International Journal of Agricultural Technology 2017 Vol. 13(7.2):1627-1638
Available online http://www.ijat-aatsea.com
ISSN 1686-9141

Gross Anatomy of the Female Reproductive Organs of Philippine Native Pig (*Sus scrofa* L.)

Neil G. Vicencio[*], Virgilio D. Viernes Jr.[1], Lerma C. Ocampo[2,3], Marlon B. Ocampo[1,2*]

[1]College of Veterinary Science and Medicine, Central Luzon State University, [2]Reproductive Biotechnology and Physiology Unit, Philippine Carabao Center and [3]Department of Biological Sciences, College of Arts and Sciences, Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines 3120.

Neil G. Vicencio , Virgilio D. Viernes Jr.1, Lerma C. Ocampo2,3, Marlon B. Ocampo (2017). Gross Anatomy of the Female Reproductive Organs of Philippine Native Pig (*Sus scrofa* L.). International Journal of Agricultural Technology 13(7.2):1627-1638.

In the Philippines, one of the fastest growing enterprises in the local swine sector is the production of organically-raised native pigs, which is mainly attributed to the increasing demand for the popular Filipino delicacy, lechon. In swine operation, farrowing rate and litter size are very essential in measuring reproductive success of a sow. To achieve these optimal reproductive rates, basic understanding of the anatomical and physiological function of the female pig reproductive system is needed in anticipating and troubleshooting reproductive problems, and in facilitating decisions which impact performance of the breeding herd. Moreover, it could be used to exploit recent advances in assisted reproductive biotechniques (ARTs) such as artificial insemination and embryo transfer. At present, theriogenological studies and anatomical data on the reproductive organs of Philippine native pigs (PNPs) are sparse if not absent, hence this study. Overall, the results obtained has provided preliminary informations on the morphometry of the reproductive organs of PNPs.

Key words: Gross anatomy, reproductive organ, *Sus scrofa L*.

Introduction

In the Philippines, swine industry is the second largest contributor to the country's agriculture next to rice. It has been the largest, most popular and developed animal industries mainly due to the proliferation of backyard producers. Among the fastest growing enterprises in the local swine sector is the production of organically-raised Philippine native pigs (PNPs; *Sus scrofa L*.) which is mainly attributed to the increasing demand for the popular Filipino delicacy, lechon. It is smaller in size compared to modern, commercially-grown pigs and are known for their ability to grow and reproduce even under adverse conditions and are more resistant to parasites and common swine diseases. In

[*] **Coressponding Author:** Neil G. Vicencio; **E-mail address:** neilvicencio@live.com

swine operations farrowing rate and litter size are very essential in measuring reproductive success of a sow. To achieve these optimal reproductive rates, basic understanding of the anatomical and physiological function of the female pig reproductive system is very essential in anticipating and troubleshooting reproductive problems, and also facilitating decisions which impact performance of the breeding herd.

Currently, there are no literatures and studies regarding the anatomy of reproductive organs of this breed in general and morphometric in particular, different researches focused more in standard or other breed of pigs. Knowledge in the morphology of the genital system is very essential for artificial insemination and different obstetrical problems (Ahmed *et al.*, 2003). Also, an important tool for assessing the reproductive status of these animal before the first insemination and pregnancy (Oberlender *et al.*, 2014). Moreover, it could be used to exploit recent advances in assisted reproductive biotechniques (ARTs) techniques such as artificial insemination and embryo transfer (Skidmore *et al*., 1998). At present, theriogenological studies and anatomical data on the reproductive organs of Philippine NP are sparse if not absent, hence this study.

Materials and Methods

Sample collection

PNPs (Fig.1) were acquired and raised for slaughter at abattoir of Llanera, Nueva Ecija with ages ranging from 6 - 12 month. The reproductive organs were removed from the lower abdominal and pelvic cavity using a sharp butcher knife and rinsed with physiologic saline in order to maintain the integrity of the organs. After post-mortem examination and collection of different organs, the samples were put in a container filled with ice and brought to the Anatomy Lab., Department of Morphophysiology and Pharmacology, College of Veterinary Science and Medicine, Central Luzon State University, Science City of Muñoz, Nueva Ecija.

