TÜBİTAK

Turkish Journal of Veterinary and Animal Sciences

http://journals.tubitak.gov.tr/veterinary/

Short Communication

Turk J Vet Anim Sci
(2013) 37: 747-749
© TÜBİTAK
doi:10.3906/vet-1304-59

Semen quality in white leghorn chicken selected for egg production traits

Shanmugam MURUGESAN*, Niranjan MATAM, Rakesh KULKARNI,
Tarun Kumar BHATTACHARYA, Rudranath CHATTERJEE
Project Directorate on Poultry, Rajendranagar, Hyderabad, Andhra Pradesh, India

Received: 25.04.2013 • **Accepted:** 01.07.2013 • **Published Online:** 13.11.2013 • **Printed:** 06.12.2013

Abstract: The present study was conducted to evaluate the effect of selection for egg production traits in White Leghorn chicken based upon the semen quality. Males of 3 pure lines of White Leghorn, namely IWH, IWI, and IWK, along with a pedigree random-bred control (IWC) population, were selected and housed in individual cages. The semen collected from individual birds was evaluated for different physical and biochemical parameters. There was significant ($P \leq 0.013$) difference in semen quality parameters studied between the lines. High egg-producing lines IWH and IWI had poor semen quality in comparison with that of the control line (IWC). Thus, it can be concluded that selection for higher egg production affects the semen quality of males in the selected lines.

Key words: White leghorn, semen, selection

Genetic selection for high production efficiency may produce correlated responses in other traits. White Leghorn chicken under the All India Coordinated Research Project (AICRP) has undergone many generations of selection for improved performance and, in the process, different pure lines have been developed. The effect of this selection program for high egg production traits based upon the semen quality in males has not been studied extensively. Niranjan et al. (1) studied some semen quality parameters in 2 White Leghorn lines and found no difference between them. Earlier, Frankham and Doornenbal (2) concluded that semen characteristics do not change as a correlated response to selection for egg production. The present study was conducted to evaluate the semen quality of 4 different White Leghorn lines that were selected differently for egg-production traits.

Males of 3 pure lines of White Leghorn, IWH, IWI, and IWK, and a pedigreed random-bred control population of White Leghorn, aged 62–68 weeks, were maintained at the Project Directorate on Poultry, Hyderabad, India, and were used in this study. For more than 28 generations IWH and IWI were selected for improved part-period egg production from the beginning of the AICRP on Poultry Breeding. The IWK was selected initially for improved part-period egg production for 18 generations, and later on for feed efficiency for 3 generations and then for egg mass to 64 weeks for 7 generations. In the control population (IWC), selection was not practiced and the population was maintained as a pedigreed random-bred control population. From the age of 18 weeks, cocks from each genetic group were reared in individual layer cages in an open-sided, elevated house with access to ad libitum feed and water.

Semen was collected following the standard practice of cloacal-abdominal massage method (3). Cocks were trained before collecting samples for evaluation. Semen was collected in sterile glass funnels individually, evaluated for volume and appearance, and then diluted 4 times using a high-temperature diluent (4), which was used for evaluation of other semen parameters.

The semen volume was assessed using 1-mL syringes with an accuracy of 0.02 mL. The appearance of semen was scored from 1 to 5 by visual examination (5). Individual motility was recorded as percentage of progressively motile spermatozoa with a drop of the diluted semen kept on a Makler chamber and examined under 20× magnification. The percentage of spermatozoa with normal, vigorous, and forward linear motion was subjectively assessed. Using the same chamber, concentration of spermatozoa of samples was estimated by computer-assisted sperm analysis (Motic Instruments, Canada). MTT dye reduction test was performed to determine the ability of of the sperm to reduce tetrazolium dye 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) to violet MTT formazan (6). Percentage of live and dead spermatozoa was estimated by differential staining technique using

* Correspondence: dr_shan@rediffmail.com

eosin–nigrosin stain (7). The same slides were used for estimating the percentage of abnormal spermatozoa.

