

Influence of a Semiochemical Analogue on Growing Performances and Meat Quality of Broilers

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ABSTRACT Stress in broilers may have severe consequences on the final product quality. A synthetic analogue of uropygial secretion of mother hens was isolated from poultry. This mother hen uropygial secretion analogue (MHUSA) was tested in farm conditions on broilers during 12 wk. The purpose of this trial was to estimate the influence of MHUSA on growing performances, meat characteristics after processing, and stress indicators of broilers. After the 80-d period, birds under treatment were heavier at 3 different weighing ages ($P \leq 0.01$, $P \leq 0.01$, and $P \leq 0.05$ at 21, 63, and 80 d of age, respectively) and had higher file weights. A strong correlation between file weight and carcass weight was found ($R^2 =$

0.83). No correlation between abdominal fat and carcass weight or between abdominal fat and file weight was observed. There was no significant difference among treatments concerning abdominal fat. Corticosterone level was higher for birds under placebo treatment ($P \leq 0.05$). No statistical difference was observed for mixed sexes concerning file weight lost from 24 h to d 6 post-mortem. After the cooking procedure, samples from the MHUSA group were less yellow compared with the control ($P \leq 0.05$). Our conclusion is that the tested semiochemical MHUSA has an influence on live weights, file weights, and corticosterone levels in Label broilers grown to 80 d of age. Constant exposure to the MHUSA enhances growth without decreasing meat quality.

Key words: broiler, stress, semiochemical, growth, quality

2006 Poultry Science 85:2112–2116

INTRODUCTION

Meat quality is a major issue in the process industry, mainly because consumers are demanding. Today, processing plants need to determine their own meat quality values, such as color, cook loss, or fat content. Described in other productions, pale, soft, and exudative (PSE) meat has seldom been related in poultry. These meats show low water-holding capacity, bad textural properties, and reduced protein extractability (Tankson et al., 2001). A relationship does exist among color, pH, and water-holding capacity (Fletcher, 1999; Woelfel et al., 2002). For example, pigs with PSE meat lose 5% more water during cooking compared with a standardized normal meat (Tankson et al., 2001). Mallia et al. (1998) also reported dark, firm, and dry carcasses in broilers. It has been shown that stress in poultry has severe consequences on the final product quality: pH, pigmentation, water-holding capacity, or fat percentage (Fletcher,

1999). Stress-related indicators are known to be heterophil:lymphocyte (H:L; Puvaldolpriod and Thaxton, 2000) and the corticosterone level (Post et al., 2003). A secretion from the uropygial gland of mother hens was isolated from poultry (*Gallus gallus*) under natural conditions. This secretion shows a chemical pattern comparable to the calming pheromones discovered in mammals (pigs, horses, dogs, etc.) that have a calming effect on their young (Moltz and Leet, 1981; Mc Glone and Anderson, 2002; Pageat and Gaultier, 2003). The native secretion, composed of fatty acids, is produced continuously from 4 d before hatching until separation occurs. A synthetic analogue [mother hen uropygial secretion analogue (MHUSA)] has the same composition as the native substance. Therefore, MHUSA has a potential to reduce stress in domestic chicken, particularly in farming conditions (Madec et al., 2005). The purpose of this trial was to estimate the influence of MHUSA on growing performances and meat characteristics of broilers after processing.

MATERIALS AND METHODS

Birds

A total of 17,600 broilers (strain SASSO T56N) were used in the study. Birds were housed in 2 similar 400-

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Received March 17, 2006.

Accepted July 12, 2006.

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Table 1. Carcass weight and abdominal fat weight at 24 h and 6 d postmortem¹

Item	Placebo		MHUSA		Significance (<i>P</i> -value)			SD
	Males	Females	Males	Females	Treatment	Sex	Treatment × sex	
CW	2,126.3 ± 36.8	1,646.4 ± 28.1	2,221.0 ± 29.9	1,682.5 ± 32.1	*	***	NS	195.0
Ab. Fat	40.11 ± 2.67	42.87 ± 3.20	43.35 ± 3.07	44.23 ± 2.51	NS	NS	NS	17.6

¹Means are indicated ± SE; CW = carcass weight (g); Ab. Fat = abdominal fat weight (g); MHUSA = mother hen uropygial secretion analogue. **P* ≤ 0.05; ****P* ≤ 0.001.

m² separate buildings (4,400 birds in each building) and had free access to water and food. The soil was covered with wood shavings. Birds stayed 12 wk on the farm, and they had free access to the outdoors from the age of 4 wk until slaughter.

