

Effects of Age on Chemical Composition and Tenderness of Muscle *Longissimus thoracis* of Martina Franca Donkey Breed

—Donkey Meat Quality at Different Age

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Received January 18th, 2011; Revised February 8th, 2011; Accepted March 8th, 2011.

ABSTRACT

The aim of this study was to determine the effects of age on chemical composition and tenderness of donkey meat. These characteristics were determined on *Longissimus thoracis* samples taken from 40 entire donkey males of Martina Franca breed slaughtered at 12 (Group 1, $n = 20$) and at 18 months (Group 2, $n = 20$) of age. Tenderness was evaluated at two and seven days post slaughter using a Warner-Bratzler shear force device. The chemical composition showed a significant increase in protein content ($P < 0.05$) in the meat of donkeys slaughtered at 18 months of age (22.3 g/100g) compared to the meat of younger animals (21.4 g/100g). Intramuscular fat content was significantly lower ($P < 0.05$) in Group 1 (2.41 g/100g) compared to Group 2 (3.71 g/100g). Shear force values at seven days post slaughter were significantly ($P < 0.01$) lower ($(5.15 \pm 0.31) \text{ kg/cm}^2$) in Group 1 compared with the results obtained at two days post slaughter ($(6.25 \pm 0.53) \text{ kg/cm}^2$). In Group 2 shear force values obtained seven days post mortem were higher ($(5.88 \pm 0.23) \text{ kg/cm}^2$) compared with Group 1 after the same ageing period but significantly ($P < 0.05$) lower if compared with those ($(6.53 \pm 0.23) \text{ kg/cm}^2$) determined in the same animals two days post slaughter.

Keywords: Donkey Meat, Martina Franca, Chemical Composition, Tenderness

1. Introduction

Donkey meat has been historically obtained from animals that were slaughtered at the end of their working lives. For this reason the meat usually had not good sensorial and nutritional characteristics, and often it was most convenient to produce salami or other kind of ripened meat rather than using fresh donkey meat for human consumption [1]. The Martina Franca is a local donkey breed native from the south of Italy, specifically from Apulia Region; in the past this breed was used for transport and work in the farms, today the interest on Martina Franca donkeys is mainly based on milk production for infant nutrition [2]. Nowadays in western Countries donkey males, entire or castrated, are not used for transport and work, but meat production from male foals can be an interesting source of proteins and can increase the income of local farmers [3]. In this context, the aim of the present study was to evaluate the effects of different slaughter

age on chemical composition and tenderness of donkey meat obtained from Martina Franca breed animals.

2. Materials and Methods

For this study, 40 entire donkey males of the Martina Franca breed were used. They were reared in an extensive pasture system in the same farm in the south of Italy and receiving the same diet. Twenty animals (Group 1) were slaughtered at 12 months of age and the mean fasted final body weight was $(148 \pm 27) \text{ kg}$. The other 20 animals (Group 2) were slaughtered at 18 months of age and the mean fasted final body weight was $(202 \pm 45) \text{ kg}$. All animals were transported to the abattoir the day before slaughter, only water was available. The animals were stunned with a captive bolt, slaughtered, skinned and eviscerated according to current European Union regulations (Council Directive 95/221EC) in an abattoir normally used for horses. All carcasses were stored for 24 h

in a cold room at about +2°C suspended by the hind legs. After 24 h storage in the cold room (2°C), carcasses were halved with a band saw. *Longissimus thoracis* muscle (LT) samples (approximately 400 g of weight) were collected from each left half carcass, between the 12th and 13th rib. A part of each sample, weighting about 100g, was placed into a zipped plastic bag and transported within about 3 h to the laboratory for the chemical analysis. The remaining part of the samples were divided into two portions, were kept in vacuum bags and were held in the same cold room of the previous day (+2°C), in which samples were stored for 2 and 7 days post slaughter before evaluating the shear force values. Chemical composition of the LT samples collected from the animals used in this study were determined following the standard methods [4]. Glycogen was determined spectrophotometrically (340 nm) using a commercial kit [5]. Glycogen content was determined within 12 h after the samples were collected. Samples designated for shear force determination were removed from the cold room after 2 and 7 days after slaughtering, then were brought to +4°C for 1 h. Chops (each 2.5 cm thick) were obtained from the mid-region of each sample, and roasted on a metal tray at an oven temperature of +180°C to an internal temperature of +73°C, monitored with thermocouples [6]. Chops were cooled to room temperature (25°C) for 30 min. From each sample, eight cores (1.3 cm in diameter) were removed, and shear force determinations were obtained with a Warner-Bratzler operating head applied on an Instron apparatus 4411 (Instron, High Wycombe, UK): the traditional triangular hole blade was used. Samples were cut in a longitudinal direction using a mechanical coring device. Peak or maximum shear force across fibre was expressed in kg/cm². Data were analysed using the general linear model procedures [7], considering as independent variable the age at slaughtering. Results were expressed as least square means. The significance test was conducted at the 95% confidence level.

