Strains of Algerian farmhouse laying hens: Physicochemical characteristics and egg incubation parameters

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Abstract.

The purpose of this study is to determine the physicochemical characteristics and incubation parameters of eggs of four strains of local farmed laying hens. Five hundred eggs (500) of each strain, divided into five (05) random blocks of 100 eggs, were the subject of our experiment. The thickness of the White strain shell is greater than that of the other strains ($p < 0.01$), but its width is significantly less ($p < 0.003$). The weight of the shells of the Nouar El Foul and Naked-Neck strains are larger than those of the White and Yellow strains ($p < 0.004$). The weight of the albumin strains of the Yellow and Naked-neck strains are significantly higher than those of the other strains ($p < 0.007$). The average weight of one egg of the Blanche strain is less important (49g) than that of the other three strains ($p < 0.02$). Fertility of the Naked neck strain (90%) is superior to the Nouar El Foul strains; White (70%) and Yellow (65%) ($p < 0.03$). The hatching rate, though low (<50%), is higher for the Nouar El Foul and Naked-neck strains (50%) and lower for the Yellow strain (25%) ($p < 0.01$). The embryonic mortalities of the Yellow and Naked-neck strain are similar (40%) and those of the Nouar El Foul (20%) and White (30%) strain are the least expressive ($p < 0.001$).

Keywords: Algeria, Eggs, Local strain, Poultry farming, Traditional breeding.

1. Introduction

In the traditional local poultry sector, farm hens show a wide phenotypic diversity in Algeria. They are in general very little studied because they influence the economic sector only very weakly. According to **Moula et *al*., (2009)**, 19 phenotypes have been identified with local vernacular names. In deep Algeria, at the level of small farms, the farming of farm hens is practiced only for the self-consumption of meat and eggs. These chickens have a capacity of adaptation which makes that they do not require any investment for their breeding. In general, they live in the open without any enclosures and feed on insects, seeds and worms that they find around homes. They are very resistant to pests and diseases (**Djelil et *al*., 2012**) and thrive in the difficult environment of the mountainous areas of Aurès and Kabylie. The latter is characterized by very cold winters (0°C) and hot summers (35°C average temperature). Egg production is used for family consumption and reproduction, thus ensuring the sustainability of the breeding. The price of eggs is more attractive than that of industrial layer hens because livestock is considered to be natural without added commercial feed inputs and is therefore considered organic (**Kaci, 2013**). However, this breeding remains inefficient with a high consumption index and a low average daily gain according to **Amghrous** and **Kheffache (2007)**. **Ofiaal (2001)**, registered 150,000 local chicken farms with an average of 12 animals per farm in the national territory. They are managed by women who remain powerless in the face of the rise of intensive poultry farming since 1975. The latter has strongly limited the development of local breeds by the use of imported hybrid strains imported highly profitable (**Mahmoudi, 2002**).

This study was developed to determine the physico-chemical characteristics and incubation parameters of local populations of poultry (*Gallus gallus domesticus*) in the Highlands region of the Sétifien.

2. Materials and methods

100 eggs from each dominant farm chicken population (Nouar el foul, Blanche, Yellow and Naked Neck) were collected from 5 farms in the region of Ain Azel wilaya de Sétif, on farms where cocks and hens live together freely. The average storage time of eggs was 10 days at a temperature of 6 ° C.

A total of 50 eggs from each population were used to determine their physical characteristics. They were numbered and weighed individually (to the nearest 0.1g). The length and width of the eggs were measured to the nearest 0,01mm, using a digital caliper. After breaking the eggs, the constituents were deposited on a flat surface. The height of the white was determined using a graduated ruler placed midway from the yolk contour. The height of the yolk was determined by placing a ruler vertically and its diameter with a caliper according to the method of **Angrand** (**1986**). After separation, the weight of the albumen, the yolk and the shell were weighed with an electronic scale (Precision 0.01g). The thickness of the shell was determined using calipers at three locations: at the pointed end; at the rounded end and in the middle.