Experimental Design

Birds in building A received a placebo treatment, whereas birds in building B received the semiochemical treatment (MHUSA). After 12 mo, a replication occurred, meaning that birds in building B received the placebo treatment, whereas birds in building A received the MHUSA treatment. Both batches were studied using exactly the same design. The treatment (placebo or MHUSA) was included in a manufactured slow-releasing shape weighing 150 g. Each block contained 2% of the semiochemical and released (passive diffusion) it during 4 wk. Blocks were hanged 150 cm above the ground, out of birds’ reach. A total amount of 24 blocks (3 replacements × 8 blocks) were used per building. The placebo product consisted of blocks of the same aspect as the MHUSA ones, containing just the matrix. The treatment started on the day previous to the arrival of the chickens (noted d 0).

Observed Indicators

Body live weights were computed for 300 individuals per building. Each bird was chosen at random. For each

batch, birds were weighed on d 21, 63, and 80 (1 d before slaughter). On d 80, blood samples were performed on 220 individuals. The blood was collected via the wing vein and conserved in EDTA tubes. The physiological blood indicators consisted of H:L and corticosterone levels. Heterophil:lymphocyte was estimated from blood film smears using May-Grunwald and Giemsa stains (Lucas and Jamroz, 1961). Corticosterone level was determined by the RIA method (De Jong et al., 2001). Carcasses were dissected 24 h postmortem. For all of the following measurements, 160 chickens were used (80 for each treatment). Dead weights and pectoralis major weights (both right and left) were measured, in addition to abdominal fat weight. After evisceration, body parts subject to measurements were excised, using the same procedure for all birds, performed by the same technician. All measurements were performed inside a refrigerated room (+2°C). Each bird was chosen at random before operating measurements. Measurements were performed in the same order, following a method described by Fletcher et al. (2000). After excision and weighing, muscle pH was recorded using a pH meter (model CG 843, Schott UK Ltd., Stafford, UK). The electrode was inserted into the anterior area of the ventral part of the pectoralis major at a 100-mm depth. Each pectoralis major was then stored at +4°C in appropriate polyethylene bags for further pH measurements. Color was measured on the posterior area of the ventral side using a colorimeter (model CR-10, Minolta Corp., Ramsey, NJ). Color values were in agreement with the Inter-

Table 2. Filet weight, filet pH, and color indicators observed at 24 h and 6 d postmortem¹

Item	Placebo		MHUSA		Significance (<i>P</i> -value)			SD
	Males	Females	Males	Females	Treatment	Sex	Treatment × sex	
FWh24	255.5 ± 4.0	217.3 ± 4.1	265.3 ± 4.4	229.1 ± 4.8	*	***	NS	25.7
FWd6	242.7 ± 4.0	203.4 ± 4.2	238.4 ± 4.2	218.1 ± 4.2	*	***	NS	25.2
FpHh24	5.96 ± 0.02	5.89 ± 0.01	5.87 ± 0.02	5.88 ± 0.02	NS	**	**	0.1
FpHd6	5.78 ± 0.02	5.84 ± 0.02	5.87 ± 0.02	5.83 ± 0.02	*	NS	NS	0.1
L*h24	-48.20 ± 1.48	-47.91 ± 1.44	-48.03 ± 1.44	-47.16 ± 1.44	NS	NS	NS	8.7
L*d6	-47.82 ± 1.30	-47.46 ± 1.29	-47.81 ± 1.20	-47.02 ± 1.22	NS	NS	NS	7.8
a*h24	1.42 ± 0.31	1.37 ± 0.25	1.22 ± 0.28	1.55 ± 0.25	NS	NS	NS	1.7
a*d6	0.21 ± 0.19	0.42 ± 1.19	0.54 ± 0.23	0.23 ± 1.34	NS	NS	NS	1.3
b*h24	6.18 ± 0.48	6.56 ± 0.36	5.28 ± 0.46	6.58 ± 0.36	NS	NS	NS	2.6
b*d6	3.83 ± 0.26	4.65 ± 0.26	3.33 ± 0.22	4.41 ± 0.23	NS	***	NS	1.5

¹Means are indicated ± SE; FWh24 = filet weight (g) 24 h postmortem; FWd6 = filet weight (g) 6 d postmortem; FpHh24 = filet pH 24 h postmortem; FpHd6 = filet pH 6 d postmortem; L*h24 = lightness (L*) measurement 24 h postmortem; L*d6 = L* measurement 6 d postmortem; a*h24 = redness (a*) measurement 24 h postmortem; a*d6 = a* measurement 6 d postmortem; b*h24 = yellowness (b*) measurement 24 h postmortem; b*d6 = b* measurement 6 d postmortem; MHUSA = mother hen uropygial secretion analogue.

