STUDIES REGARDING HAEMATOLOGICAL INDICATORS OF LAYING HENS AND WELFARE ASSURED CONDITION

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Abstract

Investigations were carried out on ISA Brown laying hens, exploited in according with the specifications from rearing guide, in two rearing systems agreed by EU (in batteries and in loft). Blood samples were gathered in weeks 25, 35, 45 and 55 of birds life and served for determination of metabolic and enzymatic indicators. At hens which are the end of laying period were founded superior levels for proteins (higher with 21.2-25.7%), triglycerides (with 4.7-5.4%) and cholesterol (with 39.5-43.0%), in comparison with the birds which were at the beginning of laying. Also minerals had a similar dynamics, being determined in superior rates at the end of laying period, when were higher with 32.4-35.0% for calcium and with 29.6-31.2% for phosphorous that at beginning of laying period. Sanguine enzymes were correlated with birds' laying rhythm, being higher at the end of laying with 8.3-8.5% for alanine aminotransferase and respectively, with 22.8-23.2% for aspartate aminotransferase, than at beginning of laying. The conclusion of the study was that biochemical indicators were correlated with laying intensity and with birds' freedom of movement; their level in blood increasing gradually, at the same time with birds' aging and decreasing of laid on eggs number, because were necessary smaller quantities of nutritive substances for eggs' forming.

Key words: hens, rearing system, biochemistry, welfare

INTRODUCTION

In the last decades, civic society became very attentive at the way in which animals are treated, especially the ones reared in farms, imposing its point of view inclusively at legislative level [2].

These social actions leaded to apparition of term "animals' welfare", a complex notion with have not only scientifically and ethically aspects, but is also related with economically, culturally and politically particularities [5 ,8].

Nowadays husbandry is characterized by an intensification of industrial production systems, from necessity to reply to food demands of a human population which is in a rapid growth [12].

Such a phenomenon is based on very high progresses made in productivity and animal welfare, but which, in some situations, were accompanied by a degradation of the norms regarding animals' welfare [3, 4, 8].

From the whole farm animals, laying hens had an increased attention regarding protection measures and which were improved in time, being transformed in welfare condition [1, 11, 12].

So, the first minimal protection norms for laying hens reared in batteries were legislated still from 7th of March 1988, by enacting Directive nr. 166 of European Union Council [2, 11, 12].

Few months later (20th of July 1988), EU Council enacted Directive 58 regarding protection of farm animals and their exploitation in welfare conditions [9].

The most important moment for aviculture was enacting at 19th of July 1999 of Directive 1999/74/EC which banned the exploitation of laying hens in classical batteries, starting with 1st of January 2012 [12].

This moment was intuited by aviculture specialists, whom still from 1980's years designed and introduced in practice different technical solutions which offer birds the possibility of manifestation of natural instincts (welfare conditions), but also to allow the externalizing of productive potential which is possesses by them [1, 11, 13].

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From the above mentioned reasons, by the current paper we aimed to study the way in which the utilised rearing system for exploitation of laying hens affect the level of main sanguine biochemical indicators [6, 7, 10], from the point of view of the existing connections between them and birds' welfare state [9, 13].

MATERIAL AND METHOD

Biological material was represented by laying hens belonging to hybrid ISA Brown, exploited in according with the rearing guide specifications; were utilized two rearing systems agreed at European level, respectively: in improved battery (Eurovent type) and in loft (Natura Nova Twin type).

For the both rearing systems, population was made with birds with age of 20 weeks, with initially flocks which respected the density norms regarding welfare, as follows: 36343 heads in case of shelter with loft and 10346 heads in case of shelter with battery.

During research were determined a series of sanguine indicators which allow to evaluate the birds' welfare state, respectively, if welfare condition was respected.

Gathering of blood samples was made from 5 individuals from each rearing system, in weeks 25, 35, 45 and 55 of birds life, and the itself analysis was realised with ABX Micros VET ABC device.

For identification of the possible correlations between laying intensity realised by the birds from experience and metabolic profile indicators were determined cholesterol (mg/dl), total protein (g/dl) and triglycerides (mg/dl).

