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EFFECT OF SEASON ON FERTILITY, HATCHABILITY AND EMBRYONIC MORTALITIES OF CHICKEN EGGS UNDER HIGH ALTITUDE ENVIRONMENT AT GITEGA – BURUNDI*

(with 2 Tables)

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تأثير الموسم على الخصوبه والفقس والنفوق الجنينى فى بيض الدجاج تحت ظروف الرتفاع عن سطح البحر لمدينه جتيجا - بورندى

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أجرى هذا البحث بمزرعه الدواجن التابعه للمعهد العالى الزراعى بجامعه بورندى تقع مدينه جتيجا – بورندى بارتفاع ١٦٨٠م عن سطح البحر . تفريخ ٨٧١٧ بيضه من سلاله انتاج البيض (ساسو) والمستورده من فرنسا لانتاجها فى بورندى تم تفريخ البيض على ١٩ دفعه فى موسمين (موسم المطر وموسم الجفاف). تم تقسيم هذه الدفعات الى ١٢ دفعه فى موسم المطر وبلغ اجمالى البيض المفرخ ٥٨٣٠ بيضه و٧ دفعات فى موسم الجفاف وبلغ عدد البيض ٢٨٨٧ بيضه. أظهرت النتائج أن الموسم تحت ظروف الارتفاع عن سطح البحر فى مدينه جتيجا – بورندى لا يؤثر على نسبه الخصوبه ولا يوجد اختلافات معنويه بين الموسمين فى نسبه الخصوبه. نسبة الفقس كانت منخفضه عن تلك المعروفه عند سطح البحر ولا يوجد فرق معنوى بين الموسمين فى نسبه فقس البيض المخصب ويرجع الانخفاض فى نسبه الفقس عند الارتفاع عن سطح البحر الى نقص الاكسجين فى الجو من حيث ضغطه وتركيزه والى الاثار الضاره لثانى أكسيد الكربون والى بعض العوامل الوراثيه. أظهر النفوق الجنينى زياده ملحوظه بزياده مده التفرخ، وأن هناك فروق معنويه بين الموسمين بالنسبه للنفوق الجنينى فى المرحله الثانيه من عمر ١١ – ١٨ يوم وأعلى نسبه نفوق جنينى لوحظت خلال الثلاث أيام الاخيره من التفريخ وتزداد نسبه النفوق الجنينى بزياده النمو الجنينى ويوجد ارتباط معنوى وسالب بين اخصوبه والنفوق الجنينى فى الفتره الاولى ويوجد ارتباط معنوى جدا وسالب بين نسبه التفريخ للبيض المخصب وكل من النفوق الجنينى فى مراحله الثلاث. وينصح كنتيجه لهذه الدراسه باضافه نظم تهويه خاصه فى المفرخات الحديثه تحت ظروف مدينه جتيجا – بورندى وذلك لتحسين نسبه الفقس ولتقليل نسبه النفوق الجنينى اثناء عمليه التفريخ.

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SUMMARY

This research was carried out at the poultry farm of the Agriculture High Institute (Gitega), University of Burundi. Giteg-Burundi has an altitude of 1680 m over sea level. A total of 8717 eggs from egg-production strain "Sasso" imported from France to be introduced in Burundi were incubated in 19 batches in two seasons (rain and dry season). They were incubated as 12 batches in rain season (December-May) with a total of 5830 eggs and 7 batches in dry season (July-August) with a total of 2887 eggs. The results showed that there was no significant effect of seasons on fertility percentage under the high altitude environment at Gitega-Burundi. The hatchability of fertile eggs had low percentage than that known at sea level. No significant difference was detected between seasons for hatchability of fertile eggs. The reduced percentage of hatchability and high percentage of embryonic mortalities under the high altitude environment of Gitega may be due to oxygen hypoxia. The embryonic mortalities showed an increase as the incubation period progressed. There were significant differences between the two seasons for the second period of the embryonic mortality. The highly embryonic mortality was noticed at the last three days of incubation and the embryonic mortality increased as the embryos growth developed. There was a negative significant correlation between fertility and the first period of embryonic mortality and there were negative and highly significant correlations between hatchability of the fertile eggs and the three periods of mortalities. From this work it may be recommended that, to improve the hatchability percentage and to reduce the embryonic mortality, by specific additional ventillation system to increase the oxygen injection in the modern incubators under Gitega-Burundi environment.

INTRODUCTION

The hypoxia of oxygen is well known as a problem under high altitude environments. *FRISANCHO (1975) and NORTH (1978)*

pointed out that the partial pressure of oxygen in the atmosphere decreases proportionately as the altitude increases and the oxygen concentration is less than that at sea level.

