IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB)
ISSN: 2455-264X, Volume 7, Issue 4 (Jul. – Aug. 2021), PP 52-59
www.iosrjournals.org

Histological Study of the Gonads of the Chicken *Gallus Gallus*ofBochibolochie Race in Ivory Coast

Gnonsoakala Emmanuel YOE [1, 2] ; Camille Mahn YORO [1, 2] ; Jean Jacques MIESSAN[1] ; Marie Anne d'ALMEIDA[1] ; Komenan Daouda KOUASSI[1] ; et JosephAllico DJAMAN[2].

[1]*Laboratory of Cell Biology,*
[2]*Laboratory of pharmacodynamics-biochemistry.*
UFR Biosciences- Université Félix Houphouët- Boigny (Côte d'Ivoire).
22 BP 582 ABIDJAN 22. (Ivory Coast)

Abstract
Background: *Several studies on chicken reproduction have been conducted in most continents. However, on the African continent, particularly in Côte d'Ivoire, few similar studies have been conducted. The objective of the present work is the histological study of the gonads of the rooster Gallus gallus.*
Materials and methods: *A specimen of Gallus gallus roosters of the so-called Bochibolochie breeds collected in Côte d'Ivoire was first euthanized and then dissected in order to perform a histological study of the gonads of the Gallus gallus rooster. Histological treatments and observation with a light microscope allowed the study of the gonads of the rooster Gallus gallus.*
Results: *Histologically, the testes of the Gallus gallus are composed of an albuginea, anastomosing seminiferous tubules and interstitial tissues from the outside to the inside. The albuginea covers several seminiferous tubules each containing cells at different stages of maturation. These tubes are contiguous and separated by interstitial tissue.*
Conclusion: *The seminiferous tubules as well as the interstitial tissues are the main constituents of the gonads of the rooster Gallus gallus and play an essential role in spermatogenesis. The location of the reproductive organs of the rooster Gallus gallusdomesticus, the arrangement of the testicular tissues would confer to this one or even to all the birds physiological adaptations such as flight, song, oviparity which would allow to ensure the reproduction in these birds. These adaptations are different from those of most mammals.*
Key words :*histology, gonads, rooster, Gallus gallus.*

Date of Submission: 10-07-2021 Date of Acceptance: 26-07-2021

I. Introduction

Chickens are terrestrial, non-migratory birds capable of short-distance flight[1]. Among them, the domestic chicken *Gallus gallus* is the best known species because of its food and economic importance[2]. Indeed, the chicken is considered one of the oldest domesticated birds, with the subspecies *Gallus gallusdomesticus* being the most widespread with a total of 300 breeds worldwide[3]. Thus, the domestic or African chicken is a male or female poultry, of the *Gallusgallus*, raised for the production of white meat and eggs[4]. According to[5], the breeding of African chickens is a way to produce animal proteins to face food insecurity. In addition, chicken occupies a special economic and social place with a production ensuring more than 86% of meat products of poultry origin[6]. According to[7], the meat of local chickens is more appreciated by consumers. Therefore, domestic poultry *Gallus gallus*domesticus serves as an important source of food intake for humans[8,9].

According to[10], breeding techniques such as artificial insemination have been developed for most farmed birds. However, in local breed chickens or African chickens (*Gallus gallusdomesticus*), natural mating or coocking is preferred to artificial insemination which is mainly used by breeders.

African chickens are therefore of mixed advantage. Despite the low yield, these chickens are highly valued in traditional breeding because of their great hardiness, which offers them better adaptation to different environmental conditions and good resistance to the usual diseases encountered in improved breeds[11].

In Ivory Coast, 70% of the poultry population comes from the family sector and 30% from the modern sector for the production of white meat and eggs[12]. Poultry from the family poultry sector are also used for self-consumption and marketing, which concerns more than half of the Ivorian population, both for nutritional purposes and to improve their income. According to studies conducted by the National Institute of Statistics,

rural households spend more than 60% of their budget on food, so necessarily the share of income from family poultry farming is used primarily for food[13].

