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John B. Herrick
Iowa State College

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Artificial Insemination Of Swine

John B. Herrick, D.V.M.
Research Ass't Prof. of Dairy Husbandry
Iowa State College

[Editor's Note: This completes Dr. Herrick's paper, the first of which was published Winter, 1950]

III. COLLECTION OF SEMEN

As early as 1931 McKenzie designed an artificial vagina for the collection of boar semen. For convenience, it will be referred to as the Type A vagina. It consists of a soft rubber tube, 16 in. long, one end of which is fitted over the mouth of a test tube. The other end is fitted over a 1 5/8 inch key-ring. An ordinary clamp completes the outfit. The rubber is band tubing, 1 3/16 in. inside diameter and 1½ in. outside diameter. The test tube should be large enough to hold 50 cc. of semen. This is a relatively simple device in which no special provision is needed to keep the apparatus warm during copulation. In cold weather, a pre-warming is effected by moistening the inside of the rubber tube, clamping the funnel end close to the keyring, and immersing the whole apparatus in warm water immediately prior to collection. It is important that no water run into the test tube, hence the need for a clamp during pre-warming.

Hudjahov (1936) devised a Type B model artificial vagina which closely resembles that used for cattle. It consists of an ebonite cylinder provided with valves for regulating the pressure and an inner rubber chamber. In addition, there is a rubber tube 180 mm. long and 80 mm. wide which connects with a semen receptacle of 500-800 cc. capacity. This model overcomes two deficiencies in the old model, according to Hudjakov. It is larger throughout, and has facilities for keeping the boar's penis warm during collection, evidently a matter of considerable practical importance in Russian weather. The pressure control feature is also an improvement.

The Swedish model vagina designed by Baeckstrom and reported by Lambert and McKenzie (1940) may be called Type C. It is similar to the Type B model with one additional feature: a bulb is attached to an air line to give pulsations to the boar's penis. Before being used, it should be carefully cleaned, the surface of the inner tube evenly smeared with lubricant, and water put in the jacket as in the cattle artifical vagina. Since manual pressure on the penis is impossible with this apparatus, a pulsating motion is obtained by means of a rubber bulb.

The Type D vagina was improvised by Lasley and McKenzie (1940). It consists of an inner tube 1 5/16 in. in inner diameter and 1 3/8 in. in outer diameter, and an outer rubber casing 12-15 in. long. The semen is collected in any convenient glass receptacle, preferably 50 cc. test tubes. This model is essentially a simplification of Type B for semen collection in cold weather.

The author used an artificial vagina similar to that used in collecting semen from bulls, but used a 500 cc. flask for a collecting vial. He used an improvised

"boot" to cover this and the collecting cone to prevent cold shock to the sperm.

Method of Collection

The procedure of semen collection is standard, regardless of the type of artificial vagina used. A sow is placed in a simple stanchion or tied to a wall by means of a rope around her upper jaw. The boar is admitted. When the boar mounts and attempts to copulate, the open end of the artificial vagina is placed in front of his sheath so that the penis can pass into the tube at the other end. As the penis enters the tube (of the Type A model) it is manipulated with a pulsating motion by the attendant's hand, thus encouraging continued copulation and ejaculation. Too much pressure must not be applied against the sheath or a part of the contents of the preputial diverticulum may be forced into the collecting flask. From 5-20 minutes are required for collection depending on the disposition and condition of the boar.

The presence of a sow is not essential for boar semen collection, nor, if one is used, does she have to be in heat. A dummy sow will serve just as well (Rodolfo 1934). A wooden dummy is cheaper than a metal one and is as efficient. It can be covered with canvas instead of a pigskin (Hudjakov 1936).

IV. DETERMINING FERTILITY IN BOARS

In 1947 the author was confronted with the problem of determining fertility and usefulness in 125 boars that were sold by a large commercial company and were returned because of their supposed inability to settle sows.

Many of these boars were subjected to very poor management practices so cases of swine flu, injuries and other obvious conditions were easily noticed. The 125 boars were classified and were sorted in the following classification:

Reacted to brucellosis	12
Injuries-penis, legs, etc.	8
Symptoms of chronic erysipelas	10
Swine flu	9
Lack of condition	5
No obvious ailment	81

The boars that were diseased and injured, or cases of obvious malnutrition and mismanagement were castrated and marketed. The remaining 81 head were then examined. The agglutination test for brucellosis was run at an interval of two weeks between and again five were found to be reactors. They were castrated and also placed in the fattening pen. The remaining 76 were then examined.

