

STRINGY-SPONGY RISK FACTORS AND IDENTIFICATION

Stringy-spongy (SS), also known as spaghetti or mushy breast, is a breast myopathy characterized by the loss of structural connective tissue integrity of the breast muscle. This muscle tissue degradation leads to friability and loosening of the muscle fibers, which gives the breast a “stringy” appearance. Broiler chickens are developmentally juveniles, and their connective tissues lack the maturity (i.e., cross-linking) of adult animals, which is why meat from young animals is more tender. As such, it is important that the birds receive the required nutrients and on-farm conditions to support the development and maturation of the connective tissue during growth. Following processing, the muscle fiber bundles can separate, resulting in the muscle being easily pulled apart by hand and exhibiting visual signs of spaghetti-like tissue (**Figure 1**). As with other breast myopathies, the incidence and severity of SS are variable, ranging from only a small part of the breast being affected to the whole muscle showing the condition.

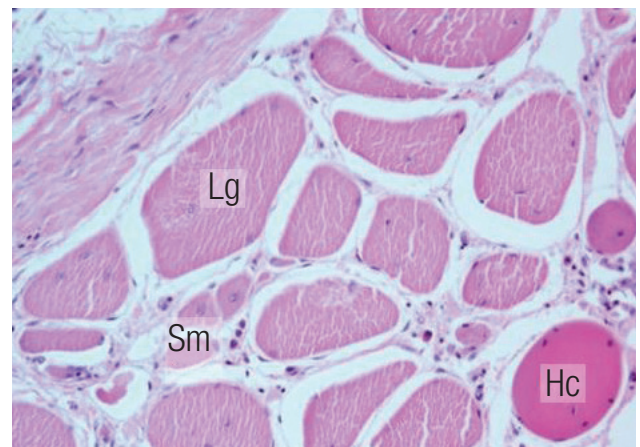
FIGURE 1. IMAGE OF FILLET WITH STRINGY-SPONGY.



HISTOLOGY OF THE CONDITION

Histologically, the muscle appears disorganized in structure, with a mix of very small and very large muscle fibers (**Figure 2**). There is evidence of hypercontracted muscle fibers, and active degeneration and regeneration of muscle fibers, although this is less pronounced than that of woody breast (WB). This condition is not as well understood as WB; thus, Aviagen[®] continues working to better understand SS and how it could be alleviated or eradicated.

FIGURE 2. HISTOMICROGRAPH OF BREAST MUSCLE AFFECTED BY STRINGY-SPONGY. FEATURES OF THE MUSCLE INCLUDE LARGE (LG) AND SMALL (SM) MUSCLE FIBERS ALONG WITH HYPERCONTRACTED FIBERS (HC) (100MM).

