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COMPARATIVE CARCASS TRAITS AND ANTI-BODY RESPONSE IN FOUR PHENOTYPES OF NAKED NECK CHICKENS

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ABSTRACT

A study was executed to evaluate the effect of four phenotypes (black, white/black, light brown and dark brown) of sexed Naked-Neck chicken on carcass characteristics and anti-body response. In total, 320-day old chicks (160♂, 160♀) comprising 80 from each plumage color, were randomly assigned to 8 experimental groups in 4 (phenotypes) × 2 (sexes) according to Randomized Complete Block Design (RCBD) with five replicate each and eight birds per replicate. Birds were reared for 20 weeks. At the end of the 20th week, 5 birds from each experimental group were selected randomly and slaughtered to collect the data regarding slaughter traits and anti-body response. Live weight (g), dressing %, liver weight %, gizzard weight %, heart weight %, intestinal weight (g) and intestinal length (cm) were evaluated. Light brown plumage color birds indicated significantly ($P \leq 0.05$) enhanced live weight and dressing% whereas black plumage color birds showed higher intestinal weight %. Among different sexes, significantly ($P \leq 0.05$) higher live weight (g), dressing %, liver weight % and intestinal length in male whereas gizzard weight% and intestinal weight % was found to be greater in female. Interaction of sexes with phenotypes clearly demonstrated maximum live weight in light brown males, dressing % in white black males, liver weight % in dark brown males and intestinal length in black plumage color males. Gizzard and heart weight % were found to be higher in light brown females and intestinal weight % remained higher in white black and black plumage females. It can be concluded that light brown phenotype had better carcass characteristics such as enhanced live weight and dressing percentage. Antibody titer against NDV was higher in light and dark brown phenotypes. Regarding sexes, males showed overall better carcass characteristics than female birds.

Key words: Naked-Neck, Phenotype, Sex, Carcass Characteristics.

INTRODUCTION

Indigenous or village chickens are among the most adaptable domestic animals that can survive cold and heat, wet and drought, sheltered and unsheltered conditions. Village chickens are defined as involving any genetic stock, improved or unimproved, that was raised extensively or semi-intensively in relatively small numbers usually less than 100 birds at a time (Sonaiya, 2003). These chickens possess better sturdiness, disease resistance and adaptability to the local climatic conditions (Khan, 2015) and can, therefore, be used in free range to scavenge for food with little or no feed supplementation (Naidoo, 2003). Furthermore, indigenous chickens retain unique adaptive traits that permit them to survive and reproduce under poor nutritional and management conditions (Mwacharo *et al.,* 2007). Local chicken breeds are important source of income and house hold food security for rural families (Cabarles *et al.,* 2012). Indigenous chickens are mostly slow growing with low carcass weight (Missohou *et al.,* 2002) and are reared mainly for egg production. Carcass traits are now the consumer's preference. It is, therefore, necessary to know the genetic and phenotypic variabilities of carcass traits for improving them through suitable breeding strategy.

The bird's immune system consists of three basic sub-systems i.e., humoral, cellular and phagocytic. Infectious diseases compromise chicken immune system and consequently cause huge economic losses particularly in intensive poultry production systems (Makki *et al.,* 2011). Newcastle Disease (ND) is one of the most important infectious diseases of poultry. Newcastle Disease Virus (NDV) is synonymous with avian paramyxovirus type 1 and infects over 200 bird species (Alexandr and Senne, 2008). NDVs are classified into velogenic, mesogenic and lentogenic strains based on their pathogenicity (Beard and Hanson, 1984). NDV infections range from asymptomatic to rapidly fatal (Alexandr and Senne, 2008). Different Strategies were applied to lessen spread of virus and economical losses of the infection. Orajaka *et al.* (1999) reported vaccination as the only safe option in control strategies of this infection. NDV vaccines provoke an immune response that minimizes or completely prevents the chance of disease occurrence and mortality from ND (Miller *et al.,* 2009).

