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Reproductive Organs of Boar and Sow

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Pigs to Pork

BREEDING

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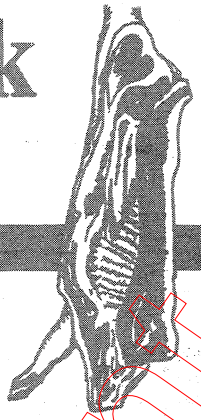

Reproductive Organs of Boar and Sow

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This publication is designed as a teaching aid for the intensive swine reproduction schools conducted by the Cooperative Extension Service. It is also included in the Pork Production Handbook for County Extension Agents. It is intended to offer a more thorough understanding of the swine reproductive system.

Introduction

The process by which new individuals come into being is known as reproduction. Reproduction is an orderly, systematic process by which each parent makes very definite contributions to the new individual's constitution. It is through the understanding of this process and its application to the problems of swine breeding that swine breeding is gradually becoming converted from an art to a science. When presently known principles of breeding come into more general understanding and use, further improvements in swine production and efficiency will result.

The purpose of these papers is to help you more clearly understand the present day knowledge. You can reap the harvest of greater usage of these principles and also be in a position to apply new technologies which loom over the horizon, eg. artificial insemination, controlled heat periods, sex determination and others.

Physiology of reproduction of swine is a composite science. For an appreciation of the subject it will be necessary to draw upon the accumulated knowledge of anatomy, embryology, physiology, endocrinology and genetics.

Terms and Definitions

Sperm, Spermatozoon; pl. sperm(s), Spermatozoa. The male sex cells, germ cells or gametes.

Ovum, egg; pl. ova, eggs. The female sex cells, germ cells or gametes.

Semen--The composite of sperm from the testicles and fluids from the testicles and the accessory glands.

Insemination--The deposition of semen in the female reproductive tract.

Semination--The penetration of the ovum by the sperm.

Fertilization--The penetration of the ovum by the sperm and the fusion of the male and female pronuclei.

Primordial germ cells--The earliest differentiated germ cells.

Spermatogenesis--The production of sperm.

Exocrine glands--Those whose secretions flow to the surface through a duct or tube; eg. tear glands.

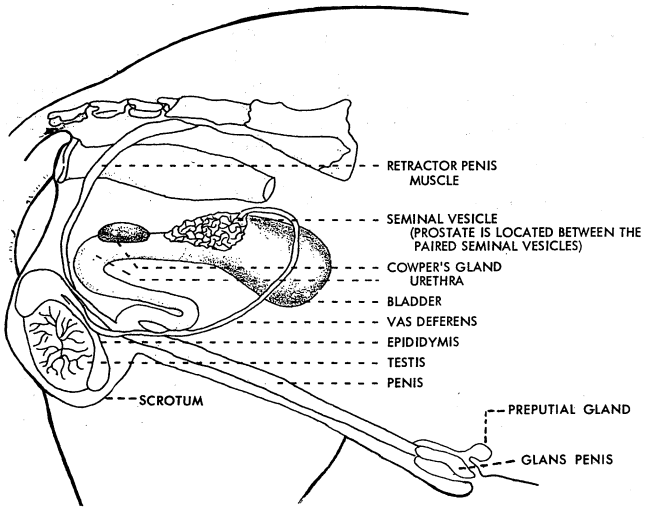


Figure 1. Diagram of the reproductive organs of the boar.

Endocrine glands--Those whose secretions pass through the cells into the blood or lymph vessels for distribution all over the body. These are the ductless glands.

The Male Genital System

The male genital system of hogs is composed of the scrotum, testicles, duct system, accessory glands, penis and sheath.

The scrotum is a sac or pouch in which the testes are suspended outside the body cavity. The function of the scrotum is twofold. It provides protection for the testicles and provides a thermal regulator. This latter function is performed by muscles which determine the nearness of the testicles to the body. The more the muscles contract the closer the testicles lie in relation to the body and the higher the temperature of the testicles. The temperature of the testicles are thus from 1 to 8° C cooler than the body temperature. As would be expected by the location of the scrotum of the boar, this thermal regulator function is the least developed in boars than any other farm animal.

The testicle, sometimes called testis, is a compound tubular gland with both an exocrine and an endocrine function. The exocrine function is spermatogenesis. The endocrine function is production of the male sex hormone.

The duct system is a long, twisting, curling tube about three miles long in bulls and probably slightly shorter in boars. The epididymus alone of boars is over 500 feet long. The function of the duct system is to mature, store, and provide passage of the sperm from the point of origin to the surface of the body. The epididymus provides maturing facilities.

