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# Meat quality attributes of Agile Wallabies

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ABSTRACT

Meat quality traits of Agile Wallaby (*Macropus agilis*) *M. longissimus* (loin) and *M. semimembranosus* (topside) were investigated. Both muscles exhibited a relatively high pH (> 5.7) and dark colour (L*-, a*-, and b*-values). Aging the loins from 2 to 21 days p.m. had a significant effect on shear force. However, the results regarding shear force, myofibrillar fragmentation index (MFI) and degradation of desmin and troponin-T suggested that the aging response largely occurred within 2 days p.m. Suspension of carcasses from one leg resulted in a side effect on shear force of the loin at 2 and 7 days p.m., but not on sarcomere length or MFI. Topsides from the free hanging leg exhibited lower shear force values (33 vs 42 N) and greater sarcomere lengths (2.51 vs 1.84 μM). Tenderness, juiciness, flavour and overall liking were higher for loins than topsides. Sensory scores for the loin and topside were slightly lower and similar, respectively, to those reported for lamb.

## 1. Introduction

The Agile Wallaby (*Macropus agilis)* is the most common wallaby over much of the north of Australia. In recent decades Agile Wallaby densities have increased dramatically, which is likely a consequence of a series of wetter seasons, the establishment of additional watering points for cattle and expansion of improved pastures and crops (Bedoya-Perez, Lawes, & McMahon, 2015). At high densities, competition for resources with cattle is thought to be strong, particularly towards the end of the dry season. Wallabies impose costs on pastoralists when feed is limited and there is direct competition with cattle. At other times their economic impact is small. Pastoralists and farmers indicate that a considerable amount of money goes into the maintenance and repair of infrastructure damaged by wallabies (e.g. fences, irrigation lines, and vehicles), as well as the destruction of pasture stands during the dry season, when wallabies do not just graze, but also dig out the roots as a food source (Hunt & Mullen, 2015). The identified management alternatives are limited to culling (shooting) and wallaby-proof fencing – both are expensive options for landholders.

Wallabies also impose costs on those growing crops such as hay (requiring exclusion fencing). They destroy seedlings in Indian Sandalwood (*Santalum album*) plantations, as well as damaging polyethylene lines in irrigation systems in both horticultural and forestry situations. It is likely that there are other significant externalities associated with these higher than normal wallaby populations. Higher grazing pressure is also a potential risk to land stability. When groundcover is depleted below 40% soil erosion risk in the top end of the Northern Territory, increase exponentially (Dilshad, Motha, & Peel, 1996). Anecdotal evidence also suggests that artificially high densities of wallabies are likely to cause damage to riparian areas (even when cattle are excluded by fencing). Given the expected expansion and intensification of agricultural production in northern Australia, Agile Wallabies will have increased interaction with the primary production sector and management of their population may be necessary. This opens the possibility for commercial harvesting.

For a variety of reasons, interest in kangaroo as a source of red meat is increasing, with a gross value of production (GVP) of A$43.9 million in 2007 (Spiegel & Wynn, 2014). Wallabies belong to the same family (*Macropodidae*) and genus (*Macropus*) as kangaroos, with the main difference being the size of the animals. However, commercial harvesting is very limited with a GVP of A$136 thousand in 2005–6 (Spiegel & Wynn, 2014). Commercial harvesting may be for pet food, meat for human consumption and byproducts like skins. Of these, meat production for human consumption offers the greatest opportunity for value adding.

An important determinant of the acceptability of meat for human consumption is the sensory quality. Of the different sensory traits (colour, tenderness, juiciness, flavour), tenderness is affected to a large extent by processing factors like chilling rate, carcass suspension method and aging period, affecting the extent of muscle contraction and tenderization during the aging period. In addition, the functional characteristics of the muscles mainly determine the contribution of the connective tissue network to toughness (Koohmaraie & Geesink, 2006). In the present study, these issues were addressed in a series of

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experiments for Wallaby *M. longissimus* and *semimembranosus* (loin and topside).

## 2. Materials and methods

### 2.1. Animals

Agile Wallabies ($n = 64$) were harvested in the Douglas-Daly region of the Northern Territory (Australia) on three separate trials ($n = 17$, 24 and 23, respectively) during the period July–September 2016, corresponding to an early, mid and late dry season harvest. The harvesting process involved the field-slaughter by head shot, recording of the weight of the animals and field-dressing. Field-dressing involved removal of the head, front and back feet, complete evisceration and recording of the field-dressed weight. Of the 64 animals, two (in trials 1 and 3) were condemned in the field because of obvious signs of severe sarcoptic mange (a skin disease caused by parasitic mites). A further four carcasses, harvested during trial 3, were not used for further analysis because the muscles were too small to collect sufficient samples for sensory analysis. In trials 1 and 3 the carcasses were suspended from both hind legs. In trial 2 the carcasses were suspended from only the left leg to create a tenderstretching effect in the right side of the carcass. In the same trial the rate of pH and temperature decline in the caudal section of the *M. longissimus* of 5 randomly selected animals was recorded using a metre (WP-80 Waterproof pH-mV-Temperature Meter, TPS Australia) equipped with a spear type gel electrode (Ionode IJ 44) and a stainless steel temperature probe. The electrode was calibrated in buffers at pH 4.0 and 6.88. Temperature and pH readings were taken at hourly intervals and the temperature at the onset of rigor (pH 6) was calculated according to Pearce et al. (2010). Ambient temperature during animal harvest and the average time taken for the carcasses to get to refrigeration, were not recorded at the time of harvest. Carcasses were transported to a chiller at the NT-DPIR Douglas-Daly Research Farm and chilled overnight at 2 °C.