P* ≤ 0.05; *P* ≤ 0.01; ****P* ≤ 0.001.

Table 3. pH and color indicators in the precooking and postcooking procedure (35-g sample)

Item	Placebo		MHUSA		Significance (P)			SD
	Males	Females	Males	Females	Treatment	Sex	Treatment × sex	
Precooking								
pH	5.87 ± 0.02	5.86 ± 0.02	5.88 ± 0.01	5.83 ± 0.01	NS	*	NS	0.1
L*	-48.46 ± 1.04	-47.93 ± 1.15	-47.77 ± 1.04	-47.77 ± 1.19	NS	NS	NS	6.8
a*	0.58 ± 0.15	0.53 ± 0.18	0.49 ± 2.05	0.23 ± 1.20	NS	NS	NS	1.1
b*	5.64 ± 0.50	6.33 ± 0.32	4.82 ± 0.23	5.76 ± 0.22	*	*	NS	2.1
Postcooking								
pH	6.18 ± 0.02	6.15 ± 0.02	6.15 ± 0.02	6.14 ± 0.01	NS	NS	NS	0.1
L*	-48.85 ± 5.07	-48.23 ± 4.90	-47.76 ± 5.02	-49.11 ± 5.10	NS	NS	NS	31.3
a*	2.71 ± 0.31	2.94 ± 0.32	3.39 ± 0.31	2.88 ± 0.29	NS	NS	NS	1.9
b*	15.33 ± 0.34	17.15 ± 0.30	15.91 ± 0.34	16.41 ± 0.37	NS	**	NS	2.1

¹Means are indicated ± SE; L* = lightness; a* = redness; b* = yellowness.

* $P \leq 0.05$; ** $P \leq 0.01$.

national Commission on Illumination system, using lightness (L*), redness, and yellowness (b*) compared with a standardized color reference (white). At 6 d postmortem, each pectoralis major was removed from its bag and wiped for additional measures. At this stage, weight, pH, and color were recorded. For meat surface color measurements, selected areas were free from obvious defects (bruises, hemorrhages, and other damages) that might have affected uniform color reading. A 35-g sample from the left anterior side of the left pectoralis major was then analyzed for weight, pH, and color before and after cooking. The cooking procedure consisted of placing each sample in a microwave for 60 s at 850 W of power. Samples were then kept at room temperature (22°C) for 90 min to cool down before measurements. Results were considered for males, females, and mixed sexes, except for weighing, because there was not enough sexual dimorphism at the age of the first weighing.

Statistical Analysis

Pooled data were examined by ANOVA using Systat Version 10 software. Comparisons were made between the placebo and MHUSA treatments after replication. We looked for the treatment and sex effect for each indicator. Significance was expressed as at least $P \leq 0.05$.

RESULTS

A sex effect (males > females; $P \leq 0.001$) and a treatment effect (MHUSA > placebo; $P \leq 0.05$) were observed on carcass weights (Table 1). Results dealing with file

variables at both 24 h and 6 d postmortem are presented in Table 2. Filet weights were higher for the MHUSA group for both measurements ($P \leq 0.05$). Filet weights were also higher for males concerning both measurements ($P \leq 0.001$). We observed a sex effect ($P \leq 0.01$) and a significant interaction of sex × treatment of pH at 24 h postmortem ($P \leq 0.01$). Filets from chickens under MHUSA had higher pH at 6 d postmortem compared with the placebo ($P \leq 0.05$). At this stage, females had higher b* values compared with males ($P \leq 0.001$). Color and pH values are presented in Table 3. Sex effect appeared to be significant on precooked sample pH (pH of males > pH of females; $P \leq 0.05$). Before the cooking procedure, a treatment effect was observed on b* (placebo > MHUSA; $P \leq 0.05$). Observed before and after the cooking procedure, sex effect was also significant on the b* values (females > males; $P \leq 0.05$ and $P \leq 0.01$, before and after procedure, respectively). Physiological indicators differed according to sex, as shown in Table 4. The corticosterone level showed a remarkable sex effect (males > females; $P \leq 0.01$) as well as H:L (males > females; $P \leq 0.001$). Corticosterone levels were lower for the MHUSA group for both males and females ($P \leq 0.05$), whereas we observed no difference on H:L. As shown in Table 5, birds under semiochemical treatment (MHUSA) were heavier at all weighing ages ($P \leq 0.01$, $P \leq 0.05$, and $P \leq 0.05$ at d 21, 63, and 80, respectively). We found a strong correlation between filet weights and carcass weights ($R^2 = 0.83$) but no correlation either between abdominal fat and carcass weights or between abdominal fat and filet weights. There was no significant difference among treatments concerning abdominal fat. No statistical difference was observed for mixed sexes for

