



## Effect of Plumage Color and Body Weight on the Semen Quality of Naked Neck Chicken

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### ABSTRACT

The low fertility of local chicken breeds is a major issue in backyard poultry system. The fertility rate varies among different males due to their difference in semen quality. The objective of the present study was to evaluate the effect of plumage color and body weight on the semen quality of Naked Neck chicken. The Naked Neck males (n=18) vary in three plumage colors (black=6, brown=6, white=6) and each color contains two body weight sub groups (heavy= >1600gm n=3 and light= <1600 gm n=3) were used in this study. The semen was collected and accessed individually for volume, pH, concentration, motility, livability and morphological defect. Black plumage color contained significantly more semen volume than brown color. The heavy body weight group (heavy= >1600 gm) contained significantly more semen volume (0.21±0.02 ml) and sperm concentration (1.88±0.06×10<sup>9</sup> ml) than the lightweight group (light= <1600 gm). So, black plumage color roosters of can be use to enhance fertility rate of naked neck chickens.

**Key words:** Body weight, Naked neck chicken, Plumage color, Semen quality

### INTRODUCTION

In spite of the highly developed commercial poultry system, backyard poultry system still occupies a significant position in Pakistan. The local native breeds are favored because of their adaptability, resistance and production of organic meat and eggs. Naked neck chickens have same protein requirement like other feather chickens (Daulat et al., 2015). The Naked Neck is a major native chicken breed which has high egg production, egg weight (44.86g), egg length (7.03mm), yolk weight (14.57mm), shell weight (4.29mm) and yolk height (3.29mm) (Adedeji et al., 2015) capacity with a higher heat tolerance than

other native breeds. The Naked Neck chickens have problems of low fertility and hatchability than other native breeds (Peters et al., 2008). Naked neck roosters are criticized for low semen volume, higher abnormal sperms, and higher coiled tailed defective sperm (Fathi et al., 2013).

To acquire a good fertility rate, the semen quality must be excellent to ensure the fertilization process. Assessment of semen characteristics gives an excellent indicator of their reproductive potential (Mothibedi et al., 2016). The proper selection, of physically elite roosters and hens, helps to improve these breeds containing higher genetic potential (Anjum et al., 2012). Semen quality can be accessed through the direct measurement of in vitro

semen parameters like volume, concentration, motility, livability and morphological abnormalities which determines the male fertility (Liu et al., 2008). However, this procedure of semen collection and assessment is very stressful, time consuming, costly and these facilities are not available in villages. Many researchers have recommended the use of secondary sexual characteristics such as: body weight and body color of males as good indicators of semen quality in chicken (McGary et al., 2003; Wilson et al., 1979). The selection of healthy males with developed secondary sexual characteristics can improve fertility rate due to good quality semen (McGary et al., 2002). Thus, simple, reliable and indirect method for the estimation of semen quality based upon the correlation with secondary sexual traits should be evaluated (Udeh et al., 2011). To this date, there has been no information available about the selection of breeding cock for backyard poultry system in Pakistan.

Thus, the objective of the present study is to evaluate the effect of plumage color and body weight on semen quality of Naked Neck chicken for the selection of breeding cock.

## MATERIALS AND METHODS

### Ethical approval

Society for Protection and Care of Animals (SPCA) University of veterinary and animal sciences Lahore, Pakistan is the responsible to avoid any kind of act that is harmful to animals and make sure all rules and regulation regarding animal rights must have followed during experiment.

### Experimental roosters

A total of 18 necked neck roosters (6 birds with brown color, 6 birds with black color and 6 birds with white color) were selected from avian research centre Ravi campus university of veterinary and animal sciences Lahore on base of physical appearance. Roosters do not have any physical abnormality, having red comb and wattle, shiny feathers, wet cloacae and free from any kind of parasites were selected. Roosters were divided into three groups on the bases of their colors (6 males/plumage color). Each plumage color category contained two body weight sub groups contained heavy and light body weight (>1600gm and <1600gm respectively, 3 males/body weight/plumage color). The birds in each sub group were caged separately and fed with a standard breeder diet (100g per day). The availability of water was round the clock. The photoperiod of 16L:8D was provided. The duration of experiment was six months.

### Semen collection

The roosters were trained for semen collection prior the start of original experiment. Semen was collected twice weekly by abdominal massage technique in an insulin syringe (Riaz et al., 2004). The same person and same time during whole experiment to minimize the stress collected the semen 20 times.