Aseel, Naked-Neck and Desi are the major indigenous breeds in Pakistan. Naked-Neck is used in backyard poultry mainly for laying and meat purpose. Featherless neck and vent are the most prominent characteristics of Naked-Neck chicken. The Naked-Neck gene (Na) is associated with less feed consumption, better disease resistance and adaptation to harsh climate, higher growth rate and dressing percentage (Ajayi, 2010). Additionally, Naked-Neck chickens possess sustainable immune system resulting in lower mortality as compared to normal feathered breeds (Haunshi *et al.,* 2002). Enough literature is available on growth and egg production performance of Naked-Neck chicken but little work has, so far, been done to evaluate the carcass characteristics in different phenotypes of Naked-Neck chicken. The present study was, therefore, planned to evaluate the carcass characteristics and immune status in four phenotypes of Naked-Neck chicken (black, white black, dark brown and light brown).

MATERIALS AND METHODS

A study was executed at Indigenous Chicken Genetic Resource Centre (ICGRC), Department of Poultry Production, UVAS, Pakistan. In total, 320 day old chicks comprising four plumage colors (Black, White black, Light brown and Dark brown birds), 80 from each, were procured from a commercial hatchery and randomly assigned to 8 experimental groups in 4 (phenotypes) × 2 (sex) in a Randomized Complete Block Design (RCBD). Each experimental group was replicated 5 times with 8 chicks in each. Birds in each replicate were placed in a separate cage. All chicks were initially weighed and individually tagged for identification. The chicks were housed in cages and placed in a well-ventilated open sided poultry house under similar management conditions like temperature, humidity, ventilation, floor space and light up to 20 weeks of age. The birds had free access to clean and fresh drinking water through nipple drinker system up to 20th week and were provided only natural day light. The experimental birds were fed a balanced ration, formulated according to recommendations made by NRC (1994). One week prior to slaughtering, all the experimental birds were vaccinated (intra-ocular) against ND using ND (LaSota) viral strains to evaluate and compare the titer in four phenotypes of Naked Neck chicken.

At the end of 20th week, 5 birds from each experimental group were selected randomly and blood samples (3ml/bird) were collected from the brachial vein with the help of 5 ml disposable syringe without anticoagulant. These birds were then kept off feed for 5-6 hours prior to slaughter. These birds were individually weighed on sophisticated electronic digital balance prior to slaughter; after slaughtering, all the organs were eviscerated and weighed separately, evaluated and carcass characteristics compared such as: Live weight (g), dressing (%), giblet weight % (Liver, heart and gizzard), Intestinal weight %, Intestinal length (cm) and anti-body response to NDV.

Antibody response was determined by the haemagglutination Inhibition (HI) method. A 25µL serum containing antibody was successively diluted into a 96-well plate with PBS (4°C, pH 7.4). To react and bind with the antibody, the same quantity of virus antigen was added. Addition of 2% red blood cell solution in each well showed the ability of NDV left to agglutinate with red blood cells. When enough antibodies were bound to virus during the incubation period, hemagglutination was inhibited completely. The titer was expressed as log2 of the reciprocal of the last serum dilution showing hemagglutation inhibition (Xie *et al.,* 2008).

Statistical Analysis: The data were analyzed through two-way ANOVA by using the GLM procedure of SAS (SAS Institute Inc., 2002-03) with the mathematical model:

$Y_{ijk} = \mu + V_i + S_j + V_i \times S_j + \varepsilon_{ijk}$

Where Y_{ijk} = each observation

μ = Population mean

V_i = Effect of ith variety (i = 1,2,3,4)

S_j = Effect of jth sex (j = 1,2)

$V_i \times S_j$ = Interaction effect

ε_{ijk} = Residual effect associated with ith observation and jth treatment NID ~ 0, σ^2

The comparison among treatment means were made through Tukey’s HSD test, at 5% probability level.

