RESEARCH ARTICLE

Effects of genotype on fertility and hatchability of funeral alpha chicken

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This project was carried out to determine the effect of genotype, used as a treatment on fertility, hatchability, and embryonic mortality of Funaab Alpha indigenous chicken. In the cause of the project, a total of 100 birds commercial lines of funaab alpha of the genotypes that includes, naked neck, frizzle, normal feather raised at the Pearl unit at the directorates of university farms which proper feeding and water were given to the birds through the period of this study. Semen was collected from sires using a trusted procedure and inseminated into the dam to get fertile eggs. Eggs were collected, labelled according to genotype and then moved to the hatchery unit where it was stored at a very low temperature, to retain the content inside the eggs. Eggs were set on weekly basis, using the incubator, candling was carried out at the 18th day after the setting of eggs into the incubator, to identify fertile eggs. All contaminated eggs, bangers and infertile eggs were disposed while the fertile eggs were restored into the incubator. All hatched eggs developed into chicks on the 21st day and all dead in shell and weak in shell were set aside, the estimated values for them were noted. At the end of the study, it was noted that all the genotype used in the cause of this project had significant effect on the percentage fertility and percentage dead in shell. However, there was no significant on all the genotypes used in the cause of this study by the percentage hatchability, percentage dead in germ, or percentage weak in shell. This depicts that; genotype has a great influence on estimated hatchability and dead in shell of the eggs, resulting in embryonic mortality of eggs. Dead in shell is higher in naked neck genotype, followed by normal feather and least in frizzle while weak in shell is high in normal feather, followed by naked neck and least was in frizzle.

Keywords: Chicken genotypes; Funaab alpha; Nigeria; Reproductive traits; Frizzle

INTRODUCTION

In Africa, chickens mostly dominate flock total composition; they make up about 98% of the total poultry members which includes, ducks, turkeys and guinea fowl. In addition to this, chickens possess unique qualities like their ability to hatch on their own, brood and scavenge for major parts of their food; they also possess an encouraging immunity from endemic diseases. The indigenous fowl possesses great potentials for genetic improvement through breeding programme like being used for selection and or cross breeding as it was discussed in the report made in researches. 80%of the 120 million poultry type raised in the rural areas in Nigeria constitutes of Indigenous Chicken. Their products meat and eggs are preferred by Nigerians because of the pigmentation, taste, leanness and suitability for dishes. The fertility and hatchability characteristics of egg type chickens in Nigeria are two main traits of determining the ability of pullets. An important parameter in chicken production, which also reflect the total reproductive capacity of female and male expressed by their ability when mated together to produce offspring is fertility. An egg is said not to be fertile when it fails to show any sign of developing embryo during candling defined fertility as the fertile stage of eggs laid over a period of time by a single hen, or by commercial flocks and is usually expressed as the percentage of all laid eggs over a period of time. Fertility of an egg is a factor of the genotype of the embryo to which both parents contribute. The concentration of sperm, the progressive motility of sperm and other behavioral factors such as the ability of the cock to successfully mate with the hens are considered the effect of sire on fertility; dam effects on fertility include egg quality, behavioral and physiological factors such prevalence of sperm storage tubules. Hatchability is a trait of economic importance in the chicken production because it has a strong effect on chicks output. It is influenced by weight of eggs, eggs turning, eggs storage, humidity, shell strength, egg size and various genetic factors within the chicken kept. The ability of the embryo to successfully escape from the shell is called hatchability. Hatchability also describes the percentage of fertile eggs that were hatched successfully after right incubation. Good egg hatchability of eggs is heritable, but it is determined by a genetic constitution and other environmental factors. According to, the gene make up of an individual chicken is determined at fertilization and hence fertility and hatchability are generally considered as traits of two parents. Embryonic mortality can be confirmed at different stages after setting in the incubator as a result, there could be early, mid and late embryonic mortality which occur on eggs incubated as reported. Each progressive stages of embryonic mortality tends to be more prevalent in eggs of various size ranging from small, medium and large size of eggs depending on factors like lipid utilization, respiration, thick shell, longevity of storing eggs which results in embryo growth prior to incubation [1-6].

