J. Natn. Sci. Coun. Sri Lanka 1980 **8** (2) : 177—186

Studies on Artificial Insemination of Swine in Sri Lanka

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(*Date of receipt* : 6 *September* 1979)
(*Date of acceptance* : 16 *September* 1980)

Abstract: With intensive swine production, there is now a need to increase the genetic potential of swine for higher production through artificial insemination. In this study three experiments were conducted to make specific recommendations for the inauguration of an artificial insemination service for the pig belt and major pig farms of Sri Lanka. In Experiment I, twenty gilts were served at oestrus, 10 by natural service and the balance 10 artificially with undiluted semen. A reduction in litter size, birth weight, number of piglings weaned and weaning weight of piglings were observed with artificial insemination but the differences were not statistically significant ($P < 0.05$). Three diluents (skim-milk, Illini variant temperature (IVT), Beltsville (BLT) were tested for their ability to preserve boar semen at room temperature in the second experiment. Results showed that both IVT and BLT diluents were suitable to preserve boar semen upto 24 hours and that IVT is the better diluent of the two. In Experiment III, 32 sows were distributed randomly to four treatments namely, natural service, insemination with fresh undiluted semen, fresh diluted semen and 24 hours stored semen. The mean litter size, birth weights, number of piglings weaned and weaning weights were not different among treatment groups.

1. Introduction

Of the domesticated mammals, the pig is the most rapidly reproducing animal, being extremely prolific and maturing early. Hence it is very suitable for rapid improvement through the use of artificial insemination (AI) which offers the following advantages :

1. Makes maximum use of proven boars,
2. Enables synchronised farrowing without an increase in the numbers of boars,
3. Allows the use of older, heavy boars or gilts which are comparatively small in size,
4. Is economical as it avoids the expenses of maintaining a stud boar, specially benefitting the small farmer,
5. Prevents spread of venereal diseases,
6. Saves time considerably if a large number of sows are to be bred,
7. Enables the extension of the useful life of boars, as a heavy aged boar will continue to work effectively on a dummy sow after he has become too large and awkward for natural breeding.

The progress of AI in swine though not spectacular as in cattle, has been steady over the years. At present AI in swine is carried out extensively in USSR, Hungary, Holland, Germany, Federal Republic, and Japan and to some degree in England, Denmark, Yugoslavia, Rumania, Finland and France.

The earliest work done on the AI of pigs was by Milanov,[5] Rodolph,[7] Rodin and Lipator,[6] who have shown that semen could obtained from the boar by means of a 'dummy' and artificial vagina. Since then considerable information has accumulated from work done in different countries on semen collection, dilution, storage and insemination.

In Sri Lanka, AI of cattle was first introduced in 1938 and steady progress has been maintained. However, very little work has been undertaken on artificial insemination of pigs. Jeganathan[3] obtained successful results from AI of gilts with semen imported from Britain. The lack of interest on AI on swine in the past was due to the fact that there was very little organized pig breeding in the country and also due to the fact that the total attention of the Department of Agriculture was focussed on AI of cattle. With a ready market available for pork and improved feed position, there is today a revival of the pig industry, and largescale pig rearing is carried out in the pig belt along the western sea border. With intensive management there is now a demand for pigs with higher food conversion efficiency, better carcass weight and carcass quality. The most practical, quick and least expensive method of improving these traits in the local pig population is by AI with semen from proven boars.

The purpose of this paper is to record the results of a study aimed at making specific recommendations for the inauguration of an AI service for the pig belt and major pig farms of Sri Lanka. The objectives of the study were:

1. Evaluation of the litter size, birth weight, number weaned and weaning weight of piglings following natural service and AI with undiluted semen.
2. In vitro evaluation of diluents for the preservation of semen at room temperature.
3. Evaluation of the litter size, birth weight, number weaned and weaning weights of piglings following AI of sows with semen stored at room temperature.

2. Materials and Methods

The experiments were conducted at the University piggery, Upper Hantane, and at the Laboratory of the Department of Animal Husbandry, Faculty of Agriculture, University of Peradeniya, Peradeniya.

