Fertility and Hatchability of Fayoumi and Dominant Breeds of Chicken in Debre Zeit Agricultural Research Centre, Ethiopia.

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ABSTRACT

An experiment was conducted to assess the effects of egg weight on hatchability and fertility and to evaluate fertility, hatchability, and associated traits between Fayoumi and Dominant breeds of chicken in Debre Zeit Agricultural Research Centre from November, 2011 to March, 2012. Simple random sampling technique was employed to select 288 hatching eggs; 144 eggs from each parent stock of Fayoumi and Dominant breeds were set into the incubator. According to the finding, fertility and hatchability was highest for Fayoumi breed than Dominant breed. Breed difference has no significant effect on fertility, though, there is difference in fertility between the two breeds. Early embryonic death is highest for Fayoumi. This difference is statistically significant (p<0.05). Late death is highest for the Dominant breed. This is highly significant (p<0.01). Death after hatching is highest for the Dominant breed. Post hatch performance of chick is not affected by breed. Egg size has significant effect on the fertility of egg (p<0.05). Infertility is highest for larger eggs than the smaller one. Early and middle death of embryo was not affected by egg size but there was significant difference in late death of embryo (p<0.05). Post hatch performance of chick was not affected by egg size. Finally, breeds having better fertility and hatchability, proper egg handling and nest hygiene were recommended.

Key words: Chicken, Debre Zeit, dominant breed, fayoumi, fertility, hatchability.

INTRODUCTION

The world poultry population has been estimated to be about 14 Billion heads (FAO, 2000). Poultry production in tropical countries is based on the traditional scavenging system and chickens are the most important poultry species. The shares of family poultry from the total poultry population in developing countries in general and in Africa is particular and are not well documented but has been estimated to reach 70 to 80% of the total population (Gueye, 2000). Developing countries in most case go for high performing commercial breeds from developed countries to increase animal productivity through cross breeding or if conditions are allowed by breed substitutions without properly investigating the production system and potential of the indigenous birds (Hodges, 1990). The low productivity of local birds coupled with the infancy of the commercial sector (only contribute less than 10% of the total poultry and poultry products) has resulted in a low supply of poultry meat and eggs to the nation. The major reasons for the low poultry productivity are a low standard of management and a low performance of the indigenous chicken (Tadelle and Ogle, 2000).

Like in most developing countries, poultry production in Ethiopia plays a very important role as being one of the main sources of protein and income generation (Alamargot, 1987). The recent estimate of the Ethiopian poultry population is about 65 million (FAO, 2000). In Ethiopia, it appears that improved breeds kept under
intensive management systems are increasing in number. This is mainly because of the privatization of the existing state poultry farms and the emergence of a number of small-scale poultry farms, especially in and around the capital Addis Ababa and Debrecen (Aleme and Tadelle, 1997).

There are a number of factors affecting chick quality from fertilization of the ovum to placement of the day old chicks at the broiler farm. Some of these factors can be controlled while others cannot. From the point of fertilization to the start of incubation the physical quality of the egg, the stage of development of the embryo at oviposition, the time taken and the conditions prevailing between oviposition and storage and the storage conditions of the incubating eggs all need to be considered. It is important to emphasize that good quality egg, incubators, and management need to be set at very high standards to maximize chick quality (Decuypere et al., 2001).

There are 3 periods of embryonic mortality: early, middle, and late. The early dead embryo mortality period represents the eggs that die during the first seven days of incubation. The death is usually a result of failure of the embryo to resume development after having been stored and placed in the setter. The mid dead embryo mortality period represents the eggs that die between day 8 and 14 of incubation. The death is usually related to nutritional deficiencies in the broiler breeder diet or embryonic abnormalities. The late dead embryonic mortality period represents the eggs that die during the last week of incubation. In this case, death is often due to abnormal positioning, complications in physiological changes and lethal genes (North and Bell, 1990).

