

Meat quality and palatability attributes of pork from pigs fed corn, hulless barley or triticale based diets

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An experiment was conducted to compare the meat quality and palatability of pork from pigs (36 barrows, 36 gilts) fed growing-finishing diets in which the major energy feedstuff was corn, hulless barley, triticale, or a 50:50 mixture of hulless barley and triticale. The feeding period (28 – 110 kg) was divided into three phases, and diets within each phase were formulated to provide equivalent digestible energy to available lysine ratios across treatments.

Cereal type in the diet had no effect on the protein or marbling fat content of the loin eye muscle (*longissimus thoracis*), and limited effects on other muscle quality attributes. The loin eye muscle of pigs fed corn was darker compared to the same muscle from pigs fed hulless barley or triticale. The water holding capacity of the loin eye muscle was lower in pigs fed hulless barley compared to the other three diets, but the values obtained were within the range expected for normal pork and therefore not indicative of poor muscle quality. Objective measurements of tenderness were not affected by diet, but taste panelists rated broiled loin chops from hulless barley fed pigs more tender than chops from pigs fed corn or the 50:50 mixture. Chops from triticale fed pigs were found to be similar to chops from the other three treatments.

Implication

From this trial, it was concluded that triticale can be successfully substituted for corn or hulless barley in the diets of growing-finishing (25 – 110 kg) pigs, without compromising muscle quality or palatability.

The influence of gender and diet on the palatability and consumer acceptance of pork

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Ninety intact male, 89 castrated male and 60 female pigs were slaughtered at a mean market weight of 95.7 kg and a mean age of 151.1 days. All pigs were housed in groups of four and were fed *ad libitum* either a corn or wheat based ration, until 24 h pre-slaughter, at which time feed, but not water was withheld. Skatole and steroid levels in 20 and 24% of the intact males respectively, exceeded acceptable levels. (i.e. 0.25 mg/g and 50 mg/g, respectively). In contrast 2.5 and 3.4% of the castrated male and 1.8 and 0.0% of the female pigs exceeded these skatole and steroid levels, respectively. Six percent of the samples from castrated and 30% of the samples from intact male pigs were perceived to have an inappropriate barnyard aromatic at relatively high intensities by a highly trained flavour profile panel. Only 2% of the samples from castrates, as opposed to 27% of the samples from intact males were perceived to have a sex taint aromatic at relatively high intensities. Although samples from females were perceived to have an inappropriate barnyard aromatic at relatively high intensities, no sex taint aromatic was detected from these samples. Higher proportions of chops from intact males produced objectionable odours during cooking and unpleasant flavours during consumption than their counterparts from castrates and females. There was no effect of diet on either palatability or consumer acceptance.

Implication

Although dietary grain source appears inconsequential to pork palatability and consumer acceptance, an effective means for screening for sex taint must be developed, if the economic advantages associated with the production of intact males is to be capitalized on.

The effect of castration on live performance, carcass yield, and meat quality of male pigs fed wheat or corn based diets

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Intact (85) and castrated (86) male pigs were slaughtered at 96.3 kg and at an average slaughter age of 150.1 days producing 79.1 kg carcasses. Either a corn or wheat-based, nutritionally equivalent ration was fed *ad libitum*.

Nine percent less feed was required to market entire males when compared with castrates. In addition, entire males had at least 1.9% more lean content and perhaps as much as 10% greater carcass value. In addition little evidence was found to suggest entire males had reduced meat quality. Pre-slaughter handling was an important aspect, since detrimental effects from inadequate pre-slaughter handling techniques appeared to be greater than those associated with gender. Therefore, considering production aspects only, entire male pigs should be able to be successfully marketed in Canada. However, detection and control of "sex-taint" and consumer acceptance of fresh pork from entire male pigs must be addressed.

Implication

Intact males required 9% less feed, and had 1.9% more carcass lean, and up to 10% greater carcass value than castrates, but an effective means for controlling sex taint must be achieved.

The hygienic performances of the carcass dressing and cooling processes at four pork packing plants

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The numbers of total aerobic bacteria and *Escherichia coli* on hog carcasses after polishing, after dressing and after cooling at four packing plants were assessed by a random sampling technique. At three of the plants, the log mean numbers of total aerobic counts on carcass were similar at all three stages of processing. At the fourth plant the log mean numbers of total aerobic counts were less after dressing than after polishing, because of pasteurizing of the uneviscerated carcasses, and greater after cooling than after dressing. At two of the plants, the number of *E. coli* was higher after dressing than after polishing, but were similar at those two stages of the process at the other two plants. *E. coli* numbers were reduced by the cooling processes at three of the plants, but were unaffected by the cooling process at the fourth plant.

