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Review

Egg physical traits, performance, fertility and hatchability in exotic and Nigerian indigenous chickens

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Abstract

Nwosu (1985) reported that there is no major difference in the egg laying performance of Nigeria local chicken of the eastern strain viz Nsuka strain, Awgu strain, Owerri stain. Peters (2000) discovered that normal feathered dam laid highest number of eggs than the exotics, frizzled feathered an egg shell and naked Neck respectively.
Narushin and Romanov (2002) revealed that egg shell parameters are shell characteristics which include shell thickness shell porosity etc, egg shell performs a dual function during embryo development. It has to be thick and strong, adequately enough to protect the embryo from external insult and aggression.
Similarly, shell of chicken egg should be adequately thin and fragile not to impede hatching process, because the thickness and thinness of egg shell has a marked implication on hatchability of eggs. Additionally, although egg shell need enough pores to supply the developing embryo with oxygen, it should be noted that however high concentration of egg shell pores should not be too much to allow pathogenic micro flora to gain entrance into the egg interior (Narushin and Romanov (2002).

Key words: Strain, micro flora, hatchability, egg shell, shell porosity, egg shell pores.

INTRODUCTION

An avian egg is a biological system and characteristics of many interrelated biological system. And a such slight aberrations in any of the egg physical traits results in collapse of the interacting parameters and consequently its major physiological functions to provide enabling environment for fertility, hatchability and developing embryo. Regardless of huge efforts of researchers and breeding companies it has proved impossibly difficult to produce eggs with uniform physical traits.
Consequently, 20 -40% of chicken eggs still fail to hatch (Anonymous, 1994).

Egg laying performance of exotic and Nigerian indigenous chicken

Akinokun (1990) reported in the evaluation of local chicken and exotic chicken in Nigeria stressing that exotic chicken are generally inferior in the tropical environment than in their zones of origin in terms of survivability and adaptability, prolificacy, although the expected higher performance was recorded over their local chicken counterparts.

In several studies, indigenous chickens have been compared with exotic chickens in the tropics, although the exotic outshines their local counterparts in so many ramifications, though performance is relatively low as to what is obtained in their zone of origin (Akinokun, 1990 and Adebambo, 2003).

Horst (1989), indicated that local chickens are abundantly endowed with about 7-9 major genes existing in their gene pool that are genetically conserved for special utility in the tropics. The presence of these major genes makes them envied for genetic exploration (Peter, 2000).

Nwosu (1985) reported that there is no major difference in the egg laying performance of Nigeria local chicken of the eastern strain viz Nsuka strain, Awgu strain, Owerri stain. Peters (2000) discovered that normal feathered dam laid highest number of eggs than the exotics, frizzled feathered and necked Neck respectively.

Research shows that the egg number laid per clutch ranges from 4 to 14 eggs. Sonaiya and Olori (1990) indicated that an average of 9 eggs was laid within the period 12 days. Ikeobi *et al.* (1996) opined that the production of 8 to 9 eggs per clutch was laid within 2 to 14 days during a laying period 32 to 36 weeks.

Nwosu and Omeje (1985) studied the egg laying performance of local chickens and reported that their production ability is in the range of 40 to 80 eggs, although their genetic potential for egg production is about 125 eggs

Mating between birds of different strains or breeds is called cross breeding. It results into heterosis or the hybrid vigor in terms of performance, egg laying capacity over the homogenous parents (Peters, 200).

Hybrid vigour as defined by Sherian (1981) is used in describing difference in the performance of breed relative to their parents. The heterosis can said to be the measure of the better performance exhibited by the offspring over their parents.

Sato *et al.* (1989) reported heterosis for egg performance characteristics in reciprocal crosses between highly inbreed of Japanese quill. The homogenous were found to be superior to their parent lines in terms of egg weight, shell thickness, egg length and yolk colour.

