

Dept. of Animal Husbandry, Fac. of Vet. Med.,
Sohag University, Sohag, Egypt.

A FIELD STUDY OF WELFARE STATUS IN FOUR STRAINS OF COMMERCIAL BROILER CHICKENS KEPT UNDER INTENSIVE REARING CONDITIONS (With One Table and 2 Figures)

By

**M. ELSAYED MAHMOUD;
REEM MAHMOUD DOSOKY*
and M. MOHAMED AHMED***

* Dept. of Animal Hygiene, Fac. of Vet. Med.,
Assiut University, Assiut, Egypt.
(Received at 12/6/2011)

**دراسات حقلية على حالة الإراحة في أربع سلالات لبدارى دجاج التسمين
التجارية تحت ظروف التربية المكثفة**

معمد السيد محمود ، ريم محمود دسوكي ، مصطفى محمد أحمد

الخلفية البحثية: الدراسات التي أجريت لقياس حالة الإراحة في الدجاج داخل نظام التربية المكثفة في مصر لم تشمل جميع مؤشرات وفي دراسة سابقة للباحثين تم قياس مستوى الخوف عند التعرض للاحتكاك بالإنسان وعلاقته بالكفاءة الإنتاجية. الغرض من الدراسة: هو قياس المؤشرات الهرمونية والمناعة كبيان لحالة الإراحة داخل المزرعة وارتباطها بالكفاءة الإنتاجية في سلالات بدارى دجاج التسمين التجارية الأكثر شيوعاً في صعيد مصر وهي الإيفيان ٤٣، الهبرد، الروس والكوب. طرق البحث والنتائج: تم قياس مستوى هرمون النمو وهرمون الغدة الدرقية النشط في مصل الدم لما لهم من تأثير على معدل النمو والتحويل الغذائي في دجاج التسمين. هذا بالإضافة إلى قياس حالة المناعة الخلوية والتوتر والتمثلة في نسبة خلايا الدم البيضاء المحببة (العدلات) إلى الخلايا الغير محببة (الليمفاوية) وكذلك قياس حالة المناعة المختلطة والتمثلة في اختبار منع التلزن لأنتيجين فيروس مرض النيوكاسل. أوضحت هذه الدراسة أن سلالات الروس والكوب ذات معدلات النمو وكفاءة التحويل الغذائي الأعلى لديها أيضاً مستويات أعلى من هرمون الغدة الدرقية النشط عند عمر ٢ أسبوع ولكن مستوى هرمون النمو كان أقل عند عمر ٢، ٤ أسبوع في هذه السلالات عند مقارنتها بالأفيان ٤٣ والهبرد، هذه النتائج تدل على وجود ارتباط بين مستوى هرمون الغدة الدرقية النشط ومعدلات النمو وكفاءة التحويل الغذائي هذه السلالات، أما الاستجابة المناعية فعند قياس خلايا الدم البيضاء المحببة (العدلات) إلى الخلايا الغير محببة (الليمفاوية) فوجد ارتفاع في هذه النسبة في سلالة الأفيان ٤٣ والهبرد في الأسبوع الرابع والسادس عند مقارنتها بالسلالات الأخرى، وعند عمل اختبار منع التلزن لأنتيجين فيروس مرض النيوكاسل فانه وجد أن سلالة الأفيان ٤٣ لديها إنتاج أكبر من الأجسام المضادة عند مقارنتها

بالسلالات الأخرى الاستنتاج: أن مؤشرات حالة الإراحة مثل درجة الضغوط وحالة المناعة أعلى في سلالات الروس والكوب عند مقارنتها بسلالات الأفيان ٤٣ والهبرد، حيث تزداد الكفاءة الإنتاجية مع زيادة حالة الإراحة في سلالات بدارى دجاج الروس والكوب مقارنة بسلالات الأفيان ٤٣ والهبرد في مرحلة النمو والتسمين عند تربيتها تحت ظروف التربية المكثفة في صعيد مصر.