However, despite the important socio-economic and cultural role played by local chickens, data on African chickens remain basic and insufficient. According to the literature, there is almost no data on African chickens, especially those from Ivory Coast. It is in this context that studies on the chicken *Gallus gallus* have been initiated in the laboratories of Cell Biology and Pharmacodynamics-Biochemistry at the University Felix HouphouetBoigny. The present works are carried out in order to have a reliable database concerning the African chickens. The general objectives are the study of the different organs of the chicken *Gallus gallus* of bochibolochie race. But the present article is only related to the study of the gonads of the rooster *Gallus gallus* at the histological level in order to highlight their structural organization and to deduce their physiology.

II. Materials And Methods

Biological material

The biological material concerns the roosters*Gallus gallusdomesticus*of African race, adult and aged of 72 weeks. The sampling was done at the markets of Cocody, Bingerville, Abobo and Yopougon in Abidjan and at some farms in Odienné in Ivory Coast. On these markets and in these farms, the poultry are fed ad libitum with a feed consisting of corn bran mixed with pellets from the company IVOGRAIN.

Macroscopic method

The animals were photographed with a Lumix 12 pixels digital camera and a FUJIFILM 12 pixels digital camera. The observation of the testicles of the specimens was done with the naked eye after dissection.

Anesthesia method

The testicles were revealed after dissection. For this purpose, the animals were anesthetized and euthanized. Anesthesia was performed by introducing the animals under an anesthesia bell containing cotton soaked in ether. After falling asleep, the animal was euthanized.

Dissection method

For dissection, the animal was laid on its back and a longitudinal antero-posterior slit was made on the ventral side. The skin, muscles, and skeleton were successively spread to expose the internal organs. After opening, the systems observed are respectively the digestive system, the respiratory system. These last ones are separated in order to highlight and the reproductive system the object of our study. Once exposed and the reproductive system was photographed in toto using a digital camera brand Lumix 12 pixels and another brand FUJIFILM 12 Pixels for the anatomical study. After photography, the latter were taken immediately and fixed in aqueous Bouin for histological studies.

Histological method

For the present work, the techniques used by[14] were used as reference. The testicles, as soon as they were collected, were immediately fixed by immersion in aqueous Bouin. They were successively dehydrated in ethanol baths of increasing degree: 70°, 95° and absolute ethanol (100°). The parts were then pre-impregnated in baths consisting of the 100° ethanol and butanol mixtures of increasing volume. The baths are successively ¼ butanol and ¾ ethanol 100°, ½ butanol and ½ ethanol 100°, ¾ butanol and ¼ ethanol 100°. The last bath is pure butanol. Since the butanol was a holding bath, the parts were the next day pre-impregnated in liquid kerosene prepared for this purpose. The impregnation itself is done in the oven at 60°C in three successive baths of liquid kerosene (Paraplast brand: MONOJECT scientific). The embedding is done with the same medium. Sections of 7 µm were made with a MICROM HM 310 microtome. The sections were also collodionized (Collodion 4%, Merk) to avoid their detachment. The slides resulting from these treatments were stained with hemalun and eosin. The observation and the photographs were made with an OLYMPUS CKX 41 photomicroscope adapted to a DELL computer with the optica software.

III. Results

General view of the chicken Gallus gallus before dissection and observation of the testicles after dissection

The males of the African breed "Bochibolochié" have a variable plumage with a white and well-developed tail (Figure 1). The testicles are paired, undeveloped, whitish in color, bean-shaped and directly cover the kidneys (Figure 2).