Peters (2000) opined that dam genotype expressed significant influence on hatchability. He further stated that the performance among local chicken and exotic chicken where normal feathered dam laid the highest number of total fertile eggs set and hatched followed by the exotic dam, frizzled dam and naked neck dam respectively, thus submitting that the normal feathered local chicken can favourably compete with their exotic counterparts in the tropics in terms of fertility of egg and production. Also the higher performance of local normal feather over exotic chicken in terms of egg production, fertility and hatchability is said to be environmentally influenced, in the sense that semen of the local cock is as a result of the adaptability to the warm humid tropics. The potency of the semen of the local chicken sire strains can say to be greatly influenced by genotype-environment interaction (Peters, 2000; Peters et al., (2004); Horst (1989) and Ikeobi *et al.* (1996)

Peters (2000) discovered that at highest number of dead-in-shell was observed in necked dam. Merat (1986) submitted that necked reduced embryonic livability and it becomes increasingly reduced when necked neck gene is in its recessive homogenous condition rather than heterozygous dominant condition.

Further still, Horst (1989) indicated that naked neck dam is said to have the highest egg production capacity than frizzled, followed by normal and exotic dam respectively. This trend may be probably due to the possession of major genes, genotype-environment relationship and adaptability to warm humid tropical environment. The enviable egg production necked neck is also as a result of ability for feed conversion and adult fitness hence they can be selected four commercial egg production.

Despite considerable research effort in this regard, it has been proven impossible to make egg laying hens produce eggs with identical physical characteristics. A consequence of this set back is that 20-40% of chicken eggs still fail to hatch (Anonymous, 1994). Fertility and hatchability are major parameters of reproductive performance which are mostly sensitive to environmental and genetic interactions (Stromberg, 1975).

Factors affecting these two main parameters of hatching profitability includes conditions and length of storage of eggs, nutrition, strain difference, semen quality, egg internal quality, mating ratio.etc (Landauer, 1967; North, 1981; Stahl *et al.;* Peebles and Brake, 1987).

Nwagu (1997) submitted that malnutrition, presence of antinutritional factors/toxicants/ contaminants in feeds, age of the breeders flock, mating ration, strain/breed difference, inbreeding, chromosomal abnormality, occurrence of parthenogenesis, stocking density etc are factors affecting fertility and hatchability of poultry eggs. Eggs fertility ratio of eggs laid over a period of time by a single hen or group of hens usually expressed in percentage of fertility egg laid while, hatchability denotes the proportion of fertile eggs that continued to develop and produce viable chicks. Hatchability has been found to be influenced by physiology, egg size, nutrition, genotype and possession of major genes (Huston, 1981; Bus, 1982, and peters *et al.,* 2004).

Studies done by Moiseyeva and Tolokonnikova (1968) and Tsanrenko and Kurova (1989) establish that egg physical characteristics affects hatchability and they are ranked in the order importance for successful hatching. (i) Egg weight/size (ii) Shell parameters (iii) Egg shape index (iv) Internal egg content/quality.

Egg weight and egg size

A lot of investigations had established the relationship between egg weight and hatchability. In general, many research works had unanimously agreed that it is preferable to have egg of average weight to achieve good hatchability as far as

Chicken is concerned (Rendel, 1943; Brunson and Godfrey, 1953; Moris *et el.,* 1968; Kumar and shingari, 1969; Wilson, 1991; and Gonzales *et al.,* 1999). Curvilinear relationship between egg weight and hatchability was studied by Shatokina, (1975) who established that the hatchability of egg weighing 46-50g as well as those in the category of 50-77g was between 8-10.5% lower than eggs of average weight of 50-66g. Similar data was reported by Nordskog and Hassan (1969) who discovered that hatchability was at maximum when the egg weighs about 56g on average. It is note worthy to stress that, 10g increase in egg weight above the optimum value of 56g lowered hatchability by 3.9%. A somewhat close relationship was reported for egg from Japanese quail Insko *et al.,* Sharma and Vohra (1980) and Serapati *et al.,* (1996).

Similarly, Williamson and Payne (1978) found that small and large eggs. In furtherance of the above Landauer (1967) confirmed that egg size has a pronounced effect on hatchability.

Asuquo and Okon (1993) established that egg size has a marked effect on hatchability and this was in agreement with what was reported by Pascal (1981), Oluyemi and Roberts (1979) where they reported that hatchability is at maximum when medium egg size are set for hatching, stressing that there was a significant difference between the medium and large eggs, with average percentage of claimed was probably due to embryonic mortality because there was a high correlation between fertility and hatchability between medium (r=0.84) and large (r=0.95) eggs.

