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A Creative Work

The Reproductive Organs and Follicles of Five-Month Old Pigs From a Local Abattoir in Los Baños, Laguna

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Abstract

Gross morphological, macroscopic and microscopic examinations of the reproductive parts of five 5-month old pigs from the Los Banos Slaughter House in September 2006 were conducted to assess their reproductive condition upon slaughter. Results from gross morphological analysis showed non-significant differences in ovarian lengths ($p>0.226$, $\alpha=0.05$) and weights ($p>0.533$, $\alpha=0.05$) and the HU widths ($p>0.373$, $\alpha=0.05$). However, the ovarian length to weight ratios showed positive correlation (0.862, $\alpha=0.05$) but not the ovarian weight to width of HU and the number of follicles (-0.342 and -0.431, respectively, $\alpha=0.05$). Furthermore, SO1 and SO3 exhibited seemingly normal distribution of follicle diameters (largest follicles of 5.60mm, 81% and 6.40mm, 68%, respectively). Atretic follicles could not possibly be identified from the intact ovaries examined macroscopically. No corpora lutea were also noted. Based on present findings, the reproductive organs of the slaughtered pigs generally exhibited normal conditions based on the uterine and ovarian status. The uterine parameters were consistent with the observations from the reported works on uterine environment. The ovaries of the five-month old gilts showed developing follicles at the right schedule of physiological dictates. This work may be useful in future and continuing work on the recovery of viable follicles from local abattoirs for experimental and instructional purposes.

Keywords: abattoir, Image J, morphology, pigs, reproductive system, swine

INTRODUCTION

The local abattoir contracts pigs for slaughter from various sources within a given locality and the number and quality of pigs for slaughter could be determined by the number of finishing farms mostly backyard and the quality of management the raisers apply in their backyard farm. The major concern of the slaughter house personnel is to get the meat and other parts of the animal that are marketable. The swine raisers and the butchers do not give important attention to the reproductive condition of the pigs but look only at meat quality and the external characteristics as health indicators. This paper presents some aspects of the reproductive organs and the reproductive cells of female pigs from a local abattoir in Los Baños, Laguna.

The general aspect of histological characteristics of mammalian reproductive tissues, specifically of ovaries, is known and has been documented by a number of workers from biological (Browder *et al*., 1991; Gilbert, 1997) and veterinary points of view (Downey and Driancourt, 1994; Liu *et al*., 2000; Ford *et al*., 2002). However, there are greater chances that throughout the life of the farm animals such as swine may encounter various forms of disorders pertaining to the gonads or parts related to it. These may be due to different factors that the swine have in contact with that may target the gonads. Intrinsically, hormones are regulators of the biological activities of the animal. At abnormal levels and with altered structures or activities may contribute to certain reproductive conditions such as reduced efficiency in the regulation of the reproductive functions. This in turn may result to altered swine productivity.

There are several factors that can influence ovulation rate or number of ova shed by individual gilt or sow. Sows may ovulate 18-20 ova while gilts may ovulate 12-14 ova. Flushing or increased energy levels prior to estrus may increase ovulation rate yet may have little effect on the ultimate litter size. The white or maternal breeds generally have a higher ovulation rate. Crossbred females generally have a higher ovulation rate than either of the parent breeds (Ford *et al*., 2002).

As estrus or heat approaches, six to 10 follicles or "blister like" structures form on each ovary. Follicular growth could be observed to accelerate about 3 days before estrus and was influenced by FSH released from the pituitary gland, located at the base of the brain. A maturing ovum is held within each follicle and the granulosa cells within the follicle secrete estrogen, a hormone, responsible for the typical signs of estrus. Ovulation or release of the ova into the body cavity is stimulated by LH. Ovulation occurs about 40 hours after the onset of estrus, but this interval may vary (Liu *et al*., 2000). The LH are accommodated by the expression of LH receptors in granulosa cells of pigs at early or immature stage of 2.00mm follicular diameter which would allow the development of multiple dominant follicles (Britt *et al*., 1985; Varley and Foxcroft, 1990).

Denkova *et al*. (1999) were able to culture porcine ovaries obtained from pigs sacrificed more than 20 min after sacrificing the animal. The antral follicles were removed from the ovary under sterile conditions and cleaned of adhering interstitial tissue and were able to exclude microscopically atretic follicles and the granulosa cells (GCs) from large follicles (LGCs) were isolated from follicles by the nonenzymatic needle puncture method.