MATERIALS AND METHODS

Experimental birds, semen collection, insemination

Experimental birds were the sire and the dams with 3 varying genotypic and phenotypic characteristics of the funaab alpha improved indigenous chickens maintained at the PEAR unit of the animal breeding and genetics department. The phenotypic characteristics of the funaab alpha chickens included dams and sires of varying feather colors that include the barred, black, ash, mottled, while the genotypes of the animals were the Normal feathered (Nm), Frizzled (F) and Naked neck (Na).

Following the method of reproduction to be used in the course of this project, the semen was acquired from the sires thrice in a week using the massage method. Lake and Stewart, abdominal massage method of semen collection for artificial insemination was used. The semen was collected from the each of the experimental cocks proposed for use in this project by carefully lifting it from the cage, place on the top of the cage. The cock was softly and gently given an abdominal massage and back stroke from underneath the wing flap close to the tail, while ensuring to apply pressure

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at the base of the tail to which expectedly allows the phallus to be erect within the cloaca. The inseminator applied pressure around the cloaca and the cock, in response to the touch, allows its tail to be flattened to the back, thereby causing the phallus to protrude from the cloaca. The thumb was used to press on the bird abdomen directly beneath its vent. This resulted in the release of the semen almost immediately from the ductus deferens. Semen was collected in a conical graduated collection tube while blood stained, and contaminated semen will be condemned as quality would have been tampered with.

The dams that were used for the experiment were inseminated using the semen acquired from the sires that were used during the project. The dams were inseminated in the cage by gently applying pressure to the left side of its abdominal region around its vent, which allows the cloaca to evert and the oviduct protrude. The inseminator inserted a syringe or plastic straw which contained the precise amount of semen quality to be discharge into the oviduct at a depth of 20 mm which is best for domestic fowls. The insemination was carried based on the mating design [7-11].

Egg collection incubation fertility test

The fertile eggs that were laid by the dams used in this experiment were collected after labeling of the eggs using pencils in accordance with the cage number of the bird, the bird's genotype, as well as the date of collection were all inscribed on the tip of the egg shell. Eggs collection was carried out on daily basis and arranged according to their phenotypic characteristics. Eggs that were collected daily were transferred to the hatchery for setting into the incubator.

The fertile eggs collected were set in the incubator on weekly basis following the storage of the eggs in a cold room prior to setting in the incubator to prevent embryo development and spoilage, as well as low hatchability of the eggs. The temperature and relative humidity of the incubator was ensured to maintain adequately and standardize to support proper embryonic development.

Cracked and contaminated eggs were put aside during setting. Eggs set in the incubator were candled at 18^{th} days to detect fertile and infertile eggs; the fertile eggs afterwards were hatched and total number of hatched and unhatched chicks was recorded. Data on dead in germ, dead in shell, weak in shell, abnormal chicks, as well as, dead chicks were all is noted.

Data collection

The data obtained included the following:

Egg number: This is the total number of eggs laid by each of the dam proposed for use during the experimental period.

Percentage fertility: This is the proportion or percentage of eggs fertile out of the total eggs it can be calculated as follows:

Percentage hatchability: This is the proportion of eggs that hatched out of the total fertile eggs it can also be represented as:

$$\%\ \text{Dead in germ} = \frac{Total\ number\ of\ dead\ in\ shell}{Total\ number\ of\ fertile\ eggs\ per\ sire/dam} \times 100$$

$$\%\ \text{Dead in shell} = \frac{Total\ number\ of\ chicks\ dead\ in\ shell\ per\ sire/dam}{Total\ number\ of\ fertile\ eggs\ per\ sire/dam} \times 100$$

$$\%\ \text{Weak in shell} = \frac{Total\ number\ of\ chicks\ weak\ in\ shell}{Total\ number\ of\ fertile\ eggs\ per\ sire/dam} \times 100$$

Statistical analysis

Data collected will subjected to One way Analysis of Variance (ANOVA) using a general linear model procedure of SAS 9.1 (SAS, 2003) and the means were separated using the Duncan's multiple range test.

