



SHORT COMMUNICATION

Mannan oligosaccharide supplementation during gestation can enhance porcine reproductive and respiratory syndrome virus (PRRS)-specific antibody levels of sows and their piglets

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ABSTRACT

PRRS vaccination is widely used to induce humoral and cell-mediated protective immune (CMI) responses. However, vaccination alone is often insufficient to induce protective immunity. Mannan oligosaccharide (MOS), the outer cell wall of yeast, is known to potentiate both cell-mediated and humoral immunity. This study aimed to evaluate the potentiating effect of MOS on the PRRS-specific antibody production in the sows and subsequent antibody transfer to their offspring. Thirty seven sows were randomly assigned to 3 experimental groups: control, supplementation of 400 and 800 ppm MOS in feed during gestation. The PRRS-specific antibody in the sera of sows and their piglets were measured one day before and after parturition, respectively. The results showed that at 400 ppm MOS as feed additive for sows were effectively enhance PRRS-specific antibodies (by ELISA S/P ratio) but not for neutralizing antibody. At 800 ppm MOS in sows' feed, significantly increase of neutralizing antibody was showed. In conclusion, supplementation of MOS in sows' feed would be helpful to strengthen the effect of PRRS vaccination.

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INTRODUCTION

Mannan oligosaccharide (MOS), the outer cell wall of yeast, has been used as a growth promotant as an alternative of antibiotics. Also, their modulating immune response in animals has been demonstrated (Che *et al.*, 2011). Recently, Zanello *et al.* (2013) showed that administration of yeast to sows during late gestation and lactation could induce the increase of total IgG level in colostrum and milk.

Porcine reproductive and respiratory syndrome (PRRS) causes major economic loss in swine industry worldwide (Neumann *et al.*, 2005). Management practices and elimination programs have been applied to reduce and eliminate PRRSV challenge. However, due to the high investment costs, not all of pig farms could afford those valuable measures. Instead, they use the PRRSV vaccination as an alternative measure (Charerntantanakul, 2012).

Series of experiments in sows (Osorio *et al.*, 2002) and piglets (Lopez *et al.*, 2007) showed that passive transfer of the immune sera can render sufficient NA titer to protect against the homologous challenge and the trans-placental infection of PRRSV. Therefore, vaccination at late gestation plus supplementation of MOS (Actigen®) during gestation period would allow effective transfer of protective immunity and enhance the protective effects of PRRSV vaccination to their piglets.

MATERIALS AND METHODS

Thirty seven crossbred sows (Large White x Landrace) from commercial pig farms near Khon Kaen University which considered stable according to their sample to positive S/P ratio were used in this study. This farm had previous experience of type 2 PRRSV outbreaks and has been using a commercial type 2 modified live

virus (MLV) for vaccination. Only sows of the parity 2 to 6 were randomly assigned to 3 treatment groups: Control group (n=10) received gestation diets without supplement; 400MOS group (n=14) received gestation diets supplemented with 400 ppm MOS and 800MOS group (n=13) received gestation diets supplemented with 800 ppm MOS.

The treatment started from day 42 of gestation until parturition. The amounts of diet were adjusted according to the body condition and the parity of sows. All sows received modified live PRRS vaccine (Boehringer Ingelheim) on day 55 of the gestation and 2 weeks later.

Blood samples from sows were collected from ear vein one day before parturition. Three biggest and 3 smallest piglets (by body weight) from each litter were selected for blood collection 1 day after birth.

A commercial ELISA kit for PRRSV antibody test (IDEXX PRRS X3 Ab Test) was used to detect PRRSV specific antibodies. According to the manufacturer's instruction, sample to positive control (S/P) ratio of >0.4 was considered positive. Serum neutralizing (SN) titers were performed as described previously (Geldhof *et al.*, 2012). Neutralizing antibody titers were expressed as the reciprocal of the highest serum dilution in which no cytopathic effect (CPE) was observed. Each sample was run in triplicate.

Ten serum samples from piglets (2 from control, 3 from 400MOS and 5 from 800MOS groups) and 2 serum samples from sows (from 800MOS groups) were excluded due to hemolysis.

The SN titers were evaluated as continuous variables after \log_2 transformation of the raw titers. Difference of SN titers and S/P ratio between groups was evaluated by Analysis of Variance (ANOVA). Difference between each pair was then analyzed using Turkey's t-test. Chi-square test was used for analysis of dichotomous data (the number of positive pigs at the cut-off value 1:32). Statistical differences were declared at $P < 0.05$.