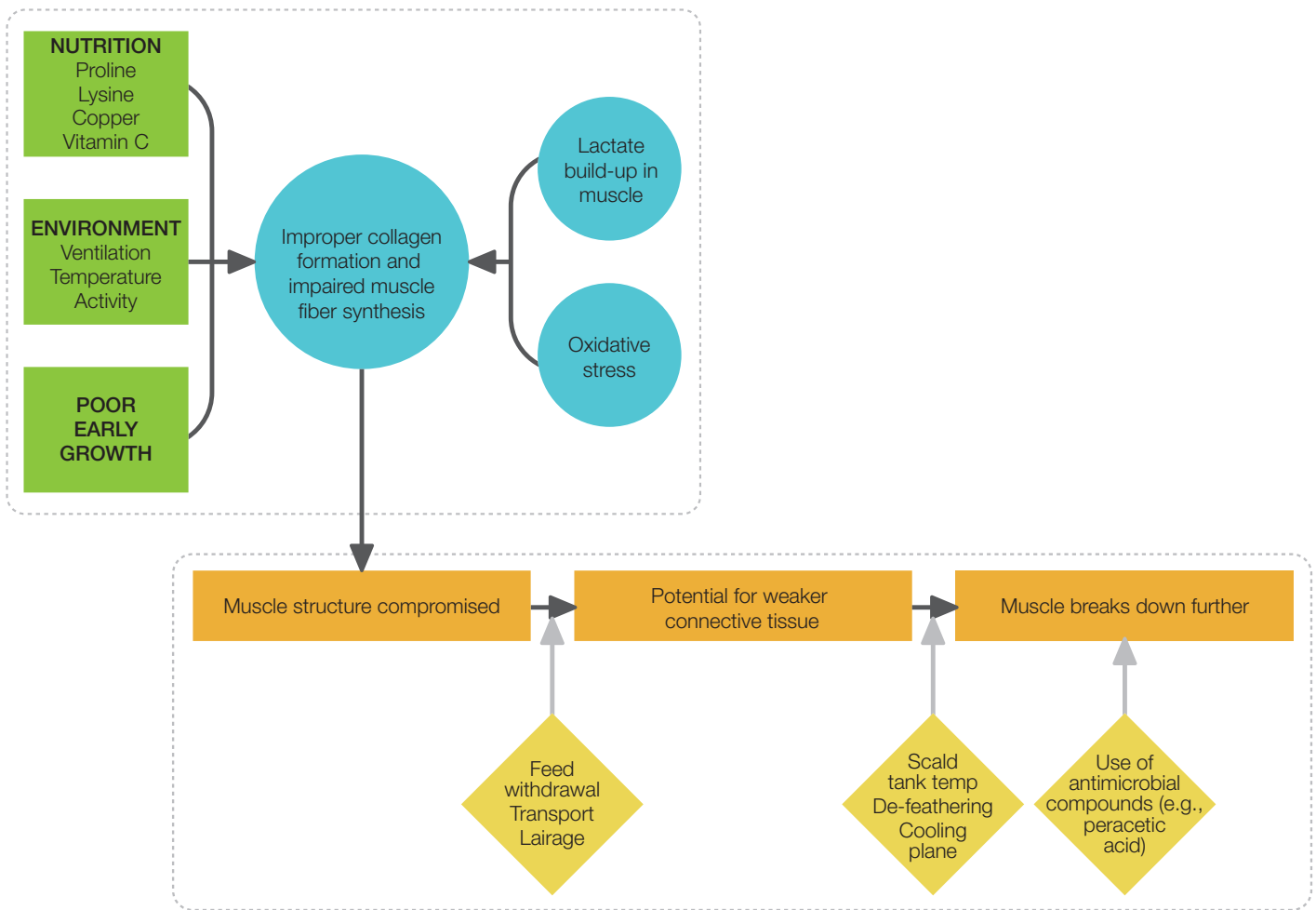


POSSIBLE CAUSES OF THE CONDITION

There is ongoing research into this condition, but it is thought to be linked to increased lactic acid accumulation in the muscle, which can cause degradation of the connective tissue holding the muscle fibers and bundles together. Increased levels of lactic acid can inhibit protein synthesis, which may also impact the maturation and, thus, integrity of the connective tissue in the muscle.

When the pH drops in the muscle, it can cause lysis of the muscle fibers, which releases proteolytic enzymes into the extracellular space. These enzymes can degrade the developmentally labile connective tissue. A third possible cause or contributing factor is inadequate dietary levels of amino acids (AA) critical for proper development of the connective tissue “sheath” (i.e., endomysium) covering the muscle fibers (e.g., proline), particularly when birds are fed plant protein-based diets. In general, plant-based feed ingredients are much lower in proline than animal proteins; hence, the possible risk factor associated with feeding only plant-based diets. **Figure 3** provides insight into the components that may play a role in developing SS.

FIGURE 3. FACTORS CONTRIBUTING TO THE DEVELOPMENT OF STRINGY-SPONGY.



MANAGING RISK FACTORS

To date, Aviagen has been unable to identify SS on the farm immediately post-mortem. However, if birds are euthanized and left to cool at ambient temperature, SS can sometimes develop a few hours later. This supports the hypothesis that SS is linked to post-mortem muscle changes and carcass cooling rate (i.e., length of time).

