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IN LIVESTOCK PRODUCTION

PROCEEDINGS



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INSTITUTE FOR ANIMAL HUSBANDRY
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EATING QUALITY OF BEEF MEAT

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Review paper

Abstract: When we talk about the edible quality of beef, the habits of a particular population should first be taken into account. One of the most important traits of beef for consumers is "eating quality". It is difficult to generally define the characteristic "eating quality" because it depends on many factors. These are primarily the factors that affect the traditions and habits of a population of consumers who prepare and consume beef in a certain way. Some consumers prefer meat rich in fat and meat of older animals, while others are quite the opposite which in turn depends on the habits and methods of preparation. The manner of culinary processing is different in a way that particular population of consumers traditionally thermally process beef by cooking, baking, grilling or prefer raw fermented processed meat. The process of globalization has an impact on the harmonization of the criteria for eating quality. World restaurants that are present on the planet, such as McDonald's, Kentucky Fried Chicken, followed by Chinese, Italian, Japanese, Muslim and other restaurants have played major role in this process, especially in the younger population of consumers. The paper presents the most important criteria of beef meat eating quality such as colour, tenderness, softness and flavour of meat. Also analyzed are the most important pre-mortem and postmortem factors that affect the eating quality of meat. These are primarily factors such as the procedure of transportation, "stress syndrome", method of cooling - "cold shortening".

Key words: Beef, beef production, edible quality, meat tenderness, juiciness, flavor, tenderness.

Introduction

One of the most important traits of beef for consumers is "eating quality". It is difficult to generally define the characteristic "eating quality" because it depends on many factors. These are primarily the factors that affect the traditions and habits of a population of consumers who prepare and consume beef in a certain

way. Some consumers prefer meat rich in fat and meat of older animals, while others are quite the opposite which in turn depends on the habits and methods of preparation. The manner of culinary processing is different in a way that particular population of consumers traditionally thermally process beef by cooking, baking, grilling or prefer raw fermented processed meat. The process of globalization has an impact on the harmonization of the criteria for eating quality. World restaurants that are present on the planet, such as McDonald's, Kentucky Fried Chicken, followed by Chinese, Italian, Japanese, Muslim and other restaurants have played major role in this process, especially in the younger population of consumers. The scientific studies have been performed to determine the similarities and differences in beef eating quality of consumers of different countries (*Oliver et al., 2006*). There are attempts to standardize eating quality using certain instrumental technique. Thus, Quality Meat Scotland made IMEQ project (Integrated Measurement of Eating Quality) where the parameters of pH, temperature, colour, covering of carcass with fat, etc. were integrated. There is also an MSA (Meat Standard Australia) for eating quality that involves parameters such as colour, marbling, fat thickness, age, and pH24.

Production of beef meat

Production of beef depends primarily on the number of cattle. Number of cattle in the world and in Serbia has been steadily declining.

Table 1. Number of cattl in Republic of Serbia

Year	Total number of cattle	Number of cows and pregnant heifers	Category from 3-12 months
1996.	1,325.000	827.919	211.111
2000.	1,246.000	817.000	158.082
2005.	1,079.000	720.000	149.000
2011	937.000	542.000	186.000

Cattle production is an important branch of livestock production in the Republic of Serbia (*Aleksić et al. 2012*). The data presented in Table 1 shows that over the last 16 years, the number of cattle was continuously declining. This unfavorable situation is compensated by continuously improving the genetic potential of cattle for both milk production and meat production (*Aleksić et al. 2009*).

Number of slaughtered cattle in the Republic of Serbia in the World

Number of cattle in the Republic of Serbia in the year 2011 totaled 368.000 head of which 38.000 were calves. Total production in the world in year 2010 was 57.323 million tons, of which 12.048.00 tons in USA, Brazil 8.085 million tons, 8.085 million tons in EU, in China 5.600.000 tons. In year 2012, in the People's Republic of China production of beef meat was 5.540.000 tons which is 9.7% of the total world production of beef (*Aleksić et al. 2013*).

Consumption of beef in the Republic of Serbia in the World

The annual consumption of beef in the Republic of Serbia is much lower than the EU average. Consumption of beef per capita in Serbia is on a constant decline, from about 50.2 kg in year 2000 it dropped to 41.4 kg in year 2009. The total consumption of beef in year 2010 in the world was 56 million tons, of which 12.04 million tons in USA, in EU 8.185 million tons, 7.592 million tons in Brazil, and in China 5.589 million tons. As recommended by the World Health Organization (WHO), the amount of meat in the human diet should be 200 g / day or 75 kg / year.