RESULTS AND DISCUSSION

Live weight (g): All treatments including phenotypes, sexes and their interaction showed variations in live weight (Tables 1 and 2). It has been reported that growth rate in Naked-Neck is associated with Naked-Neck gene (Na) (Adomako, 2009). Among different phenotypes, light brown showed significantly (P≤0.05) higher live weight than rest three phenotypes (1217.10 vs. 1135.20, 1105.90, 1101.20g; $P \leq 0.05$). Difference in live weight among different phenotypes might be linked to their genetic differences as it is reported that genetics has major share in body weight (Batkowska *et al.,* 2015). Variations in growth performance have already been reported among different breeds of Naked-Neck and normal feather chicken (Rajkumar *et al.,* 2010) endorsing the above view that live weight changes from strain to strain (Santos *et al.,* 2005), breed to breed (Shahin and Elazeem, 2005) and genotype to genotype (Jaturasitha *et al.,* 2008). Mikulski *et al.* (2011) highlighted higher body weight in Naked-Neck and Frizzle as compared to normally feathered sibs. Male demonstrated greater live weight than female (1331.55 vs. 948.15 g, $P \leq 0.05$), this difference in live weight among different sexes may be attributed to the genetic effect of sex which arises from the male physiological activities (Fayeye *et al.,* 2006). Azahan *et al.* (2007) also linked the higher body weight of the males to their genetic make-up stating that males are more efficient and grow faster than females. Moreover, it was reported that sex differences are usually due to the variations in hormonal profile (Ilori *et al*., 2010). Sexual dimorphism usually favors male compared to female especially in poultry for growth parameters (Peters *et al.,* 2010). Like the current findings, it was reported that males had greater live weight than females in all three strains of Tswana (Kgwatalala *et al.,* 2013). A similar study conducted to compare the growth of different sexes also indicated greater body weight in males than females (Corzo *et al.,* 2005) endorsing the view that variations exist in growth of different sexes. As far as the interaction is concerned, light brown phenotype males exhibited maximum live weight.

Dressing Percentage: Dressing percentage showed discrepancies with respect to different phenotypes, sexes and their interaction (Tables 1 and 2). Among phenotypes, Naked-Neck birds having light brown plumage displayed significantly greater dressing percentage than those of dark brown and black plumage (68.39 vs. 66.20, 65.31%; $P \leq 0.05$), which might be attributed to the higher live weight of light brown phenotype as it is believed that dressing % has direct association with live weight (Fanatico *et al*., 2013). Moreover, disparities in dressing % might also be linked with the difference in their genetic make-up as various genetic groups, strains, varieties, breeds or genotypes (Choo *et al.,* 2014) are reported to have differences in dressing percentage. Islam and Nishibori (2009) declared the indigenous Naked-Neck of Bangladesh superior in term of dressed percentage than those of indigenous normal feathered chickens. With respect to the interaction of sexes with phenotypes, males of white black plumage color revealed maximum dressing percentage. Enhanced dressing percentage was observed in males compared to females (68.78 vs. 64.61%; $P \leq 0.05$), which might be attributed to the comparatively enhanced live weight of males. Like the current findings, higher dressing percentage was observed in Kashmir indigenous cocks than hens (Iqbal *et al.,* 2009). RIR male, likewise, has higher dressing percentage as compared to female (Jahan *et al.,* 2015). Isidahomen *et al.* (2012) studied indigenous chickens in Nigeria, likewise, reported the effect of sex on carcass characteristics and slaughter yield at twenty weeks old. Certain other studies, similarly, reported the same response of males with respect to dressed weight (Shafey *et al.,* 2013) endorsing the fact that males are superior in term of carcass or dressed weight.

Liver weight %: Sexes alone and in interaction with different phenotypes showed pronounced effects in liver weight' whereas phenotypes independently could not influence liver weight (Tables 1 and 2). Males exhibited remarkably higher liver weight % than female birds (6.51 vs. 5.32%, $P \leq 0.05$). It might be attributed to the enhanced lipogenesis in the liver of male birds. Similar response of male was reported in another study conducted on Desi and Sonali chickens where higher liver weight was observed in males compared with females (Jahan *et al.,* 2015). Thutwa *et al.* (2012) also observed higher liver weight in male Naked-Neck birds compared to their female counterpart. Several other researchers, likewise, reported heavier giblet yield in males than females establishing the difference between sexes for carcass traits (Shafey *et al.,* 2013). The interaction effect revealed that males with dark brown plumage manifested maximum liver weight percentage.