$Yij = \mu + Gi + \varepsilon ij$

Where:

Yijk=Dependent variables such as fertility, hatchability, dead in shell etc.

μ=Population mean,

Gi=Fixed effect of the ith genotype (G=1,2,3)

εijk=Random residual error

RESULTS

Table 1 showed the effect of genotype on fertility, hatchability and embryonic death of funaab alpha chickens. The Pearson's correlation coefficient on fertility, hatchability and embryonic death of funaab alpha chicken genotypes was presented in Table 2. The effect of genotype was significant ($p<0.05$) on the percentage fertility and percentage dead in shell but not significant ($p>0.05$) on other reproductive traits. Naked neck genotype has the highest significant fertility of 78.64%, followed by normal feather (66.2%) and the frizzle feather genotype (61.39%). Hatchability also followed the same trend with highest hatchability of 70.67% for naked neck genotype, and the least hatchability percentage for Frizzle feather genotype with 57.91%. As presented in Table 1, the normal feathered chicken genotype has the highest dead in shell (3.22%) while the least dead in shell was recorded for naked neck genotype (0.33%). Though not statistically significant, the normal feathered had the highest weak in shell (0.88%) while the other two genotypes (frizzle feathered and normal feathered) relatively recorded lower values. Statistically, effect of sex was not significant on dead in germ but the normal feathered chicken genotype has the highest percentage dead in germ value (5.88%), while the other two genotypes (naked neck and frizzle Feathered) relatively recorded lower values. The coefficient of correlation between the reproductive characteristics and the genotypes ranges from low to medium to high, within each genotype, having both negative and positive correlation [12-16].

The correlation coefficient of the fertility and hatchability of the frizzled feathered funaab alpha chicken genotype was observed to be highly significant ($p<0.001$). However, negative correlation was observed in the reproductive characteristics which involved the correlation among fertility and dead in germ (-0.46) and the correlation among dead in shell and dead in germ (-0.08). In addition weak in shell was positively correlated to some reproductive traits that was evaluated; weak in shell and dead in germ (0.88), weak in shell (0.16), weak in shell (0.61), though not statistically significant ($p<0.001$). The correlation coefficient of reproductive characteristics observed within the normal feathered chicken genotype was generally high, but positively negatively correlated, however, only correlation involving fertility and hatchability were significant ($p<0.001$). Correlation among weak in shell and dead in germ (r=0.44) is positively correlated while others are negatively correlated. The correlation coefficient of reproductive characteristics observed within the naked neck genotype was not significant at all reproductive characteristics that was evaluated and generally low. Positive correlation was observed in correlation between fertility and hatchability (r=0.94), fertility and dead in shell (r=0.27), fertility and dead in germ (r=0.17), hatchability and weak in shell (r=0.07), hatchability and dead in shell (r= 0.32), dead in shell and dead in germ (r=0.98) while others were negatively correlated. The highest and lowest coefficient of correlation values were (r= 0.98) and (r=-0.02).

TABLE 1

Least squares mean ± SEM showing effect of genotype on fertility, hatchability and embryonic mortality of funaab alpha chickens

Genotype	Fertility (%)	Hatchability (%)	DIS (%)	WIS (%)	DIG (%)
Frizzle	61.39 ± 5.08^{b}	57.91 ± 5.25	0.50 ± 0.34^{ab}	0.50 ± 0.50	1.50 ± 0.62
Normal	66.20 ± 3.36^{a}	61.34 ± 3.71	3.22 ± 1.19^{b}	0.88 ± 0.35	5.88 ± 2.35
Naked neck	78.67 ± 6.74^{ab}	70.67 ± 6.83	0.33 ± 0.21^{a}	0.17 ± 0.17	2.50 ± 1.45

Note: ab with similar superscript are not significantly different, P>0.05, DIS: Dead in Germ; WIS: Weak in Shell; DIS: Dead in Shell; SEM: Standard Error of Means. Normal, normal feathered, Frizzle, frizzled feathered, naked, naked neck.

