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Assessment of Breeding Soundness by Comparative Radiography and Ultrasonography of Rabbit Testes

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***Abstract*—**In order to improve the animal protein recommended daily intake of Nigerians, there is an upsurge in breeding of hitherto shunned food animals one of which is the rabbit. Radiography and ultrasonography are tools for diagnosing disease and evaluating the anatomical architecture of parts of the body non-invasively. As the rabbit is becoming a more important food animal, to achieve improved breeding of these animals, the best of the species form a breeding stock and will usually depend on breeding soundness which may be evaluated by assessment of the male reproductive organs by these tools. Four male intact rabbits weighing between 1.2 to 1.5 kg were acquired and acclimatized for 2 weeks. Dorsoventral views of the testes were acquired using a digital radiographic machine and a 5 MHz portable ultrasound scanner was used to acquire images of the testes in longitudinal, sagittal and transverse planes. Radiographic images acquired revealed soft tissue images of the testes in all rabbits. The testes lie in individual scrotal sacs sides on both sides of the midline at the level of the caudal vertebrae and thus are superimposed by caudal vertebrae and the caudal limits of the pelvic girdle. The ultrasonographic images revealed mostly homogenously hypoechogenic testes and a hyperechogenic mediastinum testis. The dorsal and ventral poles of the testes were heterogeneously hypoechogenic and correspond to the epididymis and spermatic cord. The rabbit is unique in the ability to retract the testes particularly when stressed and so careful and stressless handling during the procedures is of paramount importance. The imaging of rabbit testes can be safely done using both imaging methods but ultrasonography is a better method of assessment and evaluation of soundness for breeding.

***Keywords*—**Breeding soundness, rabbits, radiography, ultrasonography.

I. Introduction

THERE is an urgent need to improve the common sources of animal protein to the Nigerian population. Recommended animal protein daily intake by WHO is 13.5 g/ day but in Nigeria, consumption remains low at 6.0-8.4 g/ head/day [1]. This recommended daily intake of animal protein is grossly below the recommended daily allowance among the Nigerian population [2] and there are efforts at improving the shortfall [3]. Some of the methods of improving the deficit include improved breeding methods of domestic animals and the breeding of animals for food which were hitherto not very common as food. Some of these animals include the rabbit and small rodents like the cane rat because of their high efficiency in converting forage to meat, short gestation period, and high prolificacy, relatively low cost of production. The high nutritional quality of rabbit meat which includes low fat, sodium, and cholesterol levels and a high protein level of about 20.8% are some of the other reasons [4]. The consumption of rabbit meat is also not limited by cultural or religious biases [5]. The breeding of these animals requires improved production methods and the use of breeding stock which will maximize the potential for accelerated multiplication. These animals are useful as sources of animal protein as they can quickly be multiplied and in large numbers if effective monitoring of their reproduction is well managed [5], [6].

Rabbits are small mammals in the family *Leporidae* and in the order *Lagomorpha.* Rabbits (*Oryctolagus cuniculus)* are reared in rabbiteries for the production of cholesterol free meat commercially for the consumption of man; the meat has a high level of protein and rabbits are also becoming popular as pets among families especially in urban areas [7]. Territorial aggression usually occurs in the rabbit herds so as to maintain dominance among intact males [8]. Male rabbits (bucks) most times attack the scrotum of other bucks especially during fights and this can result into one or the two testicles of the other being removed. This behavioural trait is an attempt by the dominant buck to sterilise the other potential male to avoid rivalry and maintain hierarchial dominance [10].

To achieve optimum reproduction, an assessment of breeding soundness should be done. The breeding soundness examination (BSE) involves a complete and systematic evaluation of the reproductive potential of a given male, including mating ability and libido, general physical examination and inspection of the genital organs, and assessment of sperm production and quality [10]. This usually is to evaluate the suitability of the animal for the reproductive process. The easiest means of determining breeding soundness is by a thorough examination of reproductive organs. In rabbit reproduction, the male is used to mate multiple females, which significantly increases the impact of having a fertile and highly active male. Also, the female rabbit does not possess an oestrus cycle and is described as an induced ovulator, which simply means ovulation occurs once copulation takes place [11]. The reproductive system of the male rabbit consists of two sets of testes, epididymis, ampullae, vas deferens, urethra, penis, and also two sets of preputial glands and the accessory glands. The rabbit presents this peculiarity in the external genitalia, similar to marsupials, of well-developed scrotal sacs located cranial to the penis and the urogenital opening [12]. The testicular position in these animals varies depending on

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factors such as how the body is positioned, the temperature of the body, the breeding activity, the amount of food within the stomach, and how much fat is around the abdomen [12]. The rabbit also has the ability to retract its oval-shaped testes from within the scrotum into the abdomen. They remain in communication with the abdominal cavity, where they were at birth but descend into the scrotum at about ten to twelve weeks of age. The rabbit is actually able to withdraw its testes when frightened or fighting with other males or if it is stressed. The appropriate BSE methods therefore have to be as stressless as possible. A rubber ring may be used to restrain the testes in some instances to prevent retraction [13].

