



## Review

# Carcass characteristics, meat quality and nutritional value of horsemeat: A review



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## ABSTRACT

Meat has exerted a crucial role in human evolution and is an important component of a healthy and well balanced diet due to its nutritional richness. The aim of the present review was to shed light on the nutritional composition of horsemeat and their benefits for human health. One of the reasons for such interest was the occurrence, in Europe several years ago, of dioxin, Bovine Encephalopathy and foot-and-mouth disease problems in farm animals. Therefore, consumers began to look for alternative red meats from other non-traditional species. There is no carcass classification system on horses designated to meat consumption. It would be advisable to standardize the equine meat market to reduce variations that may reflect differences in meat quality. The nutritional composition of horsemeat by comparison with pork, beef or poultry is characterized by low levels of fat and cholesterol (about 20% less), relatively high concentrations of *n*–3 fatty acids and heme iron indicating that its consumption may be beneficial for health. Therefore, horsemeat may supplement the meat market with good quality products, although as in other dietary components moderation is advisable.

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## 1. Introduction

Apart from consumer choices related to vegetarian/vegan lifestyles against meat consumption in recent years a demand for alternative

meat compared to conventional meat is increasing. Horsemeat could play a major role in this context as a red meat alternative to beef and be claimed as “dietetic” meat (Badiani, Nanni, Gatta, Tolomelli, & Manfredini, 1997; Lorenzo, Fuciños, Purriños, & Franco, 2010) but only if the productive chain is under a strict control to guarantee traceability. In addition, regular consumption of horsemeat may contribute to reduced total and LDL cholesterol intakes and improve omega-3

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index, docosahexaeneic acid (C22:3n–6) and iron status (Del Bo et al., 2013).

The European horsemeat chain is not standardized due to several reasons: a general low consumption/per capita/year limited to the traditional horsemeat consuming-countries (Spain, Italy, France, Belgium); a large number of animals imported from East European countries not for meat purposes but are slaughtered often illegally; the lack of specialized production systems because of the use of animals that come from drought races or saddle horses, often at the end of their career or that are slaughtered for health reasons (Badiani & Manfredini, 1994; Lanza, Landi, Scerra, Galofaro, & Pennisi, 2009; Tateo, De Palo, Ceci, & Centoducati, 2008); these factors put serious constraints on animal traceability, due to often illegal market practices.

According to recent European Union agricultural policies addressed to the sustainability of productive systems a short equine meat production chain could be a potential strategy to satisfy the demand of the modern meat consumer. In this sense, the valorisation of local equine breeds or populations should be addressed through the standardization of husbandry practice, slaughter ages and weights, and sex, with the aim of developing low input productive systems. Moreover improving consumer confidence to promote the consumption through a traceability strategy appears to be necessary.

Foal represents the most studied horse slaughter category in the European Union although sex, slaughter ages and breeds are quite different (Franco, Crecente, Vázquez, Gómez, & Lorenzo, 2013; Franco & Lorenzo, 2014; Franco, Rodríguez, et al., 2011; Juárez et al., 2009; Lanza et al., 2009; Lorenzo, Sarriés, et al., 2013; Lorenzo et al., 2010; Martin-Rosset, Boccard, Jussiaux, Robelin, & Trillaud, 1980; Sarriés & Beriain, 2005; Sarriés, Murray, Troy, & Beriain, 2006; Tateo et al., 2008).

Foals are usually naturally weaned on natural, often wooden, pasture and immediately finished in stall on concentrates and hay or, alternatively, straw until target slaughter weight, or spend a prolonged period at pasture to be subsequently finished in stall as above. For animals imported is very difficult to assess breed and feeding regimen so the commercial value depends on slaughter age and morphotype (Segato, Cozzi, & Andrighetto, 1999).

The donkey (*Equus asinus*) is a member of the horse family and its meat has been historically obtained from animals that were slaughtered at the end of their working lives; for this reason the meat usually did not have good sensorial and nutritional characteristics and it is not much used for human consumption (Polidori, Vincenzetti, Cavallucci, & Beghelli, 2008). Donkey meat production from young males can represent an interesting source of proteins and can increase the income of local farmers (Polidori, Beghelli, Cavallucci, & Vincenzetti, 2011; Polidori, Cavallucci, Beghelli, & Vincenzetti, 2009).

In order to extend knowledge on equine meat quality by improving consumers awareness of the high quality value of this kind of meat in comparison with other red meats and to override its negative reputation due to scandals, not dependent by intrinsic characteristics but from illegal practices, a review was carried out to characterize several aspects of equine meat quality. In this context papers published on this topic, especially in the last decade were analyzed to give an overview of the main quality attributes, focussing on foal meat quality.

