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Journal Article

EFFECTS OF *ESCHERICHIA COLI* VACCINATION IN GILTS ON PIGLET PERFORMANCE IN A FARM IN PERAK

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SUMMARY

This study aimed to observe the effects of *Escherichia coli* (Neocoliporvaccine – Merial) vaccination on diarrhoea percentages, growth parameters (average weight per piglet and average daily gain) and mortality rate in new-born piglets. A field trial was conducted in 35 litters of piglets from gilts selected from a farm in Perak. They were randomly allocated into Treatment (16 litters from *E. coli* vaccinated gilts) and Control (19 litters) groups respectively. Body weights of the piglets were measured at days 1, 7, 14 and 21 of age and the episodes of diarrhoea and piglet mortality were monitored daily for each pen. The Treatment group had significantly lower Day 1 neonatal diarrhoea percentage ($p < 0.05$) and significantly lower mortality rate from Day 1 to Day 7. The total mortality rate for overall period of 1 - 21 days in the treatment group was at 3.90% when compared to the control group at 8.96%. However, there were no significant differences ($p > 0.05$)in the overall diarrhoea percentages (1 - 14 days) and weekly growth parameters between both groups. Environmental stress and inevitable routine treatment of diarrhoea with antimicrobials within the farm may have affected the significance of the diarrhoea percentages and growth parameters in this study. In conclusion, *E. coli* vaccination in gilts was shown to significantly reduce piglet mortality from Day 1 to Day 7 and neonatal diarrhoeal percentageson1-day-old piglets under typical farm conditions in this pilot study in Malaysia.

Keywords: Escherichia coli vaccination, neonatal piglet diarrhoea percentage, neonatal piglet mortality rate, average weight per piglet, average daily gain

INTRODUCTION

Escherichia coli, also known as *E. coli*, is an ubiquitous organism and one of the leading causes of diarrhoea in suckling piglets, especially in piglets reared under intensive management system (Fürer *et al*., 1982). Neonatal diarrhoea associated with *E. coli* is most commonly observed in piglets aged from 0 – 4 days (Loh *et al*., 2006; Schwartz, 2009). The severity of neonatal diarrhoea associated with *E. coli* is also age-related, and the highest incidence of life-threatening diarrhoea occurs during the first 2 to 5 days of life, with less serious diarrhoea occurring later (Loh *et al*., 2006; Schwartz, 2009). Neonatal diarrhoea and deaths caused by enterotoxigenic *Escherichia coli* (ETEC) were observed in many herds, especially in piglets farrowed by gilts, whereas piglets from older sows showed lower vulnerability (Too, 1997; Riising *et al*., 2005).

The high pre-weaning mortality rate in Malaysia of about 12% of total piglets born alive has not changed over a period of 15 years (1981–1996) and this post a major problem in the swine industry (Loh *et al*., 1999). Heavy losses have been reported in piglets during the first week of life in Malaysia and many were thought to be as a result of *E. coli* infection, or commonly known as colibacillosis, where more than 95% of *E. coli* isolated from diarrhoeic piglets had developed multiple antibiotic resistances, and more than 50% showed resistance to 10 types of antimicrobials tested (Loh *et al*. 2006) can impose a high economic impact to the producers. Therefore, it is highly recommended to prevent this disease than to continuously fight it (Holden *et al*., 2006).

Antibodies in colostrum provide passive protection to suckling piglets from sows that have built up immunity to specific *E. coli* strains (Carr, 2006). Active immunization of sows effectively provided protection to the newborn piglets through the transfer of antibodies via colostrum (Riising *et al*., 2005). The protection of newborn pigs against *E. coli* infection by sow vaccination has been a well-established practice in Denmark for more than 2 decades (Riising *et al*., 2005). This practice is not commonly done in farm conditions in Malaysia.

This study has its aim to observe the effects on the neonatal (first week) and pre-weaning (second and third week) performance of piglets sowed by gilts vaccinated with *E. coli* vaccine in a farm in Perak, Malaysia for the following parameters: (1) Diarrhoea percentages, (2) Growth Performance–average body weight and average daily gain and (3) Mortality rate.