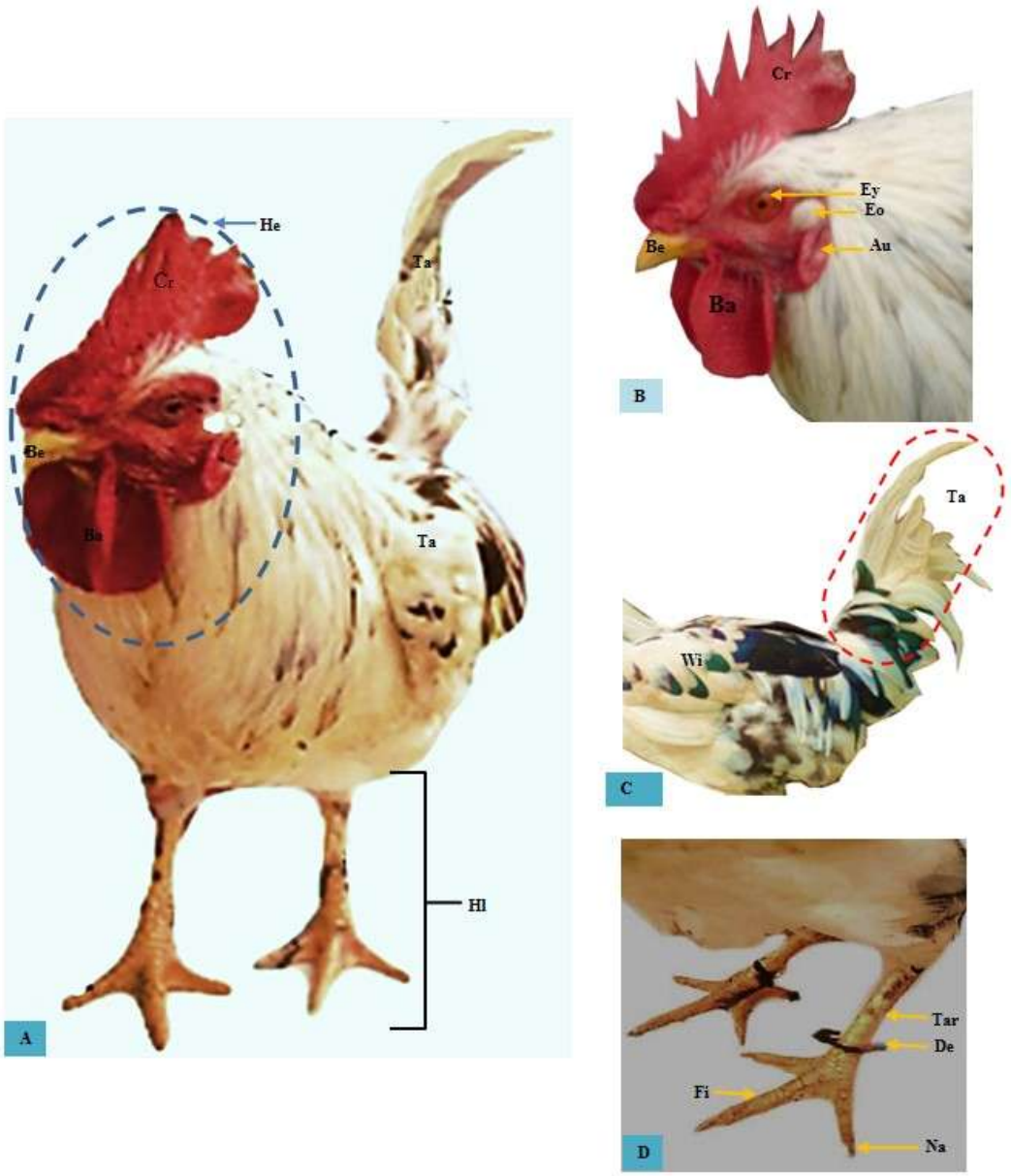

Figure 1 : Morphology of *Gallus gallusdomesticus*

A: General morphology. B: Morphology of the head. C : Morphology of the tail.
D : Morphology of the hind legs.
Tê : head ; Cr : crest ; be : beak ; Oe : eye ; ba : barb ; Ori : ear opening ;
Or : auricle ; Qe : tail ; Ma : forelimbs ; Ai : wing ; Mp : hindlimbs ; Tar : tarsus ;
Do: fingers; on: nail; Er: dewclaw.
Magnification : G x 1/5