The indoor system of intensive management was practiced at the piggery with permanent housing and concrete floors, etc. Feeding was common to all groups used in the experiments and consisted of swill collected from the University halls of residence supplemented with compounded concentrate feed consisting of coconut poonac and rice bran as the main ingredients and added mineral mixture. The boars were housed separately from the sows and gilts. Individual sows with litters were kept in separate pens.

Semen was collected from three young boars using a sow in oestrus. The semen samples were evaluated for concentration, mass activity, motility % and dead sperm % and based on this two boars were selected for this study. They were trained to mount a 'dummy' sow to collect semen to be used in the experiments. The dummy sow was made of $\frac{3}{4}''$ galvanized iron tubing and a log (Figure 1) stuffed to a proper shape and covered with a plastic cloth. It was fixed to a light wooden platform so that the boar kept it in place by means of its own weight. The hind-most part of the platform was covered by a rubber mat so that the boar stood steady.

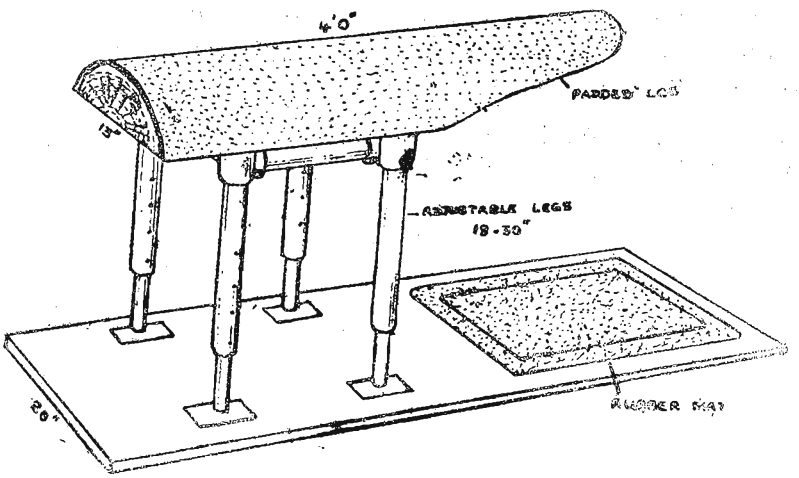

Figure 1. A dummy sow

The training of the boar was done in a separate, quiet darkened room in the piggery. A sow in oestrus was brought into the room and the boar was allowed to mount it. This was practised once a week in the same room and continued for three weeks. After three weeks, the dummy sow was placed in the room and secretions of a sow in oestrus were applied on its back. The boar and sow were brought into the room and when the boar became excited, the sow was removed. With some direction, the boar mounted the dummy sow. With further training, the boar mounted the dummy sow without any stimulation as it was brought into the room.

Semen was collected from the mounted boar into a sterilized plastic bottle of 500 ml capacity, by firmly gripping the glans penis, gently pulling it down and maintaining pressure on it. An average of 250 ml of semen was collected at each collection which took about 5-15 mins.

2.1 Experiment I

In this experiment, natural service and AI was carried out on 10 gilts each at natural oestrus. The gilts that came back into oestrus in each group were reserved to the boars or reinseminated until conception occurred. The same boars were used for natural service as well as for AI.

The detection of oestrus was on the basis of the swelling and reddening of the vulva, the 'immobility response' and also on the response to the advances of the boar. Services, both natural and artificial, were carried out twice both late on the first day and early on the second day of oestrus to ensure maximum conception rates.

For natural service, the boar was taken to the pens with the gilt or gilts in oestrus. For AI, the semen was collected as described above and strained through two layers of cotton gauze into a graduated measuring cylinder of 500 ml capacity.