The three accessory glands, no one of which is essential for fertility, provide the fluid portion of the semen. The three are the seminal vesicles, prostate, and cowper's glands (bulbo-urethral glands).

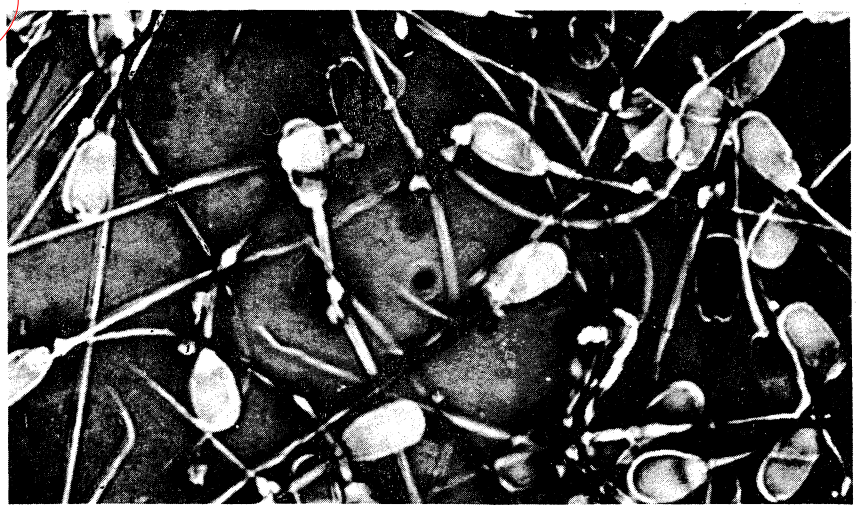


Figure 2. These boar spermatozoa are magnified about 1,000 times. About 20 billion spermatozoa are ejaculated at each service by the boar. A single sperm unites with one egg to form the new individual. Sperm are considerably smaller than the egg but each contributes equally to genetic make-up of the offspring.

The seminal vesicles are the largest of the accessories and as such are often erroneously thought to store sperm. They do not store sperm but do produce the "tapioca-like" material in boar semen. This makes up some 15 to 25% of the total semen volume of the boar and the stallion.

The prostate gland is much smaller and lies between the seminal vesicles and the cowper's glands. This prostate gland contains a rudimentary uterus which responds to estrogen, a female sex hormone, in the same way as does the uterus of the female. This estrogen response causes trouble in older men by enlarging this rudimentary uterus thus constricting the urethra. The prostate gland produces a thick fluid which imparts the characteristic odor to semen and which is also thought by many to help activate sperm motility.

The cowper's glands (bulbo-urethral) are the last of the three accessories and are intermediate in size. They secrete a clear, lubricating material (similar to thick saliva) which clears the urethra of urine prior to ejaculation and lubricates the vulva before vulvar secretions start flowing. These glands are best developed in man and in the boar.

The penis is the male organ of copulation. It deposits semen into the uterus and/or vagina of the female reproductive tract. To accomplish this it has many modifications in the various species. For example, dogs, mink, fox and raccoons have a spoon shaped bone (os penis) along the under side of the penis. The penis of the tom cat has barbs along either side. The oppossum has a forked penis, rams have a slight corkscrew prepuce and boars have a marked corkscrew prepuce. The function of the "corkscrew" is to ease the entry through the vulva and cervix because the semen is deposited into the uterus. The sheath protects the penis in the retracted state and helps guide the penis in copulation.

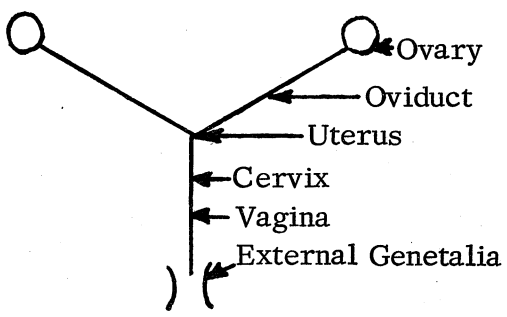
The semen is the composite of sperm and the fluids of the accessory glands. It helps activate sperm motility, provides a transport medium for sperm in the female reproductive tract and coagulates and forms a mechanical barrier to prevent loss of sperm from the female reproductive tract.

