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RESEARCH ARTICLE

CHARACTERISTICS OF LOCAL GUINEA FOWL (*NUMIDA MELEAGRIS*, L.) EGGS IN BURKINA FASO

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Abstract

Eggs are an important source of animal protein for humans. However, their physico-chemical and nutritional characteristics vary across and within breeds. The aim of this study was to determine the physico-chemical and nutritional quality of 109 eggs from local guinea fowl (*Numida Meleagris*, L.) in Burkina Faso. For that purpose, the following parameters were collected for each egg: egg weight albumen, yolk, and shell weights, egg length and width, pH, shape, and coloration of the shell and yolk. The physical parameter values analyzed showed that local guinea fowl lay small eggs with average weight of 34.91 ± 3.33 g. The length and width were 46.95 ± 2.48 mm and 36.80 ± 1.09 mm, respectively. The egg a shape index was 0.79. The majority of eggs were oval in shape (90.83%) and reddish in color (70.64%). The albumen, yolk, and shell weighed on average 14.79 ± 3.47 g, 13.17 ± 2.28 g, and 5.95 ± 0.84 g respectively. The majority of eggs had a pH ranging between 9 and 10 for the yolk and around 7 for the albumen. The yolk had a light-yellow color with an average index of 4.66. Water and ash contents were higher in the albumen than in the yolk and while the dry matter content was higher in the yolk. These results, although limited in terms of the number of parameters studied, represent a very interesting basis for assessing the nutritional quality of local guinea fowl eggs consumed by Burkina Faso population.

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Introduction-

In most African countries south of the Sahara, poultry farming is an important source animal protein and income to the local population. It plays an important role in the lives of rural families (Sanfo *et al*., 2012; Zaaboube et Benrahou, 2014). Meleagriculture (guinea fowl rearing) has been particularly popular in West Africa in recent years (Sanfo *et al*., 2012). In Burkina Faso, guinea fowls rank second after chickens in terms of population size. In fact, guinea fowls represent 19.2% (6,117,826 heads) of the total poultry population in Burkina Faso (FAO, 2019). Guinea fowls play an important nutritional, social, and economic role in rural Burkina Faso. It is a primary source of household income in rural areas (Sanfo *et al*., 2012; Dahloum *et al*., 2015). In terms of it is contribution to food security, guinea fowls are the subject of considerable speculation because their meat and eggs are highly prized by the local populations (Halbouche *et al*., 2010; Traoré *et al*., 2018). Eggs are a cost effective and a high-quality source of animal proteins. Thus, eggs are crucial for food security and for the alleviation of malnutrition and undernourishment in several areas of the world (Rehault-Godbert *et al*., 2019). Guinea fowl's eggs are rich in protein, healthy fats, vitamins, essential minerals, enzymes, antioxidants, and other biologically active materials including growth and defense factors (immunoglobulins) (Pamplona-Roger, 2004; Ruxton, 2010; Rehault-Godbert *et al*., 2019). Eggs have been consumed by humans for many centuries and they are considered to be as one of the healthiest and safest food and for individuals of all ages (Clayton *et al*., 2017; Rehault-Godbert *et al*., 2019). Chicken, guinea fowl, quail, and duck eggs are the most consumed poultry eggs (Aronu *et al*., 2021). Consumption preferences for eggs of a given species would be based on the knowledge of their physico-chemical characteristics, nutritional and therapeutic qualities on one hand, and their availability and cost on the other (Orlich *et al*., 2014; Gibson and Gray, 2020). In Burkina Faso, the number of local guinea fowl eggs consumed is only second to those of local chicken breeds. Furthermore, they are much more preferred by consumers. However, there is no available scientific information on the physical, chemical, and nutritional qualities to support the consumer preference to guinea fowl eggs. The chemical composition and nutritional qualities of eggs vary according to species and breeds, rearing conditions, and environmental conditions (Trziszk *et al*., 2004; Giannenas *et al*., 2009). Data on the physico-chemical and nutritional characteristics of local guinea fowl eggs are almost non-existent in the scientific literature. The general objective of this study is therefore to assess the physico-chemical characteristics of local guinea fowl (*Numida meleagris*, L.) eggs in Burkina Faso. It will provide producers and consumers with useful information on the physico-chemical and nutritional quality of local guinea fowl eggs in order to better meet their preferences.

