11) PLASMA CORTICOSTERONE LEVELS IN LAYING HENS FROM THREE DIFFERENT HOUSING SYSTEMS

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Abstract
Adrenocortical and thyroidal hormones are physiological indicators of various forms of stress in the fowl. In order to establish possible variations in corticosterone levels, blood samples were collected from ISA Brown hens reared in three different housing systems (cage, floor and organic way). Results showed that corticosterone concentrations were highest in caged hens, intermediate in organic reared hens and lowest in floor reared hens It could be assumed that in the last one system birds have an adequate space in controlled environment that permits them to satisfy, though partially, their behavioural needs without the presence of different chronic stress factors acting in the other systems.
Key words: Laying hen, housing systems, corticosterone

Riassunto
Sono state valutate possibili variazioni nei livelli di corticosterone in galline allevate in gabbia, a terra e seguendo il metodo biologico. I livelli più alti di corticosterone si sono riscontrati in gabbia mentre quelli più bassi a terra. Una situazione intermedia era ascrivibile al gruppo allevato biologicamente. E' verosimile ipotizzare che l'allevamento a terra, fornendo alle galline un adeguato spazio, permetta di soddisfare alcune loro esigenze comportamentali senza la presenza di fattori di stress cronico che agiscono sugli altri allevamenti.
Parole chiave: Galline ovaiole, sistemi di allevamento, corticosterone

Introduction
Conditions of intensive farming often deprive animals of stimuli important for the general welfare. This is a potential cause of stress and in a number of cases the lack of stimuli and or space has been associated with behavioural and endocrinological changes indicative of stress and reduced well being. Adrenocortical and thyroidal hormones are physiological indicators of various forms of stress in the fowl (Edens and Siegel, 1975). Elevated plasma corticosterone levels have been associated with thirst, hunger or heat stress in laying hens (Beuving and Vonder, 1978). Management conditions also have been shown to influence plasma corticosterone levels in laying hens (Mashaly et al., 1984; Koelkebeck and Cain, 1984). The aim of this work was to determine whether or not there are plasma corticosterone variations in laying hens reared in three housing systems (cages, floor and organic way)

Material and Methods
Investigations were performed in a farm consisting of 32.000 commercial ISA Brown hens, housed at 22 weeks of age in three different housing systems: 26.000 hens (A) were located in battery (4 birds per 50 x 50 cm sized cages), 3000 (10 per square/meters) were reared on floor (B) in conventional house and 3000 in organic(C) way according to Council Regulation (EC) N.1804/99. The birds reared in floor and in cages were fed on layers mash and a similar photoperiod was provided in both systems by supplementary electric lighting (16L:8D). Blood samples were collected monthly from 20 birds from each management systems. The first blood sampling was performed when the birds were 30 months old. Extreme care was taken to minimize handling stress and to randomize treatment samplings. Time from initial bird contact through sample collection was monitored. The corticosterone concentration was measured by Radioimmunoassay using the commercial kit (Gamma-B^{125}I-Corticosterone RIA, PANTEC Torino). The data were examined for statistical differences by analysis of variance using the variance to one way and t Student's test.

Results and discussion
The results of this study, reported in table 1 and fig.1, indicated that plasma corticosterone concentrations were highest in caged hens, (26,4 ng/ml) intermediate in organic (25,3ng/ml) hens and lowest in floor reared hens (21,5 ng/ml). If plasma corticosterone status of birds may provide a measure of welfare of birds in each system, it could be speculated that in the present study the floor reared hens were exposed to fewer stress factors than those in caged, with the organic rearing occupying an intermediate position. It is to underline that this study was performed when the social interactions into the cages, often responsible for the increase of plasma corticosterone (Mashaly et al., 1982), were established from time. Previous studies (Compton et al., 1981) reported that a decrease in space could chronically elevate corticosterone levels in response to alteration in "personal space", particularly when the space allowance was below 400 cm2/birds. It is also known that the intensive farming conditions often deprive animals of access to stimuli that may be of significance for the performance of the normal behavioural needs (dustbathing, lack of nests); this could be a

