Effect of the Wooden Breast Myopathy on Broiler Chicken Collagen and Myogenic Regulatory Factor Protein Expression

Lauren Shortnacy, Joshua J. Flees, Charles W. Starkey, and Jessica D. Starkey

The global demand for chicken meat continues to rise because it is a nutritious and affordable source of protein. In response to the increased demand for chicken meat, the poultry industry has selected broiler chickens for rapid growth rate and high breast meat yield. Wooden Breast is a condition recently observed in rapidly growing, high-yielding broiler chickens reared for meat. The *pectoralis major*, or breast muscle, of chickens affected with Wooden Breast is extremely rigid or hard to the touch and can result in a negative eating experience for consumers. Currently, the broiler industry is losing millions of dollars each year due to various issues related to this meat quality defect. However, the reason why the Wooden Breast defect occurs is still unclear. Muscle growth is regulated by the expression and function of myogenic regulatory transcription factors such as myoblast determination protein 1, or MyoD. Insights regarding the amount and type of collagen infiltrating the affected muscle tissues as well as the muscle stem cell transcription factor protein expression profiles at various stages of production are needed. Knowledge regarding differences in affected and unaffected birds at the cellular and molecular level will aid in the effort to understand the problem in the muscles of the rapidly growing broilers affected with the Wooden Breast phenotype.

The goal of this research was to test the hypothesis that broiler chickens affected with the Wooden Breast myopathy will have elevated concentrations of myogenic regulatory factors and collagen in their breast muscle. Muscle samples were obtained from broilers affected with Wooden Breast (n = 8) and unaffected/normal broilers (n = 8) and reared to either 25 or 43 days of age. The Wooden Breast phenotype can be visualized at 25 days of age. The common processing age for US broilers is 43 days. In accordance with these milestones, total protein was extracted in this study from the samples (n = 32 total samples) and electrophoresed on polyacrylamide gels and transferred to PVDF membranes. Target protein concentrations were assessed using an established multiplexed, fluorescence-based Western blot detection method. The background corrected volume of each target protein signal (Figures 1C and 2C) was normalized to total protein (Figures 1D and 2D) in the respective lane or channel for DNA fragments to travel when electric current is applied.

On day 25, there was no change in the protein expression of collagen (P = 0.7072; Figure 1A) and MyoD (P = 0.9636; Figure 1B) between birds unaffected and affected by Wooden Breast. On day 43, collagen protein expression was significantly increased in birds affected by the Wooden Breast muscle defect compared to birds unaffected by the myopathy (P = 0.0051; Figure 2A). There was no change in the expression of MyoD on day 43 (P = 0.7027; Figure 2B). Results from this experiment show that collagen expression increases on day 43 when broilers are severely affected by the Wooden Breast defect compared to broilers that are unaffected, but expression of MyoD was similar.

Ultimately, the results of this study provide the basis for further exploration of the Wooden Breast meat quality defect and possible selection targets for producers to work with to eliminate this undesirable condition in commercial broiler chicken production.

Statement of Research Advisor

Lauren's work related to determining the proteomic profiles of broilers unaffected and affected with the Wooden Breast myopathy is novel and will serve as the basis for further experiments in our laboratory to be conducted by future students. The results of Lauren's project will be included in a peer-reviewed journal article of much larger scope that will ultimately serve as a contribution to the scientific literature concerning the Wooden Breast broiler meat quality defect.
– *Jessica Starkey, Poultry Science*

