# The effect of superovulation and different feed protein levels on sow reproductive performance

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# The effect of superovulation and different feed protein levels on sow reproductive performance

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**Abstract**. This study aimed to evaluate the effectiveness of superovulation and different feed protein levels before mating on sow reproductive performance. Eighteen gilts weighted 100-107 kg were used in this study. There were two types of hormones used for superovulation agents in this study, namely PMSG (Folligon, Intervet, North-Holland) and hCG (Chorulon, Intervet, North-Holland). Meanwhile, prostaglandins (Prosolvin, Intervet, North-Holland) was used to synchronized estrus. The study was arranged using a completely randomized design with a factorial model of 2×3, whereas the first treatment factor was the superovulation hormone PMSG + hCG with two levels, namely zero injection of hormones (as a control) and hormone injections; and the second treatment factor was the level of feed protein with three levels of administration, namely: 14%, 16% and 18% level of feed protein, respectively. Each treatment combination was repeated 3 (three) times. The variables observed were the gestation period of the sow, the weight of sow at the end of pregnancy, and the birth litter size. The results showed that the treatment had significant effect on the gestation period of sows and its body weight at the end of gestation, but there was no significant difference in the litter size of birth. It is concluded, the reproductive performance of sows through superovulation and feed protein level before mating, were able to shorten the length of gestation, improve the bodyweight of pregnant sows and litter size born.

## 1. Introduction

Pig production is dependent on the success rate of the reproductive process. The ability of reproduction greatly determined by the success of the sow to produce offspring both quality and quantity. The weight of the piglet at the time of birth is determined by the growth of prenatal (during the pregnancy) which is an accumulation of growth since the zygote develops into an embryo and fetus until birth. The maximum growth of piglets could be achieved through an increase in the secretion of endogenous hormones of pregnancy by means of dual ovulation using Pregnant mare's serum gonadotropin (PMSG) and human chorionic gonadotrophin (hCG). PMSG and hCG are known as superovulation hormones which have been proven to increase pregnancy hormone secretion. Thus, reproductive performance will increase livestock productivity and vice versa poor reproductive performance will reduce livestock productivity.

A good reproductive appearance if not accompanied by the quality needs of pigs before mating until the lactation period will have an impact on the growth and development of the fetus until the number of piglets born alive.

Multiple ovulation with PMSG and hCG has been shown to have a positive effect on pig body weight, increase in phenotype of birth weight, body length, and height of piglets at birth [1]. If accompanied by

improved feed, the production of mother's milk during lactation will improve the growth phenotype of lambs and goats [2,3].

Delaval [4] stated that an increase in milk production that is not balanced with an increase in feed will result in the removal of reserve nutrients which ultimately leads to a decrease in animal body weight. Decreased milk production caused by a lack of feed protein will also result in a decrease in initial lactation body weight.

Preliminary study on multiple ovulation techniques has been carried out without regard to feeding quality. The result was positive for litter size born but the mortality rate of piglets increased from 14.92 to 26.64% [5]. This study was continued by using the multiple ovulation method and included feed quality parameters with various protein levels.

This study would answer various problems faced by farmers in Minahasa Regency, especially the people who raise pigs. This study is intended to be a breakthrough in the discovery of the reproductive quality of the parent superovulated with various levels of protein ration.

## 2. Materials and methods

### *2.1. Materials*

A total of 18 sows with body weights ranging from 100-107 kg were used in this study. Superovulation agents used were the hormones PMSG (Folligon, Intervet, North-Holland) and hCG (Chorulon, Intervet, North-Holland). Prostaglandin was used for estrus synchronization (Prosolvin, Intervet, North-Holland). The rations used during the study period are shown in table 1.

**Table 1**. Composition of ingredients and substance in pork rations (%).

| Feed Ingredient | The proportion of feed ingredient | | |
|---|---|---|---|
| | % | % | % |
| Corn | 49 | 44 | 39 |
| Rice bran | 34 | 34 | 34 |
| Coconut cake | 9 | 9 | 9 |
| Fish meal | 5 | 10 | 15 |
| Concentrate | 3 | 3 | 3 |
| Total | 100 | 100 | 100 |
| Feed nutrition | | | |
| Crude protein (%) | 14.3427 | 16.3922 | 18.4417 |
| Crude fiber (%) | 8.3215 | 8.2355 | 8.1495 |
| Metabolic energy (Kcal/kg) | 3291.3048 | 3323.6088 | 3355.9128 |

### *2.2. Methods*

The study was arranged using a completely randomized design (CRD) with a 2×3 factorial design. The first factor was superovulation with the hormone PMSG + hCG which consists of two levels: zero (control) and PMSG + hCG. The second factor was the levels of feed protein; 14%, 16%, and 18%. The each level of protein was repeated three times. The data obtained in the study was analyzed using analysis of variance following the linear model procedure of $Y_{ij} = \mu + \alpha i + \varepsilon_{ij}$ [6].

### *2.3. Procedure of the study*

The study was used 18 pigs that divided into two groups; first group of 9 pigs were injected with PMSG and hCG with a single dose of 400/200 (600 superovulation) IU per head and the other 9 were injected with physiological NaCl 0.95%. Before administration of PMSG and hCG, estrus synchronization was performed by injecting one ml of PGF2α twice at an interval of 14 days. In the second PGF2α injection, or three days before estrus, intramuscular injection of PMSG and hCG was done. During the observation,

pregnant pigs were kept together in a postal cage, and two weeks before giving birth, pigs were placed in individual cages of 2.5 × 3.5 $m^2$ equipped with feed and drink containers until 49 days after giving birth (postpartum).

