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Research Article

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Influence of Breed-type on Cocks body Weight and Semen Characteristics

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Abstract

There are controversies that semen production is dependent on body weight and breed-type hence this study evaluated the influence of breed-type on cocks body weight and semen characteristics. A total of 24 mature cocks, six each of Sasso, white and golden brown spotted, white and black spotted and Nigerian indigenous breeds were used in obtaining data on body weight and semen characteristics. It was shown that Sasso cocks had the highest body weight (2.5kg), followed by white and black spotted (1.7kg), white and golden brown spotted (1.63kg) while, the least (1.1kg) was recorded in Nigerian indigenous cocks. Semen volume ranged from 0.18 – 0.25mL and was statistically similar (P = .05) among the cocks. The active spermatozoa were more (79.5 – 95.8%) and statistically similar (P = .05) in Nigerian indigenous, white and black spotted and white and golden brown spotted cocks compared to 51.5% recorded in Sasso. Spermatozoa concentration was highest (6.97 x 10^9/mL) in Nigerian indigenous cocks followed by 4.51 x 10^9/mL, 4.02 x 10^9/mL and 3.66 x 109/mL in white and black spotted, Sasso and white and golden brown spotted cocks, respectively. Nigerian indigenous cocks were relatively smaller than the other breeds therefore breed-type may influence cocks body weight. The semen volume was seemingly same among the cocks thus semen production may not be dependent on breed-type. However, the Nigerian indigenous cocks had more spermatozoa concentration therefore, body weight may not influence semen production hence the need to upgraded Nigerian indigenous cocks.

Key words: *Fowl; Pousins, Sasso; Spermatozoa; Spotted feather*

Introduction

Poultry birds include ostrich, emu, geese, turkey, duck, fowl, guinea fowl, pigeon and quail. In Nigeria, fowl is the commonest poultry bird reared by nearly all the tribes. Although, duck, geese, turkey, pigeon and quail are also reared, the population of these species put together may not be as much as fowl population alone. FAO [1] reported that Nigerian poultry industry comprises about 180 million birds and emphasised that Nigeria has the second largest fowl population in Africa after South Africa. Interestingly, Peters et al. [2] stated that the Nigerian indigenous fowl account for about 80 – 90% of the local population of fowls in Nigeria. Hence, the contribution of Nigerian indigenous fowl to survival and adaptability of poultry population in the tropics is vital to sustainable genetic improvement and biodiversity security of indigenous fowl populations [3]. However, the size or weight is not comparable with those of the exotic breeds. The exotic breeds include those fowl species

that are not native to Nigeria such as British and Continental breeds [4]. There are several studies on the potentials for meat and egg production of the Nigerian indigenous fowl [5, 6, 7]. For instance, it was postulated [8] that the Nigerian indigenous fowls appeared to produce less than the exotic breeds yet, they possess attributes that made their sustainability on available local resources, more ecological and economical in the long term. More so, Nwosu [9] reported that Nigerian indigenous fowl, supplies most of the poultry meat consumed in Nigeria. Since reproduction is the utmost key component of poultry breeding and semen quality is crucial in any breeding program, the influence of breed-type on body weight and semen characteristics of cocks were examined in this study.

Materials and Methods

Experimental site

The study was conducted at the Poultry Section of the Demonstration and Research Farm of the Faculty of Agriculture, Nasarawa State University, Keffi, Shabu-Lafia Campus, located within the guinea savannah zone (8° 29' 30" N, 8° 31' 0" E) of north central Nigeria.

Plates a – d represent the breed-type of cocks used in this study

Experimental animals' welfare

Six mature cocks each of Nigerian indigenous cocks (sourced from households in the Staff quarters, College of Agriculture, Lafia, Sasso (from African Chicken Genetic Gains Research Group) as well as black and golden brown spotted and white and black spotted breeds gotten from Nasarawa State University, Keffi, Shabu-Lafia Demonstration and Research Farm. All the 24 cocks were paired in 3 different pens based on breed-type (see plates a - d), offered commercial feed and clean drinking water ad libitum for a period of 20 days and the pens were cleaned regularly.

Semen collection and evaluation

Gentle "to and fro" stroke on the back feather using one hand accompanied with abdominal massage toward the tail with the other hand to stimulate the copulatory appendage was done to cause the ejaculatory papillae to swell. Upon eventual secretion of semen on the swollen ejaculatory papillae, capillary tube was used in the semen collection [10, 11]. The collected semen was thoroughly checked for presence of foreign materials then, the volume was determined using a graduated tube and the pH was determined using pH paper [7, 12]. It was promptly processed for glucose level determination following standard procedures [13, 14]. The sperm cells

characteristics (active, dead, length and concentration) were determined as described by Bakst and Long [15] and García-Herreros [16].

Data collection and analysis

The cocks were weighed individually using table scale (Five Goats®) to obtain body weight. Semen volume, pH and glucose as well as active sperm cells, dead sperm cells, sperm cell length and sperm cells count were collected and all the data were subjected to analysis of variance and the means were separated using Duncan's Multiple Range Test of the same software package procedures [17].

