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Original Research Article

Duration of storage and positioning of the egg before brooding: effect on the internal quality and hatchability parameters of local chicken (*Gallus gallus* domesticus) eggs in Cote d'Ivoire

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Abstract

In Côte d'Ivoire, the local hen breeding constitutes nearly 70% of national poultry livestock in Côte d'Ivoire. Local hens of Côte d'Ivoire in general, are less known by scientific community because it is almost fewer characterized. In this context, it is necessary to work with the aim of improving local hens' productivity in order to contribute at food self-sufficiency. Therefore, the present study was carried out to assess the shelf life and placement of the egg before brooding.240 eggs from 82 local hens aged 36 weeks were divided in 6 batches of 40 eggs each. At first 3 batches were stored during 3 days, 5 days and 10 days respectively for batch 1, batch 2 and batch 3. Secondarily, the 3 others batches were stored during 5 days using 3 breeding positions namely vertical position with small end up, vertical position with the small end down and the horizontal position. Influences of storage duration on eggs weight and position of eggs on hatchability characteristics were evaluated.

The study showed that the positioning of the eggs significantly influenced hatchability and the horizontal storage position gave the best results compared to the two other positions. The average fertility of the local eggs recorded in this study showed out that long-term stored eggs presented lower hatching average. For the local hens, a storage of 5 days maximum before incubation of the eggs is advisable.

The positioning and storage time significantly influenced the weight and hatchability of local eggs.

Keywords: Storage, Egg position, Hatchability, Local hens, Cote d'Ivoire

Introduction

In developing countries, traditional poultry breeding is the primary source of animal protein and can be considered as the spring of income, particularly for women (Guèye, 2005). Promotion of rustic poultries breeding and the gradual improvement of the zootechnicals performances of poultries can be source of economic development and for the biodiversity safeguard (Magothe et al., 2012). In Côte d'Ivoire, the local hen breeding like met inside the villages is essentially extensive type. Although the weaknesses that can present this system and the strains of its production like described by Dessie et al., 2011., the

local hen constitutes nearly 70% of national poultry livestock in Côte d'Ivoire (N'Goran et al., 2016). Yet, local hen of Côte d'Ivoire in general, is less known by scientific community because it is almost fewer characterized. It is otherwise admitted that the pressure of interbreeding with exotics races can lead permanently to a risk of genetic erosion. In such a situation, the question of its sustainability arises. However, sustainability of all species starts by the study of its biology singularly its reproduction and afterwards its characterization. Thereby, for well carrying out these studies, special provisions are needed namely to work onto sufficient number of animals having especially the same age. Overcome these problems artificial brooding stays the likely solution. It is so in this context that it appeared to us to work with the aim of improves local hen productivity in order to contribute at food self-sufficiency and to lead proper protocols for genetics researches. More specifically, this research is designed to identify the optimal storage's time of the hens from locals race as well as the best eggs positioning during the eggs storage for an optimization of hatchability parameters.

Materials and Methods

The work was carried out with 240 eggs coming from locals' hens called commonly « bicycles chickens». These hens were raised in semi-confinement housing in semi-modern poultry farm located in the locality of Tiéplé at 15 km from Bouaké capital of Gbeke's Region. This locality is characterized by a vegetation of wooded savanna and is influenced by a humid tropical climate. Temperature recordings ranged between 22°C and 35°C with humidity's rate who ranged between 50% and 60%. The rainfall of 1200 mm/year is average. Agriculture and farming are heavily practiced by almost the entire population of this locality.

Technical equipment is simply an incubator with a capacity of 300 eggs located at Bouaké in a private hatchery, far from 11 km of the eggs collection farm where was the hatchery with a capacity of 300 eggs. Airs cells have been also used for eggs collection and storage.

Recording data

Eggs collection for the experiment was done into two sessions, shortly after the number of laying hens is enough for obtaining the number of egg included in a laying trial. Indeed, onto the 82 hens and 10 roosters presents on the farm, a prior organization allowed us to obtain laying in group. Thus the experiment has really begun when more than half of the hens started laying. Eggs collected (40 eggs by batch) was stored with butt pointing (habitual positioning of storage) and according to different periods of conservation in order to establish the best hatchability's rate in accordance with storage time.

First the batch 3 which storage time is the longest was collected six days before hatching. After, precisely two days before hatching, the batch 2 was collected two days before hatching. And at the end, exactly one day before hatching, the batch 1 was collected.

After collecting the eggs, the batch 1 was stored during one day before hatching; the batch 2 was stored during five days before hatching and the batch 3 was stored during ten days before hatching.

Then, in this first experiment, a sample of 05 eggs was removed from every batch shortly before hatching for evaluating internal egg quality characteristics such as Haugh unit and egg yolk index. All 40 eggs by batch collected for eggs storage time were also weighted first days and the last day of storage in order to identify theirs weight variation. For determining internal egg quality analysis breaking eggs was done thanks to a knife. The content of eggs was thereafter spilled in to a glass plate and then examined for egg yolk index and the measure of Haugh unit.

