Electronic nose differentiates pre- and post-challenge samples in an induced bovine respiratory disease model

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Introduction

Bovine respiratory disease (BRD) is the most common disease challenge in feedlot cattle. Visual observation, with or without body temperature, continues to be the standard method of BRD diagnosis, although previous studies have shown a poor correlation between trained observers and actual lung lesions at slaughter, indicating there is room for improvement in antemortem BRD diagnosis. Several chute-side diagnostic tools have been developed and tested for the diagnosis of BRD, but many lack adequate sensitivity or practicality for widespread use in cattle feeding operations.

The current study evaluated the Cyranose 320 electronic nose (eNose) (Sensigent, CA) for the detection of BRD in cattle from respiratory samples (expired air and nasal swabs), following an experimentally induced challenge with bovine herpesvirus-1 (BHV-1) and *Mannheimia haemolytica*. The use of eNose technology has proven effective for the diagnosis of certain inflammatory and infectious diseases in human and veterinary medicine; however, its use as a chute-side diagnostic tool for BRD remains unproven. The objective of this study was to test the effectiveness of the Cyranose 320 eNose for the diagnosis of BRD in cattle.

Materials and methods

Twelve, 150 kg (range: 143-172 kg) intact male Holstein calves were sourced from a commercial dairy. Prior to study initiation, animals were individually identified and allowed to acclimate overnight. On study days 1-3, expired air and nasal swab samples were collected once per day from each animal and analyzed with the eNose. Expired air samples were collected through a veterinary anesthesia mask with a rubber diaphragm, attached to a one-way valve, into a 3.8-liter mylar bag until fully inflated. The nasal swab was inserted into the nostril of each calf, alternating nostrils each day, and placed into a plastic 6 milliliter (mL), preservative-free blood collection tube and sealed. Volatile compounds within the air of the sample containers were collected and analyzed with the eNose by inserting a needle into either the mylar bag or through the rubber stopper of the blood collection tube.

Following collection of respiratory samples on day 3, each animal was inoculated with 4 mL of $1x10^5$ TCID50 per mL bovine herpesvirus-1 by fully inserting a 5 cm plastic nasal cannula into the left nostril. On day 5, all animals were additionally challenged with *M. haemolytica* by endoscopically inoculating ~10^{10} CFU into the tracheal bronchus. Expired air and nasal swab sample collection and eNose analysis resumed on day 6 and occurred daily until day 13. Results from nasal swabs and expired air samples analyzed by the eNose were reported as the percentage of correctly identified pre- (days 1-3) and post-challenge (days 6-13) samples.

Results

In the current study, 122 nasal swabs and 122 expired air samples were collected for analysis. For pre-challenge samples, the eNose correctly identified 30/31 (96.8%) expired air samples and 29/31 (93.5%) nasal swab samples. Correct post-challenge classification was lower for expired air (66/91; 72.5%) than for nasal swabs (89/91; 97.8%). However, the majority of incorrectly classified post-challenge samples (76% [19/25] for expired air and 100% [2/2] for nasal swabs) occurred within 48 hours of the bacterial challenge.

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