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Proceedings & Abstracts

FOOD HYGIENE
INVITED SPEAKERS PROCEEDINGS
MEAT QUALITY AS A PREREQUISITE FOR CONSUMER’S SUCCESS

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Introduction

The global pork industry has made dramatic progress in the production of leaner, heavier muscled pigs. Producers have been rewarded for increased lean in the form of carcass premiums. The amount of lean produced in a carcass will continue to be extremely important. The quality of that lean tissue will be even more important in the future of the pork industry. If we take the time, effort and investment to grow an animal, we should make every effort to produce the highest quality product from that animal.

Historically, acceptable “pork quality” was defined as the absence of PSE (pale, soft and exudative) and unacceptable “pork quality” was defined as the presence of PSE. PSE-type pork, a condition confounded by specific genetic factors and animal stress, results in pork muscle that is extremely soft, light in color and very watery in appearance. The percentage of true PSE pork has dropped dramatically in the United States pork industry. However, low-pH pork and color two-toning due to pH differences within a single muscle remain a concern in the industry. In addition, with major ration changes due to the ethanol industry, major concerns have developed in regard to fat quality.

At Iowa State University, we have expanded the definition of “pork quality” to include a whole host of measurements that we perform on pork muscle. Also, through our close association with the packing and processing industry, we have found that one definition of pork quality is not enough to satisfy domestic retail, domestic processor, export retail and export processor needs.

Measuring Pork Quality in the Laboratory

We rely on several instruments to measure pork quality, including pH meters, colorimeters and an Instron for mechanical tests; however, one of the most important instruments that we use is the trained human sensory panel. We train human subjects to objectively evaluate pork for texture profiles (tenderness, juiciness, chewiness, mealiness…), taste profiles (sweet, sour, salty, bitter) and flavor notes (roasted, nutty, meaty, browned…). Also, any off-flavors in the product are identified and quantified…if at all possible. The most prominent off-flavor note that we experience is sourness, in relationship with pork with lower pH values.

Other Measurements

In addition to the measurements noted above, on occasion we have determined fatty acid profiles, iodine values, vitamin and mineral concentrations and amino acid profiles on pork muscle to help shed light onto a specific quality issue. Along with eating and processing quality, shelf-life is an extremely important quality trademark of a fresh pork supply.
Vacuum packaged boneless pork (fresh, never frozen) must withstand extended storage periods, especially if it is to compete in the export market.

**Redefining Pork Quality**

After evaluating about 15,000 samples of pork over the past 10 years, several trends become obvious that will meet consumer demand for high quality pork.

“Low or Inferior Quality Pork” is light in color, has a high purge loss, has a low ultimate pH, has high cook loss, may be dry and usually contains one or more off-flavors. Although this type of pork may by tender, the unacceptable texture is mealy and separates into numerous small pieces in the mouth. This type of pork does not hold cure well and will still be light in appearance after processing.

“High or Superior Quality Pork” is darker in color, contains a moderate amount of marbling, has no or low purge loss, has a higher ultimate pH, has low cook loss, is extremely tender and juicy, is not chewy, has a well-balanced flavor and contains no off-flavors.

Unfortunately, not all pork falls into one of the above two categories. A full range of qualities exists along the spectrum from inferior to superior quality. However, the most obvious factor that we have noted is that as the ultimate pH of pork trends lower, quality suffers and as ultimate pH trends higher, quality is enhanced.

**Measuring Pork Quality in the Processing Facility**

Measuring pork quality in the packing plant is much more challenging than measuring it in the laboratory. To profile quality in the plant, measurement of ultimate pH and muscle color would be good parameters to begin with. The muscle is in an active rate of metabolism 30 to 45 minutes after death and measurement of these two factors on the kill floor does not provide a good estimate of final product quality. Therefore, muscle pH and color, measured 22 hours after chilling, are good indicators of quality.

