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Quantitative Proteomic Characterization Associated with Woody Breast Meat from Broilers Fed a Standard or an Amino Acid-Reduced Diet

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Objectives

Woody or wooden breast (WB) is an emergent myopathy of broilers and is macroscopically characterized by hardened areas of the *Pectoralis major* muscle. Woody broiler breast fillets can result in harder texture, higher pH, lower amounts of proteins, lower water-holding capacity, and increased cook loss when compared to normal breasts. The impaired meat quality of WB has been reported to be closely associated with improved nutrition and fast-growth rates. The present research compared the proteome of normal and woody breast muscle from broilers that were fed with either a control diet or an amino acid (AA)-reduced diet.

Materials and Methods

Mixed-sex broilers were assigned to 16 pens (15 chicks per pen) and fed with control or reduced AA diets (20% reduction of digestible lysine, total sulfur amino acids, and threonine). At 8 wk of age, live broilers were evaluated manually for WB myopathy. Within each diet group, 4 male broilers with normal breast and 4 male broilers with WB were selected (one bird in each pen) and euthanized using CO_2 gas. The breast muscle from the cranial portion was immediately sampled after bleeding and snap-frozen in liquid nitrogen. All experimental procedures were approved by the Institutional Animal Care and Use Committee of Mississippi State University (IACUC-16-542). Whole muscle proteins of normal and woody breast were extracted from frozen samples of three birds within each treatment. Two-dimensional gel electrophoresis (2-DE; 6 gels per treatment) coupled with image analysis and mass spectrometry were used to investigate differences in the expression levels of proteins (more than 2.0-fold intensity differences) from chicken breast muscle. Differences were evaluated using Student's *t* test at a confidence interval of 95%.

Results

When the broilers were fed with the control diet, 10 proteins were expressed differentially between normal and woody breasts. Apolipoprotein A-I, desmin, annexin A2, annexin A5, and ubiquitin carboxyl-terminal hydrolase were overexpressed ($P < 0.05$) in WB. Peptidyl-prolyl cis-trans isomerase, four and a half LIM domains protein 1 isoform X3, and an uncharacterized protein were only present in WB muscle, but not in normal chicken breast. Two proteins, keratin, type II cytoskeletal 8 and α-1,4 glucan phosphorylase, were overexpressed ($P < 0.05$) in normal chicken breast. These differentially expressed proteins were involved in glycolytic metabolism, cell structure, and cellular defense.

Interestingly, only one protein (heat shock protein β-1) was expressed differentially between normal and woody breasts when broilers were fed with the AA-reduced diet. This protein was overexpressed ($P < 0.05$) in WB samples and found to play a role in stress resistance and actin organization.

Conclusion

The protein profiles of normal and woody chicken breast samples were different, which might help explain the changes in meat quality. Essential amino acid intake resulted in minimizing difference in protein profiles between normal and woody chicken breasts.