The apparatus used for insemination is shown in Figure 2. 80-100 ml of the separated undiluted semen was filled into the plastic squeeze bottle. The spiral tip and part of the length of the rubber inseminating catheter was lubricated with an antiseptic cream (Hibitane) and the catheter was gently inserted into the vagina of the gilt in oestrus until it reached the cervix. It was then twisted in an anti-clockwise direction until it locked firmly in the cervix. The plastic squeeze bottle was fixed to the free end of the catheter and the semen was squeezed in through it slowly.

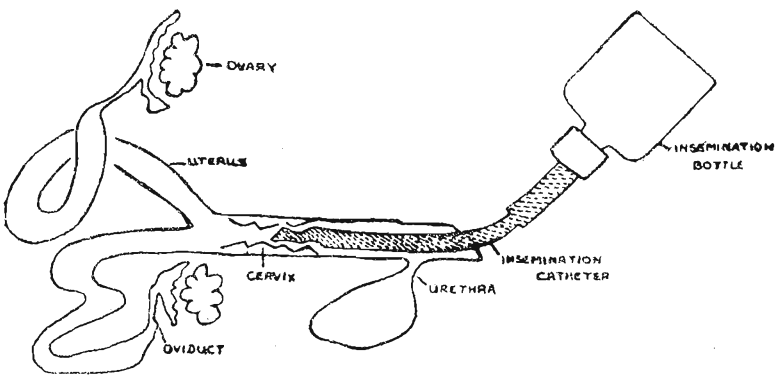

Figure 2. The insemination catheter locked firmly in the cervix.

After farrowing, the litter size, birth weight, number of piglings weaned and the weaning weight of piglings of each of the 20 gilts were recorded.

2.2 Experiment II

The composition of three diluents used for the preservation of semen is shown in Table 1.

TABLE 1. The composition of three diluents used for the preservation of Boar Semen

Diluent I —	*Skim milk diluent*	
	Skimmed milk powder	— 4.5 gm
	Glucose	— 1.5 gm
	Streptomycin	— 1.0 gm.
	Penicillin	— 1×10^6 I. U.
	Distilled water	— 100 ml
Diluent II —	*Modified IVT diluent*	
	Sodium citrate	— 20 gm
	Sodium bicarbonate	— 2.1 gm
	Glucose	— 3 gm
	Potassium chloride	— 4.4 gm
	Sulphadimidine	— 3 mg
	Streptomycin	— 0.5 gm
	Penicillin	— 0.5×10^6 I. U.
	Distilled water	— 1000 ml
Diluent III —	*Beltsville (BLT) Extender*	
	Sodium citrate dihydrate	— 1.0 gm
	Sodium bicarbonate	— 0.2 gm
	Glucose	— 2.9 gm
	Potassium chloride	— 0.03 gm
	Streptomycin	— 0.1 gm
	Penicillin	— 1000 I. U./ml.
	Distilled water	— 100 ml

Semen for this experiment was collected by the method described earlier. Soon after collection, the plastic bottle containing semen was kept inside a rigiform container to prevent cold shock by rapid cooling, and the temperature was recorded. Semen was transported in rigiform and at the laboratory (3 miles from piggery) it was strained through two layers of cotton gauze (to remove the gel portion) into a graduated measuring cylinder of 500 ml capacity, kept in a water bath maintained at 37°C. The volume of semen was read directly. The mass activity was determined using a drop of semen from the measuring cylinder. The concentration of sperms per ml was determined using haemocytometer.

4 tubes of 15 ml capacity with caps were taken and labelled as control I, II and III. 7 ml of diluent from the diluents I, II and III were introduced to the corresponding tubes I, II and III. These three tubes and the empty control tube were kept in the water bath to attain a temperature of 37°C. Semen was introduced into the four tubes gently from the measuring cylinder in the water bath, 14 ml to the control tube and 7 ml each to the tubes labelled I, II, III containing the corresponding diluents. The contents of the tubes were mixed and the four tubes were transferred to the rigiform container.

Evaluation of the diluent was on the basis of % motility of sperms and % of dead sperms. These were determined for the semen in the four tubes at ½- one hour, 6 hours, 12 hours, 24 hours and 48 hours after dilution.

