The perceived eating quality of pork

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Abstract

In the last decade, studies with the specific objective of improving the sensory quality of pork have come to the forefront of meat research, likely a result of consumer complaints of blandness levelled against modern lean meat and the frequent reference to the more strongly flavoured meat that was available years ago. Regardless of the lack of scientific evidence to substantiate or refute these claims, the consumer perception of deteriorated quality is real and presents a challenge for the pork industry. Hence, a comprehensive review has been undertaken with the aim of providing insight into potential sources of amelioration of the eating quality of fresh pork. Existing works are collated, encompassing animal effects, such as, species, breed, muscle type, fat and ultimate pH, as well as environmental influences, including pre-slaughter conditions and housing and exercise, and post-slaughter parameters, such as, electrical stimulation and cooking. A summary of findings is reported here.

Introduction

Most studies that include pork eating quality have not been undertaken with the explicit aim of improving the organoleptic properties of pork, but instead to improve financial returns, generally at the production stage. Evaluation of organoleptic properties, when undertaken, has been aimed at ensuring minimal negative effects of the production changes and at best maintaining current sensory characteristics. Even when the concept of increasing the consumer appeal of pork has been considered, improving sensory properties has often been surpassed by the prospect of enhanced nutritional properties, in spite of taste being cited far more often than nutritional quality, as one of the reasons people like pork (Ngapo *et al*., 2007).

It is really only in the last decade that studies with the specific objective of improving the eating quality of pork are reported. This has likely come about as a result of consumer complaints of blandness levelled against modern lean meat and the frequent reference to the more strongly flavoured meat that was available years ago (Ngapo *et al*., 2003; Wood *et al*., 1999). Unfortunately there is little scientific evidence to support or refute these claims. However, regardless of the reality of these assertions, the consumer perception of deteriorated quality is real and presents a challenge for the pork industry.

Well stated by Lister (1996), any attempt to fix quality in meat animals must go hand in hand with scientific and technological progress, first of all, in breeding and husbandry. For many years research has focused on negative aspects of pork and achieving a minimal acceptable eating quality. With this in mind, a comprehensive review (Ngapo & Gariépy, 2008) has been undertaken with the intention of providing insight into potential sources of amelioration of the eating quality of fresh, unprocessed, normal pork, that is, potential avenues to improve an already acceptable pork to produce a meat that is perceived as even better.

Discussion

Existing works in which pork eating quality has been studied, both as a primary objective and otherwise, have been collated (Ngapo & Gariépy, 2008), encompassing the effects of animal factors, such as, species, breed, muscle type, fat and ultimate pH, as well as environmental parameters, including pre-slaughter conditions, housing and exercise, and post-slaughter processes, such as, electrical stimulation, chilling and cooking. The meat used in sensory evaluation, its ageing, storage and cooking are noted for each study reflecting the importance of these methodological sources of variation on eating quality. Some findings are reported here, but, for reasons of limited space, citing the more than 200 references reviewed is not feasible.

Cooking: The review begins with a discussion of cooking, the importance of which is exemplified by its necessity to induce what can be considered "meat flavour", thus a process imperative in the evaluation of pork eating quality. Cooking generally occurs just prior to consumption, and therefore this process may influence the perception of the effects of other factors. It is, thus, considered pertinent that the reader be cognisant of the influence the cooking process has on the eating quality of pork while reflecting on and comparing effects of other factors, effects which are ultimately imposed upon by the cooking process.

Experiments with a range of pork cuts and cooking methods have shown that of eating quality parameters, juiciness is the most affected by the cooking conditions, declining as the final core temperature is increased in the range 60-80ºC. However, increasing final internal temperature of pork has also been

found to decrease abnormal flavour and/or increase pork flavour. Ideal end-point cooking temperatures have been proposed, differences of which illustrate how cultural and historical aspects of human nature which, even with the best recommendations based on scientific research, must be incorporated into consumer focussed research, such as setting standard cooking methods for pork.

Consumers: Unlike trained panels, consumers are not generally used to measure given characteristics, but rather to assess the perceptibility of changes and/or express acceptability or preferences. The three main components of eating quality for the consumer are tenderness, juiciness and flavour and findings show that consumers overall liking of pork is influenced, in order of importance, by flavour and tenderness.

Breed and selection: Two groups of studies were apparent when compiling the data of breed effects on eating quality; those making comparisons to either Duroc or Chinese pig breeds. While not always the best, most reports place the meat from Duroc or Duroc-sired pigs in a favourable light. Comparing up to ten pig breeds, studies have shown that pork from Duroc and Duroc-sired pigs shows high, if not the highest scores for texture and tenderness, juiciness, palatability, flavour and overall liking.

Differing results have been found comparing Chinese and Western breeds of pig. Chinese purebred pigs, Meishan and Ming, have achieved higher sensory scores than of Landrace x Duroc crossbred pigs, but pork from sire breeds of Duroc, Meishan, Fengjing and Minzhu crossed with composite white gilts have shown no differences in tenderness, juiciness, flavour intensity and off-flavour. And pork from purebred Yorkshire pigs has been found more tender and juicier than other breeds when comparing purebred Yorkshire and Meishan pigs and reciprocal crosses. The Chinese breeds present a model of not only higher levels of IMF compared to European breeds, but also different distribution and deposition of lipids in the tissue. Therefore, a lack of differences in eating quality between Chinese and European breeds of pigs is somewhat surprising and further questions the role of IMF in sensory quality.