### Semen evaluation

Following parameters of individual ejaculate were estimated 20 times. The volume of ejaculate was measured by the insulin syringe. The pH was determined by digital pH meter (WTW, Germany). The concentration was determined by hemocytometer using the dilution rate of 1:500. Briefly, 2.5 ml formal saline was taken in a test tube and 5µl semen was added in a test tube after discarding 5µl of formal saline. The cover slip was placed on counting chamber and charged with diluted semen. Sperm were counted at 400× under light microscope. The number of sperm per ml of semen was calculated by using the formula.

Number of sperms/ml = number of sperms counted × 5 × 10 × 500 × 1000

The motility was determined by placing a drop of extended semen on pre wormed glass slide at 37 °C. After putting a cover slip on the percentage of motile spermatozoa was estimated under light microscope at 100×. At least three fields (the procedure was repeated three times) were observed before taking the final value. Percentage of live spermatozoa was calculated by using eosin nigrosin staining technique. The small drops of semen and eosin nigrosin stain was mixed on pre wormed glass slide at 37 °C. A uniform thin smear was made with the help of another clean glass slide. After air-drying, the slide was observed under light microscope at 400×. The spermatozoa containing unstained head was counted as live while stained head of spermatozoa counted as dead. Before taking final value two hundred spermatozoa were counted. Eosin nigrosin stained slide was observed by using oil emersion lens at 1000× of light microscope to estimate morphological defects. The two hundred sperms were counted before taking final value.

### Statistical analysis

General linear procedure was performed for all plumage colors (brown, black and white) and two body weight groups i.e. heavy and light (3x2 factorial). All data were presented as Mean±SEM All analyses were performed using statistical software SAS Enterprise Guide® (version 4.2, SAS Inst. Inc., Cary, NC, USA).

## RESULTS AND DISCUSSION

In the present experiment, the effect of body weight and plumage color on semen quality and physiological semen traits of Naked Neck chicken was evaluated. Better semen quality improves the fertility and hatchability traits which could be helpful for improvement of Naked Neck chicken breed.

### Physiological traits of Naked Neck chicken semen

The values for semen parameter were as follows; volume (0.18 ml), motility (72.77%), concentration ( $1.82 \times 10^9/\text{ml}$ ), pH (7.12), livability (83.25%), morphological defects (11.63%) (Table 1). The physiological traits of Naked Neck chicken semen were in

accordance with the results of previous studies (Ajayi et al., 2011; Fathi et al., 2000).

**Table 1.** Physiological semen traits of Naked Neck chicken (n=18), Lahore, Pakistan (January to June 2016)

Parameters	Means $\pm$ SE
Volume-ml	0.18 $\pm$ 0.009
Motility%	72.77 $\pm$ 0.52
pH	7.12 $\pm$ 0.007
Concentration $\times 10^9/\text{ml}$	1.82 $\pm$ 0.03
Livability%	83.25 $\pm$ 0.65
Morphological Defects%	11.63 $\pm$ 0.53
Plasma Membrane Integrity%	83.71 $\pm$ 0.71