3. Results

Donkeys slaughtered at 12 months of age showed a significant ($P < 0.05$) lower fat content, specifically 2.41% compared with 3.71% obtained in older animals (Table 1). Cholesterol content was similar in both the groups of animals, 67.4 mg/100g in Group 1 and 68.7 mg/100g in Group 2, confirming that cholesterol level in meat is not strictly related to fat content [8]. Protein content increased significantly ($P < 0.05$) in donkeys slaughtered at 18 months of age, showing a value of 22.3% compared with 21.4% obtained in Group 1. Ash and glycogen content did not show significant differences between the two groups; the results of this study established that glycogen

can be determined in donkey meat, as previously demonstrated [9], confirming the usual possibility of finding out this compound in equine meat [10]. Moisture content was significantly lower ($P < 0.05$) in samples of LT collected from animals belonging to Group 2 (72.5%) compared to Group 1 (74.8%), due to the increase of protein and fat content in older animals. Two days after slaughtering no significant differences were determined (Table 2) between meat samples collected from donkeys slaughtered at 12 months of age (6.25 ± 0.53 kg/cm²) and from donkeys belonging to Group 2 (6.53 ± 0.41 kg/cm²). At

Table 1. Chemical characteristics (Mean \pm S.E.) of *Longissimus thoracis* muscle.

	Group	Mean	S.E.
Moisture (%)	1	74.8 ^a	3.31
	2	72.5 ^b	2.21
Fat (%)	1	2.41 ^a	0.71
	2	3.71 ^b	0.43
Protein (%)	1	21.4 ^a	2.95
	2	22.3 ^b	3.01
Ash (%)	1	1.04 ^a	0.77
	2	1.10 ^a	0.89
Glycogen (%)	1	0.36 ^a	0.03
	2	0.42 ^a	0.07
Cholesterol (mg/100g)	1	67.4 ^a	0.81
	2	68.7 ^a	0.93

Group 1: animals slaughtered at 12 months of age ($n = 20$); Group 2: animals slaughtered at 18 months of age ($n = 20$); Means within each component (at the same column between the two groups) with different letters were significantly different (b: $P < 0.05$).

Table 2. Tenderness (kg/cm²) of *Longissimus thoracis* muscle after two and seven days post mortem.

	Mean	S.E.
<i>Two days post mortem</i>		
Group 1 ($n = 20$)	6.25 ^a	0.53
Group 2 ($n = 20$)	6.53 ^a	0.41
<i>Seven days post mortem</i>		
Group 1 ($n = 20$)	5.15 ^c	0.31
Group 2 ($n = 20$)	5.88 ^b	0.23

Group 1: animals slaughtered at 12 months of age ($n = 20$); Group 2: animals slaughtered at 18 months of age ($n = 20$); Different letters in the column indicate significant difference (b: $P < 0.05$; c: $P < 0.01$).

seven days post slaughter, the shear force values determined for LT muscles obtained from donkeys belonging to Group 1 (5.15 ± 0.31 kg/cm²) were significantly lower ($P < 0.01$) compared to the values registered in the same group at two days. The shear force obtained seven days post slaughter in Group 2 showed higher values (5.88 ± 0.23 kg/cm²) compared with Group 1 but significantly lower ($P < 0.05$) with the results obtained in the same animals at two days. In a study conducted on horse meat [11], shear force values of 5.24 kg/cm² were obtained 10 days after slaughtering using male animals slaughtered at 11 months of age. The results of the present study demonstrated that, after an adequate ageing period, donkey meat tenderness can be considered very similar to the same quality parameter determined on horse meat, according also to the results obtained in Sanfratellano and Halflinger foals [12]. An ageing period of seven days is considered necessary to improve meat tenderness for most of the red meats [13-15]. No data are actually available about tenderness evaluation in donkey meat, that has been scarcely studied. The results obtained in this study demonstrated that also in donkeys meat tenderness can be improved after a week of storage in a cold room, and confirmed that donkey meat production can be of interest to specific farmers and consumers.

4. Discussion

This study showed that meat obtained by entire donkey males slaughtered at 12 months of age showed a significant lower fat content compared with the same category of animals slaughtered at 18 months; age of animals did not affect cholesterol content, while protein content significantly increased with the age. Meat tenderness was significantly lower in LT samples collected by younger animals after an enlargement of the ageing period from 2 to 7 days post slaughter. The results obtained in the present experiment demonstrated that donkey meat can be considered very suitable for human consumption, considering both its chemical composition and its shear force values, and can give an additional resource to local farmers in addition to milk production. It is also confirmed the importance of ageing period for red meat to improve final tenderness.

5. Acknowledgement

This research was supported by a grant of the Italian Ministry of Agriculture n. 30340/2009.

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