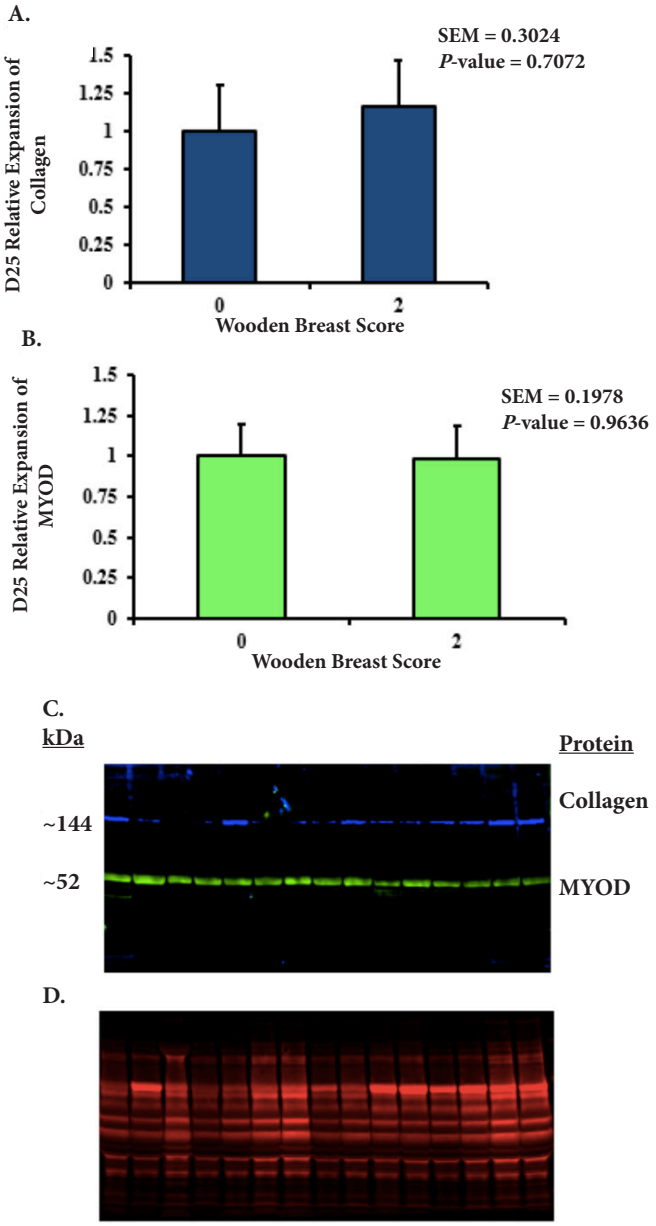

Figure 1. Relative protein expression of collagen and MyoD in pectoralis major muscle samples from normal (score 0) and Wooden Breast-affected (score 2) broiler chickens at 25 d posthatch (n = 8 per score). The expression of collagen (Panels A and C (blue bands)) and MyoD (Panels B and C (green bands)) proteins were quantified relative to total protein (Panel D). Means were separated at $P < 0.05$.

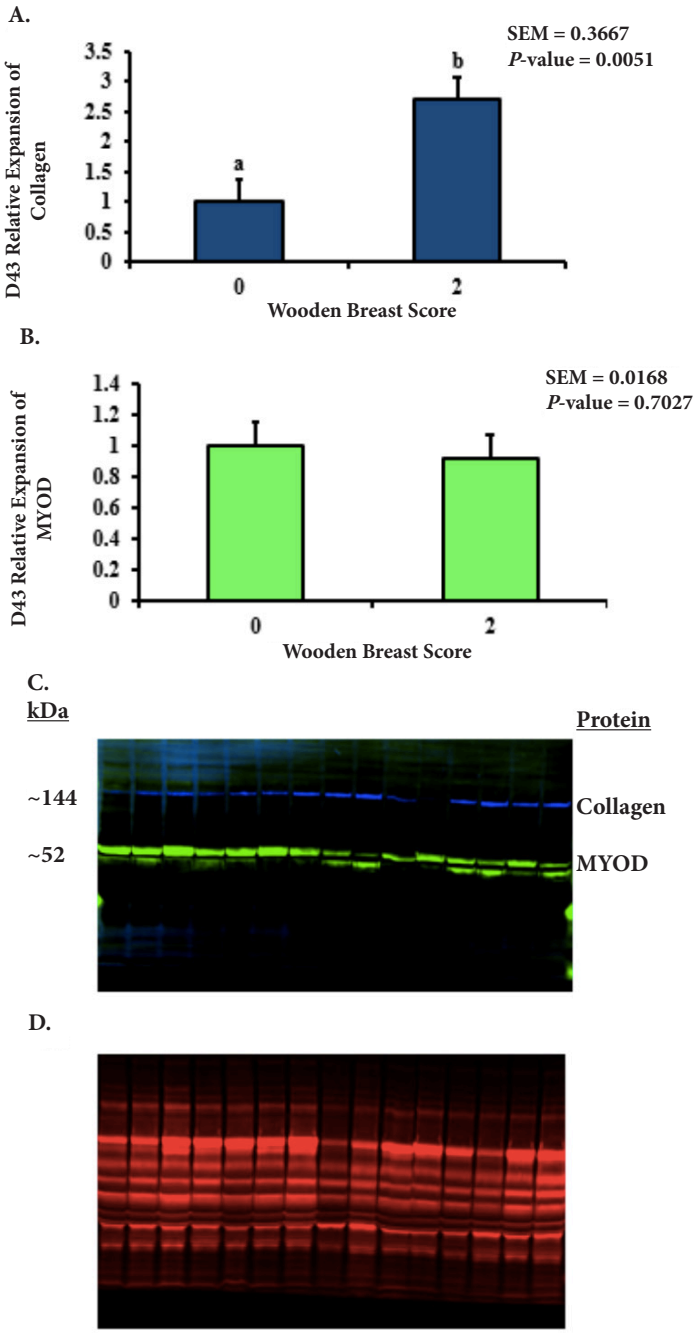

Figure 2. Relative protein expression of collagen and MyoD in pectoralis major muscle samples from normal (score 0) and Wooden Breast-affected (score 2) broiler chickens at 43 d posthatch (n = 8 per score). The expression of collagen (Panels A and C (blue bands)) and MyoD (Panels B and C (green bands)) proteins were quantified relative to total protein (Panel D). Means were separated at $P < 0.05$ and bars with different letter superscripts differ.