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# Specific features of muscles and meat from 'AOC' guaranteed-origin Taureau de Camargue beef cattle

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ABSTRACT

The French AOC Taureau de Camargue guaranteed-origin breed certification was obtained in 1996. This denomination covers two local breeds, *di Biou* and Brave, and crossbreeds between them. On average, 2000 head of these beef cattle are raised every year, yielding 300 tons of meat. Little research has been done on these breeds, especially on meat quality. The aim of the work reported here was to characterise the muscles of these animals. Two muscles, *semitendinosus* and *triceps brachii*, were taken on slaughter from 10 males and 10 females from each of the two breeds. Colour, contractile and metabolic properties, intramuscular lipid contents and fatty acid composition were recorded for each sample.

The results obtained highlight special features of the muscles of Taureau de Camargue cattle. Compared with all other French beef breeds, these muscles have a strongly oxidative metabolism, associated with a dark red colour and a very low proportion of IIx fast glycolytic fibers. They also contain very low levels of intramuscular lipids. Analysis of fatty acid composition revealed a particularly favourable dietary profile, with 15–20% polyunsaturated fatty acids and about 10% C18:3 fatty acids. We noted a darkening of the meat in both muscles from both breeds, and a strong propensity for myoglobin oxidation.



## 1. Introduction

Since 1992 the Camargue beef farming trade has been an active advocate for local quality Camargue beef. In 1996 the official Taureau de Camargue guaranteed-origin certification ('AOC') was obtained (Table 1). The breeds covered are the two local breeds *di Biou* and Brave, and crossbreeds between them. A small number of bulls, some 30–60 per year, are selected for bull runs (*di Biou* for Camargue bull runs and Brave for corridas). The guaranteed-origin meat comes from males not selected for this purpose, and from cull cattle. The selection of these animals has never been based on beef production criteria. On average, 2000 head of cattle are slaughtered for beef every year, representing some 300 tons of meat. These cattle include bulls, bullocks, cull cows and heifers.

These cattle are raised extensively at stocking rates of less than 1 LU (livestock unit) per 1.5 ha on heath, range or grassland. The farming system is based on the use of wet rangeland or very dry summer or winter pasture. Grazing on wet rangeland is one condition of the guaranteed-origin specification: the cattle must graze for at least 6 months in the wet area set by the regulations. Herds are moved according to season and forage availability. Feed can be supplemented with locally-grown hay and cereals. Drug-containing feed and composites are forbidden.

In 2008, AOC Taureau de Camargue carcasses came from 97 farms totalling 17 000 cattles including 6000 breeding cows. The animals have to be aged at least 18 months to yield carcasses weighing on average more than 100 kg. The meat from these animals has long been used to prepare the traditional Camargue dish *gardianne*, an emblem of local heritage. Very

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**Table 1**
Main characteristics of AOC Taureau de Camargue (*from* Trift, 2003).

| | |
|---|---|
| Production | Production volume: 310 metric tons<br>Average carcass weight: 170 kg<br>Proportion certified guaranteed-origin: 83%<br>Numbers of *di Biou* breed: approx. 10000 head in 100 farms<br>Numbers of Brave breed: approx. 5000–6000 head in 30 farms |
| Locality | Guaranteed-origin area based on Camargue homeland<br>Two overlapping areas:<br>Guaranteed-origin area (Nîmes, Montpellier, Istres)<br>Wet area (Petite Camargue – winter pasture) |
| Products | Cull cows, bullocks aged 4–6 years, bulls rejected for bull runs.<br>Camargue breed renamed *di Biou* to prevent confusion between the guaranteed-origin area and breed name<br>Sensory tests typically indicate a specifically local nature of Taureau de Camargue meat according to farming methods |
| Husbandry practices | Management of lineage to breed in aptitude for bull runs<br>Alternating summer and winter pasture<br>Testing of males for bull runs and culling of unselected animals |

little scientific work has been done on the properties of the meat obtained from this type of livestock. Accordingly, the primary aim of our work was to achieve a better characterisation of the muscles and meat of AOC Taureau de Camargue cattle and identify the specific features it displays compared with other beef breeds. In addition, meat traders have noted a problem of meat colour stability, particularly in Brave males. They report a much darker meat 48 h after slaughter in these animals. To address the problems encountered by the sector, the secondary aim of our work was to gain insight into the oxidative processes that take place in this meat during storage.

