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A Survey of Chick Mortality at Hatching in three Selected Hatcheries in Jos, Central Nigeria

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Abstract: A questionnaire-based survey was conducted to investigate chick mortality at hatching in three commercial hatcheries in and around Jos, central Nigeria. Mortality was defined as the sum of dead chicks, dead-in-shell embryos and culls due to various other reasons. There was a large variation in culling rates due to poor hatching. The major reasons for culling were dead-in-shell embryos, weak chicks, dead chicks, omphalitis and physical abnormalities such as incomplete feathering, weak limbs, distorted beaks and wetness. There was no significant correlation between the age of breeding flock and percentage of culls indicating that culling rate was not strongly influenced by the age of breeding flock. Although, factors contributing to poor hatching include management and incubation failures, the most probable cause of abnormalities, weak chicks and omphalitis are diseased breeder flocks or poor hygiene and sanitation in hatchery operations. Two of the hatcheries used a combination of formaldehyde and iodine for disinfection but hygiene standards were compromised due to inadequate cleaning in all three hatcheries. The poor hatch experienced in this study suggests that there is considerable room for improvement in hatchery operations particularly with regards to hygiene and sanitation. Adequate training of hatchery operators in understanding the crucial role hygiene plays in ensuring high chick quality is needed.

Key words: Chick quality, hatchery, culling, Nigeria

INTRODUCTION

Commercial hatchery operations are not well-developed in Nigeria and the few hatcheries located in specific parts of the country appear to be experiencing increasing demand with the continued growth of the poultry industry. In hatchery management it is often assumed that hatching success and chick quality are linked and that high hatchability translates into optimal chick quality. The hatchability of an egg does not necessarily correlate with the quality of chick (Tona *et al.*, 2005). The quality of chick that emerges out of an egg depends on factors such as the age of breeder, length and storage condition of egg before incubation and the incubation conditions (Tona *et al.*, 2005). Other factors such as faecal contamination of egg shells, the design and ventilation of the hatchery, stocking density, insufficient and soiled nesting boxes, all lead to reduced hatchability of eggs and mortality due to micro organisms (Shane, 1999). The main sources of contamination in a hatchery are people, equipment, air and eggs (Ernst, 1975). All these must be successfully controlled to minimize mortality and since, the beginning of the twentieth century the need to control hatchery disseminated diseases of poultry has been recognized (Lancaster, 1962). The effective control of disease in the hatchery depends on good design for cleaning and disinfection.

The majority of disinfectants used in the hatchery are quaternary ammonium compounds, phenolic compounds, glutaraldehydes and their combinations, chlorine, peroxide and iodine. In order to achieve high levels of sanitation in the hatchery, a system of monitoring of microbial levels is important (Ernst, 1975). Sanitation is achieved through proper cleaning and disinfection. Some of the factors that affect the performance of a disinfectant in the hatchery are the hardness of the water being used, the level of organic matter on the equipment being sanitized and the pH of the disinfectant (Spielholz, 1998).

This study was initiated with the objective of determining the levels of mortality of chicks at day of hatch, the level and reasons of culling and the types of chemicals used for the sanitation of hatchery and hatching eggs. Chick mortality was defined as the sum of culled and dead chicks on the day of hatch.

MATERIALS AND METHODS

A questionnaire-based survey was conducted in three commercial hatcheries in and around Jos city central Nigeria. There are five commercial hatcheries in and around Jos. Based on their egg-setting capacities they were ranked into small (2000 eggs per setting), medium (2000-10,000 eggs per setting) and large (>10,000 eggs

per setting). From each group, one hatchery was randomly selected for the study making a total of three hatcheries studied. Ten visits were conducted to each hatchery over a three-month period between March and June, 2007 and the questionnaire was administered on each visit. The questionnaire incorporated open and closed questions designed to obtain data to meet the objectives of the study. Questions in the survey covered demographic details, egg management, fertility, hatchability, chick abnormalities and culling.

The questionnaire was pretested on a Research farm/hatchery in order to obtain an indication of possible responses. Some of the questions were then adjusted based on this pretesting. Data from the pretesting were however not included in the results. Data collection techniques also included direct questioning and discussions with hatchery operators including a review of hatchery records where possible. Observation was also used to verify data collected.

Study area: All three hatcheries are located at distances not >50 km from the centre of Jos city which is situated on latitude 9° 55' 21.61" N and longitude 8° 53' 32.19" E at an elevation of 1072 m (3518 feet) above sea level. Two of the hatcheries are located in Jos north and the third one in Jos south. The hatcheries were designated as H1 (small), H2 (medium) and H3 (large).

