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THE EFFECT OF TRANSPORT AND SLAUGHTER ON RABBITS REARED IN TWO DIFFERENT PRODUCTION SYSTEMS

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ABSTRACT

The effect of transport and slaughter on the stress response of 400 rabbits assigned to 2 homogeneous groups reared in cages (GC) or in an indoor pen (GP) was assessed. Heart rate (HR), body temperature (BT) and blood samples were collected 10 days before transport (T_0), immediately before transport to the abattoir (T_1) and at slaughter (T_2). Plasma were assayed for cortisol, urea nitrogen, glucose, AST, CPK and LDH. In both groups, transport and slaughter induced a significant increase of all physiological parameters, which suggest that these procedures represented a severe stress for the animals. The T2 higher CPK activity recorded in GC rabbits, compare to those pen-reared, might indicate the reduced fitness of these animals which lead to a greater muscular exertion during the transportation process. In conclusion, transport and slaughter shown to have an adverse effect on farmed rabbits, independently from the type of production system. However, pen-reared subjects seem to cope better with the physical stress involved.

INTRODUCTION

Rabbit intensive production requires to re-examine stocking density and cage size to reduce environmental bareness, restriction of movements and footpad injuries (Morisse, 1998). Current public concern for animal welfare has promoted the producers to explore more "natural" production systems, which should better satisfy the behavioural and social needs of these animals. However, a scientific assessment of the welfare state of these subjects should be carried out, without the involvement of moral considerations (Broom, 1988). Recent research on the welfare of rabbit has mainly addressed issues relating to housing (Bigler and Oester, 1994; Ferrante et al., 1992) and feeding (Krohn et al., 1999). So far, there is little information available regarding rabbit welfare problems related to alternative production systems (Auxilia, 1987; Crimella et al., 1996). Moreover, their impact on some management operations, such as transport and slaughter, which have already been shown to be stressful in rabbits (Jolley, 1990), as well as in livestock (Shaw and Tume, 1992), should be further evaluated. It is well known that transport and slaughter method can influence both rabbit welfare and zootechnical performance in a negative way (Luzi et al., 1992; Dal Bosco et al., 1997).

A wide variety of neuroendocrine-metabolic changes are involved in the stress response, which extent and complexity depend upon several factors (Wiepkema and Koolhaas, 1993). To provide estimates of stress in the current study several components of the animal's physiological responses have been measured. The aim of the study was to assess the effect of transportation and slaughter on the stress response of rabbits reared under two different production systems.

MATERIAL AND METHODS

Animals, housing and diets

The study was carried out in October and November 1999. Four hundred hybrid rabbits, reared in an intensive rabbitry in Central Italy, were weaned at 35 days and divided into 2 homogeneous groups (sex, weight) differently housed: Group Cage (GC: 2 rabbits/cage - 17 rabbits/m^2) and Group Pen (GP: in an indoor pen with 10 rabbits/m^2, with wheat straw litter which was periodically changed). Animals were fed a commercial diet ad libitum with the following characteristics: crude protein 16.5%, crude fibre 16.2%, ether extract 2.5%, digestible energy (DE) 11.0 MJ/kg. Feed intake and live weight were recorded weekly.

Laboratory analysis
At slaughtering time, the animals (about 85-90 day old) were collected from the farm and loaded in cages (12 rabbits/cage) on a vehicle and transported by road for 6 hours to the abattoir. Here they were slaughtered previous stunning.
From 15 animals of each group, after manual restraining, heart rate (HR), body temperature (BT) and blood samples were collected at predetermined times: 10 days before transport (T_0), and immediately before transport to the abattoir (T_1) and at slaughter (T_2). HR was recorded by a phonendoscope and BT by a intra-rectal thermometer. Blood samples were collected in heparinized tubes by venipuncture of the marginal ear vein, immediately centrifuged at 3.000xg for 15 min at + 4 °C, and stored at - 20 °C until analysis. Plasma samples were analysed for cortisol, urea nitrogen, glucose, aspartate aminotransferase (AST), creatine phosphokinase (CPK) and lactate dehydrogenase (LDH). Cortisol was assayed by a RIA commercial kit (IM 2021 – Ortho - Clinical Diagnostics, Milano) with 0.1 mg/dL sensitivity and 4.25% and 6.8% of intra and inter-assay coefficients of variations. Urea nitrogen, glucose, AST, CPK and LDH were determined using a Technicon RA-XT Random Access Chemistry Analyser (Bayer Diagnostic, Technicon Division).