MATERIALS AND METHODS

Study animals

The field trial was carried out as a prospective study involving the progeny of 35 in-house bred Landrace-Yorkshire gilts artificially inseminated with semen from in-house bred Duroc boars, randomly assigned to Treatment Group – 16 gilts (vaccinated with *E. coli* bacterin – Treatment Group) and Control Group – 19 gilts, from a farm in Perak with a sow population of 4,000. Gilts were

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placed into standard size farrowing pens in an intensive open house system and each litter of respective gilts consisting of siblings were monitored for 21 days. Cross fostering of piglets to other sows was strictly prohibited in this study. Good farm husbandry management and facilities (heating lamps) were equally provided to both groups.

E. coli vaccine

The vaccine tested is an inactivated vaccine (Neocolipor–Merial) containing recombinant porcine *E. coli* strains with F4 (F4ab, F4ac, F4ad), F5 adhesins and inactivated field porcine strain with F6, F41 adhesins. This covers the main adhesins that dominate in neonatal diarrhoea (Runnels *et al*., 1987).

E. coli vaccination

Vaccination of the treatment group was done prior to the study period. The first dose was given by intramuscular injection in the neck region behind the ear, 5 – 7 weeks before farrowing, with the booster dose given 2 weeks before farrowing. The newborn piglets were allowed to suckle colostrum.

Evaluated Parameters

The numbers of diarrhoeic piglets observed in each litter were recorded daily for 14 days. This was done by the visual observation of every piglet's anus for stains of diarrhoea. Litter size and the cumulative weight of siblings were recorded on Days 1, 7, 14 and 21 using an analogue weighing scale, with an accuracy of 0.5kg. The average body weight and the average daily gain were computed. Piglets that died during the study were recorded as mortality throughout the 21 days of study. Although, the cause of death was not thoroughly investigated, piglets crushed by sow or died due to external trauma were excluded from the study. All data collected was analysed using Mann-Whitney-U Test at 95% confidence level.

RESULTS AND DISCUSSION

Diarrhoea percentages

The results for the average percentage of diarrhoea episodes per litter for Week 1 and 2 are shown in Figure 1. There were no statistical differences between groups ($p > 0.05$), despite Treatment group exhibiting lower diarrhoea episodes in Week 1 and a non-significant slightly higher diarrhoea score in Week 2 compared to the Control group. These findings can be attributed partially to the higher mortality of piglets in the Control group in Week 1 (Figure 1). Piglets with *E. coli* infection will most commonly suffer from severe neonatal secretory diarrhoea, leading to the death. Piglets that had died from the study were omitted, as no further data could be obtained from them after such point. These piglets may likely be the ones greatly affecting the diarrhoea scores, and subsequently the body weight parameters in the study.

The average diarrhoea percentage per litter was further analysed on a daily basis for the first week (Figure 2). At day 1, control group piglets exhibited significantly more diarrhoea ($p < 0.05$) and had a higher peak percentage when compared to the piglets in the treatment group (i.e. 19.0% versus 13.8%, respectively). On day 2, peak diarrhoea episodes in both the treatment and control group piglets were observed.

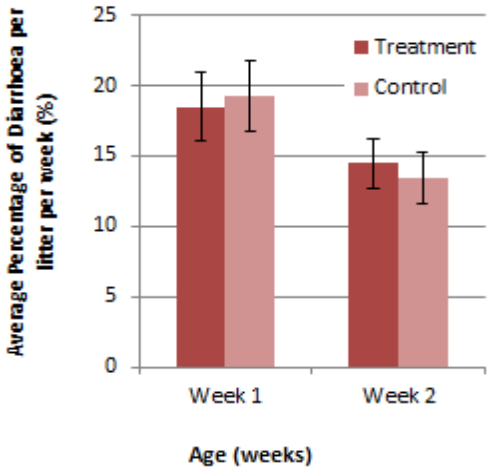

Figure 1: Average percentage of diarrhoea episodes per litter in Treatment and Control groups