SUMMARY

Background: Studies of welfare status in commercial broiler chickens in Egypt were still not including all welfare indicators. **The purpose:** The present study was designated to investigate the welfare status in the previously studied commonly reared broiler strains in Upper Egypt in terms of hormonal assay, immunological and productive traits when they were kept collectively under the same husbandry conditions. **Methods:** Strains under investigation were Avian 43, Hubbard, Ross and Cobb. Firstly, tri-iodothyronine (T_3) and growth hormone (GH) were measured. Secondly, Heterophil to lymphocyte ratios (HLRs) were also measured as an indicator to slight and moderate physiological stress and in addition to their indication about cellular immunity. Thirdly, the humoral immune component was estimated by measuring heamagglutination inhibition (HI) titer to Newcastle Disease Virus (NDV) antigen. **Results:** Serum GH levels were lower in Ross and Cobb strains when compared with Hubbard and Avian 43 strains at 2nd and 4th weeks old. On the other hand serum T_3 levels were significantly higher in Ross and Cobb strains when compared with Hubbard and Avian 43 strains at 2 weeks old. Therefore, the higher serum T_3 levels at first 2weeks the higher were the feed conversion and final body weight. These results indicated that T_3 has more impact on body weight gain than GH in commercial broiler strains in broiler chicken reared under intensive housing systems. HLRs were significantly increased with ages in all strains, but HLRs were higher in Avian 43 and Hubbard broilers when compared with Ross and Cobb broilers at 4th and 6th weeks of age. **Conclusion:** Welfare status in terms of immunity and stress tolerance was higher in Ross and Cobb broilers when compared with Avian 43 and Hubbard broilers. Therefore, the high welfare status could be translated into high productive performance in commercial broilers that kept under intensive rearing conditions in Upper Egypt.

Key words: Broiler Chickens, T_3 , GH, Heamagglutination inhibition, HLRs.

INTRODUCTION

Productive performance, physiological, behavioral and immunological measures have played a prominent role in evaluation efficiency of applied husbandry system. Modern selection programs have produced rapidly growing efficient broilers (Siegel, 1995). But this selection has also induced endocrine changes, more particularly at the level of thyroid and somato-tropic axis (Gonzales *et al.*, 1999).

Thyroid hormone levels, especially for 3, 3, 5-tri-iodothyronine (T_3) are closely related to metabolism (Gonzales *et al.*, 1999). Growth hormone (GH) plays a central role in growth and metabolism of birds as it stimulates the release of insulin-like growth factor and inhibits the de-iodinization of thyroxine (T_4) to metabolically active form in birds which is T_3 (Lam and Scan, 1986). Therefore hypothyroid chicken had lower growth rate (Decuyper *et al.*, 1987) that could be related to decreased food intake (Lunger *et al.*, 2001). In addition T_3 was not significantly different between Hubbard and Ross strains of chicken but decreased linearly with advancing of age (Bordas and Minvielle, 1999).

Heterophil to lymphocyte ratio (HLR) was a highly heritable trait (Al-Murrani *et al.*, 1997). McFarlane *et al.* (1989); Gross and Siegel (1983) reported that increased HLRs were a good indicator to slight and moderate degrees of physiological stress. HLRs were considered the only non-infectious hormonal responses of leucocytes to stress in broiler chicken (Maxwell, 1993; Siegel, 1995). Regarding HI titer as an indicator of humoral immune component, a high titre of HI antibodies after vaccination was produced under a satisfactory level of immunity and a low immune status was associated with a reduced titre of HI antibodies (Levy and Rones, 1973; Fanguy, 1982).

Criteria to evaluate welfare should include its indicators which are productive, physiological, behavioral and immunological traits. Considerable literature existed on behavioral responses, production characteristics, physiological and immunological responses. However, all these are lacking full criteria in an integrated study. After measuring behavior and productive traits in broilers strains in our previous study under publication (Mahmoud *et al.*, 2011), this study was performed to fulfill the criteria about the welfare status in terms of physiological and immunological traits in most commonly reared broiler strains kept under intensive rearing conditions in Upper Egypt.