This particular creative work primarily aimed to check the general condition of some of the reproductive organs and the quality of follicles growing in the ovaries of slaughtered pigs in Los Baños abattoir using the gross morphology of the ovaries and the growing follicles. Similar works were conducted couple of decades ago using abattoir samples in search for abnormalities in the reproductive organs of pigs (Perry and Pomeroy, 1956) and in looking for the reproductive failures in repeat-breeder sows (Warnick *et al*., 1949).

Specifically, the body of the uterus (BU), the horns of the uterus (HU), and the ovarian dimensions were noted. The fresh weights (g) and the lengths (mm) of intact ovaries were also measured. Using available software, the digital images taken during the documentation of specimens were subjected to free software analytical program (Image J, NIH, USA) software. Lastly, the histological features of the growing porcine follicles were microscopically examined to describe the different stages of follicle development and to do morphological assessment of the ovarian system of five-month old (~90.0kg) slaughtered pigs at Los Baños abattoir.

The collection of swine ovaries was limited to a one-time schedule in the morning of 20 September 2006 at the abattoir of the municipality of Los Baños, Laguna. All pertinent analysis was done in the Physiology Laboratory of the Animal and Dairy Sciences Cluster of UPLB. All necessary information about the slaughtered pigs was supplied by the personnel or the Meat Inspector of the abattoir.

MATERIALS AND METHODS

Collection of Ovaries

Pig ovaries were supplied by the Los Baños abattoir during a pre-scheduled visit in the slaughter house early in the morning of 20 September 2006. The randomly selected representative slaughtered pigs (n=5) were all five-month old with approximated mean live weight of 90kg as per the local abattoir standard. The intact reproductive organs of slaughtered pigs were immediately placed individually in zipper bags (Zip Lock® Reynolds Co., Phils.) including the body fluids without freezing and were immediately transported to the Animal Physiology Laboratory of ADSC. Left and right ovaries were coded accordingly as SO1, SO2, SO3, SO4, and SO5. These were isolated from the rest of the parts and the respective fresh weights (g) and lengths (mm) of ovaries were gathered for data analysis.

Morphological Analysis of Other Reproductive Organs

The uterine body (BU) and the uterine horns (HU) of the five representative slaughtered pigs were measured using the free software Image J (NIH, USA) for standardized and digitized way of obtaining the numerical values of the L and W especially on the non-straight parts of the reproductive organs. All measurements were expressed in mm unit and Means and Standard Deviation (M±SD) and/or Standard Errors of Means (±SEM). The reproductive organs had cervices cut in different sections and would not suffice data collection that these were not included among the organs studied.

Ovary and Follicle Assessment

Each ovary (left and right) labeled accordingly as SO1, SO2, SO3, SO4, and SO5 were noted for the overall appearance. The slaughtered pigs did not exhibit any unusual characteristic which may indicate any abnormality. The number of mature or growing Graafian follicles from each ovary was either manually (straight ruler) or digitally (Image J software) counted and measured, the presence or absence of corpora lutea, and atretic follicles were also noted.

The large and transparent yet visible superficial follicles were initially noted of the developing oocyte inside. These were individually photographed digitally using Sanyo camera (Xacti, Japan) for purposes of documentation and further measurements. Digital photography was done in such a way that uniform pixel density of 1,600 x 1,200 (2MP) of each specimen was closely observed.

Statistical Analysis

All data gathered were subject to descriptive statistical analysis assisted with ANOVA (α=0.05 or 0.01) and correlation analysis (Statistica v.6.0 and Microsoft® Excel 2003 version) to look for possible relationship that would be observed between parameters. All values were expressed as ±SEM or mean±SD depending on the values analyzed.

RESULTS AND DISCUSSION

Intact Reproductive Organs of Five-month old Pig

There were five sets of the intact reproductive organs from the cervix to the ovaries obtained from the slaughter house. These organs were salvaged parts from those that would be included in the wasted parts of slaughtered pigs. In practice, these parts may either be collected by the swine growers themselves or by anybody for whatever purposes. However, this study found out that these organs from the slaughter house are useful materials for instruction purposes in swine biology. These are useful based on the general appearance and no observable morphological diversions from the expected “normal” appearance.

Figure 1. The isolated reproductive organs (n=5) of five-month old pig with live weight of approximately 90kg. Organs and tissues shown: cut cervix, body of the uterus (circle); uterine horns (arrowhead); mesosalphinx (*); oviduct (small arrow); and left ovary (thick arrow).

