



## An overview of venison

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**Abstract.** Game meat is found in countries with tradition and relief corresponding to game development, being considered a delicacy with numerous nutritional and ecological advantages. Game meat is a healthier option compared to meat from farm animals, being considered a substitute for meat from cattle and sheep. Nowadays, humanity is more and more concerned about a proper and healthy diet, thus, they are looking for food of superior quality. Game meat is considered a healthy alternative, rich in proteins and minerals with low fat and cholesterol content. The purpose of this review was to observe and gather essential information from the specialized literature about the perspectives of game meat.

**Key Words:** consumption, food quality, health, safety, venison.

**Introduction.** Game meat plays an important role in human nutrition, due to its high-quality proteins, mineral intake and favorable profile of fatty acids compared to meat from intensively raised animals (Allievi et al 2015; Esattore et al 2022). Hunting is considered a prestigious sport in many parts of the world, with an important role in meat consumption (Grunert 2006).

The number of hunters is increasing, so the countries with the most registered hunters are: France, Spain, Italy and Great Britain (Morales et al 2018). According to the existing statistics in the specialty literature, they confirm the expansion of game species in Europe, and this aspect may signal a concern regarding the human-wildlife relationship and the expansion of infectious diseases (Cornish et al 2016).

Some wild animals can sometimes end up being considered harmful for human activities, due to the impact on agricultural and forestry crops and with a major risk in the case of road accidents (ENETWILD consortium et al 2019). Exaggerated conservative measures, the decrease of the population in rural areas and the increase of forested areas can lead to the increase of the game population (Allievi et al 2015). Game meat can also come from breeders dedicated to hunting in ways similar to production animal rearing systems, with proper control of transmissible diseases being maintained (Marescotti et al 2019). Usually the population is open to the opportunity to consume meat from hunted animals, being often considered a challenge (Hoffman et al 2007; Webb 2013; Alonso et al 2020).

Data are limited regarding intrinsic factors and extrinsic factors that can determine a well-defined quality of game meat, and the standardization of a quality concept is more difficult to achieve (Vanhonacker & Verbeke 2014; Borilova et al 2016).

Environmental factors have a considerable influence on meat production, the nutrition these animals benefit from and the environment in which they develop (Guzek et al 2013; Neethling et al 2016). Meat represents the skeletal muscle part together with the tissues that adhere to it (Hoffman & Wiklund 2006).

According to data from specialized literature, the essential component of meat is represented by muscle tissue (Hutchinson et al 2010; Fabijanac et al 2023). The game species in Romania are represented by: roe deer (*Capreolus capreolus*), red deer (*Cervus*

*elaphus*), black goat (*Rupicapra rupicapra*), wild boar (*Sus scrofa*), common rabbit (*Lepus europaeus*), bear (*Ursus arctos*), pheasant (*Phasianus colchicus*), partridge (*Perdix perdix*), quail (*Coturnix coturnix*), grouse (*Tetrao urogallus*), coot (*Fulica atra*), mallard (*Anas platyrhynchos*), summer goose (*Anser anser*), great grebe (*Anser albifrons*), lesser grebe (*Anser erythropus*) (Leslie Jr. et al 1995; Ilie & Enescu 2018; Cazacu et al 2014).

**Physico-chemical composition of game meat.** Regarding the physico-chemical composition of game meat, it is distinct from that of domestic animals (Fisher 2009; Strazdina et al 2013). Thus, according to specialized literature, the amount of protein is approximately 21-23% in the case of venison, the fat value is below 1.2% and the amount of mineral salts in venison is superior to common animal species, for example venison has a higher content in phosphorus (P) compared to meat from fish and the content of potassium (K) is higher compared to meat from pork, beef and lamb (Onyango et al 1998; Strazdina et al 2013).

The digestibility coefficient can be increased in the case of game meat with the help of advanced ripening and fattening procedures, thus resulting in meat with increased juiciness and tender consistency, appreciated by consumers (Onyango et al 1998).