MATERIALS and METHODS

1. Subjects and housing:

The study was conducted in Animal Production Department in experimental farm, Faculty of Agriculture, Assiut University. The commercial strains under examination; Avian 43, Hubbard, Cobb and Ross broilers were supplied from provider companies. Each flock stocked in a closed environmental house. Food and water were supplied ad libitum. A group of forty chicks from each of the previous four flocks (Ross, Hubbard, Cobb and Avian 43) were selected at random upon arrival, individually weighed and identified by leg tags. Upon receipt they were randomly allocated within the same hutch of their parent flock but in separate space (2.0X 1.5 X0.5m³). Pens were made of wire meshes equipped with chopped wheat straw bedding, a feeder and a drinker identical to the flock groups. Rearing and maintenance conditions followed recommendation of manufacturer companies.

2. Blood sampling:

During catching birds, an experimenter quietly and gently entered the pens and allowed 3 min for the birds to adjust to the presence of the catcher. Blood samples were taken from 6 chicks that were selected randomly each time and caught with both hands and held in an inverted manner. While moving through the pens, the experimenter avoided pushing and stirring the birds deliberately. Following blood sampling, the birds were marked by leg tagging using plastic adhesive tapes and returned to their home pens. Each chick was caught and sampled, immediately one after another. This procedure should not influence other members of the flock (Zulkifili *et al.*, 2002; Zulkifili and Azah, 2004). About 0.5 to 1ml blood samples were collected from each chick at 2nd, 4th and 6th week ages respectively to represent starting, growing and finishing periods of commercial broilers under intensive rearing conditions.

3. Hormonal analysis:

To avoid circadian variations in serum hormone concentrations all samples were taken at the same time of the day (Bishop *et al.*, 1992). Hormonal analysis in serum samples were performed according to Immulite system protocol for both growth hormone (Hattori, 1988) and tri-iodo-thyroxine (NCCLS, 1998) in laboratory of hormonal assay, Department of Clinical pathology, Assiut University Medical Hospital.

4. Heterophil to lymphocytes ratio (HLR):

Brachial venopuncturing sampling in micro-heamatocrite centrifuge tubes was performed. Blood smears were prepared using May-Grunwald-Giemsa stain (Maxwell, 1993). Heterophils and lymphocytes were counted up to 400 cells. The other portion of blood sample collected in Epindoorf's tubes was centrifuged and sera were used for Heamagglutination inhibition test.

5. Heamagglutination inhibition (HI) test:

Heamagglutination inhibition titers were determined by using four heamagglutination units of Newcastle Disease Virus (NDV) antigen according to established and published protocols (Purchase, 1989; Lunger *et al.*, 2001).

6- Statistical analysis:

All statistical analysis of data was performed using SPSS (2007) Software. Data were presented as means \pm standard error (SE). Descriptive statistics of 3 age groups in 4 broiler strains were analyzed by two-ways ANOVA. Tukey's HSD was used for multiple comparisons of mean values at 2nd, 4th and 6th weeks of age in different broiler strains.

RESULTS and DISCUSSION

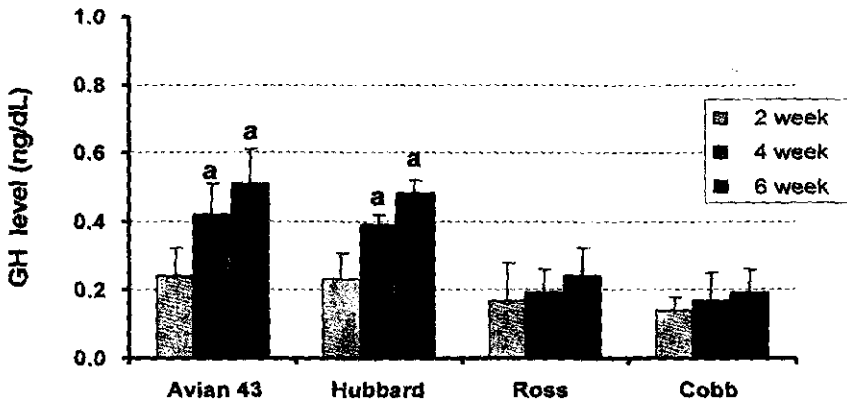


Fig. 1: Serum GH concentration in four broiler strains at 2nd, 4th and 6th weeks of age. Two ways ANOVA indicated a significant effect of age on levels of GH, with advancing age, there were increasing level of GH. Post hoc Tukey's HSD tests showed that Avian 43 and Hubbard strains showed significant higher levels of growth hormone when compared with Ross and Cobb strains at 4th and 6th weeks of age. All values were presented as SEM, values superscripted with letters mean significant ($P < 0.05$).

