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Variations of some blood parameters in rabbit reared under different environmental conditions

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RIASSUNTO – Variazioni di alcuni parametri ematici in conigli allevati in differenti condizioni ambientali. *Presso un allevamento commerciale di conigli, una medesima prova di allevamento è stata condotta, dallo svezzamento a fine ingrasso, in condizioni di clima fresco e caldo, controllando accrescimenti, consumi alimentari, caratteristiche del contenuto ciecale e profilo metabolico. Lo stress da caldo ha indotto variazioni nei parametri ematici solo in parte correlabili al riscontrato calo di ingestione. Le più consistenti relazioni tra caratteristiche del contenuto ciecale e variazioni metaboliche in condizioni di stress termico indicano una maggiore criticità delle caratteristiche delle diete in tali situazioni.*

Key words: rabbit, metabolic profile, temperature.

INTRODUCTION – High environmental temperature induces physiological stress in rabbits leading to production losses, also because of their quite poor thermoregulation ability. Some consequences of heat stress affect digestive system functions, with impaired appetite, growth and feed conversion, but also with increased disease incidence. These effects can also reflect on the levels of some blood metabolites. Relatively few experimental works are available on the effects of high environmental temperature on the rabbit metabolic profile reared in commercial farms. The aim of this study was to study, in separate experiments, the effects of "fresh" spring and of "hot" summer temperatures on rabbits performance with particular attention to the behaviour of some metabolic parameters and of some aspects of the functionality of the digestive system.

MATERIAL AND METHODS - In a commercial rabbit farm, a trial was carried out twice, according to the same experimental protocol but under different climatic conditions: springtime fresh temperature (T1) and summer high temperature (T2). In each trial, WNZ rabbits were housed, after weaning (1.09 and 1.01 kg of mean live weight, LW, in T1 and T2 respectively), in 64 cages of 7 animals each, reared until the end of fattening and slaughtered at 2.75 (T1) and 2.55 (T2) kg of mean LW. The animals were divided into two groups and fed *ad libitum* two different commercial complete rabbit pellets, with different contents of structural and non structural carbohydrates and protein. During post-weaning (PW) period (4 weeks) diet 1 was (DM basis) 19.47% CP, 40.84% NDF and 14.90% starch; diet 2 was 15.30% CP, 46.28% NDF and 12.45% starch. Fattening (3 weeks) diet 1 was 19.58% CP, 38.56% NDF and 20.22% starch, and diet 2 was 15.82% CP, 41.43% NDF and 16.61% starch. Heart blood samples were withdrawn at half (PW1) and at the end (PW2) of the PW phase as well as at the end of fattening (F) from 8 rabbits/diets (4 males and 4 females). At the end of F, controls were carried out also on the caeca for weight, pH and chemical characteristics of the content. Feed intake was recorded weekly for any cage, and temperature was measured continuously with a strip chart recorder. Blood plasma was analysed for haematocrit (PCV), glucose, NEFA, β-OHB, cholesterol, triglycerides,

urea, creatinine, GOT/AST, γ-GT, alkaline phosphatase, lactic dehydrogenase (LDH), total protein, albumin, globulin, total bilirubin, zinc, ceruloplasmin, aptoglobin, Ca, inorganic P, Mg, Na, K and Cl. Feeds and caecal contents were controlled for proximate analysis, starch and fibre fractions according to EGRAN (2001) guidelines. At any control time controls were also carried out on live weight of any cage and of the sampled rabbits. The data were processed using the GLM procedure of SAS, including the effects of the trial (T1 and T2), the rearing phase (PW1, PW2, F), the sex (male, female), the diets (diet 1 and diet 2) and their interactions. The interaction diet*trial was not significant for any of the blood parameters considered and was no longer considered. Correlations were calculated among blood parameters and caecal contents features. Significance was declared at $P<0.05$ level.

RESULTS AND CONCLUSIONS – Average temperature within the barn ranged from 20 (Min.) to 23-25°C (Max.) in T1 but from 23-25 (Min) to 31-32 (Max)°C, with some peaks around 35°C, in T2. According to Cervera and Carmona (1998), thermoneutrality for rabbit is between 15 and 25°C. The high temperature of T2 significantly lowered feed intake (g d^{-1} kg LW^{-1}) by 24.5% during PW and by 22% during F. Growth were also reduced to the same extent. Similar results were reported by Chiericato *et al.* (1994). Mean dry matter percentage of caecal contents was very similar in T1 (22.39%) and T2 (22.33%). Similarly, no differences were recorded for pH (5.69 *vs.* 5.75 in T1 and T2, respectively) and ADF contents, whereas NDF was higher in T2 *vs.* T1 (41.20 *vs.* 38.12% DM).