The fresh reproductive organs of slaughtered pigs have generally exhibit normal and unaltered condition based on color and composition. These were used as basis in using these organs for study. Any alterations such as cut and missing parts of a particular organ would cause some biases on the analysis. Except for cervix which was cut in different portions of the cervical body, the uterus and the ovaries remained in good condition.

The Uterine Horns

The uterus of the sow is diffuse type with total length (base of the body to the boundary of the uterine horn and the oviduct or the uterotubal junction) of 35 to 60cm and the horns may account for 80 to 90% of the total length. This is organ where the fetus attaches for nourishment (Park, unknown year, http://nongae.gsnu.ac.kr/~cspark/teaching/lecture_under.html) and also for various events that involve the immune system (Robertson, 2000).

Looking specifically at each part of the reproductive tract of 5-month old pigs from this present work, all samples showed almost similar overall status or conditions of the uterine horns (HU) as shown in Table 1. The HU of the 5-month old finishing pigs had a mean length of 252.64mm (25.26cm) and 256.64mm (25.66), left and right, respectively. These lengths ranged from shortest at 196.52mm to longest at 307.23mm. Generally, it was observed that the left and the right horns would normally differ without any relationship with the physiological state of the ovaries. This was consistent with the previous observations by the works of Chen and Dziuk

(1993) and Vallet *et al*. (2002). Several works on unilateral ovariohysterectomy in pigs confirmed that uterine lengths determine uterine capacity (Wu *et al*., 1988; Chen and Dziuk, 1993; Wu and Dziuk, 1995). Furthermore, the uterus must become capable of carrying off the developmental events that will take place eventually when there has been embryonic implantation (Robertson, 2000).

Table 1. Summary of values for uterine horns (HU) using Image J (NIH, USA) for checking the quality of the reproductive tissues of 5-mo old pigs slaughtered in Los Baños Abattoir on 20 September 2006 (n=5) for commercial distribution.

Swine Code	HORNS OF UTERUS (mm)	
	Left	Right
SO1	307.23	292.27
SO2	290.28	247.53
SO3	252.90	296.71
SO4	196.52	200.50
SO5	216.27	246.22
Mean±SD	**252.64±47.09**	**256.64±39.43**

The Uterine Body

On the other hand, the BU of five-month old pigs was uniquely different morphologically from the others. Measuring the width and the length of each BU could help in determining variations of this part of the pig's reproductive tract. The Y-shaped bifurcation portion of the BU also was unique among all the samples observed. The BU of pigs from the September 2006 samples had dimensions shown in Table 2.

Table 2. Summary of the values obtained for uterine body (BU) using Image J (NIH, USA) for checking the quality of the reproductive tissues of 5-mo old pigs slaughtered in Los Baños Abattoir on 20 September 2006 (n=5) for commercial distribution.

Swine Code	Length, mm	Width, mm	Depth, mm	Volume, mm^3
SO1	64.258	19.235	15.000	18,540.04
SO2	82.356	20.344	15.000	25,131.76
SO3	52.209	17.464	15.000	13,676.67
SO4	42.376	18.028	15.000	11,459.32
SO5	38.072	17.337	15.000	9,900.81
Mean±SD	**55.85±17.92**	**18.48±1.28**	**15.00±0.00**	**15,484.12**

The BU of all five samples had mean volume 15,484.12mm^3 with the smallest volume recorded from SO5 with only 9,990.81mm^3 and the largest from SO2 with 25,131mm^3. This varying volumes of uterine body positively corresponded with the length of their uterine horns (0.605, α=0.05). This would imply that the development of the BU would always link to the development of the HU. This has something to do with the anatomical and physiological preparedness of the animal for reproduction.

Figure 2 shows the scatterplot of lengths and widths of the five BU samples indicating a linear relationship between the two parameters. This clearly shows that the development of the uterine body follows a strict pattern. This is a way of making the uterine body a suitable pathway of the sperm cells during breeding. Any external irregularity would mean internal irregularity that could impede the movement of sperm cells upon ejaculation by the boar. In the present findings, the uterine bodies of the five slaughtered pigs have attained the normal development of this particular reproductive part.