In the second experiment, three others batches (40 eggs by batch) were constituted depending on eggs positioning in the cell before hatching, the goal being to evaluate the effect of storage positioning on hatchability parameters of eggs collected. The batches were constituted as follows. In batch 1, eggs were positioned in vertical position with the small end up; in batch 2, eggs were positioned in vertical position with the small end down; in batch 3, the eggs were put in horizontal position. The storage time was five days for the three shares. Different parameters were studied in this research.

Egg yolk index (YI): it is the ratio between height and diameter of eggs yolk given by this formula:

$$egg\ yolk\ index\ (YI) = \frac{Yolk\ height\ (YH)}{Yolk\ diameter\ \ (YD)}\ X\ 100$$

Haugh unit (UH): Haugh unit were calculated from the recorded egg weights and albumen heights. It permitted to appreciate eggs consistency and mention about eggs degradation status, by the formula:

$$UH = 100log\ [H - \frac{\sqrt{G(30W^{0.37} - 100)}}{100}$$

Where HU =Haugh unit, H = height of the albumen (mm), and W = egg
Weight (g), G= 9.81 m/s^2

Fertility: determination of fertility rate was effectuated by:

$$\text{fertility rate} = \frac{\text{Number of fertile eggs}}{\text{Number of incubated eggs}} \text{ X } 100$$

Hatchability: the different parameters were determined according to formula used by Ayorinde and Ayeni *(*1986). The following formulas permits respectively to determine embryonic mortality rate (EMR), apparent hatching rate (AHR), real hatching rate (RHR):

$$\text{embryonic mortality rate} = \frac{\text{Number of chick dead in eggshell}}{\text{Number of fertile eggs}} \text{ X } 100$$

$$\text{apparent hatching rate} = \frac{\text{Number of hatch chick}}{\text{Total number of incubated eggs}} \text{ X } 100$$

$$\text{real hatching rate} = \frac{Number\ of\ hatch\ chick}{Number\ of\ fertile\ eggs}\ X\ 100$$

Statistical Methods

The analyses were conducted using an excel computer programmer and R statistical system version 3.3.1 for analysis. Analysis of variance was effectuated for determining the significance level. And a significance threshold of 0.05 was adopted for all the statistical parameters. Analysis parameters are eggs weight, eggs yolk index and Haugh unit. The factors taken into account were storage time. The proportions about reproductions parameters were calculated with G test as well as chi-squared test or χ^2 test according to the different positioning and storage time.

Results

The effect of storage time onto eggs weight before and after storage

Variations of eggs weight before and after the storage period are presented in Table 1. Eggs weight in this study varied from 47.85 to 48.63g. No significant effect was found in eggs weight before their storage during the storage period from the analysis. However significant differences were found in egg weight loss during the storage period which gradually increased from 0.13 to 1.27 with storage time.

The effect of storage time onto internal eggs quality

The internal quality characteristics of local chicken eggs during different storage periods are shown in table 2. Yolk index values of local chickens ranged to 35 at 37 either an average of 35.67 with increased storage period. Nevertheless, Haugh unit values were significantly different. Indeed, Haugh unit values decreased significantly from 59.22 to 46.91 with increased storage period.

Table 1: Egg weight losses after storage periods

Storage period (Day)	Number of Egg	Eggs weight before storage (g)	Egg weight after storage (g)	Egg weight loss (g)
1	40	48.12 ± 1.6 3	47.99 ± 1.6	0.13 ±0.00[a]
5	40	47.85 ± 2.04	47.01 ± 0.13	0.84 ± 0.11[a]
10	40	48.63 ± 2.11	47. 36 ± 1.14	1.27 ± 0.09[a]

Means sharing same letters are statistically non-significant at P≤ 0.05

Table 2: Internal quality characteristics of local chicken eggs according to storage time

Storage period (Day)	Yolk index	Haugh unit
1	37 ± 2.12[a]	59.22 ± 11.03[a]
5	35 ± 2.54[a]	47.1 ± 7.14[b]
10	35 ± 1.33[a]	46.91 ± 5.31[c]

Means sharing same letters are statistically non-significant at P≤ 0.05

The effect of storage time onto hatchability characteristics of local chickens

Storage time (Table 3) had a significant effect onto reproduction characteristics. Thus hatchability characteristics of eggs stored 1 day before incubation was better than eggs stored until 5 days and 10 days before incubation. Nonetheless fertily rates (FR) were respectively 97.05 % , 54.76 % and 22.72 % for batch 1, batch 2 and batch 3. Moreover, apparent hatching rate (AHR) in batch 1 was respectively 1.77 and 4.27 times higher than those recorded in batch 2 and 3. In addition, the half of embryo was died in batch 3 stored during 10 days before incubation. Real hatching rate

(RHR) in batch 1 (75.76 %) was better than those recorded in batch 2 (43.48 %) and batch 3 (40 %).