Measurement of these two factors in high-speed cut operations poses several problems. Plants killing and cutting at 1,000 per hour allow for about 3 seconds (about 17 measurements per minute) to perform a measurement on a carcass. If measurements are performed on the meat cut, usually producer identification is lost. Several high-speed color measurement systems are available and high-speed pH monitoring equipment is under development. Problems arise with breakage of glass pH electrodes and pH carry-over from one sample to the next.

**The Future**

Product uniformity will play a much greater role in the industry future. Major concerns of uniformity include variation in color, size, marbling, texture (softness vs. firmness), water holding capacity and eating quality. Any technology or input into the industry that would make the global pork supply more uniform could have a tremendous impact. As the industry moves forward to nutritionally labeled products destined for case ready applications, product consistency and uniformity become critical for success. With careful monitoring of inputs at
the producer level and processes at the packer level, the industry will be able to achieve value-added opportunities.

In summary, overall pork quality and the measurement of that quality will become more and more important in the future of producing and processing pigs. Just as the demand for leaner pigs changed the industry, the demand for leaner pigs with superior pork quality will bring all of us associated with pork to the next level.
PRODUCTION, CONSUMPTION AND IMPORTANCE OF MEAT IN JAPAN

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The meat production and consumption culture in Japan differs from that of other countries. Up to the middle of the 19th century there are various types of meat products, which are now commonly available, had not been consumed in Japan for the previous 1,000-years. However, as the time goes by and in sharp contrast to the traditional agricultural methods and dietary habits, Japanese farmers have developed the special cow species, Japanese black cattle, called “Wagyu”. Gloss and fine meat color combined with meat marbling are considered as a prominent feature of Wagyu (Fig.1). In these cattle, intra-muscle fibers are characterized by numerous fat cells and fatty tissue and the outstanding marbling quality of this meat is referred to as “Sashi” (fat lining) or “Shimofuri” (white frostiness) in Japanese. Thus, marbling and color are priority features for carcass meat evaluation and meat grading in Japan. Kobe beef is a very well known type of Wagyu, but brands of this meat may differ according to location, and all are of excellent quality throughout the country.

Recently, the yield of meat has been improved through use of the deboning machine developed by the Japanese meat industry. This type of technology was presented at the 56th International Congress of Meat Science and Technology, which was held in Jeju, South Korea (Sakata, 2010). For greater tenderness of chicken breast, electrical stimulation in combination with deboning is also being conducted hygienically as an innovation in Japan (Sakata, 2013).

In a previous study on meat product safety, nitrite and nitrate color forming agents to accelerate color formation were used in lesser amounts, and substantial effort was made to find alternative agents to enhance reddening. Whey protein hydrolysates were examined as color formation accelerators in meat products such as hams and sausages and to establish to what extent they stabilize heme pigments (Sakata, 2008). These hydrolysates may be obtained by enzymatic degradation. Residues still present following removal of casein were examined for potential application in color acceleration. Peptides in muscle have been shown to promote color formation. The same has been noted for peptides from milk and other dairy products. Whey protein (WPC 80) hydrolysates promoted color formation and with increase in degradation time with protease, greater redness was achieved.

In another study on red pigment in Parma ham, pigment separation and purification were performed (Sakata, 2008). Parma ham produced in northern Italy is famous worldwide.
Though this product is prepared from pig thigh using only marine salt with controlled aging, a unique red color is produced. China produces a raw ham in a manner similar to that for preparing Parma ham. This ham, Jin-Hua ham, a traditional specialty of the Jin-Hua province, is made using only pig thigh and marine salt over a long aging period to achieve red color. In the salting stage, these hams are prepared in essentially the same manner. Nitrite and nitrate as color forming agents may possibly have given rise to carcinogenic substances such as nitrosamines. Efforts were therefore made to devise a method for reddening without the use of any nitrite or nitrate.

