Effect of Antemortem Acute Cold Stress, Age, Sex, and Lairage on Broiler Breast Meat Quality

S. Dadgar*, E. S. Lee, T. L. V. Leer, N. Burlinguette, H. L. Classen, T. G. Crowe and P. J. Shand
University of Saskatchewan, Saskatoon, Saskatchewan, Canada

Introduction
Transportation of broilers during winter could affect bird welfare and subsequent meat quality. Broiler chickens were exposed to cold temperatures (-18 to -4°C) during 3 h of simulated transport to evaluate the effect of age, sex, and lairage on bird welfare, breast meat quality and the incidence of dark, firm and dry (DFD) breast meat.

Materials & Methods

- Experimental Setup:
  - Simulated Transport System: An environmental chamber with 2 grided drawers (15 birds/drawer) (Fig. 3).
  - Broilers: 360 birds at 5 and 6 weeks of age (180 and 180); core body temperature (CBT) was monitored by internal temperature logging Thermocron iButtons®(Fig. 3).
  - Treatment Temperatures: -18, -15, -12, -8, and -4°C as cold and -20°C as control temperature.

- Analysis
  - Meat Quality: Drip loss, CIE LAB color, ultimate pH (pHu), thaw loss, cook loss, Warner-Bratzler shear force, water-binding capacity (WBC), processing cook yield (PCY), glycolytic potential and lactate concentrations were measured.
  - AET (Apparent Equivalent Temperature): calculated based on temperature and RH in the birds surrounding (Fig. 1) was used to group the birds.

- STATS, ANOVA option of the GLM (SAS, Institute, Cary, NC). Means were separated using Duncan’s multiple range test option.

Results

- Welfare Assessment
  - CBT decreased significantly ($P < 0.001$) during the 3 h exposure to cold AET (Fig. 2).
  - Males showed significantly ($P < 0.05$) greater drop in CBT compared to females.
  - Further drop in CBT with 2 h rest prior to slaughter at AETs below-12°C.

- Muscle Metabolites
  - Lactate and glycolytic potential (GP), were lower for birds exposed to AETs below -9°C (Fig. 4).
  - No significant ($P < 0.05$) effect of sex was observed on muscle metabolites.
  - Two h of lairage resulted in significantly lower ($P < 0.01$) GP (113 μM/g) compared to 0 h lairage (122.4 μM/g).

- Meat Quality Defect
  - Breast meat with pH > 6.1 and L* < 46 was considered to be DFD.
  - Breast meat from 5 week old birds exhibited significantly higher ($P < 0.001$) pHu, darker and redder color with lower cook loss and higher WBC, when exposed to AET below -6°C. Similar results were observed for the 6 week-old birds when AET dropped below -12°C (Fig. 5).

- Results

Acknowledgements

- Exposure to extreme cold environment prior to slaughter resulted in a significantly ($P < 0.001$) lower core body temperature and darker colored breast meat with higher pHu and water holding ability.
- Birds at 6 weeks of age (heavier with more feather coverage) coped better with extreme cold conditions. Their meat quality and welfare parameters were compromised at AET below -12°C compared to -6°C for 5 week-old birds.
- It might be beneficial to limit the length of lairage prior to processing following acute cold stress to improve welfare and reduce meat quality defects.

Conclusions

Figure 1- Temperature distribution inside the drawer when inlet air is at -18 and +20°C.

Figure 2- Change in CBT with time during exposure and lairage for 5 and 6 week-old birds.

Figure 3- Steps in research study; administrating birds with iButtons (a), iButtons for measuring environmental temperature and humidity (b), Bird placement in the drawer (c), simulated transport chamber (d), shackling (e), defeathering (f), iButton recovery (g), meat quality assessment (h), normal and dark breast meat (i).

Figure 4- Effect of AET on GP and pHu of the meat from 5 and 6 week-old birds.

Figure 5- Effect of AET on breast meat color (L*) and PCY from 5 and 6 week-old birds.

Figure 6- Interaction effect of AET with age and lairage on incidence of DFD breast meat.