The volume and concentration of sperm varies widely from one class of farm animals to another. For example, the stallion and the boar produce sperm in low concentration in large volumes. The stallion ejaculates from 75 to 150 cc per service while the boar ejaculates 125 to 500 cc with an average of about 200 cc. Because of the large volumes ejaculated, a boar's mature sperm (those capable of fertilizing the ova) can be depleted due to over work. Recovery is fast, usually 24 to 48 hours. On the other hand the bull and the ram ejaculate small volumes with a higher concentration of sperm. The bull ejaculates some 1 to 14 cc per service while the ram ejaculates 1/2 to 2 cc per service.

The Female Genital System

The female genital system includes the ovaries, oviducts, uterus, cervix, vagina and external genetalia.

The following simplified diagram of the female genital system shows the location of each part in relation to the whole system.



The ovary is a dynamic organ undergoing constant changes in a rather cyclical fashion. The size, and to some extent the shape, is under complete endocrine control. This accounts for the ever changing appearance of the ovary. Many modifications of the ovary exist in various species. Each general modification reflects the usual number of young produced by the female at the time of parturition. In those species of animals having single births, the female has an oval shaped ovary. The one exception to this general statement is the mare--her ovary is kidney bean shaped. Litter bearing animals have a berry shaped ovary. This can best be visualized by thinking of the ovary as being shaped like a large dewberry or an extra large blackberry or raspberry. The rounded protrusions on the surface of the ovary are follicles, each containing one egg.

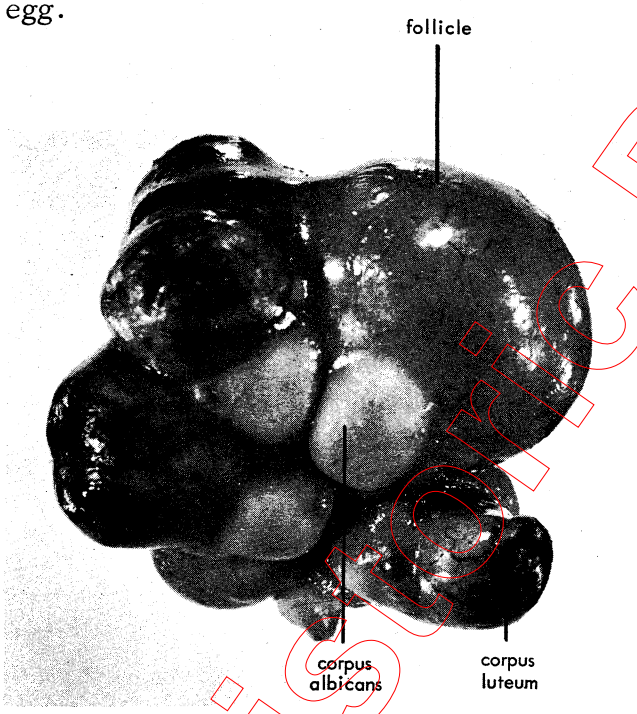


Figure 3. Ovaries of a non-pregnant gilt, magnified about 3 1/4 times. Six developing corpora lutea are on the ovaries. The large follicle on the upper ovary has not yet ruptured. When it ruptures and releases the enclosed egg to the Fallopian tube, it will become a corpus luteum like the one below it and produce hormones. If the sow does not become pregnant, the corpora lutea will regress and soon appear like the corpora albicantia (center of picture), which are left from the previous estrous cycle.

The ovarian function, like that of the testicles, is both of exocrine and endocrine. The exocrine function is oogenesis or the production of ova while the endocrine function is the production of ovarian hormones. In oogenesis, the germinal epithelium, which gives rise to the ova, covers the surface of the ovary as contrasted to its lining the seminiferous tubules in the testicle. Each cell in the germinal epithelium is, theoretically, capable of producing an ovum. In the process a single epithelium cell is slightly departed from its bordering cell and possibly becomes completely surrounded by one layer of differentiated cells to become a primary follicle containing an ovum. In the next stage of development, known as a secondary follicle, the ovum is surrounded by one or two layers of cells but with a clear ring separating the ovum and these surrounding cells. In the final stage of development, the mature follicle is very evident. This is a large, blister-like protrusion on the surface of the ovary. The ovum is now mature and capable of being fertilized upon ovulation.

Ovulation is the process by which the mature follicles are ruptured and the ova are discharged. This occurs usually near the end of the heat period. In multiple ovulation, as in sows, this takes place over a period of several hours and, as we shall see later, this accounts for the necessity of timing the mating for best results. In the process of ovulation the ruptured follicle first fills with blood and then "heals over" to form corpora lutea, commonly called yellow bodies. The corpora lutea eventually degenerate into white spots, corpora albicans, by the time of the subsequent heat period. Thus, at any one time in the ovary of a post-pubural gilt, we can see primary follicles, secondary follicles, mature follicles, yellow bodies and white spots. The ratio of one to the other varies according to the hormone influence at the stage of the cycle.