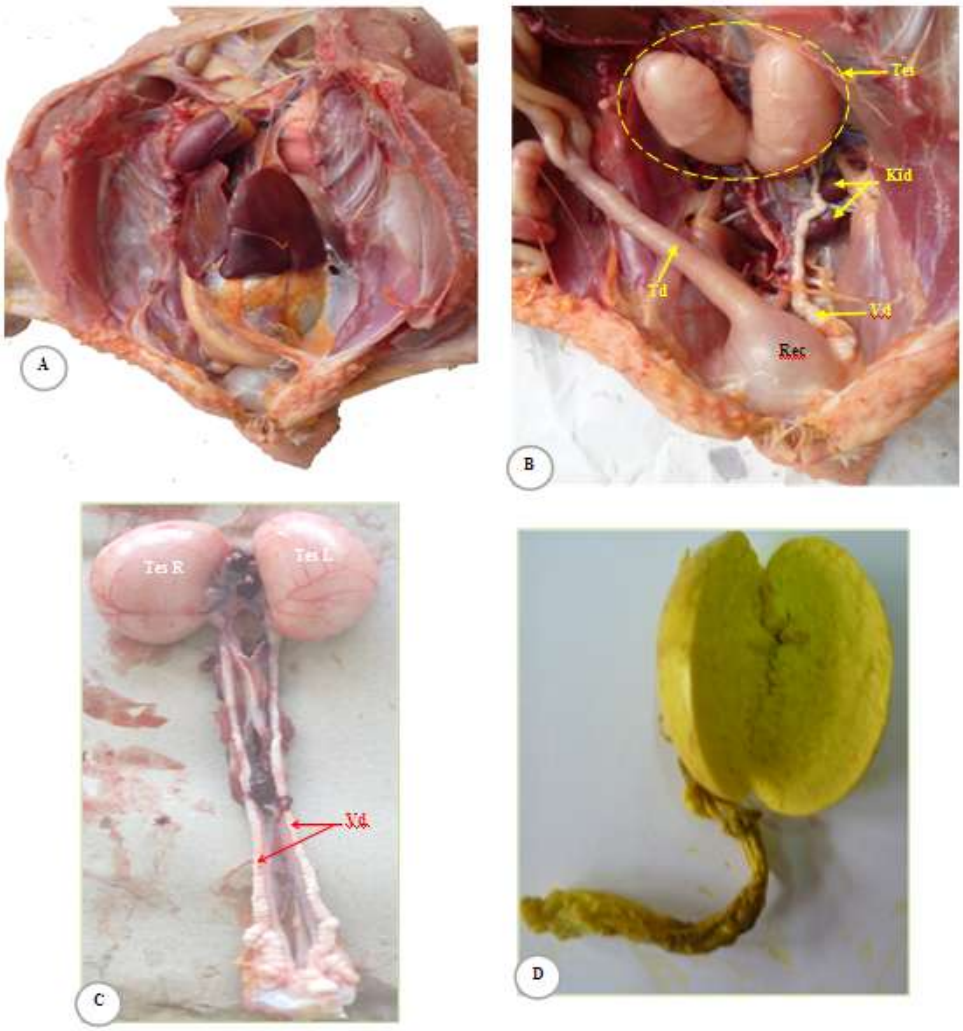

Figure 2: Anatomy of the reproductive system

A: General view of the organs covering the reproductive system
B: Reproductive organs in toto covering the kidneys;
C: isolated reproductive organs
D: Isolated and fixed reproductive organs
Tes: testicles; Tes L: left testicle; Tes R: right testicle; Vd: vas deferens; Re: kidney; Td: digestive tract; Rec: rectum
Magnification : A; B: G x 1/10; C, D: G x 1/5

Histology of the gonads of the *Gallus gallus*

Microscopic observation of the longitudinal section of the testis or gonad of *Gallus gallus* shows from outside to inside a thick layer covering several differently shaped and anastamosing seminiferous tubules (Figure 3 A). Between two or three contiguous tubes is an interstitial tissue containing leydig cells (Figure 4 B).

The thick layer of about 200 µm is the albuginea, which consists of three layers, two of which are fibrous layers separated by dense connective tissue (Figure 3 B). The seminiferous tubules are at different stages of maturation. Mature seminiferous tubules have a lumen while immature ones do not. The wall of the mature seminiferous tubule is up to about 300 µm thick.

From the outside to the inside of the seminiferous tube, a vitreous is observed; surmounted by the germinal epithelium. The seminiferous tube contains cells at different stages of evolution (Figure 4 A).

From the periphery toward the lumen, germ cells are observed (Figures 4 C and D):

-the spermatogonia, round-shaped with condensed nuclei;

-spermatocytes, round with a large nucleus

-spermatids, oval in shape and with small dense nuclei are close to the light.