Equipment and Procedure

An artificial vagina 14 in. long and 2¼ in. inside diameter with a collecting cone was used and instead of a 5cc. graduated vial for a collecting vial, a 250 cc. graduated flask was used. The air pressure between the shell and inner lines was higher than commonly used for bulls. The water temperature was maintained at around 130°F. A sow in heat was used for the boar to mount.

A chart was set up that included the boars identity, date of collection, volume of semen, density, motility, the difference in amount of jelly-like material and concentrated sperm, and morphology.

Density and motility was graded from 1-5 by visual observation under the microscope. The boars that would not ejaculate over 50 cc. of semen were collected from again in 5 days. A hemocytometer was used at first to determine the actual count and to establish a means of judging density. Morphology was determined by examining smears stained with the Fast Green method.

Of the 76 boars, 28 refused to mount the sows even when left alone with them. These were placed separately and were treated for timidity with hormone therapy. The remaining 48 head were then examined and the results recorded. Boars with an ejaculate less than 50 cc., motility lower than 3, concentrated semen less than 25 percent of total ejaculate, and morphology showing over 25 percent of curled tails or abnormal heads were discarded. Ten boars were discarded by this process. The remainder were resold

again following a clean blood test and as far as any records could show were satisfactory.

The 28 boars that showed lack of libido were treated with chorionic gonadatrophic hormone and testosterone. It was found that the intravenous injection of chorionic gonadatrophic hormones gave a more immediate response than intramuscular injections. Ten of the 28 head showed evidence of libido, and repeated examination showed that 2 of these exhibited semen samples showing abnormal morphology and were discarded. The remaining 18 head did not respond to hormone therapy to the extent that they could be placed with a herd.

Final analysis showed the 125 head fell into the following catergories:

Brucellosis	17
Injuries to penis	8
Symptoms of swine erysipelas	10
Swine flu	9
Lack of condition	5
Timidity	18
Infertile as evidenced by semen examination	12
Fertile and resold	46
	125

Forty-six out of 125 or 37 percent of boars returned were found to be fit to resell. Eight of the 46 were boars that responded by showing increased libido due to hormone therapy.

It is a commonly known fact to swine breeders that a good many boars are sold and returned which are fertile. A good share of this could be avoided by proper management. A 5-10 percent return on a group of sale boars is not unusual. No attempt was made in this study to determine the specific reason why the boar was returned.

It is apparent that a good many boars can be examined to determine fertility before they are castrated. However, it must be remembered that these various tests are mere indicators, and the ability of a boar to produce pregnancy is the most positive test.

V. INSEMINATION OF SOWS

The second day of heat is generally considered best for successful insemination. Haring (1937), reported by Anderson, observed that ovulation in sows begins about 24 hours after the onset of heat and is completed in 30 hours or at most 38 hours after the onset of heat.

Dilution: Amount of Semen to Use

Because of the large uterine horns in the sow, relatively large volumes of semen are sometimes recommended for insemination. No conclusive data are available as to the quantity required. Lambert and McKenzie (1940) state that, with undiluted semen, volumes of 50-100 cc. seem sufficient for insemination if the sperm concentration in the semen is reasonably high. Rodin and Lipatov (1935) state that the optimum volume of diluted semen is 100-150 cc., depending on the size of the sow. Larger sows should get the larger doses. If the fraction containing the high sperm concentration is used, a smaller volume of about 25 cc. may be used after it is diluted with a good swine diluent (Lambert and McKenzie 1940).

A brief review of boar semen diluents has been given. One part of semen to four parts diluent is generally recommended (Lambert and McKenzie, Rodin and Lipatov, Wishart).

Insemination Technique

Taken mostly from
Lambert and McKenzie 1940.

Before the sow to be inseminated is brought in, all apparatus should be made ready and placed in a convenient location for the operator. The sow should be placed in a crate or breeding chute or tied to a wall by means of a rope about her upper jaw and should, of course, be at the proper stage of oestrus. The equipment needed consists of a glass syringe of 50 cc. capacity, one piece of rubber pressure tubing 45 cm. long and about 4 mm. inner diameter that has been fitted to the syringe and tapered at the free end. An ebonite nozzle attached to the syringe may be substituted for the rubber tubing. When the sow is ready for

insemination and the tubing (or nozzle) and syringe have been filled with semen, the nozzle is introduced into the vagina and pushed forward into the cervix. The semen is slowly expelled into the cervix by pressure on the plunger of the syringe. The object is to place the semen well into the anterior end of the vagina and preferably directly into the cervix, thus simulating conditions of natural breeding. After depositing the semen it is well to push a moistened cotton plug just within the vestibule of the vagina. This prevents excessive waste of semen.