Asuquo and Okon (1993) submitted that appropriate egg size required to achieve highest hatchability lies between the ranges of 45-56g egg size. This range of egg size would probably hatch better than small egg size. The report of Asuquo and Okon (1993) was close to what obtained by Madlekar (1981), he reported that highest hatchability will be achieved when egg size falls within the range of 51g-59g. Landauer, (1967), Nashein (1972), Williamson, Payne (1979) and Madlekar (1981), unanimously established that medium and large egg size will perform better than small egg size in terms of maximum hatchability

Shell thickness and porosity

As reviewed by Narushin and Romanov (2002), egg shell parameters are shell characteristics which include shell thickness shell porosity etc, egg shell performs a dual function during embryo development. It has to be thick and strong, adequately enough to protect the embryo from external insult and aggression.

Similarly, shell of chicken egg should be adequately thin and fragile not to impede hatching process, because the thickness and thinness of egg shell has a marked implication on hatchability of eggs. Additionally, although egg shell need enough pores to supply the developing embryo with oxygen, it should be noted that however high concentration of egg shell pores should not be too much to allow pathogenic micro flora to gain entrance into the egg interior (Narushin and Romanov (2002). Most researchers agree that a moderately thick egg shell to be desired for the following;

(i).Encouragement of maximum use of nutrients contained in the egg by the embryo (shipts and Danilova, 1960; Eremeyev, 1969; and Sergeyeva, 1986).

(ii).Increase in embryonic development (Zlochevskaya, 1962; Tsanrenko, 1988; Roque and Soases, 1994). (iii) Reduction in chance of microbial or bacteria penetration into the egg (Tsanrenko, 1988 and Finisin *et al.,* 1990).

(iv) Provision of appropriate protection against mechanical damage and external insult as well as aggression as reported by Sergeyeva (1986) and Tsanrenko (1988).

Tsarenko (1988) opined that hatchability of thick shelled egg was 30% higher than those of thin shell. To further support this claim, Sergeyeva (1956) confirmed that an increase in shell thickness of one micrometer in the range of 0.29-0.35mm lead to an increase in hatchability of about 2%. For instance, when the shell thickness of turkey egg increased from 0.44/0.05mm, their hatchability rose from 67%-80% (Sharlano *et al*. 1978).

However, Andrew (1972) reported that the hatchability of eggs of turkey was higher with thin shell. Similarly, shell porosity in terms of pores concentration and diameter has prominent influence on hatchability of eggs and its correlates positively with shell thickness. (Brake and Peebles, 1987 and Chistyakova, 1988), shell porosity influences gas and air exchange of the developing embryo. Both low and high pore concentration affects negativity embryo development. (Narushin and Romanov, 2002). Low pores and or pores of small diameters causes difficulties in oxygen exchange, thus increasing embryonic mortality. (Tullett and Deeming, 1982, Burton and Tullett 1983 and 1985 and Peebles and Brake, 1985).

High pore concentration or pores with large diameter causes a greater negative effect on embryonic development by causing dehydration etc (Tullett and Burton 1982; Burton and Tullett, 1985; Peebles and Marks, 1991; Demming, 1995; Gonzalez *et* al.; 1991 and Oluyemi and Robert, 1979) Research study conducted into the correlation between internal egg qualities and hatchability reveals that hatchability decreases when liquid content of the egg increases reported by Zloechevskaya (1966), Moieseyeva and Tolokonnikova (1966), Rolink (1968), Tsanrenko (1969), Shatokina (1975), Kurova (1986) and Luykx (1994). The nature of egg yolk, albumen, ratio of height to the average diameter of the albumen or yolk, albumen height, index of the albumen form fraction by means of the torsion pendulum technique as described by Tsarenko (1988) as marked effect on hatchability. Similarly, the above factors discussed have no marked effect on fertility but they have significant effect on hatchability as revealed by the literatures sited above.