Consumer trends in food selection are increasingly being based on health considerations, particularly in the case of the elderly. For such persons, soft foods which can be easily chewed should thus be made readily available for wide distribution. The authors of a relevant study (Sakata et al., 2009) examined soft sausage prepared by steam heating in regards to the following criteria: 1) Features of sausage prepared with a steamer (stainless steel container) instead of a steam convection oven and 2) rheological and microbiological properties of sausage. Maximum force, breaking strain and other parameters were found to be less in fresh soft sausage and observed to increase with refrigeration and freezing. Rheological properties of sausage were essentially the same as for Tsumire (fish ball or ground fish meat product in Japan). No _Escherichia coli, Staphylococcus aureus_ or _Salmonella_ could be detected in any sausage sample. Aerobic bacterial count was considerably less than the standard.

Research is also being directed to game for high quality processing of meat such as sausage, jerky, bacon and so on. In the country side of Japan, the populations of deer and wild boar in particular, are increasing rapidly owing to frequent breeding and the scarcity of natural predators. The meat of these animals contains little fat and many proteins, and thus would serve as a healthful food. At present, game meat quality and flavor are being examined in Japan.

References


Sakata, R. (2013). Processing technology and research trends of meat in Japan. _In the First Turkish-International Circle's Workshop on Food Science and Technology, Kayseri-Turkey._

MEAT SAFETY AND QUALITY IN RUSSIA - STATE OF ART

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Experts say that human health depends on governmental health programs only by 8-14%, while the share of the health effects of socio-economic conditions and the conditions of human life, is 52-55%.

Meat production and consumption profiles have changed during the last years. A person in Russia still consumes less meat than in 1990-s. In 1990-s that was about 75 kg per person, then consumption began decreasing and reached its minimum of 45 kg by the year 2000. In 2011 average meat consumption was 72 kg with more or less equal amounts of poultry and pork, but only 47kg produced in the RF. Still one third of total consumption is imported meat.

Consumer requirements for food products are very diverse and vary depending on the change in priorities. In 1990s price was the major priority for a Russian consumer. Now - consumer considers that a product should be firstly safe, natural, healthy, wholesome, high-quality. Recent inquires showed new priorities. Now we have a big group of Russians who want a product made "personally for him"

Changes in consumer preferences lead to a change in meat production profile (Fig. 1).

![Fig.1. Meat production profile for 2000-2012 (thou tons)](image-url)

It is necessary to control meat products which were subjected during their manufacture to various technological processes causing significant nutrient content and functional property changes. Improper handling might also cause

Quality and safety control is one of the priorities. Over 20 thousand food items are being tested each year at VNIIMP and non-conformities were identified (table 1).
Table 1. Main groups of non-conformities identified in meat and meat products

<table>
<thead>
<tr>
<th>Non-conformity</th>
<th>% of the total samples tested</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microbial</td>
<td>14,5</td>
<td>18,0</td>
<td>16,0</td>
<td></td>
</tr>
<tr>
<td>Chemical composition</td>
<td>22,0</td>
<td>25,0</td>
<td>20,0</td>
<td></td>
</tr>
<tr>
<td>Toxicological</td>
<td>0,12</td>
<td>0,25</td>
<td>0,10</td>
<td></td>
</tr>
<tr>
<td>Ingredient (histological method)</td>
<td>26,0</td>
<td>29,0</td>
<td>25,0</td>
<td></td>
</tr>
<tr>
<td>Ingredient (PCR)</td>
<td>18,0</td>
<td>20,0</td>
<td>18,0</td>
<td></td>
</tr>
</tbody>
</table>

The results obtained in nine years of monitoring of the three most popular brands of cooked sausages are shown on Fig.2. No improper additives were identified in 22% of sausages been analyzed (Table 3). Carrageenan appears to be the most common additive to cooked sausages in 2012, about 33% identifications. Then come starch (20%), soya and animal proteins (11% each), gums and flour 8%, each.