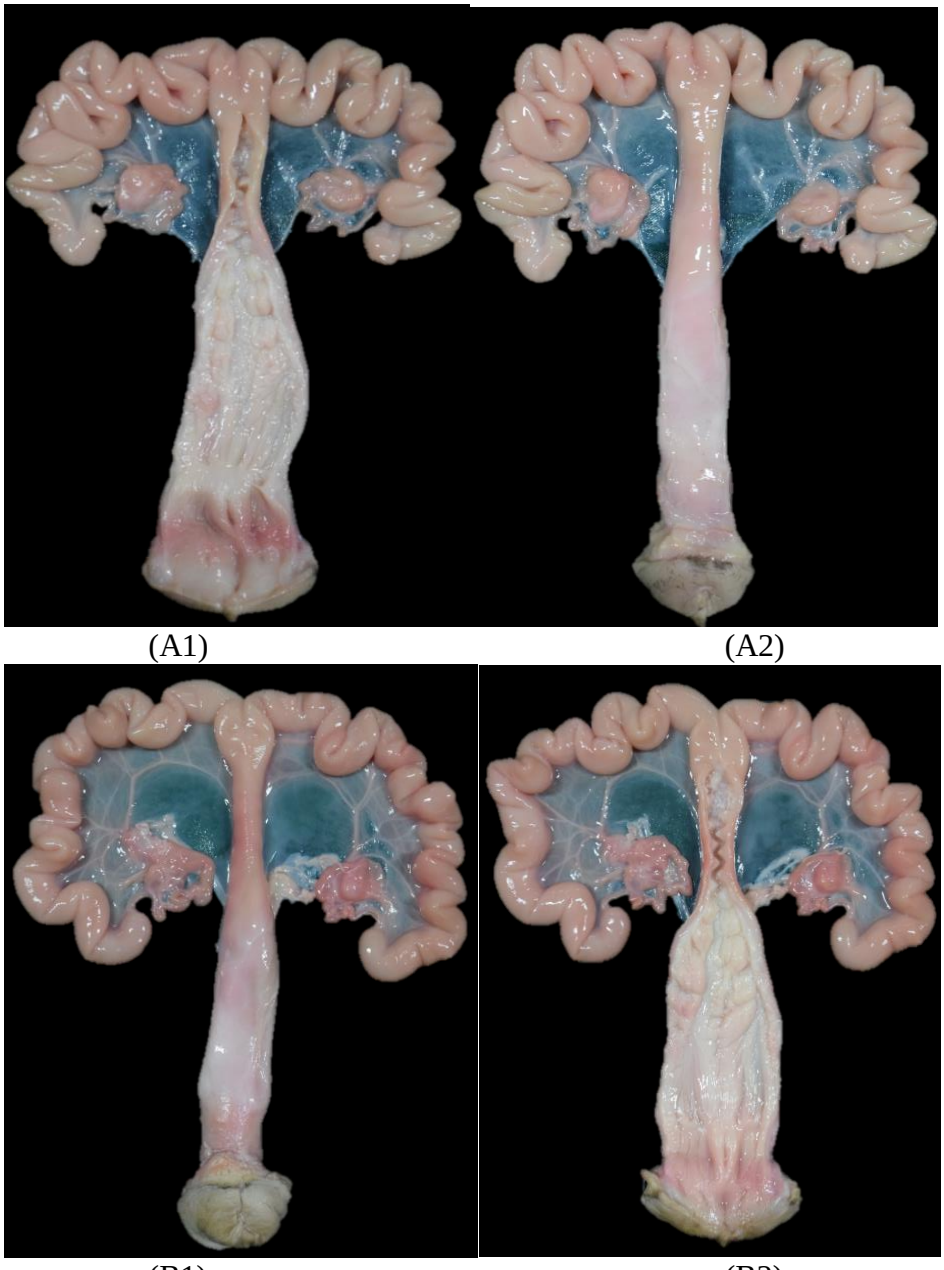
Data collection

Gross appearance

Prior to the removal of the reproductive organs after incising the median abdominal line, the gross appearance of different reproductive organs were examined by noting the shape, color, texture and its relationship to adjacent

organs. The oviduct, uterus, vagina and vulva were incised at the dorsal side to investigate the inner structure of these tubular organs (Fig. 2). Afterwards, photographical documentation were done in each organs.

Fig. 1. PNPs (*Sus scrofa* L.) has a coarse, thick black coat color with patches of white color hairs on their sides. The tail has a bunch of elongated, black color hairs at its tip, which is used to drive away the flies. This pig is pure black and has an elongated snout having medium-erect ears and well-developed teeth, with the huge lower and upper canines or tusks, structuring laterally and upwardly projecting. The female pigs have a body length between 124 cm and 125 cm, with the tail length ranging from 11 cm to 12 cm (Paras, 2014).



