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The eating quality of Canadian pork and its relationship with intramuscular fat

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Abstract

This study was undertaken to assess the effect of various levels of intramuscular fat (IMF: <1%, 1.0–1.49%, 1.5–1.99%, 2.0–2.49% and 2.5–3.0%) produced from Canadian pigs on the eating attributes of pork loin. Sensory and instrumental eating attributes were determined on 85 pork loins (*m. longissimus lumborum* and *thoracis*). The following correlations were found between IMF and eating attributes: softness, −0.32 ($P < 0.01$); initial tenderness, −0.31 ($P < 0.01$); chewiness, −0.27 ($P < 0.01$); rate of breakdown, −0.20 ($P = 0.07$); juiciness, 0.17 ($P > 0.05$); flavour intensity, 0.24 ($P = 0.02$); off-flavour, 0.13 ($P > 0.05$); mouth coating, 0.13 ($P > 0.05$); amount of perceptible connective tissue, −0.02 ($P > 0.05$), and instrumental tenderness (Warner–Bratzler shear force), −0.41 ($P < 0.001$). As tenderness is considered the most important attribute that determines overall acceptance of pork, the threshold level of IMF for ensuring a positive eating experience was identified as a function of the attributes describing tenderness. Increasing the level of IMF past 1.5% did not change ($P < 0.05$) the panelists scores for softness and initial tenderness. Average shear force, an instrumental measure of tenderness, was higher ($P < 0.05$) at less than 1% IMF but did not change past 1.0% IMF ($P > 0.05$). It is proposed that the threshold level of IMF that will ensure a pleasing eating experience is 1.5% IMF.

Keywords: Pork loin; IMF; Eating attributes; Threshold

1. Introduction

For the pork industry to be successful requires meat products that will satisfy the consumer. Consumers' satisfaction can be achieved at the point of purchase as well as at the point of consumption.

At the point of purchase, the amount of visible fat is the strongest visual discriminative stimulus entering in the decision making process (Brewer & McKeith, 1999; Brewer, Zhu, & McKeith, 2001; Fernandez, Monin, Talmant, Mourot, & Lebret, 1999b). These authors observed that the amount of marbling or intramuscular fat (IMF) in loin was the primary characteristic driving consumers to purchase pork. They concluded that loin chops with a low or medium amount of marbling received higher acceptability and purchase intent scores than loin chops with high marbling; health concerns associated with fat being the major driving force behind the reluctance of the consumer for purchasing high fat meat (Resurreccion, 2004).

Consumption frequency is influenced by the consumer liking for pork (Bryhni et al., 2003). The sensory experience during consumption consists of several attributes: among the more important ones are tenderness, juiciness, flavour and absence of off-flavours (Bredahl, Grunert, & Fertin, 1998; Bryhni et al., 2003). It is generally accepted that a higher level of marbling or IMF has a positive influence on the sensory experience associated with eating pork (Bejerholm & Barton-Gade, 1986; Brewer et al., 2001; DeVol et al., 1988; Ellis, Webb,

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Avery, & Brown, 1996; Fernandez, Monin, Talmant, Mourot, & Lebret, 1999a; Poste-Flynn, Butler, & Fortin, 1994; Støier, Olsen, & Magnussen, 1998; Wood, 1990; Wood et al., 2004) although there has been reports where there was no or little association between eating quality and IMF (Channon, Kerr, & Walker, 2004; Rhodes, 1970; Tornberg, Andersson, Göransson, & von Seth, 1993; van Laack, Stevens, & Stalder, 2001; Wood, Dransfield, & Rhodes, 1979). In these latter studies, however, the range and absolute levels of IMF might not have been sufficiently variable to have had any impact on the eating quality of pork. Ante and/or postmortem treatments, different genotypes, cooking procedures (grill vs convection oven), end point cooking temperature, and discrepancies in panels' perception of eating quality might have also influenced the IMF-eating attributes relationships.

