Turkey breast quality affected by exposure of birds to endotoxin

Deirdre K Titel, James R Claus, and Mark E Cook

Department of Animal Sciences, Meat Science and Muscle Biology Laboratory, University of Wisconsin, Madison, WI 53706

OBJECTIVE

To determine whether nasal exposure of E. Coli 055:B5 endotoxin causes a pink defect in turkey breast.

CONCLUSIONS

- **Results show that in the case of turkey, it appears that endotoxin exposure via the nares has little to no contribution to creating a pink defect.**
- **In contrast, previous research in our lab showed evidence of an effect of 1mg/kg E. coli (055:B5) treatment via intraperitoneal injection on chickens caused a pink defect in breast meat.**
- **Research that leads to a more complete understanding of the physiological differences in endotoxin response between turkeys and chicken to be completed.**

INTRODUCTION

In some cases, uncured cooked poultry can exhibit a pink color even when cooked to temperatures above the safe zone. This pink defect causes a negative consumer reaction resulting in reduction of sales and significant monetary losses for the poultry industry. Endotoxins are naturally present in poultry houses. Exposure to endotoxin causes an immune response in animals in which nitric oxide synthase is induced resulting in increased circulating levels of nitric oxide. Nitric oxide can bind to the heme ring of myoglobin forming nitrosylhemochrome (pink, cured pigment) upon cooking.

METHODS

- **Three trials were completed using 18 hens.**
- **Treated (TRT) and control (CON). Birds were divided into three pre-harvest exposure times (8, 12, and 16 hr).**
- **TRT birds were given doses of 2mg/kg of E. coli (055:B5) in saline solution via the nares. CON birds were given a saline-only solution in each nare.**
- **A 7.6x7.6cm sample was vacuum packaged and cooked in a 77C water bath.**
- **Dependent variable determinations included:**
  - **Raw**
    - **CIE L*a*b*; L*=dark to light, a*=green to red, b*=blue to yellow; chroma and hue (Minolta Colorimeter CR-310)**
    - **Oxymyoglobin (OMb); %R610/%R525 (Model 2101PC, Shimadzu Inc)**
    - **pH, 1 g meat homogenized in 10 g double distilled water, pH electrode (Thermo Orion, Beverly) attached to a pH meter (Accumet AR50; Fischer Scientific)**
  - **Cooked**
    - **CIE L*a*b*; L*=dark to light, a*=green to red, b*=blue to yellow; chroma and hue**
    - **Nitrosylhemochrome extraction (Hornsey, 1956)**
    - **Nitrosylhemochrome (spec); %R650nm/%R570nm**
    - **Nicotinamide (spec); R%537nm/%R553nm**

Fig 1. Nasal injection of endotoxin solution via each nare on hens

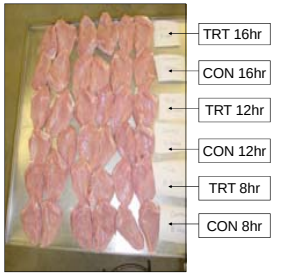

Fig 2. Raw turkey breasts after deboning

RESULTS

- **No differences (P>0.05) were found in endotoxin treatment (main effect) for any of the color measurements and pH (Table 1).**
- **Within TRT, the 16 hr exposure time had higher (P<0.05) nitrosylhemochrome (spec) than 12 hr (Table 2).**
- **No other differences (P>0.05) were found in cooked samples of endotoxin treatment (main effect) for any of the color measurements (Table 2).**
- **Relative to the exposure time main effect, OMb and redness levels were higher (P<0.05) at 8 and 16 hr compared to 12 hr (Table 3).**
- **Nicotinamide levels were higher (P<0.05) at 12 and 16 hr compared to 8 hr (Table 3).**
- **Significant endotoxin treatment by exposure time interactions were found for cooking yield and nitrosylhemochrome (spec). At 16 hr, nitrosylhemochrome (spec) was higher (P<0.05) in the TRT than CON.**

Table 1. Least square means of treatment by time for raw turkey breast samples

Dependent Variable	Endotoxin Exposure Time (hr) 8	12	16
CIE L*			
Control	52.95	52.99	54.17
Treatment	54.05	54.38	54.33
CIE a*			
Control	3.50	2.64	3.06
Treatment	3.19	3.54	3.57
CIE b*			
Control	0.47	1.10	1.62
Treatment	0.90	1.21	1.68
Chroma			
Control	4.25	3.71	4.04
Treatment	3.80	4.07	4.26
Hue			
Control	137.50	118.16	121.90
Treatment	141.00	94.70	61.60
OMb			
Control	1.22	1.17	1.19
Treatment	1.23	1.20	1.21

Treatment x time interaction standard errors:CIE L* (1.146), CIE a* (0.368), CIE b* (0.518), chroma (0.470), hue (30.039), OMb (0.01597). No significant main effects on interactions found (p>0.05).

Table 2. Least square means of treatment by time for cooked turkey breast sample

Dependent Variable	Endotoxin Exposure Time (hr) 8	12	16
CIE L*			
Control	83.07	83.17	83.24
Treatment	83.77	82.30	83.20
CIE a*			
Control	5.75	5.58	5.57
Treatment	5.84	5.95	5.10
CIE b*			
Control	9.70	9.98	9.80
Treatment	10.06	9.80	10.18
Chroma			
Control	11.32	11.49	11.29
Treatment	11.66	11.48	11.41
Hue			
Control	59.71	61.07	60.50
Treatment	59.82	58.79	63.28
Nitrosylhem. (Hornsey 1956)			
Control	0.053	0.037	0.114
Treatment	0.058	0.046	0.081
Nitrosylhem. (spec)			
Control	1.23^{xy}	1.24^{xy}	1.21^{xyb}
Treatment	1.23^{xy}	1.21^{y}	1.24^{xa}

^{ab}means column with dependent variable and exposure time with unlike superscript letters are different (p<0.05). ^{xy}means row with unlike superscipt letters are different (p(0.05). Treatment x time interaction standard errors: CIE L* (0.4590), CIE a* (0.2511), CIE b* (0.178), chroma (0.204), hue (1.154), nitrosylhem. (Hornsey) (0.0318), nitrosyhem. (spectro) (0.0098)

Table 3. Time based means for cooked turkey breast samples

Dependent Variable	Endotoxin Exposure Time (hr) 8	12	16
Redness	1.54^{a}	1.46^{b}	1.48^{ab}
Nicotinamide	1.03^{a}	1.04^{b}	1.04^{b}
Oxymyoglobin (raw)	1.23^{a}	1.19^{b}	1.20^{ab}

^{ab}means row with dependent variable and exposure time with unlike superscript letters are different (p,0.05). Time interaction standard errors: Redness (0.02852), Nicotinamide (0.001988), oxymyoglobin (0.01207)