Data analysis: Data were analyzed using Epi Info® (CDC, 2008) version 3.4.1 to calculate frequency of distributions and to examine correlations between selected parameters.

RESULTS

Thirty questionnaires were administered but only twenty five were returned with complete information. The major breeding stocks used in broiler production in the study were Yaffa (H1), Anak (H2) while, Lohman Brown (H3) was for egg production. The small Hatchery (H1) also, collected eggs from small farmers and hatched them for a fee. All breeding stocks (100%) were sourced from grand parent farms located in the south western part of the country. Two Hatcheries (H2 and H3) were located on the same site as their breeding farms while, for H1 the breeding farm was located on a different site about 10 km away from the hatchery. Some of the staff working on the breeding farm in H1 also, worked in the hatchery and the vehicle used to transport eggs was also used for transporting staff between farm and hatchery in this hatchery. Records were poorly-kept in H1 and H3 but H2 had well-kept and up-to-date records of all breeding and hatching data.

H1 and H2 had a ratio of 1:10 male to female breeding birds while, H3 had a ratio of 1:9. Two hatcheries compounded their feed on site while, the small Hatchery (H1) used commercial feed for its breeders. All

hatcheries candled their eggs only once during the incubation period between days 11 and 14 of incubation. Eggs were collected on an average of six times daily amongst the hatcheries surveyed.

There was a wide variation in the percentage of culls at day of hatch ranging from 0.01-20% in the study area. Reasons for culling ranged from omphalitis (unhealed navel) (40%), physical abnormalities (32%), dead-in-shell embryos (24%) and weak chicks (4%) for all three selected hatcheries. The distribution of culls by hatchery showed a 10.9% culling rate in H1, which was mainly due to dead-in-shell embryos, weak limbs and incomplete feathering. There was a 0.19% culling rate in H2 mainly due to omphalitis, dead-in-shell embryos and weak limbs while, in H3 a 2% culling rate was observed mainly due to dead-in-shell embryos, wetness, distorted beaks and incomplete feathering. Detailed causes of culling indicated that the major cause of culling was dead-in-shell embryos in all three hatcheries while, in H2 omphalitis (25.2%) was another major cause and in H3 physical abnormalities (35.2%) were also a major cause of culling. The widest variation in culling percentages occurred in H1 (0.4-20%) while, H2 had the lowest culling percentages (0.01-0.05%). Culling percentage in H3 ranged from between 1 and 4%.

Physical abnormalities were due to causes such as weak limbs, insufficient feathering, wetness and distorted beaks. All three hatchery operators said they interpreted omphalitis to be due to an infectious agent possibly *Salmonella* or *E. coli*.

Two hatcheries H2 and H3 used a combination of formalin and an iodophore for egg sanitation while H1 used only formalin. Eggs were generally stored for between 3 and 4 days before setting in all three hatcheries. Dirty eggs were generally cleaned with dry steel wool but not always immediately after collection in all 3 hatcheries. H2 stored eggs at 18°C in an air-conditioned room designated as the egg room. H1 and H3 stored their eggs at ambient temperature which could rise up to 32°C during the warmer months in the study area.

There was a significant ($p = 0.005$, $R^2 = 0.99$) positive correlation between the number of fertile eggs and number of chicks hatched indicating that the number of chicks hatched was strongly influenced by the number of fertile eggs. There was no significant ($p = 0.001$, $R^2 = 0.07$) positive correlation between the age of breeding flock and percentage of culls indicating that the percentage of culls was not strongly influenced by the age of breeding flock.

DISCUSSION

Records of culling at day of hatch along with mortality in the first seven days of brooding have been used as a measure of chick quality (Chou *et al.*, 2004). The large variation in culling rates (0.1-20%) amongst the

hatcheries studied is an indication of poor hatch in the study area. Management and incubation problems can lead to poor hatching. Poor sanitation also causes both poor hatching and subsequent mortality during brooding although generally a culling rate of up to 1.5% at hatch is expected (Tona *et al.*, 2005). H2 had the lowest culling rate which ranged from between 0.01 and 0.05% while, H1 had the highest culling rate and highest variation of between 0.4 and 20%. H3 had culling rates of between 1 and 4%. The major reasons for culling were dead-in-shell embryos in H1, omphalitis and physical abnormalities in H2 and physical abnormalities and dead-in-shell embryos in H3. The most probable causes of physical abnormalities, weak chicks and omphalitis are diseased breeder flocks or poor hygiene and sanitation in hatchery operations (Ernst, 1975).