Table 1. Comparative carcass characteristics and antibody response in males, females and four different phenotypes of Naked-Neck chicken

Variables	LW ---(g)--	DP	LW	GW	HW	IW	IL --(cm)--	ND titer
		(%)						
Phenotypes								
Black	1101.20±66.66^{b}	65.31±0.98^{b}	6.60±0.72	3.30±0.09	0.84±0.08	5.39±0.20^{a}	116.80±9.44	4.00±0.08^{c}
White black	1105.90±65.87^{b}	66.82±1.22^{ab}	5.68±0.27	3.47±0.14	0.93±0.03	4.98±0.18^{ab}	108.00±8.56	4.29±0.11^{b}
Light brown	1217.10±74.58^{a}	68.39±0.43^{a}	5.53±0.36	3.72±0.17	0.93 ±0.05	4.88 ±0.16^{b}	109.50±9.55	5.01±0.10^{a}
Dark brown	1135.20±63.75^{b}	66.20±1.05^{b}	5.84±0.37	3.51±0.20	0.93±0.05	5.10±0.13^{ab}	114.70±8.75	4.99±0.07^{a}
Sex								
Male	1331.55±23.26^{a}	68.78±0.61^{a}	6.51±0.12^{a}	3.33±0.11^{b}	0.85±0.04	4.86±0.14^{b}	136.75±3.85^{a}	4.40±0.12^{b}
Female	948.15±13.35^{b}	64.61± 0.44^{b}	5.32±0.41^{b}	3.67±0.10^{a}	0.94±0.04	5.31±0.07^{a}	87.75±1.27^{b}	4.70±0.10^{a}

Note: Different alphabets on means within column show significant difference ($P \leq 0.05$); Liv W: live weight, DP: Dressing percentage, LW: Liver weight, GW: Gizzard weight, HW: Heart weight, IW: Intestinal weight, IL: Intestinal Length,

Table 2. Interaction effects on carcass characteristics and anti-body response in males, females and four different phenotypes of Naked-Neck chicken.

Variables		Liv W ---(g)--	DP	LW	GW	HW	IW	IL --(cm)--	ND titer
			(%)						
Black	Male	1294.40±33.43^{b}	66.70±1.68^{b}	6.46±0.29^{abc}	3.23±0.08^{b}	0.72±0.10^{b}	5.33±0.39^{ab}	144.60±3.34^{a}	3.83±0.08^{c}
	Female	908.00±14.79^{c}	63.92±0.74^{c}	6.74±1.5^{ab}	3.38±0.17^{ab}	0.96±0.13^{ab}	5.44± 0.14^{a}	89.00±1.94^{c}	4.16±0.09^{c}
White black	Male	1295.20±37.36^{b}	70.16± 1.02^{a}	6.29±0.30^{abc}	3.38± 0.18^{ab}	0.92±0.05^{ab}	5.35±0.13b^{c}	90.80±2.33^{b}	4.05±0.06^{c}
	Female	916.60± 14.58^{c}	63.48±0.31^{c}	5.08±0.24^{abc}	3.57± 0.23^{ab}	0.92±0.05^{ab}	5.35± 0.13^{a}	90.80±2.33^{c}	4.53±0.14^{b}
Light brown	Male	1433.20±40.32^{a}	69.55±0.33^{ab}	6.47±0.27^{abc}	3.37±0.10^{ab}	0.86±0.07^{ab}	4.57± 0.23^{c}	137.40±3.96^{ab}	4.98±0.15^{a}
	Female	1001.00±7.64^{c}	67.23±0.29^{b}	4.59±0.28^{c}	4.06±0.24^{a}	1.00±0.06^{a}	5.20± 0.14^{abc}	81.60±2.48^{c}	5.05±0.15^{a}
Dark brown	Male	1303.40±51.84^{b}	68.73±1.17^{ab}	6.82±0.12^{a}	3.34±0.42^{b}	0.89±0.06^{ab}	4.94± 0.15^{abc}	139.80±5.23^{ab}	4.92±0.13^{ab}
	Female	967.00±38.19^{c}	63.80±0.79^{c}	4.86±0.36^{bc}	3.69±0.06^{ab}	0.88±0.08^{ab}	5.26± 0.20^{abc}	89.60±1.63^{c}	5.07±0.07^{a}

