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Review

Horse-meat for human consumption — Current research and future opportunities

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ABSTRACT

The consumption of horse-meat is currently not popular in most countries, but because of its availability and recognized nutritional value consumption is slowly increasing in several western European countries based on claims that it could be an alternative red meat. In this review, horse-meat production, trade and supply values have been summarized. In addition, the advantage of horse production is noted because of its lower methane emissions and increased uptake, particularly of n-3 polyunsaturated fatty acids (PUFAs), which is based on its digestive physiology. Of particular interest in this review is the unique fatty acid composition of horse-meat with its high level of the nutritionally desirable PUFAs in both the adipose and muscle fat. Because of its large frame size and digestive physiology, the horse can be considered an alternative to bovine meat, with large advantages regarding the maintenance of less favored mountain grazing areas and its facility to transfer PUFA from feed to meat.

Contents

1. Horse — its acceptance as edible meat

Horses have been associated with humans for many years. It is thought that all domestic horses are descended from two wild horses (*Equus ferus*): 1) Tarpan, which was native to eastern Europe and Russian steppes and 2) Przewalski from Mongolia (Peplow, 1998; Valderrábano, 1970). There is evidence that before domestication, horses were already used as a food source by humans. Discovered cave paintings and horse bones dated the Paleolithic era (10,000 B.C.), evidence that horses were hunted for food in western Europe (Edwards, 1998; Hintz, 1995; Peplow, 1998). Furthermore, horse tissues might have been a valuable source of essential fatty acids (FAs) for the Upper Paleolithic people, time where plants and marine foods availability were minimal due to recurrent glaciations (Guil-Guerrero, Rincón-Cervera, Venegas-Venegas, Ramos-Bueno, & Suárez-Medina, 2013a). Animal domestication dates at the end of Neolithic era (6000–5000 B.C.), where nomadic tribes of central Asia were mainly involved. Afterwards, horse carcasses and milk, were used as a food source, as

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well as a draft and working animals. Horse riding, however, dates from a much later era, approximately 1500–1000 B.C. (Brown, Pilliner, & Davies, 2003; Peplow, 1998).

Horse-meat consumption has been interrupted throughout history due to religious, social and/or cultural reasons (Fernández de Labastida, 2011). As a consequence, it was not contemplated as a popular meat and was generally associated with poor social classes, famine and periods of short food supply. Presently, this animal can generate positive emotions, such as affection, closeness or tenderness, and for this reason horses are considered as a pet which has further stopped its consumption in several countries.

Historically, horse breeds noted for meat production came from old animals used for farm-working, while nowadays, selected horses for this purpose are bred (Martuzzi, Catalano, & Sussi, 2001; Tateo, De Palo, Ceci, & Centoducati, 2008). Furthermore, nowadays meat production is generally supplied by young animals that are offspring of mainly ancient heavy draft breeds (Tragsega, 2003) which are characterized by high dressing percentages as well as good meat yields (Badiani, Nanni, Gatta, Tolomelli, & Manfredini, 1997; Tateo et al., 2008). In the past century, however, in several European regions, indigenous breeds were replaced by more productive breeds resulting in a high risk of disappearance of the more traditional ones (García et al., 2013). Consequently, some local horse breeds have been classified as endangered and included in the list of Domestic Animal Diversity Information System hosted by FAO (FAO, 2015a).

2. Horse-meat production, trade and supply

According to the information provided by the Food and Agriculture Organization of the United Nations (FAO), worldwide horse-meat production kept quite constant between 1965 and 1990 at an average of 500,000 tonnes per year (FAO, 2015b) (Fig. 1). Since that time, due to the increase of Asian and European production, horse-meat overall production increased by 40%, averaging 700,000 tonnes per year. The significant increase in Asia could have been related to the inclusion of Kazakhstan and Kyrgyzstan in the FAO's database after 1992, as well as an important increase of horse-meat production in China. On the other hand, the main increase in Europe occurred in the nineties, mostly associated with the bovine spongiform encephalopathy crisis (Fernández de Labastida, 2011). By comparison to other meat-producing species like pork, poultry, bovine or ovine, current horse-meat production represents only 0.25% of the total worldwide meat production (Fig. 2; FAO, 2015b).

