

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 industry¹.
- 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 bacteria².
- 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).



Figure 1: Overview of the study design

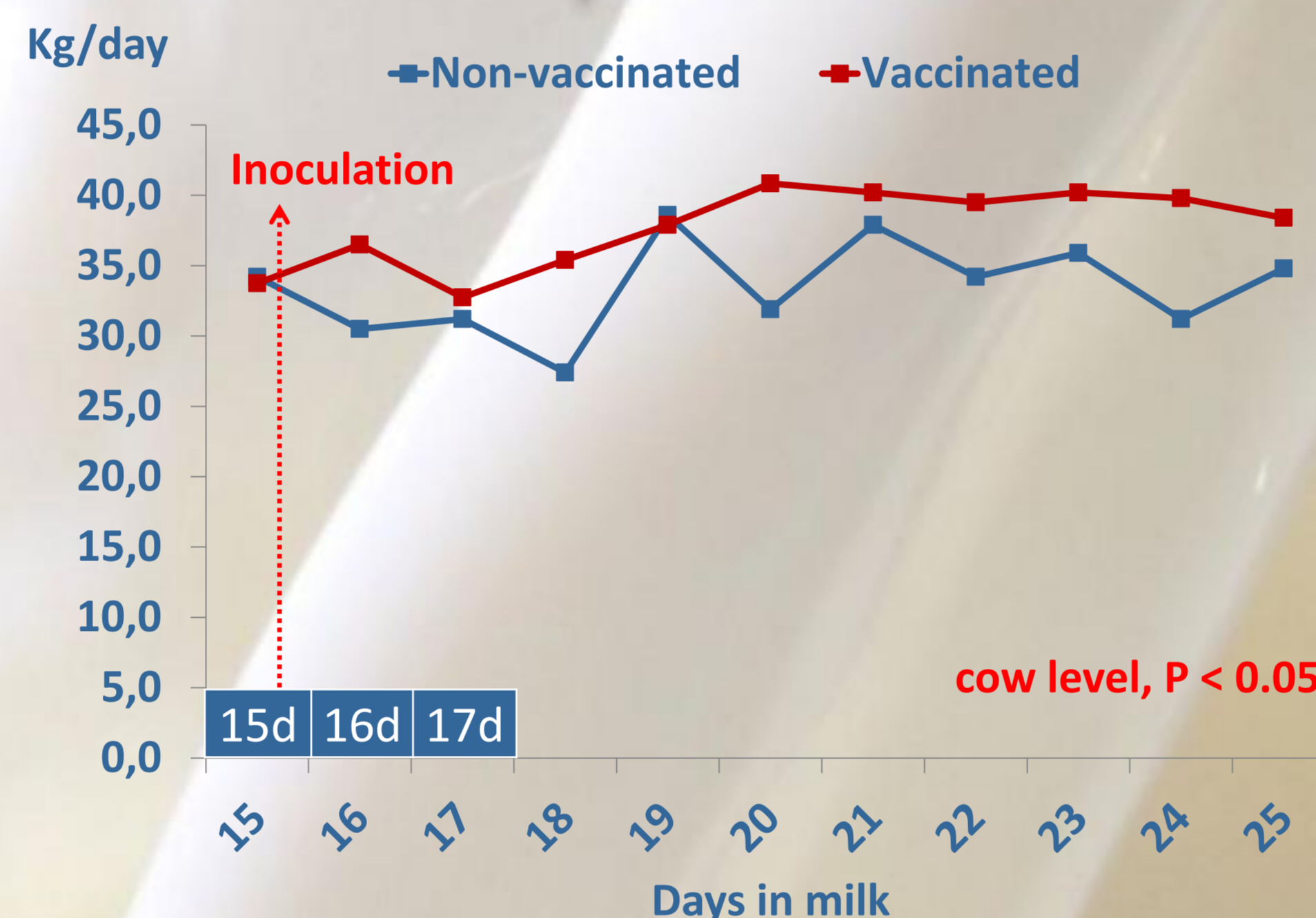


Figure 2: Average daily milk yield for the vaccinated and non-vaccinated animals before, during and after the study period

