Fertility and Hatchability of Eggs of Horasi Chicken Ecotype Collected Under Farmer's Condition in Central and Lake Zones of Tanzania

Buliro, A.B., S.H. Kafuku, E.H. Goromela, C. Mpemba, A. Mtambuki, O. Robert, M. Chando and M. Mwanibanza

Tanzania Livestock Research Institute (TALIRI) P.O. Box 1425, Mtwara, Tanzania

*Corresponding author's e-mail: *aminaburilo@gmail.com;* Phone: +255 789 283 183

Abstract

A study was conducted to determine the fertility and hatchability of Horasi chicken eggs collected from farmers in three districts in Tabora region (Uyui, Nzega and Urambo), and three districts in Shinyanga region (Kahama, Ushetu and Msalala). Then eggs were packed, transported and hatched at Msigani Poultry Farms and Hatcheries in Dar es Salaam. A total of 12,141 eggs were set for hatching in three batches based on arrival at the hatchery and chicks hatched out from the eggs after 21 days of incubation period. After candling on the 7th day, breakout was performed on the candled clears and on day 23, breakout was performed on the eggs which did not hatch. Fertility was high in batch three (74.6%), followed by batch two (70.3%) and batch one (58.5%). Hatchability was high in batch one (43.3%), followed by batch two 27.3%, and batch three (18.8%). Both fertility and hatchability did not vary significantly between three batches. It was concluded that fertility and hatchability were generally poor; dead in germ and mortality were also high. Differences in managerial practices and transport of eggs for long distances may have contributed also to these results.

Keywords: Break out analysis, Embryo mortality, Pips, Horasi eggs

Introduction

Chicken has been recognized as the entry point to address the problems of malnutrition, food insecurity, low income and poverty as a whole (Ekka *et al.,* 2016). Tanzania is endowed with over 72 million chickens out of which 40 million are local chickens and the remaining 32 million are exotic poultry, which include 24 million broilers and 8 million layers (NBS, 2018). Local chickens are the mostly kept in the traditional system and supplies most of the poultry meat and eggs consumed in rural areas and about 20% in urban areas (MLD, 2006). Their special features are scavengers; high disease tolerance, late maturity with higher fertility (Desha *et al.,* 2015). These features are the key influencers for consumer preferences to both meat and eggs, and hence higher prices compared to exotic breeds. Findings from various studies have revealed the existence of considerable variation between different indigenous chickens for both eggs and meat production (Katule, 1991).

Horasi chicken ecotype is one of the local breeds in Tanzania that has shown to perform better both in meat and egg production (Guni *et al.,* 2013). Scientists has shown interests in improving the performance of Horasi ecotype by increasing genetic potential through planned breeding programs, such as mass selection. Desha *et al* (2015) have revealed that to increase the genetic potential of indigenous chicken, planned breeding program is necessary, that can allow researchers to develop strains with specific traits for improved productivity and efficiency (Wilson *et al.,* 2018). However there is scanty information about performance of Horasi ecotypes, which are main aspects of breeding program. Therefore this study was conducted in order to investigate the fertility and hatchability of Horasi chicken eggs collected under farmer's conditions.

Materials and Methods

Description of the study area

The study was conducted at Msigani Poultry Farm and Hatchery in Dar es Salaam. The hatchery is located at Latitude 6°48'S and Longitude 39°17'E. The average annual temperature in Dar es Salaam is 26.1°C and the area receives up to 1114 mm of rain annually.

Egg collection and transportation

The Horasi chicken eggs were collected from a total of six districts, of which three districts were in Tabora region (Uyui, Nzega and Urambo) and three districts in Shinyanga region (Kahama, Ushetu and Msalala), where Horasi chicken ecotype is commonly found. Hatching eggs were purchased from farmer's flock in which the storage conditions and egg handling from the farmers were not known, but the storage length was less than four days from being laid. The collected eggs were packed in trays and transported by using a public bus from a common point, Kahama, to Dar es Salaam which is about 977 km; and the journey took about14 hours to reach the Hatchery. Eggs were collected, packed and transported in three batches.

Incubation, candling and hatching

A total of 12,141 eggs were incubated in three batches of 3,613 eggs (batch one), 5,310 (batch two) and 3,218 (batch three). The incubation temperature, humidity and turning were monitored and adjusted according to the recommendations of the manufacturer. Incubation temperature was 37.50°C, relative humidity was 65%, and turning was automatic after every one hour. Egg candling for fertility and breakout analysis was done on the7thday of incubation in a dark room to remove infertile eggs and early embryonic deaths from fertile eggs. The fertile eggs were seen to be densely clouded and opaque with a network of veins indicating embryo development within the egg while the infertile eggs were translucent under light. Then fertile eggs were transferred to a Hatcher at 18 days of incubation. Breakouts on candled clears and hatch debris were performed at day 7, and at the end of the incubation period respectively. After candling on the 7th day, breakout was performed on the candled clears and they were categorized as; infertile clears (representing infertility), positive developments, blood rings and dead embryos, blastoderm without embryo and rotten eggs. On day 23, all trays were removed out containing hatch debris, and breakout was performed on the eggs which did not hatch. And they were categorized as; pips which included the number of eggs of those embryos attempted breaking out with their beaks but were not successful and died in shells, live embryos in shells included the number of eggs in which the embryos were still in eggs and alive, and died in shells included the number of eggs in which the embryos were still in eggs and died.

