



DOI: 10.1515/isspar-2015-0035

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## **INFLUENCE OF CROWDING ON BODY MASS, SERUM TOTAL PROTEIN AND AMINOTRANSFERASE (ALT, AST) CONCENTRATION AND ACTIVITY IN THE FERAL PIGEON *COLUMBA LIVIA F. URBANA***

### ABSTRACT

19 males and 24 females of feral pigeons *Columba livia f. urbana* were transferred from a room with 1.4 individuals/m<sup>3</sup> to one with 3.1 individuals/m<sup>3</sup>. They were fed *ad libitum* during the entire experiment. Body mass, blood serum total protein and transaminase (ALT, AST) concentrations were measured. After a 40-day period of crowding, a statistically significant decrease in serum total protein was observed for both sexes. This resulted in a mean 16.1 g body mass increase in females. An increase in ALT transaminase activity in females was also observed. Therefore, a high density of 3.1 individuals/m<sup>3</sup> (“crowding”) does not seem to cause significant distress in feral pigeons.

**Key words:** Pigeon, *Columba livia f. urbana*, body weight, total protein, AST, ALT, crowding

### INTRODUCTION

Pigeons are widely used as experimental models in biomedical research. Blood tests allow the evaluation of an individual’s health status, and, therefore, every patient facing a medical treatment must first visit the laboratory.

Blood serum total protein concentration is a very important indicator used in health assessment. A lowered level can be caused by protein-losing nephropathy, enteropathy or liver failure, and may indicate colloid (hydroxyethyl starch) supplementation. An increase in total protein may be caused by dehydration or inflammatory diseases (Finco 1997, Harr 2002).

Enzymes catalyzing amino acid interconversion by amino group transfer are called aminotransferases or transaminases. Aspartate aminotransferase (AST) (formerly glutamate oxaloacetate transaminases, GOT) and alanine aminotransferase (ALT) (formerly glutamate pyruvate transaminases, GPT) are diagnostically important. High levels of aspartate transaminase are found in many different tissues, mostly in liver and muscles (Kendal 2002). The concentration of AST and ALT in blood serum is low. Elevated aminotransferases levels are evidence of muscle or liver cells damage. Therefore, these enzymes are believed to be important biomarkers.

Pigeons can be reared for meat (Sales and Janssens 2003). Since the early 1990s commercial production of squab (young pigeons) takes place in North America (Sales and Janssens 2003, Stanhope 1978). African countries, e.g. Nigeria (Adang et al. 2008), also show an interest in this kind of meat production. One pair of pigeons can raise about 15 squabs per year (Johnston and Janiga 1995). This is not a highly efficient method to produce animal protein, but pigeon meat is considered a delicacy.

Due to economic factors, commercial poultry breeding is always related to a decrease of available space for the birds. Therefore, we investigated the influence of space limitation (hereinafter referred to as "crowding") on body mass, blood serum total protein and aminotransferase (alanine (ALT) and aspartate (AST)) concentration in the feral pigeon *Columba livia f. urbana*.

## MATERIALS AND METHODS

The study on adult feral pigeons was conducted from December 2004 to January 2005, after the birds had moulted but before intensification of the breeding season. All individuals originated from the population inhabiting the old city of Słupsk, in northern Poland (54°28' N, 17°10' E). The birds were kept in a tenement attic of 102 m<sup>3</sup> and tagged with colour bands. Their sex was determined by observations of sexual behaviour. During the entire experiment the birds were fed *ad libitum* with R372 food (Central Soya Twaróg) for pigeons in non-breeding period. The food contained energetic ingredients as well as vitamins which met the energetic need of wintering pigeons. Access to water was also unlimited. Individuals chosen for the experiment did not show any visible symptoms of disease. All birds survived the entire experiment which was assured by their good health status. Before the experiment, all pigeons were kept together in a spacious and closed attic, at a density of 1.4 individuals/m<sup>3</sup>. Condition of the crowding experiment was 3.1 individuals/m<sup>3</sup>. Blood samples were collected from all experimental birds immediately before and after the experiment.

Blood samples (1.5 ml) were collected from the brachial vein of 19 male and 14 female pigeons in non-heparinized test tubes. Clotted blood was centrifuged and the separated serum transferred to clean tubes for further biochemical analysis.

Body mass was determined with a dynamometric scale (Pesola) with 1 gr accuracy. Afterwards, the animals were transferred to the experimental room of 44 m<sup>3</sup>. After 40 days of the experiment body mass was determined again.