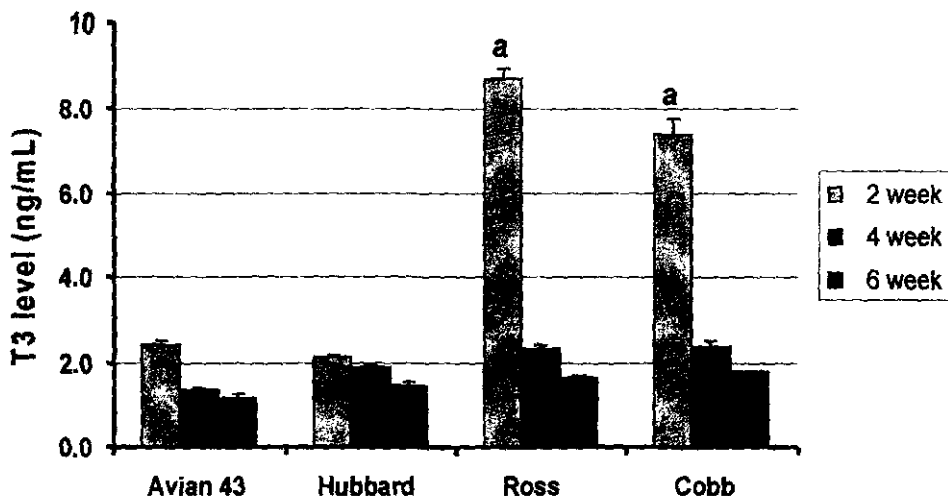


Fig. 2 Serum T₃ concentration in four broiler strains at 2nd, 4th and 6th weeks of age. Tukey's HSD Post hoc tests indicated that Ross and Cobb had higher levels of T₃ when compared with Avian 43 and Hubbard only at 2nd week of age ($P < 0.01$).

In present study, there was a general decrease of serum T₃ concentrations with advancing the age within all strains. These results were agreed with Carew *et al.* (1998) who found that serum T₃ concentrations level at 2nd weeks of age was 2.20 ± 0.09 ng/ml. Bordas and Minvielle (1999) reported that T₃ level decreased linearly with age increment. Lunger *et al.* (2001) also found that T₃ level is positively correlated to the feed intake and weight gain in broiler chickens up to 7 weeks age.

Regarding the relationship between GH and thyroids Closset (1983); Reiprich *et al.* (1995); Hall (2001) found that the early rapid growth of broilers during 1st three weeks corresponded to relatively low levels of GH concentration but had high T₃ levels. The later decreased growth rates were linked to increased amounts of plasma GH concentrations. This negative correlation between T₃ and GH was illustrated by Donoghue and Scanes (1991) who found that T₃ inhibited growth hormone release by reducing the availability of intracellular stores of GH and inhibiting GH release. Regarding Humoral immune component, HI titer in broiler strains (Table 1) two-ways ANOVA revealed a significant main effect of strain and age differences ($P < 0.05$).

Post hoc Tukey's HSD tests indicated significant differences ($P < 0.01$) between Ross and Cobb when compared with Hubbard and Avian 43. Kidd *et al.* (2001) found that Hubbard broiler had an average of 51 Log₁₀ antibody titers in HI test.

In present study there was significant decrease of HLR with advancing of age. Differences in heterophils to lymphocytes ratios that reported by Kliger *et al.* (2000). Their measures of HLRs were as followed: 0.25 and 0.27 for 3 weeks and 6 weeks post hatching respectively in broiler chickens. Elston *et al.* (2000); Campo *et al.* (2001) suggested that H/L ratios of about 0.2, 0.5 and 0.8 that associated with low, optimum and high level of stress respectively. Therefore in the present study the high HLRs in Avian 43 and Hubbard may indicate higher degree of stress and hence lower welfare status when compared with Ross and Cobb broilers.

Table 1: Serum T3 and GH levels, HI titers and HLRs in commercial broiler flocks.