(A1) (A2)

(B1) (B2)

Fig. 2. Reproductive organs of 6 (A1 and A2) and 9 (B1 and B2) months old PNPs.

Length, width, and thickness measurement of the reproductive organs

Vulva - *v*ulva was cut starting from the external urethral orifice down to the ventral commissure. Length was taken using the tape measure or vernier caliper as the distance between the ventral commissure and external urethral opening. Width was measured as the external diameter of vulva. Thickness was measured as the actual thickness of the wall of the vulva (dorsoventrally).

Vagina - vagina was cut from the suburethral diverticulum to the cervix of the uterus. Dorsal incision was made and continued in a straight line to the dorsal commissure of the vulva in order to fully expose the vagina. Using tape measure or vernier caliper, length was taken as the distance between the external urethral opening and the fornix vaginae. The width was taken as the external diameter about the middle of the organ whereas, thickness was dorsoventrally.

Uterus, cervix, uterine body, and uterine horn were incised starting from the external orifice of the uterus up to the uterotubal junction in order to expose the lumen for examination. The shape and size of the caruncles were also identified and measured. Using tape measure or vernier caliper, the length of the cervix was taken as the distance between the external orifice of the uterus and the posterior part of the uterine body. Length of the uterine body was taken as the distance between the anterior part of the cervix and posterior part of the uterine horn. Length of the uterine horn was taken as the distance between the anterior part of the uterine body and posterior part of the oviduct. The width of cervix, uterine body, and uterine horn was taken at the distance across the side of the shortest horizontal dimension. While, thickness was taken dorsoventrally in each segment of the uterus.

Oviduct - **t**he oviduct was incised starting from the uterotubal junction up to the anterior portion of the fimbriae in order to expose the lumen for further examination. Length of the oviduct was taken as the distance between the anterior part of the uterine horn and fimbriae which is attached to the posterior part of the ovary. The width was taken as external diameter of oviduct and the thickness was taken dorsoventrally.

Ovary - incision of the ovary was done to examine the inner structures and identify the different follicles present. The length of the ovaries was measured using a tape measure or vernier caliper in an oblique sagittal section whereas, the width was measured in the frontal section. Thickness was measured as the distance between opposite sides of the ovary.

Weight Measurement

Before measuring the weight of each reproductive organs, the entire reproductive tract was separated from the rest of the carcass including all tissue attachment. Then, the weight of the entire reproductive organs were measured using a digital weighing scale (Keimav digital LCD electronic kitchen weighing scale). After getting the entire weight, specific organ were separated by incising and cutting using a scalpel blade and scissors from its adjacent organs before weighing individually.

Data Analysis

All data were tabulated using Microsoft Office Excel. The results were descriptive in nature and was only limited to the morphometry of different parts of the reproductive organ of PNPs.

Results and Discussion

Vulva - the vulva is the terminal and external genitalia of the female animals endowed with blood vessels. It comprises the right and left labia, which meet on the dorsal and ventral midline at the rounded dorsal commissure and ventrally in more pointed ventral commissures. The ventral commissure is usually somewhat pendulous and conceals the clitoris, a structure of erectile tissue that has the same embryonic origin as the penis in the male. The labial skin of PNPs is partly or not pigmented (black), though individual variations occur.

The small ruminants, labia of the vulva are not very prominent, and at the ventral commissure taper to a point which is longer in the ewe. The body of the clitoris is short in both species, and the tip of the glans projects only slightly from the fossa clitoridis (Nickel *et al.,* 1979). In carnivores, the labia of the vulva are often pigmented, round, and covered more or less densely with hair. The dorsal commissure is usually covered by a transverse cutaneous fold, while the ventral commissure is pointed. The crura and body of the clitoris are relatively large and lie ventral to the floor of the vestibule. The body consists of dense adipose tissue and ends in a cavernous glans, which lies in the floor of the fossa clitoridis (Nickel *et al.,* 1979). The external genitalia of the female pig is composed of some connective and fatty tissues. It is usually round and wrinkled and bear only a few hairs, and the ventral commissure is drawn out to a point. In gilts the vulva is often observed to swell and change color near the time of estrus. This swelling and color change are not as evident in sows or gilts,

and color changes are not observable in dark skinned pigs. Body of the clitoris is tortuous and up to 8 cm long which lies under the floor of the vestibule and ends with a poorly developed glans in the fossa clitoridis (Frandson *et al.,* 2009; Nickel *et al.*, 1979; and SwineReproNet, 2003).