For separation of the seminal plasma, samples from 5 or 6 birds were pooled together in each line and centrifuged at 3000 rpm for 10 min twice. Samples were then analyzed for protein by Lowry's method (8) and cholesterol by the method described by Zak et al. (9). Nitric oxide in seminal plasma was determined by the method described by Miranda et al. (10). Total nitrite was determined by Griess assay after conversion of nitrate to nitrite by vanadium(III) chloride reduction and the color intensity was measured at 540 nm in an ELISA reader. Malondialdehyde (MDA), the end product of lipid peroxidation, was assessed using the thiobarbituric acid method (11).

Data from the experiment are presented as mean ± SE. Percentage values were arcsine transformed before analysis. Statistical analyses of data were performed by one-way analysis of variance using SPSS 10. Some birds gave watery semen or a very low volume of semen, and those values were also included in the analysis to reflect the line characteristics.

The results of the gross semen parameters and seminal plasma parameters are presented in the Table. Except for seminal plasma protein and nitric oxide level, all other parameters were significantly ($P < 0.05$) different between the lines studied.

Overall, the IWC layer line had better quality compared to other lines in the present study. The rates of dead and abnormal spermatozoa were significantly lower in the control line. The seminal plasma cholesterol was highest in IWK, which was selected for higher egg mass. Lipid peroxidation was highest in the control line and lowest in the IWH and IWI lines. There was no significant difference for any of the parameters studied between the IWH and IWI lines. In addition, some males of these 2 lines failed to give semen or gave watery semen. Our finding is similar to that reported by Niranjan et al. (1), where the authors also did not find any significant difference between IWH and IWI lines in the semen quality parameters studied. The IWH and IWI lines produced more eggs at 40 weeks of age, followed by IWK, with the lowest being IWC. Frankham and Doornenbal (2) could not find any difference in either semen volume or sperm numbers between selected and control strains. Furthermore, Williams and McGibbon (12) did not find any relationship between semen yields and hen-housed egg production for different strains of White Leghorn chicken. This is in contrast to our results, where the males of high egg-producing lines had poor semen quality in comparison to the control line. Similar to our findings, Jones and Lamoreux (13) reported a difference in semen volume between high and low egg-producing lines. Cluster analysis of the presently studied 4 White Leghorn lines by Chatterjee et al. (14) indicated IWH and IWI in 1 cluster and IWK and IWC further away from that

Table. Mean ± SE semen quality and seminal plasma parameters of White Leghorn lines selected differently for egg-production traits.

Semen quality parameters	IWC (n = 55)	IWK (n = 56)	IWH (n = 59)	IWI (n = 53)
Volume (mL)	0.25 ± 0.01^{a}	0.22 ± 0.01^{a}	0.18 ± 0.01^{b}	0.16 ± 0.01^{b}
Appearance	4.00 ± 0.12^{a}	4.11 ± 0.09^{a}	3.34 ± 0.12^{b}	3.21 ± 0.06^{b}
Individual progressive motility (%)	69.00 ± 2.16^{a}	62.77 ± 2.47^{a}	52.93 ± 3.17^{b}	58.77 ± 2.68^{ab}
Spermatozoa concentration (millions/μL)	6.13 ± 0.18^{a}	5.10 ± 0.17^{b}	3.70 ± 0.23^{c}	3.39 ± 0.17^{c}
MTT dye reduction test (nM of MTT formazan min^{-1} million $spermatozoa^{-1}$)	14.45 ± 0.46^{ab}	15.22 ± 0.61^{a}	12.21 ± 0.80^{bc}	10.10 ± 0.58^{c}
Live spermatozoa (%)	88.84 ± 1.97^{a}	76.91 ± 4.05^{ab}	58.88 ± 4.80^{c}	65.71 ± 4.63^{bc}
Dead spermatozoa (%)	9.51 ± 1.11^{b}	15.82 ± 2.86^{ab}	19.75 ± 2.88^{ab}	24.86 ± 3.75^{a}
Abnormal spermatozoa (%)	1.54 ± 0.25^{b}	3.07 ± 0.59^{ab}	7.04 ± 1.62^{a}	3.69 ± 0.69^{ab}
Seminal plasma parameters				
Protein (g/dL)	1.00 ± 0.07^{a}	0.99 ± 0.05^{a}	1.05 ± 0.12^{a}	0.90 ± 0.03^{a}
Cholesterol (mg/dL)	62.15 ± 5.66^{ab}	81.02 ± 4.82^{a}	50.19 ± 4.40^{b}	64.50 ± 8.31^{ab}
Nitric oxide (μM/L)	357.20 ± 11.97^{a}	379.32 ± 27.24^{a}	413.73 ± 31.98^{a}	402.94 ± 109.32^{a}
Lipid peroxidation (moles of MDA/g protein)	3.17 ± 0.64^{a}	2.75 ± 0.30^{ab}	1.12 ± 0.26^{b}	1.01 ± 0.22^{b}