Results and Discussion

Cocks' breed-type, body weight and semen characteristics

Table 1 shows the influence of breed-type on body weight and semen characteristics of Sasso, golden brown spotted, white black spotted and Nigerian indigenous cocks reared in Lafia. There were statistical differences (P = .05) in all the parameters evaluated across the cocks' breed-type except, the semen volume that ranged from 0.18mL in Nigerian indigenous cocks to 0.25mL in Sasso cocks. The body weight was highest (2.5kg) in Sasso, followed by 1.7kg (white and black spotted). 1.63kg (white and golden brown spotted) and 1.11kg in Nigerian indigenous cocks, respectively. While the semen pH ranged from 6.75 – 8.61, the semen glucose was 14.00, 13.33, 5.55 and 5.50mmoL/L in Sasso, white and black spotted, white and golden brown spotted and Nigerian indigenous cocks, in that order.

Active sperm cells were within a range of 79.50 – 95.83% in Nigerian indigenous, white and black spotted and white and golden brown spotted cocks, compared to 51.50% reported in Sasso cocks. The sperm cells were longer (16.00µm) in Nigerian indigenous cocks, compared to 13.50, 14.41 and 14.91µm recorded in white and black spotted, Sasso, white and golden brown spotted cocks, accordingly.

Parameters	Cocks breed-type				P-value
	Sasso	White and golden brown spotted	White and black spotted	Nigerian indigenous	
Body weight (kg)	2.50 ± 0.08^{a}	1.63 ± 0.16^{b}	1.70 ± 0.06^{b}	1.11 ± 0.11^{c}	0.0001
Semen volume (mL)	0.25 ± 0.05	0.23 ± 0.05	0.21 ± 0.04	0.18 ± 0.04	0.1245
Semen pH	6.75 ± 1.29^{b}	7.40 ± 0.89^{b}	8.61 ± 0.48^{a}	7.41 ± 0.66^{b}	0.0130
Semen glucose (mmoL/L)	14.00 ± 0.00^{a}	5.55 ± 0.08^{c}	13.33 ± 0.81^{b}	5.50 ± 0.00^{c}	0.0001
Active sperm cells (%)	51.50 ± 40.84^{b}	95.83 ± 3.43^{a}	94.50 ± 7.36^{a}	79.50 ± 10.27^{a}	0.0062
Dead sperm cells (%)	48.50 ± 40.84^{a}	4.17 ± 3.43^{c}	5.50 ± 7.36^{c}	20.50 ± 10.27^{b}	0.0062
Sperm cell length (µm)	14.41 ± 0.49^{b}	14.91 ± 0.49^{bc}	13.50 ± 1.04^{c}	16.00 ± 0.31^{a}	0.0001
Sperm cell count (x10^{9}/mL)	4.02 ± 79.10b^{c}	3.66 ± 4.92^{c}	4.51 ± 7.14^{b}	6.97 ± 4.50^{a}	0.0001

^{a,b,c}: Mean values on the same row with different superscripts are significantly different at P = .05.

Table 1: *Influence of breed-type on cocks body weight and semen characteristics.*

The sperm cells count was highest (6.97 x 10^{9}/mL) in Nigerian indigenous cocks whereas it was 3.66 x 10^{9}/mL (white and golden brown spotted cocks), 4.02 x 10^{9}/mL (Sasso cocks) and 4.51 x 10^{9}/mL in white and black spotted cocks.

The body weight of the experimental cocks was similar to a range of 1.3 – 2.98kg reported at sexual maturity in local and exotic cocks raised in Ethiopia [18, 19, 20] and Nigeria [21]. However, the exotic breeds' body weight was characteristically higher than the local breeds, largely due to better upgrading system and conscious regular selection strategy over a period of time. Unlike in local breeds characterised with insufficient upgrading system and irregular selection strategy. Interestingly, the survival of local cocks in most climes depends on natural selection with the attendant consequences of environmental adversity and low productivity. It has been established that body weight of a cockerel is important when selecting for breeding flock performance. For example, Harris et al. [22] and Lukaszewicz and Kruszynski [23], reported significant negative correlations between body weight and reproductive

performance in cocks. It is therefore crucial for a cock to attain a minimum body weight, typical of a given breed, strain or type, before it could be used for successful breeding program [24]. Therefore, the experimental cocks used in the presented study were probably sexually matured.

More so, it has been speculated that sperm cell per ejaculate and body weight have been positively correlated and that body weight and shank length, comb and wattle development were predictors of good semen attributes in cockerels [23, 24]. Although, positive correlation between body weight and semen volume has been recorded in cockerels [22], the present study revealed that the Nigerian indigenous cocks with the least body weight (1.11kg) had the best sperm cell count value ($6.97 \pm 4.5x10^9$/mL). This observation seemingly confirmed the contrary negative effect of body weight on poultry semen production reported elsewhere [25, 26]. Thus, body weight may not influence semen quality in poultry species.