The value of the thickness is determined by the average of these three measurements (**Çağlayan et *al*., 2009 ; Moula et *al*., 2010 ; Menezes et *al*., 2012 ; Hanusová et *al*., 2015**). The color of the yolk was appreciated using the DSM scale according to the method of **Mertens et *al*., (2010)**. The Haugh unit allowing the appreciation of the freshness of the eggs (**Buffet, 2010**) was calculated using the formula of **Silversides, (1994)**. The yellow / white ratio was calculated using the formula of **Çağlayan et *al*., (2009)**. The following variables were also calculated:

- Shape index: Width of the egg / length of the egg X 100;
- % Albumen: Albumen weight / Egg weight X 100;
- Percentage of shell (%) = weight of shell / egg weight × 100 Percent of yolk (%) = weight of yolk / weight of egg × 100;
- Yellowness index: Height of yolk / diameter of yolk X 100;
- Incubation parameters were determined on 50 eggs from each population;
- The eggs were incubated for 19 days (37.5 ° C and 60% RH) with a flip every 8 hours before being transferred to the hatchers (38 ° C, 70% RH).

2.1 Statistical analysis

The descriptive statistics and the analysis of variance of the general uni-variate linear model (**ANOVA**), were carried out with SPSS statistical software version 2.5. The general linear model was used to test the effects of factors on variables. The differences were considered significant with a risk of error of 5%.

3. Results and discussions

3.1 External physical characteristics of eggs

The weight of the egg is similar for the Yellow, Nouar el Foul and Cou nu populations between 52g and 54g (Table 1) and are consistent with those recorded by **Halbouche et al., (2009)**. The white population, on the other hand, recorded a lower weight (49.12 g p <0.03) which is close to the minimum of the weight range advanced by **Moula et *al*., (2003)** (50 and 54g) for the Kabyle hen. Comparatively, the egg weight of the selected and commercialized strains weighs on average 60g and depends on the strain. However, all of the weights of the 4 local farm chickens remain significantly more predominant than those of Guinea (30.7g) (**Mourad et *al*., 1997**) and Senegal (37.5g) (**Missohou et *al*., 1998**). **Dafaalla et *al*., (2005)** and **Fosta, (2008)** reported lower weights between 37.95 and 44.9g for local eggs from West and Central Africa. **Egahi et *al*., (2013)** explain this difference by a genetic divergence and the influence of the medium.

The length and width of the egg are uniform for the populations Neck; Yellow and Nouar el foul with respectively 57mm and 42mm inducing a similar shaped index of 74. The latter remains below the value of the standard for eggs to be packaged in standardized packaging (**Smith, 1992**). **Fayeye et *al*., (2005)** in Morocco found values of 35.24 and 23.59 mm respectively for the length and width of eggs of local breeds. The size, age, health status and weight of the hen are factors influencing the egg shape index (**King'ori, 2012**).

Table 1 External physical characteristics of eggs

	Populations					
	White	Yellow	Nouar el foul	Naked neck	ESM	p
Weight of the egg (g)	49.12b	54.13a	52.77a	53.45a	4.14	0,03
Length of the egg (mm)	54.10b	57.75a	56.83a	57.00a	3.40	0.045
Width of the egg (mm)	40.80b	42.63a	42.00a	42.33a	1.21	0.003
Shape index	75.51b	74.72a	74.58a	74.34a	3.58	0.020
Averages followed by different letters are significantly different						

3.2 Internal physical characteristics of eggs

The weight of the shell between the 04 local hen populations is segmented into two groups with a significant difference p <0.043. Nouar el foul and Naked neck populations claim higher shell weights with 6.74g and 6.66g, respectively (Table 2). **Halbouche et *al*., (2009)** advance in their study on the eggs of local populations and neck in northwestern Algeria, results of 6.5g, which remain below our results. **Samandoulougou et *al*., (2016)** in their study of local and improved breed eggs consumed in Ouagadougou, Burkina Faso, give results of 4.44 g for the local hen and 6.62 g for the improved breed. **Moula (2012)**, on the Kabyle hen records shell thickness results between 4,72 and 5,34g. **Moula et *al*., (2015)** on breeds of local Belgian hens advance results of the same order. Shells of low weight are more favorable for gas exchange with the external environment which induces a shorter shelf life of eggs (**Nys and Sauveur, 2004**).

