Introduction
For decades, antibiotics (also called growth promoters) have been used as feed additives in various livestock species (Adv. in Pork Prod., 2005). However, with the growing concern around antimicrobial resistance, alternatives to antibiotics are in demand. The use of beneficial bacteria (probiotics, direct-fed microbials) as feed additives is being explored. In this series of experiments, the effect of a direct-fed microbial (DFM) containing bacteria from the genera Bacillus and Lactobacillus on growth performance, digestibility, methane production, and gut health was measured across multiple livestock species.

Experiments

Experiment 1: 6-week, 48-pen floor pen poultry study
1296 straight-run broiler chicks (27/pen), Ross 508. Day of Hatch (Day 0).

Treatments
• USA: None (Control) high protein pelleted diet
• USA: DFM (200 g/mT in starter & 500 g/mT in grower & finisher feeds)
• AU: None (Control) low protein pelleted diet
• AU: DFM (200 g/mT in starter & 500 g/mT in grower & finisher feeds)

Data collected: Body weight, feed weights and digestibility evaluation at days 0, 14, 28, and 42. Feed conversions and mortality adjusted feed conversions. Total mortality and daily observations throughout the study.

Results: While no significant difference (p>0.1) in MAFC within the USA feeding program, there was a trend seen in the groups treated with the DFM 100g/mT treatment vs. the control at 42%.

Experiment 2: In-vitro digestibility study in continuous culture of rumen contents
Rumen inoculum obtained from two non-lactating dairy cows 4 hours after feeding. Diets consisted of Timothy and Orchardgrass, and molasses liquid feed (MLF).

Treatments
• Diet 1: Hay + MLF
• Diet 2: Hay + MLF + DFM, 0.28mg/g MLF (BW1) equiv. to 25g/mT

Diets fermented in triplicate under the following conditions:
• Liquid dilution rate 10% /hr
• Solids retention time 30 hr
• Temperature 39° C
• Feed intake 30 g DM/d
• Feeding frequency 2X/day, 12 hr intervals (1/2 of total g DM/feeding)
• pH Monitored, recorded at 30 min. intervals

Results: Use of hay as the primary feed caused high variability in this study (hard to stir/slow to digest), therefore, no statistically significant differences were obtained. However, there were trends observed in the digestion of nutrients consistent with field observations.

Experiment 3: Methane production and digestibility in beef cattle
Seven steers fitted with rumen cannulas were used in an incomplete replicated 4 x 4 Latin square design.

Treatments
• Control
• Control + DFM, 25 g/mT
• Control + DFM, 100 g/mT
• Control + DFM, 200 g/mT

Diet consisted of Bermuda grass hay, alfalfa hay, cracked corn, dried distillers’ grains, soybean meal, and molasses. Intake was limited to 2.5% of body weight. Steers housed in individual pens with ad libitum access to water.

Results: Rate of methane produced was statistically different in the DFM 100g/mT treatment vs. the control at 42%.

Experiment 4: Field trial – swine
Four pens of females – 2 controls and 2 DFM (200g/T) mash feed for 2 months. 140 females total - 60 controls and 80 DFM harvested 8/20 – 9/1/2014. Average Daily Gain (ADG) and Feed Conversion Ratio (FCR) recorded.

Results: Due to high variability within and between groups, statistical differences were not seen. However, there was a trend seen in the groups treated with the DFM vs. the control groups.

Conclusion
These studies show that diets supplemented with a DFM can enhance growth, improve digestibility and potentially improve gut health by shifts in the microbiome. In most cases, performance like body weight or feed conversion ratio improves to up to 5% (Adv. In Pork Prod., 2005). These beneficial effects are generally explained by modifications of the intestinal bacteria and their interaction with the host animal thereby also supporting animal health. With increasing regulations around use of antibiotics in animal feed, DFMs provide a viable alternative without the concerns of antibiotic use.