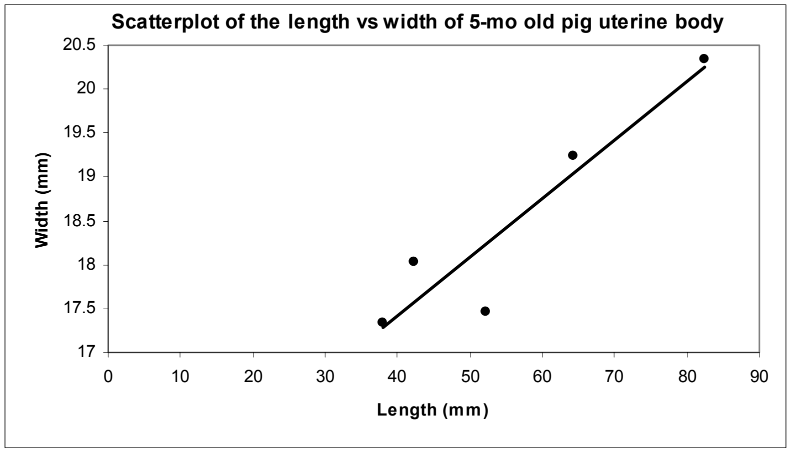

Figure 2. Scatterplot of BU length vs width of the 5-month old slaughtered pigs on 20 September 2006 in Los Banos shwing almost linear relationship between the two parameters.

The Ovaries

The ovaries are the primary sex organs of female animals including pigs. The ovaries of pigs are polytocous which can produce 10 to 25 ova per estrus cycle and can give several piglets per gestation period. The average size is about 35mm in length and the almond shape could be altered by the growing follicles or corpora lutea (Park, unknown year, http://nongae.gsnu.ac.kr/~cspark/teaching/lecture_under.html). Figure 3a is a macroscopic image of the fresh ovary of a 5-month old (~90.0kg) pig from the slaughter house. Note the “blister-like” appearance of the superficial follicles of different sizes. Figure 3b is a close up view under bright field microscopy of a single large follicle with visible oocyte surrounded by granulosa cells and germinal vesicle near the center.

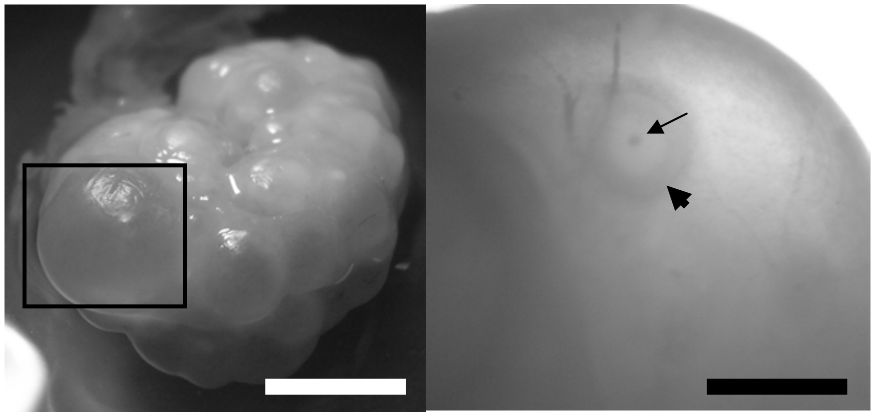

Figure 3. Intact fresh left ovary of a 5-month (~90.0kg) slaughtered pig from Los Banos showing (a) the different sizes of the growing follicles superficially (box part in b) (white bar = 10.00mm); and (b) a close up view of one of the largest follicles under bright field microscopy showing a growing oocyte surrounded by granulosa cells (thick arrow) and a visible germinal vesicle (thin arrow) (black bar = 2.00mm).

Table 3 is a summary of the results of measuring the lengths and weights of the left and the right ovaries of the five slaughtered pigs in September 2006. The pigs were reported to have reached approximately the fifth month and have attained average live weight of 90kg as per slaughter house regulation (personal communication, Anselmo Ribas, Slaughter House Meat Inspector).

Table 3. Summary of the values obtained for ovarian length and weight used for checking the quality of the reproductive tissues of 5-mo old pigs slaughtered in Los Baños Abattoir on 20 September 2006 (n=5) for commercial distribution.

Ovarian Length (mm)

	SO1	SO2	SO3	SO4	SO5	Mean±SD
Left	22.00	22.00	25.00	22.00	20.00	**22.20±1.79**
Right	22.00	22.00	27.00	22.00	25.00	**23.60±2.30**
Mean±SE	**22.00±0.00**	**22.00±0.00**	**26.00±1.41**	**22.00±0.00**	**22.50±3.54**	**22.90±0.36**

Ovarian Fresh Weight (g)

	SO1	SO2	SO3	SO4	SO5	Mean±SD
Left	2.49	2.13	3.16	2.42	1.57	**2.35±0.58**
Right	2.55	2.35	2.73	2.30	2.77	**2.54±0.21**
Mean±SE	**2.52±0.05**	**2.24±0.16**	**2.95±0.31**	**2.36±0.08**	**2.17±0.85**	**2.45±0.26**

The length of ovaries did not show any significant variations among each other or between the overall left and right ovarian lengths. SO3 having a mean length of 26.00±1.41mm was found to be the largest of all the 10 samples (five pairs). The right ovary of SO3 was relatively bigger at 27.00mm than the left which was 25.00mm long while the right ovary of SO5 was relatively bigger (25.00mm) than its left (20.00mm). The mean length of all the ovary samples was computed to be 22.90±0.36mm.

