

## **QUALITY CHARACTERISTICS OF POULTRY PRODUCTS**

### **Ensuring quality carcass and meat in broilers**

Good broiler carcass and meat quality starts with a healthy chicken, nourished to support optimal growth. Genetic selection also plays an important role in determining carcass and meat traits.

## **SENSORY ATTRIBUTES OF POULTRY PRODUCTS**

Some of the most important factors in the acceptance of food are its flavor, color, texture and appearance.

### **1. Color Characteristics**

Acceptance or rejection of food by humans is based, in part, on the color of the product compared to an expected reference. Humans also use color to provide some information regarding the flavor of a product. When the color of a product is switched to another color, people can be tricked into believing that the product has a different flavor.

In poultry meat marketing, color is very important, and consumers are often willing to pay a premium for a product with an acceptable color. On the other hand, when consumers perceive a color problem/defect, they would probably not buy the product.

Poultry skin and muscle color are affected by a variety of factors, including;

1. Age,
2. Environment
3. Diet

The color of poultry skin can vary from cream-colored to yellow. Skin pigmentation is the result of melanin deposition (i.e., pigment produced by the bird). The color of raw muscle ranges from pink to red due to hemoglobin and myoglobin within the muscle.

### **Effect of muscle type**

Meat color is largely dependent on the amount of meat pigment, myoglobin, present in the fiber. Chicken breast muscle is predominantly composed of white fibers, which have a low myoglobin level and, therefore, a light color. On the other hand, thigh meat is mainly composed of red fibers and shows a darker color. These differences can also be seen when measuring the actual heme content in light and dark muscles.

The more a muscle is used, the more myoglobin is present in the muscle. When cooked, the meat from frequently used muscles is known as dark meat. Dark meat typically comes from the legs or thighs of a bird. Muscles that are used less, like the breast, are lighter in color and thus referred to as light meat.

### **Effect of feed**

Numerous studies have shown that consumers commonly prefer poultry skin color that is traditionally available in their region. The skin color usually reflects local feeding practices.

The birds fed strictly wheat diets tended to have breast fillets that were lighter in color, whereas birds fed strictly milo seed diets tended to have fillets that were more red. Birds on strict corn diets tended to have breast fillets that were slightly yellow in color.

### **Effect of muscle pH**

Another important factor affecting color is the pH of the meat. Lower pH levels in the muscle are associated with lower water-holding capacity, due to alterations in the structure of myofibrils within the muscle when in a low-pH environment. If a muscle can hold more water, it typically will be lighter in color.

Postmortem, biochemical changes occur in the muscle that causes rigor mortis to develop along with a drop in pH. The decline in pH is a result of lactic acid being produced in the muscle when oxygen is not available. If the pH of the muscle declines rapidly while the temperature of the carcass is still high, there will be protein denaturation in the muscle fibrils, causing the meat to be pale. This defect, known as pale, soft, and exudative (PSE) meat, is a growing problem in poultry industry. The paleness occurs due to increased sarcoplasmic protein denaturation, which in turn leads to increased scattered light, causing the meat to be lighter.

### **Effect of Age**

Age is also an important factor that affects meat quality. As chickens and other animals age, the level of myoglobin in the muscle increases, resulting in darker colors.

## **2. Flavor and Aroma Characteristics**

One of the most important factor in the acceptance of food is its flavor. Flavor is a combination of taste and smell.

Raw meat has a distinctive flavor very unlike its cooked form. Generally, raw meat has a bloody, metallic, salty taste, with an aroma resembling blood serum. The flavor is changed drastically once cooked. Flavor develops during cooking through complex reactions between components found in raw meat combining with heat. The primary components of flavor may include reducing and phosphorylated sugars, amino acids, thiamine, and lipids.

Chemical compounds found in the meat also undergo thermal degradation, resulting in flavor formation.

Several of the compounds contributing to aroma and flavor have been isolated and identified. **Ribose** may be the most important compound in chicken aroma. **Thiamine** (B1) has also been shown to be an important precursor of a wide range of sulfur compounds.

The diet source of the bird has a noticeable effect on the flavor of broiler breast meat. Three diets with different primary carbohydrate sources (corn, milo, and wheat) were fed to 28-day-old broilers in a study. Meat from birds fed corn, however, scored significantly higher for both than meat from birds fed milo or wheat.

### 3. Muscle pH

pH is commonly used as an indicator of meat quality. As rigor mortis develops within the cell after slaughtering, ATP concentration declines and lactic acid begins to be built up due to glycolysis, thus decreasing the overall pH of the muscle. A rapid pH decline may cause protein denaturation, resulting in a decrease in tenderness and juiciness as well as a less intense (pale) color of the muscle.

### 4. Texture Properties

Acceptance of meat is driven by several factors, texture, particularly tenderness, being one of the most important.

Determining the textural parameters of a poultry product is important in optimizing growing and processing conditions so an acceptable product can be offered to the consumer.

Tenderness has been noted as the most important factor in consumer perception of quality of a meat product. Therefore, understanding the biological and physiochemical inter-relationships that influence tenderness is required to produce tender meat.