Of course, all gelatinous material is discarded before the syringe is loaded, assuming that fresh undiluted semen is used. This can be done, as previously noted, by ejecting the lumps from a glass bowl with a glass rod or by straining the material through freshly laundered cheesecloth.

Hudjakov (1936) has described a special apparatus for making injections. It consists of a 600 cc. glass cyclinder which is firmly fixed in a wooden stand. The lower end opens into a rubber tube which is attached to a glass tube in the vagina of the sow. The semen passes into the vagina due to the pressure from the different levels of the fluid and the absorbing capacity of the uterus.

Production Testing and the Keeping of Records

The most important advantage of artificial insemination in dairy cattle is that it permits the widespread use of *superior proved* sires at a price that is within the means of the dairy farmer. Sires are proved on the basis of milk production records of female near-relatives and progeny. The accuracy with which a sire is proven is dependent on the accuracy of milk production records, usually kept by cow-owners cooperating with the bull stud.

When applied to swine, however, the words "superior" and "proved" are still in the process of being defined and standardized. The merit of a boar is determined by his individuality primarily. He is bought or rejected according to the judgement of the farmer as to how he will influence the progeny of sows in his particular herd. Such judgement varies between breeders and between herds, although efforts to standardize type in swine breeding are tending to minimize large differences in judgement. Some breed associations, realizing the inadequacy of this methods of sire selection, have instituted production testing of registered sows. Such tests are designed to determine the ability of sows to bear and raise large litters to heavy weaning weights, thus testing her fertility, motherliness, and milking ability. Boars from such sows or siring litters of sows that meet the requirements of this test might come under the title of superior or proved, but they represent a very small fraction of the boar population. Also, testing standards for sows need to be generally accepted.

Other Factors of Practical Significance

Science has devised the apparatus and technique for artificial insemination of sows and has made strides in semen storage, but it has not told the farmers just what he may expect with regard to conception rate, litter size, and vigor of pigs resulting from such a breeding plan. These items are much more important to pork production than to milk production; they are, in fact, the physical basis of profit to the swine producer.

It has been noted that McKenzie was able to inseminate 13 of 28 gilts with concentrated semen 1-2 days old and diluted four times when two or more inseminations per heat period were made. Conception was thus less than 50 percent on first service under these conditions. Extra inseminations in the same heat period doubled the percentage of pregnancies. This same source (1939) used semen from boars of proved fertility to inseminate 63 Poland China gilts, 24 of which became pregnant. Semen 1-4½ days old proved satisfactory. Under these conditions, then, 38 percent conception of first service was obtained.

It should be borne in mind that studies of this kind have not been conducted extensively enough to produce general averages; also, that average conception

rate under farm conditions with natural service is not available for comparison. When is it the boar's fault and when is it the sow's fault? This is a commonly debated question among swine producers. Farmers do not advertise boars of low breeding efficiency and it is difficult to say how large a fraction of the boar population is furnished by such individuals. Feeding and management play a large part in the fertility of both sexes.

Even fewer data are available (to the writer) regarding the influence of artificial insemination on litter size and strength. Yet Winters *et al* (1938) state that litter size might well be reduced as a result of the reduction in the amount of semen used. Certainly, the farmer is justified in waiting for more assurance on this point before giving his support to artificial insemination of swine.

Another point brought out by the same author is that the cost per sow is likely to be too great for community insemination except in the case of valuable purebred stock. Here again the question of what determines the value of a sire comes up. As long as boars are available for little more than slaughter price, which is on a weight basis, there will be plenty of buyers for them. As long as the packer makes no distinction in quality for the price paid for market hogs, there will be no general incentive to produce quality hogs; hence, any ordinary boar will serve the purpose. It is a vicious circle leading back to the need production testing, sire proving and carcass evaluation.

It must be said that the initial cost of the boar is not nearly as high in proportion to the number of services obtained from him, as is the case with the dairy bull and the cost per insemination would probably be higher than the farmer would like to pay, unless he had only one or two sows. Moreover, the boar has relatively more market value when his breeding career is over than does the dairy bull. Also, if both bull and boar were properly managed, the boar would be less dangerous to handle than the bull. These facts combine to form a logical argument for the farmer to continue breeding his sows by natural service.

One of the greatest points of significance concerning artificial insemination in hogs is the disease control factor. Swine producers are all conscious of the difficulty of selecting a boar from a farm that is, free from parasites, erysipelas, enteritis and brucellosis. With the use of artificial insemination this ever present problem could be easily controlled and save swine producers many dollars annually.