Statistical analysis
A linear model for repeated measures (SAS/STAT, 1990 - procedure GLM) was used to evaluate the effect of transport/slaughter and of housing system (cage vs pen) on physiological parameters.

RESULTS AND DISCUSSION

In all occasions, in both groups, BT (up to 39.8 T°C) and HR (up to 194 pulse/min), even if they were within the normal range (Fowler, 1986; Cooper et al., 1985), they were rather elevated as reaction of the animal to the manipulation necessary for the blood sampling (Table 1). Morera et al., (1991) also observed increases of BT in response to heat stress in rabbits, which was more higher (+ 0.4°C; $P<0.05$) in subjects handled for the first time with respect to trained ones. Heart rate increases are a consequence of the activation of the autonomic nervous system (Wiepkema and Koolhaas, 1993). The major heart rate response, which sometimes involve an initial bradycardia, is tachycardia (Broom, 1988). Therefore, this finding has been widely used as an indicator of the sympathetic response to stress in several species (Hargreaves and Hutson, 1991). The significant difference ($P<0.01$) in HR recorded at T_1, between cage-reared rabbits and pen-reared ones (194 vs 188 pulse/min; Table 1) might related to a greater excitement of these animals, but, from the physiological point of view, the entity of such a difference has no relevance.
The GLM means of the biochemical parameters and relative significant differences within groups are reported in Tables 2-3, whereas differences between groups in Graphs 1-6. Within each group, a large effect related to transport and slaughter was observed for biochemical parameters, which all significantly rose in T_2. In particular, a large adrenal response was observed, as shown from the extent of the T_2 plasma cortisol levels, which were about five-times the pre-transport (T_1 and T_0) values in both groups (Graph 1; Table 2 and 3). The increase of adrenal activity is strictly related to metabolic changes, such as the elevation of

plasma glucose concentrations (Graph 2). Jolley (1990) already observed significantly greater plasma glucose levels in transported rabbits compare with those not transported (4.27 and 3.45 mmol $^{-1}$ at 6h), which extent was partially related to prior access to food and time in transit. The most marked increase in T_2 plasma glucose concentrations of GP rabbits compare those reared in cages, seems to indicate a greater ability of these subjects in mobilising energetic reserves to cope with stress (Graph 2; Table 2 and 3).

As already reported in details from Dal Bosco et al., (paper presented at this Congress), pen-reared rabbits showed lower feed intake and weight gain compare to those reared in cages. Furthermore, a large consumption of litter wheat straw was observed, which might partially explain the significant increase of T_1 and T_2 urea nitrogen levels in pen-reared rabbits, compared to cage reared ones (Graph. 3). This may related to a progressive increase in litter urine contamination during the production cycle. Morisse et al. (1999) observed a strong preference of pen reared rabbits for a wired netting floor compared to straw-litter, which had little effect on the behavioural pattern and no influence on animal reactivity.

In all subjects, significant increases of CPK, LDH and AST activities was observed. In particular, in both groups, CPK levels markedly rose at T_2 (Graph 5; Table 2 and 3), probably as a consequence of the physical stress related to aspects of transportation, such as movement in a novel environment, reduced space allowance, vibration and jolting, rapid foot adjustments, as well as to slaughter operations. Dramatic rises in CPK and LDH have been recorded in several species after muscular exertion, therefore increases in the activities of these enzymes have been used as indicators of muscle damage. T_2 higher CPK levels observed in GC rabbits, compare to those reared in the pen (Graph 5), seem to indicate that the different components of the transportation process might interact to produce a more detrimental effect on the welfare of the rabbit reared in cages which suffered a greater muscular exertion. This would also explain the tendency, during all experimental period, to find AST, CPK and LDH levels more elevated in the cage-reared rabbits (Graph 4 and 6; Table 2 and 3). In these animals, the closed confinement within the cage may prevented the expression of some natural movements, such as assuming the erected posture or running. Their behavioural response to stress, being the flight-fight response hampered, may evolved in prolonged isotonic muscular contraction which, in other species, has already been shown to predispose to poor tissue perfusion, hypoxia and focal muscle necrosis (Spraker, 1982).

In conclusion, transport and slaughter demonstrated to have an adverse effect on farmed rabbits, independently from the type of the production system. However, it would seem that pen-reared rabbits better stand the physical stress involved in such processes. However, management changes are need to improve their lower productive performances. Moreover, problems related to ammonia emission should be strongly reduced, i.e. by adequate litter aeration and management, or by the adoption of a wire netting floor.