As a result of Russia participation in WTO we started to harmonize Russian and European food safety requirements. Identified levels of polycyclic aromatic hydrocarbons (PAHs) in meat products are of top priority now. PAH are of concern because some compounds have been identified as carcinogenic, mutagenic, and teratogenic. PAHs are found in in meat cooked at high temperatures. According to the RF legislation only benzo[a]pyrene is to be identified in meat products with the approved level of 1 µm/kg or less while in the EU it is 5 µm/kg for benzo[a]pyrene and 30 µm/kg for benzo[a]pyrene, benz[a]anthracene, benzo[b]fluoranthene and chrysene.

Polycyclic aromatic hydrocarbons are lipophilic, meaning they mix more easily with oil than water. Table 2 shows the PAHs accumulation in pig fat and meat during hot smoking.
Table 2. PAH concentration in pig fat and meat, µm

<table>
<thead>
<tr>
<th>№</th>
<th>PAHs</th>
<th>concentration, µm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fat</td>
</tr>
<tr>
<td>1</td>
<td>cyclopenta[c,d]pyrene</td>
<td>3,43</td>
</tr>
<tr>
<td>2</td>
<td>benz[a]anthracene</td>
<td>1,25</td>
</tr>
<tr>
<td>3</td>
<td>chrysene</td>
<td>1,19</td>
</tr>
<tr>
<td>4</td>
<td>5-methylchrysene</td>
<td>0,08</td>
</tr>
<tr>
<td>5</td>
<td>benzo[j]fluoranthene</td>
<td>0,07</td>
</tr>
<tr>
<td>6</td>
<td>benzo[b]fluoranthene</td>
<td>0,92</td>
</tr>
<tr>
<td>7</td>
<td>benzo[k]fluoranthene</td>
<td>0,34</td>
</tr>
<tr>
<td>8</td>
<td>benzo[a]pyrene</td>
<td>0,81</td>
</tr>
<tr>
<td>9</td>
<td>dibenzo[a,l]pyrene</td>
<td>0,02</td>
</tr>
<tr>
<td>10</td>
<td>dibenz(a,h)anthracene</td>
<td>0,18</td>
</tr>
<tr>
<td>11</td>
<td>benzo[ghi]perylene</td>
<td>0,76</td>
</tr>
<tr>
<td>12</td>
<td>indeno(1,2,3-cd)pyrene</td>
<td>0,40</td>
</tr>
<tr>
<td>13</td>
<td>dibenzo[a,e]pyrene</td>
<td>0,64</td>
</tr>
<tr>
<td>14</td>
<td>dibenzo[a,i]pyrene</td>
<td>0,01</td>
</tr>
<tr>
<td>15</td>
<td>dibenzo[a,h]pyrene</td>
<td>0,04</td>
</tr>
</tbody>
</table>

We have considered that benzo(a)pyrene is not a suitable marker for the occurrence of polycyclic aromatic hydrocarbons in meat (meat products) and that a system of eight PAH would be the most suitable indicators. These PAH will be included in new RF standard.

Standards – are important tools towards achieving the required safety and quality of meat and meat products. In meat industry of the USSR there were 122 state standards (GOST). Now there are 133 interstate and 34 national standards (GOST & GOST R) and over 6000 specifications (TU) for meat products in Russia. Nowadays a very important activity is to launch Laws and Requirement of the Custom Union. Custom union of Belorussia, Kazakhstan and Russia was founded in July of 2010 with the main target to facilitate trade between these countries and avoid technical and legislative differences. The VNIIMP specialists are members of the Working Group to develop Technical regulations (TR CU). Customs Union Technical Regulation on Food Safety is a key CU umbrella regulation covering standards and requirements for all food products and processes of their production. It has come into effect as of July 1, 2013 and includes new requirements: obligatory HACCP implementation, allergen labeling, traceability, different conformity assessment procedures.

The CU TR on meat and meat product safety will come into effect as of January 14, 2014.