

Title: Evaluating the impact of low-level hydrogen sulfide exposure on pathogenesis of zoonotic and endemic infectious swine diseases- **NPB #17-012**

Investigator: Dr. Wilson K. Rumbleha

Institution: Iowa State University

Co-Investigators: Dr. Phillip C. Gauger

Date Submitted: January 07, 2019

Scientific Abstract:

Hydrogen sulfide (H₂S) is a toxic gas that affects the respiratory, cardiovascular and central nervous systems. It is commonly present and is an environmental stressor for both caretakers and pigs in intensive swine confinement operations. In low concentrations, it is an upper and lower respiratory tract irritant. Influenza A virus (IAV) is a zoonotic disease of public health significance. After the H1N1 2009 pandemic, it is estimated that the pork industry lost over 1 billion dollars in revenue. Studies in rats have shown that H₂S exposure increases bacterial retention in the respiratory tract, thus aggravating respiratory disease. However, the effects of low-level H₂S exposure on the pathogenicity of IAV in pigs have not been investigated. We hypothesized that repeated exposure to low concentrations of H₂S, increases the pathogenicity of IAV in pigs. To test this hypothesis, thirty-five 3-week old crossbred pigs of mixed sex were exposed via inhalation in a custom-made chamber to H₂S concentrations ranging from 0 to 50 ppm for 6 hours daily for 12 days; five controls were exposed to breathing air (BA) and were challenged only with a placebo. Pigs were exposed either to BA or H₂S for 7 days before intratracheal and intranasal challenge with approximately 3x10⁵ TCID₅₀ H3N2 IAV (C) or given placebo (NC) on day 0. The experimental design was as follows: Group1 BA/NC; Group2 BA/C; Group3 0.5ppm/C; Group4 5ppm/C; Group5 50ppm/NC; and Group6 50ppm/C. Data shows that pigs exposed to H₂S at 50ppm had significantly lower growth rate compared to other groups. Pigs in Groups 3, 4, and 6 exhibited significantly more severe clinical signs compared to those in Group2 (BA/C). Group3 pigs exhibited the most severe clinical signs, including elevated body temperature. Pigs in Group6 (50 ppm/C) had the greatest percentage of IAV-induced pneumonia both grossly and histologically. H₂S, at any concentration used in this study, increased the severity of lung lesions i.e. necrotizing bronchiolitis and interstitial pneumonia. Another significant finding was that IAV titers in the nasal swab and lung lavage fluids were elevated in all H₂S/C groups compared to BA/C, indicating that H₂S exposure increased nasal shedding of IAV as well as lung viral load. Pro-inflammatory cytokine concentrations were lowest in Group6 suggesting a dose-dependent suppression of these cytokines by H₂S. Bacterial cultures for secondary infections in the lungs were negative. Overall, these preliminary results suggest that H₂S, even at 0.5 ppm, increased IAV shedding and increased the severity of IAV lung infection in pigs. These results have significant public health significance considering IAV is a zoonotic disease.

These research results were submitted in fulfillment of checkoff-funded research projects. This report is published directly as submitted by the project's principal investigator. This report has not been peer-reviewed.

For more information contact:

National Pork Board • PO Box 9114 • Des Moines, IA 50306 USA • 800-456-7675 • Fax: 515-223-2646 • pork.org