The morphometric values of the vulva of 6-, 9- and 12- month old PNPs were summarized in Table 1. The mean length of the vulva ranges from 4.9 - 5.9 cm with weight of 23.3 - 42.3 gm. Also, the mean width ranges from 1.8 - 2.1 cm and the thickness from 0.4 - 0.5 cm.

Table 1. Mean morphometric values of vulva of pubertal PNPs.

Age(months)	No. of samples	Length(cm)	Width(cm)	Thickness(cm)	Weight(cm)
6	3	4.9	1.8	0.4	23.3
9	3	5.0	2.0	0.4	30.0
12	3	5.9	2.1	0.5	42.3

Vagina **-** is the portion of the reproductive tract that lies within the pelvis between the uteri cranially and the vulva caudally. Together with vulva and vestibule, which constitutes the copulatory organ of the female. Vagina serves as the birth canal during parturition and it usually receives the penis of the male during copulation. In ruminants, vagina act as receptacle for the seminal fluid. While in dog, pig and horse, the semen is usually deposited in the cervical canal or directly into the uterus (Frandson *et al.*, 2009; and Nickel *et al.*, 1979). In pig, vagina is 10-12 cm long and relatively thin-walled tube extending longitudinally inside the pelvic cavity, dorsally to the rectum and ventrally to the urinary bladder and urethra. In mare, is a long distensible tube, which projects cranially from the perineum into the peritoneal part of the pelvic cavity. In cow, vagina is about 30 cm long which has muscular thick walls, and is capable of great distension, although its lumen is collapsed in situ. In carnivores, it is very long and covered with peritoneum cranially (Nickel *et al.*, 1979). The level of the external urethral orifice is the junction between the vagina and vestibule where it connects vagina with the outside. Basically, in women, this junction is marked by the presence of a well-developed transverse fold, called the hymen, which separates the two parts. On the other hand, in domestic mammals hymen is poorly developed and is represented by a few small transverse folds at the vagino vestibular junction (Frandson *et al*., 2009; and Nickel *et al*., 1979).

The vagina of PNPs was relatively shorter than commercial breeds of pig at puberty (7-8.2 cm vs 10 - 12 cm). Moreover, the weight, width and

thickness were lower than other breeds of pig at 21.3 – 34.0 gm, 1.8 - 2.5 cm and 0.5 - 1.1 cm, respectively (Table 2).

Table 2. Mean morphometric values of vagina of PNPs.

Age(months)	No. of samples	Length(cm)	Width(cm)	Thickness(cm)	Weight(cm)
6	3	7.0	1.8	0.5	21.3
9	3	7.0	2.2	0.7	23.3
12	3	8.2	2.5	1.1	34.0

Cervix - is a short canal that is 1cm long and projects caudally into the vagina. But the tissue thickening extends beyond the external ostium as a fold of the vagina. Cervix is a heavy, smooth muscle sphincter that is tightly closed except during estrus and parturition. During estrus the cervix relaxes slightly, permitting spermatozoa to enter the uterus (Dyce *et al.*, 2010). Cervix of sow measures 15-20 cm long and has 8 mm thick wall. It opens gradually into uterus and vagina without noticeable demarcation. The inner surface of the cervix is arranged in a series of circular ridges or rings, sometimes called annular folds (Nickel *et al.*, 1979). In PNPs, the cervix is 7 - 14.4 cm long with thickness of 0.4-0.8 cm. Its weight was 10.3 - 40.7 gm with a width of 1.1 – 2.5 cm (Table 3).

Table 3. Mean morphometric values of cervix of PNPs.

Age(months)	No. of samples	Length(cm)	Width(cm)	Thickness(cm)	Weight(cm)
6	3	7.0	1.1	0.4	10.3
9	3	8.8	1.7	0.7	25.0
12	3	14.4	2.5	0.8	40.7