The oviduct is a very thin, tortuous tube with a funnel shaped end. There are finger-like projections found on the rim of the funnel. The oviduct picks up the discharged ova and propels them to the uterus. The propulsion is done by muscle contractions in the wall of the tube and by the wave like action of the motile cilia, hair like projections in the lumen of the tube. Fertilization usually takes place in the oviduct. In sows the eggs are in the oviduct for about 3 days.

The uterus is a hollow muscular organ which is continuous with the oviduct and opens posteriorly into the vagina. There are many types of uterii found in the various species of animals. Examples of the more prominent types are listed below.

Oppossum--2 ovaries, 2 oviducts, 2 uterii, 2 cervices, 2 vaginas, 2 external openings.

Rabbit--2 ovaries, 2 oviducts, 2 uterii, 2 cervices, 1 vagina, 1 external opening.

Sow--2 ovaries, 2 oviducts, 2 uterii, 1 cervix, 1 vagina, 1 external opening.

Cow and Ewe--2 ovaries, 2 oviducts, 2 uterine horns, 1 uterine body (partitioned), 1 cervix, 1 vagina, 1 external opening.

Mare--similar to that of cow and ewe but with no uterine partition.

Woman--similar to that of the mare but with no uterine horns and a thicker uterine body wall.

Individual females in each specie may revert back to a more primative type, but no case has ever been known to have a higher type of uterus. The last three types listed above are designed for single births. The other more primative forms are designed

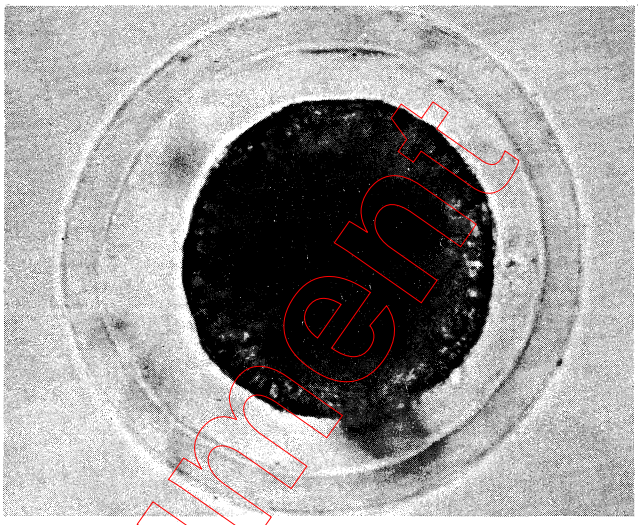


Figure 4. After the ovum or egg is fertilized it begins to divide. This picture is magnified 340 times.

for multiple births. The function of the uterus is to receive the eggs from the oviducts. If the eggs are fertilized, the walls of the uterus thicken, its blood supply increases and the uterus allows the fertilized eggs to attach to the walls for the development of the new individuals. With the sow type uterus having one cervix and two uterine horns, the attachments are equalized as to number and location in each horn. The pregnant horns grow with the developing embryos and fetuses. Near term, they are much larger in diameter and longer than before fertilization.

The attachment of the fertilized egg to the wall of the uterus is called placentation. Ruminant animals have a cotyledenous type of placentation. In this situation there are about 100 special areas of attachment. The attachment is as the meat of an English walnut fits into its hull. The sow and the mare have a diffuse type of placentation. In this case there is a loose attachment at no particular area. The sow placentation occurs on or about the tenth to fifteenth day of pregnancy.

In all types of uterii, the blood of the mother and fetus circulate in entirely sepa-

Figure 5. Reproductive tract of a gilt 28 days pregnant (approximately 1/4 actual size). Enlargement in the uterine horns and an increase in blood supply to the uterus have occurred. Embryos usually space themselves evenly, as in the nine shown here.

