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# Fertility results of Artificial Insemination in swine performed with liquid boar semen stored at different temperatures: A comparative study

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**Abstract**
The aim of the present study was to compare the fertility results of artificial insemination performed with liquid boar semen diluted in Farmer friendly Boar Semen Extender (FBSE) stored at refrigeration temperature (5-8 ºC) with that of Beltsville Thawing Solution (BTS) stored at 15-18 ºC. An experiment was designed with 20 crossbred LWY sows which were randomly and equally divided into two groups namely; group F and group B based on the semen diluents used (FBSE and BTS). The semen was utilised within 24 hours after collection. Fertility results were measured by evaluating farrowing rate, litter size at birth and at weaning and average individual litter weight at birth and at weaning. The farrowing rate was 60 and 80%; litter size at birth was 9.66 ± 1.08 and 9.00 ± 1.77; average individual litter weight at birth was 1.08 ± 0.05 and 1.03 ± 0.95; litter size at weaning was 6.83 ± 0.90 and 6.00 ± 0.91; average individual litter weight at weaning was **7**.91 ± 0.95 and 8.00 ± 1.36 respectively, with FBSE and BTS. The results of the present study indicate that the farrowing rate was significantly higher for BTS diluted semen stored at 15-18 ºC. However, the litter size at birth and at weaning, average individual litter weight at birth and at weaning did not differ significantly ($p > 0.05$). In conclusion AI can be practiced satisfactorily with liquid semen stored at 5-8 ºC with 3 billion sperm per dose of 60 ml when utilised within 24 hours of dilution.

**Keywords:** LWY cross bred pigs, insemination, different temperatures, FBSE and BTS.

## 1. Introduction
Pork is the most consumed meat in the world and accounts for more than 35% of the world's meat intake [7]. Whereas, pork production in India is limited, representing only 7% of the country's animal protein sources. Average meat yield of pigs in India is 35 kg/animal, which is 55% lower than the corresponding value of world average [6]. The bulk of the pig population in India is of indigenous type with poor growth rate and productivity. Absence of sufficient number of breeder farmers throughout the country is a major constraint leading to lesser availability of quality pigs for farmers [15]. Repeated use of same boars lead to lower litter size and lower growth rate, which might be due to inbreeding [1]. Therefore AI is a very useful tool to introduce superior genes into sow herds, with a minimal risk of disease [12].
AI in the swine industry is mostly conducted using diluted semen stored at 15-18 °C. Conditioning boar semen at 15-18 °C requires use of refrigerators equipped with a thermostat for temperature adjustment. However, such equipment can be expensive for small swine operations [5]. Therefore keeping pig semen in cooled temperature around 5 ºC was reported to be a cheaper alternative than liquid nitrogen to help with increasing the use of artificial insemination in the pig industry [12]. Another benefit is that bacterial growth is reduced at 5 ºC, which would improve the quality of semen [2]. The lower performance of AI in field condition most likely to be due to the handling error of semen dosses, failure in maintaining of correct temperature while storage and transportation [14]. Therefore an alternative temperature range (5-8 ºC) for classical storage temperature (15-18 ºC) and frozen semen was addressed of in the present study using FBSE with satisfactory fertility results.

## Materials and methods
A total of 20 cycling non-pregnant, healthy LWY cross breed sows (75% LWY x 25% local) irrespective of parity were selected and housed individually; water was provided *ad libitum* and 2.5 - 3 kg well balanced ration was provided per animal per day.

Animals were randomly divided into two groups (10 each) namely; group F and group B. The animals in group F were inseminated with FBSE (ICAR central costal agricultural research institute, Goa, India) diluted semen and animals in group B were inseminated with BTS (IMV, Gurgoan, India) diluted semen. Three LWY cross bred boars were trained for semen collection using a stainless steel dummy sow and semen was collected by "Double hand gloved method" twice a week from each boar. Ejaculates having thick consistency, rapid wave motion, > 70 % motility, ≥ 85% normal sperm morphology and concentration > 25 to $65\times10^6$ sperm/ml were used for AI. Semen was extended with a dosage of $3x10^9$ sperm cells in 60 ml volume.

