Poultry Meat Quality - Its Impact on Processed Meat Products

Larry L. Borchert, Ph.D.
University of Wisconsin

We are all aware of the continuing increase in per capita consumption of poultry meat in the United States. This growth is, in-part, due to the increasing quantities of poultry meat used in processed meat products. The wide-spread use of poultry in processed products started slowly post WWII. It became significant in the early 1980's with the nationalization of some regional poultry processors (Louis Rich, Bilmar, Butterball).

The growth of poultry as a component of processed meats continues to exceed the growth of the processed meat category as a whole. This is do to highly desirable processing characteristics of poultry meat and its relatively low cost. The reason poultry meat is a desirable raw material is its tremendous versatility (it is low in flavor, low in pigment, low in fat, and it has a similar water holding capacity (WHC) and fat binding capacity as red meat).

The processed products that utilize poultry vary from hot dogs and bologna to pre-cooked turkey breast for the deli trade. Included in the family of processed poultry products are breaded turkey and chicken nuggets as well as batter and breaded chicken parts.

Many consumers do not realize that most national brands of presumably red meat processed products contain significant quantities of poultry. This is due to poultry based raw materials called mechanically separated chicken (MSC) or mechanically separated turkey (MST). Mechanically separated poultry (MSP), as the product category is known, is the finely comminuted product that results from passing frames, which contain small quantities of muscle, through a machine which squeezes the muscle from the bone. Initially MSP was extremely poor in quality. It contained finely powdered bone as a result of the separation process. It often had a rancid flavor and aroma because it was not chilled immediately following manufacture. It sometimes had a “burned” flavor and aroma because the manufacturers were attempting to achieve maximum recovery by increasing the back-pressure in the deboner until the product “scorched” due to mechanical friction.

Unfortunately, in the 1970's, turkey and chicken hot dogs had a reputation for poor quality and were not accepted by the consumer. These negative flavor, texture and aroma characteristics made poultry products inferior to similar red meat based products. Many companies made public statements that they did not use poultry in their products.

When Oscar Mayer Foods Corp. acquired Louis Rich Inc. in 1980 one of the first visible activities was to improve the quality of MST. New deboner heads were developed to minimize the amount and size of bone particles. Pressures were controlled to eliminate scorching, while in-line heat exchangers were employed to chill the product rapidly to reduce bacterial growth and associated flavor problems. A rigid quality control program was implemented that trained plant employees to conduct formal evaluations of the poultry raw material quality before it was used.
The result of these changes was highly acceptable poultry wiener and bologna. The next logical step was to blend poultry in the form of MSP into traditional red meat formulas. In 1990, after extensive testing, Oscar Mayer marketed its first blended product. The nation's favorite hot dog, now had MST as fifty percent of its meat component. Bologna followed soon after with MSC as its poultry component. The poultry containing products were indistinguishable from the all red meat original. Because they contained significant qualities of poultry, qualifying statements identifying the presence of a poultry component were required, but that did not cause concern with the consumer. In fact, because of the positive perception that many consumers have regarding the healthiness of poultry meat, that may have been a positive factor.

Today most processed meat products contain poultry and some may contain 75 to 85% of their meat component as poultry. This is a key reason for the national increase in poultry meat consumption.

As you can see, quality improvement of the poultry raw material was an integral part in creating poultry as a recognized processed meat raw material. Quality in this case was, as we have indicated, the lack of undesirable flavor, texture and aroma. Other quality factors that are important to meat processors are water and fat holding capacity as well as muscle texture.

The development of pre-cooked catering breast products paralleled the growth of the highly comminuted products. Because of a favorable regulatory climate, poultry, as opposed to red meat, can be pumped with unlimited quantities of water. This is not considered economic adulteration because the increase in moisture content tenderizes the breast muscle, makes it juicy and reduces its already low fat content even more. The primary factors for quality of the poultry breast muscle in the product is its water holding capacity (WHC). The better the WHC the more water the product can contain. If WHC is poor, undesirable free juice may accumulate in the plastic bag the product is cooked in.

In 1980 Oscar Mayer scientists observed that the processed turkey industry had a condition called the "summer yield" problem that was similar to the pale, soft, exudative (PSE) problem the pork industry had known for 25 years. Both pork and turkey, on an occasional basis, exhibited whiter (pale) than normal muscle which was soft in texture and which gave up (exuded) its juice more than normal. The problem in both species was exacerbated by hot and humid conditions seen in summer. The problem was more severe in the hotter, more humid, Southeast growing area than it was in the Midwest. In the Southeast, when the summer yield problem was at its worst, the amount of moisture that could be held by the cooked muscle was so low that the added water had to be reduced, creating an economic, as well as a quality problem.