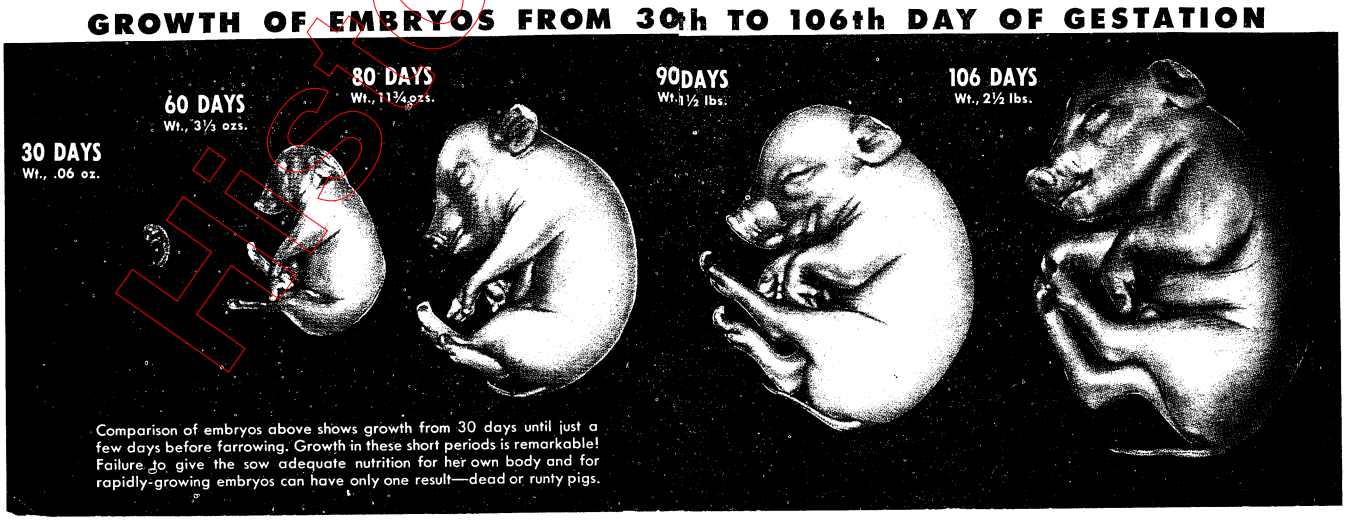


Figure 6. One pig embryo 28 days after fertilization.

rate channels. There are no direct neural connections between the mother and the fetus. All nutrients and metabolic products must pass through both the fetal and maternal membranes of the placenta. This is commonly referred to as the placental barrier.

The cervix is the door to the uterus. It is basically a sphincter muscle. There are three basic types of cervices. These are typlified by that which appears in woman, having four interlocking annular rings, and in the mare having longitudinal folds, and lastly in the sow, having interlocking knobs. Ejaculation occurs in the uterus of the mare and the sow. The longitudinal folds of the cervix of the mare and the relaxed interlocking knobs of the cervix of the sow at the time of copulation makes for easier entry of the penis.

The cervix forms a closed door to the pregnant uterus. The cervix has glands which secrete a viscous, stringy mucous which forms a bactericidal plug over the cervix opening. If this plug is ruptured, abortion usually follows immediately. The cervix furnishes a lubricant for the vagina and vulva of the open tract.

The vagina is a tubular passage which extends horizontally through the pelvic cavity from the cervix to the external genetalia. Its function is twofold. It serves as a birth canal and it receives the semen at copulation, in all cases excepting mares and sows.

The external genetalia is made up of the clitoris and the vulva. The clitoris is the female homolog of the penis; composed of erectile tissue and containing numerous nerve endings. The vulva is the terminal part of the female genital tract.

Sterility and Impaired Fertility

The terms and definitions of sterility and fertility are:

Sterility--complete reproductive failure.

Fertility--a qualitative term of relative reproductive efficiency.

The most efficient sow, from the point of view of reproduction, is one which requires the fewest number of services per conception and shows the highest rates of ovulation, fertilization, implantation and number of pigs born. It has been found that about 10 percent of the total breeding population do not conceive.

Half of these sows were sterile because of anatomic uterine defects, tubal obstructions and cystic follicles. The other half are hard to settle sows. They show no anatomic bars to fertility and eventually conceive although a great many breedings may be required. There is no satisfactory explanation for this reluctance to conceive. These sows are sterile from the point of view of the hogman, since to rebreed them as often as is necessary to get them pregnant is neither economical nor practical.

It has been estimated that another 10 to 15 percent of the total breeding population

shows some degree of impairment of **fertility.** In this category, the litter size is drastically reduced to as low as one or two pigs per litter. This is due to intrauterine fetal mortality after the implantation of a litter of normal size and cannot be blamed on infectious organisms. Nothing is known concerning the physiological causes behind this almost complete intrauterine fetal resorption.

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