Oviduct - the uterine tube or oviduct, is a narrow, muscular tube, which conveys the oocytes released from the ovary to the uterus. Each tube is suspended by the mesosalpinx (König *et al.*, 2004). The ovarian end of the uterine tube is formed by the funnel-shaped infundibulum. The free margin of the infundibulum are bordered by numerous diverging irregular process, called *fimbriae* which adhere to the surface of ovary. The abdominal ostium which is marked by the presence of folds leads to the ampulla, where fertilization usually takes place. In pig, uterine tube is 15-30 cm long; in dog, 5-9 cm long; in small ruminants, 15-16 cm long; in cow, 25-28 cm long and in mare 25-30 cm long (Nickel *et al.*, 1979). Ovarian bursa is formed between the

mesosalpinx laterally and the proper ligament of the ovary, the mesovarium. In the mare, it is shallow and is too small to contain the large ovary. In the ruminants and pig, the mesosalpinx is very thin and translucent and ovarian bursa covers the ovary like a cape. In the cat, it surrounds the ovary but it has wide communication with the abdominal cavity. In the dog, the bursa encloses the ovary completely (König *et al.*, 2004; and Nickel *et al.*, 1979). In PNPs, the oviduct length ranges from 12.8 – 23.3 cm with an estimated weight of 1.0 - 1.7 gm. The width ranges from 0.4 – 2.5 cm (Table 4).

Table 4. Mean morphometric values of oviduct of PNPs.

Age	No. of	Length (cm)		Width (cm)		Weight (gm)	
(months)	samples	left	right	left	right	left	right
3	3	14.7	12.8	0.5	0.4	1.0	1.0
9	3	18.5	18.3	0.5	0.6	1.7	1.3
12	3	23.3	21.7	0.6	2.5	2.0	1.7

Uterus - is the highly expandable, tubular organ where the fetus and embryo develops. It act as a passageway for sperm to reach the oviduct and are the site of fetal development (Singleton *et al.*, 2004). The uterus of the domestic mammal consists of a body, a cervix (neck), and two horns. The relative proportions of each vary considerably with the species, as do the shape and arrangement of the horns. It is suspended bilaterally from the body wall by the mesometrium. The mesometrium, mesosalpinx, and mesovarium collectively constitute the broad ligament (Frandson *et al.*, 2009). The sow's uterus is distinguished by its short body and long, intestiniform horns. The body, about 5 cm long, is shorter than first appears because the immediately adjacent parts of the horns lie side by side. In PNPs, the uterine body is only 1.1 – 3.7 cm long with thickness of 0.2 – 0.5 cm. Its weight ranges from 2.3 - 6.3 gm (Table 5). In ruminants, uterus consist of a relatively long body succeeded by two divergent, tapering horns which is coiled ventrally with the first convexity facing dorso-cranially. Tips of the horns reach beyond the pectin of the pubis into the abdominal cavity. The body is furnished by the two horns lying side by side within shared serosal and muscular coats, which is an arrangement suggested by a dorsal groove that becomes more pronounced toward the bifurcation. The superficial tissues initially bridge the gap where the horns diverge, forming short dorsal and ventral intercornual ligaments that bound a small pocket conveniently arranged to allow the organ to be fixed by a finger during rectal examinations. The uterus of mare has a large body and two

divergent horns. The horns are about 25 cm long, lie within the abdomen and diverge sharply from each other. The broad ligaments allow the horns to suspend from the abdominal roof on the mass of intestines, whose width varies such that the extremities of each horn are more tightly tethered than the intermediate part. The body of the uterus is a little shorter than the horns which is 20 cm long and lies partially within the abdomen and partly within the pelvis. The body is often displaced to one side by a distended bladder or by pressure from the gut. When the uterus is empty, both horns and body are flattened and the lumen almost obliterated (König *et al.*, 2004; and Dyce *et al.*, 2010).

Table 5. Mean morphometric values of uterine body of PNPs.

Age(months)	**No. of samples**	**Length(cm)**	**Width(cm)**	**Thickness(cm)**	**Weight(cm)**
6	3	1.1	1.3	0.2	2.3
9	3	1.3	1.5	0.4	3.7
12	3	3.7	2.4	0.5	6.3

Uterine horn - Each uterine horn is 2-3 feet in length in the non-pregnant sow. In the non-gravid state, each horn measures about 1 m, and as it is suspended by a fairly generous broad ligament, it enjoys considerable freedom of position, relations, and arrangement, although it fails to reach the abdominal floor. Some parts become mingled with coils of small intestine and can be confused with these (Dyce *et al.*, 2010). In non-pregnant PNPs, the length of the uterine horn ranges from 33.2 – 104.0 cm long with thickness of 0.1 – 0.2 cm. Also, the width of the uterine horn measures from 0.9 – 2.0 cm with a weight range of 14.7 – 139.3 gm (Table 6).

