

## STUDY OF THE THERMOREGULATION CAPACITY OF TRANSYLVANIA NAKED NECK CHICKS COMPARED TO RHODE ISLAND CHICKS

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### SUMMARY

In Romania there is a poultry breed raised in the hill region of Transylvania which has a better thermolysis than other breeds because its body plumage is up to 30% less than the normal one. The study presents the adaptive capacity to heat stress specific to this breed by analysing the growth performance of chicks and some physiological indicators.

**Keywords:** thermoregulation, stress

### MATERIAL AND METHODS

Poultry perceive differently the environmental stimuli as stressors, according to their individual experience on the length, intensity and frequency of the contact with those stimuli, according to the level of phenotypic expression of the interaction between the genotype and the environment. Within this context appears the phenomenon of tolerance to heat that can be a display of the ability some poultry breeds have to increase considerably heat loss through convection and radiation, or it can be a genetic advantage (Yahav et al., 1997, Cooper et al., 1998).

The study monitored the advantage of the lower plumage body by performing a comparative analysis of certain physiological indicators of two poultry populations, Transylvania naked neck chicks and Rhode Island chicks submitted to different environmental temperatures. The value correlations between the growth performance and the physiological indicators of the chicks from these breeds are unique and the product of this working team. The experiment was conducted on two poultry populations, Transylvania naked neck and Rhode Island, reared for egg and meat production in the population households from Transylvania.

The trial involved 72 chicks (males and females) aged 6 weeks, with the average body weight 480 g, assigned to 3 groups of 24 chicks each, housed in 6 cages placed in environmentally controlled rooms. For two weeks the growth program of the chicks was as follows: 12 hours of light per day and standard diet with 17% CP and 2850 Kcal ME. The birds had free access to the feed and water. During this period the chicks were submitted to constant but different environmental temperatures: 22°C and 55% RH for group 1 (control), 15°C and 65% RH for group 2 and 38°C and 45% RH for group 3. Feed ingesta was recorded on a daily basis and the weight gain, average daily gain and feed conversion ratio were determined weekly calculating the average values per group and the standard deviation.

The rectal temperature was measured by inserting a digital thermometer for 6 cm into the rectum. Digital thermometers were also to determine the surface temperature. To that purpose they were introduced subcutaneously through a small incision in the skin of the neck at the level

of the axile in a region not covered by feathers. The recordings were done individually, four times a day and the weekly averages and the standard deviation were calculated for the three groups. Each week blood samples were taken from the brachial vein into syringes on heparin and assayed for hematocrit using the micromethod and for haemoglobin using the photocolometric method. The experimental results were processed with statistics software for the arithmetic mean and standard deviation. The results were used to evaluate the physiological response of the two poultry populations exposed to different environmental temperatures.

## EXPERIMENTAL DATA AND RESULTS

The neuroendocrine mechanisms triggered by the varied action of the different stressors are quite stereotypic: initially, the simpatico-adrenal mechanism, then the hypothalamic–adenohypophysis-corticosuprarenal axis, which are able to maintain or restore homeostasis.

Under an environmental temperature of 15°C, the temperature recorded in Transylvania naked neck chicks at the skin surface in the neck area is significantly higher, by 31%, than the similar temperature recorded in Rhode Island chicks. The difference of temperature recorded at the axile of the two populations was not significant (Table 1). At the environmental temperature of 38°C, the difference of temperature recorded at the skin surface in the neck area was 3.6°C, which means 10.4% higher heat loss in the Transylvania naked neck chicks compared to Rhode Island chicks. The heat loss recorded at the axile of the two populations was not significant. The variation of the rectal temperature between the two populations both for the environmental temperature of 15°C and of 38°C was not significant (Table 1).

**Table 1.** The arithmetic mean and the standard deviation of the average weekly values for the surface temperature recorded at the neck and axile level and of the body temperature in the two populations of chick aged 6 to 8 weeks under different conditions of temperature

Variables	Ambient temperatures (°C)	Transylvania naked neck chicks	Rhode Island chicks
Surface temperature for the neck	22	36,1 ± 2,40	35,7 ± 2,25
	15	34,3 ± 2,84	26,2 ± 1,80
	38	38,2 ± 3,52	34,6 ± 2,85
Surface temperature under the wing	22	39,3 ± 3,60	39,6 ± 4,24
	15	38,4 ± 2,90	38,1 ± 4,13
	38	41,8 ± 3,45	41,5 ± 3,40
Rectal temperature	22	41,7 ± 3,30	41,4 ± 3,52
	15	41,5 ± 3,25	41,2 ± 3,11
	38	42,7 ± 3,17	43,6 ± 3,80

At the environmental temperature of 38°C, the difference of temperature recorded at the skin surface in the neck area was 3.6°C, which means 10.4% higher heat loss in the Transylvania naked neck chicks compared to Rhode Island chicks, while the heat loss recorded at the axile of the two populations was not significant. The variation of the rectal temperature between the two populations both for the environmental temperature of 15°C and of 38°C was not significant (Table 1).

Table 2 shows the values for haematocrit and haemoglobin according to temperature, in both populations.

