SENSORY AND PHYSICO-CHEMICAL PROPERTIES OF MEAT FROM HORSES OF DIFFERENT AGE GROUPS

Pierre-Alain Dufey

Swiss Federal Research Station for Animal Production, CH-1725 Posieux, Switzerland

Keywords: horse, meat quality, age, tenderness

Background

In 1993, the domestic horse meat production did not exceed 20 % of the demand. In search of alternative production methods utilizing grassland in an extensive way, farmers might produce horse meat under label conditions. The intended age at slaughter of approximately 30 months is related to the idea that these animals spend two entire seasons on pasture. However, such a production system was criticised by Swiss and foreign butchers alike because of the questionable meat quality at this age period. The promoters of the above production system wanted to verify the validity of this argument on a scientific basis.

Objectives

Comparing the sensory and physico-chemical properties of the meat of 30 months old horses with that of foals and adult horses.

Methods

A total of 56 horses of the Franches-Montagnes breed (a light cold blooded draught and riding horse of Switzerland) were used comprising the following three age categories: **7 months** old foals beeing raised with their mothers on pasture (age: 7.2 ± 1.1 months), **30 months** old horses (age: 30.7 ± 6.2 months), and over 5 years old, culled horses or **adults** (age: 6.5 - 20.5 years). Identity papers guaranteed age and breed.

Muscle samples were taken from the *longissimus thoracis* (**LT**) and *semitendinosus* (**ST**) of the left half of the carcass four days p.m. The samples which had to undergo an additional maturation (sensory analysis, MFI) were vacuum-packed (High Vac) until day 14 p.m. and then deep-frozen at -28 °C.

The following parameters were measured: a) ultimate pH with a Wintion pH meter, b) Minolta L*, a* and b* -values, c) drip loss % during vacuum storage (10 days and after freezing) d) cooking loss %, e) Warner-Bratzler shear force values, f) sarcomere length with light microscope and image analysis, g) myofibril fragmentation index, h) sensory analysis and preference testing with an experienced taste panel (scoring with non-structured scale). Some specific chemical analyses completed the study: a) heme iron, b) residual glycogen, c) collagen and its hydrothermal solubility at 90 °C (hydroxyproline x 8), d) NPN, e) cholesterol.

Results and discussion

The physico-chemical properties of the two muscles LT and ST are summarized in table 1. *Ultimate pH* in the LT and ST muscles of 30 months old horses attained values of 5.67 and 5.73 which are comparable to those of culled horses but different from seven months old foals (5.35 and 5.46; $p<0.001$). BADIANI *et al.* (1993) also observed low pH in four to seven months old foals. The higher ultimate pH positively influences the *waterholding capacities* of fresh meat resulting in smaller drip losses after maturation and defreezing compared to foal meat ($p < 0.001$). At 30 months, the LT and particularly the ST muscle were darker than corresponding samples of seven months old foals (L*: 33.02 and 34.59 compared to 37.17 and 41.23), and in comparison to culled horses, the red colour was more intensive (a*: 13.72 and 13.70 compared to 12.61 and 12.88). These values are comparable to those measured in lamb of different origins (DUFEY and WIRZ, 1995). The highest myoglobin levels, determined as *heme iron*, also occur in this age group of 30 months. According to ROBELIN *et al.* (1984) and BOCCARD (1975), the heme iron content increases quite rapidly up to an age of 24 to 30 months, then stabilizes, followed by rather decreasing values when reaching an age of over eight to ten years. In contrast to findings of ROBELIN *et al.* (1984) with 12 to 18 months old horses, *collagen* content of the LT muscles revealed no age dependency. On the other hand, *solubility*, calculated as soluble collagen over total collagen, fell from 46.1 % for seven months old foals to 27.2 % for 30 months old horses to reach 15.3 % in older culled horses. The same authors found solubilities of 40 to 50 % for 12 months old and 22 to 27 % for 30 months old horses. On average, the ST muscle contained twice as much collagen than the LT muscle, the highest collagen levels being found in the youngest animals (941 mg/100 g). As seen in the LT muscle, the collagen quality is age dependent. Between seven and 30 months, solubility dropped from 51.8 % to 25.8 %, attaining 13.7 % in over five years old horses.

The *fragmentation index* (MFI) is generally high. The values of the ST muscle exceeded those of the LT muscle. The highest index was determined in the 30 months age group, the group differences being significant in the LT muscle. LT *sarcomers* of 30 months old horses were 6 % longer than in seven months old foals but 8 % shorter in the ST muscle.

A *shear force* of 2.54 kg was necessary to rupture the LT muscle of the 30 months age group which did not differ from the other age categories. In the ST muscle, the required shear force amounted to 5.19 kg, 2.5 kg more than in the seven months age group. Between the two muscles, the force that had to be applied in meat samples of 30 months and older horses was doubled. Similar observations were made by ROBELIN *et al.* (1984) in these muscles of 12 to 30 months old animals.

Except for *cholesterol*, age is a determining factor for all components of the LT muscle (table 2). In general, the values of the 30 months age group take an intermediate position between the foals and the culled horses.