The effect of eggs positioning before incubation onto hatchability characteristics

According to data presented in able 4, best fertility rates were recorded in horizontal position (batch 3) with 72.5% of fertility, however eggs of batch 2 presented the lowest performances of reproduction with 42.5 % fertility rate. The embryonic mortality rates were lower (10 %) for batch 1, followed by batch 3 (23.53%) and batch 2 (35.29%). The best real hatching rate (RHR) was 72.41% and the worst was 52.5% recorded with batch 2. The best apparent hatching rate was also obtained with batch 3. All these reproduction characteristics showed that batch 3 (horizontal position) presented the best performances of reproduction.

Table 3: The effect of storage time onto hatchability characteristics of locals' hens

Hatchability characteristics	Eggs storage time before incubation			*G-test*	*P>F*
	[1 day] Batch 1	[5 days] Batch 2	[10 days] Batch 3		
FR	97.05 %^{a}	54.76 %^{b}	22.72 %^{c}	*53.48*	*0.01*
AHR	73.53 %^{a}	23.81 %^{b}	9.09 %^{c}	*65.57*	*0.01*
EMR	3.03 %^{c}	26.09 %^{b}	50 %^{a}	*36.13*	*0.01*
RHR	75.76 %^{a}	43.48 %^{b}	40 %^{c}	*33.94*	*0.01*

FR: fertility rate; AHR: apparent hatching rate; RHR: real hatching rate; EMR: embryonic mortality rate. Means sharing same letters are statistically non-significant at P≤ 0.05

Table 4: Hatching performances according to eggs positioning before incubation

Hatching characteristics	Eggs storage position before incubation			*G-test*	*P>F*
	Batch 1	Batch 2	Batch 3		
FR	50%^{b}	42,5%^{c}	72,5%^{a}	*11,93*	*0,01*
AHR	35%^{b}	10%^{c}	52,5%^{a}	*33,94*	*0,01*
EMR	10%^{c}	35,29%^{a}	13,79%^{b}	*37,57*	*0,01*
RHR	70%^{b}	23,53%^{c}	72,41%^{a}	*33,94*	*0,01*

FR: fertility rate; AHR: apparent hatching rate; RHR: real hatching rate; EMR: embryonic mortality rate. Means sharing same letters are statistically non-significant at P≤ 0.05

Discussion

According to Bordas and Mérat (1993), there are unfavorable effect about long storage length onto eggs weight for hatching. But, the results of this study carried out that storage length hasn't decreased significantly the weight of eggs. This could be imputed to the short eggs storage length which duration was 10 days maximum in our work. However, this result was confirmed by the researches of Yassin et al., (2008) who demonstrated that the negative effect of storage increases with storage length. According to the same authors, on average, each extra day of storage of eggs before the seventh day reduced hatchability by 0.2% and after the seventh day by 0.5%. Furthermore, our observations support the logic that long-term stored eggs may induce weight loss of eggs. In this study, there was no significant effect of storage time onto yolk index. That could be imputed at storage conditions which were respected in this research. Indeed, other studies of researchers such as Tilki and Saatçi (2004) reported that storage length wasn't the first factors which affected yolk index which is more sensible to the temperature and humidity of the environment in which the eggs are stored. Nonetheless, Haugh unit values decreased significantly with eggs storage time in the current study. That was most likely due to an alteration of the eggs yolk, itself imputed to long-term stored eggs. These results are consistent with the findings of Monira et al., (2003) who reported that Haugh unit values of more 6 days storage could decrease until almost more than 30 units. Moreover, the present results relating to the effect of storage time on egg internal quality are similar with the findings of Tilki and Saatci (2004), and Demirel and Kirikçi (2009),

who reported that the Haugh unit, albumen and yolk index values of partridge and pheasants eggs significantly decreased with increasing days of storage.

The average fertility of the eggs recorded in this study showed out that long-term stored eggs presented lower hatching average. Our results are in accordance with the findings of Safaa et al., (2013) who showed that storage length above more than one week would carry a decrease of hatchability and an increase of embryonic death. The decrease of fertility could be due to loss of water from the eggs resulting in egg weight loss too (Ewonetu, 2016).

Our work showed that eggs position statistically affected eggs fertility and hatching. The highest hatching average observed beside eggs of horizontal position batch indicated that this position is the best for an optimization of productivity.

The common position of storage used before hatching especially the vertical positions wouldn't be appropriated for optimal hatching. Indeed, the results obtained with this position in the present study was widely lower than the results of eggs in horizontal position. These results are in concordance with the natural practice occurring during brooding by hens and show that the horizontal position is the best one for local hen eggs hatching and fertility.

Conclusion

This study conducted for the first time with local hens in Cote d'Ivoire was designed in order to show the effect of storage time and positioning onto hatching. The results showed that long-term stored eggs may lose weight conducting to deterioration of eggs internal quality first and secondly at considerable decrease of their fertility and the hatching. For the local hens, a storage of 5 days maximum before incubation of the eggs is advisable. Moreover, the position of eggs for hatching in storage cell affects significantly characteristics of hatchability. The horizontal position during storage time recorded the best performances eggs hatching.

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