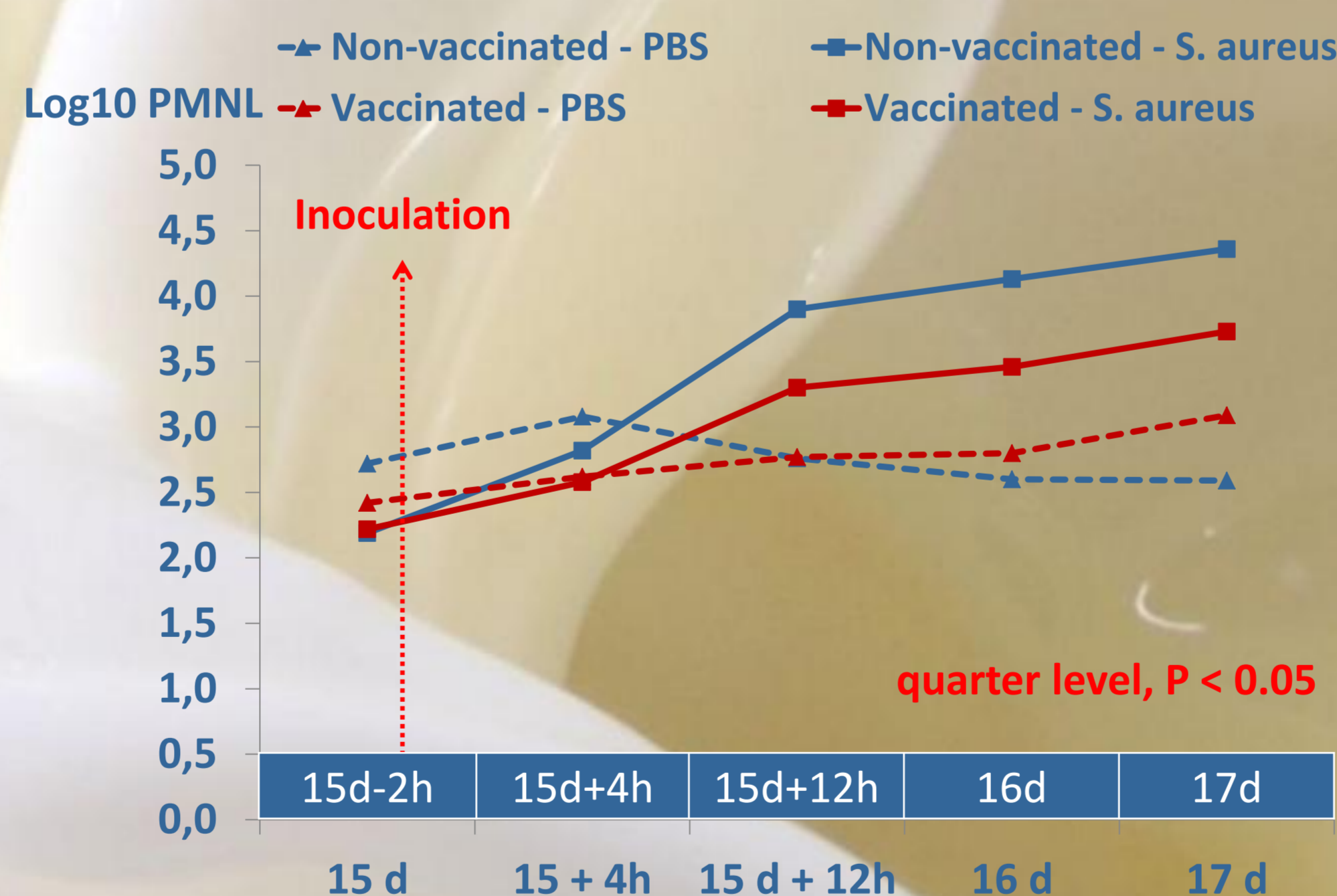


Figure 3: Log10-transformed milk PMNL concentration for the vaccinated and non-vaccinated animals during the study period