## 2. Carcass characteristics

The horse carcass is characterized by its dark color, with absence of large fatty adipose tissues and a peculiar yellow fat (Price & Schweigert, 1994). Subcutaneous fat appears with low levels of adiposity and the fat depots of the kidney and the flank region are relatively lean. Horsemeat has a deep dark color that changes to a brown or black with a bluish tinge on exposure to air. The large variability among European equine carcasses comes from the different horse origin, breed and husbandry system. It is difficult to compare results with those of other researches, as foals are of diverse ages and breeds. Carcass parameters such as meat cut or tissue composition depend on cutting and dissection procedures.

Moreover, dressing percentage was mainly calculated as hot carcass weight divided by slaughter weight in all studies.

Horse is a thin animal as the whole body contains on average 69.6% muscle, 10.4% fat and 17.4% bone (Table 1). The aptitude for meat production is estimated by muscle and bone (M/B) ratio, which increases from 3.9, in the 6 month old animals to 4.8 for animals 30 months old (Martin-Rosset et al., 1980; Table 1).

The crossbreeding of native breeds with horses for meat production and supplying better finishing diets (type and amount) also increases the M/B ratio (Franco, Fernández et al., 2011; Franco et al., 2013). Several works have demonstrated that horses from heavy breeds are well adapted to meat production (Robelin, 1978). Rossier and Berger (1988) suggested that French equine breeds offer high dressing percentages, close to 70%, well above the 65% (Table 1) for Spanish and Italian breeds. These percentages drop to 50–59% (Franco et al., 2013; Lanza et al., 2009; Table 1) for local or rustic types.

The main factors that affect the horse carcass are: age or slaughter weight, breed, sex and production system. With regard to the first factor, it has been found that the fatness level increases with age and weight. As shown in Table 1, the proportion in total fat depots increases from 9.6% to 14.2% between 6 and 30 months of age (Martin-Rosset et al., 1980), while muscular growth changes very little during this period. Franco, Fernández et al. (2011), Franco et al. (2013) also found no differences in muscle content in animals 11 and 15 months of age, with values for meat in the range 69–73%

Concerning anatomical location, Martin-Rosset et al. (1980) suggested that there are different growth rates on the different adipose fat depots due to their different location. Internal depots which involve the thoracic fat area have the highest growth rate (Williams & Bergstrom, 1976). They are followed by intermuscular adipose tissues and finally the subcutaneous fat depot has the lowest growth rate. Breed has an effect on subcutaneous, intermuscular and thoracic fat, as suggested by Robelin (1978). On the other hand, Juárez et al. (2009) found no differences in carcass weight between Burguete and Hispano-Bretón foals slaughtered at 24 month, although there were significant differences in morphometric measurements such as thoracic depth and limb length. Differences by breed effect in carcass weight, dressing percentage and tissue composition can be observed in Table 1.

Concerning sex, and according to Martin-Rosset et al. (1980) and Robelin, Boccard, Martin-Rosset, Jussiaux, and Trillaud (1984) female and male foals at the same live weight at slaughter (504.8 Kg) produce dressing percentages close to 70% for both sexes and similar percentage of muscular tissue (70%). On the other hand, female foals have higher proportions of fat depots in the carcass (12.3 vs. 9.4%) and smaller percentage of skeleton fat (14.9 vs. 15.8%) than males. The most important difference between male and female foals is that the degree of fatness is higher in female foal carcasses than in male carcasses. In agreement, Sarriés and Beriain (2005) and Lorenzo et al. (2013) found no significant effect of sex on dressing percentages in Burguete foals slaughtered at 16 and 24 months and Galician Mountain foals slaughtered at 15 months, respectively. Finally, regarding livestock system and feeding strategies, only a few manuscripts Franco, Fernández et al. (2011), Franco et al. (2013); Sarriés & Beriain, 2005) have been published. In these works, little effect was found on carcass features.

There is no carcass classification system on horses designated for meat consumption and an equine carcass classification system is needed to ensure that a sufficient supply of a given quality is available to fulfill the needs of consumers.

## 3. Meat quality

### 3.1. Chemical composition

Horsemeat has a moisture content ranging from 68.34% in the meat of Burguete foals slaughtered at 16 months (Sarriés & Beriain, 2005) to 77.40% in Galician Mountain foals slaughtered at 15 months of age from

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