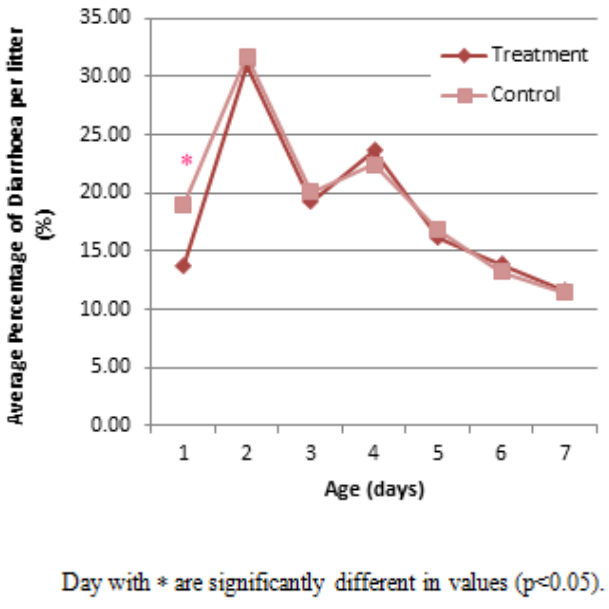

Figure 2: Average daily percentage of diarrhoea episode per litter during week 1 in Treatment and Control groups

The average percentages of diarrhoea per litter for the subsequent days were not significantly different ($p > 0.05$) and gradually declined in frequency in both groups. The peak in diarrhoea score at day-2 with subsequent declining pattern coincides with the manifestation of *E. coli* infection, when peak diarrhoea manifestation is usually between 2 to 5 days of age (Schwartz, 2009). Other diseases causing neonatal diarrhoea were less likely, judging from the clinical signs and diarrhoeic patterns (Schwartz, 2009).

Growth Performance

The average body weight of the piglets from the Treatment and Control groups are shown in Figure 3. There were no significant differences in the average body weights of piglets ($p > 0.05$) in both Treatment and Control groups at all the ages monitored, i.e. day-1, day-7, day-14 and day-21, despite the higher body weights of 5.7% in the Treatment group over the Control group, i.e. 5.01kg and 4.74kg respectively at Day 21.

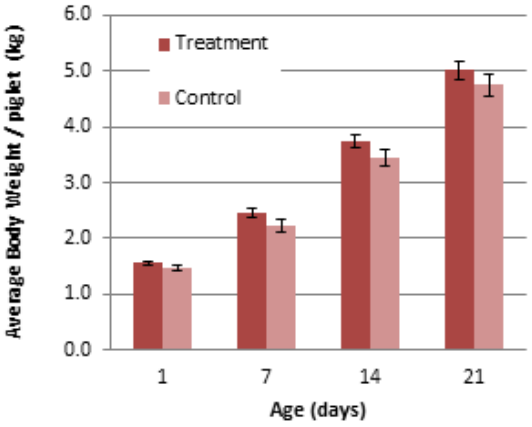

Figure 3: Average body weight per piglet in Treatment and Control groups

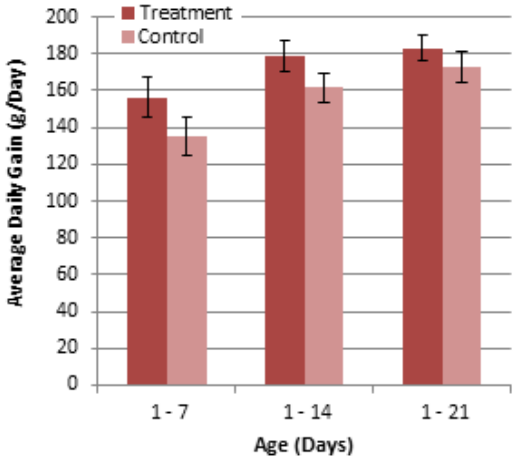

Figure 4: Average Daily Gain of the piglets in Treatment and Control groups

The average daily gain (ADG) of the piglets from gilts vaccinated with *E. coli* bacterin vaccine and the control group are shown in Figure 4. Similar to the average body weight, the ADG of piglets in the Treatment group were higher than in the Control group, however the differences were not significant ($p > 0.05$). Piglets in the Treatment group had an overall better daily gain of 5.9% over piglets in the Control group from day 1 – 21.