All animals were taken under culling permits issued by the Northern Territory Parks and Wildlife Commission. An accredited kangaroo shooter was used to shoot the animals and to dress the carcasses. The standard operating procedures for harvesting were derived from the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Commercial Purposes (Dept. of the Environment, Water, Heritage and the Arts, 2008 and the National Kangaroo Harvester Hygienic Field Dressing Manual (RIRDC, 2010.

### 2.2. Sampling

At one day post mortem, carcasses were skinned and loins (*M. longissimus*) and topsides (*M. semimembranosus*) were collected from both carcass sides. In trial 1 and 2, topsides from each carcass were vacuum packaged and randomly assigned to 7 or 14 days of aging at 2 °C. Loins were divided into an anterior section and a posterior section, vacuum packaged and assigned to either 2, 7, 14 or 21 days of aging at 2 °C. In trial 3, loins and topsides from both sides of the carcass were vacuum packaged and aged for 14 days. Samples were frozen at − 20 °C and shipped frozen to UNE for further analysis. Further analysis was conducted after defrosting the vacuum packaged samples overnight at 2 °C.

### 2.3. Colour and pH measurement

The pH of the samples was measured using an insertion probe (WP-80 Waterproof pH-mV-Temperature Meter, TPS Australia). The electrode was calibrated in buffers at pH 4.0 and 6.88. Colour was determined on a freshly cut surface after 30–40 min blooming using a Minolta Chroma Meter CR-300 with a closed cone. The instrument was calibrated with a white tile (Y = 93.3, x = 0.3135, y = 0.3198) using illuminant D-65, with 2° standard observer. A total of 3 readings were taken on each steak and averaged. CIE lightness (L*), redness (a*) and yellowness (b*) were recorded.

### 2.4. Cooking loss and shear force measurements

Shear force and cooking loss were determined as described by Hopkins and Thompson (2001) with minor modifications. Briefly, vacuum packed samples (about 65 g) were suspended in a 70 °C water bath for 30 min and subsequently chilled under running tap water for 30 min. Cooking loss (%) was determined by recording the weights of the samples before and after cooking. For shear force analysis, six subsamples (fibre direction parallel to the length of the sample) with a rectangular cross section of 15 mm wide by 6.66 mm deep were cut from each sample. The sample was clamped and cut with a 0.64 mm thick blade at a speed of 100 mm/min. The peak shear force of each sub-sample was measured using a Lloyd Instruments LRX Materials Testing Machine fitted with a 500 N load cell (Lloyd Instruments Ltd., Hampshire UK) and the average was recorded.

### 2.5. Total and soluble collagen content

The method for determination of total and soluble collagen was based on AOAC method 990.26 (AOAC, 2000), as described in detail by Starkey, Geesink, Oddy, and Hopkins (2015). Total collagen was determined in duplicate on 0.10 g samples of freeze dried muscle powder and soluble collagen on 1.5 g of freeze dried muscle powder by determining the hydroxyproline content. Total collagen content was calculated as hydroxyproline content × 7.25 / 1000 / (sample weight / 250) and soluble collagen as hydroxyproline content × 7.25 / 1000 / (sample weight / 400). The results were expressed in mg/g dry matter.

### 2.6. Sarcomere length

Sarcomere length was determined according to Cross, West, and Dutson (1981) using phase contrast microscopy and the filar micrometer method. Using an image analysis package (Nikon Elements version 3.22), the length of ten sarcomeres in a row were measured. Ten myofibril fragments were evaluated for each individual muscle to determine the average sarcomere length.

### 2.7. Myofibrillar fragmentation index

The myofibrillar fragmentation index (MFI) was determined according to Culler, Parrish, Smith, and Cross (1978) with minor modifications. Muscle tissue (2 g) was weighed and homogenized (Ystral homogenizer, series × 10/25, 10-mm shaft, Ballrechten-Dottingen, Germany) in 20 mL of cold MFI buffer at 13,000 rpm for 10 s. After centrifugation at 1000 × *g* for 15 min at 2 °C the supernatant was discarded and the pellet re-suspended with 20 mL of MFI buffer. After centrifugation at 1000 × *g* for 15 min at 2 °C the supernatant was discarded and the pellet re-suspended with 10 mL of MFI buffer. The myofibrillar suspension was filtered using a household mesh tea strainer and another 10 mL of MFI buffer was added to wash the strainer. Protein concentration of the myofibrillar suspension was determined as described by Frank et al. (2017) using a Pierce™ BCA protein assay kit. The myofibrillar suspension was diluted to a final concentration of 0.5 mg/mL with MFI buffer and the absorbance at 540 nM was determined in triplicate. MFI was expressed as A540 × 200.

### 2.8. SDS-PAGE and Western blotting

Samples for SDS-PAGE and Western blotting were adjusted to a protein content of 5 mg/mL using SDS-PAGE sample buffer (125 mM Tris/HCl, 4% SDS, 20% glycerol, 10% (v/v) β-mercaptoethanol, 0.01% (w/v) bromophenol blue, pH 6.8). SDS-PAGE was performed using