Data collection

Data on fertility, hatchability and breakout analysis findings of all collected eggs were recorded. Fertility was calculated on the basis of total eggs set, whereas hatchability was calculated on the basis of total fertile eggs set. The egg fertility and hatchability of fertile egg set were calculated by using the following formulae:

$$fertility\% = \frac{Number\ of\ \ fertile\ eggs}{Total\ number\ of\ \ eggs\ incubated} \times 100\% \quad (1)$$

$$Hatchability\ of\ \ fertile\ eggs\ set\% = \frac{Number\ of\ \ eggs\ hatched\ out}{Total\ number\ of\ \ fertile\ eggs} \times 100\% \quad \mathbf{(2)}$$

Data analysis

Data collected were entered in Microsoft excel worksheet and the descriptive mean of fertility and hatchability of fertile eggs for each batch, and other parameters observed during breakout analysis were calculated.

Results

Candling and breakout analysis

The incubation results and findings of breakout analysis of candled clear eggs of Horasi chicken ecotype are presented in Table 1. Percentage fertility was higher for batch three, followed by batch two and batch one. The percentage of the infertile clears was also high in batch three compared to batch one and two which was almost similar. These eggs were not fertilized and showed no development. The percentage of positive developments was higher in batch three and almost the same in batch two

and one. However it was higher in both batches as compared to the normal range of 1 to 2% of all candled clears.

Blood rings and dead embryos were much higher in batch one compared to batch two and three. These eggs showed a ring of blood outlined on the inner surface of the shell and some of them contained fairly advanced embryos that have died only recently. Blastoderm without embryos were very high in batch two, followed by batch one and batch three. These eggs indicated dead and abnormal embryo from the fertile eggs, but they lacked any visible embryo structures, hence indicating that they were blastoderm without embryos. There were also significant number of eggs found with Live and healthy embryos from the candled clears in all three batches, these eggs had Living normal embryos with clearly defined blood vessels with no hemorrhagic areas evident, some body movement when stimulated and a generally health appearance.

Significant number of rotten eggs was also found with minimum variation between the three batches, which included smelly eggs, exploding eggs, and those with their contents curdled. Some eggs had black liquid around the embryos caused by non-microbial contaminants as a result of normal breakdown of tissue after death.

Hatchability and egg breakout analysis

The hatching results and findings of break out analysis of unhatched eggs are presented in Table 2.

The average percentages of live embryos well developed that could not hatch and were found alive and healthy in shells, Pips that included eggs in which the chick has broken the shell in an attempt to hatch but failed and died immediately or remained alive for more than 24 hours were high in all batches.

The percentage of unhatched eggs with undefined structures and unpleasant smell indicating that, embryos had died at the middle (third stage) of the incubation before transfer to Hatcher (7 to 14 days) was higher in batch three

Table1: Candling breakout analysis

SN	Parameters	Percentage (%)			
		Batch 1	Batch 2	Batch 3	Average
1	Fertility	58.5	70.3	74.6	67.8
2	Eggs with live embryos	2.5	3.2	0.4	2.0
3	Positive developments	2.7	2.9	16.2	7.3
4	Eggs with blastoderm without embryos	22.7	43.7	5.1	23.8
5	Eggs with blood ring and dead embryos	25.3	6.9	4.4	12.2
6	Infertile clears	45.7	43.2	73.4	54.1
7	Rotten eggs	1.1	0.1	0.5	0.6

Table 2: Hatchability and egg breakout analysis

SN	Parameters	Percentage (%)			
		Batch 1	Batch 2	Batch 3	Average
1	Hatchability	43.3	27.3	18.8	29.8
2	Pips alive	6.6	2.3	1.4	3.4
3	Pips dead	0.2	0.9	0.5	0.5
4	Live embryos in shells	10.7	23.5	0.3	11.5
5	Dead in shells and wet	21.7	32.4	19.5	24.5
6	Dead in shells and dry	1.2	0.9	0.2	0.8
7	Unhatched eggs with undefined features with unpleasant smell	54.3	40.1	78.2	57.5

compared to batch one and two.

