

## Effects of a semiochemical on feed conversion index and related indicators on fast-growing broilers housed during forty-two days

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**ABSTRACT** Consequences of stress in poultry may be assessed through a wide range of parameters. A semiochemical named mother hen uropygial secretion analogue (MHUSA) is known to decrease stress in broilers. Because stress influences their feeding behavior, this trial has been built so as to test the influence of MHUSA on feed conversion index and related indicators. Two hundred forty chicks were placed into 24 similar crates (10 chicks per crate) at 1 d of age. After 35 d, chickens under MHUSA presented similar feed conversion index compared with control. A treatment

effect was observed on both heterophil:lymphocyte ratio and corticosterone (MHUSA < control;  $P \leq 0.001$  for both), indicating a lower level of stress under MHUSA. Glucose, total cholesterol, and triglyceride values were comparable among treatments. Live weight and daily weight gain were greater under MHUSA ( $P < 0.01$  for both), whereas daily food intake was comparable among treatments. It may be concluded from this study that broilers under MHUSA tend to better assimilate food, leading to a faster growth, because they cope better with stress in their surrounding.

**Key words:** broiler, stress, semiochemical, feed conversion, welfare

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### INTRODUCTION

Consequences of stress in birds may be assessed through a range of parameters. For example, stress affects welfare, because it decreases complexity of both locomotor and resting sequences (Maria et al., 2004). The level of stress may also be observed through blood parameters. Mainly, the heterophil:lymphocyte ratio (**HLR**) and the corticosterone (**CS**) concentration are observed to assess stress in poultry (Thaxton et al., 2006). Secondary blood parameters are also known to be influenced in a stressing situation, because stress causes elevation in glucose (**GLU**) and total cholesterol (**CHOL**), whereas triglyceride (**TRI**) concentration is decreased (Mumma et al., 2006). In stressed broilers, one can observe both low growing performances (Siegel, 1995) and weight gain (Zulkifli et al., 2002). The synthetic analog of a semiochemical, named mother hen uropygial secretion analogue (**MHUSA**), is known to have favorable effects on broilers by lowering HLR and CS concentration, thus decreasing the stress response (Madec et al., 2005, 2006). The native semiochemical is secreted from the uropygial gland of mother hens (*Gallus gallus*) when isolated in natural mothering condi-

tions. It has a similar effect compared with the specific appeasing pheromones of the species mainly described in mammals (Moltz and Leet, 1981; McGlone and Anderson, 2002; Pageat and Gaultier, 2003). The native secretion of the hen, composed of fatty acids, is produced continuously from 4 d before hatching until separation occurs (Pageat, 2002). Madec et al. (2006, 2008) showed that both carcass weights and growth rate improved using MHUSA. According to Mumma et al. (2006), stress leads to proteinic catabolism and increases food and water consumption. Authors added that stress has a negative effect on feed conversion. Moreover, according to several studies (Richards, 2003; Maria et al., 2004), the feeding behavior of broilers is disturbed by stress. Thus, because stress influences feeding behavior, we hypothesize that less stressed broilers would tend to better utilize food. Because MHUSA has a potential to decrease stress, it could thus influence feeding efficiency in broilers. The following trial was designed to assess the stress-decreasing effect of MHUSA on the feed conversion index (**CI**) and other related stress indicators.

### MATERIALS AND METHODS

#### *Birds and Housing Conditions*

Two identical buildings were used for the study. Each one was divided into 6 identical crates of 120 cm ×

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125 cm each. Apart from dimensions, these crates were comparable to basically floored pens. In each crate, a heater (infrared light) was provided during the first week. Artificial light was maintained at 23L:1D providing 20 lx per building when light was on, whereas temperature, hygrometry, and dead birds were checked twice a day. A total of 240 broilers (strain Ross PM3) were utilized in the study. There were 60 birds in each building for each one of the 2 trials, using a 1:1 sex ratio as in conventional husbandries. Five males and 5 females were placed at 1 d of age in each crate. Each bird was individually identified by numbered wing tags before placement. Animals had free access to water and a nutritional adequate diet. A starter diet was provided during the first 18 d, and a growing-finishing diet was provided from 19 to 42 d. Animal care and sample collection were performed according to the 95/29/CE European convention.

### **Treatment**

The product tested in our experiment is a synthetic analog of an odorous secretion coming from the uropygial glands of hens (also known as the preening gland). Our treatment was identical to the one tested and described in the study by Madec et al. (2006). Briefly, the treatment was incorporated into a gelatin matrix block composed of water (135 g), nonionic surfactant (7 g), and a gelling gum (5 g), plus either 3 g of water (control) or 3 g of MHUSA. This gelatin matrix block (control or MHUSA) was held in specially manufactured perforated plastic containers suspended 120 cm above the ground, out of reach of the birds. Because they are fatty acid methyl esters, the components of MHUSA are heavier than air, and this delivery arrangement allowed the treatment to diffuse into the air around the birds. Finally, treatment was blinded, because it was impossible to tell the difference between MHUSA and control matrixes (difference in odor and appearance is impossible to make), and the persons involved in the trial were unaware of which group was given which treatment.