Hatchability can also be impaired when the machine temperatures fluctuates (Lourens et al., 2005). Too low an incubation temperature often leads to dead but piped, large staggered chicks. The hatch is normally late and prolonged because the chicks do not dry off normally. In addition, reports that too high an incubation temperature can also lead to dead, piped embryos or chicks, which are small and sticky with a high incidence of unhealed navels. Often these chicks have deformed toes. Overheating in both setters and hatchers are one of the biggest reasons for down grading chicks (Deeming, 2000). Environmental temperature for the highest hatchability lies within the range of 37 to 38% and that tolerance to deviations to this temperature is a function of the duration to these exposures and to the stage of development (Decuypere et al., 2001). A significant and negative association of mortality with net profit, suggesting that increase in mortality would result in a decrease of net profit (Faroq et al., 2001).

Several factors influence hatchability of eggs like pre-incubation, storage time, fertility and incubation condition such as temperature, humidity, ventilation, position, egg turning and candling. Variation in feed composition resulted in variation in hatchability (Mussadeq et al., 2002). Egg production and hatchability of broiler hatching eggs were the parameters most influenced by the flock, environmental temperature and laying hens' stock (Al-Bashan and Al-Harbi, 2010). Apart from these, other factors that can have considerable influence on hatchability include nutrition of the breeding hen, genetic constitution of the embryo, disease, egg size, age and shell quality (Kingoriani, 2011). Egg weight, fertility, hatchability, and late embryonic mortality varied greatly between feed regimes (Lariviere et al., 2009). Similarly, the fertility of an egg is affected by factors directly related to the laying hen such as her ability to mate successfully, store sperm, ovulate an egg cell and finally, produced a suitable environment for the formation and development of the embryo (Brillard, 2003).

Little has been done on comparative fertility and hatchability of available breeds including local ecotypes (Mebratu, 1997). Fertility and hatchability are the major determinant of profitability in the hatchery enterprise (Peters et al., 2008). These parameters appear to be very important as far as parent stocks are kept to produce final hybrids. Therefore, this study was conducted: (i) to evaluate fertility, hatchability and associated traits between Fayoumi and Dominant chicken breeds (ii) to assess the effects of egg weight on hatchability and fertility.

MATERIALS AND METHODS

Study area description

The study was conducted in Debre Zeit Agricultural Research Centre (DZARC) between November, and March, 2012. The area has an annual rainfall of 866 mm of which 84% is in the long rainy season from June to September. The dry season extended from October to February. The mean annual maximum and minimum temperature are 26 and 14°C respectively, with mean relative humidity level of 61.3%. The study area has an altitude of 1850 m a.s.l. Farmers in the vicinity of Bishoftu town use a mixed crop and its surroundings have variable and representative agro-ecologies of the country. These agro climatic zones are inhabited with different plants and animal species (NMSA, 2011).

Study population and sampling method

Simple random sampling technique was followed to include 288 eggs of Fayoumi and Dominant breeds to investigate fertility and hatchability. Equal numbers of
eggs were taken from the Fayoumi and Dominant breeds of chicken, that is, 144 eggs from Fayoumi and 144 eggs from the Dominant breed.

**Study design**

An experimental design was followed to evaluate fertility and hatchability in Fayoumi and Dominant breeds of chicken from November, 2011 to March, 2012 in Debre Zeit Agricultural Research Centre. A total number of 288 eggs were selected randomly in order to study fertility and hatchability in Fayoumi and Dominant breed. Fertility and hatchability of eggs were determined based on fertile eggs and hatched out chicks. Infertile eggs were detected by candling method. Eggs, which failed to develop embryo were regarded as infertile eggs. Candling to detect fertility was done after a week of incubation. Fertility was detected using the formula:

\[
\text{Fertility} = \frac{\text{No. of fertile eggs}}{\text{No. of total eggs}} \times 100
\]

The term hatchability is used by poultry men on the basis of total set for incubation. Hatchability was detected as the percentages of eggs hatched out. Hatchability of the chicks has been calculated using the formula:

\[
\text{Hatchability} = \frac{\text{No. of hatched out chicks}}{\text{No. of total eggs}} \times 100
\]

**Egg collection and storage**

Prior to egg storage the eggs in each group were divided into 3 (>50 g large, 45 to 50 g medium and 42 to 44 g, small). Eggs were then stored for 7 days in a cool room at approximately 17°C and 75 relative humidity. The hatching eggs were then fumigated with potassium permanganate and Formalin before set.