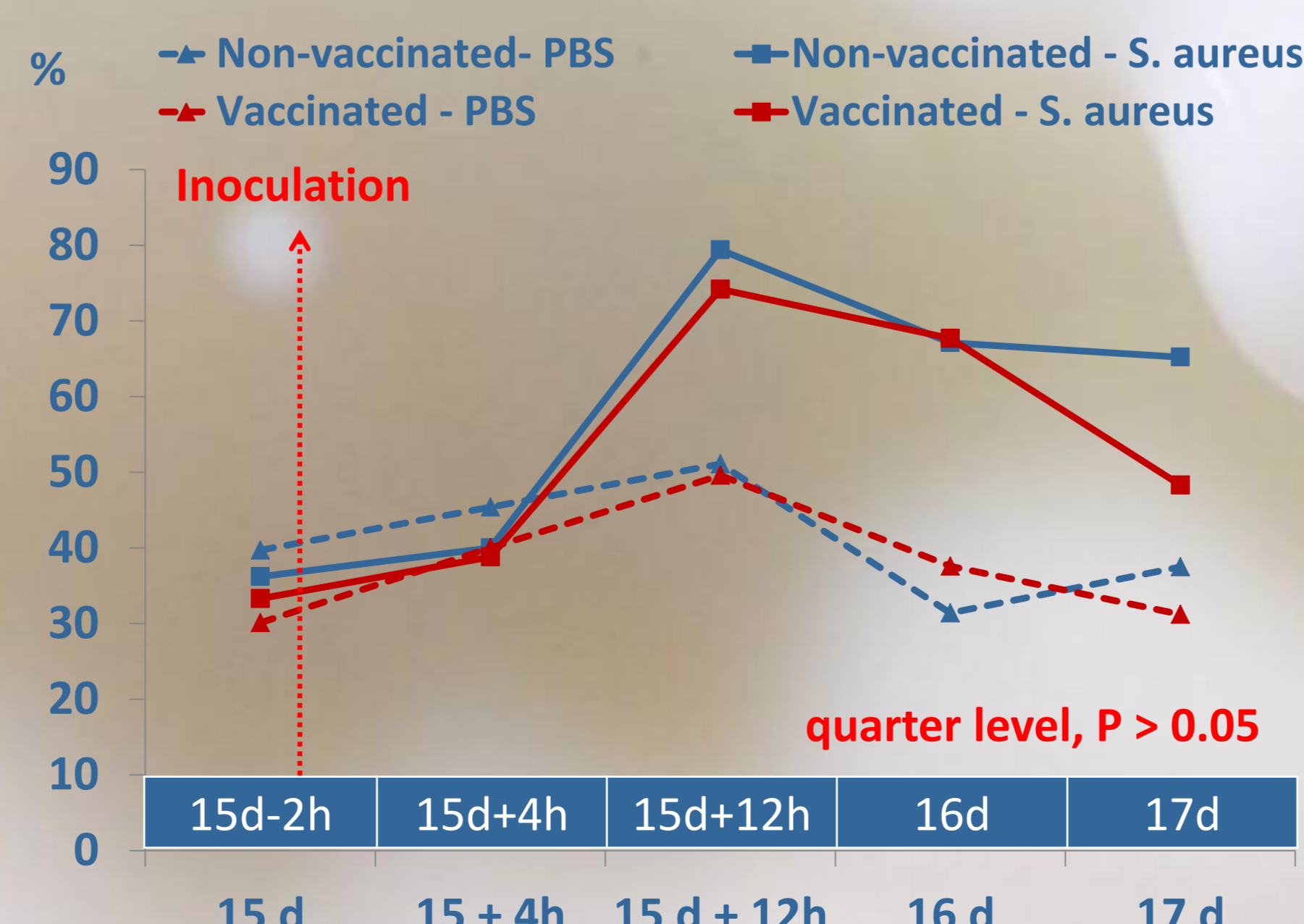


Figure 4: Proportion of viable milk PMNL for the vaccinated and non-vaccinated animals during the study period

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.