To establish the absorption rate from blood of the mineral substances necessary for egg shell forming were dosed calcium (mg/dl), magnesium (mg/dl) and phosphorus (mg/dl).

To evaluate the hepatic metabolism were determined aspartate aminotransferase and alanine aminotransferase.

The obtained date were statistically processed, calculating: arithmetic mean ($\overline{X}$), standard deviation of mean (±sx) and variation coefficient (V%).

RESULTS AND DISCUSSIONS

The effectuated haematological analysis show a certain correlation between the level of some biochemical indicators and birds' laying intensity, but in connection with the physical effort made by them.

Even if, were differences under productive aspect between those two birds batches (battery vs. loft), biochemical indicators presented quite a similar dynamics and without major value differentiations, because metabolism of hens from loft functioned also to compensate the energetic spends due to the movement on much greater areas (tab. 1).

So, at birds with the best egg production (the ones reared in battery), cholesterol oscillated between 152.78±10.01 mg/dl as it was in week 25 of life and 218.55±14.42 mg/dl in week 55 of life, while at hens with a reduced egg production (the ones accommodated in loft), variation limits were between 157.83±12.84 mg/dl (week 25) and 220.21±22.52 mg/dl (week 55).

A similar situation was recorded for triglycerides, their level was a little bit reduced in the blood of hens reared in battery (189.66-199.88 mg/dl) and a little bit greater at the ones exploited in loft (193.32-202.45 mg/dl).

Regarding the level of total proteins at hens reared in loft, this one was 4.05±0.81 g/dl at individuals with age of 25 week, 4.26±1.0 g/dl at the ones of 35 weeks, 4.42±0.87 g/dl at hens of 45 weeks and 4.91±1.03 g/dl at hens with age of 55 weeks; in case of hens reared in battery, total proteins determinate at the same ages had the levels of 3.97±0.79 g/dl; 4.16±1.11 g/dl; 4.38±0.77 g/dl and respectively, 4.99±1.26 g/dl.

This dynamics we associated with a gradually diminishing of laying intensity, which supposed mobilization from blood of some reduced quantities of proteins for albumen forming.

Table 1 Bio-chemical indicators for the studied birds

Specification		Age of birds							
		25 weeks		35 weeks		45 weeks		55 weeks	
		$\bar{X} \pm s_{\bar{x}}$	V%	$\bar{X} \pm s_{\bar{x}}$	V%	$\bar{X} \pm s_{\bar{x}}$	V%	$\bar{X} \pm s_{\bar{x}}$	V%
Cholesterol (mg/dl)	A	157.83±12.84	23.23	172.29±15.51	22.72	191.86±24.22	31.74	220.21±22.52	29.90
	B	152.78±10.01	16.16	168.18±14.60	21.09	187.91±15.82	30.33	218.55±14.22	31.81
Triglycerides (mg/dl)	A	193.32±9.40	16.81	196.35±10.60	14.43	199.05±11.59	23.04	202.45±12.84	22.17
	B	189.66±6.27	10.09	192.11±9.11	12.79	195.03±12.54	23.36	199.88±11.22	19.58
Total protein (g/dl)	A	4.05±0.81	12.12	4.26±1.00	20.49	4.42±0.87	12.38	4.91±1.03	16.56
	B	3.97±0.79	14.05	4.16±1.11	22.22	4.38±0.77	14.74	4.99±1.26	17.17
Calcium (mg/dl)	A	9.12±0.50	12.24	8.98±0.49	15.33	11.09±0.89	17.24	11.89±0.94	19.14
	B	8.55±0.20	16.29	8.17±0.29	15.24	10.24±0.95	15.11	11.03±0.87	18.84
Phosphorous (mg/dl)	A	7.15±0.83	24.98	6.58±0.98	27.12	7.88±1.22	26.21	8.63±1.10	26.22
	B	6.96±0.69	25.83	6.12±0.56	28.84	7.01±1.03	26.89	7.93±0.99	28.17
Glucose (mg/dl)	A	215.16±21.10	20.76	229.29±22.13	21.91	242.40±22.03	22.15	260.04±24.02	22.95
	B	207.55±21.14	20.20	217.32±22.01	21.31	224.34±22.05	22.52	235.18±23.17	23.41
Uric acid (mg/dl)	A	11.10±0.65	20.24	10.22±0.57	21.01	9.32±0.52	20.75	7.99±0.48	23.19
	B	9.93±0.61	20.79	8.96±0.55	21.25	7.65±0.50	21.29	6.39±0.38	24.65
Urea (mg/dl)	A	5.38±0.42	20.17	5.42±0.48	22.58	5.56±0.51	23.03	5.88±0.63	19.88
	B	5.21±0.45	20.28	5.29±0.46	23.09	5.47±0.50	21.88	5.61±0.58	20.22
ALP (U/l)	A	92.11±20.25	18.18	94.62±20.38	21.56	97.29±22.87	20.20	99.78±21.58	22.41
	B	89.78±19.81	19.06	92.03±19.91	20.81	95.63±20.64	20.04	97.44±21.44	20.73
AST (U/l)	A	243.55±18.71	20.50	265.28±22.15	21.05	281.73±24.33	23.24	299.02±23.76	21.89
	B	240.97±19.10	21.23	262.19±22.14	22.91	279.58±24.28	23.25	296.98±23.54	26.87