Determination of the % motility

This was done separately for each of the 4 tubes. A drop of semen was taken into a slide and examined under a microscope on the high power. The number of progressively motile spermatozoa out of 10 in several fields was counted and from these the % motility was determined.

Determination of % dead sperms

This too was done separately for each of the four tubes. A drop of semen was mixed with three drops (0.4 ml) of Nigrosin-eosin solution in a watch glass. The slide smears were prepared after 2 mins, and examined under oil immersion. 100 sperms were examined from each slide and the % dead sperms were determined.

2.3 Experiment III

On the results of Experiment II modified IVT diluent was chosen for dilution of semen in this experiment. Thirty two sows were used and they were distributed randomly to the following 4 treatments.

Treatment A — Natural service

Treatment B — Artificial insemination with fresh undiluted semen

Treatment C — Artificial insemination with fresh diluted semen

Treatment D — Artificial insemination with fresh diluted semen kept for 24 hours, at room temperature.

The sows that returned to oestrus in each treatment group were reserved to the boars or reinseminated with appropriate semen until conception occurred. After farrowing, the litter size, birth weight of piglings, number of piglings weaned and the weaning weight of piglings of each of 32 sows were recorded.

3. Results and Discussion

The results of Experiment I are presented in Table 2. There is a reduction in litter size, birth weight of piglings, number of piglings weaned and the weaning weight with AI compared to natural service. However, statistical analysis showed that there was no significant difference between natural service and AI for these characteristics. These results are in agreement with those of Skjervold,[8] who reported smaller litter size at birth with AI for first litters, and Meding and Rosbech,[4] who reported lower litter sizes at birth and at weaning with AI. It is possible that the reduction in litter size with AI was due to lower percentage of fertilized ova and/or an increase in embryonic mortality.

TABLE 2. Mean litter performance following natural service and artificial insemination in gilts

Characteristic	Natural service	Artificial insemination
Number of gilts	10	10
Number farrowed	9	8
Litter size	6.3 ± 2.8	5.1 ± 1.5
Birth wt. in lbs	2.3 ± 0.5	2.3 ± 0.3
Number weaned at 8 weeks	5.6 ± 2.4	4.6 ± 1.9
Weaning wt. in lbs	24.9 ± 8.5	23.2 ± 3.6

NS at P: 0.05

The results of Experiment II are presented in Tables 3 and 4.

TABLE 3. Percent Motile Spermatozoa during storage of Boar semen in different diluents at room temperature

(Mean ± S. D.)

Time hrs.	Control	Diluent I skim milk	Diluent II IVT	Diluent III BLT
0.5–1	75.0 ± 5.6	68.1 ± 8.3	71.9 ± 6.6	70.6 ± 4.6
6	36.3 ± 21.6	50.6 ± 11.6	70.0 ± 5.0**	70.0 ± 4.3**
12	25.6 ± 20.5	45.0 ± 12.0	70.0 ± 5.0**	68.3 ± 12.9**
24	0.6 ± 0.7	23.8 ± 15.4	66.3 ± 7.0**	56.3 ± 12.9**
48	0	3.5 ± 4.1	8.1 ± 12.2	23.9 ± 17.1

**P > 0.01

TABLE 4. Percent dead spermatozoa during storage of Boar Semen in different diluents at room temperature

(Mean ± S.D.)

Time hrs.	Control	Diluent I	Diluent II	Diluent III
0.5–1	14.3 ± 3.6	16.0 ± 5.1	16.3 ± 10.8	16.6 ± 8.1
6	14.8 ± 3.3	15.3 ± 5.7	15.5 ± 5.4	13.8 ± 4.7
12	16.9 ± 3.2	17.8 ± 3.0	15.0 ± 4.6	13.6 ± 4.0
24	34.8 ± 20.5	37.4 ± 11.0	17.1 ± 4.4*	17.8 ± 5.8*
48	71.6 ± 10.9	67.0 ± 16.0	24.4 ± 6.1**	24.3 ± 9.3**