-spermatozoa with an elongated shape and a flagellum and a head are in the lumen. Sertoli cells of oval shape with an oval nucleus are scattered in the wall.

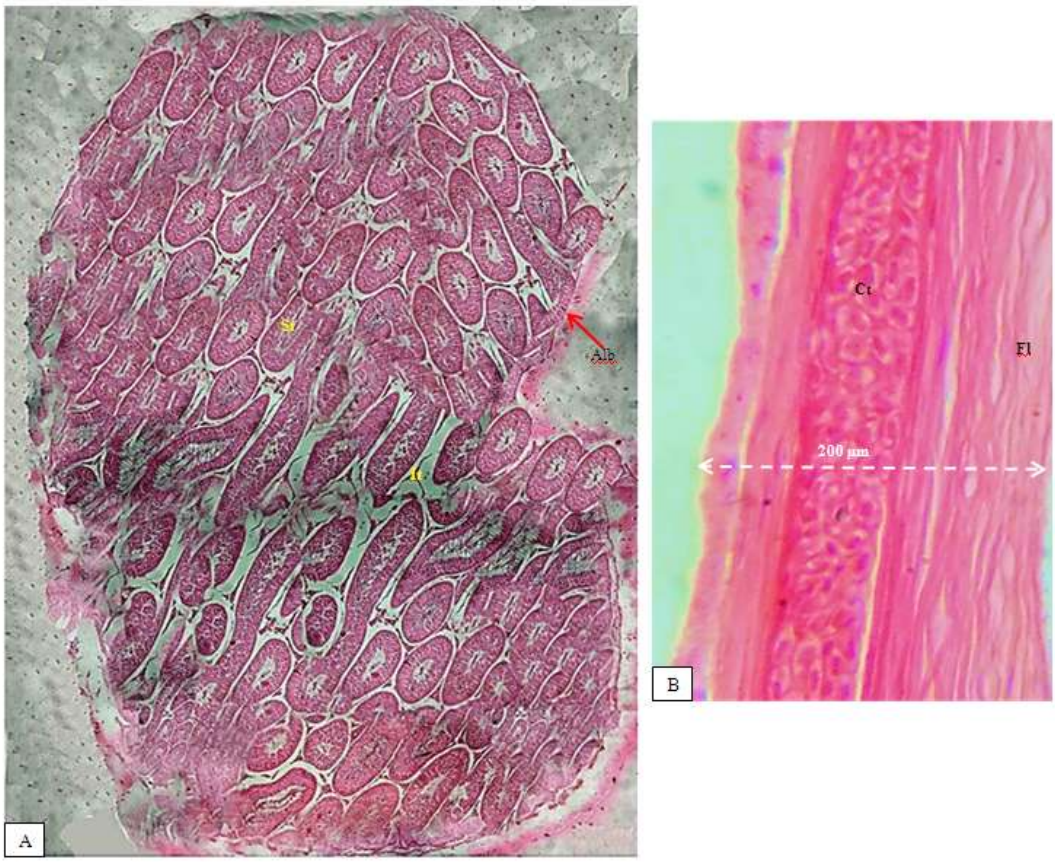

Figure 3: General Histology of the testis of the cock *Gallus gallus*

A: Longitudinal section of the testis of the cock; B: Detailed view of the albuginea
St : Seminiferous tube; Alb : Albuginea; It : Interstitial tissue;
Fl : Fibrous layer; Ct : Connective tissue
Staining: Hemalun-eosin; Magnification: A: G x 100, B: G x 1000.

