Original Research Article

Influence of the weight of the eggs of Flesh Roux and Kuroiler breeding hens on their hatching in an incubator

ABSTRACT

To contribute to the development of poultry farming in Ivory Coast, a study was carried out in the Lakes Region, precisely in Yamoussoukro. The aim of this study was to determine the influence of egg weight on their hatching. To do this, Kuroiler (29 females and 6 males) and Chair Roux (29 females and 6 males) breeders aged 6 to 7 months were used. After rearing, 483 eggs including 230 Chair Roux eggs and 253 Kuroiler eggs were collected over twenty-one days. After identification and determination of their characteristics (weight, length and diameter), the eggs were classified into three categories according to weight (Small, Medium and Large) and incubated in three incubators (Incubator 1, Incubator 2 and Incubator 3). In each incubator, the incubation performance was determined. The results showed that the average egg rate was higher (66.52% for Chair Roux eggs and 66.79% for Kuroiler eggs).Large eggs showed the highest fertility rate (95.92% for Chair Roux strain eggs, and 97.44% for Kuroiler strain eggs), followed by medium eggs (90.85% for eggs of the Chair Roux strain and 91.72% for eggs of the Kuroiler strain). In terms of the embryonic mortality rate, it was the small eggs which presented the highest rates with 17.85% for eggs of the Chair Roux strain and 26.66% for those of the Kuroiler strain. As for the actual hatching rate, large eggs recorded the highest rates (82.97% for Chair Roux eggs and 76.31% for Kuroiler strain eggs) followed by medium eggs (77.85% for Chair Roux strain eggs and 76.28% for Kuroiler strain eggs). Apart from Incubator 3 which recorded a higher embryonic mortality rate for large eggs (15.38%), Incubator 1 and Incubator 2 recorded higher rates for small eggs with respectively 11. 76% and 37.5%. In terms of the actual hatching rate, large eggs recorded the highest rates with 87.5% at Incubator 1 and 83.33%. Thus, it appears that large eggs and medium eggs are indicated to obtain a better hatching rate.

Keywords:Eggs, category, weight, hens, incubation, Flesh Roux, Kuroiler

1. INTRODUCTION

In recent years, the modern Ivorian poultry industry has experienced significant growth. From 2012 to 2019, chicken meat consumption increased from 1.47 kg/inhabitant/year to 2.62 kg/inhabitant/year, an increase of 78.23%. Over this same period, egg consumption increased from 34 eggs/inhabitant/year to 45 eggs/inhabitant/year, an increase of 32.3% (MIRAH, 2022). Laying hen production is estimated at 5,190 tonnes during 2022, a decrease of 10 percent from 5,882 tonnes the previous year. The lower production rate of layers compared to broilers is due to the emphasis on broiler farms (USDA, 2023).

Today, the country has around 2,200 poultry farms, including 1,500 for broilers and only 700 for layers. It has about 22 chick hatcheries, only a third of which operate in a commercial setting. A large number of small hatcheries purchase hatching eggs from large commercial

companies that own their own hatcheries (USDA, 2023). This state of affairs can be explained by the low production of farms which are unable to meet the demand from hatcheries. In turn, the glaring lack of day-old chicks is leading some broiler breeders to start breeding breeders and incubating eggs with homemade incubators. This form of activity is growing more and more in certain areas far from Abidjan.However, this activity is not without risk. Failure to control brooding parameters and lack of training for breeders in the field very often leads to heavy losses. Among the parameters that can influence egg incubation and chick life is egg weight (Sanfo et al., 2007). The objective of this work was to offer breeders the best weight category which could allow them to obtain better brooding rates. Thus, the study then aimed to (i) categorize the eggs collected then (ii) determine the incubation performance according to the strains and incubators.

