of the organism to harmful factors of the environment. Stress outcome can be adapting or exhausted adapting, leading to collapse. Stress as the consequence of transportation represents the condition of the anxiety of the entire organism under the influence of different stress factors (extreme temperatures – low and high, noise, rough treatment of animals, excessive food deprivation, sudden and frequent changes of the air pressure).

Upon first signs of stress in pigs, stress factors should be eliminated and animal should be left to rest. Due to stress, organism cannot neutralize microorganisms entering the digestive tract, resistance to infectious diseases is reduced and there is also negative impact on sensory meat properties, consistency, taste, smell and colour.

Negative impact on sensory meat properties can also be induced by duration of the transportation (Warriss, 2000). It is considered that the transportation (shorter than four hours) has slight effect on pH values 24 hours after slaughtering, provided that the transportation conditions were satisfactory (Grandin, 2000). Villarroel *et al.* (2003) from Spain,

investigated the effect of conditions and duration of transportation (30 minutes, three and six hours) on sensory meat properties (smell, tenderness, succulence, aroma intensity, aroma quality and general impression). The authors concluded that the duration of transportation had influenced the sensory meat properties, primarily tenderness and general impression.

Every activity of the animal (aggressive behaviour, long duration of transport, excessive use of the electric prods, etc.) requires energy, i.e. use of glycogen from the muscles. Glycogen reserves in musculature before slaughtering have very important impact on meat quality attributes: pH value of meat after slaughtering, succulence, sustainability, colour and water binding capacity. Glycogen concentration in cattle and sheep ranges from 75 and 120 mmol/kg (Immonen *et al.*, 2000). So, certain losses in the quantity of glycogen can be tolerated in the meat ripening process, until the critical limit is reached (45–57 mmol/kg) below which the expected pH value after slaughtering cannot be achieved (5,5–5,6), (Ferguson and Warner, 2008; Tarrant, 1989). Dark, firm and dry meat occurs as consequence of stress due to low glycogen content at the moment of slaughtering, and in the process of glycolysis small amount of lactic acid is generated which slightly decreases the pH value of the muscles, which has negative effect on process of meat ripening and quality. Pale, soft and exudative meat, as consequence of stress, occurs due to denaturation of muscle proteins, by combined action of increased temperature of the musculature and higher quantity of lactic acid as consequence of intensive glycolysis.

Instead of conclusion

Numerous factors which have negative effect on meat quality, and are related to animal welfare, can be reduced in the meat production chain, only by respecting adequate legislative regulations, implementation of good manufacturing practice, permanent staff training and management support.

References

- Baltić Ž. M., Dimitrijević M., Teodorović V., Karabasil N., Đurić J., Marković R., Pavličević N., 2010a. Meso u tradicionalnoj srpskoj kuhinji. 2. Simpozijum "Bezbednost i kvalitet namirnica animalnog porekla" 11-12 novembar 2010., Zbornik radova, 44–54.
- Baltić Ž. M., Đurić J., Karabasil N., Dimitrijević M., Marković R., Mirilović M., Pavličević N., 2010. Istorijski osvrt na proizvodnju mesa u Srbiji. 21 Savetovanje veterinara Srbije (sa međunarodnim učešćem). Zlatibor 15-18 septembar 2010, Zbornik referata i kratkih sadržaja str 249–259.
- Baltić M., Karabasil N., 2005. Veterinarska kontrola proizvodnog procesa klanja stoke. Zbornik radova i kratkih sadržaja, 17. Savetovanje veterinara Srbije, 7–10 septembar Zlatibor, 123–133.
- Baltić Ž. M., Dragičević O., Karabasil N., 2002. Trendovi u potrošnji mesa. Zbornik kratkih sadržaja i radova, uvodni referat, štampan u celosti, 14 Savetovanje veterinara Srbije, Zlatibor od 10 do 14 septembra, 2002, 123–130.

