Evaluation of a combined recombinant vaccine against atrophic rhinitis and erysipelas in pigs

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Introduction
Atrophic rhinitis (AR) and swine erysipelas are widespread and economically important diseases in swine production. We prepared non-toxic derivatives of Pasteurella multocida toxin (PMT), Bordetella dermonecrotic toxin (DNT), and the surface protective antigen (SpaA) of Erysipelothrix rhusiopathiae (serotype 2) by Escherichia coli recombinant DNA technology. The objective of this study was to evaluate the efficacy of a combined vaccine containing three subunit proteins of rPMT, rDNT and rSpaA by analysis of the neutralizing antibody titers or by challenge with E. rhusiopathiae.

Materials and Methods
Experiment 1:Sixteen 5-week-old piglets were divided into 5 groups: group 1 (n=2) vaccinated with rPMT, group 2 (n=2) vaccinated with rDNT, group 3 (n=6) vaccinated with rPMT + rDNT + rSpaA, group 4 (n=5) vaccinated with Suimmugen® ART2 (the commercial AR vaccine produced by Kaketsuken which is composed of toxoids of PMT and DNT) and group 5 (n=1) as a negative control. All pigs were intramuscularly administered for primary vaccination and revaccinated after a 3-week interval.

Experiment 2:Four sows were divided into two groups: group 1 (n=2) vaccinated with rPMT + rDNT and group 2 (n=2) vaccinated with rPMT + rDNT + rSpaA. The sows were immunized intramuscularly twice with a 3-week interval. Moreover, sows were given a third injection 3 months later.

Experiment 3:Two pregnant sows were vaccinated with rPMT + rDNT + rSpaA at 5 and 2 weeks before farrowing. One pregnant sow was used as a non vaccinated control. Three piglets of each sow were challenged intradermally with 0.1mL (10^8 CFU) of the Fujisawa strain of E. rhusiopathiae

These results indicate that the vaccines containing rPMT and rDNT had almost the same effectiveness as the commercial vaccine, and no effect on the neutralizing antibody responses was observed by a combination of rPMT, rDNT and rSpaA.

Experiment 2: The neutralizing antibody titers against PMT and DNT were higher following the 3rd vaccination (1:4096–1:1024) than after the 2nd vaccination (1:32–1:8). The SpaA ELISA S/P ratio was also increased after the 3rd vaccination. In general, the duration of the presence of maternal antibodies from sows vaccinated with bacterins was not very long. However, these results indicate that a high antibody response is obtained with an additional vaccination of this recombinant vaccine at each farrowing, and those piglets were protected from AR and swine erysipelas for a long time after weaning.

Experiment 3: All three piglets from a non vaccinated sow challenged with the Fujisawa strain of E. rhusiopathiae showed typical clinical signs of erysipelas: i.e. pyrexia, systemic urticarial lesions. One of the three died 3 days after the challenge and E. rhusiopathiae were isolated from all organs examined. In contrast, all piglets from vaccinated sows survived and showed no clinical signs following challenge. No E. rhusiopathiae organisms were isolated from any organs of all piglets of vaccinated sows.

In all experiments, no incidences of systemic and local reactions due to the recombinant vaccine were observed (data not shown).

In conclusion, efficacy and safety of the combined vaccine containing of rPMT, rDNT and rSpaA were confirmed in laboratory tests.

Results and discussion
Experiment 1: Neutralizing antibody titers against PMT and DNT in the sera of all piglets were undetectable before the first vaccination. The neutralizing antibody titers against PMT of group 1, group 3 and group 4 reached 1:64 or 1:128 at 2 weeks after the 2nd vaccination (Fig.1). In contrast, group 2 and group 5 remained seronegative throughout the experiment period. The neutralizing antibody titers against DNT of group 2 and group 3 reached 1:256 or 1:512, but only 1:128 in group 4 at 2 weeks after the 2nd vaccination (Fig.2).

Group 1 and group 5 were seronegative. Group 2 and group 3 reached 1:64 or 1:128 at 2 weeks after the 2nd vaccination. Moreover, sows were given a third vaccination (Fig.1). In contrast, group 2 and group 5 reached 1:64 or 1:128 at 2 weeks after the 2nd vaccination.