Material and Methods

Material

Study area

The study was carried out over a three-month period (June to August 2020) at the Centre de Recherches Environnementales, Agricoles et de Formation de Kamboinsé (CREAF-K) located a dozen kilometers north of Ouagadougou. The experiment took place in the Animal Production and Health Research Laboratory (LaRePSA).

Biological material

The biological material used was the eggs of the local guinea fowl (*Numida meleagris*). A total of 109 local guinea fowl eggs from different provinces were randomly collected directly from local markets and transported in cardboard trays to the laboratory. A preliminary candling test was carried out, followed by an immersion test to select only fresh eggs for analysis. The eggs were stored in plastic trays and transported to the laboratory to be stored in a refrigerator.

Technical equipment

Weight measurements were taken using an electronic precision balance with a maximum capacity of 500 g and a sensitivity of 0.0001 g. Metric data (length and large diameter) of the egg were collected using an electronic micrometer calibrator, with a range of 150 mm and a sensitivity of 0.01 mm. Other technical laboratory equipment used included Petri dishes, crucibles, incubators, ovens, single-use pipettes, a graduated beaker, scalpel blades, a pH meter, a desiccator, a DSM colorimetric fan (for egg yolk), NaCl and water.

Méthodes

Visual examination and measurement of the whole egg: Each pre-identified egg was inspected by visual examination to determine its shape (oval, round, or elongated). Measurements were taken for height (length), the distance between the large end and the small end of the egg, and for widthwhich is measured at the large diameter of the egg. Eggs were individually weighed using a precision electronic balance.

Egg densimetry
The densimetry technique used in this study to assess egg freshness consisted of immersing the egg in a 10% NaCL concentrated solution. As the density of a fresh egg is slightly greater than 1, it does not float in either ordinary or salt water. But as the egg ages, the inner tube enlarges and its density decreases. The egg will eventually float in ordinary and salt water.

Evaluation of the egg components weight
The weights of yolk, spawn, and shell were measured after carefully separating the spawn and yolk in a sterile Petri dish, identified and weighed empty. The pH of the albumen and yolk was obtained by inserting the end of a paper strip into the albumen or yolk. After about 30 seconds, the reading was taken by comparison with a colorimetric scale. The color of the yolk, after separation from the albumen, was determined using the DSM Yolk Color Fan on a scale of 0 to 14.

Determination of Dry Matter and Mineral Matter
The dry matter (DM) and ash (AS) of the albumen and yolk were evaluated. The dry matter (DM) content was determined in accordance with French standard NF V O3-707 (2000), by placing 5 g of eachsample in an oven at 105°C for 12 h. Ash (EC) was obtained in accordance with international standard IS0 2171 (2007) by mineralising the samples in an oven at 550°C for 12 hours. Each crucible was previously identified by a number. Two 5 g samples were taken from each egg component to obtain an average dry matter or ash content. For the dry matter, after taking the empty weight (ew) of the Petri dishes and crucibles, the balance was tared to 5 g (pe) of the sample (yolk, white, or mixture). The samples were then placed in an oven at a temperature of 105°C for 24 hours. Finally, the sample were transferred to a desiccator (to prevent moisture) and weighed after cooling to obtain the dry weight, dw (weight MS including ew). The weight as a percentage of the DM is obtained using the following formula:

$$\%\,\mathbf{DM} = \frac{\mathbf{dw - ew}}{\mathbf{pe}}\mathbf{x100}$$

The mineral matter was obtained by placing the crucibles used for MS determination in the oven. Ash (AS) was obtained in accordance with international standard IS0 2171 (2007) by mineralizing the samples in the oven at 550°C for 12 hours. The Ash obtained was transferred to a desiccator and then weighed to obtain the pc weight (weight of ash including ew). The percentage of MM was obtained using the following formula:

$$\mathbf{AS}\,(\%) = \frac{\mathbf{pc - ew}}{\mathbf{pe}}\mathbf{x100}$$

Data processing and analysis
All the study data were stored in an excel spreadsheet. The data entered were analyzed using R software version R.5.3.3 (ref). The analyses consisted in obtaining descriptive and summary statistics (means, standard deviations, coefficients of variation, and frequency coefficients).

Results
External qualitative and quantitative characteristics of guinea fowl eggs: Most of the eggs were oval (90.83%), followed by oblong (7.34%), and round (1.83%). The color of the eggshell was distributed between white (1.84%), dirty white (25.68%), russet (70.64%), and brown (1.84%). Of all eggs collected, 60.55% were fresh and were used in the various analyses. The external quality characteristics of guinea fowl eggs are shown in Table 1.