A series of biochemical changes occur in the body of the hunted animal, among which we mention: the drop in pH being lower than 5.7, the installation of the glycolysis process and the appearance of muscle stiffness, which leads to a meat that matures more difficult (Mihaiu 2010).

In the case of game meat that is in the stage of deterioration due to the influence of several internal and external factors, the existing characteristics are similar to meats from other animals, specifying the fact that game meat degrades faster in the muscle regions and everything that it comes into contact with the abdominal area (Mihaiu 2010; Boaitay & Minegishi 2020). There are cases where the musculature of the abdominal region does not meet the freshness characteristics, but the rest of the muscle regions, such as the thigh region or the spine region, are in a normal stage of freshness (Clark et al 2017).

The purpose of this review was to support research on existing game meat data. The objectives pursued were related to the identification of aspects regarding the labeling of game meat with the main game species in Romania, respectively improving the transability of game meat, following in general terms the physico-chemical composition and the main bacterial contaminants.

**The major bacterial contaminants of boar meat.** The most conclusive characteristics in the case of altered game are the following: during the control, greenish spots can be observed on the surface of the skin which are based on fermentative processes with sulphhydro-ammonia smell, the hair or feathers depending on the species of game animal are easily extracted, by section at the level of the musculature, a color change to brown is observed, with an unpleasant odor and in some cases the presence of fermentative activities (Mihaiu 2010). The microbial load can be influenced by the location of the gunshot wound, which can be in the abdominal or thoracic region (Fisher 2009; Fabijanac et al 2023). The bacterial species that evolve in the case of an abdominal wound are the following: *Escherichia coli*, *Salmonella abortus equi*, *Salmonella abortus ovis*, *Salmonella cholerae suis*, *Salmonella dublin*, *Salmonella gallinarum*, *Salmonella paratyphi*, *Salmonella typhi*, *Proteus inconstans*, *Proteus mirabilis*, *Proteus morganii*, *Proteus rettgeri*, *Proteus vulgaris*, *Bacillus anthracis*, *Bacillus cereus*, *Bacillus coagulans*, *Streptococcus faecalis*, *Streptococcus mitis*, *Streptococcus salivarius*, *Streptococcus sanguinis*, *Streptococcus zymogenes* (Gill 2007; Dinev et al 2023).

The bacterial species present in the case of a thoracic wound of game are the following: *Klebsiella ozaenae*, *Klebsiella pneumoniae*, *Klebsiella rhinoscleromatis*, *Proteus inconstans*, *Proteus mirabilis*, *Proteus morganii*, *Proteus rettgeri*, *Proteus vulgaris*, *Clostridium bifermentans*, *Clostridium botulinum*, *Clostridium perfringens*, *Clostridium septicum*, *Clostridium sporogenes*, *Clostridium lentoputrescens*, *Clostridium nigrificans*, *Clostridium putrefaciens*, *Clostridium septicum* (Dinev et al 2023).

The main transformations that take place in the meat during the muscle stiffness stage are: biochemical changes, physical-chemical changes and histological transformations (Jeremiah et al 1972; Mihaiu 2010). From the category of biochemical changes we can specify: the stage of glycogen degradation through the process of glycolysis with the achievement of a low pH, the decrease in ATP and phosphocreatine values with the appearance of ammonia (NH<sub>3</sub>), the migration stage of calcium ions (Ca) which are released from the sarcoplasmic reticulum and through the diffusion process reach the level of the myofibrillar proteins, leading to the appearance of the protein-calcium complex and the formation of the actomyosin complex through the association of actin with myosin which ultimately produces the muscle strengthening effect (Savell et al 2005; Mihaiu 2010).