Mortality Rate

The mortality rate observed for Treatment and Control groups at Weeks 1, 2 and 3 are shown in Table 1. Piglets in the Treatment group had a significantly lower mortality ($p < 0.05$) during the first week as compared with the Control group (2.6% and 5.9%, respectively). It may be inferred that the piglets who were highly contributing to the diarrhoea score in Week 1 in the Control group did not survive to the second week, whereas, in the Treatment group, piglets having diarrhoea in Week 1 surviving into the second week were recorded for the incidence of diarrhoea. The surviving piglets from a diarrhoeic episode may perform slightly

Table 1: The effects of *E. coli* vaccination on mortality rate in Treatment and Control groups

Week	*Treatment (%)*	*Control (%)*
1	2.60[a]	5.88[b]
2	1.30	1.60
3	0	1.07
Total Mortality Rate	3.90[c]	8.56[d]

[a], [b]and [c], [d] Values with different superscripts are significantly different ($P < 0.05$)

slower than normal healthy piglets (Edfors-Lilja *et al.*, 2000), subsequently affecting both the diarrhoea score and the growth parameters. There was no difference in piglet mortality in both groups during the second and third week of age. However, the mortality difference was significantly lower ($p < 0.05$) in the Treatment group as compared with the Control group for the overall period of 1 to 21 days (i.e. 3.9% and 8.6%, respectively). Previous field trials carried out in Austria and Norway for the same *E. coli* vaccine showed piglet mortalities of 4% for the Treatment groups and 10% in the Control group, similar to the results in this study. This may suggest the reproducibility of the results under farm environments.

Piglets in the Control group had consistently higher neonatal mortality rates when compared to the treatment group with a peak at days 3 and 4 (1.6%) at first week of age. The treatment group had peak mortalities at day 4 with a neonatal mortality rate of 1.3% (Table 2).

Table 2: Daily mortality rate of Treatment and Control group from Day 1 to Day 7

Day	*Treatment (%)*	*Control (%)*
1	0	0.53
2	0.65	1.07
3	0.65	1.61
4	1.30	1.61
5	0	0.53
6	0	0.53
7	0	0

This study did not control for factors that include: (a) the unavailable data from diarrhoeic piglets that died in the first week of life, (b) other pathogens (other than *E. coli*) involved in neonatal diarrhoea and the diagnosis of the causes of diarrhoea and mortalities, (c) possible effects of the environment (cold weather during the study), management policies and other factors involved in a actively producing farm (blinded and equal treatment of diarrhoeic animals with sulphonamide-trimethoprim and gentamycin sulphate on both groups) to minimize production losses, and (d) dam effects (variable milk quality and quantity).

CONCLUSION

In conclusion, this pilot study showed significant reduction in the first week mortality of neonatal piglets and Day-one diarrhoeal percentages ($p < 0.05$) in piglets from gilts vaccinated with *E. coli* (Neocolipor – Merial) vaccine. The result is reproducible as it is in agreement with other field trials (Anon, 2003) which indicate that *E. coli* vaccination in dams could be an alternative way of moderating mortality due to *E. coli* in a farm environment. No significant differences ($p > 0.05$) were observed in the overall diarrhoeal percentages and growth parameters at the other ages monitored. These could be attributed to various factors, i.e.: (1) unavailable data after the mortalities of piglets, in particular from the Control group, (2) this study had no real control over external factors (ambient temperature, environmental stressors and routine farm practices such as giving treatment to the diarrhoeic piglets). More field trials and experimental studies are warranted to further investigate the effects of *E. coli* vaccination in gilts as well as on sows under natural and controlled environmental conditions to show its benefits on the control of piglet diarrhoea and subsequent performance of pigs in farm environments in Malaysia.

CONFLICTS OF INTEREST

None of the authors of this paper has a financial or personal relationship with other people or organization that could inappropriately influence or bias the content of the paper.

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