**Incubation and setting to hatchery**

The incubator was set at 37.8°C with a RH of 55% for 21 days. Eggs were turned 90° hourly up to day 15. After 21 days of incubation, eggs were transferred to the Hatcher and set at 37.5°C with 75% relative humidity.

**Candling**

Eggs were candled on the 7th and 14th days of incubation to identify and remove infertile and eggs with dead embryos (dead in germ). The eggs which failed to develop embryo were regarded as infertile eggs. The rest of the eggs were transferred from the setter to the Hatcher on the 18th day of incubation and later on the 21st the Hatcher was opened.

**Statistical analysis**

During the study, the breed and weight of each egg was recorded and stored in a Microsoft Excel spreadsheet. The result of hatchability, fertility, embryo mortality, and post hatch performance of chicks were also added to the spreadsheet. The data was analyzed by STATA Microsoft (version 11.0). Descriptive statistics such as percentages and chi-square ($\chi^2$) tests were conducted. In all the analyses $P<0.05$ was set for significance.

**RESULTS**

Mean fertility was 95.1% for Fayoumi and 91.6% for the Dominant breed. There was no significant difference in fertility between the two chicken breeds. Mean hatchability was 86.8% for Fayoumi and 51.4% for the Dominant breed. There was significant difference in hatchability between the two breeds of chicken (Table 1). Among the eggs set to the incubator, the number of eggs unfertile in the case of Fayoumi breed was 7(4.86%) in number and 12(8.3%) in Dominant. This is not statistically significant ($P>0.05$) but there was statistically significant difference ($P<0.05$) between the two breeds of chicken eggs and early embryonic death. Early embryonic death in Fayoumi breed 4(2.8%) was higher than in the Dominant breed 0(0%) (Table 2). Egg weight has significant difference on fertility of chicken and late embryonic death ($p<0.05$). However, there was no statistically significant difference between egg weight and early and middle embryonic death and death after hatch and weak chick ($P>0.05$). Highest infertility rate was observed in larger eggs 10(12.3%) than the smaller eggs 2(3.1%). Late death

**Table 1. Fertility and hatchability in two breeds of chicken.**

<table>
<thead>
<tr>
<th>Breed</th>
<th>No. of eggs examined</th>
<th>Fertility</th>
<th>Hatchability</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fayoumi</td>
<td>144</td>
<td>95.1%</td>
<td>86.8%</td>
<td>0.003</td>
</tr>
<tr>
<td>Dominant</td>
<td>144</td>
<td>91.6%</td>
<td>51.4%</td>
<td></td>
</tr>
</tbody>
</table>
was 24(29.6%) and 10(15.3%) in larger and smaller eggs respectively (Table 3).

**DISCUSSION**

The finding of this study showed that breed difference has significant effect on different hatchability parameters and fertility. This has conformity with the study of Durmus et al. (2010) which states that late period embryonic mortality, hatchability of fertile eggs and early embryonic mortality differs between genotypes. Islam et al. (2002) also showed that difference in breed had significant effect on the different hatchability parameters as these characters are genetically controlled. Jull (1951) also reported genetic constitution had some effect on the hatchability performance of eggs. This study is therefore in line with the finding of this study that hatchability performance of eggs depends on genetic factors in addition to others.