THOMPSON (1952) showed that the hypoxia of oxygen at an altitude of 2230 m to 3280 m had no eefect on the reproduction of chickens. *North (1978)* indicated that the altitudes had no effects on the fertility of chicken eggs.

The hatchability of chicken eggs decreases as the altitude increases *(FRANCIS* et al., *1967 and FRANCIS, 1972)*. The low hatchability under high altitude may be refer to determinatal effects of carbon dioxide in the incubator *(SADLER* et al., *1954)*. The ability of chicken embryos to be grown decreases as the altitude increases and there were many determintal embryonic developments which lead to a marked depression in hatchability *(NORTH, 1978 and MORENG, 1983)*. *BOHREN* et al. *(1977)* suggested that the differences observed in hatchability between low and high altitude locations may be due to some genetic factors. The chicken embryos in the high altitude environment could be adapted to the oxygen hypoxia by reducuing the metabolic rate *(WANGESTEEN* et al., *1974 and PAGANELLI* et al., *1979)*. This adaptation of chicken embryos depends upon the gas exchange balance *(NORTH, 1978; PAKARD* et al., *1979; RAHN, 1980 and RAHN & AR, 1980)*. *RAHN (1980)* developed some equations for predicting the required changes in oxygen, carbon dioxide and water vapour composition of incubator gas at any altitude.

The high embryonic mortality under high altitude environment was noticed at 13 and 14 days of incubation. This mortality was refered to the delay and low hemoglobin production *(NORTH, 1978)*.

This work was carried out at Gitega-Burundi altitude (1680 m over sea level) to study the effect of two seasons (rain and dry season) on the incubation traits of chicken eggs at the high altitude environment. It aimed in the same time to evaluate the fertility, hatchability of fertile eggs and the embryonic mortalities of "Sasso" egg-production strain.

MATERIAL and METHODS

This experiment was carried out on 200 "Sasso" chicks. "Sasso" is an egg-production strain imported from France to Burundi by the Animal Production Department, Ministry of Agriculture, Burundi. The chicks were reared and maintained at the poultry farm of the Agriculture High Institute (Gitega), University of Burundi. The chicks were brooded on the floor at 35°C in the first week, thereafter it was reduced 2°C weekly until 5 weeks of age. They were fed ad libitum on a diet

containing 20% total protein and 3000 kcal./Kg. The photoperiod was 24 h of lighting during the first week and reduced to 10 h/day to sexual maturity. At 8 weeks of age, the chicks were moved to a rearing house with open system yards and fed ad libitum on a diet containing 18% total protein and 2800 kcal./Kg. At sexual maturity, the pullets were moved to egg-laying house with open system yards and fed ad libitum on a ration containing 16% total protein, 2600 kcal./Kg and 3.5% Ca. The photoperiod was increased to 14 h/day by using the artificial lighting during the laying season. Random mating system was practiced between males and females with considering the sex ratio as 12 females/male.

After three months from sexual maturity, the eggs were collected four times/day and conserved in a cooled room (12-15°C) for ten days. The eggs were selected and fumigated with formaldehyde gas before setting in the incubator.

In a forced and semi-automatic incubator, the eggs were incubated for 18 days in the incubation section and after 18 days, they transformed to the hatcher section.

At hatching time, all good, abnormal and died chicks were counted. The non-hatched eggs were broken to determine the infertile eggs and the different embryonic mortalities which classified as *HUNTON (1969)*:

1- First period (died from 0-10 days).
2- Second period (died from 11-18 days).
3- Third period (died in shell after 18 days).
4- Pipped eggs.

A total of 8717 eggs were incubated in two seasons. The first season was from December to May (rain season) included 12 batches with a total of 5830 eggs and the second season was from July to the end of August (dry season) with a total of 2887 eggs.

All data collected during the incubation batches were calculated as percentages for fertility, hatchability of fertile eggs and the embryonic mortalities. Means, and differences between means of the two seasons were estimated by using T test with unequal sub-class numbers of batches. Comparisons between mortalities means by Duncan test and phenotypic correlations between the incubation traits were calculated *(SNEDECOR and COCHRAN, 1981)*.

RESULTS

Means of fertility percentage are presented in Table 1. The mean was 80.13% and there was no significant difference in fertility between the two seasons (Table 1).

Hatchability means of fertile eggs (Table 1) showed low value (70.87%) under high altitude environment and there was a slight difference but not significant between the two seasons (Table 1).