Implication

Similar carcass preparation processes at different plants can have very different effects on the microbiological conditions of carcasses. Appropriate microbiological data are therefore required for identification of the hygienic performances of carcass preparation processes.

An alternative true value based hog carcass grading system

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Lacombe Research Centre has developed a hog carcass grading system that uses a video imaging system to make measurements on the hot carcasses and uses an ultrasonic imaging system to measure the loin fat depth and muscle area. A video camera was placed at some distance away from a dark colored backdrop, positioned behind the carcass, recorded digital image of the side and dorsal view of each carcass. A Microsoft Windows based computer program was developed to make one- and two-dimensional and angular measurements on the images. A total of 215 hog carcasses of varying fatness, weight and body length were used to provide cutout data for this study. The carcass value was computed as the sum of the price multiplied by the weight all individual commercial cuts. The ultrasound images of the loin area at grading site were also digitized. Subcutaneous fat depth and loin area was measured from it. There is 9% and 7% increase in accuracy (R^2) for predicting lean yield and carcass value, respectively, from using hot carcass measurements and ultrasound measurements compared to using only Destron probe measurements.

Implication

This could be an objective grading system, which provides more accurate carcass value assessment.

Relationships among intramuscular fat content, marbling and the PSE condition in Alberta pigs

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Intramuscular fat content is lower in pigs carrying the halothane gene, and it may or may not be related to the PSE condition in pork. The PSE condition tends to be associated with lower marbling scores. Intramuscular fat is correlated with marbling but the correlation of marbling with fat is too low to be used for predictive purposes. The current study was conducted to determine current intramuscular fat levels within commercial pigs in Alberta and to investigate the relationship of fat and marbling levels to the PSE condition.

A total of 1006 pork backs were collected from two Alberta packing plants. Marbling, objective color, protein solubility (measure of the PSE condition) and intramuscular fat content of the longissimus muscle were assessed and halothane genotype was ascertained from a fat sample.

The average intramuscular fat content within longissimus muscles of Alberta pigs is 3.0% (on a wet weight basis). Approximately one quarter of muscles had fat contents less than 2.0%. Halothane genotype did not have a significant effect of fat content. Approximately one third of muscles were devoid of marbling.

Within pigs not carrying the defective halothane gene, 35% were "devoid" of marbling, but only 9% of those with "small" levels of marbling, had protein solubility values less than 140 g/kg (ie. likely to give PSE pork). The frequency of muscles likely to yield PSE pork was highly related to the marbling score, but was independent of fat content.

Implication

Decrease of intramuscular fat below current levels is expected to adversely affect palatability. Furthermore, within this population of pigs, selection to further decrease visible marbling could cause a detrimental increase in the frequency of PSE pork.

Alberta pork tests positive for the 'acid meat' phenotype

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The 'acid meat' phenotype is caused by the 'RN' gene in European Hampshire pigs. The RN gene is inherited as a dominant trait and causes the accumulation of glycogen in the muscle. Carriers of the RN allele (RN/+) have ~70% more glycogen than normal and homozygous genotypes (RN/RN) have >2-3 times more glycogen and score better for lean yield %. The high glycogen content can lead to 7-9% more water loss during ham processing and lactic acid build up in the meat causing a lower ultimate pH which may lead to paler colored meat. The RN phenotype can be identified by measuring the Glycolytic Potential or the Modified Napole Yield of the meat from the carcass. A gene test has not been developed for the live animal but the RN gene has been mapped to chromosome 15 in pigs. Breeding companies therefore rely on pedigree analysis and DNA markers linked closely to the RN gene. Tests were performed at the Lacombe Research Centre to determine, 1) if the acid meat phenotype exists in pork chops sold in Alberta retail outlets, 2) whether the genetic markers used in European studies can be applied to North America Hampshire pigs, 3) whether the RN phenotype exists in the Alberta commercial white pig population. For this study, a random sample of 50-60 center loin pork chops were purchased from a variety of central Alberta grocery stores and blood from ~80 pigs including 14 purebred Hampshire pigs were tested. Pork chops were evaluated on their Glycolytic Potential, Modified Napole Yield, pH, color, and genotype. Blood and pork chop samples were DNA tested for the genetic markers linked to the RN gene and a newly developed DNA test for coat color. Approximately 8% of the pork chop samples tested positive for the high glycogen content which correlated with a significant drop ($P>0.05$) in pH (from 6.0 to 5.8), a higher cooking loss (from 9.8% to 20.6%), and a tendency towards a more yellowish color (b^* value; 9.9 to 11.3 $P=0.12$). DNA markers Sw120 and Sw936 which are linked near to the RN gene did not significantly correlate with the published European data for predicting high glycogen content in this study. The DNA test for coat color showed that 44% of the high glycogen pork was from white pigs, proving that the acid meat phenotype is *not* only found in the Hampshire population.