Table 4. Heterophil:lymphocyte (H:L) and corticosterone (CS) level from blood samples at d 80¹

Item	Placebo		MHUSA		Significance (P)			SD
	Males	Females	Males	Females	Treatment	Sex	Treatment × sex	
H:L	0.324 ± 0.026	0.231 ± 0.022	0.402 ± 0.047	0.276 ± 0.030	NS	**	NS	0.21
CS (ng/mL)	16.42 ± 0.46	9.91 ± 0.81	13.39 ± 0.89	8.55 ± 1.00	*	***	NS	6.9

¹Means are indicated ± SE; MHUSA = mother hen uropygial secretion analogue.

* $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$.

Table 5. Live weight, depending on bird age¹

Day	Placebo (g)	MHUSA (g)	Significance (P-value)	SD
21	276.7 ± 6.1	294.3 ± 3.2	**	0.1
63	1,722.5 ± 23.2	1,801.3 ± 19.5	*	0.3
80	2,233.4 ± 21.5	2,298.6 ± 22.1	*	0.4

¹Means are indicated ± SE; MHUSA = mother hen uropygial secretion analogue.

* $P \leq 0.05$; ** $P \leq 0.01$.

filet weight loss from 24 h to 6 d postmortem concerning treatment. After the cooking procedure, lost water was comparable between the 2 observed groups (16.1 and 16.7%). Filets from the MHUSA group showed lower pH variations from 24 h to 6 d postmortem ($P \leq 0.05$).

DISCUSSION

According to our observations, no chronic stress happened during the trial, which is in accordance with the absence of a significant difference on H:L (Campo et al., 2005). Fletcher et al. (2000) and Fletcher (1999) showed that the stress before slaughter may have many consequences on meat quality, such as decrease of the shear value by increasing water-holding capacity, lower L* value, and higher redness value. Our results tended to show that the semiochemical has no effect on the stressors at the slaughter place, because we observed no difference between the 2 treatments concerning indicators discussed by Fletcher et al. (2000). On the one hand, according to a review by Barbut et al. (2005) on 40-d-old broilers, studied characteristics would classify the studied meat for pH and cooking loss as PSE-like meat and as normal for L* values 24 h postmortem. On the other hand, results by Petracci et al. (2004) would classify the studied meat as dark regarding L* values and cooking loss, but as pale for pH. Because no difference has been observed between both groups on cited meat indicators, we can only conclude that the studied samples were in average ranges. Differences observed between sexes in b* could be due to a higher fat percentage of females compared with males (Boorman and Wilson, 1977). The observed sex effect on weight measurements seems logical regarding gender influence (Woelfel et al., 2002). Fletcher (1999) showed that acute stressors such as struggle and fight lead to a decrease of the glycogen supply. This argument, related to the observed corticosterone level difference, could explain the lower pH variation (from 24 h to 6 d postmortem) of meat in birds under MHUSA. Davison et al. (1982) showed that in the case of corticosterone-induced stress, birds had lower live weights, but they found no differences on the fat content and food intake. In our results, we observed the same tendency: lower corticosterone levels and higher live weights in the MHUSA group, hypothetically less stress, and no significant difference on abdominal fat. We observed a correlation between carcass weight and filet weight but no correlation between fat and carcass

weight, thus we can argue that birds under MHUSA were not heavier because of a higher fat content. Indeed, abdominal fat is known to be correlated with body fat content (Alleman et al., 1999). Siegel (1995) showed that stress leads to lower live weights compared with chickens that are not stressed or that are less stressed, which is in accordance with our findings. Thus, we could hypothesize that classical housing conditions are not optimal because of stressing conditions, because a reduction of stress leads to a better growth, as shown by our BW measurements under the treatments. This study showed that the tested semiochemical has an influence on live weight, filet weight, and corticosterone level in Label broilers grown within 12 wk. Constant exposure to the MHUSA enhances growth without decreasing meat quality.

ACKNOWLEDGMENTS

We thank the breeder and employees from the slaughter place, the Syndicat des volailles de l'Ain, and all employees.

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