Table 1. Mean values of some blood metabolites in rabbits reared at different ambient temperatures (all significantly different, $P<0.05$).

	Units	T1	T2	MSE
PCV	l/l	0.399	0.369	0.00039
Cholesterol	mmol/l	2.04	2.77	0.36283
Tryglicerides	mmol/l	1.28	1.46	0.21590
Creatinin	mmol/l	73.51	84.30	62.28864
Inorganic Phosphorus	mmol/l	2.76	2.34	0.05687
Magnesium	mmol/l	1.25	1.21	0.00685
Chlorine	mmol/l	104.95	108.30	11.27660
Total protein	g/l	57.90	54.44	13.23801
Albumin	g/l	37.35	34.55	3.13661
GOT/AST	U/l	10.56	14.80	34.51366
Total bilirubin	mmol/l	1.11	1.42	0.06574
Ceruloplasmin	mmol/l	5.92	6.79	5.24861

Compared to the spring trial, in the summer one the following significant changes of blood parameters (table 1) were observed:

- reduced PCV, usually observed in different animal species under heat stress, that seems to be better ascribed to a more pronounced oxidative stress with a reduced half life of erythrocytes rather than to haemodilution (Bernabucci *et al.*, 2002);
- among the parameters related to the energy metabolism, cholesterol was markedly higher at any stage of growth, as already noted by Chiericato *et al.* (1994). As lipomobilisation is unlikely in growing animals, an impairment of lipids absorption or of the liver synthetic activity can be hypothesised. Lower NEFA were measured, but triglycerides were higher and β-OHB unchanged. The behaviour of these parameters in rabbits under high ambient temperature is not well described in literature, but in dairy cow they appeared to be not consistently affected by heat stress;

- creatinine was always higher and it continuously and significantly increased with age (68.72, 76.99 and 91.00 mmol/l, respectively in PW1, PW2 and F) as already reported by Chiericato *et al.* (1994). The reason of these changes are not clear, but here its relationships with muscle mass rather than with kidney function seems more important;
- among the minerals, the inorganic P decreased from T1 to T2. Heat stress caused a similar decrease (Chiericato *et al.* 1994) but also no changes are cited by the same authors. It significantly decreased also from PW1 (2.78 mmol/l) to PW2 (2.57 mmol/l) and F (2.32 mmol/l): in other trials it appeared higher in older rabbits, but in ruminants it decreases as calves get older (Bertoni *et al.*, 1999). Similar variations were observed for Mg and Zn. On the contrary, Cl increased from T1 to T2, to compensate for the higher bicarbonate renal excretion;
- lower levels were measured for total protein and albumin. In our situation lower albumin could be mainly due to a reduced synthesis in the liver;
- among the enzymes correlated to the liver functionality, only GOT/AST was modified, being higher in T2 and confirming the results of Chiericato *et al.* (1994);
- higher total bilirubin was recorded in T2, but mainly in the PW phase. Together with the previous albumins decrease, it can suggest a reduced liver functionality in T2;
- ceruloplasmin, considered an index of inflammatory processes (Bertoni *et al.* , 1999) was higher in T2.

The correlations calculated among blood parameters and caecal features did not put into evidence constant relationships. In particular, in T1 few correlations appeared significant while in T2, in environmental less favourable conditions, metabolic parameters appeared better related to digestive features. In particular, the fibre (as NDF, ADF and ADL) content of caecum appeared negatively correlated with aptoglobin (r=-0.48 with NDF) and LDH (r=-0.54 with NDF), suggesting a negative effect of lower levels of fibre on the liver functionality. No relationships were detected between pH and blood parameters. Similarly, no consistent correlations could be put into evidence among these metabolic indices and growth rate recorded during the fattening phase in the two trials. Under high temperature rabbit metabolism was significantly altered and the relationships among some traits of digestive functionality and metabolic parameters were more evident, suggesting that rabbit diet composition can become more critical in order to not worsen with digestive upset the negative effects of heat stress.

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