- Council Regulation (EC) No 1099/2009 of 24 September 2009** on the protection of animals at the time of killing.
- Council Directive 2001/88/EC of 23 October 2001** amending Directive 91/630/EEC laying down minimum standards for the protection of pigs.
- Defra, 2010.** Dept. for the Environment, Food and Rural Affairs. Farm Animal Welfare Slaughter United Kingdom, accessed, March 26, 2010 (<http://www.defra.gov.uk/foodfarm/farmanimal/welfare/slaughter/index.html#1>).
- FASS, 2010.** Guide for the care and use of agricultural animals in research and teaching. Third Edition, Federal of Animal Science Societies. Illinois, USA: Champaign (<http://www.fass.org/page.asp?pageID=216> (accessed April 3, 2010)).
- Ferguson D. M., Warner R. D., 2008.** Have we underestimated the impact of pre-slaughter stress on meat quality in ruminants? *Meat Science* 80, 12–19.
- Fiddes, N. 1997.** Declining meat: past, present and future imperfect? In Caplan, P. (Ed.), *Food, health and identity*. London: Routledge. Pp. 252–267.
- Fitzgerald, R. E., Stalder, K. J., Matthews, J. O., Schultz-Kaster, C. M., Johnson, A. K., 2009.** Factors associated with fatigued, injured, and dead pig frequency during transport and lairage at a commercial abattoir. *Journal of Animal Science*, 87, 1156–1166.
- Grandin T., 2010.** Auditing animal welfare at slaughter plants. *Meat Science* 86, 56–65.
- Grandin T., 2010.** *Improving Animal Welfare: A Practical Approach*. Wallingford, Oxfordshire, Oxfordshire, UK: CABI International.
- Grandin T., 2000.** *Livestock handling and transport (2nd ed.)*. Wallingford, Oxon, UK: CABI Publishi.
- Grandin T., 1998.** Objective scoring of animal handling and stunning practices at slaughter plants. *Journal of the American Veterinary Association*, 212, 36–39.
- Gregory N. G., 2007.** *Animal Welfare and Meat Production, 2nd Edition* Wallingford, UK: CABI Intl.
- Gregory N. G., 2003.** *Animal welfare and meat science*. USA: CABI Publishing, 64–92.
- Gregory N.G., 2000.** Consumer concerns, 46th INCoMST, 804–809.
- Hewson C. J., 2003.** Can we access welfare? *The Canadian Veterinary Journal*, 44, 749–753.
- Immonen K., Kauffman R. G., Schaefer D. M., Puolanne E., 2000.** Glycogen concentrations in bovine longissimus dorsi muscle. *Meat Science*, 54, 163–167.
- Jacob R. H., Pethick D. W., Ponnampalam E., Speijers J., Hopkins D. L., 2006.** The hydration status of lambs after lairage at two Australian abattoirs. *Australian Journal of Experimental Agriculture*, 46, 909–912.
- MAF, 1996.** Code of recommendations and minimum standards for the emergency slaughter of farm animals. Code of Animal Welfare, No. 19. Ministry of Agriculture and Forestry. New Zealand: Wellington (<http://www.biosecurity.govt.nz/animal-welfare/codes/emergency-slaughter/index.htm> (Accessed April 3, 2010)).
- Ministarstvo poljoprivrede, Republike Srbije. 2009.** Zakon o dobrobiti životinja, „Sl. glasnik RS“, br. 41/2009, <http://www.minpolj.gov.rs/postavljen/123/dobrobit1.pdf>
- National Pork Board, 2008.** *Trucker Quality Assurance Manual*, Des Moines, Iowa, USA, <http://www.pork.org/Producers/TQA/TQA.aspx> (accessed April 3, 2010).
- OIE, 2010.** *Terrestrial Animal Health Code*, 19th Edition, World Organization for Animal Health Paris.
- Ritter M. J., Ellis M., Bertelson C. R., Bowman R., Brinkman J., Dedecker J. M., Keffaber K. K., Murphy C. M., Peterson B. A., Schlipf J. M., Wolter B. F., 2007.** Effects of distance moved during loading and floor space on the trailer during transport on losses of market weight pigs on arrival at the packing plant. *Journal of Animal Science*, 85, 3454–3461.
- Ritter M. J., Ellis M., Brinkman J., DeDecker J. M., Keffaber K. K., Kocher M. E., Peterson B. A., Schlipf J. M., Wolter B. F., 2006.** Effect of floor space during transport of market-weight pigs on the incidence of transport losses at the parking plant and the relationships between transport conditions and losses. *Journal of Animal Science*, 84, 2856–2864.
- Ristić M., 2009.** Die bedeutung der sensorik als kriterium der fleischqualität – ein vergleich zwischen verschiedenen fleischarten und –erzeugnissen. *Tehnologija mesa*, 50, 2009, 1–2, 148–158.
- Tarrant P. V., 1990.** Transportation of cattle by road. *Applied Animal Behaviour Science*, 28, 153–170.
- Grandin T., 2010.** Auditing animal welfare at slaughter plants. *Meat Science*, 86, 56–65.
- Troeger K., 2009.** Neue technologien bei der schlachtung, Grob- und feinzerlegung – einfluss auf sicherheit und qualität des fleisches. *Tehnologija mesa*, 50, 1–2, 37–42.
- USDA, 2010.** *United States Department of Agriculture. Humane Methods of Slaughter Act*, National Agriculture Library, Accessed March, 26, 2010.
- Villarroela G. A. M., Mar'yá C., Sanudoa J. L., Olleta G., Gebresenbetb, 2003.** Effect of transport time on sensorial aspects of beef meat quality. *Meat Science* 63, 2003, 353–357.
- Warriss P. D., 2000.** *Meat science: an introductory text*. Wallingford, Oxon, UK: CABI Publishing.
- Wythes J. R., Kaus R. K., Newman G. A., 1985.** Bruising in cattle slaughtered at an abattoir in Southern Queensland. *Australian Journal of Experimental Agriculture*, 25, 727–733.

Dobrobit životinja za klanje i uticaj na kvalitet mesa

Karabasil Neđeljko, Dimitrijević Mirjana, Milićević Dragan

Rezi me: Dobrobit životinja ima značajnu ulogu u lancu proizvodnje mesa. Duž celog lanca proizvodnje od farme do trenutka klanja, zadatak stručne javnosti i ostalih osoba uključenih u proizvodnju mesa, jeste obaveza da se sa životinjama postupa na human način, kako bi se pošteđele straha, patnje i bola. Pošto klanice predstavljaju nepoznato okruženje za životinje i samim tim stresnu sredinu, negativni efekti mogu se umanjiti adekvatnom manipulacijom sa životinjama. Garancija odgovarajućeg odnosa prema životinjama i posleđičnog kvaliteta mesa je poštovanje odgovarajuće zakonske regulative i kontinuirane edukacije osoblja uključenog u lanac hrane animalnog porekla.

Ključne reči: dobrobit, kvalitet, meso.