However, an overall evaluation of the effects of these production systems on rabbits welfare should be carried out, taking in account that, the most relevant problem for evaluating animal welfare is to weigh the varied findings and to integrate them to a final assessment. Therefore, further evaluation of physiological changes, productive performances and carcasses quality is necessary to highlight welfare related problems of these rabbit production systems and suggest possible management improvements.

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Table 1: Body temperatures and heart rates of GC and GP

	Body temperature (BT)		**Heart Rate (HR)**	
	T_0	**T_1**	**T_0**	**T_1**
	means ± SD	means ± SD	means ± SD	means ± SD
Group Cage (GC)	39.3 ± 0,13	39.6 ± 0,15	145.71 ± 13.09 A	194.02 ± 9.95 B
Group Pen (GP)	39.4 ± 0,49	39.8 ± 0,20	151.00 ± 13.46 A	188.16 ± 15.73 B
P between groups				**

Table 2: Biochemical parameters of GC

Parameters		**Group Cage (GC)**		
		T_0	**T_1**	**T_2**
		means ± SD	means ± SD	means ± SD
Cortisol	mg/dL	2.14 ± 0.60 A	1.28 ± 0.84 A	10.88 ± 7.55 B
Glucose	mg/dL	147.78 ± 15.46 ab	137.92 ±15.67 a	163.00 ± 20.64 b
Urea Nitrogen	mg/dL	11.92 ± 1.81	13.50 ± 1.82	18.92 ±2.58
AST	U/L	24.14 ± 10.81 A	24.21 ± 14.65 A	55.07 ± 14.95 B
CPK	U/L	546.21 ± 138.25 A	791.64 ± 736.86 A	4585.07 ± 1467.33 B
LDH	U/L	200.85 ± 281.03 A	119.71 ± 74.51 A	569.78 ± 292.32 B

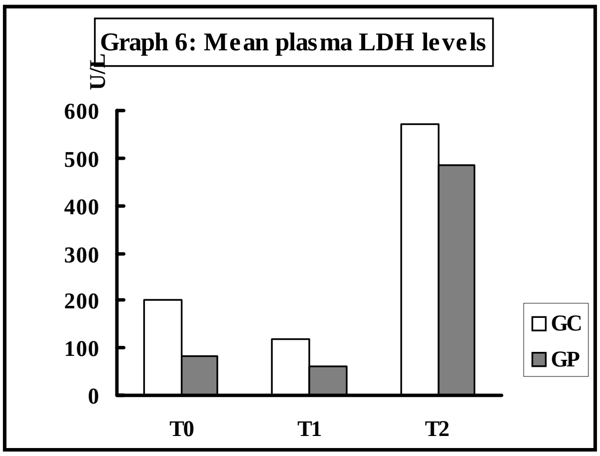
Table 3: Biochemical parameters of GP

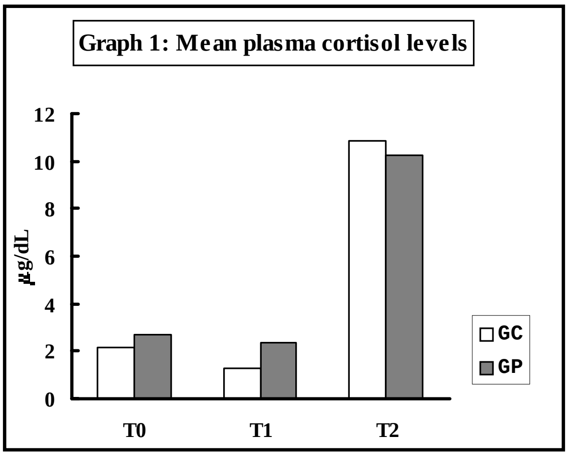
Parameters		**Group Pen (GP)**		
		T_0	**T_1**	**T_2**
		means ± SD	means ± SD	means ± SD
Cortisol	mg/dL	2.69 ± 1.64 A	2.39± 1.96 A	10.22 ± 9.18 B
Glucose	mg/dL	136.92 ± 8.62 A	149.08 ± 23.23 A	214.25 ± 107.77 B
Urea Nitrogen	mg/dL	10.23 ± 3.65 a	39.06 ± 61.49 b	40.06 ± 57.51 b
AST	U/L	22.00 ± 9.66 A	17.00 ± 5.54 A	47.66 ± 9.04 B
CPK	U/L	472.53 ± 260.35 A	386.20 ± 248.84 A	2475.20 ± 751.91 B
LDH	U/L	81.92 ± 25.97 A	61.92 ± 28.26 A	484.75 ± 184.77 B