**Table 2.** Effect of plumage color on semen quality of Naked Neck chicken, Lahore, Pakistan (January to June, 2016)

Items	Brown	Black	White	Means
<b>Volume (ml)</b>				
Heavy	0.19 $\pm$ 0.01 <sup>aA</sup>	0.27 $\pm$ 0.02 <sup>bA</sup>	0.21 $\pm$ 0.02 <sup>aA</sup>	0.22 $\pm$ 0.01 <sup>A</sup>
Light	0.14 $\pm$ 0.01 <sup>aA</sup>	0.14 $\pm$ 0.01 <sup>aB</sup>	0.13 $\pm$ 0.08 <sup>bA</sup>	0.14 $\pm$ 0.007 <sup>B</sup>
Means	0.16 $\pm$ 0.01 <sup>a</sup>	0.21 $\pm$ 0.02 <sup>b</sup>	0.17 $\pm$ 0.01 <sup>ab</sup>	--
<b>Motility (%)</b>				
Heavy	75.00 $\pm$ 1.62 <sup>aA</sup>	74.16 $\pm$ 1.60 <sup>aA</sup>	72.08 $\pm$ 1.43 <sup>aA</sup>	73.75 $\pm$ 0.89 <sup>A</sup>
Light	72.50 $\pm$ 0.75 <sup>aA</sup>	72.08 $\pm$ 1.14 <sup>aA</sup>	70.83 $\pm$ 0.56 <sup>aA</sup>	71.80 $\pm$ 0.49 <sup>A</sup>
Means	73.75 $\pm$ 0.91 <sup>a</sup>	73.12 $\pm$ 0.98 <sup>a</sup>	71.45 $\pm$ 0.76 <sup>a</sup>	--
<b>pH</b>				
Heavy	7.14 $\pm$ 0.01 <sup>aA</sup>	7.13 $\pm$ 0.01 <sup>aA</sup>	7.10 $\pm$ 0.04 <sup>aA</sup>	7.12 $\pm$ 0.08 <sup>A</sup>
Light	7.13 $\pm$ 0.02 <sup>aA</sup>	7.09 $\pm$ 0.01 <sup>aA</sup>	7.11 $\pm$ 0.02 <sup>aA</sup>	7.11 $\pm$ 0.01 <sup>A</sup>
Means	7.14 $\pm$ 0.01 <sup>a</sup>	7.11 $\pm$ 0.01 <sup>a</sup>	7.10 $\pm$ 0.01 <sup>a</sup>	--
<b>Concentration <math>\times 10^9/\text{ml}</math></b>				
Heavy	1.92 $\pm$ 0.05 <sup>aA</sup>	2.05 $\pm$ 0.10 <sup>aA</sup>	1.85 $\pm$ 0.08 <sup>aA</sup>	1.94 $\pm$ 0.04 <sup>A</sup>
Light	1.72 $\pm$ 0.03 <sup>aA</sup>	1.71 $\pm$ 0.06 <sup>aB</sup>	1.67 $\pm$ 0.04 <sup>aA</sup>	1.70 $\pm$ 0.02 <sup>B</sup>
Means	1.82 $\pm$ 0.03 <sup>a</sup>	1.88 $\pm$ 0.06 <sup>a</sup>	1.76 $\pm$ 0.05 <sup>a</sup>	--
<b>Livability (%)</b>				
Heavy	84.41 $\pm$ 1.40 <sup>aA</sup>	84.66 $\pm$ 1.41 <sup>aA</sup>	81.54 $\pm$ 1.90 <sup>aA</sup>	83.54 $\pm$ 0.87 <sup>A</sup>
Light	85.04 $\pm$ 1.24 <sup>aA</sup>	81.83 $\pm$ 2.20 <sup>aA</sup>	82.04 $\pm$ 1.50 <sup>aA</sup>	82.97 $\pm$ 0.98 <sup>A</sup>
Means	84.72 $\pm$ 0.91 <sup>a</sup>	83.25 $\pm$ 1.23 <sup>a</sup>	81.79 $\pm$ 1.19 <sup>a</sup>	--
<b>Morphological Defects (%)</b>				
Heavy	10.12 $\pm$ 1.35 <sup>aA</sup>	10.04 $\pm$ 1.52 <sup>aA</sup>	11.83 $\pm$ 1.16 <sup>aA</sup>	10.66 $\pm$ 0.77 <sup>A</sup>
Light	11.20 $\pm$ 1.17 <sup>aA</sup>	12.62 $\pm$ 1.53 <sup>aA</sup>	13.95 $\pm$ 0.85 <sup>aA</sup>	12.59 $\pm$ 0.70 <sup>A</sup>
Means	10.66 $\pm$ 0.88 <sup>a</sup>	11.33 $\pm$ 1.09 <sup>a</sup>	12.89 $\pm$ 0.73 <sup>a</sup>	--

<sup>a-b</sup> denote significant difference within the rows ( $P < 0.05$ ); <sup>A-B</sup> denote significant difference within the columns ( $P < 0.05$ )

### Effect of plumage color and body weight on semen quality of Naked Neck chicken

The semen volume was found higher ( $P < 0.05$ ) in black than brown plumage color while it did not differ

( $P > 0.05$ ) with white breed i.e. (black =  $0.21 \pm 0.02$  ml, white =  $0.17 \pm 0.01$  ml and brown =  $0.16 \pm 0.01$  ml). The maximum semen volume was harvested from heavy black roosters than all the other groups ( $0.27 \pm 0.02$  ml,  $P < 0.05$ ).