## 2. Materials and methods

### 2.1. Animals

This work involved 40 animals belonging to the two guaranteed-origin breeds: 10 males (mean age 4 years) and 10 females (mean age 6 years) of the Brave and *di Biou* breeds. The animals were slaughtered according to standard commercial procedures after a one- or two-hour resting time. Muscle samples were taken from *triceps brachii* muscle (TB) and *semitendinosus* muscle (ST) at 45 min for pH, glycolytic potential, fiber typing, lipid content and at 1 day post mortem for colour and lipid oxidation measurements. Carcasses were placed in the cold room until the next day and at that time, the muscle temperature reached 2 °C.

### 2.2. Measurements and variables analysed

#### 2.2.1. Muscle pH

Muscle pH was measured in 2 g of fresh tissue sampled 45 min and 24 h after slaughter and mechanically blended in 18 mL of a 5 mM iodoacetate solution. Homogenate pH was measured using a pH meter (Hanna instruments, Woonsocket, USA) equipped with a combined electrode.

#### 2.2.2. Muscle glycogen, lactate and glycolytic potential

The glycolytic potential (GP) of the muscle was determined in 1 g of muscle using the protocol of Monin and Sellier (1985). This estimates the *post mortem* acidifying power of the muscle by assaying the energy stored in the muscle, i.e. glycogen.

Glycogen, glucose, glucose-6-phosphate and lactate of muscle homogenate were measured by enzymatic procedures according to Dalrymple and Hamm (1973) and Bergmeyer (1974) with slight modifications. Muscle tissue (1 g) was homogenized with 10 mL of 0.5 M perchloric acid. Aliquots of homogenate (0.5 mL) were taken for enzymatic determination of glycogen, glucose and glucose-6-phosphate after glycogen hydrolysis with amyloglycosidase. Lactic acid was determined in the supernatant resulting from the centrifugation at 20 min at 4000 g of homogenate. Results were expressed in micromoles per gram of muscle.

The glycolytic potential (GP, i.e. the amount of compounds transformable into lactic acid) was measured at 45 min and 24 h *post mortem*. Calculation was done according to the following formula (Monin and Sellier, 1985):

$$GP = 2 \times ([\text{glycogen}] + [\text{glucose} - 6 - \text{phosphate}] + [\text{glucose}]) + [\text{lactic acid}].$$

The GP was expressed as micromoles of lactate equivalent per gram of fresh tissue.

#### 2.2.3. Muscle histochemical analysis

The contractile properties of the muscles TB and ST were determined on samples taken at 45 min *post mortem*, previously frozen in liquid nitrogen. The isoforms of myosin heavy-chain: MyHC I (slow), IIa (fast oxido-glycolytic) and IIx (fast glycolytic) were determined by electrophoresis using an acrylamide gradient of 3.5–10% with 200 mM Tris pH 8.8. After separation of the three isoforms according to their molecular weight, the proportion of each band was quantified by densitometric analysis according to Picard et al. (1999).

#### 2.2.4. Measurement of enzyme activities

The metabolic properties were evaluated by measuring spectrophotometrically the activities of enzymes representative of glycolytic metabolism, specifically lactate dehydrogenase (LDH) and phosphofructokinase (PFK), and oxidative metabolism, specifically isocitrate dehydrogenase (ICDH), cytochrome C oxidase (COX) and citrate synthase (CS), in ground muscle (Cassar-Malek et al., 2004 and Gondret et al., 2004). One unit of the enzyme was defined as the amount which catalyses per min the disappearance of 1 µmol of NADH for PFK and LDH, the liberation of 1 µmol of coenzyme A for CS and the reduction of 1 µmol of NADP for ICDH. Enzyme activities (means of triplicate) were expressed in µmole per min per gram of wet muscle.

#### 2.2.5. Colour measurements

To measure colour change, 150 g muscle slices were taken 24 h *post mortem* and placed in a tray wrapped with oxygen-permeable film and stored at 4 °C. Colour measurements were performed at 1 and 5 days *post mortem*. Reflectance spectra were recorded in the visible range (360–760 nm) on a Uvikon 933 spectrophotometer (Kontron instruments)