Strain Age	Avian 43	Hubbard	Ross	Cobb
Body weight				
2 week	305 ± 3.83	255.8 ± 4.58	246 ± 3.2	303.6 ± 2.31
4 week	1040.8 ± 16.7	970 ± 5.14	975.8 ± 7.7	914.8 ± 6.6
6 week	1576.2 ± 3.53	1560.8 ± 8.45	1563.5 ± 7.92	1736.7 ± 11.22 ^a
Heamagglutination inhibition (HI) titers (Log ₁₀)				
2 week	51 ^a	36	32	32
4 week	53 ^a	31	34	36
6 week	52 ^a	33	37	35
Heterophil to lymphocyte ratios (HLRs)				
2 week	0.24 ± 0.03	0.23 ± 0.08	0.17 ± 3.83	0.14 ± 0.04
4 week	0.42 ± 0.13 ^a	0.39 ± 0.03 ^a	0.19 ± 3.83	0.17 ± 0.08
6 week	0.51 ± 0.08 ^a	0.48 ± 0.04 ^a	0.24 ± 3.83	0.19 ± 0.07

Tukey's HSD Post hoc tests indicated Cobb had highest body weight at 6th week of age when compared with other strains. While HI titers were higher in Avain 43 strains than others. HLRs were also higher in Avian 43 and Hubbard when compared with Ross and Cobb. Data are presented as SEM and values with superscripted letter means significantly different ($P < 0.05$).

Results of this study indicated that HLRs were more descriptive to the degree of stress in commercial broilers. In addition, T₃ had more positive impact on final body weight than growth hormone in commercial broiler chicken reared under intensive housing systems.

Conclusion: Welfare status was higher in Ross and Cobb broilers when compared with Avian 43 and Hubbard broilers were characterized by high T₃ levels, low HLRs and associated with high productive performance. Therefore, high welfare status in terms of immunity and stress tolerance could be responsible for high productive performance.

ACKNOWLEDGEMENTS

The authors acknowledge Prof. Dr. Awad Abdelhafez (Department of Poultry Diseases, Assiut University, Egypt) for kindly providing Newcastle Disease Virus (NDV) antigen.

REFERENCES

- Al-Murrani, W.K.; Kassab, A.; Al-Sam, H.Z. and Al.Athari, A.M. (1997):* Heterophil/Lymphocyte ratio as a selection criterion for heat resistance in domestic fowls. *Br. Poult. Sci.* 38 (2): 159-163
- Bishop, L.; Kirk, D.; Janet, L. and Fody, E. (1992):* Clinic.chemistry second Edition. J.B. Lippincott. Co. Philadilphia.pp. 132-135.
- Bordas and Minvielle (1999):* Growth patterns and feed intake of in divergent lines of laying domestic fowl selected for residual feed consumption. *Poultry Science.* 78: 317-323.
- Campo, J.L.; Gil, M.G.; Torres, O.B. and Davila, S.G. (2001):* Association between plumage condition and fear and stress levels in five breeds of chickens. *Poultry Science* 80: 549-552.
- Carew, L.B.; Evarts, K.G. and Alster, F.A. (1998):* Growth, feed intake and plasma thyroid hormone levels in chicks fed dietary excesses of essential amino acids. *Poultry science* 77: 295-298.
- Closset, J. (1983):* Purification of the 22.000 and 20.000 mol.wt. forms of human somatotropin and characterization of their binding to liver and mammary binding sites. *Biochemistry Journal* 214: 885-892.
- Decuyper, E.J.; Buyse, C.G.; Scanes, L.M. Huybrechts and Kuhn, E.R. (1987):* Effects of hyper and hypothyroid status on growth, adiposity and levels of growth hormone, Somatomedin C and