Note: Different alphabets on means within column show significant difference ($P \leq 0.05$); Liv W: live weight, DP: Dressing percentage, LW: Liver weight, GW: Gizzard weight, HW: Heart weight, IW: Intestinal weight, IL: Intestinal Length,

Gizzard weight %: Weight of gizzard showed marked differences with respect to sexes alone and their interaction with different phenotypes. However, phenotypes separately showed same pattern in gizzard weight (Tables 1 and 2). Female had higher gizzard weight than males (3.67 vs. 3.33%; $P \leq 0.05$). It is possible that gizzard weight might be sex dependent as it has already been reported that sex has significant effect on giblet weight (Kumar, 2014). Endorsing the current findings, Jahan *et al.* (2015) reported higher gizzard weights in females of Deshi, Fayoumi and RIR chicken than males. On the other hand, Shafey *et al.* (2013) reported heavier giblets yield in males than females establishing the difference between sexes for carcass traits. No significant difference in gizzard weight due to sexes has been reported (Muhammad, 2016). Interaction of both treatments showed maximum gizzard weight in light brown females.

Heart weight %: All experimental groups except their interaction indicated non-significant differences in heart weight. Maximum heart weight was found in light brown females (Tables 1 and 2). Contrary to the current findings, Thutwa *et al.* (2012) reported maximum heart weight% in male than female highlighting the effect of sex on heart weight. In the present study heart weight was found to be similar among all phenotypes. However, other study presents the facts other way round and highlighted variation in heart weight% in different poultry strains concluding that heart weight is genotype dependent (Peters *et al.,* 2010).

Intestinal weight %: Treatments separately and their interaction showed obvious differences in intestinal weight. Female birds had significantly increased intestinal weight compared to males (Tables 1 and 2). Higher intestinal weight was also reported in Naked-Neck females than males (5.31 vs. 4.85%, $P \leq 0.05$). Validating the current findings, other studies reported greater intestinal weight in Naked-Neck female than male establishing that Naked-Neck females are superior to males in term of intestinal yield % (Thutwa *et al.,* 2012). Among different phenotypes, birds with black plumage had higher intestinal weight than those with light brown plumage (5.39 vs. 4.88%, $P \leq 0.05$). Interaction of sexes and phenotypes manifested maximum intestinal weight in females belonging to black and white black plumage. However, Intestinal length was found to be unaffected in sexes and different phenotypes separately except their interaction, where it remained higher in black plumage males.

Antibody response to ND: Phenotypes or varieties of Naked-Neck birds showed different titer against Newcastle Disease Virus (NDV) (Tables 1 and 2). ND titer in light and dark brown Naked-Neck phenotypes was found to be greater than white black and black varieties (5.01, 4.99 vs. 4.29, 4.00; $P \leq 0.05$). Endorsing the current findings, Rehman *et al.* (2016) reported higher ND titer in Lakha and Sindhi Aseel varieties than Peshawari and Mushki. In another study conducted by Chao and Lee (1991), indigenous Taiwan country chicken exhibited higher antibody titer responses to NDV than White Leghorn birds. Regarding sexes, higher ND titer were observed in females than males (4.70 vs. 4.40; $P \leq 0.05$)

Conclusions: Live weight was highest in light brown males and dressing percentage was greater in white black males. Among different phenotypes, light brown phenotype indicated better carcass characteristics such as enhanced live weight and dressing percentage. Antibody titer against NDV was higher in light and dark brown phenotypes compared to white black and black. Regarding sex, males showed overall better carcass characteristics than female birds.

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