Heritability estimates are reported for pork tenderness, juiciness, flavour and off-flavour intensity, and overall acceptability indicating that there is sufficient genetic variation to allow improvement in meat quality by selection. A noted shortfall of heritability estimates is that eating quality parameters are not measured as a part of pig improvement, but instead indirect traits must be sought as viable indicators of amelioration. Despite divergent findings of the impact of IMF on the eating quality of pork, IMF is a factor of particular interest to the industry, but not without challenge. While some studies have indicated that it is possible to modify the IMF content by selection without producing undesirably fat carcasses, others have found an unfavourable correlation between the IMF and lean contents, thus limiting the IMF selection perspectives.

Sex (excluding boar taint): Sex of the pig has been reported as having no influence the organoleptic properties of pork. However, twice as many studies show sex does affect eating quality with barrow meat generally being more palatable, more tender, and juicier than that of gilts, in turn, more so than from boars.

Diet: Eating quality of pork from pigs raised on a diverse range of diets has been widely investigated and for most studies no effects of dietary changes are observed on eating quality. Unfortunately, when changes in the porcine diet have influenced the eating quality of meat, in most cases the effects have been negative. However, a few studies have found that feed has the potential to enhance the sensory quality of pork, notably the flavour and juiciness with naked oats, Laird lentils and swill. In addition, pork flavour has been found enhanced with dietary additions of corn oil and α-tocopherol combined, bamboo vinegar and fat soluble vitamins; juiciness with low protein diets, but at the expense of deteriorated flavour.

Weight: Flavour desirability, juiciness and overall palatability have all been significantly correlated with slaughter weights (SW) grouped from 80 to 134 kg. In addition, juiciness, tenderness and overall acceptability scores are found highest in pork from light weight pigs (41-50 kg SW), but flavour score lowest in meat from these animals, maximal from the heaviest group studied (91–100 kg SW).

Environment: No differences in the eating quality of pork from indoor and outdoor finishing systems are reported, with the exception of heavy pigs (carcass weights of 127-134 kg) where a juicier and more acceptable pork was obtained from those finished outdoors than indoors.

Stress: Ante mortem treatment showed no influence on texture, juiciness, flavours, odours and overall acceptability of pork when pigs were subjected to combinations of stress simulating commercial handling, including transport, mixing with unfamiliar animals and being driven around the lairage in a group.

Electrical stimulation (ES) and accelerated-processing: No differences in tenderness, flavour and juiciness have been shown comparing conventional and accelerated processing. Conflicting findings are reported with the application of ES. Some workers have found that consumer scores of tenderness, juiciness and overall liking improve with ES; no differences in odour and flavour scores were observed. Other studies have shown that while pork loin flavour increased with ES, juiciness decreased and neither texture nor overall acceptability was affected, or in some cases less tender pork was produced.

Ageing: Investigations have shown that ageing of pork for 6 to 10 days has a positive impact on its

eating quality compared to ageing only 1 or 2 days; pork flavour increases and abnormal or acidic flavours are reduced. After 12 days, however, flavour has been described as unusual, unbalanced and unblended.

Fat: It is generally accepted that meat lipids provide flavour and aroma volatiles that impact both directly and indirectly via the Maillard reaction on meat flavour, in particular giving rise to species-specific aromas. However, in spite of numerous studies on the subject, the role of IMF in the sensory quality of pork is far from understood. A positive effect has been shown in a number of studies, while others have not shown any influence or even negative effects. Unfortunately, as a source of variability of IMF level, pig breed has often been used inherently introducing other sources of variability.

Some studies where eating quality of pork is differentiated from breed, show a positive relationship between IMF levels and flavour. Attributes describing tenderness have also been significantly correlated with IMF content from <1.00 to 3.00%. However, it has been observed both that at IMF levels above 2.0%, higher IMF content gives more tender meat, and increasing IMF beyond 1.5% did not change panellists' scores for softness and initial tenderness. Juiciness data also shows conflicting results in some studies being significantly correlated with both IMF level and marbling score; other studies finding no correlation.

Ultimate pH: Tenderness, juiciness, flavour and off-flavour have all been observed most highly correlated with ultimate pH than other pork quality traits. Ultimate pH 5.8-6.0 has been found the most acceptable in terms of flavour, minimising off-flavours and maximising pork flavours. Strong positive correlation between ultimate pH and tenderness have also been found, a more tender meat associated with higher ultimate pH up to 6.30. However, findings of pH influence on tenderness are conflicting, as are reports on juiciness, ranging from pH accounting for only 5% of juiciness to strong correlations whereby higher ultimate pH is associated with juicier meat; the lowest juiciness observed at pH 5.4.

Conclusions

Many studies report on the sensory quality of meat and in these studies are a treasure trove of findings which, because the sensory quality until the last decade was not of primary importance, require much deciphering and interpretation. As with any review comparisons among studies can be difficult as conditions differ from one experimental environment to another and are not always provided in detail, yet several noteworthy findings are evident here. An abundance of publications dispel popular beliefs of the importance of animal feedstuffs on eating quality. The disparity of results in an equally large number of reports illustrates the uncertainty of the role of fat in the sensory quality of pork, regardless of its perceived contribution. And the relative consistency in publications on ultimate pH and ageing establish the importance of these two factors in pork eating quality. Unfortunately, ultimate pH is relatively difficult to control and is often measured as a consequential factor; ageing, in contrast, is controlled by the industry. However, ageing criteria were established at a time when the sensory quality of meat was not of primary importance to the industry and are based largely on tenderness at the detriment of other eating quality characteristics. Of course, longer ageing periods translate into greater production costs of pork. Is the consumer willing to pay more for what is a relatively cheap and under-valued meat in many societies? If the pork industry is sincerely interested in promoting improved eating quality of pork, perhaps instead we should ask how much is the industry willing to invest to satisfy the consumer?

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