Immunological response to an experimental intramammary inoculation with a killed *Staphylococcus aureus* strain in vaccinated and non-vaccinated lactating dairy cows

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**Introduction**

- Worldwide, mastitis accounts for the largest proportion of antibiotic drug use in the dairy industry.
- Enhancement of the cows’ immunological response to intramammary infection (IMI) by vaccination could be an attractive approach for mastitis control.
- Polymorphonuclear neutrophilic leucocytes (PMNL) play a major role in the first line immune defense of the udder against bacteria.*
- Little is known about the effect of vaccination on the PMNL concentration and viability.

**Aims**

- To determine the effect of inoculation with inactive *S. aureus* in vaccinated and non-vaccinated cows:
  - Clinical parameters: body temperature, heart beat, respiration rate, appetite, and rumen motility.
  - Daily milk yield (MY)
  - Immune response:
    - Quarter milk somatic cell count (qSCC),
    - Neutrophil concentration and viability.

**Materials and Methods**

- **Study design (Figure 1):**
  - Animals:
    - 4 animals vaccinated with Startvac®.
    - 4 non-vaccinated animals.
  - Intramammary inoculation in contralateral quarters:
    - Control quarters: phosphate buffered saline.
    - Test quarters: formaldehyde killed *S. aureus* C195 strain.
- **Bacteriological culturing:**
  - According to NMC-procedures.
  - In duplicate at quarter level.
- **Somatic cell count:**
  - With the Direct Cell Counter (De Laval®).
  - At quarter level.
- **PMNL identification:**
  - Determined by flowcytometry.
  - At quarter level: concentration and % viability.
- **Statistical analysis:** different linear mixed regression models (PROC MIXED, SAS 9.3).

**Results**

- **Systemic response:**
  - All animals remained clinically healthy during trial period.
  - In the non-vaccinated group average daily MY decreased from 32.3 liter/day at 15 DIM to 27.3 liter/day at 16 DIM (P < 0.05).
  - In the vaccinated group, no significant differences in average daily MY were observed over time.
- **Somatic cell count:**
  - The milk qSCC of the non-vaccinated cows altered from 26,000 cells/ml at 15 DIM up to 349,000 cells/ml at 16 DIM and back to 294,000 cells/ml at 17 DIM.
  - The vaccinated animals had on average a milk qSCC of 31,000 cells/ml at 15 DIM, and increased the next two days (111,000 cells/ml and 176,000 cells/ml).
  - The difference in milk qSCC between the control and inoculated quarters was substantially higher in the non-vaccinated animals compared to the vaccinated animals from 12h after inoculation on (P < 0.05).
- **Neutrophil concentration and viability:**
  - Milk PMNL concentration was higher in the inoculated quarters (P < 0.001) than in the control quarters (Figure 3).
  - In the non-vaccinated group, a distinct difference was observed between the inoculated and control quarters from 12h after inoculation on (P < 0.001) (Figure 3).
  - Milk PMNL viability was higher in inoculated quarters in comparison with the control quarters (P < 0.001).
  - The difference between inoculated and control quarters did not depend on the vaccination status of the animal (P = 0.61) (Figure 3).

**Conclusions**

- Vaccinated animals seem to undergo a less severe inflammatory response than control animals.
- This could possibly explain why no change in daily MY was observed in the vaccinated animals while the non-vaccinated animals suffered from a substantial drop in milk after inoculation.
- Still, the differences in inflammatory response cannot be explained by differences in milk PMNL viability.
- Further research is needed to unravel the mechanism behind the observed differences in immune response and the relevance for the cows’ udder health.

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*References can be obtained from first author.*