The semen volume recorded in the present study was close to a range of 0.24 – 0.52 mL reported in Rhode Island Red and White Leghorn [27] except the Nigerian indigenous cock with 0.18mL apparently lower than 0.40 – 0.73mL reported in different strains of indigenous Nigerian chickens [6]. Semen volume of 0.55mL, 0.34mL, 0.27mL, 0.24mL and 0.22mL has been reported in Hubbard [28], broiler cocks [29], naked neck, frizzle and normal feather cocks [30, 31]. Since it has been established that poultry species semen volume is relatively low but very high in sperm cells concentration [2, 11], the observed variations may be due to the breed type, age, body size, nutritional plane, environment as well as inadequate vitamins A and E. Therefore, breed-type may play a significant role in poultry species semen volume.

The semen pH value was within a range of 6.92 – 7.04 reported in Lingnan, Arabic, Kedu and Bangkok cocks [32]. This could be largely due to the promptness of semen evaluation during the studies. Delay in semen pH evaluation may result in oxidative reactions thereby influencing the buffer condition that may be deleterious to sperm cell. According to Salisbury et al. [33], the pH of semen is likely to decrease as the time between collection and measurement increases and the semen collection tubes are narrow in shape, causing sperm cell to break down fructose in the semen to lactic acid under anaerobic conditions. Semen samples that contain many dead sperm cells may evolve ammonia that may influence the pH.

Tomar et al. [34] speculated that poor initial sperm cell motility caused low semen pH ranging from slightly acidic to slightly alkaline condition in bulls. Semen pH is measured using a specially treated paper blot that changes colour according to the alkalinity or acidity of the specimen exposed to it [35]. The normal semen pH is slightly alkaline ranging from 7.2 to 7.8 and it has been observed that the prostatic secretion is acidic while the seminal secretion is alkaline [36]. Therefore, semen pH alterations may reflect a dysfunction of one or both of these accessory glands. Since Van Wambeke [37] reported that chicken and turkey sperm cells can tolerate a pH of 6.0 – 8.0, the present study apparently expressed the suitability of Sasso, golden brown spotted, white and black spotted and Nigerian indigenous cocks for artificial insemination. The observed semen glucose surge in the Sasso as well as white and black spotted cocks may seem inexplicable, it could be a mere coincidence and partly an indication of sperm cells inability to utilise the energy source during the evaluation process. The importance of sugars as energy-yielding nutrients possibly elucidated the nature of the seminal sugars considered to be a suitable starting point for sperm cell competitiveness "survival for the fittest" in the uterus immediately after deposition. Mann [13] reported that the presence of fructose in semen, may affect colour reaction employed but this was not sufficiently specific to distinguish between fructose and other ketoses, or between free fructose and bound fructose as in the various fructose phosphates. Since there was apparently no linearity between semen glucose and other parameters evaluated, the range of 5.50 – 14.0mmoL/L recorded in the study, may be enough to sustain sperm cells, during dilution process for artificial insemination.

Although the active sperm cells were relatively low in Sasso cocks the recorded values in Nigerian indigenous, white and black spotted as well as white and golden brown spotted were similar to 80 – 84% reported in Lingnan, Bangkok, Kedu and Arabic cocks [32]. This observation could be largely due to the relatively low pH value (6.75) recorded in the Sasso semen and partly due to the time lapse between when the semen was collected and evaluated. According to Bogdonoff and Schaffner [35], low pH may reduce motility, lactic acid production and oxygen uptake in avian spermatozoa, whereas high pH increases metabolic rates in vitro.

Meanwhile, Bakst and Long [15] stated that a good fresh semen sample from most breeder toms and broilers will have more than 90% active and morphologically normal sperm cells. This seemingly buttressed the report of Bah et al. [7], that though semen quality of local cocks in Sahel region of Nigeria did not differ from

others, it was suggested that cocks with higher semen volume and total sperm count, should be selected for breeding. Consequently, Nigerian indigenous, white and black spotted as well as white and golden brown spotted breeds in Nigeria may be suitable hence, preferred for breeding strategy. The sperm cell length was higher than 10.48µm and 9.84µm reported in Gallus domesticus and Numida meleagris, respectively [16]. The longest value (16.00µm) recorded among the Nigerian indigenous cocks, may enhance sperm cell motility and longevity. The sperm cell count value was close to 5.04 – 5.61 x 10^9/mL reported in Rhode Island Red and White Leghorn [27] and Nigeria local breeder cocks [7]. Meanwhile, as high as 6.97 x 10^9/mL recorded in Nigerian indigenous cocks, seemingly indicated high fertility rate potential, if properly harnessed for artificial insemination.

Conclusion

The Nigerian indigenous cocks were comparatively smaller than the other breeds thus breed-type may influence cocks' body weight. But the Nigerian indigenous cocks were superior in sperm cells' length and concentration. Therefore, body weight may not influence semen characteristics in cocks. Meanwhile, the semen volume was similar among the cocks therefore semen production may not be dependent on body weight and breed-type. Thus, Nigerian indigenous cocks may be upgraded in order to achieve chicken sufficiency in the country.

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Competing interests

The author declared that no competing interests exist.

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