### **Experimental Design**

Two buildings and 2 batches were utilized in the experiment: building A and building B. In the first trial, birds in building A acted as control (received control containers), whereas birds in building B received the semiochemical (MHUSA containers). After the first trial was done (meaning birds were slaughtered), a 14-d clean-out was conducted on the research facilities. After the clean-out, a replication occurred (meaning arrival of new day-old birds): birds in building B acted as control, whereas birds in building A received the MHUSA treatment. A total amount of 24 blocks (4 replacements  $\times$  6 blocks) was used per building and per batch, meaning 1 block was provided per crate and was replaced every

10 d. Both trials were conducted in the same manner. This experimental design was chosen, first to be free of a potential building effect and second to avoid any cross contamination of treatments from one building to another. Because MHUSA is a semiochemical, it could not be placed in the same building as the controls. Because of this treatment fashion, we randomized treatments on buildings rather than on chickens.

### **Indicators**

Each bird was individually weighed 11 times (Bird Weighing System 1050, Weltech International Ltd., Cambridgeshire, UK): once the first week, then twice a week. Feed intake was measured the same days birds were weighed (i.e., twice weekly) so that the CI could be calculated for each period. Feed conversion index, the main dependent variable, was calculated by dividing daily feed consumption by daily weight gain (**DWG**). Data collected allowed for the determination of CI, daily food intake (**DFI**), DWG, and live weight (**LW**). On d 39, blood samples were pulled on each bird. The blood was collected via the brachial vein and conserved in EDTA tubes. The physiological blood indicators (HLR and CS) were studied at d 39, three days before slaughter. Heterophil:lymphocyte ratio was estimated from blood film smears using May-Grunwald and Giemsa stains (Lucas and Jamroz, 1961). The CS concentration was determined by RIA method (De Jong et al., 2001). Both HLR and CS were measured by a specialized laboratory (LDH, ENV Nantes, La Chantrerie, Nantes, France). Apart from these 2 blood indicators, we also measured GLU, CHOL, and TRI. Glucose, CHOL, and TRI were analyzed by a private independent laboratory (Aubert-Verneuil, Apt, France) and determined using an autoanalyzer (Ektachem model DT60, Kodak, Paris, France) using enzymatic procedures (Elliott, 1984).

### **Statistical Analysis**

To eliminate the potential effect of the blood sampling on feeding behavior, the d 35 results were analyzed. First, we thought that blood samples could have had an effect on feeding behavior and thus on many linked parameters. Second, we wanted to analyze each parameter (except from blood sample) on the same basis (i.e., d 35). Results dealt with data from either 240 values (10 birds  $\times$  12 crates, replicated) or with 24 values (12 crates, replicated), depending on available data. The bird represented the experimental unit (240 values) for the dependent variables blood and growth parameters. The crate was the experimental unit (24 values) for CI, DFI, and our main parameter was CI. Results were analyzed using the Statistica 5.0 software (Statsoft, Tulsa, OK), and means that were significantly different (MHUSA vs. control) at the  $P < 0.05$  were separated using the repeated  $t$ -test.

**Table 1.** Influence of mother hen uropygial secretion analogue (MHUSA) treatment on individual performance indicators at d 35<sup>1</sup>

Item	Control	MHUSA
Feed conversion index	1.85 ± 0.20	1.78 ± 0.10
Live weights (g)	1,130 ± 294	1,238 ± 331**
Daily weight gain (g)	32.3 ± 8.4	35.4 ± 9.5**
Daily food intake (g)	2,093 ± 305	2,344 ± 538

<sup>1</sup>Means are indicated ± SE.\*\**P* < 0.01.

## RESULTS

Growing conditions of birds were comparable among treatments, because we did not observe any difference either in temperature ( $34.9 \pm 5.7^\circ\text{C}$  vs.  $34.1 \pm 4.4^\circ\text{C}$ , for MHUSA and control, respectively, for the overall period) or percentage of hygrometry ( $52.6 \pm 14.8$  vs.  $52.9 \pm 14.9$ , for MHUSA and control, respectively, for the overall period). Moreover, we noted comparable results concerning dead birds, because we observed a total of 8 and 7 dead birds in MHUSA and control, respectively. As presented in Table 1, there were no significant differences between treatments for CI and DFI, whereas LW and DWG were significantly heavier for the MHUSA ( $P < 0.01$  for both). Results from blood samples are presented in Table 2. There was a treatment effect for both HLR and CS, which were lower in the MHUSA group ( $P < 0.001$  and  $P < 0.001$  for HLR and CS, respectively). None of the other blood indicators showed such a difference. Indeed, GLU, CHOL, and TRI values did not show any difference among treatments.