Implication

The RN (Hampshire gene) phenotype exists in Alberta's commercial white pig population. High glycogen content affects the quality of retailed pork chops.

Simulation of chronic stress using ACTH infusion

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Various nutrients (electrolytes, tryptophan, and others) may reduce the effects of stress on carcass yields and meat quality of pigs. Research progress in this area is slow because of difficulties in controlling the degree of stress, and animal welfare concerns. Consequently, we investigated using ACTH, a naturally occurring hormone, to stimulate the pig to produce and release its own cortisol as if it was physically stressed. Ear vein catheters were inserted in a simple, rapid surgical procedure in 12 pigs. Six pigs received 50 IU porcine ACTH via the catheters at 3 h intervals from 0800 to 2100 h for 3 days, followed by 100 IU at 6 h intervals, while 6 control pigs received saline at the same times. All pigs were slaughtered at the Lacombe Meat Lab following commercial procedures at 0800 h on the day following final treatments. Results showed that ACTH treatment of unstressed pigs resulted in similar cortisol levels as in transport-stressed pigs. The adrenal glands (site of cortisol production) were 42% heavier, and the liver was 19% heavier in ACTH pigs. Dressing percentage of ACTH pigs was reduced significantly compared to control pigs (70.6 vs 73.2%).

Implication

ACTH treatment may be useful for humanely studying stress in pigs.

Relationships between stress hormones and meat quality in pigs

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A study using 158 pigs on 4 nutrition treatments was conducted to investigate the relationship between stress hormones and meat quality. Pigs were individually weighed, mixed together in groups of 10, and transported for 1 hr. Pigs were weighed on arrival and blood samples taken immediately before stunning. All pigs were killed within 1-2 h after arrival. Pre-slaughter blood was analyzed for stress hormones (adrenalin, noradrenalin, dopamine, cortisol). Pre-stress and post-transport saliva, and post-slaughter blood, was analyzed for cortisol. Temperature and pH of meat were recorded at timed intervals post-slaughter. Shear values (toughness), colour, drip loss, and numerous other measurements were recorded for two muscles susceptible to PSE. There was very little PSE (0.6%) compared to typical levels under commercial conditions (20%). Out of 158 pigs, 1 pig produced dark, firm, dry (DFD) meat, one pig produced PSE meat, and 10 pigs were classified intermediate between normal and PSE. Relationships between stress hormones and meat quality will be discussed in detail.

Implication

Value and limitations of stress hormones for predicting meat quality.

Husbandry stress, lighting and meat quality in swine

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Pigs ($n = 80$) were born and raised to market weight under either natural ($n = 37$) or artificial ($n = 43$) lighting conditions. Natural lighting was achieved by a system of reflective tubes called Sun Lite manufactured by Patterson Enterprises Inc, Calgary, Alberta. The stress response of piglets to weaning on day 24 was assessed by measurement of differential white blood cell counts and plasma cortisol levels. Pigs housed under natural light demonstrated a lower plasma cortisol response to weaning ($P < 0.03$) and a reduction in the relative percentage of eosinophils ($P < 0.04$).

Salivary cortisol levels in adult pigs were raised in response to handling and transport ($P < 0.0001$). Pigs housed under natural light demonstrated lower baseline salivary cortisol levels compared to pigs in the artificial lighting condition ($P < 0.02$), and a lower salivary cortisol response to handling and transport ($P < 0.03$).

Male pigs housed under natural light had greater fat depth ($P < 0.03$) and a lower lean yield ($P < 0.05$) than pigs housed under artificial light. Also, subjective and objective measures of meat color demonstrated that barrows produced paler meat than gilts. It was noteworthy that barrows demonstrated a greater cortisol response to handling and transport.

Implication

Natural light may alter the circadian rhythm of cortisol secretion by reducing baseline levels such that the response to stressful husbandry practices is reduced. Stress, lighting, time of day and endocrine responses may be factors influencing the incidence of undesirable meat quality traits.