The mean weight of all five pairs of ovaries was 2.45±0.26g. The left ovary of SO3 was the heaviest among all 10 individual samples followed by the right ovary of the same animal. On the other hand, the smallest was the left ovary of SO5 at only 1.57g which happened to be the smallest. Correlation analysis showed that the weight had positive relationship (0.862, α=0.05) with the size of the ovary. This was shown by the SO3 and the SO5.

Follicle Count

The porcine ovary contains a relatively large number of follicles which is approximately 430,000 (Gosden and Telfer, 1987) which could all qualify for *in vitro* use (Brüssow *et al*., 2000). The superficial “blister-like” follicles counted from the intact fresh ovaries SO3, SO4, and SO5 were presented (Figure 4) comparing the left and the right ovaries of each pair. Note that only three of the five samples were compared. The two samples (SO1 and SO2) which were set aside and counted the follicles using the digital images produced after preservation. These were then were cut into two parts while fresh for histological preparations and fixation should not to be delayed to prevent tissue drying up and possible shrinkage of the follicles and result to biased observations and evaluations. There were no observable indications on the presence of atretic follicles from any of the five samples. Corpora lutea were also not observed at this time.

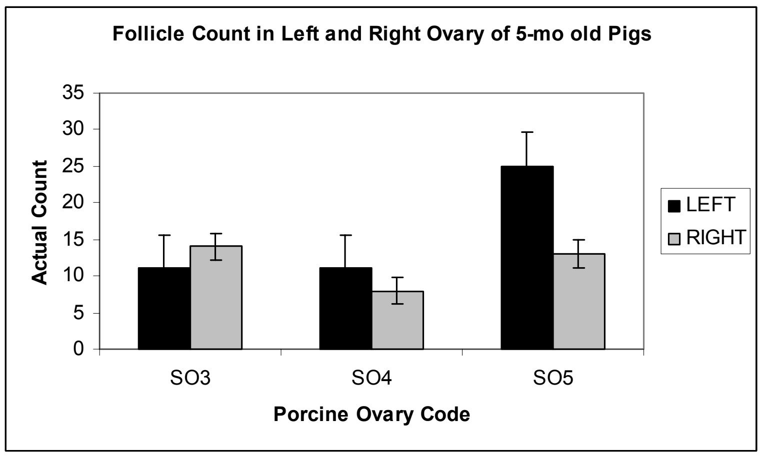

Figure 4. Actual counts (±SE) of the superficial follicles from three of the five samples of intact fresh ovaries of 5-month old slaughtered pigs on 20 September 2006 from Los Baños, Laguna.

The largest and heaviest ovaries of SO3 surprisingly had relatively less superficial follicles (n=27) compared to SO5 (n=38) which ranked last in terms of weight (2.17±0.85). The correlation between weight and the number of follicles was determined and found to show negative relationship (-0.431, α=0.05) and the same manifestation with the ovarian length (-0.342, α=0.05). This did not confirm the expected 1:1 correlation between the weight and the number of growing follicles in the natural condition. There are many other factors that may contribute to the overall fresh weight of the ovary such as the amount of water and proteins in the follicular fluid and the degree of connective tissue cover of the organ, which means that a heavy ovary exhibiting less number of follicles could be populated by a number of larger antral follicles filled with follicular fluid and supported by connective tissues to support them.

Follicle Diameter

Browder *et al*. (1991) stated that in the mammal, all oogonial decisions and transformation into oocytes are completed either before or shortly after birth. No oocyte growth could be observed until puberty. Then, cohorts of oocytes resume development during each cycle.

Pigs slaughtered in Los Baños abattoir were found to be in their late pre-pubertal stage being on their fifth month based on the follicular size distributions (Figure 5) after digitized measurement using Image J (NIH, USA) comparing them with the descriptions by Webb *et al*. (2004) which work was on cattle ovarian follicular waves as a function of hormonal influences beginning on primordial stage to recruitment into large follicles.