*P > 0.05 **P > 0.01

3.1 % Sperm motility

There was a rapid decline in motility with diluent I in comparison with diluents II and III, which between them showed similar motility upto 12 hours of preservation. The motility at 6, 12 and 24 hours of preservation with diluents II and III was much superior to that of the control ($P > 0.01$) and indicated that diluents II and III can be used to preserve semen at room temperature upto 24 hours. Between diluents II and III, diluent II was superior considering the motility at 24 hours of preservation. The motility of semen with diluent 1 though significant from control at 24 hours of preservation ($P > 0.01$) did not favour its selection due to a very low value. Similar experiments carried out by Baritean, Bussiere and Courot[1] with diluents IVT and Beltsville (BLT) had shown that BLT was superior to IVT for preservation of semen at + 15°C.

The longer preservation time with diluents II and III may have been due to their composition which differed markedly from diluent I, but between them were similar. Since there is a close correlation between sperm motility and fertility, it can be concluded from the above results that diluent II (IVT) and diluent III (BLT), can be used to preserve semen for insemination upto 24 hours, at room temperature.

3.2 % Dead sperms

There was no significant difference between the diluents and the control in the % dead sperms upto 12 hours of preservation. Diluents II and III showed a significantly lower % dead sperms at 24 hours ($P > 0.05$) and 48 hours ($P > 0.01$). There was no significant difference in the % dead sperms in semen preserved with diluent I and undiluted semen. Thus diluent I (skim milk) is clearly not suitable for preservation of semen, at room temperature.

The lower % of dead sperms upto 12 hours in the undiluted semen and the diluents may be due to the sustaining ability of the sperms by the seminal fluid. Beyond 12 hours, this ability decreases and the % of dead sperms in diluent 1 and undiluted semen are high, the components in diluent I being unable to sustain the sperms beyond 12 hours, to the same degree.

The lower percentage of dead sperms with diluent II and III at 24 and 48 hours is due to their better sustaining ability of the sperms, by the nature of their composition discussed earlier. Thus from the results it can be concluded that diluents II and III are suitable to preserve semen only upto 24 hours since at 48 hours the percentage of dead sperms are high for both.

Table 5 summarises the results obtained in Experiment III. It can be seen that the mean litter size, birth weight of piglings, the number of piglings weaned and weaning weight were not affected by treatment. The mean litter size and the number of piglings weaned were larger than that obtained in Experiment I. This may be attributed to the sows used in Experiment III and also to the experience gained in AI of pigs.

TABLE 5. Mean litter size, birth weight, number weaned and weaning weight of piglings following natural service and artificial insemination of sows with fresh, diluted and stored semen

Characteristic	Natural service	Artificial insemination with fresh semen	Artificial insemination with fresh diluted semen	Artificial insemination with fresh stored diluted semen
No. of sows treated	8	8	8	8
No. farrowed	8	7	8	7
Mean litter size at birth	9.4 ± 2.8	9.6 ± 1.5	9.8 ± 2.4	10.2 ± 1.9
Mean birth wt. in lbs	2.3 ± 0.4	2.4 ± 0.5	2.2 ± 0.3	2.2 ± 0.4
Mean number of piglings weaned	8.4 ± 2.8	8.6 ± 1.5	8.8 ± 2.4	8.2 ± 1.9
Mean weaning wt. at 8 weeks	28.8 ± 8.1	27.2 ± 3.2	20.0 ± 6.1	27.0 ± 4.8

NS at: 0.05

It is the general experience of the Sri Lankan pig breeder that on a suitable feed using locally available ingredients, imported animal protein, mineral mixture and under good management, 180-200 lbs live weight could be reached in 7-10 months. Whereas under western conditions with better feeds these weights are obtained at 5½ - 6 months. Therefore unless feed problems that have remained unsolved since the inception of industry are corrected, the advantages of A I using semen for high genetic quality cannot be realised.

Acknowledgements

The authors gratefully acknowledge the assistance given in the form of a research grant by the Animal Production and Health Division of the Ministry of Rural Industrial Development.

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