Biochemical analysis was done with a Cobas Mira (Roche) biochemistry analyzer, with the use of human blood serum biochemistry reagent sets (Cormay).

Blood serum total protein concentration was measured using the biuret test. Aminotransferase (ALT and AST) activity was determined by the enzymatic rate method.

Because the data samples were not normally distributed, the Wilcoxon signed-rank test was used. Differences were considered significant at a level of  $p < 0.05$ . All statistics were done using Statistica 12.5 (StatSoft).

## RESULTS AND DISCUSSION

Excessive proximity between individuals, generated by crowding, causes an increase in stress which can manifest itself as a change in blood biochemistry indices. Table 1 summarizes the results.

Table 1. Mean and standard deviation of body mass and blood serum biochemical parameters of feral pigeons before and after crowding. Statistically significant differences ( $p < 0.05$ ) are marked in red.

Parameter	Males (N=19)			Females (N=14)		
	Before crowding	After crowding	P value Wilcoxon test	Before crowding	After crowding	P value Wilcoxon test
Body mass [g]	441.8 ± 50.1	439 ± 59.6	0.28	387 ± 24.6	403.1 ± 29.4	<b>0.03</b>
Protein [g/dL]	4.3 ± 0.4	3.8 ± 0.5	<b>0.004</b>	4.6 ± 0.5	4.1 ± 0.6	<b>0.02</b>
AST [IU/L]	127.8 ± 37.6	123.5 ± 32.5	0.63	104.9 ± 53.7	114.5 ± 26.0	<b>0.03</b>
ALT [IU/L]	34.3 ± 7.6	30.5 ± 9.1	0.05	32.0 ± 13.6	32.7 ± 14.9	0.83

Before as well as after crowding, females were significantly lighter than males, with difference of 55 g ( $p < 0.0002$ ) and 36 g ( $p < 0.04$ ), respectively. A statistically significant increase in mean body mass by 16 g ( $p < 0.03$ ) after crowding was noted in females. Because all birds had unlimited access to food during the entire experiment, changes in mass cannot be linked to feeding. Body mass is helpful in the assessment of health condition in birds (Krementz et al. 1989, Tinbergen and Boerlijst 1990, Gaston 1997).

We observed lower levels of blood serum total protein concentration in males before and after the experiment. Also, a significantly lower value was recorded in males before crowding ( $p < 0.01$ ). Despite unlimited access to food, crowding caused a decrease in total protein concentration in both males ( $p < 0.004$ ) and females ( $p < 0.02$ ). A statistically

significant body mass increase during the experiment was noted only in females. In both rooms, i.e. before and during the experiment, birds were limited in their movements, i.e. they could only walk and flutter their wings. Blood serum total protein was most likely converted to fat or muscle tissue which, in the case of females, resulted in a statistically significant increase in body mass. The decrease of serum total protein in males did not cause significant changes in body mass. It is possible that serum protein was converted to energy. In terms of commercial breeding, females tolerate an increase in flock density.

As a result of crowding, aspartate aminotransferase (AST) activity increased significantly only in females ( $p < 0.03$ ). Such an increase in AST concentration in pigeons could be induced by intensified activity of the liver rather than the damage of its cells. AST is considered to be very sensitive but a nonspecific indicator of liver damage (Dabbert and Powell 1993; Jaensch et al. 1990). In pigeons, it is shown to be highly sensitive in detection of hepatocellular damage caused by ethylene glycol (Lumeij 1998). Changes observed in serum ALT concentration during the experiment should not be associated with crowding but rather with unlimited access to food and intensified liver activity, as suggested by Kim et al. (2008). An increase in AST concentration was observed in humans (Nagel et al. 1990) and birds (Abdel-Rachied et al. 2014) during a period of intensified physical activity. Significant AST activity increase in female pigeons kept under crowded conditions could not be caused by excessive movement because the flock density of 3.1 individuals/m<sup>3</sup> greatly restricted active flight.

There were no significant changes in alanine aminotransferase (ALT) activity in either sex before and during crowding nor between males and females. Crowding did not affect permeability of the liver cell membrane in feral pigeons.

## SUMMARY

An increase in flock density from 1.4 to 3.1 individuals/m<sup>3</sup> did not negatively affect the well-being of feral pigeons. A significant decrease in serum total protein resulted in a significant increase in the body mass in females. An observed ALT concentration increase in females was most likely caused by an intensification of liver activity. It seems that the feral pigeon is a species well-suited to commercial breeding.

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