## DISCUSSION

Previous studies using MHUSA in broilers showed that birds under this semiochemical had greater LW compared with control (Madec et al., 2005, 2006, 2008). The current study results are similar for LW, but the results did not support the hypothesis that CI would be improved for broilers exposed to MHUSA. It appears that broilers treated with MHUSA tend to be heavier, whereas their food consumption is not significantly different, although greater, to that of the control birds. This may explain the lack of significant difference in CI among treatments. Nevertheless, our values of CI are in accordance with previous observations (Coufal et al., 2006), but LW appear lower compared with other studies (Mehaffey et al., 2006). It appears that brooding conditions did not support optimal performance. The test sites probably did not provide adequate environmental control leading to temperature variations, which are known to influence growth in chicken (Lin et al., 2005). Nevertheless, in our experiment, temperature and hygrometry were comparable among treatments, whereas mortality was similar among treatments and below references, stated at 1.5% of the total population by Hadorn et al. (2002). These observations mean that

**Table 2.** Influence of mother hen uropygial secretion analogue (MHUSA) treatment on blood indicators at d 39<sup>1</sup>

Item <sup>2</sup>	Control	MHUSA
HLR	0.355 ± 0.220	0.269 ± 0.109***
CS	10.1 ± 12.2	3.8 ± 7.1***
GLU	2.57 ± 0.27	2.52 ± 0.28
CHOL	1.28 ± 0.22	1.31 ± 0.27
TRI	0.92 ± 0.35	0.98 ± 0.40

<sup>1</sup>Means are indicated ± SE.<sup>2</sup>HLR = heterophil:lymphocyte ratio; CS = corticosterone (ng/mL); GLU = glucose (g/L); CHOL = cholesterol (g/L); TRI = triglycerides (g/L).\*\*\**P* < 0.001.

current breeding conditions were acceptable, even if not idealistic, for animal growth and welfare. Moreover, our stocking density was well below commercial densities (Omeira et al., 2006). The current study utilized 10 birds per crate, which was 7 birds/m<sup>2</sup> as compared with 20 birds/m<sup>2</sup> observed in some farms. It is known that birds show changing behavior patterns under stress, because they tend to be less active and eat less often (Nielsen, 1999), which is in accordance with our observations. Moreover, Maria et al. (2004) pointed out a lower activity in stressed birds because of lower body energy level, and Mumma et al. (2006) described lower growth curves in case of adrenocorticotrophic hormone-induced stress in laying hens. In pigs, a synthetic maternal pheromone, similar to MHUSA, is known to have a potential to stimulate feeding behavior and weight gain in piglets (McGlone and Anderson, 2002). These references showed that MHUSA may have decreased stress level but also increased activity and feeding behavior. This hypothesis is in accordance with results by Bohus et al. (1987) showing a correlation between feeding behavior and CS concentration and with those of Tachibana et al. (2007), which proved the existing positive relationship between CS concentration and anorexia. The current results show that the CS concentration was lower for the MHUSA-exposed birds, which supports the theory that MHUSA decreases stress. This is similar to a previous study testing MHUSA in broilers, in which MHUSA lowered CS (Madec et al., 2006, 2008). Observed differences in DWG tend to show that chicks exposed at an early age to MHUSA are positively influenced, because LW at d 7 is correlated to LW at both d 21 and 42 (Gonzales et al., 2003). In their study, these authors did not find any differences in HLR, indicating no chronic stress state, which is not similar to the current results. In our study, the difference observed in HLR among treatments may be due to the repeated visits due to experimental needs. The presence of humans could be considered a disturbing event (Luescher and Sheehan, 2005) and thus affect both HLR and CS if repeated. The 3 remaining blood parameters (GLU, CHOL, and TRI) were apparently not influenced by the treatment, which is different from what had been found in other studies in which a stressing situation tended to increase these values (Puvadolpirod and Thaxton,

2000; Mumma et al., 2006). It has to be noted that these studies used a model of stress by continuous adrenocorticotrophic hormone injection. This is different from the present study. Thaxton et al. (2006) found no influence on GLU, CHOL, and TRI on a stressing situation in overcrowded male broilers, whereas CS showed greater values compared with control. Our findings appear logical, because body fat content and concentration of TRI are linked (Oh et al., 2007). Indeed, a comparable TRI concentration between treatments reaches conclusions similar to those by Madec et al. (2006), who observed no statistical differences in body fat between MHUSA and control. It could thus be hypothesized that the observed weight difference is due to muscle metabolism. It would then appear that birds under MHUSA could transform eaten food in a valuable way. Because MHUSA seems to be specific to poultry, it could be compared with the fact that newborns are attracted to breast odors in humans (Porter and Winberg, 1999), indicating a relationship between a mother semiochemical and feeding behavior of related young. We planned behavioral observations in subsequent studies to ascertain if the mother semiochemical MHUSA influences feeding behavior in broilers. Finally, it seems possible that, as a consequence of better food utilization, the litter pH could be lowered in less stressed birds because of a better amino acid utilization and decreased nitrogen excretion (Pope et al., 2004). This could result in a decreased ammonia volatilization in broiler houses (Burgess et al., 1998), but additional studies are needed to ascertain this hypothesis and to fully understand chain reaction from the diffusion to specific reaction due to MHUSA.

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