2. MATERIAL AND METHODS

2.1. Biological material

The biological material consisted of 70 breeders (48 females and 12 males) aged 6 to 7 months belonging to two strains of chickens (Kuroiler and Red Flesh). Breeders of Kuroiler strains had an average live weight of 1.674 ± 0.18 kg for hens and 2.501 ± 0.34 kg for males. As for those of the Flesh roux strain, the females had an average weight of 2.184 ± 0.28 kg and the males had an average live weight of 4.538 ± 0.49 kg. Each strain consisted of 29 females and 6 males. Over the twenty-one days of rearing, 483 eggs including 230 Chair Roux eggs and 253 Kuroiler eggs were collected. All the chickens and eggs came from Ange Farm in the Lakes Region.

2.2. Technical equipment

The technical equipment consisted of three incubators, two of which were hand-made (Incubator 1 and Incubator 2) and one was industrially manufactured (Incubator 3). Incubators 1, 2 and 3 had capacities of 1,056 eggs, 300 eggs and 128 eggs, respectively.On the other hand, it consisted of an Electronic Kitchen Scale SF400 brand electronic scale with a capacity of 10 kg and a precision of 1 g, a Digital Caliper brand electronic caliper with a precision of 0.2 mm; a flashlight, cells and markers.

Comment [p1]: Where did you use the Digital Caliper brand 0.2 mm precision electronic caliper?

2.3. Methods

Eggs were collected twice a day (in the morning at 7 a.m. and in the evening at 2 p.m.) for 21 days. Every day, after collection, eggs with defects were removed and the others were identified with the marker and weighed using the scale. After weighing, they were classified into three categories: Small (35 to 45g), Medium (46 to 55g) and Large (56 to 65g). The length and diameter were determined using calipers. Then, they were stored in the breeding building in a fence to protect them from predators. Every three days, the collected eggs were transported in cells to the incubation room to limit their deterioration following long storage periods. Once in the incubation room, the eggs were checked to remove those with damaged shells.

All incubators were started before the start of the first incubation. Incubations were carried out in the mornings. On the eighteenth day of incubation, a mirage was made. This candling, with the flashlight, made it possible to remove the clear eggs as well as those with a dead embryo. A temperature and humidity check were carried out every morning and evening in each incubator. Thus, incubator 1 displayed an average temperature of 37.40±0.55°C and an average hygrometry of 54.58±1.80%; incubator 2 displayed an average temperature of 37.58±0.49°C and an average hygrometry of 54.86±3.26% and incubator 3 displayed an average temperature of 37.59±0.53°C and an average humidity of 59.98±6.02%.

The data were analyzed using Statistica 7.1 software and the student's t test was used to compare the means two by two at the threshold of 0.05.

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Proportion of different categories of eggs

Figure 1 illustrates the numbers of the different categories of eggs collected during the trial period. In each strain the number of medium eggs outnumbered small and large eggs. Thus, in the Chair Roux strain the percentage of average eggs was 66.52% followed by the percentage of large eggs (21.30%) and that of small eggs (12.17%). In the Kuroiler strain, after these percentages were respectively 66.79%; 15.41% and 17.78%.