Production by continents shows that 46% was produced in Asia, 30% in America, 18% in Europe, 4% in Oceania and 2% in Africa (2013 data; FAO, 2015b). Looking at individual countries, China was the major producer (26% of the world production), followed by Kazakhstan (12%),

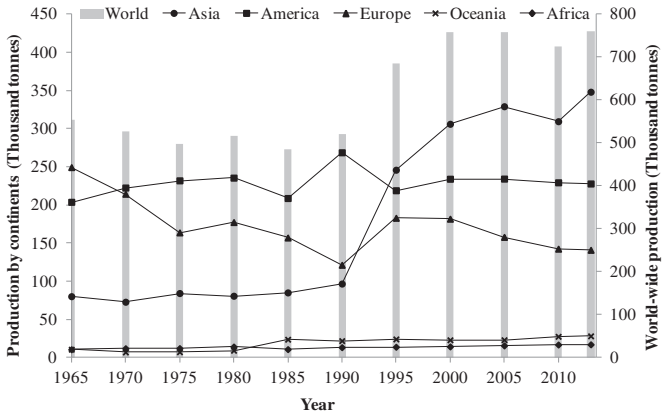

Fig. 1. Worldwide horse-meat production by continents from 1965 to 2013. The lines represent the production per continent with axis on the left in thousand tonnes, while the bars represent the world total production with axis on the right in thousand tonnes.

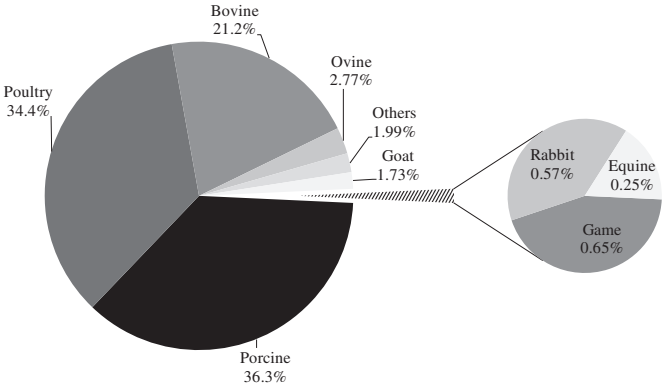

Fig. 2. Worldwide meat production (%) by species in 2013 (FAO, 2015b). Poultry group is represented by chicken, turkey, duck, birds, geese and guinea fowl. The other group represents ass, buffalo, camel, mules, other camelids, and other rodents but not sea snails.

Mexico (11%), Russia (7%) and Argentina (4%); representing 58% of the total word horse-meat production (FAO, 2015b).

Horse-meat trade among continents, shown in Fig. 3, is also considerable (2011 data; FAO, 2015b). The Asian continent is the major producer, with very low imports and exports of 13,651 and 9007 tonnes, respectively. Imports into America are negligible, while exports reached 59,977 tonnes with Europe being the main destination. Horse-meat trade in Europe is important with eastern countries exporting to western European countries. Considering worldwide horse-meat trade, the 10 major importing (a) and exporting (b) countries are summarized in Table 1. Italy, Russia, Belgium and France were the main importing countries, while, Argentina, Belgium, Canada and Mexico were the main exporting countries with each over 10% of the total worldwide imports and exports, respectively.

The fraction of the horse-meat destined for human consumption may in some cases be uncertain, especially in countries where the acceptability of horse-meat as a food source is non-existent (Gill, 2005). Horse-meat supply per capita (2011) was calculated using net production values (production plus imports minus exports) relative to human population data. Overall, it was estimated that the average worldwide horse-meat supply is about 0.10 kg per capita. Countries where the horse-meat supply per capita values are clearly above the world average are Mongolia (5.81 kg), Kazakhstan (4.92 kg), Kyrgyzstan (3.50 kg), Iceland (2.19 kg), Switzerland (0.73 kg), Italy (0.70 kg), Croatia (0.69 kg), Belgium (0.58 kg), Russia and Finland (0.51 kg, each), France (0.27 kg), Malta (0.26 kg), Ukraine and Greece (0.25 kg, each) (Fig. 3). In spite of being the largest producer, the supply value in China is only 0.14 kg per capita. These data demonstrate the regional differences of horse-meat production and consumption, and the globally low utilization of this resource even though there is a huge potential to make a more rational and efficient use of this valuable resource. A partial replacement of beef consumption by horse-meat could be less stressful on the environment since the enteric emission of methane is lower in horses, and they provide a good source of essential FAs due to the high transfer efficiency of PUFAs from pastures to meat. These two aspects will be reviewed in the following sections.

3. Horse — the large framed non-ruminant domestic grazer and browser

Grass and rangelands are traditionally used to maintain ruminant herds that support most ruminant meat production. Ruminants are the most specialized and efficient digesters of grassland and range vegetable biomass (Clauss, Hume, & Hummel, 2010; Janis, 1976). The high efficiency of fiber digestion of ruminants is mainly due to the long retention time in the large gastric fermentative chambers where fibrous particles are subjected to extensive microbial cellulolysis (Van Soest, 1994). However, the high microbial digestive efficiency of ruminants comes at