The male to female ratio of breeding flocks in the study area was between 1:9 and 1:10, which are within the recommended ratio.

The source of breeding stock can be one of the major defining factors in determining chick quality. Even though, all 3 hatcheries sourced their flocks from the same geographical location, the difference in the levels of culls is an indication that other factors such as management, nutrition or disease may have played a role in poor hatching. The most important step in egg sanitation is the production of nest-clean eggs (Ernst, 1975). This requires the frequent collection of eggs. Egg collection in the study area was conducted on an average of 6 times daily which is considered adequate. In order to maximize hatchability, eggs must be stored in a room used only for that purpose and kept at a temperature of between 20 and 25°C for not longer than 3 days (Ruiz and Lunam, 2002). Several studies have shown that the ideal storage time should be between 3-4 days as hatchability declines if storage exceeds 3 days irrespective of storage temperature (Ruiz and Lunam, 2002; Shafey, 2004; Tona *et al.*, 2004). All hatcheries in the study complied with this recommended storage time. But H1 also collected eggs from other farmers without consideration to their storage conditions. This mixing of eggs from different sources could be a potential source of contamination of chicks, poor hatchability and high culling rates and may have been responsible for the high culling rates observed in H1.

The source and quality of feed for breeding flock also has an impact on the quality of chicks produced. Self-compounded feed may be of a higher quality than commercial feed as both quality and quantity of micronutrients can be accurately determined and included. However, if the feed is not well-compounded or well-mixed and stored the advantage of self-compounding could be lost. The quality of commercial feed used in H1 could also have played a role in the high culling rates experienced in this hatchery.

The four main sources of contamination in any hatchery

are said to be people, equipment, air and eggs (Ernst, 1975). Therefore eggs improperly handled on the farm can be an important source of contamination. Eggs are laid warm and as they cool, their contents contract and any bacteria on the shell will be drawn into the interior through the pores (Haynes and Smith, 2003). It is therefore necessary to disinfect eggs as soon as they are collected while the egg is still warm. High temperatures also encourage bacterial growth and may be a potential source of egg-contamination prior to setting. Contamination could also occur at the time of internal pipping on the 19th day of incubation or through the contamination of unhealed navel during or after hatching (Shane, 1999). Lower standards of hatchery hygiene may also result in a deterioration of chick quality manifested as omphalitis, Aspergillosis or colibacillosis (Shane, 1999). The storage conditions in H2 (18°C) may have been responsible for the low culling rates observed in this hatchery.

The location of breeding flocks in relation to hatcheries is an important aspect in disease control in hatchery management as breeding flocks may serve as potential sources of disease transmission to the hatchery (Bailey *et al.*, 2006). Although, H1 is located far from its breeding farm, it had the highest percentage of culls attributed to dead-in-shell embryos. This may have resulted from contamination of egg cases, vehicle or workers probably during transportation as some of the staff working on the breeding farm also worked in the hatchery.

The most commonly used disinfectants in the hatchery are quaternary ammonium compounds, phenolics and iodophores (Haynes and Smith, 2003). In the study area formaldehyde was commonly used in combination with iodine in H2 and H3 and all the three hatchery operators believed that applying disinfectants alone was sufficient sanitation. This view is contrary to the general recommendation that the use of disinfectants should be combined with the use of water, detergent and thorough cleaning.

Conclusion: The aim of this survey was to obtain baseline data on specific aspects of the hatchery production system and investigate chick mortality at hatching in the area under study. This information can be used by extension staff for the training of hatchery operators with the view to improving chick quality in Nigeria. Although, only 60% of hatcheries in the area were studied, the results can be considered representative of the general production pattern of hatcheries in Jos. The high rates of culls experienced in this study suggest that there is considerable room for improvement in hatchery operations particularly with regards to sanitation. Adequate training of hatchery operators in understanding the crucial role hygiene plays in ensuring high chick quality is needed. A system of monitoring of microbial levels in the hatchery is an

important tool for effective disease control. Capacity-building by relevant authorities to promote the submission of culled chick samples to the laboratory for proper investigations for fungi such as *Aspergillus* and for bacteria such as *Salmonella*, *E. coli* and *Pseudomonas* is advocated. Culling standards for defective chicks should be established. To maintain efficient operations hatchery operators need to maintain proper records.

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