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Embryonic and Chick Mortality of Four Native Japanese Chicken Breeds

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Abstract: The objective of the present study was to survey embryonic and chick mortality in native Japanese chicken breeds (Onaga-dori; ONA, Tosa-jidori; TJI, Ukokkei; UKO and Hinai-dori; HNI). The embryonic mortality for each breed was 45.7 (ONA), 51.7 (TJI), 42.9 (UKO) and 26.7% (HNI), throughout the incubation period. The ONA and TJI were found to show high mortality at the early embryonic stage (1-7 days) and it accounted for approximately 70% of total embryonic mortality. In the UKO, high mortality was detected at both the early and late (15-21 days) stages of incubation. Total chick mortalities up to 10 weeks of age were 68.0 (ONA), 62.8 (TJI), 26.4 (UKO) and 6.0% (HNI). In the ONA and TJI, higher mortalities were observed during the 2nd and 3rd week periods of life and reached more than half of their mortalities. The UKO was found to show the highest mortality during the 1st week of life. The HNI exhibited no specific mortality trends throughout the experiment period. These results suggest that embryonic and chick mortalities in Japanese chicken breeds are controlled by genetic factors. Changes in the management routines for each breed might reduce embryonic and chick mortalities and lead to the conservation of these rare Japanese chicken breeds.

Key words: Embryo, chick, mortality, Japanese native chicken, incubation, Japan

INTRODUCTION

Japan has a great variety of indigenous chicken bioresources. There are approximately 50 breeds of native chickens in Japan and almost all of them were developed for special plumage, crowing and fighting traits (Tsudzuki, 2003). In the past, these breeds were hardly used for egg and meat production although, they have good quality eggs and meat. Thus, they are valuable genetic resources for improving commercial chickens. In fact, new meat type chickens have been produced in some prefectural livestock research institutes using native Japanese chickens (Kubo *et al*., 2009). However, the population sizes of some indigenous chicken breeds have declined rapidly due to the reduction of breeders by aging and/or depopulation in rural areas and lack of government attention to the indigenous gene pool.

For the conservation of native Japanese chickens, it is useful to assess the mortality predominantly occurring during incubation and early age of life. Embryonic and early deaths pose a great challenge to scientists and breeders and are also a matter of great concern from both biological and economic points of view. However, few investigations have been published indicating the characteristics of native Japanese chickens on embryonic and chick mortality. The aim of this study was to survey the embryonic and chick mortality of four Japanese indigenous chicken breeds in order to preserve valuable indigenous bioresources for improving commercial chickens.

MATERIALS AND METHODS

Chicken breeds: The data were collected from four Japanese indigenous chicken breeds namely Onaga-dori (ONA), Tosa-jidori (TJI), Ukokkei (UKO) and Hinai-dori (HNI).

Embryonic mortality: The number of fertile eggs used for data analysis was 604 (ONA), 184 (TJI), 168 (UKO) and 105 (HNI). All eggs were collected from chickens reared at the institute, stored at 15°C within 10 days and incubated in a Murai MIC-14C incubator (Murai Incubator Co., Nagoya, Japan) the temperature and relative humidity of which were 37.7±0.2°C and 65±5%, respectively. Candling was performed at 7 and 14 days of incubation and fertility and/or mortality of embryos were investigated. At 22 days of incubation, unhatched eggs were opened and embryo

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death was determined. The embryonic death stage was classified into three categories that is early (1-7 days), middle (8-14 days) and late (15-21 days) stages.

Chick mortality: The number of chicks used for data analysis was 175 (ONA), 86 (TJI), 87 (UKO) and 67 (HNI). At 22 days of incubation, newly hatched chicks were wing-banded for individual identification and transferred into a brooder (Zenkei-GS44 type, Zenkeien Manufacturing Co. Ltd., Hamamatsu, Japan) adjusted at 30°C with additional space to where chicks can move if they feel excessive heat.

About 24 h lighting was provided to the chicks during the observation period. Standard commercial starter (0-6 weeks: CP, 20%) and grower (7-10 weeks: CP, 17%) diets were provided *ad libitum* and the birds had free access to water. All chicks from different breeds were subjected to similar managerial conditions. Mortality was recorded daily and summarized as each 1 week period up to 10 weeks of age.

The handling of birds was performed in accordance with the regulations of the Animal Experiment Committee of Hiroshima University.

RESULTS AND DISCUSSION

Embryonic mortalities in fertile eggs of native Japanese chicken breeds are shown in Table 1. The ranking in order of total embryonic mortality was TJI (51.7%)>ONA (45.7%)>UKO (42.9%)>HNI (26.7%). For all breeds, mortality at the middle stage was lower than other stages. Although, approximately 70% of total mortality were observed at the earlier stage in the ONA and TJI, high mortality was found at both the early and late stages in the UKO.

Table 2 shows the chick mortality of each breed during the first 10 weeks of life. Differences between breeds were also observed in the chick mortality as in the case of embryonic mortality. The ranking in order of total chick mortality was ONA (68.0%)>TJI (62.8%)>UKO (26.4%)>HNI (6.0%). In the ONA, cumulative mortality during the 2nd and 3rd weeks of age was especially high (52.9% of total mortality) and thereafter the mortality gradually decreased toward the end of the observation period.