Radiography and ultrasonography are imaging methods utilized in disease diagnosis and in evaluation of anatomical architecture of animals. They are useful tools because they can be used non-invasively. They reduce the stress to which animals are subjected and show detail that is useful for a decision on whether to breed with the animal or not. They are especially useful tools that are used to evaluate anatomical conformity with normal and can be used to evaluate breeding soundness in male animals.

Radiography is a diagnostic imaging tool used to assess any area where there is contrast. It is able to assess opacities like metal, bone, soft tissue, fat/fluid and air in decreasing opacity. The ability to appreciate image geometry on a radiograph may be affected by the magnification, distortion and unfamiliar image as well as concepts known as summation and silhouette, all of which are involved in radiographic quality. Advantages of using radiography include the easy access and clear imagery wherever there is contrast. Ultrasonograpy utilizes echoes generated by sound sent into the organ based on its density and creates images with the echoes. It is a useful imaging modality for soft tissues and is useful for non-invasive evaluation of soft tissues [13]. Ultrasonography makes a distinction between solid and fluid-filled structures and provides internal details of such structures [14], [15]. Advantages of using ultrasonography in BSE include the lack of ionization that may occur with radiography which predisposes to radiation hazards.

Lack of baseline imaging data has made the use of diagnostic imaging in disease diagnoses difficult. The use of imaging techniques is mostly dependent on images of normal architecture/anatomy to avoid misinterpretation. This study therefore seeks to use radiography and ultrasonography to evaluate rabbit testes with a view to recording normal imaging and assess which modality is preferable for the evaluation and assessment of the species both for breeding purposes and for clinical disease diagnosis.

II. Materials and Methods

Four intact male rabbits weighing 1.2-1.5 kg were purchased from a local rabittery for this study. They were acquired after a thorough physical examination to ascertain that they were free of any abnormalities (nasal discharges, ocular discharges, rough hair coat and soiled perineal region) and acclimatized over a two weeks period. They were housed in individual partitions of a cage at the experimental animal unit and concrete feed and water troughs were provided for each individual rabbit. They were fed a commercial growers mash with 15% crude protein content twice daily and water *ad libitum*. Heamatological sampling to ascertain good health was done before the images were captured. There was no need for anesthetic use as rabbits had been acclimatized to handling by picking them up twice a day during the two week acclimatization period.

Radiographic images using an automatic Allengers radiographic machine with exposure factors of Kvp 65 and mAs 10 were acquired. Only dorsoventral images of the testes were obtained due to the location of the rabbit testes.

Ultrasonographic images were acquired using a Medison 5 MHz table top scanner in three planes, longitudinal, sagittal and transverse using two different probes. The ultrasound gel was applied on the probe covering the entire surface and then pressed gently on the surface of the testes held within the scrotal sac by the attendant restraining the rabbit gently in dorsal recumbency. The images were captured from the monitor and stored on an electronic device. Testicular ultrasound protocol for the bucks involved viewing the longitudinal, sagittal and transverse planes for both testes in each of the animals [15].

III. Results

The images of radiographic and ultrasonographic imaging to acquire normal images for comparison for soundness examination and clinical diagnosis are presented in Figs. 1-4. The radiographic images revealed soft tissue opacity of the testes and due to anatomical location of the scrotum, the pelvic girdle and the caudal vertebrae overlie the testes. Fig. 1 demonstrates the dorsoventral view of the pelvic region of the male rabbit and shows the pelvis overlying the soft tissue opacity of the testes causing the summation of the area. Fig. 2 is an enlarged view of a dorsoventral view of the same area in an attempt to show the summation and the testes. The scrotal wall is seen separately from the testicular tissue and the spermatic cord can be distinguished within the sac.