Supporting early growth and development is important for initiating the growth and subsequent development of the connective tissue. Ensuring optimal brooding conditions and nutrient provision to achieve recommended seven-day body weight will help with the development of the muscle tissue as the bird ages. Broiler shed management with regards to temperature and ventilation through the life of the flock is also important to support ongoing development and maturation of the connective tissue in the muscle.

As part of the investigations into the biological basis for SS, Aviagen quantified the level of hydroxyproline present in muscle samples with and without SS. Hydroxyproline is a key component of collagen, which gives strength and integrity to the connective tissue within the muscle. Our results showed that as SS severity increases, a reduction in hydroxyproline content is seen. This indicates that pectoralis major (breast) muscles with a reduced hydroxyproline content are more predisposed to developing SS during processing. As such, it is important to closely monitor dietary levels of AA to support the building blocks of collagen.

De-feathering time and intensity have also been identified as risk factors for the manifestation of SS. If the carcasses are de-feathered too intensely or for too long, muscle fiber integrity can be lost, and muscle fiber integrity can be affected. Scalding temperature should also be considered as a risk factor for SS. When the plucking scald temperatures are low, more intense de-feathering is required to remove feathers, which can ultimately impact the integrity of the muscle. Excessive scald temperatures have been associated with an increased risk of SS occurring; this is likely linked to the subsequent rate of cooling.

The use of substances like peracetic acid (PAA) may also impact the incidence of SS. As with lactic acid, PAA can cause degradation of the connective tissue and loss of integrity of the meat. Consequently, prolonged or repeated exposure of carcasses and/or breast fillets to PAA can be associated with higher incidences of SS.

EVALUATING STRINGY-SPONGY SEVERITY

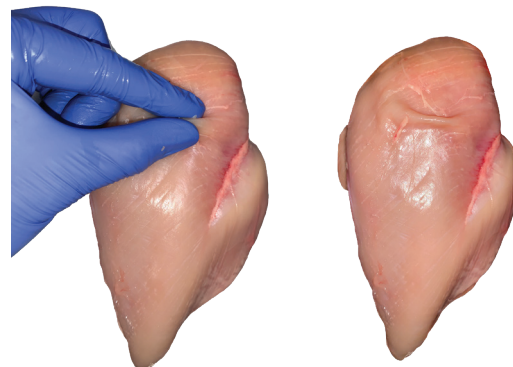
Occurrence and acuteness of SS are variable, so it is essential to understand not only basic visual identification of the myopathy but also how to identify the level of severity. The Aviagen Breast Myopathy Scorecard for SS ranges from Score 0–Score 2, with Score 0 being a normal breast (**Figure 4**) and Score 2 showing severe signs of tissue degradation.

FIGURE 4. SCORE 0: A NORMAL BREAST WITH NO SIGNS OF STRINGY-SPONGY.



Score 1 (**Figure 5**) indicates an area of open breast fibers affecting no more than approximately 30% of the breast in any one area (top, middle, or bottom) or an area of looseness that can be pinched and lifted, accounting for approximately 40-50% of the breast meat.

FIGURE 5. SCORE 1: BREAST WITH MILD-MODERATE SIGNS OF STRINGY-SPONGY.



Score 2 (**Figure 6**) indicates two areas of the breast showing open areas with exposed fibers or one area showing severe damage with exposed fibers affecting >50% of the surface.

FIGURE 6. SCORE 2: BREAST WITH MODERATE-SEVERE SIGNS OF STRINGY-SPONGY.



KEY CONSIDERATIONS FOR STRINGY-SPONGY

- ▶ Ensure adequate environmental conditions and nutritional requirements are met to promote strong early growth and collagen production.
- ▶ Control de-feathering time and intensity in the processing plant. Higher intensity can be detrimental to breast quality and promote the expression of SS.
- ▶ Monitor carcass cooling time. A carcass cooled at a slow rate (longer than 4°C [39.2°F] in 2 hours) may begin to exhibit signs of SS.
- ▶ Monitor and control the use of antibacterial compounds like peracetic acid, which can degrade collagen.