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Consumer evaluation of venison sensory quality: Effects of sex, body condition score and carcase suspension method

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ABSTRACT

Intact fallow bucks ($n=20$) and non-pregnant fallow does ($n=24$) (*Dama dama*), in the body condition score (BCS) of 2, 3 and 4 (lean, prime and fat) and rising 2 year old red deer stags ($n=26$) (*Cervus elaphus*) of the same BCS range (2–4) were used in this study to determine the impact of sex, BCS and method of carcase suspension on consumer perception of venison quality. Consumers were asked to evaluate cooked meat samples (*M. gluteus medius*) on an unstructured line scale for colour, flavour, tenderness, juiciness and overall liking. Meat from both fallow deer and red deer was preferred by consumers when carcases had hung by the pelvic suspension (PS) method compared with the Achilles tendon (AT) method of hanging ($p<0.001$). Consumers also noted a difference in colour between sexes in fallow deer venison, with venison from 36 month-old does being darker ($p=0.015$), and preferred venison from does over 18–24 month-old bucks. There was a significant difference in the consumer scores for tenderness in red deer stags of BCSs 2 and 4 ($p=0.05$) with panellists determining BCS 4 animals to be more tender; however no tenderness differences were observed for fallow deer does compared with bucks.

1. Introduction

One of the primary objectives of the red meat industry has been an attempt to deliver consistently high quality meat to consumers. Eating quality has long been recognised as a determinant for repeat purchasing (Grunert, Bredahl, & Brunso, 2004). Many forms of assessment are utilised to ensure a good eating experience by the consumer, including monitoring of pre and post-slaughter parameters and physical measures such as shear force, water-holding capacity and colour. These measures attempt to predict various aspects of the eating experience of consumers, however, the ultimate way of testing a product is to place it with a consumer panel for sensory analysis (Russell, McAlister, Ross, & Pethick, 2005).

A range of objective meat quality measurements, including water-holding capacity and colour as well as chemical and nutritional composition of meat, have been related to sensory attributes of beef (Egan, Ferguson, & Thompson, 2001; Perry, Thompson, Hwang, Butchers, & Egan, 2001; Thompson, 2002); lamb (Sanudo et al., 1998; Hopkins, Walker, Thompson, & Pethick, 2005; Pethick, Davidson, et al., 2005; Pleasants, Thompson, & Pethick, 2005; Thompson, Hopkins, et al., 2005); goat meat (Carlucci, Girolami, Napolitano, & Monteleone, 1998; Mushi, Elk, Thomassen, Serheim, & Adney, 2008) and pork (Aaslyng et al., 2007; Bertram & Aaslyng, 2007; Lloveras et al., 2008).Tenderness of beef has been tested for consumer preference (Rosenvold, van den Berg, Andersen, Johansson, & Lundstrom, 2002; Voges et al., 2007; Sawyer et al., 2007; Destefanis, Brugiapaglia, Barge, & Dal Molin, 2008), and Thompson (2002) found a high correlation between tenderness and overall liking in beef samples, but it appears similar studies have not been done with fallow deer venison.

The sensory quality of venison has not been studied extensively but some research has reported various sensory attributes for red deer (*Cervus elaphus*) (Wiklund, Manley, Littlejohn, & Stevenson-Barry, 2003) and reindeer (*Rangifer tarandus tarandus*) (Wiklund, Johansson, & Malmfors, 2003). Sensory evaluation studies have been conducted on some other game species including buffalo (*Bubalus bubalus*) (Vasanthi, Venkataramanujam, & Dushyanthan, 2007), camel (*Camelus dromedarious*) (Dawood, 1995), rabbit (*Oryctolagus cuniculus*) (Combes et al., 2008), springbok (*Antidorcas marsupialis*) (Hoffman, Kroucamp, & Manley, 2007), ostrich (*Struthio camelus var domesticus* and *Struthio camelus australis*) (Hoffman, Muller, Cloete, & Brand, 2008), and feral goats (*Capra hircus*) (Swan, Esguerra, & Farouk, 1998), while Rodbotten, Kubberod, Lea, and Ueland (2004) developed a sensory map of 15 species, both domesticated and non domesticated. The deer venison included in that study was from wild reindeer (*Rangifer tarandus tarandus*), moose (*Alces alces*) and roe deer (*Capreolus capreolus*).

Body condition score is a useful tool in assessment of animal nutritional status, and a frequently used descriptor in the buying and selling of livestock for slaughter. Market specifications are often

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established according to the amount of subcutaneous fat coverage on the live animal and scales of reference have been established that allow accurate prediction of carcase characteristics from live animal BCS assessments in fallow (Flesch & Mulley, 2002) and red deer (Tuckwell, 2003). Venison from fallow deer carcases hung by PS has been shown to be consistently more tender than venison from carcases hung by the AT (Sims, Wiklund, Hutchison, Mulley, & Littlejohn, 2004), and this improvement to product quality has been demonstrated across different sex and age classes of fallow deer. The technique of PS is now used commercially for carcases from domestic species like beef and lamb, especially within quality control systems that guarantee a tender product (Meat Standards Australia, 2001). The effect of PS as an alternative carcase suspension technique on meat quality has not been reported for red deer prior to this study.

This paper describes consumer sensory analysis of venison from red and fallow deer of various BCSs collected from carcases hung by either the AT or by the PS technique. The data are analysed and presented separately for fallow deer and red deer.

2. Materials and methods

The experimental procedures used in this study were approved by the Animal Care and Ethics (ARP 00.09) and Human Ethics (HEC 03-206) committees of the University of Western Sydney (UWS).