Mean volume was higher ( $P < 0.05$ ) in the heavy than the light weight group ( $0.22 \pm 0.01$  and  $0.14 \pm 0.07$  ml respectively). Mean concentration was recorded to be higher ( $P < 0.05$ ) in heavy than light weight group ( $1.94 \pm 0.04 \times 10^9$  and  $1.70 \pm 0.02 \times 10^9$ /ml respectively). Concentration was observed higher ( $P < 0.05$ ) in heavy black group than all light weight groups. Motility, pH, livability and morphological defects did not differ ( $P > 0.05$ ) among weight and plumage color groups (Table 2). The present study has shown that plumage color affects the volume of semen in the heavy weight group only in which black group contained higher volume. The semen volume and sperm concentration were influenced by body weight while other parameters were not affected. Similar to our results El-Hammady et al. (1995) found that heavy weight cocks contain higher ( $P < 0.05$ ) sperm concentration. Recently Galal (2007) reported the positive correlation between semen qualities and body weight. In chickens, the males are selected based on comb and wattle size, body weight and body color. Females prefer the healthy males with well developed secondary sexual characteristics may be due to high reproductive efficiency (Zuk et al., 1995). The development of secondary sexual characters has been associated with the androgen production. It has been stated that heavy weight males contain large and heavy testes which results in the production of more semen and androgens (Riaz et al., 2006). The quality of semen may vary with age, body weight of cocks, collection technique and breed. According to the Udeh et al. (2011) it was suggested that where there are no facilities for semen evaluation the secondary sexual characteristics can be used for the estimation of semen quality of cock. More over continuous reduction in genes of indigenous chicken breed may lead to high embryo mortality in backyard poultry (Ajayi et al., 2016). It was concluded that heavy body weight rooster with black plumage color contain more semen volume and sperm concentration and can be used for breeding purposes in backyard poultry system.

#### Author's contribution

Adnan Jabbar Ansari and Waseem Abbas were main responsible for tabulation of experimental data and article writing under supervision of Amjad Riaz, Muhammad Akram and Yasir Allah Ditta.

#### Competing interests

The authors declare that they have no conflict of interest with respect to the research, authorship, and/or publications of this article.

## REFERENCES

- Adedeji TA, Amao SR, Popoola AD and Ogundipe RI (2015). Fertility, Hatchability and Eggs Quality Traits of Nigerian Locally Adapted Chickens in the Derived Savanna Environment of Nigeria *Journal of Biology, Agriculture and Healthcare*, 5: 36-42. <https://www.researchgate.net/publication/291515024>
- Khan DR, Wecke C and Liebert K (2015). Does the Naked Neck Meat Type Chicken Yield Lower Methionine Requirement Data? *Division Animal Nutrition Physiology, Department of Animal Sciences, Georg-August-University, Kellnerweg 6, 37077 Goettingen, Germany*. Doi:10.3390/ani5020151
- Peters SO, Ilori BM, Ozoje MO, Ikeobi CON and Adebambo OA (2008). Gene Segregation Effect on Fertility and Hatchability of Pure and Crossbred Chicken Genotype in Humid Tropics. *International Journal of Poultry Science*, 7(10): 954-958. Doi: 10.3923/ijps.2008.954.958
- Fathi MM, Galal A, EL-Safty S and Mahrous M (2013). Naked neck and frizzle genes for improving chickens raised under high ambient temperature: I. Growth performance and egg production. *World's Poultry Science Association*. Doi: 10.1017/S0043933913000834
- Kebadiretse M, Shalaulani N J, Esau EW and Patrick MK (2016). semen characteristics of pure bred naked neck Tswana and black Australorp x naked neck Tswana crossbred chicken under an intensive management system in Botswana. *American Journal of Research Communication*. [http://www.usa-journals.com/wp-content/uploads/2016/10/Mothibedi\\_Vol410.pdf](http://www.usa-journals.com/wp-content/uploads/2016/10/Mothibedi_Vol410.pdf)
- Anjum MA, Sahota AW, Akram M, Javed K and Mehmood S (2012). Effect of selection on productive performance on Desi chickens for four generations. *The Journal of Animal & Plant Sciences*, 22(1): 1-5.
- Liu SJ, Zheng JX, and Yang N (2008). Semen quality factor as an indicator of fertilizing ability for geese. *Poultry Science*, 87:155–159. Doi:10.3382/ps.2007-00300.
- McGary S, Estevez I and Bakst MR (2003). Potential Relationships Between Physical Traits and Male Broiler Breeder Fertility. *Poultry Science*, 82: 328–337. <http://digitalcommons.unl.edu/usdaarsfacpub/663/>
- Wilson HR, Piesco NP, Miller ER and Nesbeth WG (1979). Prediction of the fertility potential of broiler breeder males. *World's Poultry Science Journal*, 35: 95-118. Doi: <https://doi.org/10.1079/WPS19790008>
- McGary S, Estevez I, Bakst MR and Pollock DL (2002). Phenotypic Traits as Reliable Indicators of Fertility in Male Broiler Breeders. *Poultry Science*, 81: 102-

