PSE in Pork and Poultry

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For five decades, the variation in qualitative properties of pork muscle have interested meat scientists and have been a concern to the meat industry world-wide. More recently, a similar variation has been observed in turkey breast muscle. The variability in both pork and turkey is extensive, primarily because of differences existing in genotypes. Pigs carrying the halothane gene for stress susceptibility and those with the "Hampshire affect" are examples prone to producing undesirable quality. Furthermore, numerous environmental factors (such as housing, transportation and holding of live animals; processing, chilling and storage of carcasses) are known to influence quality attributes even to a greater extent than genetic factors.

Some muscles contain higher proportions of white, anaerobic type fibers. There are about 100 paired striated muscles in the pork carcass, but less than 10 are subject to major quality variations. Five of these muscles (*biceps femoris, longissimus thoracis et lumborum, gluteus medius, semimembranosus, semitendinosus*) comprise nearly one-third of the total musculature and represent the major muscles of the two most important economic parts of the carcass — the loins and hams. Although each muscle has its own unique properties, the quality conditions of the five are related and the quality condition of any one muscle can be used to predict the quality of the others. For turkey musculature, most of the attention has been directed to the *pectorales superficiales*.

When discussing PSE, it is obvious that another similar class should be considered. This is RSE (reddish pink, soft and exudative). RSE exists in significant proportions of the population, especially in pork. Unfortunately, most persons in the industry are unaware of it and assume that if color is "normal," than water-holding capacity and texture are equally acceptable. Even some meat scientists are not aware of or are convinced that RSE exists or that it is a problem!

Earlier studies have demonstrated that it is impossible (at least to date) to accurately predict ultimate quality by measuring the physio-chemical properties of pre-rigor muscle. The muscle conditions exhibiting quality variations have yet to be established early post-mortem (except for extreme PSE examples). Therefore, after examining many exhibits, methods have been identified that are effective in classifying post-rigor quality. Results from using light reflectance and scattering, electrical conductivity and resistance and pH probes suggest that by combining pHu, light reflectance and electrical conductivity, more than 90% of pork musculature can be correctly classified into one of the four quality categories (PSE, DFD, RSE, RFN). Combining electrical conductivity and pHu can account for >85% of the variation in water-holding capacity and this accountable variation declines very little when only RFN and RSE muscles are included.

When compared to DFD and RFN, PSE muscles experience greater protein denaturation, and RSE muscles specifically have greater denaturation of the sarcoplasmic proteins creatine kinase and phosphorylase. Most other RSE biochemical characteristics are similar to RFN.

Recent research indicates that drip loss appears to decrease over time post-mortem, but an explanation for this is not clear.

Recent research has also indicated that if early post-mortem, pre-rigor muscle pH decline could be slowed or totally prevented, the PSE and RSE conditions could be eliminated. Sodium bicarbonate is being either perfused or injected into pre-rigor musculature to accomplish this. Preliminary results indicate that pHu can be elevated and, if excess quantities are used, DFD results. When severe PSE muscles are treated they can be transformed into RFN. That is, pHu is elevated by about 0.3 unit, the pale color changes to reddish pink and the drip loss is reduced from 10% to <5%. A patent is pending on this research finding.

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Reciprocal Meat Conference Proceedings, Volume 49, 1996.

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Discussion

B. Schwartz: Is moisture pick-up during chilling causing any PSE problems?

A. Sosnicki: We didn't see any correlation between PSE and water pick-up. We did see a positive effect of fast chilling for minimizing these adverse conditions.

Schwartz: I don't know if the effect of water chilling is causing these PSE problems?

Sosnicki: If you use an ice water slush 20 min. post-mortem, the ice water chilling is more effective than air chilling for minimizing the PSE condition.

J. Claus: On the cooked product, some of the processors I have been working with are concerned with the raw material that shows PSE. We have not been able to create from a raw material a cooked product that has this mushy, pasty product that has slicing problems. How can you tell us what indicators to look for in raw materials so we can get a cooked product that has these quality problems?

Anonymous: Have you worked on cured product?

Claus: No these were uncured products.

Anonymous: You can get this effect using cured product.

R. Kauffman: There is no question that we can make DFD pork, not by adrenaline but by bicarbonate. We first observed this by buffering up the pH of early pre-rigor muscle, that we could really change things.

B. Gwartney: Is there any relationship between the time you identify RSE vs. implementation of quick chill systems? Is that part of the explanation?

Kauffman: No, I'm not for certain, I think that RSE has been with us for some time. If you will look at the charts that Briskey showed to us in 1964, in that big document, it has RSE in there as well, as far as this intermediate stage. All I see is that RSE is just some place between RFN and PSE.

Kauffman: Larry, have you seen any WHC problems in hams by chilling with dry ice?

L. Borchert: No, if you start the chilling process soon enough post-mortem, you reverse the PSE process.

Kauffman: I haven't seen, and maybe someone can produce the data here, that by quick chilling, that we have prevented RSE. I think we have prevented some of the PSE but I don't have the evidence that snap chilling does the trick.

D. Gerrard: Bob, why can't we generate PSE?

Kauffman: We can, I think F. McKeith has demonstrated that to some extent, that with high temperature you can do it, but not with DFD, because there is no glycogen there. By maintaining the high temperature, 39°C, you can get PSE conditions, especially if the glycolytic rate is going pretty fast.

G. Schmidt: I would submit that some of the chillers that are jammed so full of carcasses may be worse than leaving a carcass at room temperature.

Kauffman: Good point.

Claus: What do you know about the impact of collagen in relation to the turkey PSE situation, relative to solubility and insolubility and enzymatic activity?

Sosnicki: I'm sure we are familiar with the Swatland paper that tracked down the proportional increase of muscle fiber size of connective tissue, endomysial connective tissue, in the growing turkey breast muscle. He found that there is a dramatic decrease in proportional thickness of the connective tissue related to the fiber size. He thinks that one of the reasons for this softness, fragility of the processed turkey breast meat, is due to the lack of connective tissue that is supposed to support the muscle structure.

Second Session

Anonymous: Does the dark muscle condition also occur in turkey?

Sosnicki: Yes, but very rarely.

J. Busboom: Where does the Hampshire effect fit into all of this?

R. Van Laack: We have no clue as to how prevalent this is, but based on the data presented, I would say we don't have much of it.

E. Reynolds: Did you see any change in drip loss if there was a delay in the injections?

Kauffman: We looked at this in three phases. We removed the biceps as soon as possible, less than 10 minutes post-bleeding. We noted that in the post-rigor (24 hours) muscle, we didn't get the color changes but the drip loss went down a little. We did see an improvement in drip loss, however.