Table 1:- Characteristics of external quality parameters of local guinea fowl eggs.

Shape (%)	Oval	90.83
	Oblong	7.34
	Round	1.83
Color (%)	White	1.84
	Dirty white	25.68
	Russet	70.64
	Brown	1.84
Freshness (%)		60.55

The average egg weight was 34.91 g. Egg length and width averaged 46.95 mm and 36.8 mm respectively, with an average shape index of 0.79 (Table 2).

Table 2:- External quantitative parameters of local guinea fowl eggs.

Characteristic	Mean	Standard Deviation	Coefficient of variation
Weight (g)	34.91	3.33	9.55
Egg length(mm)	46.95	2.48	5.28
Egg width (mm)	36.8	1.09	2.96
Shape index (%)	0.79	0.43	5.51

Internal qualitative and quantitative characteristics of guinea fowl eggs: The pH was 9.19 and 7.01 for the egg white and yolk respectively. The average color of the guinea-fowl egg yolk was 4.66. The average weight of the yolk, white and shell was 13.17 g, 14.79 g and 5.95 g respectively (Table 3).

Table 3:-Internal quality parameters of local guinea fowl eggs.

Characteristic	Mean	Standard Deviation	Coefficient of variation
White pH	7.01	0.12	1.71
Yolk pH	9.19	0.66	7.18
Yolkcolor	4.66	1.28	27.46
YolkWeight (g)	13.17	2.28	17.31
White Weight (g)	14.79	3.47	23.46
Shell weight (g)	5.95	0.84	14.11

Chemical characteristics of local guinea fowl eggs:
For local guinea fowl eggs produced in Burkina Faso, the average values of the chemical parameters of the yolk dry matter (43.00%). The egg white had higher water (85.60%) and ash (8.00%) contents than the egg yolk (57.00% water and 6.00% ash).

Table 4:- Chemical parameters of local guinea fowl eggs.

Chemical characteristic (in %)		Mean ± SD
White	Dry matter (n=66)	14.40 ± 0.13
	Water (n=66)	85.60 ± 0.13
	Ash (n=5)	8.00 ± 0.01
Yolk	Dry matter(n=66)	43.00 ± 0.34
	Water (n=66)	57.00 ± 0.34
	Ash (n=5)	6.00 ± 0.01

Discussion

Egg freshness

The results of this study show that over 60% of the eggs were fresh, compared with only 40.45% floating in a 10% NaCl solution. These results are close to those obtained by Bijve (2006) who reported a freshness rate of around 63%. However, our results are lower to those reported by of Saïdou-Alzouma (2005) who obtained an average of 91.25%, 100% and 100% for eggs from Niger, Nigeria and Ghana respectively. The existence of non-fresh eggs can be explained partially by the storage conditions and the time elapsed since they were laid which are associated with an increased air chamber of the eggs resulting therefore in a decrease in their density compared to that of the solution.

External Characteristics of Eggs

The external egg characteristics of the large diameter, length, weight and shape index revealed that local guinea fowl lay small eggs. The average egg weight (34.91 ± 3.33 g) is within the range of 34.0 to 45.7 g reported by Alkan *et al*. (2013). However, these results are lower than the the around 39.0 g reported by Sanfo *et al*. (2012) and Bouda (2017). With regard to egg length, the average value (46.95 mm) obtained in this study for local guinea fowl eggs is similar to the value of 47.6 mm reported by Sanou (2005). However, it is higher than the value of 37.1 mm reported by Sanfo *et al*. (2012) in Burkina Faso. The egg length value obtained in this study is lower than the average of 49.47 mm reported by Alkan *et al*. (2013). The average eggs width found in this study (36.8 mm) is is similar to the

37.3 mm reported by Sanou (2005). Across the egg external characteristics, these differences are likely to be linked to environmental factors, genetic variability, the start of laying, the laying period and the protein content of the feed (Sauveur, 1988). The egg shape index (0.79) is higher than the 0.71 and 0.75 (Gendron and Blentz, 1970). The shape index is used to calculate the mechanical strength of the shell (Kingori, 2012) and the value obtained in this study supports the idea that local guinea fowl eggs are more resistant to breakage than local hen eggs.

The eggshell color of the eggs recorded in this study is highly variable. The diversity of eggshell color is linked to genetic variability in guinea fowl, according to the hypothesis of Mertens *et al*. (2010). According to these authors, eggshell color and shape depend above all on genetic factors, but can also be influenced by diseases, rearing conditions, and specific environmental factors.

