CHICKEN MEAT QUALITY: GENETICS, PRE-SLAUGHTER STRESS AND NUTRITION FACTORS

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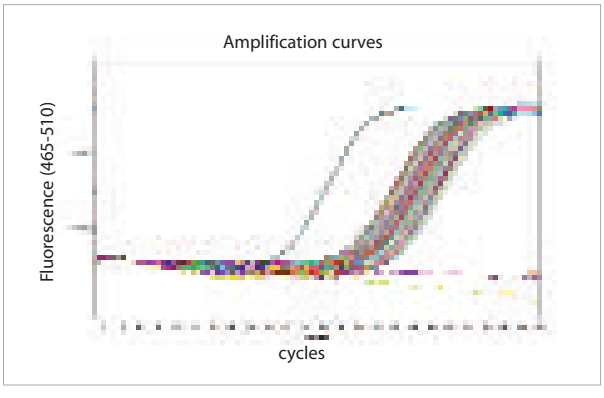
Above, chickens in the experimental units; and on the left, monitoring chickens for heat stress



Quantitative PCR amplification curves

Chicken meat production is an important agrobusiness component, leading Brazil to a remarkable position in meeting the global market, as well as the domestic demand. Meat quality, considering fresh and processed broiler meat, is essential for the consumer acceptance of the product. As a background, elevated temperature during summer months can impact production efficiency and meat quality. In particular, pre-slaughter heat stress has been known to interfere with final product quality and was elected as a relevant aspect to be studied. Temperature, transportation and abattoir management are able to induce changes in the internal body regulation with consequences to the transformation of muscle in meat and on the meat functional properties. The main focus of this interdisciplinary project is to identify and characterize factors affecting chicken meat quality such as genetics, heat stress and nutrition, improving the comprehension of these aspects and opening the possibility of managing those factors. The specific objectives of this project include (a) the definition of an experimental model to relate pre-slaughter heat stress to chickens physiologic changes and meat quality; (b) to determine if different genetic lines of chickens have different physiological responses to heat stress conditions; (c) to investigate the gene expression pattern under pre-slaughter heat stress condition and its effect on breast meat quality; (d) to determine the chemical (pH, composition, susceptibility to oxidation) and physical (color, water holding capacity, tenderness) properties of chicken breast meat exposed to heat stress prior to slaughter and the effects on meat stored under refrigerated or frozen conditions; (e) to identify changes in proteolysis and migrations between the myofibrillar and sarcoplasmatic fractions due to heat stress; (f) to determine the effectiveness of plant extracts and tocopherol, as natural antioxidants, on chicken performance and meat quality and stability during storage. This study represents a contribution to the productive chain of chicken meat in order to maintain its quality and competitiveness.

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

The experimental model to simulate the stressing conditions in chickens transport to the slaughterhouse was defined as 35°C and 85% relative humidity for up to two hours. Compared to chickens kept in therm neutral environment, the heat-stressed chickens have showed adaptive responses of increase in body temperature and respiratory frequency, followed by physiologic responses such as hemodilution to avoid hypovolemia that may occur due to weight loss represented mainly by transpiration. Differential water drainage among tissues was observed in the heat-stressed birds, with preservation of water in the breast muscle and loss in legs and wings.

In the breast muscle, differentially expressed genes were investigated by macroarray and qRT-PCR. Macroarray analysis revealed 259 differentially expressed genes, with 149 induced by heat stress. Nine genes were selected for qRT-PCR analysis: *Myostatin*, *Citrate Synthase*, *HSP 70* and *90* were induced by heat stress, while *Glycogen Pphosphorilase* was repressed.

The meat quality studies revealed that the heat stress provoked increased frequency of breast meat with higher pH and lower L* (lightness) values. Consequently, less cooking weight loss was found in the breast meat from heat-stressed chickens. A complementary study on the molecular aspects concluded that heat stress decreased the rate of myofibrillar fragmentation, but the proteolytic extension was not changed. Also, specific myofibrillar fragments were formed, with no alteration in shear force. Modifications in the sarcoplasmatic fraction were observed in pale meat.

The nutritional studies demonstrated that the addition of herbs extracts (rosemary, thyme, oregano, sage, bay and basil) and spices (cinnamon, clove and ginger) to broilers diets resulted in positive antioxidant effect in precooked chicken meat stored frozen, while not affecting the other meat quality parameters. Also, aqueous extracts of mate (*Ilex paraguariensis*) protected efficiently precooked meat balls from oxidative deterioration during storage. This strong antioxidant effect may be at least partially related to a synergistic interaction with vitamin E, which seems to be regenerated by the water soluble phenolic compounds from mate.

MAIN PUBLICATIONS

Santos CC, Delgado EF, Menten JFM, Contreras-Castillo CJ, Pedreira ACM, Mourão GB, Brossi CB, Silva IJO. 2008. Sarcoplasmatic and myofibrillar protein changes caused by acute heat stress in broiler chicken. *Scientia Agricola*. **65**: 453-458.

Almeida EA, Jorge EC, Silva NA, Brossi C, Contreras-Castillo CJ, Menten JFM, Coutinho LL. 2008. Impact of ante-mortem heat stress on skeletal muscle gene expression and meat quality. *Scientia Agricola* (submitted)

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