The present results on follicle measurements confirm the basic knowledge on breeding schedule that five-month gilts are not yet suitable for natural breeding but they could be induced artificially to have precocious ovulation. This idea has valid basis from the observations that these young follicles induced for maturation would not be properly supported by the uterus being underdeveloped (Ford *et al.*, 2002; Henning and Davis, 2003) as breeders.

SO1 and SO3 would show seemingly normal distribution of follicle sizes but it could be noted that the follicular sizes of SO1 had fewer follicles with diameter of about 3.0-3.5mm compared to SO3. This may suggest that the weight of SO3 could be due to the greater volumes of the follicular fluid accumulating in the follicular cavity and would indicate the possibility of the synchrony of follicular development in the ovaries of SO1 and SO3. The observed size distribution of follicles from the present study is comparable to the results obtained by Gee *et al*. (1991) after treatment of sows with dexamethasone (DXM) and ACTH at day 9 to 17 and day 19 to end of estrus. The follicular diameters in the control group (n=5) on day 19 of estrus were grouped into >6.00mm (n=10.9±5.2) and <6.00mm (n=12.8±11.8) and after day 26 follicles with diameter of <6.00mm increased to 22.6±4.5 and those >6.00mm reduced significantly in number to only 0.3±0.5. This observations implied follicular cycle or newly emerging follicles after the previous estrus of untreated pigs.

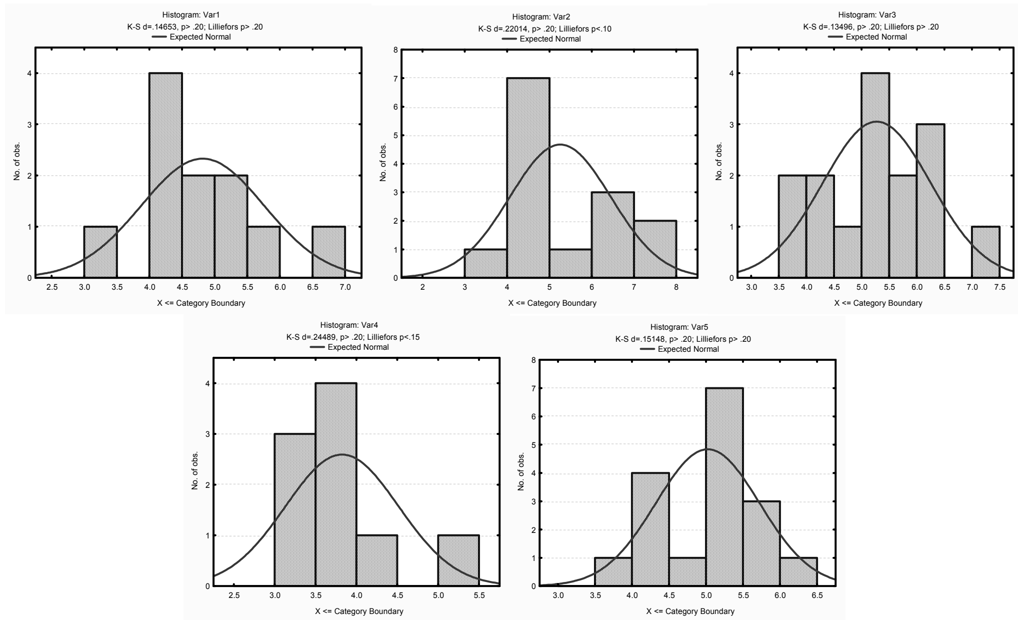

Figure 5. Follicle size distribution (diameter, mm) from the fresh left ovaries of 5-month old slaughtered pigs on 20 September 2006 in Los Baños measured using the Image J (NIH, USA).

SO1 was at its early developmental phase as shown by the more observed small or young follicles probably at primordial stage (<3.0mm diameter) compared to SO3 which had more observed follicles with diameters between 5.50 to 7.50mm or already at the recruitment stage (Webb *et al*., 2004) but have not reached the antral phase. The follicular diameters of 5.50 – 7.50mm from SO3 were presumably synthesizing significantly different concentrations of estradiol and progesterone in their follicular fluid (Liu *et al*., 2000). In another study, Wu *et al*. (2001) were able to demonstrate that pre-antral follicles from a slaughter house ovary samples and matured *in vitro* could be fertilized through intra-cytoplasmic sperm injection (ICSI) and have shown to produced viable embryos.