- thyroid metabolism in broiler chickens. *Reprod. Nutr. Develop.* 27: 555-565.
- Donoghue, D.J. and Scanes, C.G. (1991):* Triiodothyronine (T₃) inhibition of Growth hormone secretion by chicken pituitary cells in vitro. *General and comparative Endocrinology* 84: 344-354.
- Elston, J.J.; Beck, M.M.; Alodan, M.A. and Murillo, V.V. (2000):* Laying hen behavior 2. Cage type preference and heterophil to lymphocyte ratios. *Poultry science* 79: 477-482.
- Fanguy, R.C. (1982):* Rearing density as a stressor in the production of commercial broilers. *Poultry sciences* 91: 1563 [Abstract].
- Gonzales, E.; Buyse, J.; Sarto, J.; Loddi, M. and Decuyper, E. (1999):* Metabolic disturbances in male broiler of different strains.2. Relationship between the thyroid and somatotrophic axes with growth rate and mortality. *Poultry Science* 78: 516-521.
- Gross, W.B. and Siegel, H.S. (1983):* Evaluation of the heterophil to lymphocyte ratio as a measure of stress in chickens. *Avian Diseases* 27: 972-979.
- Hall, A.L. (2001):* The effect of stocking density on the welfare and behavior of broiler chickens reared commercially. *Animal welfare* 10: 23-40.
- Hattori, N. (1988):* Urinary growth hormone levels measured by Ultrasensitive Enzyme linked Immunoassay. *J. Clinic. Endocrinol. Metabolism.* 66: 727-732.
- Kidd, M.T.; Peebles, E.D.; Whitmarsh, S.K.; Yeatman, J.B. and Wideman, Jr.T. (2001):* Growth and immunity of broiler chicks as affected by dietary arginine. *Poultry Science* 80: 1535-1542.
- Kliger, C.A.; Gehad, A.E.; Hulet, R.M.; Roush, W.B.; Lillehoj, H.S. and Mashaly, M.M. (2000):* Effects of photoperiod and melatonin on lymphocytes activity in broiler chickens. *Poultry Sciences* 79 (1): 18-25.
- Lam, S.K.S. and Scanes, C.G. (1986):* Somatostatin inhibits thyroid function in fowl. *General and comparative endocrinology* 63: 134-138.
- Levy, R. and Rones, Z. (1973):* Immunization of chickens with an activated oil adjuvant Newcastle disease virus vaccin. *Avian disease* 20: 598-604.
- Lunger, D.; Shinder, D.; Rzepakovsky, V.; Rusal, M. and Yahav, S. (2001):* Association between weight gain, blood parameters

and thyroid hormones and the development Ascitis syndrome in Broiler chickens. Poultry Science 80: 965-971.

- Mahmoud, M.E.; Dosoky, R.M. and Ahmed, M.M. (2011):* Assessment of Fear level in commercial broiler chicken strains when exposed to human contact. Assiut Veterinary Medical Journal (In Press).
- Maxwell, M.H. (1993):* Avian blood leucocyte response to stress. World's Poult. Sci. J. 49: 34-43.
- McFarlane, J.M.; Cutis, S.E.; Simon, J. and Izquierdo, O.A. (1989):* Multiple concurrent stressors in chicks. 3 Effects on plasma corticosterone and Heterophil/lymphocyte ratio. Poultry Science 68: 522-527.
- National Committee for Clinical Laboratory Standards; NCCLS. (1998):* Procedures for the collection of diagnostic blood specimens by venipuncture; approved standard. 4th ed NCCLS Document H3-A4, Wayne, P.A.
- Purchase, H.G. (1989):* Practical application of nucleic acid techniques to avian disease problems. Avian disease 33(4): 609-14.
- Reiprich, K.; Muhlbauer, E.; Decuypere, E. and Grossmann, R. (1995):* Characterization of growth hormone gene expression in the pituitary and plasma growth hormone concentrations during post hatch development in the chicken. Journal of Endocrinology 145: 343-353.
- Siegel, H.S. (1995):* Stress, strains and resistance. Br. Poult. Sci. 36: 3-22.
- SPSS (2007):* Statistical Package for Social Science, version 16 (2007) for Window.
- Zulkifli, I.; Gilbert, J.; Liew, P.K. and Ginsos, J. (2002):* The effect of regular visual contact with human being on fear, stress, antibody and growth responses in broiler chickens. Appl. Anim. Behav. Sci. 79: 103-112.
- Zulkifli, A. and Azah, S.N. (2004):* Fear and stress reactions and the performance of commercial broiler chickens subjected to regular pleasant and unpleasant contacts with human being. Appl Anim. Behav. Sci., 88: 77-87.