111.<http://digitalcommons.unl.edu/usdaarsfacpub/676>

- Udeh I, Ugwe SOC and Ogagifo NL (2011). Predicting Semen Traits of Local and Exotic Cocks using Linear Body Measurements. *Asian Journal of Animal Sciences*, 5(4): 268-276. Doi: [10.3923/ajas.2011.268.276](https://doi.org/10.3923/ajas.2011.268.276)
- Ajayi FO, Agaviezor BO and Ajuogu PK (2011). Semen Characteristics of Three Strains of Local Cocks in the Humid Tropical Environment of Nigeria *International Journal of Animal and Veterinary Advances*, 3(3): 125-127. Doi: 10.1007/s11250-010-9743-7.
- Zuk M, Pompa SL, and Johnsen TS (1995). Courtship displays, ornaments, and female mate choice in captive red jungle fowl. *Behaviour*, 132: 821-836. <https://experts.umn.edu/en/publications/male-courtship-displays-ornaments-and-female-mate-choice-in-capti>
- Riaz A, Aleem A, and Ijaz A (2006). Relationship of Body Weight, Testes Biometry and Sperm Production in Broiler Breeder. *Korean Journal of Poultry Science*, 33(2): 165-169. [http://www.koreascience.or.kr/article/ArticleFullRecord.jsp?cn=GGHHBK\\_2006\\_v33n2\\_165](http://www.koreascience.or.kr/article/ArticleFullRecord.jsp?cn=GGHHBK_2006_v33n2_165)
- Mothibedi K, Nsoso SJ, Waugh EE and Kgwatalala PM (2016). Semen characteristics of pure bred naked neck Tswana and black Australorp x naked neck Tswana crossbred chicken under an intensive management system in Botswana. *American Journal of Research Communication*, 4(10): 38-47. [http://www.usa-journals.com/wp-content/uploads/2016/10/Mothibedi\\_Vol410.pdf](http://www.usa-journals.com/wp-content/uploads/2016/10/Mothibedi_Vol410.pdf)
- Udeh I, Ugwe SOC and Ogagifo NL (2011). Predicting Semen Traits of Local and Exotic Cocks using Linear Body Measurements. *Asian Journal of Animal Sciences*, 5(4): 268-276. Doi: [10.3923/ajas.2011.268.276](https://doi.org/10.3923/ajas.2011.268.276)
- Riaz A, Aleem A, Ijaz A, Saeed MA and Latif A (2004). Effect of collection frequency on the semen quality of broiler breeder. *British Poultry Science*, 45: 823-827. Doi: [10.1080/00071660400012691](https://doi.org/10.1080/00071660400012691)
- Fathi MM, Tharwat EE and El-Hommosany YM (2000). Response of semen quality of naked neck cocks to zinc supplementation or GnRH injection. *Egypt Poultry Science*, 20: 1047-1064.
- El-Hammady HY, Dellatif MA and Ali KM (1995). Effect of Naked Neck (Na) Gene, dietary protein level and their interaction on body weight and semen characteristics of chicken males. *Egyptian Poultry Science*, 15: 87-109. <http://dx.doi.org/10.4236/arsci.2013.13006>
- Galal A (2007). Predicting Semen Attributes of Naked Neck and Normally Feathered Male Chickens from Live Performance Traits. *International Journal of Poultry Science*, 6(1): 36-42. Doi: [10.3923/ijps.2007.36.42](https://doi.org/10.3923/ijps.2007.36.42)
- Ajayi FO and Agaviezor BO (2016). Fertility and Hatchability Performance of Pure and Crossbred Indigenous Chicken Strains in the High Rainforest Zone of Nigeria. *International Journal of Livestock Production*, 7(12): 141-144. Doi: 10.5897/IJLP2016.0308