VI. SUMMARY AND CONCLUSIONS

A review of all available literature on the artificial insemination of swine is presented. Swine semen studies by McKenzie and associates are reported in condensed form. The work of various Russian investigators is reported. Four models of artificial vaginas are described, as well as the technique of sow insemination. A brief review of diluents and buffers on semen storage is given. A broader and less technical treatment of the practical aspects is submitted, based largely on observations of the writer. Boar management, production testing, and need for sire proving are stressed. An attempt has been made to analyze the reasons for the difference in popularity of artificial insemination as applied to dairy cattle and to swine.

The data reported herein seem to warrant the following conclusions:

1. The technique of artificial insemination of swine closely parallels that of cattle. Modification of collection and insemination apparatus for swine is principally one of size, in recognition of the physical differences in the male and female genitalia of the two species. Boar semen differs from bull semen in several respects. The boar produces 125-500 cc. of semen per ejaculate as compared with about 5-10 cc. in the bull.
2. Boar semen also contains large amounts of gelatinous material and a stiff, waxy secretion from the bulbourethral glands, the latter serving as a cervical or vaginal plug.
3. Abnormal spermatozoa as an indication of boar fertility has been demon-

strated, but further knowledge of the limits of such abnormal forms in normal semen is needed.

4. Boar semen has been stored successfully for as long as 56 hours in this country and 126-128 hours in Italy by centrifuging and storing the highly concentrated sperm fraction at temperatures of 10-12°C. and 0°C. respectively.
5. Reluctance of the farmer-breeder to support artificial insemination in swine cannot be attributed to deficiences in scientific techniques.
6. The chief obstacle to a widespread use of artificial insemination of swine in this country is a lack of standardization in production testing and sire proving. Other practical factors influencing the farmer to continue breeding his sows by natural service are:
   a) The relatively low initial cost of boars in proportion to the number of services obtained from them.
   b) The relatively high market value of the animal when his breeding career is over.
   c) The probable high cost per sow of community insemination by artificial means.
   d) Insufficient information as to the conception rate, litter size, and vigor of pigs sired artifically.
7. The main advantages of artificial insemination of swine are:
   a) Disease control factor.
   b) Dissemination of a superior sire's semen to many herds.
   c) The ability to use semen from boars that are unable to serve females due to size or some injury.

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Correction

Article—Class of '49
Brucellosis Tests
Author—R. A. Packer

On page 25 the graph under Agglutination Test, should read 1-100 instead of 1-1000.

Fur Breeders

Transitory drowsiness is a side effect of benadryl therapy that can be overcome by reducing the dosage slightly and administering stimulants.

In this country the known vectors of anaplasmosis include five species of ticks, three genera of biting flies, three species of mosquitoes and the two-legged pest that goes from animal to animal with a bloody horn saw, a contaminated castrating instrument, or an unsterilized hypodermic needle.

Prolonged postpartum vaginal discharge in bitches after whelping is best treated by a 1 cc. dose of posterior pituitary extract together with intramuscular injection of 300,000 units of penicillin. Usually not over one or two injections of each drug are necessary. *Jen-Sal Journal.*

Erysipelas

Erysipelas of farm animals is on the increase in Illinois and its menace not only to the state's swine, lambs and turkeys but also to human beings, was one of the principal topics for discussion when the Illinois State Veterinary Medical Association held its sixty-eighth annual convention Feb. 1-3, in Peoria, Ill.

Rabies, which raged at a new high rate in Illinois in 1949, and bovine mastitis and bovine tuberculosis, all of which are other common animal-human diseases, also were on the program for discussion. Today's much headlined anti-histamine drugs were discussed by Dr. C. C. Pfeiffer, head of the Department of Pharmacology, University of Illinois College of Medicine, Chicago. The pros and cons of socialized medicine were presented by Dr. Walter Stevenson, Quincy, president of the Illinois Medical Society; and Dr. Austin Smith, the new editor of The Journal of the American Medical Association, Chicago, spoke on the world effect of medical advancement. Other speakers included specialists in various phases of veterinary practice from Indiana, Georgia, Wyoming, Iowa, Missouri, Kentucky, Wisconsin and Canada. More than 500 persons attended the convention. Dr. R. M. Carter, Alexis, is president and Dr. A. G. Misener, Chicago, secretary-treasurer. Dr. C. L. Miller, Oak Park, president-elect, took office during the Peoria convention.

Unlike many antibacterial solutions that deteriorate with age or lose potency under repeated temperature changes, quaternary ammonium compound solutions stay stable during long storage periods, are non-volatile and not affected by boiling or autoclaving.

When farrowing, a sow, if pigs are coming in the anterior longitudinal presentation, will give birth to a pig every five minutes. If pigs come in the posterior longitudinal presentation, they will appear in 20 minute intervals.