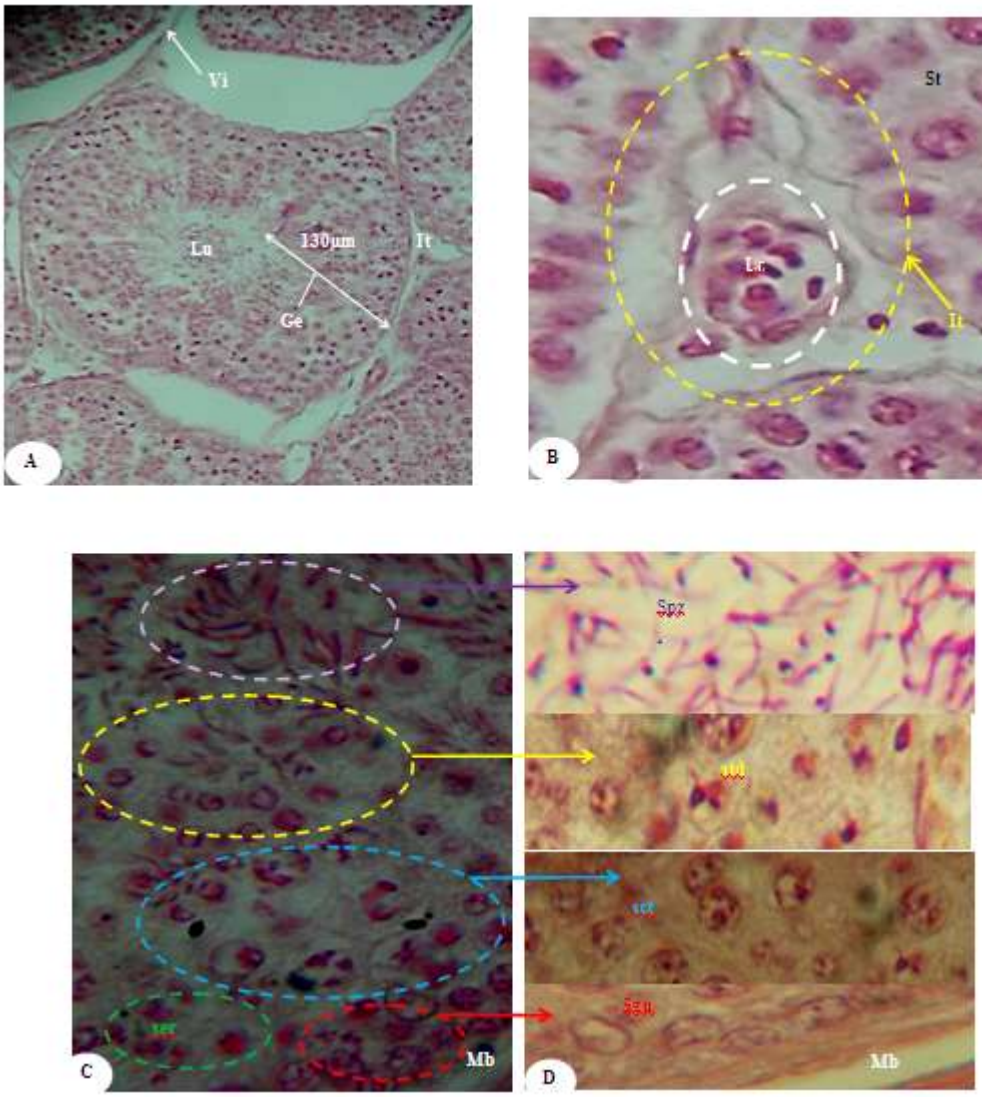

Figure 4: Detailed Histology of the testis of the cock *Gallus gallus*

A: detailed view of the seminiferous tubule;
B: detailed view of the interstitial tissue
C : Detailed view of the germinal epithelium
D : View of the seminiferous tube showing the chronology of the germline cells
Vi: vitreous; Ge: germinal epithelium; Lu: lumen; It: interstitial tissue;
Lc: Leydig cells; St: seminiferous tube; Ser: sertoli cells;
Mb: basal membrane; Sgn: spermatogonia; sct: spermatocytes; std: spermatids; spz : spermatozoa.
Staining :Hemalun-eosin; Magnification: A : G x 400, D ;E ;F : G x 1000.