RESULTS

The MOS-treated sows showed relatively higher S/P ratio than those in the control group, although the significant differences of S/P ratio were not observed ($P > 0.05$). The S/P ratio of 400MOS group was slightly higher than that of 800MOS group but statistically no significant difference between them (Table 1). Piglets obtained from MOS-treated groups had significantly higher S/P ratio ($P < 0.05$) than those from the control group. The piglets derived from the sows of 400MOS group showed higher S/P ratio than those obtained from sows of 800MOS group, although statistically no significant difference between them (Table 1).

For SN titers, the sows in the 800MOS group showed higher SN titers than those in the control or 400MOS group, although statistically no significant difference between each group (Table 2). The piglets obtained from the sows in the 800MOS group showed significantly higher SN titers than those obtained from sows in the 400MOS group or from the sows in the control group (Table 2). No difference was observed for the SN titers of the piglets from the sows of 400MOS group and from the control group.

Table 1: ELISA S/P ratio of the sows and their piglets

Treatment	S/P ratio (Mean±SD)	
	Sows	Piglets
Control	0.62±0.45 (n=10)	1.45±0.67 ^a (n=58)
400 MOS	1.37±0.95 (n=14)	2.01±0.92 ^a (n=81)
800 MOS	1.17±0.96 (n=11)	1.80±1.02 ^b (n=73)

Different superscript letters in the same column indicate significant differences between treatments ($P < 0.05$).

Table 2: SN titers of sows and their piglets

Treatments	\log_2 SN titers (Mean±SD)	
	Sows	Piglets
Control	2.8±1.5 (n=10)	4.2±1.8 ^a (n=58)
400 ppm MOS	2.6±1.3 (n=14)	4.9±1.9 ^a (n=81)
800 ppm MOS	4.1±2.2 (n=11)	5.1±2.3 ^b (n=73)

Different superscript letters associated in the same column indicate significant differences between treatments ($P < 0.05$).

Table 3: Number and the percentage of piglets having SN titers \geq 1:32 (\log_2 titer=5)

S/P ratio	Control	400MOS	800MOS
\geq 1:32 (\log_2 titer = 5)	(23/58) 40 ^a	(55/81) 68 ^{bc}	(38/73) 52 ^{ac}

Different superscript letters in the same row indicate significant differences ($P < 0.05$).

The percentage of the piglets having SN titers \geq 1:32 (\log_2 titer=5) in 400MOS group was significantly higher ($P < 0.05$) than that of the control group (Table 3). The value of the 800MOS group was higher than control group however with no statistically significant. No significant difference was seen in the S/P ratio and the SN titers of the big and small piglets of the three groups (data not shown).

DISCUSSION

The piglets fed with colostrum from the sows fed MOS in feed showed higher PRRS specific antibodies, which was demonstrated by the increase of the ELISA S/P ratio and SN titers (Table 1 and 2). The mechanisms of this phenomenon could be explained as follows; One month prepartum, serum PRRS-specific antibody of the sows translocate into the mammary gland probably by FcRn receptor (Salmon *et al.*, 2009). IgG gradually accumulates in the mammary gland and reaches the plateau at the end of gestation. After parturition, piglets receive all IgG from the colostrum within 24 hours (Klopfenstein *et al.*, 2006). The benefit of piglets having higher PRRS-specific antibody is that their maternally derived antibodies would persist longer and in high level in the blood stream compare to piglets having lower PRRS-specific antibody.

Due to dose dependent property of MOS in immune stimulation (Nochta *et al.*, 2009), 400 ppm MOS as feed additive for sows were effective to cause the enhancement of PRRS-specific antibodies (by ELISA S/P ratio; Table 1) whereas significant increase of neutralizing antibody was detected at dose higher than 400 ppm (Table 2). The number of piglets having SN titers $>1:32$ (\log_2 titer=5) which assure at least 50% sterile immunity to PRRSV in piglets (Lopez *et al.*, 2007) was significantly increase at 400 ppm MOS in sows' feed. However, no significance increased was found at 800 ppm MOS. Taken together, the result indicates that the appropriate dose should be between 400 and 800 ppm, which needed to be explored further.

Conclusions: Our results suggest that supplementation of MOS in sows' feed would be helpful to strengthen the effect of PRRS vaccination.

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