**Table 2.** The arithmetic mean and the standard deviation of the average weekly values for the haematocrit and haemoglobin in the two populations of chick aged 6 to 8 weeks under different conditions of temperature

Variables	Ambient Temperatures °C	Transylvania naked neck chicks	Rhode Island chicks
haemoglobin (g/dl)	22	10,2 ± 1,14	9,8 ± 0,90
	15	11,6 ± 1,01	10,4 ± 1,02
	38	9,7 ± 0,89	9,0 ± 0,80
haematocrit (%)	22	28,2 ± 2,76	28,4 ± 2,66
	15	35,2 ± 3,48	32,3 ± 3,20
	38	27,8 ± 2,60	26,5 ± 2,58

Haemoglobin and haematocrit values decreased irrespective of the genotype of the studied populations, under the conditions of environmental heat stress, which explains the activation of the thermolysis processes, while the low environmental temperatures increased haemoglobin and haematocrit values, which shows a build up of heat production to maintain homeostasis. At the environmental temperature of 15°C serum haemoglobin was 11.5% higher in Transylvania naked neck chicks than in Rhode Island chicks, while the average value of the haematocrit was 9% higher in Transylvania naked neck chicks than in Rhode Island chicks. No significant differences were noticed between the two chick populations at the environmental temperature of 38°C. Compared to their control groups the depression of the average values for haemoglobin was not significant in the Transylvania naked neck chicks, while the depression was significant, 8.2%, in Rhode Island chicks. The average values for haematocrit in the populations of Transylvania naked neck chicks (control and experimental) decreased insignificantly, while the depression was significant, 6.7%, in Rhode Island chicks.

At the beginning of the experiment, the average body weight of the 6 weeks-old chicks was 480 g, while after two weeks the chicks raised under normal environmental temperature reached an average body weight of 685 g. When exposed to 15°C the two populations of chicks aged 8 weeks did not display significant differences in the body weight, while at 38°C body weight was 8.8% lower in Rhode Island chicks (compared to the control group reared at 22°C) and 6% lower in Transylvania naked neck chicks (Table 3).

**Table 3.** The arithmetic mean and the standard deviation of the average weekly values for the performance of the two populations of chick aged 6 to 8 weeks under different conditions of temperature

Variables	Ambient Temperatures °C	Transylvania naked neck chicks	Rhode Island chicks
Body weight at the age of 8 weeks (g)	22	688 ± 64,6	682 ± 62,3
	15	684 ± 58,4	678 ± 66,2
	38	647 ± 60,2	622 ± 60,4
Weight gain at the age of 6 to 8 weeks (g/14zile)	22	15,07 ± 1,30	14,42 ± 1,38
	15	14,78 ± 1,20	14,14 ± 1,05
	38	12,50 ± 1,10	10,10 ± 0,09
Food intake N.C. at the age of 6 to 8 weeks (g/zi)	22	45 ± 4,30	42 ± 3,80
	15	58 ± 4,60	49 ± 4,40
	38	41 ± 4,10	36 ± 3,80

The average daily gain achieved at the environmental temperature of 15°C decreased insignificantly in both breeds, but at 38°C, the depression was 17% in Transylvania naked neck chicks of the experimental group compared to the control group and in excess of 30% in the Rhode Island chicks of the experimental group compared to the control group. Compound feed intake increased at the environmental temperature of 15°C by 28.8% in Transylvania naked neck chicks and by 16.6% in Rhode Island chicks, while at 38°C feed intake decreased by 8.8% Transylvania naked neck chicks and by 14.3% in Rhode Island chicks. Under the heat stress, the voluntary feed intake decreases proportionally with the increment of the temperature, of the duration of exposure and with the bird age, ranging from 8 to 25% (Monica Parvu et al., 2006).

At the environmental temperature of 15°C the loss of heat through radiation at the surface of the neck skin was higher in the Transylvania naked neck chicks than in the Rhode Island chicks, which required the birds to intensify their metabolic processes which means higher oxygen consumption for the cellular oxidation of the fatty acids and to stimulate new production of glucose in the liver. The red blood cells from the storage organs were mobilised in response to the increased requirement of oxygen, which increased the haematocrit and the haemoglobin, a process that was done better in the Transylvania naked neck chicks than in the Rhode Island chicks.

The increased heat production under lower environmental temperatures is also supported by a higher feed intake, by the required digestive work and by the specific dynamic action of the feeds. The intensification of cellular energy production was triggered by the activation of the simpatico-adrenal system done by a protein nutritive support. Under the conditions of similar dietary protein levels feed intake increased more in the Transylvania naked neck chicks than in the Rhode Island chicks, which shows a better adaptation to the lower environmental temperatures.

Reducing energy metabolism through a lower feed intake and through cellular biochemical modifications did the adaptation to higher environmental temperatures. The existence of a naked area on the neck intensified heat dissipation through radiation in the Transylvania naked neck chicks compared to the Rhode Island chicks.

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## CONCLUSIONS

1. The higher adaptative capacity of the Transylvania naked neck chicks is the result of a better functional correlation of the activity of the hypophysis, thyroid and adrenal glands, all of them coordinated by the hypothalamus.
2. The particular rusticity of the Transylvania naked neck chicks reared in the area of Transylvania is shown by its ability to do thermoregulation under variable environmental conditions: at higher temperatures they have the advantage of a lower plumage on the breast and abdomen, with completely naked neck up under the gizzard, while they also display resistance to lower temperatures and diseases.

## REFERENCES

1. Cooper, M.A., Washburn, K.W., 1998 – The relationships of body temperature to weight gain, feed consumption and feed utilisation in broilers under heat stress. *Poultry Science*, 77: 237–242.
2. Parvu Monica, R. Burlacu, Ioana Cristina Andronic, 2006 – Prediction of growth and development process on Rhode Island chicks, *Buletinul Universității de Științe Agricole și Medicină Veterinară Cluj – Napoca*, vol. 63, Ed. Academic Press, Cluj – Napoca, pg 26–31, ISSN 1454-2390.
3. Yahav, S., Hurwitz, S., 1997 – Induction of thermotolerance in male broiler chickens by temperature conditioning at an early age. *Poultry Science*, 75: 402–406.