Embryonic mortalities means (Table 1) showed that the percentage increases as the embryo age progressed and the highest percentage was noticed at the third period (died in shell) after 18 days of incubation. There was a significant difference between the two seasons for the second embryonic mortality from 11-18 days (Table 1). This result may be due to the high humidity percentage during the rain season and the marked oxygen hypoxia. The other mortalities showed non significant differences (Table 1). The embryonic mortality at the last three days of incubation was significantly differ with the other mortalities and the first and second mortality were significantly differ with the pipped eggs (Table 1).

Phenotypic correlations between incubation traits (Table 2) showed that there was a negative significant estimate between fertility and the first embryonic mortality. Negative highly significant correlations were found between hatchability of fertile eggs and first, second and third period of embryonic mortality. This result indicated that the highly embryonic mortalities reduced the hatchability of fertile eggs.

DISCUSSION

It seems that the fertility percentage under high altitude conditions is not more far than that well known under sea level for the standard breeds and strains *(NORDSKOG and GHOSTELY, 1954 and NORTH, 1978)*. It was possible to consider no effets of high altitude environment on fertility of chicken eggs. *THOMPSON (1952) and NORTH (1978)* showed the same conclusion.

The hatchability of fertile eggs had lower percentage than that known at sea level *(NORTH, 1978)*. The hatchability of fertile eggs under Giteg-Burundi altitude was lower than that at sea level by about 17%. This result agreed with that mentioned by *FRANCIS (1972)*. The low hatchability of fertile eggs obtained was refered to the decrease in oxygen pressure and concentration *(FRISANCHO, 1975; NORTH, 1978 and MORENG, 1983)*, to determintal effects of carbon dioxide *(SADLER et al., 1954)* and to some genetic factors *(BOHREN et al., 1977)*.

Table 1. Means (± standard deviation of fertility, hatchability of fertile eggs, embryonic mortalities and test of significant between the two seasons.

Percentage	Season1 ± S.D	Season2 ± S.D	General mean ± S.D	T test
Fertility	80.10 + 6.78	80.16 + 6.10	80.13 + 6.36	N.S.
Hatchability	68.58 + 7.16	74.80 + 5.02	70.87 + 7.01	N.S.
Embryonic mort. First period	6.64 ± 3.39	6.00 ± 4.60	6.41 ± 3.37 a	N.S.
Second period	8.58 ± 3.34	4.61 ± 1.22	7.11 ± 3.35 a	*
Third period	11.44 ± 3.49	9.80 ± 3.12	10.62 ± 3.12 b	N.S.
pipped eggs	3.78 ± 1.72	3.79 ± 2.23	3.79 ± 1.81 c	N.S.
abnormal and died chicks	0.98 ± 0.57	1.00 ± 0.80	0.99 ± 0.64	N.S.

*: any two means within the same column has not the same letter are significantly different at 5% (Duncan test).

Table 2. Phenotypic correlations between the incubation traits for pooled data.

Trait	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Fertility (1)	1	0.250	-0.490 *	0.144	-0.177	0.584 **	-0.145
Hatchability of fertile eggs (2)		1	-0.599 **	-0.769 **	-0.580 **	-0.247	-0.190
Embryonic mortalities First period (3)			1	0.260	-0.065	-0.120	-0.017
Second period (4)				1	0.389	-0.023	0.284
Third period (5)					1	-0.161	0.284
Pipped eggs (6)						1	-0.368
Abnormal and died chicks (7)							1

*,**: significant and highly significant at 5% and 1% levels, respectively (d.f. 18).

The highly embryonic mortalities under Gitega-Burundi conditions refered to the oxygen hypoxia in the atmosphere while the oxygen consumption increased as the embryos developed, to low hemoglobin production *(NORTH, 1978 and MORENG, 1984)* and to the lake of embryos adaptation by reducing the metabolic rate *(WANGENSTEEN et al., 1954; PAGANELLI et al., 1975 and NORTH, 1978)* or by gas exchange blance *(PACKARD et al., 1977; NORTH, 1978 and RAHN and Ar, 1980)* which lead to many embryonic deaths.

From this study, it is possible to recommend that, to provide the modern incubators with additional ventillation system to improve the hatchability and to reduce the embryonic mortalities under Gitega-Burundi conditons.

In Egypt, we must take care for the ventillation system in the incubators to avoid the lake of oxygen pressure or concentration. The problem of oxygen hypoxia may be occured at sea level with the bad system of ventillation which lead to increase the egg loss.

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