A-hens reared in lofts
B-hens reared in batteries

It is known the fact that for forming of egg mineral shell, blood of a bird must run 100-150 mg Ca/h; if calcium reserve is not rapidly split by intestinal absorption, calcaemia could reach zero value, in only 10-12 minutes.

In the case studied by us weren't observed such problems, because both batches of birds had fodders which were very well balanced from nutritive point of view, so weren't perturbtory factors for calcium metabolism, bony absorption and re-absorption being carried out in a normal way.

The data obtained by us showed the fact the calcium sanguine level was influenced by the egg forming rhythm, being lower at the birds with age of 35 weeks, which are in full production (8.17±0.29 g/dl at hens from battery and 8.98±0.49 g/dl at the ones from loft), in comparison with the one from birds of 55 weeks, which are to the end of productive cycle (11.03±0.87 g/dl at hens from battery and 11.89±0.94 g/dl at the ones from loft).

Phenomenon was valid also for sanguine phosphorous, which had lower values in laying peak (6.12±0.56 g/dl at hens from battery and 6.58±0.98 g/dl at hens from loft) at a little bit greater at the end of laying (7.93±0.99 g/dl at hens from battery and 8.63±1.10 g/dl at the ones from loft); the very great variability of those characteristics could be explained by the fact that phosphorous level in blood had a significant increase at 10-12 hours post-oviposition, during mineralization process of the shell of new egg which is already in uterus.

Regarding sanguine enzymes, the obtained data indicated some differences regarding hepatic metabolism intensity, due to different laying rhythm of studied birds.

So, alanine aminotransferase (ALP) oscillated between 92.11±20.25 U/l (hens with age of 25 weeks) and 99.78±21.58 U/l (hens with age of 55 weeks) in case of the ones reared in loft and respectively, between 89.78±19.81 U/l (hens with age of 25 weeks) and 97.44±21.44 U/l (hens with age of 55 weeks) at the ones which were accommodated in ecological batteries.

Aspartate aminotransferase (AST) varied in interval 240.97-296.98 U/l at hens from battery and respectively, in interval 243.55-299.02 U/l at the ones from loft.

Glucose presented oscillation levels between 207.55±21.14 mg/dl-laying start and 235.18±23.17 mg/dl-laying end, in case of hens reared in battery and respectively, between 215.16±21.1 mg/dl-laying start and 260.04±24.02 mg/dl-laying end, at the ones from loft.

Uric acid was founded in higher quantities in period of laying start (11.10 mg/dl at hens from loft and 9.93 mg/dl at

hens from battery) and a little bit reduced at its end (7.99 mg/dl at hens from loft and 6.93 mg/dl at hens from battery), while urea dosage enlightened a certain balance between young birds and the eldest ones, determinate values being 5.21-5.38 mg/dl at laying start and 5.61-5.88 mg/dl at laying end.

The final conclusion of these stage of our research was that the value of biochemical indicators determined on studied birds were in the normal limits, specific for this category.

