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Comparative Evaluation of Hatching Traits in Four Phenotypes of Naked Neck Chicken

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ABSTRACT

Background: In Pakistan, the naked neck chickens are characterized on the base of plumage colors such as black, white black, light brown and dark brown. There is scanty of information on hatching traits in different phenotypes of naked neck chicken. The current study aimed to investigate and compare the hatching traits in four phenotypes of naked neck chicken (black, white black, light brown and dark brown).

Methods: In total, 300 females (20 weeks old) comprising four plumage colors (black, white black, light brown and dark brown), 75 from each, were randomly assigned to 20 replicates (15/replicate) under a completely randomized design (CRD). Number of settable eggs, fertility, hatch of fertile, hatchability, embryonic mortality and chick quality parameters were evaluated.

Result: The results showed higher settable eggs, fertility and hatchability in black, dark brown and light brown phenotypes than that of the white black whereas better hatch of fertile and reduced embryonic mortality were recorded in black and dark brown phenotypes as compared to white black. Better chick quality was observed in dark brown phenotype followed by light brown, black and then white black. Phenotypes other than white black had better hatching performance, hence could be used to revive backyard poultry farming.

Key words: Hatching traits, Naked neck, Performance, Phenotype.

INTRODUCTION

There has been rapid increase in the number of farmers keeping chicken parent and grandparent stock leading to increase in the population of meat and egg type chickens in the world (Kathleen, 2002). Among other factors, poor fertility and hatchability rates constitute the major threat to performance of the industry (Adebambo, 2005). Fertility and hatchability characteristics of egg type chickens are the two main traits of assessing the potentials of hens (Allanah *et al.,* 2014). Fertility is an important parameter in chicken that reflects the total actual reproductive capacity of females. An egg is said to be infertile when it fails to display any evidence of developing embryo (Miazi *et al.,* 2012). Hatchability is referred as the ability of the embryo to successfully escape from the shell (Tarek, 1992). Good hatchability of eggs is to some extent heritable, but is determined by a complicated genetic constitution and the environment. Hatchability is a trait of economic importance in the chicken industry because it has a strong effect on chick output (Wolc *et al.,* 2010). Number of factors such as egg weight, turning of eggs, storage, humidity, shell strength, egg size and genetic factors influence hatchability. According to Peters *et al.* (2008) the genetic make-up of an individual chicken is fixed at fertilization. Hence fertility and hatchability are generally considered as traits of two parents.

Indigenous chicken are widely distributed in the rural areas of tropical and sub-tropical countries where they are kept by the majority of rural poor. Indigenous chicken from Pakistan are in general hardy, adoptive to rural environments (Khan *et al.,* 2017), survive on little or no inputs and adjust of fluctuations in feed availability. They are self-reliant and hardy birds with capacity to withstand harsh weather conditions and adaptation to adverse environment (Khan *et al.,* 2017). They are known to possess qualities such as the ability to hatch on their own, brood and scavenge for

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major parts of their food and possess appreciated immunity against endemic diseases. Additionally, the indigenous poultry species represent valuable resources for livestock development because their extensive genetic diversity allows for rearing of poultry under varied environmental conditions, providing a range of products and functions. Thus, great genetic resources embedded in indigenous poultry await full exploitation (Sonaiya *et al.,* 1999). In Pakistan, the naked neck chickens are characterized on the base of plumage colors such as black, white black, light brown and dark brown. There is scanty of information on hatching traits in different phenotypes of naked neck. The present study was designed to investigate and compare hatching traits in four phenotypes (black, white black, light brown and dark brown) of naked neck chicken.

MATERIALS AND METHODS

Experimental site, birds and husbandry

The study was executed at the Indigenous Chicken Genetic Resource Centre (ICGRC), Department of Poultry Production, University of Veterinary and Animal Sciences, Lahore, Pakistan, in 2016 for the duration of 22 weeks. In total, 340 birds (300 females and 40 males) comprising four phenotypic groups (black, white black, light brown and dark brown birds), 85 from each (75 female and 10 male), were selected from the breeding stock maintained at (ICGRC) and randomly assigned to 4 experimental groups under a completely randomized design. These birds were placed in 20 deep litter pens with 17 (15 female, 2 male) in each pen to get the fertile eggs. Same managerial conditions were applied at all experimental units. Vaccination and medication was done according to the standard practices under the supervision of a qualified veterinarian. The birds were fed iso-caloric and iso-nitrogenous layer mash diet (Table 1) from 20 weeks of age to the end of the experiment (42 weeks). The feed and water was supplied *ad libitum* through trough feeder and nipple drinking system.