Table 6. Mean morphometric values of uterine horn of PNPs.

Age	No. of	Length (cm)		Width (cm)		Thickness (cm)		Weight (gm)	
(months)	samples	left	right	left	right	left	right	left	right
6	3	35.5	33.2	0.9	0.9	0.1	0.1	14.7	15.0
9	3	57.7	55.7	1.4	1.4	0.2	0.2	50.0	48.7
12	3	103.5	104.0	1.9	2.0	0.2	0.2	136.7	139.3

Ovary - The ovaries of domestic mammals are oval or round, firm in consistency, and often nodular or tuberculate as a result of protruding follicles. They are paired glands usually found in the lumbar region of the abdominal cavity, a short distance caudal to the kidneys. Like all abdominal organs, the

ovaries are covered with peritoneum. They are suspended from the body wall by the mesovarium, the most cranial part of the peritoneal investments of the female genital tract. In pigs, ovaries are about 5 cm long and very uneven due to many follicles and corpora lutea on the surface (Nickel *et al*., 1979) which is located slightly ventrolateral to the pelvic inlet, and usually found hidden among the intestines. Presence of long mesovaria allows both left and right ovaries lie against the one flank (Dyce *et al*., 2010). Ovaries of dog and cat are located in the dorsal part of the abdomen which is caudal to kidneys which measures 1-1.5 cm and 1-1.8 cm respectively while in ruminants, ovaries are about 4 - 6 cm in cow and 1.5 - 2 cm in small ruminants and lie cranial to pelvic inlet, close to the ventral abdominal wall (König *et al*., 2004).

In PNPs, the ovaries are about 1.3 – 2.5 cm long, 0.7 – 1.2 cm in width, 0.1 – 0.3 cm in thickness and weigh around 1.0 – 2.3 gm (Table 7). It is smaller compared to other breeds of pig raised commercially. Its morphometric characteristics are closely related to small ruminants.

Table 7. Mean morphometric values of ovary of PNPs.

Age	No. of	Length (cm)		Width (cm)		Thickness (cm)		Weight (gm)	
(months)	samples	left	right	left	right	left	right	left	right
6	3	1.3	1.4	0.7	0.7	0.1	0.2	1.0	1.0
9	3	1.6	1.3	0.8	0.7	0.2	0.2	1.0	1.2
12	3	2.5	2.5	1.2	1.2	0.2	0.3	1.3	2.3

References

Ahmed FA, Devi J, Ssrma K. and Kalita A. (2003). Biometrical studies on female genitalia of local pig of Jammu region. Indian Vet J., 80:1255-1257.

Dyce KM, Sack WO. and Wensing CJG. (2010). Textbook of Veterinary Anatomy. 4th ed. Saunders Elsevier.

Oberlender G, Pontelo TP, Miranda JR, Miranda DR, Zangeronimo MG, Silva AC, Menezes TA. and Rocha GP. (2014). Morphological and morphometric evaluation of prepubertal gilt ovaries, uterine tubes and uterus at different oestrus cycle stages. Pesq. Vet. Bras. 34(1):83-90

Paras EP. and Cordoves RKS. (2014). Estimating liveweight of Philippine native pigs using external body measurements. Philip J Vet Anim Sci. 40 (1): 47–52.

Skidmore JA, Starbuck GR, Lamming GE. and Allen WR. (1998). Control of luteolysis in the one-humped camel (*Camelus dromedaries*). J Reprod Fertil., 114(2): 201-209.

Frandson RD, Wilke WL. and Fails AD. (2009). Anatomy and Physiology of Farm Animals. 7th ed. Wiley-Blackwell.

König HE. and Liebich HG. (2004). Veterinary Anatomy of Domestic Mammals. AZ Druck und Datentechnik GmbH.

Nickel RA, Schummer and Seiferle E. (1979). The Viscera of the Domestic Mammals. 2nd ed. Springer-Verlag. Berlin Heidelberg GmbH.

Singleton W. and Diekman M. Reproductive Physiology and Anatomy of the Sow. Purdue University Department of Animal Sciences. Retrieved on September 11, 2016 from the World Wide Web: http: //www.ansc.purdue.edu/swine/porkpage/repro/physiol/reppaper.htm.

Swinerepronet. (2003). Swine Reproduction. Retrieved on August 9, 2016 from the World Wide Web: http://livestocktrail.illinois.edu/swinerepronet/.

(Received 22 October 2017 ; accepted 25 November2017)