The fact that were founded very high values for variation coefficients at each studied characters, could be justified by the physiological state of the birds at the moment when samples were gathered (with egg indifferent forming stages, with egg prepared for oviposition or with egg already expulsed).

CONCLUSIONS

The level of biochemical indictors was influenced by birds' laying intensity and by the physical effort effectuated by them in connection with the adopted rearing system, recording their gradually increasing in blood, because were necessary smaller quantities of nutrients for egg forming.

So, at hens which are to the end of productive period were founded superior levels both for proteins (higher with 21.2-25.7%), as well as for triglycerides (with 4.7-5.4%) and for cholesterol (with 39.5-43.0%), in comparison with the young birds which are at the start of laying.

Minerals in blood were in lower quantities during peak laying period (calcium = 8.17-8.98 ml/dl; phosphorous = 6.12-6.58 ml/dl) and higher at the end of it (calcium = 11.03-11.89 ml/dl; phosphorous = 7.93-8.63 ml/dl).

Also the level of sanguine enzymes was correlated with birds' laying rhythm, in the way that were higher at laying end than at laying start with 8.3-8.5% in case of alanine aminotransferase and respectively, with 22.8-23.2% in case of aspartate aminotransferase.

The conclusion of the current study is that monitoring of biochemical indicators during productive life of laying hens allow the evaluation of welfare state in which there are; indirectly, could be appreciated the laying intensity realised at a certain moment.

REFERENCES

[1] Adams A.W. and Craig J.V., 1985 - *Effect of crowding and cage shape on productivity and profitability of caged layers: a survey.* Poultry Science, no. 64, pg. 238-242.

[2] Appleby M.C. and Hughes B.O., 1991 - *Welfare of laying hens in cages and alternative systems: environmental, physical and behavioural aspects.* World's Poultry Science Journal, vol. 47, pg. 109-128.

[3] Grandall P.G., Seideman S., Ricke S.C., O'Bryan C.A., Fanatico A.F. and Rainey R., 2009 - *Organic poultry: consumer perception, opportunities and regulatory issues.* Journal of Applied Poultry Research, no. 29, pg. 795-802.

[4] Kim W.K., Bloomfield S.A., Sugiyama T. and Ricke S.C., 2012 - *Concepts an methods for understanding bone metabolism in laying hens.* World's Poultry Science Journal, vol. 66, no. 1, pg. 71-82.

[5] Kutlu H.R. and Forbes J.M., 1993 - *Changes in growth and blood parameters in heat-stressed broiler chicks in response to dietary ascorbic acid.* Livestock Production Science, no. 36, 335-350.

[6] Mitchell A.D., Rosebrough R.W. and Conway J.M., 1997 - *Body composition analysis of chickens by dual energy x-ray absorptiometry.* Poultry Science, no. 76, pg. 1746-1752.

[7] Simaraks S., Chinrasri O. and Aengwanich S., 2004 - *Hematological, electrolyte and serum biochemical values of the indigenous chickens (Gallus domesticus) in north-eastern Thailand.* Journal Science Technology, no. 26(3), pg. 425-430.

[8] Sossidou E.N. and Elson H.A., 2009 - *Hens welfare to egg quality: a European perspective.* World's Poultry Science Journal, vol. 65, pg. 709-718.

[9] Sppoolder H.A.M., 2007 - *Animal welfare in organic farming systems.* Journal of the Science of Food and Agriculture, no. 87, pg. 2741-2746.

[10] Sugiyama T. and Kusuhara S., 2001 - *Avian calcium metabolism and bone function.* Asian-Australian Journal of Animal Sciences, no. 14, pg. 82-90.

[11] Tauson R., 2002 - *Furnished cages and aviaries: production and health.* World's Poultry Science Journal, vol. 58, no. 1, pg. 49-63.

[12] Usturoi, M.G., 2008 - *Creşterea păsărilor.* Editura „Ion Ionescu de la Brad", Iaşi.

[13] Usturoi M.G, Radu-Rusu R.M. and Lazăr Roxana, 2011 - *Studies on the welfare condition provided to laying hens within alternative husbandry systems.* Lucrări Ştiinţifice, Seria Zootehnie, vol. 55 (16), pg. 247-251. Editura „Ion Ionescu de la Brad", Iaşi.