Collection, storage and setting of eggs

Collection of fertile eggs began seven days after introducing males. In total, 600 eggs (30 from each pen) were properly tagged according to the batch number, phenotype and the date of lay before sending them to the hatchery each week. After collection, the eggs were checked for cracks, morphological deformities and dirt stains (soiled). Thereafter, these eggs were stored for one to seven days in an environmentally controlled room (15 to 18°C and 75 to 80% RH) and then incubated in automatic incubator at 37.5°C (99.5°F) and 65% RH in trays identified per replicate. Proper cleaning, disinfection and fumigation practices were ensured before setting the eggs. Candling was done on the 18thday of incubation for the identification of fertile eggs. After candling, the fertile eggs were shifted to the hatching tray, according to the phenotypes and then into the hatcher part of the incubator. After the hatch, chicks were left in the hatchery until they were 90% dried. On the 21st day, the numbers of hatched chicks (including the normal, weak and abnormal) and dead-in-shell embryos were recorded separately. Chicks were weighed after being pulled out of the incubator using a 500 grams digital scale. Normal and healthy chicks having above 30 grams weight were put into the A-grade chick category.

Data collection

Settable egg percentage was calculated as the ratio between number of settable eggs and the total number of eggs multiplied by 100. Fertility percentage was calculated as the ratio between number of fertile eggs and the total number of eggs set multiplied by 100. Hatchability percentage was calculated as the ratio between number of hatched chicks and the total number of eggs set multiplied by 100. Similarly, the hatch of fertile percentage was calculated as the ratio between number of hatched chicks and the total number fertile eggs multiplied by 100. Embryonic mortality percentage was calculated as the ratio between number of dead embryos and the total number of hatched chicks multiplied by 100. A-grade chick percentage was calculated as the ratio between number A-grade chicks and total number of chicks multiplied by 100. The data were analyzed through ANOVA technique by using the GLM procedure of SAS (SAS Institute Inc., 2002-03). Post-hoc comparison among treatment means was made through Duncan's Multiple Range (DMR) test (Duncans, 1955) at a 5% probability level.

RESULTS AND DISCUSSION

Settable eggs and fertility

Overall means of settable eggs showed significant differences among different phenotypes (Table 2). Black, light brown and dark brown phenotypes demonstrated higher settable eggs as compared to white black. Settable egg percentage is an economically important parameter. In the present study, variation in settable eggs might be attributed to the genetic differences among phenotypes. It has already been reported that settable egg varies due to strain (Renema *et al.,* 2001) or genotype effect (Dunga, 2013). Similarly, studies on different Aseel varieties (Khan *et al.,* 2017) and genotypes of poultry (Adedeji, 2015) displayed variations in settable eggs. Abudabos (2010), likewise, reported significant differences in hatching traits among different local and imported stocks of Japanese quails.

Means of fertility indicated variations with respect to different phenotypes (Table 2). Black, light brown and dark brown phenotypes illustrated remarkably higher fertility than that of white black. Fertility is an important parameter in chicken that shows the total actual reproductive capacity of females (Miazi *et al.,* 2012). Higher fertility was observed in black, light brown and dark brown phenotypes, which may be due to the genetic variations among the phenotypes. Similarly, it has been reported that genotype of different strains (Hussnain *et al.* (2013) or varieties (Khan *et al.,* 2017) responds differently for fertility. Likewise, Peters *et al.* (2008)

reported a significant strain effect on fertility of eggs. Similarly, Moreki *et al.* (2014) observed fluctuation in fertility among different genotypes, strengthening the argument that genotype is the major cause of variation in fertility (Abudabos, 2010; Adedeji, 2015). Likewise, Dunga (2013) also reported significant difference in percent fertile eggs among different phenotypes of naked neck. Significant differences in fertility among different strains (Hussnain *et al.,* 2013), ecotypes (Fayeye *et al.,* 2005) and local breeds (Ensaf *et al.,* 2005) have previously been reported. In contrast, Shafik *et al.* (2013) reported no genotype effect on fertility. In the current study, the overall F values were not optimum because the experiment was conducted under very high ambient temperatures conditions, which might have reduced bird mating activity resulting in reduced fertility. A previous study also claimed negative effect of heat stress on birds' mating activity (Ernst *et al.,* 2004).

Hatch of fertile eggs and hatchability

Different phenotypes manifested significant differences in hatch of fertile (Table 2). Higher hatch of fertile values were observed in black and dark brown phenotype as compared to white black. It might be due to the greater fertility in hens of respective phenotypic group. In line with results, Dunga *et al.* (2013) indicated variations in hatch of fertile among different phenotypes of naked neck. Similarly, it was reported that hatching traits were different ($P<0.05$) among different local and imported stocks of Japanese quails (Abudabos, 2010). Similarly, Hussnain *et al.* (2013) reported improved hatch of fertile in Cobb breeder than other breeds and lower hatch of fertile in Hubbard breeders than other strains. Likewise, Adedeji (2015) revealed significant differences in hatch of fertile among different genotypes of chicken. Similarly, significant strain (Yousria *et al.,* 2010) or variety (Khan *et al.,* 2017) effect on hatch of fertile has also been reported. In contrast, Shafik *et al.* (2013) reported no correlation between hatches of fertile and genotype.