SO2 and SO4 showed follicular size distribution being skewed to the left or exhibiting a population of relatively smaller or early stages of follicle development

(<5.00mm) especially in SO4 with much smaller follicles than ranging from 3.00 to 4.50mm. Nevertheless, these observations in SO2 and SO4 would only indicate that the ovaries of these two slaughtered pigs in September 2006 have not reached the full capacity for reproduction. Only SO5 showed a closely related double peak in the follicle size distribution representing cohorts of more mature follicles. Overall, these follicles may represent the 1st wave of follicular growth (Uribe-Velasquez *et al*., 2002).

Downey and Driancourt (1994) suggested in their report that there are factors that may regulate the uniformity of conceptus development, such as greater homogeneity of follicular characteristics or synchrony of follicular development. In the present findings on the follicle diameters of 5-month old slaughtered pigs in Los Baños, the pigs may exhibit certain degree of homogeneity of the early growing follicles (SO2, SO4, and SO5) which may be considered to be at least two cohorts. The closest influence in follicular growth is the nutrients. Webb *et al*. (2004) presented a clear illustration on the interaction between metabolic factors and the ovarian functions such as the metabolic fuels in the form of glucose, fatty acids, LDLs and HDLs, and the pancreatic hormones insulin and glucagons. However, the form of diets that grow out pigs received may not directly target the ovarian tissues but usually for carcass quality which in one way or the other would have effects on the ovarian development.

Moreover, Henning and Davis (2003) suggested based on their study on the evaluation of the reproductive status using the uterus of pre-pubertal gilts (100-150d old) that when used as recipients of embryos by embryo transfer after introduction of progestins and estrogens would have more tendency towards failure pregnancy. Their corpus luteum would have little support in maintaining pregnancy. However, the post-pubertal recipients of embryos from post-pubertal donors had more successful pregnancy. This clearly shows that the uterus of the gilts must first reach maturity to become a suitable environment for the growing embryos. Ford *et al.* (2002) also noted that in swine the surface area of the uterus must provide adequately the necessary site for exchange of nutrients from maternal to fetal blood. This, however, could be dictated by the genetic factors of the pig.

In the final analysis, the quality of the reproductive organs of the five samples from the slaughter house showed that the reproductive tissues and organs could qualify for breeders if intentionally reared for breeding by the farmers. Well nourished grow out pigs could be diverted into breeders by looking at their reproductive status such as the follicular growth and the oocyte quality (Webb *et al*., 2004) that can be harvested for growing in vitro as suggested by Flowers (1994) and Wu *et al*. (2001) who successfully cultured pre-antral follicles and produced meiotically competent oocytes that Flowers (1994) translated as powerful tools in swine industry especially for in vitro embryo culture.

SUMMARY, RECOMMENDATIONS AND CONCLUSION

Five samples of reproductive tracts from the irregularly cut cervix of slaughtered pigs in Los Baños abattoir on 20 September 2006 were analyzed for gross morphology and microscopic examinations of ovaries and follicles. Findings clearly showed that the slaughtered pigs were at their pre-pubertal stage. This observation confirmed the basic knowledge on swine breeding that they have not reached full capacity for reproduction at fifth month (average live weight of 90.0kg). The uterine horn lengths did not vary and so as the volumes of uterine bodies, but uterine horn lengths and uterine body volumes of the five samples showed positive correlation. There were very minimal variations in the ovarian weight and size status observed but nevertheless implied that direct relationship could be observed between size and weight. On the other hand, their follicles did not show direct relationship in terms of weight and number of follicles or weight to sizes of follicles.

Recommendations

This work on using recovery of useful biological materials from the waste products of local abattoir is a one-of-a-kind exploratory laboratory activity. Hence, these recommendations:

1. The work could be continued on a monthly basis to evaluate the reproductive status of the slaughtered pigs in local abattoirs; and
2. The recoverable follicles from the viable ovaries from abattoirs could be collected in bulk in the preparation and purification of estrogens for

experimental and instructional use, or to a greater extent, in commercial volumes.

Conclusion

The reproductive organs of the slaughtered pigs generally exhibited normal conditions based on the uterine and ovarian status. The uterine parameters were consistent with the observations from the reported works on uterine environment. The ovaries of the five-month old gilts showed developing follicles at the right schedule of physiological dictates. This work may be useful in future and continuing work on the recovery of viable follicles from local abattoirs for experimental and instructional purposes.

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LITERATURE CITED

Britt, J.H., Armstrong, J.D., Cox, N.M., and K.L. Esbenshade 1985. Control of follicular development during and after lactation in sows. J. Reprod. Fertil. Suppl. 33:37–54.