IV. Discussion

Histologically, the testis of the *Gallus gallus* is covered by an albuginea. The albuginea surrounds the seminiferous tubules which are tubular or oval in shape. This similarity is found in mammals according to the work of[15].In the testis, the seminiferous tubules are contiguous and separated by interstitial tissue. Each mature seminiferous tubule is surrounded by a vitreous and within it is the germinal epithelium and a lumen. This configuration is found in mammals as shown by [16]. However, the seminiferous tubules are anastomosing and are not partitioned in the *Gallus gallus* rooster unlike in mammals. [17]and [18]confirm these observations. According to [19], in birds, the seminiferous tubules branch and join to form a complex network that terminates at the rete testis. These results are in conformity with those of the present work, which was carried out exclusively on the rooster*Gallus gallus.* Moreover, for[20], in the adult rooster, the total length of the seminiferous tubules is 100 to 300 µm and their average diameter is 250 to 300µm. They consist of a multi-layered germinal epithelium supported by a basal wall. From the periphery to the lumen of the seminiferous tubule, we find successively

more or less organized in interpenetrating layers: spermatogonia, Sertoli cell nuclei, spermatocytes I, spermatocytes II, round spermatids, elongated spennatids and finally spennatozoa. In the present work, the mature seminiferous tubules can reach a diameter of about 300µm. From the outside to the inside of the seminiferous tube, we observe a vitreous; surmounted by the germinal epithelium. The seminiferous tubule contains cells at different stages of evolution. From the periphery towards the lumen, germ cells are observed: spermatogonia, spermatocytes, spermatids, spermatozoa. Sertoli cells are also observed scattered in the wall. Therefore, the present work corroborates that of [20]. The same is true for[21], according to whom the evolution of germ cells in other species of domestic birds such as ducks, mules and pintade is almost the same as that of the rooster. In the rooster*Gallus gallus* the Leydig cells are located in clusters in the testicular interstitial space between the seminiferous tubules. These observations are consistent with those of[22,23]. All stages of germ cell maturation are also encountered in the rooster *Gallus gallus* in the same section of the seminiferous tubule. These cells are adjusted in columns and evolve each independently of the other. [22] confirms these observations. Spermatogenesis in Birds mainly the rooster*Gallus gallus* is similar to that of Mammals. It includes like [24] the three phases of multiplication, growth and maturation. The maturation phase is characterized mainly by the presence of a lumen and the increase in the length and diameter of the seminiferous tube, the number of leydig cells and interstitial cells.

V. Conclusion

At the end of this work, we note that histologically, the testisof rooster*Gallus gallus* is covered by an albuginea. This albuginea surrounds the seminiferous tubules separated by interstitial tissue. However, the seminiferous tubules are anastomosing and are not septate in the *Gallus gallus* rooster unlike in mammals. The mature seminiferous tubules can reach a diameter of about 300µm. From the outside to the inside of the seminiferous tube, a vitreous is observed;topped by the germinal epithelium. The seminiferous tubule contains cells at different stages of evolution. From the periphery to the lumen, germ cells are observed: spermatogonia, spermatocytes, spermatids, spermatozoa. Sertoli cells can also be seen scattered in the wall. The seminiferous tubules and interstitial tissues play an essential role in spermatogenesis. The location of the reproductive organs of the rooster *Gallus gallusdomesticus*, the arrangement of the testicular tissues would confer to this one or even to all the birds physiological adaptations such as flight, song, oviparity which would allow to ensure the reproduction in these birds. These adaptations are differentfromthose of mostmammals.

References

[1]. Romanov M. N., Sazanov A. A., Moiseyeva I, & Smirnov A. F. Poultry, Genome Mapping and Genomics in Animals, In Cockett N.E., Kole C. Domestic Animals. Springer-Verlag Berlin Heidelberg.2009 ; Vol3: pp 324-328.

[2]. FAO.Technicalguide,editedby*E.BSonaiya&S.E.J.Swan.*Rome,Italy.Animal productionand healthmanual. 2004; 1: pp. 109-119.

[3]. Van Eekeren N., Maas A., Saatkamp H. W., Verschuur M. L'élevage des poules à petite échelle. Agrodok 4. world'sPoultry Science Association (WPSA). 2006 ; p9 12.

[4]. Moiseyeva I.G, Romanov M.N., Nikiforov A.A., Sevastyanova A., &Semyenova S.K. Evolutionary relationships of red Jungle Fowl and chicken breeds. *Genetics, selection and Evolution*.2003; 35: 403-423.

[5]. HalboucheM.,DahloumL.,MouatsA.,DidiM.,GhaliS., BoudjenahW,& FellahiA.Caractérisationmorphologiquedesanimauxetdesœufs.Actesdes1èresjournéesD'étude Ressourcesgénétiquesavicoleslocales. 2009; vol. 6A.,609 p.