Different phenotypes exhibited pronounced effects on hatchability (Table 3). Black, light brown and dark brown phenotypes showed better hatchability than that of white black that may be as a result of high fertility in these phenotypes since only fertile eggs can hatch to chicks. In the present study, differences in hatchability may also be linked to the genetic differences among different phenotypes. Similar to these findings, Khan *et al.* (2017) reported a significant genotype effect on hatchability. Likewise, Peters *et al.* (2008) reported a significant effect of strain on hatchability of eggs. Similarly, Abudabos (2010) reported that different local and imported stocks of Japanese quails influenced hatchability significantly; indicating that hatchability varies among different strains (Hussnain *et al.,* 2013) or genotypes (Heier and Jerp, 2001) of chicken. Likewise, Elibol *et al.* (2002) reported that strain is a major factor that affects the hatchability. Moreki *et al.* (2014) also observed variations in hatchability among naked neck and normal feathered chickens, highlighting the breed effect on hatchability (Adeleke *et al.,* 2012). In contrast, Ahmad (2013) claimed no effect of genotype on hatchability.

Embryonic mortality and A-grade chick

In the current study, overall means of embryonic mortality indicated marked differences among different phenotypes (Table 3). Chick embryonic mortality has long been the subject of economic interest. In the present study, black and dark brown phenotypes indicated reduced embryonic mortality. It is reported that the entire process of embryonic development and successful hatching rely highly on egg external and internal quality (Narushin, 2001, Narushin and Romanov, 2002) and many factors, including breed, strain, variety, temperature, relative humidity, rearing practices and seasons, influence egg quality (Washburn, 1990). Thus, the variations in embryonic mortality in the current study may be due to the phenotypic or genetic variations. Similarly, it was reported that breed (Adedeji, 2015) or variety (Ahmad, 2013) had a significant effect on embryonic mortality. Abudabos (2010) also reported disparities in embryonic mortality among different local and imported stocks of Japanese quails, endorsing the above view that genotype is the main source of variation in embryonic mortality (Moreki *et al.,* 2014). Non-significant differences in embryonic

Table 1: Ingredient and nutrient composition of basal diet.

Ingredient (%)	Quantity
Corn	42.61
SBM[1]	15.62
Corn Gluten (60%)	1
Rice tips	19
Wheat bran	13
DCP[2]	1.2
CaCO	7.42
DL-Methionine	0.15
Nutrient	
CP (%)	15.00
ME (Kcal/kg)	2,750
Calcium (%)	1.30
Phosphorous (%)	0.40
Lysine (%)	0.70
Methionine (%)	0.30
NA	0.16

[1]Soybean meal.

[2]Dicalcium phosphate.

Table 2: Settable egg (SE), fertility (F) and hatch of fertile (HF) in four phenotypes of naked neck chicken[1].

Treatment	Parameters		
	SE (%)	F (%)	HF (%)
Black	96.00 ± 0.8^{a}	73.96 ± 0.7^{a}	76.06 ± 1.0^{a}
White Black	92.33 ± 0.8^{b}	70.74 ± 0.7^{b}	71.39 ± 0.7^{b}
Light Brown	96.66 ± 0.5^{a}	73.11 ± 0.8^{a}	74.55 ± 1.4^{ab}
Dark Brown	96.00 ± 1.0^{a}	75.32 ± 0.7^{a}	75.05 ± 1.2^{a}
P-value	0.0075	0.0048	0.0490

[a-c]Means within a column lacking a common superscript differ ($P\leq0.05$).

Table 3: Hatchability (H), embryonic mortality (EM) and A-grade chicks (AC) in four phenotypes of naked neck chicken[1].

Treatment	Parameters		
	H (%)	EM (%)	AC (%)
Black	56.25±0.7[a]	23.93±1.0[b]	24.10±1.2[bc]
White black	50.51±0.9[b]	28.60±0.7[a]	20.68±1.1[c]
Light brown	54.49±1.0[a]	25.44±1.4[ab]	27.82±0.9[ab]
Dark brown	56.55±1.3[a]	24.94±1.2[b]	28.91±.16[a]
P-value	0.0024	0.0490	0.0011

[a-c]Means within a column lacking a common superscript differ (P≤0.05).

mortality or dead germ among different genotypes (Hussnain *et al.,* 2013; Khan *et al.,* 2017) have also been reported.

In the current study, A-grade chick quality was significantly influenced by different phenotypes (Table 3). Highest A-grade chicks were observed in dark brown followed by light brown, black and white black phenotypes. Initial chick quality has direct effect on subsequent poultry performance. Chick quality majorly depends on the type of responsible genes or gene combination. Difference in plumage color among different phenotypes is also the manifestation of genetic differences, which might have reflected variation in chick quality. Similar to the current study, discrepancies in A-grade chicks were observed in different Aseel varieties (Khan *et al.,* 2017), reflecting that chick quality depends on variety or genotype.

CONCLUSION

Settable eggs, fertility, hatchability and hatch of fertile percentages have no significant differences among black, light brown and dark brown phenotypes whereas lesser embryonic mortality was observed in eggs of black phenotype and A-grade chicks were hatched maximum in dark brown phenotype. It was concluded that all naked neck phenotypes except white black indicated better hatching characteristics.

Conflict of interest: None.

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