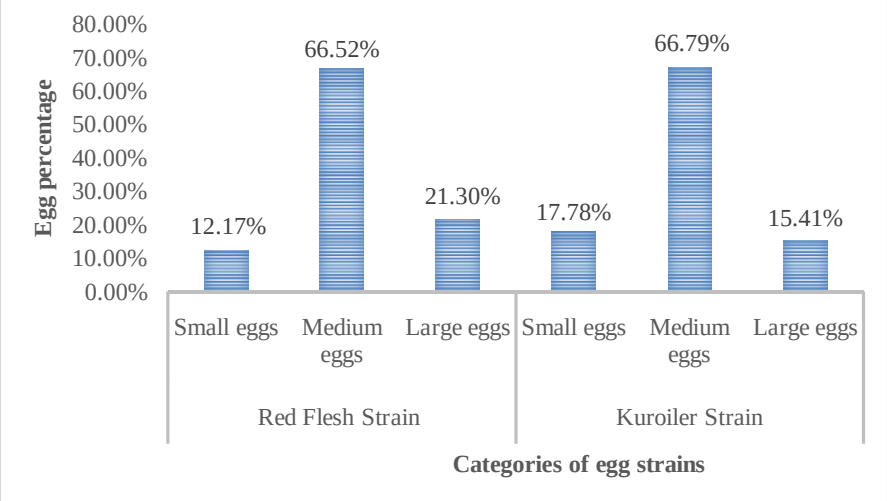

Figure 1: Proportion of different categories of eggs

3.1.1. Average number of categories of eggs collected daily

The average values of each category of eggs collected daily are mentioned in Table 1. In the Chair Roux strain, the average number of average eggs (7.38 ± 2.33) was higher than that of small eggs (1.33 ± 1.01) and large eggs (2.33 ± 1.71). Between these three values, a significant difference was noted ($p<0.05$). On the other hand, in the Kuroiler strain, only the number of medium eggs (8.28 ± 2.79) was significantly higher than those of small eggs (2.14 ± 1.1) and large eggs (1.9 ±1.67). Also, a significant difference was observed between the number of small eggs of the Chair Roux strain (1.33 ± 1.01) and that of the Kuroiler strain (2.14 ± 1.1).

Table 1: Egg categories based on strains

Strains	**Categories**		
	Small eggs	Medium eggs	Large eggs

Flesh Red	1,33 ± 1,01 **ad**	7,38 ± 2,33 **a**	2,33 ± 1,71 **a**
Kuroiler	2,14 ± 1,1 **bd**	8,28 ± 2,79 **bc**	1,9 ± 1,67 **c**

NB :Mean values on the same row or in the same column with the same letters are significantly different ($p<0.05$)

3.1.1. Egg hatching parameters

3.1.1.1. Hatching of egg categories based on strains

Table 2, below, presents the brooding parameters depending on the strains. The Kuroiler strain recorded the highest fertility rate (90.91%) compared to that of Chair Roux (90.87%). Considering the categories of eggs, in the Chair Roux strain, the fertility rate was higher at the level of large eggs (95.92%) than at the level of medium eggs (90.85%) and small eggs (78.58%). The same observation was made in the Kuroiler strain where large eggs recorded a fertility rate of 97.44 compared to 91.72 for medium eggs and 80% for small eggs.

In terms of the embryonic mortality rate, it was the small eggs which presented the highest rates with 17.85% for the eggs of the Chair Roux strain and 26.66% for those of the Kuroiler strain. However, eggs in this category showed fewer cases of intra-shell mortality with 0% for Chair Roux eggs and 2.22% for those of the Kuroiler strain. As for the actual hatching rate, large eggs recorded the highest rates (82.97% for Chair Roux eggs and 76.31% for Kuroiler strain eggs) followed by medium eggs (77.85% for the eggs of the Chair Roux and 76.28% for the eggs of the Kuroiler strain).

Table 2: Hatching of egg categories according to strains

Parameters	**Strains**					
	Flesh Red			**Kuroiler**		
	Small eggs	Medium eggs	Large eggs	Small eggs	Medium eggs	Large eggs
Number of eggs collected	28	153	49	45	169	39
	230			253		
Clear egg rate(%)	21,42	9,15	4,08	20	8,28	2,56
	9,13			9,09		
Fertility rate(%)	78,58	90,85	95,92	80	91,72	97,44
	90,87			90,91		
Embryonic mortality rate(%)	17,85	15,68	16,32	26,66	19,52	15,38
	17,7			21,73		
Intra-shell mortality rate of chicks (%)	0	0,65	0	2,22	3,55	7,69
	0,47			4,34		

Apparent hatching rate(%)	60,71	71,24	79,59	53,33	70,41	74,35
	74,34			67,19		
Actual hatching rate(%)	77,27	77,85	82,97	66,66	76,28	76,31
	81,18			73,91		