Figures bearing different superscripts in a row differ significantly ($P \leq 0.013$).

cluster. The results of the present study also show a similar pattern in semen quality, where the lines selected for egg production (IWH and IWI) had lower semen quality in comparison to the control line (IWC), with IWK lying in between. Thus, from the results of the present study, it can be concluded that selection for different egg-production parameters affected the semen quality of the males.

References

1. Niranjan M, Datt C, Das A. Semen quality studies in two White Leghorn lines maintained at Tripura. Indian J Poult Sci 2001; 36: 287–289.
2. Frankham F, Doornenbal H. Semen characteristics of lines selected for increased part-record egg production. Poult Sci 1972; 51: 1468–1469.
3. Burrows WH, Quinn JP. The collection of spermatozoa from the domestic fowl and turkey. Poult Sci 1937; 16: 19–24.
4. Chaudhuri D, Lake PE. A new diluent and methods of holding semen for up to 17 hours at high temperature. In: Proceedings of the 18th World's Poultry Congress, Nagoya, Japan; 1988. pp. 591–593.
5. McDaniel GR, Craig JV. Behavior traits, semen measurements, and fertility of White Leghorn males. Poult Sci 1959; 38: 1005–1014.
6. Hazary RC, Chaudhuri D, Wishart GJ. Application of an MTT reduction assay for assessing sperm quality and predicting fertilising ability of domestic fowl semen. Br Poult Sci 2001; 42: 115–117.
7. Campbell RG, Hancock JL, Rothschild L. Counting live and dead bull spermatozoa. J Exp Biol 1953; 30: 44–49.
8. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin phenol reagent. J Biol Chem 1951; 193: 265–275.
9. Zak B, Dickenman RC, White EG, Burnett H, Cherney PJ. Rapid estimation of free and total cholesterol. Am J Clin Pathol 1954; 24: 1307–1315.
10. Miranda KM, Espey MG, Wink DA. A rapid, simple spectrophotometric method for simultaneous detection of nitrate and nitrite. Nitric Oxide 2001; 5: 62–71.
11. Hsieh YY, Chang CC, Lin CS. Seminal malondialdehyde concentration but not glutathione peroxidase activity is negatively correlated with seminal concentration and motility. Int J Biol Sci 2006; 2: 23–29.
12. Williams C, McGibbon WH. The yields of semen among inbred lines and crosses of single comb White Leghorns. Poult Sci 1956; 35: 617–620.
13. Jones DG, Lamoreux WF. Semen production of White Leghorn males from strains selected for high and low fecundity. Poult Sci 1942; 21: 173–184.
14. Chatterjee RN, Sharma RP, Mishra A, Dange M, Niranjan M, Reddy BLN. Genetic analysis of White Leghorn pure lines using RAPD-PCR and immunocompetence. Indian J Poult Sci 2009; 44: 277–282.