Internal Characteristics of Eggs

On the internal quality, the yolk of local guinea fowl presented an average index of 4.66. This result is lower than that reported by Houndonougbo *et al*. (2014) in Benin. This difference in coloration could be explained by the guinea fowl diet and the variability of strains, which differ from one country to another. The yolk and albumen weights recorded in this study are close to those reported by Houndonougbo *et al*. (2014). The pH values found in this study were 9.19 and 4.01 for white and yolk respectively. The pH is a parameter for assessing the quality of egg white and yolk. Similar results were reported by Mertens *et al*. (2010) who reported that egg white pH is a better indicator of egg freshness than albumen height.

Egg Chemical Parameters

Our results showed that water, dry matter, and ash content of guinea fowl egg white varied between the yolk and egg white. In fact, the yolk dry matter (43.00%) was significantly higher than that of the albumen (14.40%) for local guinea fowl eggs from Burkina Faso. The egg white had higher water (85.60%) and ash (8.00%) contents than the egg yolk (57.00% for water and 6.00% for ash). Bashir *et al*. (2015) reported that the water content of poultry egg yolk, such as duck, quail and hen, is between 44.73 and 49.85%, while that of egg white is between 82.63 and 87.36%. These results corroborate our findings.

Conclusion

This study shows that guinea fowl eggs, although small in terms of weight, are an important source of minerals in their constituent media (egg white and yolk). The yolk is recognized as the most important constituent of the egg because it is packed with nutrients essential for the embryonic development of the chicks. Our study revealed the good nutritional and chemical quality of local guinea fowl eggs consumed in Burkina Faso. However, the significant rate of non-fresh eggs recorded during our analyses shows that storage conditions need to be improved to avoid potential health problems. At the production level, a balanced and sufficient diet is needed to improve the quality of the eggs laid (weight, shell quality, and yolk color). Compliance with chicken coop density and proper handling of eggs during collection are also criteria for guaranteeing good egg quality. As far as marketing is concerned, we need to ensure that storage conditions are respected and that marketing times are shortened. Although the production of eggs for consumption is increasing considerably in Burkina Faso, it is not enough to produce a lot of eggs. In order to achieve a high rate of eggs of better external and internal quality, an egg quality control system is needed and requires the full involvement of veterinary and health services at all stages, and the training for those working in the industry. Assessing the safety and microbiological quality of local guinea fowl eggs is an important area of research that needs further attention.

Reference Bibliographique

1. Alkan S., Karsli T., Galiç A. et Karaba K., 2013. Determination of phenotypic correlations between internal and external quality traits of guinea fowl eggs. *Kafkas Univ. Vet. FakDerg*., 19 (5): 861-867.
2. Aronu C. J., Aronu C. G., Morgan A., Ugwu P. C., Ihedioha J. I., 2021. Comparative Evaluation of The Nutrient Content of Table Eggs of Chicken. Guinea Fowl and Quail. *Tropical Vet*. 39 (2). 66-75.
3. Bijve Y., 2006. *Etude l'évolution des œufs de consommation dans les conditions de stockage naturelles*. *Thèse Méd. Vét.*: Dakar. 17
4. Bouda S., 2017. *Caractérisations zootechnique et morphobiométrique des écotypes de pintades (*Numida meleagris*) du Sahel et du Centre-Ouest du Burkina Faso*. Mémoire d'ingénieur du développement rural. Option « élevage ». IDR/Université Nazi BONI Bobo - Dioulasso. 98p.