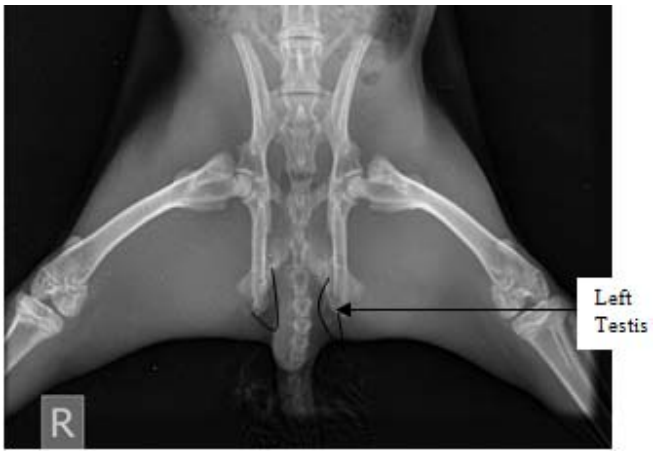


Fig. 1 Dorsoventral View of Pelvic Region of Rabbit

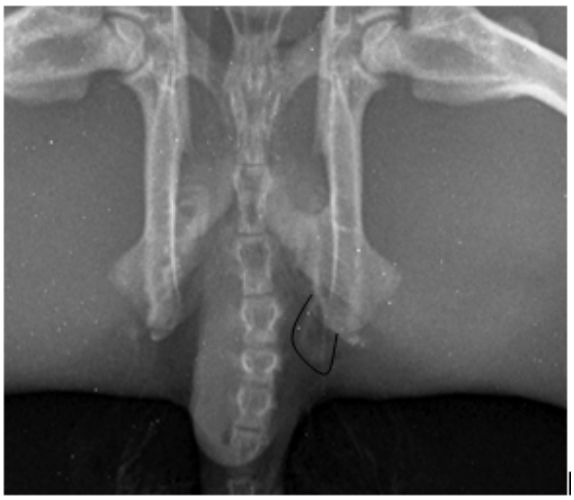


Fig. 2 Testes of Rabbit in Dorsoventral View of Rabbit



Fig. 3 Ultrasonographic Image of Rabbit Testes (Longitudinal View)



Fig. 4 Sagittal View of Rabbit Testes

The ultrasonographic images are represented by Figs. 3 and 4. The ultrasonographic images demonstrate in the longitudinal view, the scrotal wall (SW), which is highly echogenic and the heterogeneously echogenic region of the spermatic chord. The testes in rabbit are not in close proximity and each testicle is housed within an individual scrotum with its accompanying structures; epididymis, ampullae, vas deferens, preputial glands and accessory glands so, each testis was assessed individually, Fig. 3. In the sagittal view, the SW is moderately and homogenously echogenic while the mediastinum testis (M) is hyperechoic, Fig. 4.

IV. Discussion

The imaging of rabbit testes will assist with diagnosis of disease as well as the assessment of normal ultrasonography and evaluation of breeding soundness of this specie. The choice of males in rabbit breeding is a determinant of reproductive outcomes as the male animal is used for several females [16]. The BSE thus helps to determine reproductive outcomes. The rabbit has a peculiarity of being a functional cryptorchid [12], withdrawing the testes when stressed or frightened and thus requires stressless handling for physical examination. This is one of the reasons why imaging is very important as a non-invasive means of antemortem assessment of anatomical evaluation and breeding soundness. The use of radiography in imaging the testes may be fraught with dangers as ionizing radiation can alter biological systems especially those with actively diving cells like the testes. This is further compounded by the overlying pelvic girdle in the anatomical disposition of the testes. Ultrasonography is however very useful for evaluating the testes, it is reportedly the primary modality for imaging most of the male reproductive system. It is an accurate, cheap method that is useful for quick diagnosis depending on clinical signs and an added advantage of being based on sound echo rather than ionizing radiation [17]. Ultrasonography as a BSE tool has been demonstrated in bulls [18] and WAD bucks [19]. In relatively young bucks, the homogenously hypoechoic testicular parenchyma and the hyperechoic mediastinum testis are easily demonstrated. The SW is hyperechoic and the mediastinum testis is better seen on sagittal view. This is very similar to what is seen in WAD goats [15] but differs in the lack of an intertesticular septum which is missing in the rabbit as the testes are housed in individual scrotal sacs. The epididymis is seen as a hypoechoic to anechoic region between the testicular parenchyma and the SW. As in the goat study, a 5 Mhz ultrasound machine was used in this study although Harcourt-Brown and Chitty recommend a 7.5 MHz machine and opined that this may help to further demonstrate the normal architecture of the testes in rabbits more clearly. Ultrasonography is preferred for imaging the rabbit testes because there is no risk of ionization to which the animal is exposed with radiography [15]. Radiography utilizes x-rays which are a form of electromagnetic radiation which has the ability to interact with biological systems resulting in ionization which can alter genetic material in reproductive cells and this may result in mutations that become heritable [20]. In combination with sperm characteristics, testicular

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imaging obtained using ultrasonography can be assessed by farmers in male selection for breeding purposes as sperm production has been correlated with external testicular examination [21]. Considering the infancy of the use of some of these imaging modalities in veterinary practice in Nigeria, there is need for baseline data and images of normal architecture which will encourage use of and improve the skills in imaging modalities such as ultrasonography which is very user dependent. There is also need for further imaging of normal and diseased testes in this species to enable the veterinary radiologists become familiar with and enhance confidence with use of imaging to improve clinical disease diagnosis and assist with improved reproductive efficiency with a view to increased prolificacy and healthcare.

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