The important physico-chemical changes that occur at the level of the carcass are represented by: changes that occur at the level of the muscle regarding extensibility and elasticity, all of which are reduced by approximately 10%, due to the lack of ATP, so that myosin and actin filaments lead to the formation of rigid transverse links; also in the case of physical-chemical changes, water retention capacity also enters, which decreases in a few hours, the minimum being reached 24 hours post-sacrifice (Watanabe et al 1996; Verkhoturov et al 2022). The histological transformations represent muscle fibers that are poorly directed, being characterized as being straight or wavy with the presence of striations, and after 24 hours, these fibers show twists with contraction nodules (Hutchinson et al 2010).

Game meat is firm and fibrous compared to that obtained from domestic animals, so in order to be easily eaten it must go through a maturation process, which leads to a more tender meat with positive organoleptic characteristics, juicy and much more easily digestible for the consumer (Mihaiu 2010). The ripening process can be influenced by the species of the animal, the age and the way the ripening is done, especially the existing temperature, the higher the temperature, the shorter the ripening process (Banu et al 2003). The maturation and aging process of meat is due to enzymatic reactions (Mihaiu 2010). In the case of the biochemical stage of meat ripening, cathepsins, calpains, lysosomal enzymes, proteasome and collagenases participate directly, and the actomyosin complex is divided into actin and myosin and the protein-calcium bond is revealed and leads to the process of water increase and hydration meat (Živković et al 2012). There are methods that can lead to a decrease in the cooking time of the meat, namely: increasing the temperature during the cooking process but with the use of ultraviolet lamps to prevent the development of microorganisms and the use of specific enzyme preparations of animal, microbial or plant origin (Jeremiah et al 1985; Banu et al 2003; Mihaiu 2010).

Game meat that is intended for human consumption must come from approved places, animals must be hunted according to legislation, carcasses must be examined from a sanitary-veterinary point of view with appropriate examinations, for example, in the case of wild boar, trichinelloscopic examination is mandatory (Mainz et al 1992; Gherman et al 2022). Barendse (2014) stated that there are few studies on the factors that influence the sensory characteristics of game meat. In the specialized literature, the following are mentioned as factors that determine a higher quality of meat: species, age, sex, diet, anatomical location, harvesting conditions and the way the meat is prepared for consumption. The unique sensory characteristics of game meat are an important parameter to differentiate it from other meats from farmed animals (Hutchinson et al 2010).

Boar meat and the products obtained by processing it, is considered an important source of trichinellosis worldwide (Vieira-Pinto et al 2021). In Portugal, due to the fact that wild boar is the most sought-after game meat, free trichinella (*Trichinella* spp.) checks are carried out to provide consumer safety (Gitea et al 2011; Vieira-Pinto et al 2021). Wild boar meat if hunted according to legislation and properly stored respecting low storage temperature, hygienic conditions and a microbiological balance, can be kept for more than 15 days (Borilova et al 2016).

Guzek et al (2013) highlighted the main general characteristics important for the final consumer, being the juiciness of the meat, its taste and aroma. Among all game

species, the wild boar is considered a sport hunting species worldwide, the meat of this species being dark in color with low tenderness (Barrios-Garcia & Ballari 2012). According to data, the growth of interest in game meat has increased considerably in recent years due to its unique physicochemical composition and reduced ecological footprint (Mellor 2016). Game meat can be considered an alternative to beef (McKendree et al 2014; Fabijanac et al 2023).

Studies confirm the superior nutritional quality of game meat, but special attention must be paid to contamination with substances harmful to the final consumer, for example mycotoxins and heavy metals accumulated in game (McDowell et al 2006). Lenti et al (2021) evaluated the level of lead in wild boar meat with a number of 48 samples collected from three different lots from the commercial market in Italy, they concluded that there were high levels of lead in wild boar meat, but not in all samples evaluated. It started from the idea that hunting ammunition can be a major contaminant for wild boar meat and also venison due to the absorption of lead into the body. Currently, no lead value is considered safe, and specific levels for game meat have not been established.

**Conclusions.** Therefore, game meat can represent a source universally appreciated and chosen by the final consumer. This meat from hunted animals presents a major advantage for the intake of animal proteins in the public food consumption system.

**Conflict of interest.** The authors declare that there is no conflict of interest.

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