Eating quality of beef meat

When we talk about the edible quality of beef, the habits of a particular population should first be taken into account. One of the most important traits of beef for consumers is "eating quality". It is difficult to generally define the characteristic "eating quality" because it depends on many factors. The Republic of Serbia is a traditional exporter of beef to the Italian market. A typical example of how consumer behavior determines the eating quality is the Italian province of Tuscany. Based on our many years of export practices in this area, Serbia produced beef type "baby beef". This is the meat of female Simmental cattle not older than one year. This market requires the meat that is bright red, juicy and tender. On the other hand, Serbia is exporting beef to the Middle East. Request of this market is primarily to comply with the traditional-religious method of slaughtering (*Aleksić et al. 1999; 2002; 2005*). Again, in the first place is the most significant factor of edible meat quality is tradition and habit. In general we can say that the edible quality of beef from the point of view of consumers is: colour, tenderness, juiciness and flavour. Meat colour is the first perception that affects the consumer to decide on the edible quality, and only after heat treatment the criteria of eating quality of tenderness, juiciness and flavor of the meat are determined.

Here we will define the basic criteria of eating quality of beef regardless of tradition and habit. These factors can be divided into two basic groups: pre-mortem and post-mortem.

The pre-mortem factors include breed, gender, age, diet, rearing, transport, time spent in the depot immediately before slaughter, etc. Regardless of breed, sex, age, treatment of cattle during transport and at slaughter are very significant for the eating quality of beef (*Alekisić et al. 2006*). Today this problem is linked to several factors such as the housing of animals especially the pre-slaughter treatment of the animal. The basis of this problem is the stress of cattle, especially their reaction to a new unfamiliar environment during transport and in the slaughterhouse holding pens. Animals exposed to stressors react by secreting hormones by the adrenal glands. The reaction of the body, caused by hormones secreted under stress, is known as the general adaptation syndrome. The immediate consequence of the general adaptation syndrome is the occurrence of DFD meat (dark- firm-dry meat), which are the basic characteristics of the meat. DFD meat is meat of special physical-chemical, technological and other properties whose formation is related to the modern way of rearing and fattening of young cattle for slaughter as well as methods for their commercialization, transport and pre-slaughter procedures. DFD meat is consequence of increased oxygen consumption of the mitochondrial cytochrome oxidase. This condition is permanently stabilized by high pH > 6.0 of meat. Colour of DFD meat is, therefore, color of reduced myoglobin or dark. DFD meat is "firm", which is usually interpreted by its water holding capacity (WHC). Since this is meat from young animals, whose fat content is minimal, which means that a relatively higher content of protein bonds significantly more water, which contributes to a higher strength of meat. However, it is possible that other causes contribute to, or are even the primary factors of firm consistency of DFD meat. One of these reasons is the fact that rigor mortis occurs faster and more complete in DFD meat, and that the resulting actomyosine complex is held constant, i.e. the breakdown does not occur as in normal meat. DFD meat, when touched, compared to normal meat is "dry". The reason for this is the low content of free water, because the water, for the most part, is related to the proteins of meat. Also, one of the peculiarities of DFD meat is a high final pH which contributes to the binding of water to proteins, and thus attribute "dry" meat (*Alekisić et al.1995*). Primarily because of the dark meat such meat is not acceptable to the consumer.

Post-mortem factors such as method of slaughter, cooling, etc., also significantly affect the eating quality of meat. The cooling method can significantly affect a very important feature of eating meat quality – that is tenderness. Fast cooling may contribute to the hardness of meat (the phenomenon of cold shortening). Rapid cooling of carcasses (the phenomenon of cold shortening) occurs when temperature below 15 degrees ND with high pH and high

concentration of ATP. Thus, in temperature conditions of -1 degrees C, cold shortening develops even at pH 7.0. Such meat is of coarse consistency and shows a loss of juice during thermal treatment which is unfavorable from the point of eating quality of meat. There are mechanical processes that contribute to a better eating quality, such as electrical stimulation of carcasses, tumbling of meat, meat injection and thermal treatment.

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Jestivi kvalitet junećeg mesa

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Rezime

Jedna od najvažnijih osobina junećeg mesa za potrošača je jestivi kvalitet - "eating quality". Teško je generalno definisati osobinu "eating quality" jer zavisi od mnogih faktora. To su pre svega faktori koji utiču na tradiciju i navike jedne populacije potrošača koji na određen svoj način pripremaju i konzumiraju juneće meso. Neki potrošači preferiraju meso bogato masnim tkivom i meso starijih životinja, dok drugi sasvim suprotno što opet zavisi od navika i načina pripreme. Takođe, način kulinarske obrade se razlikuju tako što određena populacija potrošača tradicionalno juneće meso termički obrađuju kuvanjem, pečenjem, roštiljanjem ili preferiraju sirovo fermentisano obrađeno meso. Proces globalizacije ima uticaja i na ujednačavanje kriterijuma za jestivi kvalitet. Veliku ulogu u tom procesu naročito kod mlađe populacije potrošača Kentucky Fried Chicken, zatim kineski, italijanski, japanski, muslimanski restorani i dr. Vršena su i naučna ispitivanja radi utvrđivanja sličnosti i razlike u jestivom kvalitetu junećeg mesa potrošača različitih zemalja (*Oliver i sar., 2006*). Postoje pokušaji da se jestivi kvalitet standardizuje određenom instrumentalnom tehnikom. Tako je Quality Meat Scotland napravio projekat IMEQ (Integrated Measurement of Eating Quality) gde su integrisani parameter pH, temperatura, boja, prekrivenost trupa masnim tkivom. Takođe postoji i MSA (Meat Standard Australia) za jestivi kvalitet u koji su uključeni parametri boja, marmoriranost, debljina masnog tkiva, starost i pH24.