## 3. Results and discussion

### *3.1. Effect of treatment on pig reproductive performance*

The reproductive performance of sows observed in the study can be seen in table 2.

**Table 2**. Average data on the effect of treatment on Gestation Period (GP), Weight of Sows at Final Gestation Period (BW at final GP), Born Litter Size (BLS).

| Parameter | Treatment | Protein Level | | | Average |
|---|---|---|---|---|---|
| | | 14% | 16% | 18% | |
| GP (day) | SO | 113.33$^{bc}$ | 106.67$^{a}$ | 109.00$^{a}$ | 109.67 |
| | NSO | 116.33$^{c}$ | 114.67$^{c}$ | 113.83$^{bc}$ | 114.94 |
| | Average | 114.83 | 110.67 | 111.42 | 112.31 |
| BW at final GP (Kg) | SO | 181.67 | 190.33$^{a}$ | 188.00$^{a}$ | 186.67 |
| | TSO | 164.64$^{b}$ | 168.33$^{d}$ | 173.92$^{c}$ | 168.96 |
| | Average | 173.16$^{d}$ | 179.33 | 180.96 | 177.82 |
| BLS (Head) | SO | 10.17 | 13.72 | 11.50 | 11.80 |
| | NSO | 8.17 | 10.97 | 10.00 | 9.71 |
| | Average | 9.17 | 12.35 | 10.75 | 10.76 |

SO = superovulation; NSO = non-superovulation; GP = gestation period; BW = body weight; BLS = born litter size

### *3.2. Gestation period*

The average gestation period found in the present study was 112.31 days with a range of 106.67 - 116.33 days. The results of this study are similar to the study of Eusebio [7] which stated that the gestation period of sow ranges from 112-120 days with an average of 114 days. Analysis of variance showed that the effect of the treatment was differed significantly ($P < 0.01$) on the gestation period. The gestation period of superovulated sows is 5.27 days shorter than for those that did not superovulated. This is due to the superovulated pigs could increase growth and development as well as physiological activity of the uterus and placenta. Furthermore, supporting uterus and placenta are possible to accommodate the number of offspring and improve the weight of the embryo and fetus even in large numbers [1].

### *3.3. Weight of sows at final gestation period*

The average of sows body weight at the final gestation period was 177.82 kg. The observations showed that sows fed at different levels of protein, superovulated or non-superovulated and the interaction of the two factors had different weight at the final gestation period. Body weight of the sows fed a protein level of 14% (173.17 kg) had lower than those fed a protein level of 18% (180.96 kg). Sows superovulated produced a higher body weight (183.33 kg) than non-superovulated one. This study also confirmed that the interaction between 14% protein level and non-superovulated sows resulted in lowest body weight (164.67 kg), however the interaction between 16% protein level and superovulated sows resulted highest body weight (190.33 kg). The analysis of variance showed that protein levels factor, as well as superovulation and non-superovulation factors had a significant influence on sow body weight at the final gestation period. Similar results were indicated on the interaction of protein levels with

superovulation and non-superovulation that provided the effect on BBIBA. The Least Significant Difference Test (LSD) on the effect of the interaction showed that the interaction of 14% protein level with non-superovulation differed significantly compared to the other interactions on sow body weight at the final gestation period.

Based on the analyzes, it can be concluded that the sows at the final gestation period provided higher body weight when sows are feed a protein level of 16% or 18% ration. The weight of the final pregnant is strongly influenced by superovulation. The body weight superovulation-treated sows at the final gestation period is heavier than those without superovulation. Superovulation is a reproductive technology that is able to increase the number of corpus luteum produced [8,9]. The number of corpus luteum is closely related to the level of pregnancy hormone secretion and mammogenic hormones such as estradiol and progesterone during pregnancy [10-13]. These hormones play a role in subsequent growth and will maintain the relationship between the embryo and the uterus and allow the growth of the embryo to become a fetus with good growth [14,15].

*3.4. Born litter size*

Table 2 shows that the average born litter size (BLS) produced in this study at the 16% protein level yielded 13.72; better than that obtained from the use of 14% and 18% protein level rations; 9.17 and 10.75, respectively. Similar results were also shown in the effect of superovulation which produced 11.79 compared to non-superovulation which was 9.75. On the influence of 14% protein level interaction with non-superovulation, the lowest value was only 8.7, while the interaction of 16% protein level with superovulation produced better value than other interactions. The analysis of variance showed that protein levels had a significant influence on BLS. Likewise, superovulation and non-superovulation have a significant influence on BLS. Contrary, the interaction of protein levels with superovulation and non-superovulation did not differ significanttly.

This can be explained that the total litter size born from superovulated sows produces an average number of offspring that is almost similar to those non-superovulated sows. This due to that pigs are prolific animal. Although statistically did not showed significant effect, however, absolutely the total number of offspring born in superovulated sows were still higher than those sows without superovulation. This illustrates that physiologically the sows responded well to PMSG and hCG which work similar to FSH and LH which stimulates the growth and development of ovarian follicles to secrete estrogen which in turn stimulates ovulation [16,17] and the development of the corpus luteum to produce more ova and potentially increase the number of offspring born [1,18-22].

## 4. Conclusion

Reproductive performance of sows superovulated with PMSG and hCG before mating and protein level of 16% can shorten the length of pregnancy, improve the weight of the sows at the end of pregnancy, and number of litter size born.

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