Meat *juiciness* of the 30 months old and culled horses was superior to that of the foals, mainly due to a higher waterholding capacity. A correlation of r=-0.6 with total weight losses was calculated. Meat of 30 months old horses still possessed a *tenderness* comparable to the foal meat which became inferior in culled horses. Since the LT muscle contains little collagen, the marked drop in collagen quality had only minor effects in this muscle. This is not the case in the ST muscle with a double collagen content compared to the LT muscle. The meat of the seven months old foals had a significantly stronger *flavour*. The reason for this finding is an acidic flavour which develops during maturation. The taste panel detected this phenomenon in seven foals. In humans, the sensitivity to this acid varies considerably. For this reason, the evaluation of individual appreciation gives better information than an average preference. Three preference classes were established: bad, satisfactory, good. The relative frequencies were calculated for each class and animal category. The results are presented in figure 1. Foal meat was qualified bad in more than 20 % of the judgements. The corresponding frequency for the 30 months age group was only 7.8 %. The meat of the 30 months old horses was considered good in 50 % of the judgements, a qualification which was less frequent in the other age groups (40 %).

Conclusions

Despite major modifications meat undergoes between seven and 30 months, the one of 30 months old horses is, according to our findings, more homogenous and easier to preserve. The assertion that over five to seven years old horses have a better meat quality than 30 months old animals is not correct, particularly as far as tenderness is concerned.

Literature

BADIANI A., MANFREDINI M. e NANNI N., 1993. Qualità della carcassa e della carne di puledri lattoni. *Zoot. Nutr. Anim.*, **19**, 23 - 31.

BOCCARD R., 1975. La viande de cheval. *Bull. Techn. CRZV Theix, INRA*, **21**, 53 - 57.

DUFEY P.-A. and WIRZ H., 1995. Lamb quality II. Comparison between Swiss and foreign meat. *Revue suisse Agric.* **27**, 209 - 214.

ROBELIN J., BOCCARD R., MARTIN-ROSSET W., JUSSIAUX M. et TRILLAUD-GEYL C., 1984. Caractéristiques des carcasses et qualités de la viande de cheval. In: R. JARRIGE, W. MARTIN-ROSSET (ED.) 'Le Cheval. Reproduction - Sélection - Alimentation - Exploitation'. INRA Publications, Paris. 602 - 610.

Table 1. *Chemical and physical properties of the longissimus thoracis (LT) and semitendinosus (ST) of 7, 30 months old and adult horses*

		Muscle LT			Muscle ST		
		7 months	30 months	adult	7 months	30 months	adult
pH_u		5.35^{b}	5.67^{a}	5.66^{a}	5.46^{b}	5.73^{a}	5.69^{a}
Drip loss							
aging	%	6.29^{a}	4.51^{b}	4.03^{b}	4.60^{a}	3.68^{b}	2.99^{b}
freezing	%	7.33^{a}	5.91^{b}	6.06^{b}	6.48^{a}	4.96^{b}	5.26^{b}
Cooking loss	%	17.87^{b}	18.06^{b}	19.99^{a}	20.94	21.58	21.85
Lightness	L*	37.17^{a}	33.02^{c}	34.52^{b}	41.23^{a}	34.59^{b}	35.53^{b}
Redness	a*	13.70^{a}	13.72^{a}	12.61^{b}	11.51^{c}	13.70^{a}	12.88^{b}
Yellowness	b*	4.11^{a}	3.19^{b}	4.21^{a}	4.01^{ab}	3.47^{b}	4.58^{a}
Heme iron	mg/100g	1.09^{c}	1.94^{a}	1.61^{b}	0.67^{b}	1.43^{a}	1.36^{a}
Collagen	mg/100g	392	385	375	941^{a}	800^{ab}	838^{b}
Coll. Solubility	%	46.1^{a}	27.2^{b}	15.3^{c}	51.8^{a}	25.8^{b}	13.7^{c}
MFI		83.9^{b}	97.9^{a}	75.4^{b}	102.2	118.7	111.0
Sarcomere length	µm	1.94^{b}	2.06^{a}	2.10^{a}	2.26^{a}	2.10^{b}	2.20^{a}
Shear force	kg/cm^2	2.77^{b}	3.22^{ab}	3.37^{a}	3.41^{b}	6.57^{a}	7.23^{a}

Means within a row and muscle with different superscripts differ significantly ($p<0.05$)

Table 2. *Sensory and chemical analysis of the muscle longissimus thoracis (LT) of 7, 30 months old and adult horses*

		Muscle LT		
		7 months	30 months	adult
Moisture	%	75.43^{a}	74.73^{b}	73.15^{c}
Protein	%	21.94^{a}	21.20^{b}	20.79^{c}
IMF	%	1.07^{c}	2.35^{b}	4.24^{a}
Ash	%	1.16^{a}	1.00^{b}	1.00^{b}
Resid. glycogen	mg/100g	551^{b}	724^{a}	854^{a}
NPN	mgN/100g	450^{a}	439^{ab}	433^{b}
Cholesterol	mg/100g	45.9	45.4	45.8
Palatability traits				
Flavour		4.61^{a}	4.10^{b}	4.11^{b}
Juiciness		3.49^{b}	4.09^{a}	4.04^{a}
Tenderness		4.89^{a}	4.54^{a}	3.68^{b}

Figure 1. *Panel's preference (in %) for meat of 7, 30 month old and adult horses, expressed in the three classes: bad, satisfactory, good*