The thickness of the shell remains low (about 0.52mm) for the Yellow, Nouar el foul and Neck populations compared to the white population with 0.61mm. It seems that the weight of the shell evolves inversely proportional to the thickness of the latter. The percentage of albumen is similar for yellow populations, Nouar el foul and bare neck (about 53%) and is larger than that of the white population (50%). This value is similar to that advanced by **Moula et al., (2010)** and **Sreenivas et *al*., (2013)**. The weight of the egg albumen of this population being the least expressive (24,54g). The percentage of yolk is dominant among the Blanche, Nouar el foul and Naked neck populations (around 34%) compared to 31% for the Yellow population. These results are beyond the results advanced by **Dahloum et al., (2015)** for the Algerian local populations and those of **Nys and Sauveur (2004)** for laying eggs in France. It should be noted that this criterion is often taken into account in the context of commercial selection (**Beaumont et *al*., 2010**).

Table 2 Internal physical characteristics of eggs

	Populations					
	White	Yellow	Nouar el foul	Naked neck		
Weight of the shell	6.01b	6.10b	6.74a	6.66a	0.65	0.043
Albumen weight	24.54b	29.60a	27.70ab	28.86a	3.61	0.007
Yolk weight	16.96b	16.92b	18.08a	18.78a	2.10	0.022
Albumen height	5.25	5.22	5.86	5.43	0.86	0.67
Height of the yolk	15.37	15.44	17.66	17.40	3.09	0.376
Diameter of yolk	41.8a	36.7b	36.7b	37.2b	2.69	0.048
Index of yolk	36.77c	42.07b	48.12a	46.77a	3.32	0.02
Thickness of the shell (mm)	0,61a	0,54b	0,53b	0,51b	0.84	0.049
Unit of Haugh	75.00	79.94	78.38	74.56	6.28	0.23
Percentage of albumen	50,00b	54.71a	52.50a	53.94a	4.53	0.012
Percentage of yolk	34.55a	31.21b	34.56a	34.97a	3.23	0.046
Percentage of shell	12.24	11.46	12.92	12.47	1.31	0.145
Yellow / White ratio	69.35a	57.45b	66.64ab	65.08ab	9.02	0.023
pH of the albumen	10.06	9.97	9.87	9.67	0.19	0.426
Color of yolk	9.1	9.33	8.57	9.29	1.53	0.782

Averages followed by different letters are significantly different

3.3 Eggs incubation parameters

The egg fertility rate of the Naked Neck population is the highest with 90% (p<0,029). That of the populations White and Nouar el foul with 70% remains intermediate. The Yellow population is the least representative with 65%. This rate is related to the rooster's reproductive capacity and the fertility of the hen. It is very variable and depends on the level of breeding. The hatching rate for all the population remains low (<50%) because of a high embryonic mortality rate.

Table 3 Egg incubation parameters

	Populations					
	White	Yellow	Nouar el foul	Naked neck	ESM	p
Fertility	70b	65c	70b	90a	4.43	0.029
Hatching rate	40b	25c	50a	50a	4.95	0.033
Embryal Mortality	30b	40a	20c	40a	3.47	0.05

Averages followed by different letters are significantly different

4. Conclusion

The four local farm chicken populations show variability in the physicochemical characteristics and egg incubation parameters that would be interesting to use for breeding purposes.

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