Breed and strain

Avigdor *et al*. (1986) submitted that among the factors causing difference in hatchability of eggs among chicken is the effect of the breed differences. Oluyemi and Robert (1979) reported that fertility and hatchability of eggs are both functions of breed and environment. Peters *et al*. (2005) confirmed that dam strain had prominent effect fertility and hatchability of eggs. Nwagu (199) opined that genetics components, chromosomal aberration negatively affect fertility and hatchability. Wilson (1993), recognized that inbreeding, chromosomal abnormalities and occurrence parthenogenesis may seriously affect hatchability. Using different colour variations and their crosses for broiler production. Voroshilova (1971) obtained the least fertility and least hatchability from white and blue plumage. Ayorinde and Okaeme (1984) reported conspicuous variation in fertility, hatchability and embryonic mortality in the local flocks of ash, black, pearl and white as well as exotic counterparts (Golden, Sovereign). They observed that pearl give the highest fertility and hatchability where the smooth/normal feathered local chicken produced the highest number of fertile eggs followed by white leghorn and black near respectively.

Peters (2002) discovered that the effect of strain and breed difference do affect fertility of egg where he revealed that smooth/normal feathered local chicken laid more fertile eggs than the exotic strain followed by frizzled feathered strain and naked neck strain respectively. The superior effect of fertility demonstrated by smooth feathered local chicken is influenced by sire strain effect, which probably may be due to the productivity quality of the semen indices contributing to the potency of the sperm cell of the normal smooth feathered cock. This superiority can be adaptability to humid tropical environment, effects of major genes, these are the likely factors contributing to the potency of the local cock semen which directly influenced the higher fertility obtained in the smooth feathered local chicken. The genotype-environment interaction that favours the potency of semen of local strain for smooth feathered cock whereas this have negative effect on the potency of the exotic strain semen which indirectly affect its fertility (Peters, 2004.) Sire strain also affects hatchability alike with the same trend or pattern it affects fertility (Ibe, 1993 and Ikeobi *et al*, 1996).

Hatchability to a large extent is a derivative of fertility and the presence of major genes and strain/breed difference that affects embryonic livability (Avigor *et al*.1986 and Peters *et al*., 2005). Peters *et al*. (2005) Opined that dam strain proffers an obvious effect on fertility and hatchability of eggs. Eggs shape index can be derived by the division of egg breath by egg length, that is the ration of maximum egg breath and length, and it remained constant during the old period of incubation (Narushin and Romanov, 2002). Kumar and Shingari, (1969), Tsarenko (1988) and Burton *et al.*(1990) unanimously recognized that egg of normal morphology hatch better than those that are abnormally shaped. This results probably due to the fact that embryo changes its axial orientation in the egg at latter stage of embryonic development (Ragozina, 1961 and Rolink, 1968). In the light of the above both narrow and conspicuously oval egg shapes are likely to inhibit the axial rotation of embryo inside the egg. Eggs with abnormal shape reflects tendency for low hatchability as indicated by research performed on Isabrown by hybrid layer white leghorn by Provizen and Lvova (1982) and Harun *et al.* (2001). In addition, these authors unequivocally established that more round eggs were less successful in hatching than pointed ones. Research conducted on quail eggs of Sharma and Volva (1980) establishes negative correlation between eggs index and hatchability of egg. Fertility and hatchability has been found to be influenced by mating ratio (Landauer, 1967; North, 1981; Paschal, 1981; Stahl *et al.* 1986; Pebbles and Brake, 1987).

Mating ratio and stocking density

Borland observed that fowl are selective in choice of their breeding partners by so doing no fertile or sterile male may be selected, thus affecting the fertility of egg to be laid. The presence of dominant but non fertile cocks in the flock may prevent the fertile but less dominant cock from mating thereby reducing the productivity and hatchability. (Skaed, 1962). High ratio of female to male results into decline of fertility because the cock will have more than necessary fowl to mate with, the more the number of hen mated by a cock, the poorer of the fertility of the sperm cells which in turns affects or course decline in egg fertility. For instance 14 females to 1 male resulted in 65percent fertility compared with 80percent fertility when the number of hen to cock is in the ratio 1-1 Gonzalez and Klein (1974) established that higher fertility of about 92percent in flock were obtained where male-female ratio wads 1-5 than those ratio with 1-7.