Discussion

Candling and breakout analysis

Average egg fertility was low in all batches, probably due to the fact that eggs were collected from farmer's flocks, whereby managerial activities such as feeding, mating, vaccination and treatments are inadequateand uncertain mating ratio of female to male. It has been documented that the presence of dominant but non fertile cocks in the flock may prevent the fertile but less dominant cocks from mating thereby reducing the fertility and hatchability.

Also, findings from Onasanya and Ikeobi (2013), showed that high ratio of female to male results into decline of fertility because the cock will have more than necessary hen to mate with, hence the more the number of hen mated by a cock, the poorer the fertility of the sperm cells which in turns affects or cause decline in egg fertility.

Positive developments in all batches were also high, this could be due to improper storage, temperature fluctuation and abuse during transportation.Studies by Fasenko *et al* (2007) and Onasanya and Ikeobi (2013) indicated that higher percentages of positive development are associated with improper handling of eggs, improper storage of eggs and temperature fluctuations. Temperature variation can affect embryo development, hatchability and post hatch growth, as at some temperatures embryo development may start and some temperatures development may stop and hence the embryo may die as a result positive develops with early embryo death will increase.

Blood rings and dead embryos and blastoderm without embryos observed were associated with the effect of temperature variation during embryo development. Since the storage temperature at farms was not monitored as well as transportation temperature, it is possible that temperature fluctuation was high and hence resulted to high embryo mortalities. Eggs that had a form of embryonic mass upon break-out were categorized as fertile eggs with embryo mortality (Adebisi and Ewuola, 2019).

Live embryos in shells were found in all batches, these eggs were misinterpreted or overlooked as infertile clears while they were fertile and they contained health and well-developed embryos. This may have been contributed by inefficient egg candling equipment and workers.

Rotten eggs could be due to egg contamination. Eggs may be contaminated during egg collection, handling and cleaning, and normally the higher the number of contaminated eggs the higher the number of rotten eggs. Thus it is possible that, these eggs were contaminated from farms, during collection and packaging, and also during transportation.

The positive developments, blood ring and dead embryos, blastoderm without embryos are fertile eggs with embryo development that never took place were high in all batches; this could be due to improper managerial aspects, egg handling and transportation effects. And sometimes high early dead embryo mortality can be misinterpreted as low fertility. Thus, if all the managerial and egg handling aspects would have been monitored, most of these eggs if not all of them would have hatched into chicks.

Hatchability and egg breakout analysis

The average hatchability of Horasi chicken eggs of the three batches in this study was lower compared to that reported by Kalita *et al* (2009) in Assam (70 - 81%), Desha *et al* (2015) in Bangladesh (77.52%), Mbuthia *et al* (2007) in Kenya (66.2%) and in Egypt (77.68%) as reported by Kosba and Abd El-Halim (2008) (Table 2). Poor hatchability could be due to the fact that critical factors for ensuring balanced feed, proper collection and cleaning of eggs for hatchability purpose were not taken care at farmer's farms. Other factor might be insufficient nutrients in the egg and exposure to conditions that do not meet the needs of the developing embryo, egg size and incubation temperature.

There was a significant number of live embryos well developed that could not hatch and they were found alive and healthy in shells and pips that included eggs in which the chick has broken the shell in an attempt to hatch but failed and died immediately or remained alive for more than 24 hours. These anomalies could have been contributed by factors which

include machine temperature, relative humidity, and egg turning angle which negatively affect hatchability and reduce chick quality (Hamidu *et al.,* 2019). In the hatchery, several factors pertaining to equipment maintenance, incubator cooling, air flow patterns and other conditions may cause the embryo to overheat or cool down, and become over hydrated or dehydrated (Hamidu *et al.,* 2019).

Late mortalities were also high in all batches. This could have been due to the fact that not all egg management practices were monitored at farmer's conditions and during transportation. The storage time and conditions were also not monitored. Therefore, it is very possible that, these eggs were stored for more than 10 days before incubation and the storage conditions (ventilation, temperature) were unfavorable and hence high mortalities and poor hatchability. Khan *et al.* (2014) reported that more embryonic deaths occurred with a longer period of egg storage. The study also showed that the hatchability of fertile and all eggs decreased, and early-mid-late embryonic deaths increased from eggs stored for 9days, due to water loss and albumen degradation during storage (Khan *et al.,* 2014).

Conclusion

There are several factors that contribute to notable success and improvement of fertility and hatchability of eggs. What emerged from this study was that fertility and hatchability were generally poor. Dead in germ and mortality were also high due to the fact that these Horasi eggs were collected in different areas under varying farmers' conditions, where chicken managerial practices were not monitored. Moreover, the collected eggs were transported for long distance for many hours. For better results therefore the referred scenarios need to be avoided for improved fertility and hatchability of eggs from Horasi or other local chickens.

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