2.1. Animal selection and sample preparation

Intact fallow bucks ($n=20$) ranging from 18 to 24 months old, and non-pregnant fallow does ($n=24$) approximately 36 months old with a history of one previous lactation and with BCS of 2, 3 and 4 (lean, prime and fat) were killed by captive bolt stunning and thoracic stick exsanguination within 3 s of the stun. All fallow deer were raised on pasture and slaughtered at the University of Western Sydney deer facility, which includes a research abattoir where the deer were slaughtered. All carcases were split along the spine before chilling, with one of the sides randomly allocated to be hung by the AT and the other side hung by the aitch bone for the PS technique. All sides were measured for temperature and pH in the *M. longissimus dorsi* between the 5th and 6th rib, 1 and 24 h *post mortem*. BCS was measured ante mortem and confirmed with carcase measurements *post mortem*. The *M. gluteus medius* muscles (rumps) were boned out from each carcase side once carcase temperature was less than 7 °C, *i.e.* at 1 day *post mortem*, vacuum packaged frozen and stored at −21 °C until sensory evaluation was carried out. Kidneys with tallow were excised for later kidney fat index (KFI) calculations according to the method of Riney (1955) to assist confirmation of BCS.

Rising 2 year old red deer stags and with BCS ranging between 2 and 4 ($n=26$) were transported to commercial abattoirs and slaughtered using captive bolt stunning and thoracic stick exsanguination. Fourteen carcases were split along the mid ventral axis, and each side was randomly allotted to either AT suspension or to PS. Twelve carcases were hung by the AT. Both of the *M. gluteus medius* muscles were boned out from each carcase at 1 day *post mortem*, vacuum packaged, frozen and stored at −21 °C until sensory evaluation was carried out.

2.2. Sensory analysis

The design of the sensory facility at University of Western Sydney is consistent with ISO guidelines (1988) and equipped with six individual booths and uniform fluorescent lighting. The booths are serviced by a preparation area. During sensory evaluation of venison samples these rooms were kept at a constant 22 °C.

Meat samples were kept frozen at −21 °C and then thawed in a chiller at 5 °C, 24 h prior to cooking. Samples were cooked in vacuum packages immersed in a water bath set at 73 °C for approximately 1 h to reach an internal temperature of 67 °C, (American Meat Science Association, 1995; Wiklund, Malmfors, & Lundström, 1997) which was shown to produce a product which remains palatable and safe for human consumption (Rodbotten et al., 2004). Samples were removed from the water bath, immediately cut into 5 mm thick slices, and served to panellists without delay.

Descriptive and quantitative consumer preference (affective) sensory testing was undertaken with 42 panellists (Meilgaard, Civille, & Carr, 2007), who were recruited via newspaper advertising and email. There was an even distribution of males and females with ages ranging from 25 years to 55 years. Consumers were screened to determine if they were eaters of red meat, willing to try venison or were current venison consumers, and to ensure they preferred meat cooked to medium doneness. Participants who smoked were asked to refrain from smoking 1 h prior to and during the sessions. Familiarisation and training sessions were undertaken as recommended in ISO (1993) and as described by AMSA (1995) to assist in identifying quality attributes for venison such as liver/game flavour, colour, tenderness and juiciness.

Panellists were presented with a sample identified by a random three digit code and answered questions on the descriptive test by indicating on an 11 cm unstructured line scale (0 = low intensity) (11 = high intensity) how they rated the sample for flavour, colour, juiciness, tenderness and overall liking. Samples were presented on white plates in randomised order. Up to six samples were tasted at each session and panellists attended four sessions to complete the work; in order to avoid palate fatigue. Each session lasted 30 to 45 min and a 15 min break was given half way through each session. Panellists were seated in individual booths with a drinking cup containing water (90%) and apple juice (10%) to cleanse the palate between tastes. Sessions were conducted mid-morning and early afternoon.

2.3. Statistical analysis

Score sheets were measured using vernier callipers and the data recorded as described by Thompson, Gee, Hopkins, Pethick, Baud, and O'Halloran (2005). Data were analysed using SPSS 11.5 analysis of variance using the GLM procedure. All fixed effects and their interactions were tested in the same model. If the treatment effect was significant, treatment means were separated using Ryan's *Q* test (SPSS, 2002).

Panellists were grouped according to gender (males, $n=21$) (females, $n=21$), age group and whether or not they had previous game meat eating experience (previous experience, $n=27$) (no experience, $n=15$) for the purpose of analysis. Ages were grouped as follows: age group 1 (25–34 years, $n=14$), age group 2, (35–44 years, $n=13$) age group 3 (45–55 years, $n=15$).

3. Results

3.1. Fallow deer

The data are arranged to compare sensory evaluation of venison from bucks and does of BCS 2 hung by the AT with a mean pH_u of 5.50 (SEM 0.02) (Table 1), differences in BCS and method of post-slaughter hanging in the chiller (Table 2). In the comparison for sex effects (Table1) venison from the 36-month-old does scored significantly higher for flavour strength ($p=0.023$), for tenderness ($p<0.001$) and for colour ($p<0.001$) compared with the 18–24 month-old bucks. Panellists from age group 2 (34–55 years) detected a difference in the flavour strength of samples according to the sex of the deer. This age group determined that does had a stronger flavour compared with the bucks ($p=0.01$). The consumer group with game eating experience detected the same difference in flavour strength ($p=0.003$) between does and bucks, with venison from does determined to be stronger in flavour.