One of the major factors influencing tenderness is the presence of the connective tissue protein, collagen (Bailey & Light, 1989). It is the quality (intermolecular cross-links) rather than quantity that is the critical factor. Purslow (1985) showed that the breakdown of the meat occurs initially between the fibre bundles in the perimysial connective tissue. IMF is located mainly in the perimysium (sheath surrounding fibre bundles) and to a lesser extent in the endomysium (around myofibrils) of the muscle (Wood, 1990). One possible cause for the association between IMF and tenderness might be then that the infiltration of IMF within the perimysium connective tissue weakens the cross-linkage between collagen fibres, reducing the force required to breakdown the connective tissue (Essén-Gustavsson, Karlsson, Lundström, & Enfält, 1994). Furthermore, Wood (1990) suggested that fat cell expansion in the perimysium might open the muscle structure by forcing the muscle bundles apart. Juiciness, which depends on the amount of moisture from the meat and saliva released during mastication (Ashgar & Pearson, 1980), is enhanced by IMF by stimulating production of saliva (Blumer, 1963). Finally, flavour arises from both soluble and lipid soluble components, and their degradation products such as aldehydes, alcohols and ketones (Ashgar & Pearson, 1980; Wood et al., 1999).

Hence, the industry is faced with the dilemma of producing pork with sufficient IMF to satisfy the eating experience of the consumer but, at the same time, producing pork with minimal amount of visible fat in order to alleviate the health concern of the same consumer. Bejerholm and Barton-Gade (1986) proposed a minimum of 2% IMF (ether extract with acid hydrolysis, corresponding to 120% of ether extract) to ensure satisfactory eating characteristics. For the UK, Wood (1990) recommended a minimum of 1% IMF (ether extract). In an American study, DeVol et al. (1988) reported that a minimum level of 2.5–3.0% IMF (chloroform:methanol extract) was necessary to avoid any negative response for tenderness. More recently, the National Pork Board in the US (Meisinger, 2002) set the industry target for IMF at between 2% and 4% (ether extract); the minimum level reflecting minimum eating satisfaction requirements and the maximum level the health concerns associated with excessive fat.

To our knowledge, no recommendation, based on Canadian research, exists concerning the optimal range of IMF required to ensure a satisfactory eating experience for Canadian pork. Country differences in the level of minimum and/or optimal level of IMF to ensure satisfactory eating experience as well as country differences in the perception of pork quality and consumer liking of pork (Bryhni et al., 2002) make it difficult to apply these values to the Canadian environment.

Therefore, this study was undertaken to assess the effect of various levels of IMF (0.7–3.0%) produced from Canadian pigs on the eating attributes of pork loin. The range and levels were chosen to ensure that meaningful observations on the effect of IMF on the eating quality of pork could be made.

2. Materials and procedures

The 85 pork carcass sides used in this study are a subset of 240 sides described in a previous study (Fortin et al., 2003). In that study, carcasses had been selected at a commercial abattoir using a stratified sampling procedure (three backfat thickness groups based on Destron PG-100 measurements) to ensure selection of carcasses that would represent the entire spectrum of backfat thickness found in the Alberta commercial pig population. Out of the 240 sides, 85 sides were selected based on the IMF content of the loin (*longissimus* muscle) [(g of fat per 100 g of wet tissue) × 100]. Table 1 shows the distribution of the loin roasts.

During fabrication of the side into primal and subprimal cuts, a 15 cm portion of loin roast posterior to the last rib (*longissimus lumborum*, LL) was removed for the eating attributes determination. A loin (*longissimus thoracis*, LT) chop of 35 mm was also removed from the anterior end of the last rib for shear force determina-

Table 1
Number of loins according to intramuscular fat (IMF) group and sex

IMF group	IMF concentration in loin[a]	Sex		Total
		Barrows	Gilts	
1	Less than 1%	1	6	7
2	1.0–1.49%	12	17	29
3	1.5–1.99%	9	9	18
4	2.0–2.49%	13	11	24
5	2.5–3.0%	2	5	7
Total		37	48	85

[a] % of IMF in loin (wet basis).