Many factors influence the ultimate tenderness of broiler breast meat including **age, sex, location, cooking method** and **pH**.

Accelerating glycolysis can cause an increase in accumulation of lactic acid in the muscle tissue and cause a more rapid drop in pH of the meat. A rapid postmortem drop in pH has been found to cause a decrease in tenderness due to the changes in solubility of the protein and changes to the enzymes within the meat after slaughter. A decreased pH leads to a decreased activity of calpains and Cathepsins, enzymes that break down the protein structure and reduces postmortem tenderization causing toughening of the meat.

As **meat ages**, it tends to become tough, which results in its economic value decreasing by limiting its use as a whole muscle food. **Tenderness decreases with age**. During glycosylation (saccharides are added to proteins present in the muscle). This contributes to the formation of cross-links leading to the deterioration of collagen (protein). Over time there is an accumulation of these cross-links, which contributes to the toughness of meat from aged animals.

The effect of **outdoor access (free range) and conventional methods** on poultry meat tenderness has been noted by many researchers. Some argue that birds with outdoor access will produce tougher meat as a result of the increased mobility, and others believe that there is no difference in texture compared to conventional birds.

### 5. Water-Holding Capacity and Cooking Loss

Most poultry products contain 60–80% moisture that is held by the protein matrix. The amount of protein is usually around 10–20% of the product.

The quality of the proteins, in terms of water-holding capacity, is influenced by the type of muscle, pre- and post-rigor conditions (DFD and PSE meat), and processing treatments such as freezing.

Determining the water-holding capacity is important for fresh meat cuts sold directly to the consumer and for further processed products prepared by the industry.

Cooking loss is a very important characteristic for the processing industry as water retention is a main point of profit. The main determinants of water-holding capacity of meat are pH and protein denaturation.

Since decreased water holding capacity is one indicator of PSE meat (Pale, Soft, Exudative meat), researchers have used drip loss and water holding capacity along with L\* values and pH decline as characteristics to evaluate meat quality. A high L\* value and a low ultimate pH ( $5.7 <$ ) have been found to be indicative of broiler breast meat that was both pale in color and low water-holding capacity.

### **Stress and welfare**

Commercial broiler involves a number of potential stressors, including **crating** and **transportation** that can cause increased production of adrenal hormones and affect the welfare of the birds.

Crating causes an increase in plasma corticosterone (CORT) levels in both laying hens and broilers. The duration of crating and the method of crating can also influence the stress response shown by the bird. Although catching, crating, and loading are the procedures that are most likely to cause physical injuries, transportation has also been reported to be stressful to broilers. Birds that were crated and transported on a vehicle for 40 min had higher plasma CORT concentrations than birds that were crated and loaded onto the vehicle but not transported.

Meat quality may also be affected by **preslaughter management practices**. Preslaughter stress could be an important factor in causing these conditions. Generally, PSE (Pale, Soft, Exudative meat) results from acute stress and DFD (dark, firm, and dry) results from chronic stress. Changes in meat quality due to preslaughter stress have been extensively studied in cattle and pigs but the data on poultry are limited.

Higher preslaughter stress (crating durations stress level and holding crated broilers after transport) in broilers could influence the color of thigh meat. In an experiment with male broilers were held in crates (10 birds per crate) for either 0, 1, 2, 3, or 4 h prior to processing. Crating duration did not affect, cooking loss, shear value of breast or thigh muscles, or carcass skin discolorations of breast meat, but did change the color of thigh meat, with samples from the 3 h crating group.

In another experiment broilers were crated for either 1 or 3 h, with 9 birds per crate. Crating time did not influence color, or texture of breast and thigh meat samples. In Experiment 2, broilers were crated (nine birds per crate) early in the morning and transported 3 h to the processing facility by truck. Nine crates of birds were held in a dark quiet place for 4 h prior to

processing (H) and the remaining nine crates were processed immediately (NH). Initial pH of thigh meat of the H group was significantly lower breast meat pH was not affected by treatment. Holding had no effect on shear values, color (breast and thigh).

In a study chronic **heat stress** (23 vs 34 °C) significantly reduced meat pH value by accelerating meat glycolysis, and eventually reduced meat quality indicating that heat stress has been considered as one of the significant environmental factors affecting meat quality, which could accelerate postmortem glycolytic metabolism, and result in pale, exudative meat characteristics in chickens. Also **Acute heat stress** has been proved to reduce the chicken meat quality. It has been reported that the acute heat stress can increase lightness (L\*) and decrease redness (a\*) and yellowness (b\*) in the breast muscle of broilers. Acute heat stress could induce alterations in blood acid/ base status which may be associated leading to alterations in meat characteristics of broiler. Meat tenderness and water holding capacity were reduced after 2 h of transportation but improved again after 4 h of transportation. **Transport stress** can influence the color and texture of broiler meat.

There is a growing concern in the industry about carcass blemishes such as red wingtips, bruises, and broken bones in broilers as consequences of preslaughter stress. It is nonetheless imperative to pay more attention to these problems and develop management practices to improve the welfare of the birds and the resultant product quality.