Variations in muscle fibre type isoforms and protein denaturation across four pork muscles explain changes in cook loss and tenderness.

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Objectives: There has been a rise in poor quality Australian pork which is potentially driven by differences in muscle fibre type iso- forms and protein denaturation. The objective was to identify variations in muscle fibre type isoforms and protein denaturation peaks across muscles to understand changes in cook loss and tenderness.

Materials and Methods: Four pork muscles (*longissimus thoracis* loin; *masseter* M; *cutaneous trunchii* CT; *psoas major* PM) from 10 animals, were analysed on day 1 and day 14 (d1, d14) postmortem. Cookloss (%), Warner-Bratzler Peak Shear Force (WBPSF) and differential scanning calorimetry (DSC) were measured. Stains for mATPase and NADH were carried out on 10µm cryosec- tions to identify the cross-sectional-area (CSA) and fibre-typefrequency (%). Samples were cooked in a preheated water-bath to 70°C end point temperature and measured for WBPSF 24hr after cooking. DSC was conducted on 1d samples over 25°C to 90°C (Xiong et al., 1987).Data analysis was conducted using restricted maximum likelihood (REML) in GenStat (edition-16).

Results and Discussion: There were differences in pH between muscles where pH was lowest for loin and similar for the M, CT, and PM (5.78, 6.06, 6.16, 6.01 respectively; SED =0.09; $p<0.005$). An interaction between muscle and ageing occurred ($p=0.025$) for cook loss; cook loss for loin was similar on d1 and d14 (20.3, 22.8 % respectively; SED = 3.67) but for M, CT and PM, cook loss was higher on d14 (M, 10.73, 21.84 %; CT, 9.40, 27.65%; PM, 13.25, 23.05%; SED = 3.67). Differences in WBPSF (N) occurred between muscles ($p<0.001$); WBPSF was highest for loin and was similar for CT, M, and PM (36.48, 23.82,25.28, 21.43N respec- tively; SED = 3.28). DSC peak denaturation temperatures varied between muscles; loin 52.4, 60.5, 74.5, 82.5°C; M, 61.8 and 78.9°C; CT, 57.2, 65.5, 76.9°C; PM, 56.8, 65.0, 74.9, 82.2°C. For each muscle, CSA was largest for type-IIb (97.0±15.1µm)>type- IIa (79.5±7.9µm) >type-I (71.6±8.7µm). The frequency of fibre type varied across muscles. Fibre type composition type-IIb%, type-IIa%, and type-I% was; loin 71%, 15%, 12%; M 0%, 53%, 47%; CT 51%, 26% and 23%; PM 35%, 15%, 48%. Elevated pH in M, CT, and PM could explain the lower cook loss and WBPSF values compared to loin. Cook loss and WBSF are also impacted by fibre type CSA/%. Others reported increased proportion of intermediate and oxidative fibres in M compared to the type IIb fibres, which have increased CSA. Increased CSA and proportions of type IIb fibres are associated with increased toughness in pre- dominantly glycolytic muscles, compared to muscles with predominantly oxidative fibres (Lee et al., 2010). Myosin and actin denaturation result in transverse and longitudinal shrinkage respectively. Shrinkage results in increased water expulsion in the form of cook loss, resulting in increased toughness when cooking temperatures increase. Several studies in beef have demonstrated that protein denaturation for myosin occurs 57-60°C, sarcoplasmic proteins and collagen denature between 66-67°C and actin denatures at 78-80°C and ~85°C (less common) is usually attributed to titin (Pospiech et al., 2002; Xiong et al., 1987). In our DSC results, the first denaturation peak is 52°C in loin, 56-57°C for PM and CT, and 61°C in M thus at lower temperatures compared to the peaks for bovine (Xiong et al., 1987). The peak associated with actin denaturation, and longitudinal shrinkage ((P.P Purslow, S. Oiseth, J. Hughes, 2016), in our study was at temperature 74-76°C for loin, CT, and PM and 78°C for M compared to 78-80°C ac- tin denaturation in beef. These variations are closely linked to MHC isoform variations as MHC isoform concentration and size im- pacts cook loss and thermal stability where type-I fibres have higher thermal stability compared to type- IIb. Differences across muscles could indicate an opportunity for improved cooking guidelines as well as understanding the differences in quality across muscles.

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