3.1.1.2. Hatching of egg categories according to incubators

Table 3 shows the hatching performances of the different incubators. In incubator 1, eggs, with a low fertility rate (87.71%), had the highest actual hatching rate (86.66%) and low embryonic mortality rates (11.11%) and intra-shells (1.16%). Incubator 2, although receiving eggs with a high fertility rate (93.58%), recorded a low hatch rate of 69.86% and the highest embryonic mortality rate (25%). As for incubator 3, the eggs it contained had a fertility rate of 89.72% and an actual hatching rate of 74.04%.

Table 3: Egg hatching performance depending on the incubator

Parameters	**Incubator 1**	**Incubator2**	**Incubator 3**
Number of eggs collected	171	156	146
Number of clear eggs	21	10	15
Fertility rate(%)	87,71	93,58	89,72
Embryonic mortality rate(%)	11,11	25	17,12
Intra-shell mortality rate of chicks (%)	1,16	3,2	6,16
Apparent hatching rate(%)	76,02	65,38	66,43
Actual hatching rate(%)	86,66	69,86	74,04

3.1.1.3.Incubation performance depending on incubators and strains

Table 4 shows the egg hatching performance depending on the incubators and strains. Apart from Incubator 3 which recorded a higher embryonic mortality rate for large eggs (15.38%), Incubator 1 and Incubator 2 recorded higher rates for small eggs with respectively 11. 76% and 37.5%. In Incubators 1 and 3, the embryonic mortality rates recorded were higher for average eggs, with 12.5% and 7.69% respectively. In terms of the actual hatching rate, large eggs recorded the highest rates with 87.5% at Incubator 1 and 83.33%, followed by medium eggs (86.27% for Incubator 1 and 67.30% for Incubator 2 and 76.08% for Incubator 3.

Table4: Hatching of egg categories according to incubators

Paramètres	Strains	Incubator 1			Incubator 2			Incubator 3		
		Small eggs	Medium eggs	Large eggs	Small eggs	Medium eggs	Large eggs	Small eggs	Medium eggs	Large eggs
Number of eggs collected	Flesh Red	12	52	18	10	47	14	8	45	13
	Kuroiler	17	56	16	16	55	14	15	52	13
Clear egg rate(%)	Flesh Red	66,67	88,46	94,44	80	91,48	100	100	91,11	92,3
	Kuroiler	70,58	91,07	100	93,75	94,54	100	80	88,46	92,3
Embryonic mortality rate(%)	Flesh Red	8,33	11,53	5,55	0,3	12,76	35,71	37,5	22,22	7,69
	Kuroiler	11,76	8,92	0	37,5	25,45	35,71	13,33	13,46	15,38
Intra-shell mortality rate of chicks (%)	Flesh Red	0	13,56	5,55	0	0	0	0	8,88	0
	Kuroiler	0	12,5	6,25	0	5,45	14,28	6,66	7,69	0
Apparent hatching rate(%)	Flesh Red	58,33	75	88,88	50	78,72	64,28	62,5	60	84,61
	Kuroiler	58,82	78,57	87,5	56,25	63,63	50	60	67,3	76,92
Actual hatching rate(%)	Flesh Red	87,5	84,78	94,11	62,5	86,04	64,28	62,5	65,85	91,66
	Kuroiler	83,33	86,27	87,5	60	67,30	50	75	76,088	83,33

3.2. Discussion

The classification of eggs into categories made it possible to show that at the level of the two strains, the number of average eggs (153 eggs of the Chair Roux strain and 169 eggs of the Kuroilers strain) was more numerous. These eggs had a size between 46 and 55 g. This high number of eggs at average size could be explained by the age and lineages of the strains from which the eggs came. According to Travel et al. (2010), the weight of the egg, generally between 45 and 75 g, varies mainly with age and secondarily with the commercial crossbreeding of the hen. According to the said authors, the weight of the egg increases considerably during the year of production, but this weight depends on the hen lineage, particularly in relation to its body weight. Sanfo et al. (2015) recorded more eggs weighing between 35 and 45 g. This difference in weight could be explained by the fact that they worked on local guinea fowl eggs.