Cervical artificial insemination was done twice in pigs using a golden pig catheter (IMV, Gurgoan, India), at 12 & 24 h after standing heat was detected in sows in the presence of a boar by fence line contact. The Farrowing rate was calculated as the number of sows farrowed to the number of sows inseminated; litter size was recorded as total number of piglets born alive; litter size at weaning was analysed as number of piglets alive at weaning; average individual litter weight at birth was calculated as weight of individual piglet at birth; average individual weaning weight was calculated as weight of individual piglet at weaning. The data was analysed by t-test using compare means procedure of IBM SPSS Statistics version 21. (2012).

## Results and Discussion

The farrowing rate was 60 and 80%; litter size at birth was 9.66 ± 1.08 and 9.00 ± 1.77; litter size at weaning was 6.83 ± 0.90 and 6.00 ± 0.91; average individual birth weight was 1.08 ± 0.05 and 1.03 ± 0.95; average individual weaning weight was 7.91 ± 0.95 and 8.00 ± 1.36 respectively, with FBSE and BTS. In the present study farrowing rate was significantly higher ($p \leq 0.05$) for BTS diluted semen stored at 15-18ºC. However litter size at birth and at weaning; average individual weights at birth and at weaning were non-significant ($p > 0.05$). Similar farrowing rate and litter size were reported [8] with artificial insemination performed with egg yolk extended semen stored at 5 ºC. However higher fertilization rate (83.7 ± 4.4) was reported [5] with semen preserved at 5 ºC in PIGPEL-5 extender for 24 hours and a low farrowing rate (50%) and litter size (5.00) were noted [13] when semen was stored in 7.5 mg/ml skim milk supplemented Modena extender at 5°C for 2 weeks. The higher fertilization rate in the former study than the present might be due to appropriate time of insemination in relation to ovulation. The farrowing rate and litter size were lower in the latter study which might be due to storage of semen for longer period which is well supported [10, 9]. Hence it was concluded that LWY cross bred boar semen could be stored at 5-8 ºC with FBSE diluent without much variation in the fertility when utilised within 24 hours of dilution for artificial insemination.

However, the composition of FBSE diluent used in the experiment is not mentioned because of product was applied for patent right considerations (TEMP/E1/24427/MUM/2015) and hence was compared with BTS, whose composition was well known. The feasibility and potential benefit of AI to smallholder traditional pig production in tribal rural area was successfully demonstrated [3, 11]. However, maintenance of temperature around 15-20 ºC during storage and transport requires specialized expensive equipments. Preservation of semen at 5 °C is convenient for individual users on farms because it is applicable for use with normal refrigeration and this method requires no liquid nitrogen or expensive equipment for the chilling process [13]. The sows inseminated with extended fresh semen yield a higher litter size and tended to have a higher conception rate than sows inseminated with frozen-thawed semen [4]. Therefore storage of boar semen at 5-8 ºC in a domestic refrigerator and utilising it for AI without much variation in fertility and fecundity would further economically benefit the rural smallholder farmers.

**Table 1:** Comparison of fertility parameters between FBSE and BTS diluted semen stored at different temperatures.

| | FBSE | BTS |
|---|---|---|
| Storage temperature (ºC) | 5-8 | 15-18 |
| Number of animals (n) | 10 | 10 |
| Number of animals farrowed (n) | $6^a$ | $8^b$ |
| Farrowing rate (%) | $60^a$ | $80^b$ |
| Litter size at birth (n) | 9.66 ± 1.08 | 9.00 ± 1.77 |
| Average individual birth weight (kg) | 1.08 ± 0.05 | 1.03 ± 0.95 |
| Litter size at weaning (n) | 6.83 ± 0.90 | 6.00 ± 0.91 |
| Average individual weaning weight (kg) | 7.91 ± 0.95 | 8.00 ± 1.36 |

The values with different superscripts in the table differ significantly ($p > 0.05$).

## Conclusion

Increased production of a farm begins with improved reproductive management of the herd. AI in swine would be beneficial to small holder tribal farmers and would also produce crossbred pigs with increased genetic and reproductive efficiency. However failure to maintain proper temperature during storage and transport is the main drawback to achieve acceptable fertility and litter size. Hence an attempt was made to store swine semen at 5-8 ºC in domestic refrigerator, also transportation of extended semen at this temperature could be easily done with help of cool packs stored at same temperature. Further studies are needed to address the long term storage of extended boar semen at refrigeration temperature without compromising the fertility and fecundity. In conclusion the results of the present study indicate that AI can be practiced in swine with semen stored at refrigeration temperature without affecting fertility.

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