[6]. FouziaY.Contributionàl'étudedeshelminthesparasitesdutubedigestifdupoulet local,(Gallusgallusdomesticus,linnaeus1758) dans la régiond'Oran. 2012 ; 154p.

[7]. Syfia International. Impact des importations de volailles en Afrique de l'Ouest. Infosud. Belgique, Agence de Presse. .2004 ; 42p.

[8]. MAPA..Ministério da AgriculturaPecuária e Abastecimento do Brasil:Produção de Carne de Frango2007 [en ligne]. Disponible sur <http://www.agricultura.gov.br/> (Consulté le 15 octobre 2016).

[9]. USDA.United States Department of Agriculture: Food Availabilty Data System, 2010 [enligne]. Disponible sur < http://www.ers.usda.gov/data/foodconsumption/.> (Consulté le 20 octobre 2016).

[10]. Sauveur B. Photopériodisme et reproduction des oiseaux domestiques femelles. INRA Productions. Animales. 1996. ; 9(1): pp 25-34.

[11]. IyawaD. L'aviculturetraditionnelledans l'Adamaoua(Cameroun).ThèseMèd.Vét., UniversitédeDakar. 1988.n°4, p51-58; 102.

[12]. Ministère Ivoirien de la Production animale et des Ressources Halieutiques. Annuaire provisoire 2007 des statistiques de la Direction de la planification et des programmes.2007.

[13]. FAO. Revue du secteur avicole: Etude du secteur avicole en côte d'Ivoire, structure, importance et perspectives. Cas de l'aviculture semi-industrielle et Etude du sous secteur de l'aviculture familiale. 2008.

[14]. Martoja R, &Martoja-Pierson M. Initiation aux techniques de l'histologie Animale. Masson et Cie. 1967 ; 8-125.

[15]. Burkih H.B., Young B, & Heath J.W. Histologie fonctionnelle. 1993; London, Wheatter, 3e édition. 230 p.

[16]. Leclercq-Smekens M, &Herin M. Histologie spéciale animale: Note théorique. Troisième candidature vétérinaire à la faculté Universitaires Notre-Dame de la Paix-Namur.2004 ; 214p.

[17]. Sauveur B.Notions de physiologie de la reproduction femelle en relation avec l'insémination artificielle. In:Fertilité et insémination artificielle en aviculture. 1982 ; Station de recherches avicoles INRA, BP n°1, 37380 Monnaie / ITAVI. p. 61-75.

[18]. Soltner D. La reproduction des animaux d'élevage. Sciences et Techniques Agricoles. 1993 ; Collec. Sciences et Techniques Agricoles, 49130 Ste-Gemmes-sur-Loire, ed., 1 vol., 232 p.

[19]. Marvan F. Postnatal development of the male genital tract of the *Gallus domesticus.*Anat. Anz. Bd. 1969; 124(S) : 443-462

[20]. De Reviers M. Le développement testiculaire chez le coq : 1- croissance pondéral des testicules et développement des tubes séminifères. 1971 ; Ann. Biol. Anim. Bioch. Biophys., 11, 513-530.

[21]. Sauveur B. Reproduction des volailles et production d'œufs. 1988 ; Paris. Eds. *INRA*., vol. 1, 449 p.
[22]. Nicaise C. Système génital mâle. 2015 ; SVETB303, p9.
[23]. José M., Saez H., Le jeune O., René H. Le contrôle des fonctions différenciées des cellules de Leydig.1995 ; midecine/sciences; li: 547-53
[24]. Artoni S.M. B. Consideraçõessobreamorfologiaeahistofisiologiado testículoda codorna(Coturnixcournixjaponica).Botucatu-SãoPaulo,Tese(DoutoradoemAnatomia)- InstitutodeBiociências,UniversidadeEstadualPaulista.1993; 210p.

Gnonsoakala Emmanuel YOE, et. al. "Histological Study of the Gonads of the Chicken Gallus GallusOfBochibolochie Race In Ivory Coast." *IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB)*, 7(4), (2021): pp. 52-59.