Roiter (1976) indicated stocking density of 4 birds per meter square achieved 81percent fertility compared with 33percent fertility for bird kept at 8 per meter square, high stocking density of about 500 birds result in poor fertility (Vietman *et al,*1069). Oluyemi and Robert (1979) observed that fertility appears to be largely dependent on, mating frequency of cock.

Time/period of male withdrawal

Orji and Isu (1983) observed that number of fertile eggs were laid in the first 48hours following the introduction of male in a research conducted on poultry birds. They reported that about 50percent fertility was obtained on the 3rd day and this rose to maximum of 100percent by 8th day. This trend was maintained for a month. During the 10 days following the removal of the male, fertility was seen to be between 66percent and 88percent, dropping steadily thereafter after a few fertile eggs were laid by the 27th day. Sperm storage in the oviduct has implications on fertile because the livability of sperm into the oviduct has been found to be within the range of 2-3days, after the 3rd day of introduction of the sperm into the oviduct, the viability of the sperm diminished, thus fertility decreased (Oluyemi and Roberts,1979).

Age of parent stock

Oluyemi and Robert (1979) and Okorie (1977) reported that hatchability decreases with increase age of the hen or female parent stock .Wilson (1993) discovered that the breeding flock with more than two years in age decreases fertility and hatchability.

Asuquo and Okon (1993) reported some findings based on research conducted on poultry chicken, they reported that age –in-lay has a significant effect on hatchability and fertility throughout the 24 weeks duration of their research ,this finding is in agreement with the findings of Pascal (1981). McCartney (1976) reported that fertility increases with age-in-lay within 6 mouths of lay. This he stated was due to increase in accumulation of sperm in the oviduct of hen (Cole and Garrett, 1980 and North1981). Peter *et al.* (2005) concluded that dam age affect fertility and hatchability.

Effect of pre-incubation/holding/storage period of fertility and hatchability of eggs.

Egg storage condition prior to incubation probably influences hatchability and fertility and are of considerable concern to commercial enterprise (Butler, 1991).Environmental condition in during length of storage period, storage temperature, humidity, gaseous environment and orientation of the egg influence fertility and hatchability. (Meijerhorf, 1992; Mellet, 1993).Chicken eggs normally stored up to a week before artificially incubated (Sahan et al, 2003).Storage condition should be sufficiently cool to prevent embryonic development during this period .For most birds, critical temperature for the initiation for embryonic development appears to be about 25-27 0C (Drent, 1975).In the light of the above, adequate storage temperature should be employed to counter embryonic during storage.

Deeming (1960) and Wilson *et al.* (1979) found that hatchability of eggs can be achieved at 15^{o} C for 4-6 days. However, Gonzalez *et al* (1999) revealed that egg could be stored at 18^{o} C for 10days without hatching impairment. Kirk *et al.* (1980) indicated that better than when stored for 8 days. Conversely, long term storage appears to be the most successful at or near 12o C (Frank and Forward, 1960). Mayes and Takerballi (1994) concluded that the shorter the storage period, the higher the storage temperature required for maximum hatchability. Deeming (1993) suggested that chicken eggs stored for 7 days at temperature of range 16-18% is appropriate for maximum hatchability while for eggs stereo for long than a week, the temperature should be kept at appropriately 13oC.

However, Badly (1998) discovered that chicken eggs stored at 21oC for 134-18days had a very poor hatchability compared to eggs stored for less than 40days.Laing 919920 suggested that temperature from 18-20 0C supports good hatchability on condition that the storage time doses not exceed 40days.

Additionally, Horbakizuk (2000) determined the temperature at which eggs are stored for as period not exceeding 7days may range from 12-18 0 C support good hatchability. He also found that the hatchability of fertile eggs stored at 12 o C, 15 oC, and 18 oC were similar and were range from 78.9-80.7%. Vanschalkwayk *et al*. (1999) showed that temperature is a key in determining embryonic livability and found that embryonic mortality was lower at storage temperature at 17 o C than at 25 oC, this result is inconsistent with what is obtained by Sahan et al (2003).