Kamphues et al. (2001) also indicated that hatchability is influenced by genetic factors. According to this study, fertility is not affected by breed difference. Rahman (1995) indicated that hatchability and fertility is mainly affected by environment. In addition to inappropriate incubator conditions, increases in embryo deaths early in incubation can be indicative of inappropriate egg handling procedures, pre-incubation storage conditions and dietary toxins. Deaths in the middle period (8 to 18 day in chickens) are usually few. Any increases during this period are usually ascribed to nutritional problems notably vitamin or mineral deficiency (Leeson and Summers, 1991).

In addition to breed difference, egg weight has also its own effect on hatchability and fertility. Hatchability, hatching time, embryonic mortalities, chick weight at hatch and chicks developmental performance at post hatch period is directly affected by hatching egg weight (Baspinar et al., 1997). Both high and low water losses increased embryo mortality in the latter half of incubation. High water losses can obviously result in death of the embryo through dehydration, whilst low water losses are indicative of low conductance eggshell that probably contribute to embryo deaths through asphyxiation. The weight and composition of the chick is affected further by the time between hatching and removal from the Hatcher and this time affects post-hatching performance of the chick (Wyatt et al., 1985).

According to this study, larger egg has lower fertility and hatchability followed by medium eggs. Smaller egg has good fertility and hatchability. This result is consistent with Ogunshile and Sparks (1995); French (1997) result stated that larger egg has got increase in late mortality of embryo. An explanation for increased late embryonic mortality due to increasing egg size was that larger eggs would be expected to have greater difficulty initially achieving adequate embryonic temperature and then losing embryonic metabolic heat during later incubation (Lourens et al., 2005). Malago and Baitilwake (2009) also indicated that late embryonic mortality, fertility and hatchability in heavier egg are higher as compared to lighter eggs.

Caglayan et al. (2009) reported an idea contrary to this study, higher fertility rate of heavy group eggs compared to lower and medium egg weight groups. Late deaths can
indicate problems with the incubator environment, including egg turning (if many embryos are in malpositions) and mold growth (Aspergillus). In turkeys, hatchability can be reduced if the breeder flock is infected with Mycoplasma iowae that can be passed into the egg by the female or transmitted through semen from infected males. The organism is embryo pathogenic and losses of 2 to 5% in hatchability would be normal with the embryos being killed from 18 days of incubation onwards (Kleven, 1991).

Fertility also depends on the ability of cock to mate successfully, quantity and quality of semen deposited (Brillard, 2003; Gheisari et al., 2011). Furthermore, previous studies have shown that very large eggs did not hatch as well as very small eggs (Ogunshile and Sparks, 1995). Although, there could be maternal effects and fertility could differ between large and small eggs, French (1997) found that as egg mass increased thermal conductance did not increase proportionally, so larger eggs would be expected to have greater difficulty losing embryonic metabolic heat as well as, greater difficulty gaining heat during the initiation of incubation (Lourens et al., 2005). When large and small eggs were incubated under similar conditions, large eggs exhibited higher temperatures during later incubation (Meijerhof and van Beek, 1993; Meijerhof, 2002). French (1994) found turkey hatchability to progressively decrease with increasing egg size at high air temperature (38.5°C) but that large eggs exhibited improved hatchability when incubated at a reduced air temperature (36.5°C) during the second half of incubation mainly due to a decrease in late embryo mortality.

CONCLUSIONS AND RECOMMENDATIONS

From the current finding, it is concluded that breed had significant effect on fertility and hatchability. In addition to breed difference, egg weight has significant effect on fertility and hatchability. The result indicated that small egg ranging in size between 42 and 45 g would be suitable for setting in order to get good hatchability and fertility. Based on the aforementioned conclusion, breeds have better fertility and hatchability, proper egg handling and nest hygiene, measurement of fertility and hatchability while introducing new breeds are crucial to overcoming the shortage of poultry products. In addition, improving the local chicken by crossing with improved exotic breeds for genetic improvement was recommended.

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