The process of converting the living animal to meat begins with the total removal of the animals blood. This action initiates a series of chemical and physical changes in the animal that lead to muscle rigidity known as rigor mortis. If rigor mortis occurs before the muscle has begun to cool the muscle contractile proteins denature; in effect they are "cooked" and lose their ability to hold water.
In pork, the normal time for the muscle to go into rigor mortis, as measured by the total depletion of adenosine triphosphate, is 60 minutes. In the PSE pig this is shortened to 15 minutes. In turkey the normal time to rigor is 30 minutes, while in turkeys with poor summer yield it is about 5 minutes.

In pork the genetic cause for PSE began to be elucidated in 1970 as one of the manifestations of the Porcine Stress Syndrome (PSS). The problem is caused by the so-called halothane gene because treating carriers of the gene with the gaseous anesthesia produced an immediate and fatal malignant hyperthermia. Another gene, the Rn (Redement Napole) gene, is also involved. Porcine geneticists attributed the cause to the extremely rapid development of the highly muscular meat type hogs. Genetic selection was made for the obvious lean muscle mass while muscle quality was not considered. Denmark, where PSE was first observed in 1953, was the world leader at that time for producing muscular pigs.

The same type of revolution in selection for lean muscle mass (breast muscle size) took place in the large white turkey. George Nicholas is classic in the advances he made in this country and in England for this breed. In 1982 when we had identified the similarities of PSE in pork and the summer yield problem in turkey. We approached the staff of Nicholas Turkey Breeding Farms with the problem and asked them to consider it in their selection program. They regarded the problem seriously and cooperated closely with Louis Rich to reduce the problem genetically. Other primary breeders soon followed suit. The incidence of the problem has been reduced but it is still a significant industry problem.

Poultry meat quality improvement over the years has been responsible for its tremendous popularity as a component of processed meat products. Recognition of muscle quality in genetic selection programs is key to expanded acceptance of poultry as a processed meat raw material.

REFERENCES


May 8, 1998

91
Questions and Answers:

Dr. David Pollock

Q. Question on use of euphemisms in advertising. Why is ‘mechanically separated’ used to describe the process rather than ‘mechanically deboned’?

A. I do not know the complete history of the name change from ‘mechanically deboned’ to ‘mechanically separated’ but it occurred during the process of creating the USDA regulation on the use of the product.

Q. As an employee of the broiler industry, am I reassured that you lack of inclusion of broilers in the PSE problem means that broilers are free of such defects?

A. I do not have first hand experience with the problem in broilers but I assume that it exists. A paper is being presented at the Institute of Food Technologists meeting in June entitled ‘Characteristics of PSE Broiler Breast Muscle’.

Dr. P. Jeffrey Berger

Q. You pointed out many mechanical ways to process meat and also pointed out the need for more genetic selection on factors affecting meat quality. How does one decide whether a particular characteristic should be changed genetically or by a mechanical process? PSE is certainly one genetic trait.

A. Industry can not economically sort raw materials on the basis of quality, therefore it develops processing modifications to accommodate the poor quality raw materials. These changes usually result in an increase in processing costs. Therefore elimination of meat quality problem at its source is most desirable from the processing industry point of view.

Dr. Derek Emmerson

Q. You indicated that meat quality problems observed for birds processed during the summer could be partially overcome through formula changes - how significantly did this affect the cooked meat yield during this season?

A. Without formula changes free moisture (purge) in a deli style turkey breast roast is 30 to 90 percent higher in the summer than it is in the winter.
Dr. Alan Schinckel

Q. First of all I would comment that the vast majority of swine seed stock producers have eliminated the stress gene via DNA testing. Still variation in pH exists - with extremely lean pigs having greater drip loss. Have you looked at using antioxidants in the feed in the deboning-separation process as soon as you can after slaughter?

A. Most poultry growers use an antioxidant, usually ethoxyquin, in their feed to prevent rancidity development before the feed is consumed by the birds. This may carry over to the meat as well. Dr. Brian Sheldon a NC State, among others, has shown the positive effect of feeding alpha tocopherol but that is an expensive alternative. Adding antioxidants, usually in the form of sodium nitrite, at the time of deboning is used by some processors.

Dr. Therese Johnson

Q. The most important part of your thesis that I recall was the reduction of creatine kinase when you induced PSE by high temperature post mortem. I wonder if this has something to do with reduction in energy level too fast with too rapid glycolysis?

A. Thank you for reading my thesis; you are probably one of four or five people that have. I believe the reduction of creatine kinase occurred simply because it was one of the most labile of the sarcoplasmic proteins and its denaturation was a result of the rapid energy loss rather than a cause of it.