TABLE 2

Pearson correlation of the fertility, hatchability and embryonic mortality among funaab alpha chicken genotypes

Frizzle	**Parameters**				
	Fertility	**Hatchability**	**WIS**	**DIS**	**DIG**
Fertility		0.99***	0.24	0.05	-0.46
Hatchability	0.99***		0.28	0.06	0.41
WIS	0.24	0.28		0.88	0.16
DIS	0.05	0.61	0.88		-0.08
DIG	0.46	0.41	0.16	-0.08	
Normal	**Fertility**	**Hatchability**	**WIS**	**DIS**	**DIG**
Fertility		0.99***	-0.66	-0.65	-0.64
Hatchability	0.99***		-0.69	-0.62	-0.65
WIS	-0.66	-0.69		0.44	0.65
DIS	-0.65	-0.62	0.44		0.94
DIG	-0.64	-0.65	0.65	0.94	
Naked neck	**Fertility**	**Hatchability**	**WIS**	**DIS**	**DIG**
Fertility		0.94	-0.02	0.27	0.17
Hatchability	0.94		0.07	0.32	0.19
WIS	-0.02	0.07		-0.32	-0.34
DIS	0.27	0.32	-0.32		0.98
DIG	0.17	0.19	-0.34	0.98	

Note: DIS: Dead in Germ; WIS: Weak in Shell; DIS: Dead in Shell; SEM: Standard Error of Means; ***p<0.001

DISCUSSION

Significant differences in percentage fertility and hatchability obtained in this study were large which will encourage substantial economic value in profitable day old chick's production. However, absence of genotypic effect on hatchability may mean that these traits are no absolutely genetic but they might also be environmental and management conditions dependent. This assertion supports the findings of who recorded no significant breed differences in egg hatchability among the chicken genotypes compared. The result of this research is not in support with the report. They reported that frizzle feathered chicken genotype birds had the highest fertility and were closely followed by normal feathered chicken genotype birds. However, reported higher fertility in eggs by normal feathered chicken genotype birds. Significant percentage dead in shell was recorded in frizzle feathered chickens which also showed lowest fertility and hatchability. This result negates the reports of Peters who recorded the highest percentage dead in shell in naked neck chicken genotype in his results. In this study, the normal feathered chicken genotype had the highest percentage weak in shell and percentage dead in germ which supports the report of they reported that when Normal feathered chicken genotype was compared to the naked neck chicken genotype; there was a 6.1% reduction in embryonic survival in naked neck chicken genotype. According to during the last stage of incubation, the mortality occurs. This is also an indication that naked neck gene has lethal effect on survival of embryos. This could have caused the higher dead in shell obtained in Naked neck eggs compared to dead in germ [17-20].

CONCLUSIONS

Conclusively, this study revealed that

- Naked neck and normal feathered chicken genotypes had the highest fertility and hatchability.
- Frizzle feathered chicken genotype had reduced fertility and hatchability.
- Highest embryonic mortality was recorded in the normal feathered chicken genotype, followed by the naked neck and frizzle feathered respectively. This may be the reason for the continuous reduction of their population among poultry birds, there is a need.
- Their prompt conservation so that the frizzle genotype and naked neck genotype will not go into extinction.

- Genotype influences fertility and hatchability of the funaab alpha chickens, therefore, the genotype with the best fertility and hatchability percentage should be used for breeding purpose and other genotypes should be improved.

DECLARATION OF COMPETING INTEREST

I wish to confirm that there is no conflict of interest regarding the publication of this paper

STATEMENT OF ANIMAL RIGHTS

All the experimental procedures involving animals were conducted in accordance with the institutional animal care guidelines of the Federal university of agriculture Abeokuta, Nigeria, and approved by the animal welfare officers Ogun state province, Nigeria.

ETHICAL STANDARD

The manuscript does not contain patient or clinical data.

CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

I, Jeremiah Taiwo Boluwatife, give my consent for the publication "effect of genotype on fertility and hatchability of Funaa-Alpha chicken" to be published in the tropical animal health and production journal.

AVAILABILITY OF DATA

Not applicable.

AUTHOR'S CONTRIBUTIONS

Jeremiah Taiwo Boluwatife performed the data collection, Dr. Wheto M. conducted the data analysis and Prof. Adebambo A.O. assisted with the write up.

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