Although medium-sized eggs are the most numerous, it is large-sized eggs that recorded the highest fertility rates (95.92% for Chair Roux strain eggs and 97.44% for eggs of Kuroiler strain) followed by medium-sized eggs (90.85% for Chair Roux strain eggs and 91.72% for Kuroiler strain eggs) and finally small-sized eggs (78.58% for the Kuroiler strain eggs). Flesh Roux and 80% for Kuroilers strain eggs These high fertility rates could be linked to the breeding conditions of our breeders. The fertility rates obtained during our work are higher than those recommended by CTA (2011). which oscillates between 50 and 70%. According to this author, the best fertility results are obtained with breeders raised in conditions similar to those of layers. It should be noted that our breeders were raised in the same conditions as the layers, hence obtaining the high hatching rate.

In terms of embryonic mortality rate, small eggs had the highest rates. This rate was 17.85% in Chair Roux strain eggs and 26.66% in Kuroilers strain eggs. The rates obtained with medium-sized eggs were 15.68% for Chair Roux strain eggs and 19.52% for Kuroiler strain eggs. According to Azeroul (2006), incubation results are considered better if the rate of clear eggs is less than 5% and the embryonic mortality rate is less than 7.3%. Yoda (2011) obtained embryonic mortality rates ranging between 45.3 and 49.1%. According to this author, these differences could be explained by the preheating of the eggs before incubation, the incubation temperature, the relative humidity, the duration and conditions of storage of the eggs, the transport of the eggs, aeration, the diet and genetic origin of chickens.

Regarding the actual hatching rate, it was the eggs of the Chair Roux strain which presented the highest rate (81.18%) compared to 73.91% for those of the Kuroiler strain. Within each strain and in incubators 1 and 3, it was the large eggs which recorded the highest rates (94.11% and 91.66% for Chair Roux strain eggs then 87.5% and 83 .33 for those of Kuroiler stock). Whether we consider the strain or the size of the eggs, our results are higher than those of Yoda (2011) which vary from 28.5 to 41.7%. This difference in performance could be explained by the incubation conditions, the duration and conditions of storage of the eggs, their transport and the feeding of the breeders. Although the eggs from incubator 1 showed a lower fertility rate (87.71%) than the other two incubators (93.58% for incubator 2 and 89.72% for incubator 3), it recorded the highest actual hatching rate (86.6%).It should be noted that these hatching rates obtained during our work are consistent with the hatching rate recommended by Reijrink et al. (2010) which is around 88% for eggs stored for 3 to 4 days but beyond the range recommended (50 to 70%) by CTA (2011). According to Azeroul (2006), a good hatching rate must be above 87%. The good performance of this incubator could be explained by the maintenance of an ideal temperature for the eggs to hatch. Indeed, incubators 2 and 3 recorded higher embryonic and shell mortality rates than those of incubator 1. These mortalities could be due to a significant variation in temperature within them. According to Yoda (2011), several factors including preheating, incubation

temperature, storage duration and conditions, transport, aeration, feeding and the genetic origin of hens can be the cause of 'a performance from an incubator. Also, this good performance of our incubators would be due to the period and place of storage of the collected eggs. Indeed, all eggs were collected over intervals of no more than 3 days, stored in the breeding building during the indicated period and then transported to the hatchery.

4. CONCLUSION

This study carried out with the breeders Chair Roux and Kuroiler, showed that medium-sized eggs were the most laid by the strains. Large eggs and medium eggs showed the best hatching performance. As small eggs have a low fertility rate, they have had low hatching rates compared to large eggs and medium eggs.

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