potential cause of a chronic stress. However this conclusion should be considered with caution since the discrepancy of results was observed in different studies. Koelkebeck and Cain (1984) indeed reported the lowest mean plasma corticosterone levels occurred among hens in cage and the highest on litter, indicating that the social relationship within a large group may act as a greater stress factor than conditions found in small groups reared in cage.
Data obtained from organic hens (tab.1) showed that mean corticosterone levels were higher then those reported in hens reared on floor, though the organic system should be the best in satisfying the animal welfare. The results related to corticosterone plasma levels in organic hens also showed significant differences among the three blood samplings (fig.2). On April, indeed, we observed an increase of corticosterone, likely explained by the fact that in this month the hens started to come out and many uncontrolled agents could act as chronic stress factors (prey presence, a number of visual and olfactory stimulation). The corticosterone reduction detected in the last sampling (20,97 ng/ml) may be sign of establishing of an increasing "environmental confidence" from the hens.
In our study the lowest corticosterone levels were detected in floor reared hens. It seems reasonable to speculate that in this rearing system birds have an adequate space allowance in controlled environment that permits them to satisfy, though partially, their behavioural needs without the presence of various stress factors acting in the other systems. The time of blood sampling collection should not have any influence on the corticosterone concentration since blood was taken within 1 min. in each bird from all systems. Craig and Craig (1985) showed that delays of 2 and 3 min. after catching have little, if any, effect on basal plasma corticosterone concentration.
Further investigations are necessary to establish if plasma corticosterone can be an useful measure of long term stress or welfare in hens since the physiological level of the "stress" hormone in the hens is not still well defined and there are difficulties with the interpretation of circulating hormone concentrations due to diurnal patterns and to the sampling procedures. It may be corrected in concluding that other parameters, analogously to other species (Barone et al.), as practical estimates of welfare should be considered in different housing conditions, particularly in organic farming, where the corticosterone response may be dependent on a complex interaction with a number of other environmental variables difficult to identify.

Tab.1 Mean plasma corticosterone levels and standard deviation in differently housed hens in relation to the date of sampling.

		CAGE (a)		**FLOOR (b)**		**ORGANIC (c)**		
Sampling date		*Mean*	*Standard Deviation*	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*	*Significance*
March 04	**Corticosterone**	27.25	Γ5.11	20.04	Γ5.63	25.91	Γ5.40	a-b pP0.01 b-c pP0.01
	Temp. °C	*22-23*		*20*		*20*		a-c n.s.
April 04	**Corticosterone**	25.69	Γ7.94	22.63	Γ5.91	28.91	Γ6.90	a-b n.s. b-c pP0.01
	Temp. °C	*22-23*		*22*		*23*		a-c n.s.
May 04	**Corticosterone**	25.71	Γ5.59	21.73	Γ5.11	20.97	Γ6.90	a-b pP0.05 b-c n.s.
	Temp. °C	*22-23*		*24*		*24*		a-c. pP0.05
total		26.4	Γ6.3	21.5	Γ5.6	25.3	Γ7.2	a-b pP0.01 b-c pP0.01 a-c n.s.

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Fig.1 Mean plasma corticosterone concentration (ng/ml) in hens from the three housing systems

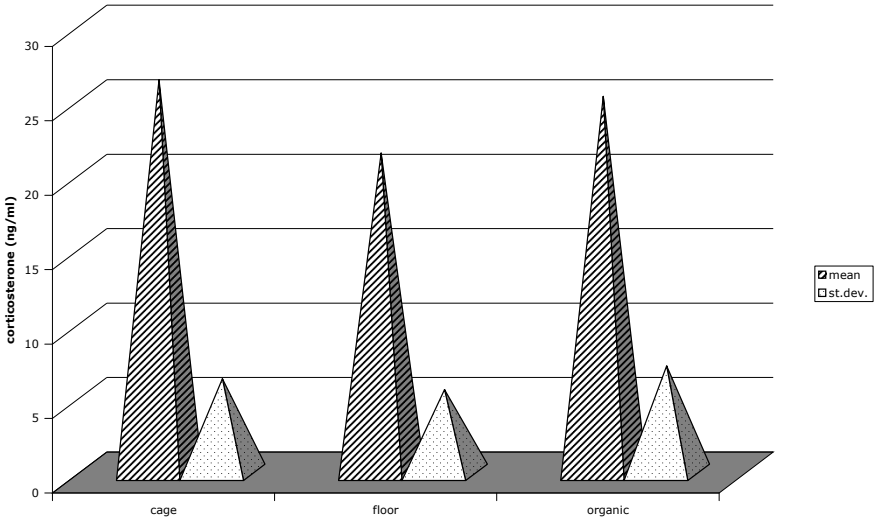

Fig.2 Comparison of plasma corticosterone concentration (ng/ml) in organic hens in relation to the date of samplings