5. Clayton. Z., Fusco. E., Kern. M., 2017. Egg consumption and heart health: a review. *J. Nutr*. 37. DOI : https://doi.org/10.1016/j.nut.2016.12.014
6. Dahloum L., Halbouche M. et Arabi A., 2015. Evaluation de la qualité des œufs chez deux phénotypes de poules locales : cou nu-frisées et normalement emplumées : Comparaison avec les œufs de souche commerciale. *Revue Agriculture*. 09: 10-18.
7. FAO (Food and Agriculture Organization). 2019. *Le devenir de l'élevage au Burkina Faso. Défis et opportunités face aux incertitudes*. Rome. Italie. 56p.
8. Gendron M. et Blentz G., 1970. La qualité de l'œuf de consommation. *Nouv. Avic. Suppl*., (125): 1-28.
9. Giannenas I., Nisianakis P., Gavriil A., Kontopidis G. and Kyriazakis I., 2009. Trace mineral content of conventional. organic and courtyard eggs analyzed by inductively coupled plasma mass spectrometry (ICP-MS). *Food Chem*. 114:706-711.
10. Gibson. S. and Gray. J., 2020. Evaluating current egg consumption patterns: association with diet quality. nutrition. and health status in the U.K. National diet and nutrition survey. *Nutrition Bulletin*, 45. DOI: https://doi.org/10.1111/nbu.12462
11. Halbouche M., Didi M., Bourezak N. et Lamari S., 2010. Performance de ponte de reproduction et de croissance de la pintade locale (*Numida meleagris*) en Algérie. *European Journal of Science Research*, 47 (3): 320-333.
12. Houndonougbo P. V., Chrysostome A. A. C., Houndonougbo M. F., Hedi A., Bindelle J. et Gengler N., 2014. Evaluation de la qualitéexterne et interne des œufs de cinq variétés de pintades locales élevées au Bénin. *Rev. Cames*. 2 (2) : 42-47.
13. Kingori A. M., 2012. Poultry egg external characteristics : egg weight, shape and shell color. *Res. J. Poult. Sci*. 5 (2) : 14-17.
14. Mertens K., Perianu C., Kemps B., De Ketelaere B., Decuypere E. et De Beardemacker J., 2010. Nouvelles techniques non invasives d'évaluation de la qualité de l'œuf. Jeudis WPSA France. 14p.
15. Orlich. M. J., Jaceldon-Siegl. K., Saate. J, Fan. J., Singh. P. N. and Fraser. G. E., 2014. Patterns of food consumption among vegetarians and non-vegetarians. *Br. J. Nutr*. 112: 1644–1653.
16. Rehault-Godbert. S., Guyot. N. and Nys. Y., 2019. The golden egg: nutritional value bioactivities and emerging benefits for humam health. *Nutrients*, 11: 684.
17. Ruxton C., 2010. Recommendations for the use of eggs in the diet. *Nursing standard* 24:47–55. doi.org/10.7748/ns2010.05.24.37.47.c7780.
18. Saïdou-Alzouma A., 2005. *Contribution à l'étude de la qualité des œufs de consommation vendus au Niger : cas de la communauté urbaine de Niamey*. Thèse Méd. Vét. : Dakar ; 17
19. Samandoulougou S., Ilboudo A. J., Sanon/Ouédraogo G., Bagre T. S., Tapsoba F. W., Compaore H., Dao A., Zoungrana A., Savadogo A. et Traore A. S., 2016. Qualité physico-chimique et nutritionnelle des œufs de poule locale et de race améliorée consommés à Ouagadougou au Burkina Faso. *Int. J. Biol. Chem. Sci*. 10 (2): 737-748.
20. Sanfo R., Boly H., Sawadogo L. et Brian O., 2012. Performances de ponte et caractéristiques des œufs de la pintade locale (*Numida meleagris*, L.) ensystème de conduiteaméliorée dans la régioncentre du Burkina Faso. *Revue d'élevage et de médecinevétérinaire des pays tropicaux*. 65 (1-2): 25-29.
21. Sanou L. C., 2005. *Caractéristiques des œufs de la pintade locale (*Numida meleagris*, L.) et leurs relations avec les paramètres d'incubation, la croissance et la viabilité des pintadeaux*. Mém. Dipl. Ing. Dev. Rur. ; Institut du Développement Rural/Université Nazi BONI, Bobo- Dioulasso. 61p.
22. Sauveur B., 1988. *Reproduction des volailles et production d'œufs*. Paris: INRA. 1988. 449 p.
23. Traoré F. G., Traoré A., Bayala B., Dayo G. K., Tapsoba A. S., Soudré A., Sanou M., Tindano K. and Tamboura H. H., 2018. Characterization and typology of Guinea fowl (*Numida meleagris*) farming systems in Burkina Faso. *Int. J. Adv. Res*., 6 (1): 6-21. DOI: http://dx.doi.org/10.21474/IJAR01/6177.
24. Trziszk A T., Dobrzańsk I. Z., Oziembłowski M., Jarmoluk A. and Krasnowska G., 2004. An attempt to compare the quality of chicken eggs from cage system and ecological production. *Arch. Geflügelk*, 68 (6): 269-274.
25. Zaaboube H. et Benrahou A., 2014. *Etude de la conformation et de la composition des œufs de la poule locale : comparaison avec les œufs de souche commerciale*. Mémoire Ingénieur d'Etat, Université Abou Bekr Belkaid – Tlemcen. 69 p.