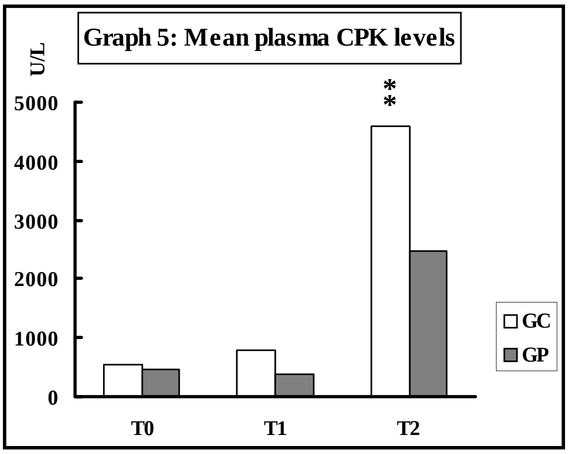
Legend

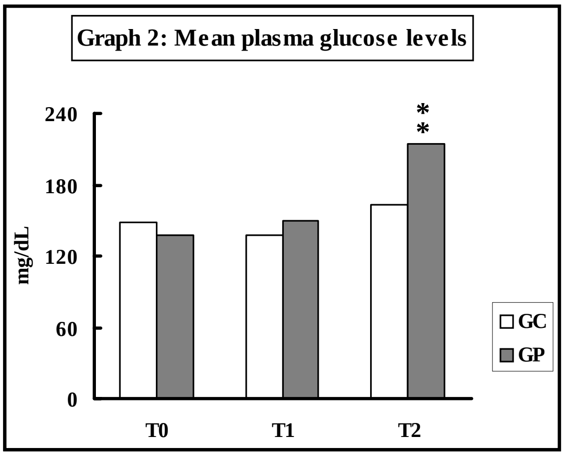
In the row: A..B: $P<0.01$; a.b: $P<0.05$ for differences within the group

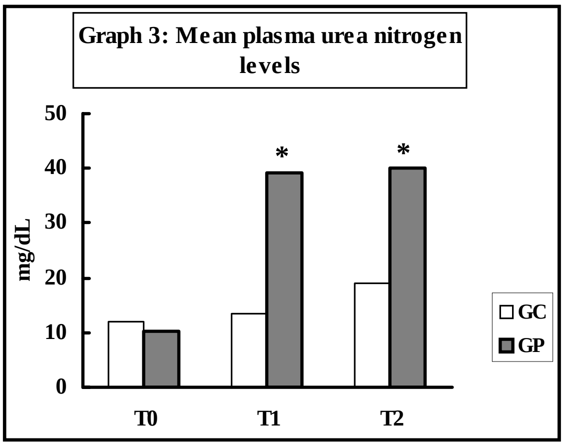
In the column: **: $P<0.01$; *: $P<0.05$ for differences between the groups

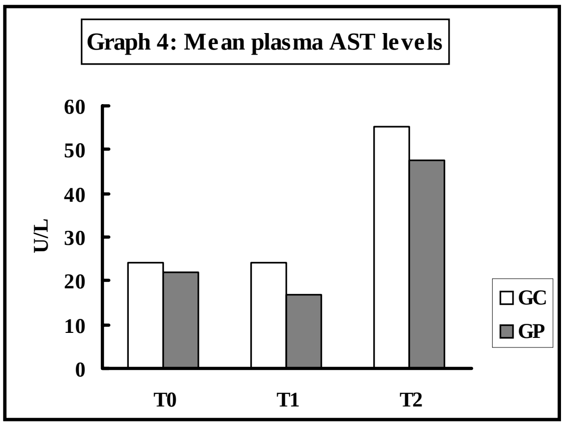

Graph 6: Mean plasma LDH levels
U/L
600
500
400
300
200
100
0
T0
T1
T2
GC
GP


Graph 1: Mean plasma cortisol levels
µg/dL
12
10
8
6
4
2
0
T0
T1
T2
GC
GP


Graph 5: Mean plasma CPK levels
U/L
5000
4000
3000
2000
1000
0
**
T0
T1
T2
GC
GP


Graph 2: Mean plasma glucose levels
mg/dL
240
180
120
60
0
**
T0
T1
T2
GC
GP


Graph 3: Mean plasma urea nitrogen levels
mg/dL
50
40
30
20
10
0
*
*
T0
T1
T2
GC
GP


Graph 4: Mean plasma AST levels
U/L
60
50
40
30
20
10
0
T0
T1
T2
GC
GP