Brüssow, K.-P., Helmut, T., Kanitz, W., and J. Råtky 2000. In vitro technologies related to pig embryo transfer. Reprod. Nutr. Dev. 40: 469-480.

Browder, L.W., Erickson, C.A. and Jeffery, W.R. 1991. *Developmental Biology*. Third edition. Saunders College Pub. Philadelphia.

Chen, V.Y. and P.J. Dziuk 1993. Influence of initial length of uterus per embryo and gestationstage on prenatal survival, development, and sex ratio in the pigs. J. Anim. Sci. 71: 1895-1901.

Denkova, R. Tz., Nikolov, B., and A. Russinova 1999. Porcine granulose cells produce progesterone secretion inhibitory activity. Endoc. Regulat. 33: 33-37.

Downey, B.R. and M.-A. Driancourt 1994. Morphological and functional characteristics of preovulatory follicles in Large White and Meishan gilts. J. Anim. Sci. 72: 2099-2106.

Flowers, W.L. 1994. Growth and maturation of preantral follicles in vitro. Annual Report, North Carolina State University. http://www.cals.ncsu.edu/an_sci/ann_rep94/tblcont.html.

Ford, S.P., Vonnahme, K.A., and M.E. Wilson 2002. Uterine capacity of the pig reflects a combination of uterine environment conceptus genotype effects. J. Anim. Sci. 80 (E-Suppl. 1): E66-E73.

Gee, C.M., Geissinger, H.D., and R.M. Liptrap. 1991. Morphometric and steroid hormone changes associated with experimental anovulatory follicles in the sow. Can. J. Vet. Res. 55: 206-211.

Gilbert, S.F. 1997. *Developmental Biology*. Fifth Edition. Sinauer. Sunderland, MA.

Gosden, R.G., and E. Telfer 1987. Numbers of follicles and oocytes in mammalian ovaries and their allometric relationships. J. Zool. 211: 169–175.

Henning, H.J. and D.L. Davis 2003. Evaluation of the uterine environment and embryos of prepubertal gilts. J. Anim. Sci.81: 2575-2582.

Liu, J., Koenigsfeld, A.T., Thomas, C. C., Boyd, C.K., Kobayashi, Y., and C.L. Matthew 2000. Growth and the initiation of steroidogenesis in porcine follicles are associated with unique patterns of gene expression for individual components of the ovarian Insulin-Like Growth Factor system. Biol. Reprod. 63: 942–952.

Park, C.S. year not indicated, http://nongae.gsnu.ac.kr/~cspark/teaching/lecture_under.html.

Perry, J.S. and R.W. Pomeroy 1956. Abnormalities of the reproductive tract of the sow. J Agric. Sci. 47: 238-248.

Robertson, S.A. 2000. Control of immunological environment of the uterus. Reviews Reprod. 5: 164-174.

Uribe-Velasquez, L.F., Oba, E., Villa-Velasquez, H., Souza, M.I.L., Lara-Herrera, L.C., and L.D.S. Murgas 2002. Mechanism by which high progesterone levels reduced diameter of dominant follicle during the growing phase of wave 1. J. Anim. Sci. 80 (Abstract).

Vallet, J.L., Klemcke, H.G., and R.K. Christenson 2002. Interrelationships among conceptus size, uterine protein secretion, fetal erythropoiesis, and uterine capacity. J. Anim. Sci. 80: 729-737.

Varley, M.A., G.R. Foxcroft 1990. Endocrinology of the lactating and weaned sow. J. Reprod. Fertil. Suppl. 40:47–61.

Warnick, A.C., Grummer, R.H., and L.H. Casida 1949. The nature of reproductive failures in repeat-breeder sows. J. Anim. Sci. 8: 569-577.

Webb, R., Garnsworthy, P.C., Gong, J.G., and D. G. Armstrong 2004. Control of follicular growth: Local interactions and nutritional influences. J. Anim. Sci. 82 (E Suppl.): E63-E74.

Wu, M. C., M. D. Hentzel, and P. J. Dziuk. 1988. Effect of stage of gestation, litter size and uterine space on the incidence of mummified fetuses in pigs. J. Anim. Sci. 66:3202–3207.

Wu, M. C., and P. J. Dziuk. 1995. Relationship of length of uterus in prepubertal pigs and number of corpora lutea and fetuses at 30 days of gestation. Anim. Prod. Sci. 38:327–336.

Wu, J., Carrell, D.T., A.L. Wilcox 2001. Development of in-vitro matures oocytes from porcine pre-antral follicles following intracytoplasmic sperm injection. Biol. Reprod. 65:1579-1585.