A similar tendency was found in the TJI: the mortality during these early periods (57.4% of total mortality) was higher than those in other periods. On the other hand, in the UKO, the highest mortality (43.5% of total mortality) was observed within the 1st week period.

The HNI exhibited no specific mortality trends throughout the experiment period. In general, embryonic

Table 1: Embryonic mortality in fertile eggs of native Japanese chicken breeds

Stages (days)	ONA (n = 604)	TJI (n = 184)	UKO (n = 168)	HNI (n = 105)
Early (1-7)	197 (32.6)	66 (35.9)	31 (18.5)	13 (12.4)
Middle (8-14)	24 (4.0)	2 (1.1)	4 (2.4)	6 (5.7)
Late (15-21)	55 (9.1)	27 (14.7)	37 (22.0)	9 (8.6)
Total	276 (45.7)	95 (51.7)	72 (42.9)	28 (26.7)

ONA: Onaga-dori; TJI: Tosa-jidori; UKO: Ukokkei, HNI: Hinai-dori; the number in parentheses is presented as a ratio (%) to the number of fertile eggs

Table 2: Chick mortality in native Japanese chicken breeds during the first 10 weeks of life

Period (weeks)	ONA (n = 175)	TJI (n = 86)	UKO (n = 87)	HNI (n = 67)
1st	7 (4.0)	6 (7.0)	10 (11.5)	1 (1.5)
2nd	35 (20.0)	15 (17.4)	3 (3.4)	1 (1.5)
3rd	28 (16.0)	16 (18.6)	2 (2.3)	0 (0.0)
4th	15 (8.6)	6 (7.0)	0 (0.0)	0 (0.0)
5th	15 (8.6)	5 (5.8)	4 (4.6)	0 (0.0)
6th	11 (6.3)	2 (2.3)	2 (2.3)	0 (0.0)
7th	4 (2.3)	1 (1.2)	0 (0.0)	1 (1.5)
8th	3 (1.7)	0 (0.0)	1 (1.1)	0 (0.0)
9th	0 (0.0)	1 (1.2)	0 (0.0)	0 (0.0)
10th	1 (0.6)	2 (2.3)	1 (1.1)	1 (1.5)
Total	119 (68.0)	54 (62.8)	23 (26.4)	4 (6.0)

ONA: Onaga-dori, TJI: Tosa-jidori; UKO: Ukokkei, HNI: Hinai-dori; the number in parentheses is presented as a ratio (%) to the number of newly hatched chicks

mortality in commercial chickens is highest with two peaks at about 3-5 days (25%) and again at about 16-21 days (65%) (Alcorn, 2008). This agreed with the results from native Japanese chickens wherein peaks of embryonic death occurred at the early and late stages (Table 1). However, the mortality at the early stage was higher than that at the late stage in Japanese native breeds, especially in the ONA and TJI. Early mortality is mostly linked to the age of the egg and sperm as well as to the conditions of egg conservation (Beaumont *et al*., 1997).

Because the conditions of incubation and conservation for each breed egg were similar in this study, there is a possibility that the age of the egg or the sperm may have resulted in the early mortality observed in the ONA and TJI. Early chick mortality is also the result of many interrelated factors such as genetic (Beaumont *et al*., 1999), managerial (Shanawany, 1988; van de Ven *et al*., 2009), nutritional (Xin *et al*., 1994; Tottori *et al*., 1997) and pathological factors (Ashraf *et al*., 2002). All these factors make the 1st week very crucial and chick mortality during the 1st week of life is considerably higher than mortality during the rest of the growing period (Xin *et al*., 1994; Heier *et al*., 2001, 2002). In the study, higher mortality was found during the 1st week period in the UKO. However, mortalities in both the ONA and TJI were quite high during the 2nd and 3rd week period of life but not during the 1st week period. These results suggest that genetic factors are predominant during the stage of chick death because managerial conditions were the same

for all breeds in the present study. Disregarding genetic factors, optimizing of rearing conditions depending on breeds might cause lower mortality because the heating and ventilation systems of poultry houses (uniform temperature and air movement) were associated with mortality during the second to 5th week (Heier *et al*., 2002). Interestingly, the embryonic and chick mortalities seen in the HNI were found to be lower than those in other breeds throughout the observation period although, all breeds were raised under similar conditions.

The reason for the low embryonic or chick mortality in the HNI is unclear but two hypotheses are offered. One is that management routines (e.g., temperature, humidity, feed and so on) in this study may have optimized the conditions for this breed while the other hypothesis is that the HNI may have genetically strong risk factors during incubation and early age. It has been reported that genetic factors are responsible for embryonic mortality (Liptoi and Hidas, 2006). Further research is needed to explain the robustness observed during incubation and early age.

CONCLUSION

Given the fact that management routines for all breeds were similar in this study, it can be assumed that there is a higher genetic variation responsible age dependent mortality in native Japanese chickens. The present result suggests that changes in the management routines to suite particular breeds might reduce the early mortality of rare Japanese chicken breeds.

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