Storage temperature is directly related to albumen quality changes which are related to period and temperature dependant effect (Brake *et al.*1993) Goodrum *et al.* (1989) opined that albumen ph increases rapidly when egg stored at high temperature .The most important effect of albumen quality appears to be on early embryonic mortality (Brake *et al* .1993) .Nwagu (1979) recommended that chicken egg should be stored at temperature range of 15.5-18.5% and at a relative humidity of 70-80% for 7days before artificial incubation declines progressively.

Effect of incubation condition on fertility and hatchability of eggs.

In correct fumigation procedures including incorrect use of spraying chemicals and the use of over-strength fumigants results in reduced hatchability (Wilson ,1993) . Maintenance of correct incubation environment is a prerequisite for desirable hatchability (Nwagu 1997).Shell porosity in relation to egg weight of the shell (SpGH_2O) to be very important for hatchability efficiency. Optimum temperature in the setter should be maintained at 50-55% and during the last (2-3weeks) at 75%.

Ancel and Girard (1992) in their study inferred that the relationship between water vapour/mass and conductance of egg and shell porosity should be taken into recognition when relating the amount of water vapour pressure in the incubation with temperature and humidity. The rate of lay, fertility and the hatchability percentage are the essential of reproductive efficiency of breeding flock (Roy *et al.*, 2003).

Roy *et al.* (2003) submitted that season has marked effect on fertility, thus correlating the research conducted under different seasons viz summer, monsoon Southwest Monsoon, Post monsoon and winter on white leghorn chicken of meghalayer where egg fertility were considered and it was discovered that the season has a significant effect on fertility This result was in agreement with what reported by Taylor et al. (1982); Kalita *et al.* (2003) and Jayarajcin (1992). Further more, Roy *et al.* (2003) suggested that season has a profound effect on hatchability, following their findings on white leghorn. The finding evolving from this research was in close agreement with what obtained by Sharma and Bora (1965); Taylor et al. (1982) and Singh *et al.* (1983).

However Singh *et al* (1991), reported higher value while Sexener (1980), Mishra *et al* (1988), and Singh and Belsare (1991) reported higher values than what were reported by Roy *et al.*(2003). In short term, all findings reported with citation above claimed that season has a profound effect on hatchability and fertility.

Similarly, Roy et al. (2003) confirmed that effect of year has a marked significant on hatchability following a research conducted on white leghorn and Rhoda Island red. These observations were in consonance with what obtained by Taylor *et al*. (1982) and Belsare (1991).

Unanimously they inferred that variation in temperature, atmosphere, humidity and rainfall may affect the physiology and metabolically activities of fowl thus leading to deterioration in some quality of fertile eggs which in turns might have course seasonal and yearly variation in fertility and hatchability. Baruah *et al.* (2001) recognized that the fertility and hatchability of duck eggs play a major role in the production of ducklings. He further stated that embryonic mortalities in duck eggs during laying process improper incubation sanitation.

In furtherance of their research, they submitted that dead-in-germs and deed-in-shell on different genetics group or duck used for their research were due to infection of E.*coli*, Bacillus and proteus *sp*. Higher concentration of E.coli was observed in party duck egg and this was put to be 25.71percent, this infection was said to be due to contamination of eggs at the time of laying and collecting of eggs.

In this wise, the presence of microbes e.g. *E.coli Bacillus, proteus sp* and their contamination at the time of laying and collection of eggs and culprit as they decrease hatchability of eggs (*Baruah et al.,* 2001).Sonaiya and Olori (1990) agreed that Newcastle disease is the most culpable problem of local foul following coccidiosis and body lice. Extreme of weather, predator, etc are culprits that reduce productivity of chicken reared under extensive system as indicated by Sonaiya and Olori (1990).

Seneviratna (1969) and Okoaeme (1983) suggested that salmonellosis, especially salmonella pollurum infection are being probably responsible for clear (unfertile) eggs and reduced hatchability. They further reported that high embryonic mortality is a result of staphylococcus, streptococcus, salmonella gallinearium, typhimurum, and asprigiellus infection, Newcastle disease, infection bronchitis and botulism are among diseases, known to have adverse effect on fertility, hatchability and embryonic development in chicken.