Generalno možemo reći da jestivi kvalitet junećeg mesa sa aspekta potrošača su: boja, nežnost, sočnost i aroma. Boja mesa je prva percepcija koja utiče na potrošača da donese odluku o jestivom kvalitetu, tek nakon termičke obrade određuju se kriterijumi jestivog kvaliteta o nežnosti, sočnosti i aromi mesa.

Ovde ćemo definisati osnovne kriterijume jestivog kvaliteta junećeg mesa bez obzira na tradiciju i navike. Ove faktore možemo podeliti u dve osnovne grupe i to: premortalne i postmortalne.

U premortalne faktore spadaju rasa, pol, starost, ishrana, način držanja, transport, vreme provedeno u depou neposredno pre klanja. Bez obzira na rasu, pol, starost tretman junadi u toku transporta i pre klanja su vrlo značajni za jestivi kvalitet junećeg mesa (*Alekisć i sar., 2006*). Danas se ovaj problem dovodi u vezu sa nizom faktora kao što su način držanja životinja a naročito tretman životinje pre klanja. Osnova navedenog problema je stres junadi, pre svega njihova reakcija na novu nepoznatu okolinu za vreme transporta i boravka u depou klanice. Životinje izložene dejstvu stresora reaguju lučenjem hormona nadbubrežne žlezde. Reakcija organizma, koju izazivaju izlučeni hormoni pod uticajem stresora, označava se kao opšti adaptacioni sindrom. Neposredna posledica opšteg adaptacionog sindroma je pojava DFD-mesa (dark-tamno, firm-čvrsto i dry-suvo), što su i osnovne karakteristike ovog mesa. DFD-meso je meso posebnih fizičko-hemijskih, tehnoloških i drugih svojstava čije je nastajanje povezano sa modernim načinom uzgoja i tova mladih goveda za klanje kao i sa metodama njihove komercijalizacije, transporta i postupaka pre klanja. DFD-meso je posledica povećanog utroška kiseonika od strane citohrom oksidaze mitohondrije. Ovo stanje se trajno stabilizuje visokim pH > 6,0. mesa. Boja DFD mesa je, dakle, boja redukovano mioglobina odnosno tamna. DFD-meso je "čvrsto" što se obično tumači njegovom sposobnošću vezivanja vode (SVV). Pošto se radi o mesu mladih životinja, čiji je sadržaj masti minimalan, što znači da na relativno veći sadržaj proteina vezuju se i znatno više vode, što doprinosi i većoj čvrstoći mesa. Međutim, moguće je da i drugi razlozi doprinose ili su čak primarni faktori čvrste konzistencije DFD-mesa. Jedan od takvih razloga je i činjenica što *rigor mortis* nastupa brže i potpunije u DFD-mesu i da se tako nastali aktomizinski kompleks održava stalno, tj. ne dolazi do njegovog razlaganja kao u normalnom mesu. DFD-meso je na dodir u poređenju sa normalnim mesom "suho". Razlog za to je mali sadržaj slobodne vode, jer je voda, većim delom vezana za proteine mesa. Takođe, jedna od specifičnosti DFD-mesa je visoki finalni pH što doprinosi boljem vezivanju vode za proteine, a samim tim i atribut "suho" meso. . Pre svega zbog tamne boje mesa ovakvo meso nije prihvatljivo za potrošača.

Postmortalni faktori kao što su način klanja, hlađenje takođe značajno utiču na jestivi kvalitet mesa. Način hlađenja može značajno da utiče na vrlo važnu osobinu jestivog kvaliteta mesa a to je nežnost. Brzo hlađenje može doprineti

tvrdooi mesa (fenomen „cold shortening“). Brzim hlađenjem trupova (fenomen „cold shortening“) javlja se pri temperaturi ispod 15 stepeni i kod visokog pH i visokog sadržaja ATP-a. Tako pri -1 stepen C „cold shortening“ se razvija čak pri pH 7,0. Ovakvo meso je grube konzistencije i pokazuje veliki gubitak soka prilikom termičke obrade što je nepovoljno sa aspekta jestivog kvaliteta mesa. Postoje i mehanički postupci koji doprinose boljem jestivom kvalitetu kao što je elektro stimulacija trupova, tamblovanje mesa, injektiranje mesa i termička obrada.

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