Genotype / environment interaction and their effect on fertility hatchability of eggs.

Fertility and hatchability are major parameters of reproduction performance which are most sensitive to genetic influence (genotype and environment (Stromberg, 1975); Oluyemi and Roberts (1970) and Peters *et al*. (2005). Say (1990) as cited by Peter (2000) suggested that the performance of any given chicken at point is a function of genotype and environment interactions. The genetic compositions of any fowl always interact with the environmental factors resulting in the phenotypic expression manifested in the offspring in terms of reproductive performance. Hatchability to a large extent is a derivative of fertility except were there is presence of major genes and breed\strain difference that reduce embryonic livability (Peters *et al.* 2004). Avigdor (1981) also stated that any difference in hatchability of chicken of different breeds or strain may probably be due to breed difference or strain differences.

Among the components that constitute the environment are climate factors, management, medication and vaccination, nutrition, storage condition, stocking density, mating ratio, light, rearing environment to mention but a few, have been found to have a profound effect on the fertility and hatchability as indicated by Landauer (1967), North (1981), Pascal (1981) Stahl *el al.* (1982). Hut (1949) reported that environment influences fertility and hatchability Jayarajcin (1992) and Singh *et al.* (1983) recognized that hatchability and fertility of eggs depend on number of factors e.g. genetic make up of the breeders stocks, physiological, social and environmental factors.

Effect of nutrition on fertility and hatchability of eggs.

Bolton and Blair (1974) observed that egg production in poultry is a function of good feeding or balanced diet, they further revealed that fertility and hatchability were affected by 2.5mg/kg of selenium in the diet but 5mg\kg causes a reduction in hatchability declined to zero at an inclusion level of 10mg/kg. Nwagu (1997) submitted that the presence of contaminant, toxins, metallic compounds, mycotoxins (Aflatoxins) in feeds of poultry birds are capable of reducing hatchability and fertility.

Seneviratna (1960) observed increased dead-in-shell, curled toe, paralysis and crusty deposit on eye lids and moulds as symptoms of riboflavin deficiency, retarded growth and mortality by the third day of incubation were listed by Wilson (1993) as being by severe deficiency of nutrients such as biotin, Vitamin A and B, Pantothenic acid, copper and boron.

Embryonic death after 18 days of incubation was quoted as being due to vitamin A, B12, K, folic acid, riboflavin, pantothenic acid Thiamine, linoleic acid, calcium, phosphorus and manganese. (Offiong and Abed, 1980 and (Offiong 1993).

Adequate balance diet and provision of quality water are essential for efficient breeding of poultry birds for enhancing fertility and hatchability as well as production efficiency.

Olayemi and Robert (1979) listed Vitamin B2 (Riboflavin), B12, D3 and important minerals e.g. calcium, manganese, for maximum fertility and hatchability while overall lack of deficiency of feeds leads to body weight and loss, reduced libido, reduced fertility and hatchability of eggs, deficiency of Vitamin A and B in diet adversely affects spermatogenesis thus reducing fertility of eggs and hatchability.

Embryonic mortality at day 14 and 15 of incubation is attributed to nutritional deficiency (Oluyemi and Robert, 1979). Intensive system of feeding, drug administration, and medication and vaccination procedure on regular basis will probably improve reproductive performance and egg production than those chicken under extensive system of husbandry in terms of egg production, weight, fertility and hatchability (Hill and Modebe, 1961) as cited by Peters (2000). Smitaner (1974), Mitskevich and Veistman (1975) and Gonzalez (1981) discovered an improvement in reproductive performance of poultry birds. They ascribed this improvement to the effect of exposure to 17-20 hours of natural light per day.

However, such improvement may be achieved in countries where there is little variation in natural day length of light, without the construction of light houses which require power supply.

CONCLUSION

The rate of egg lay, fertility and hatchability percentages are essential attributes of reproductive efficiency/performance of any breeding flock. The cost of production of chicken is dependent on the production of the flock. (Roy *et al*., 2003). An avian egg is a highly integrated biological system therefore any abnormality in the physical characteristics of egg may lead to a break down in the interaction of these egg parameters and consequently cause a collapse in their main physiological function.

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