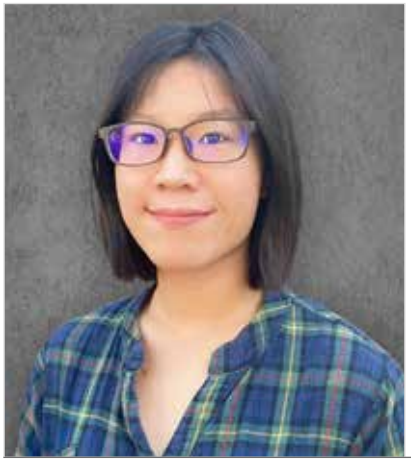

A FUTURE WITHOUT ZINC OXIDE

Kayla Wong
Technical Specialist
Manuka Biotech

"By 2022, EU farmers will have to be prepared to grow their piglets without using medicinal levels of zinc and in the next few years, we can expect producers worldwide to have to start looking for alternatives to zinc oxide as seen in the trend of international AGP ban."

Traditional methods of controlling post-weaning diarrhoea have been using zinc oxide at high doses (2500-3000mg/kg feed) together with antibiotics. While there are many benefits of using zinc oxide linked to improving gut health, there are more negative effects such as increasing antibiotics resistance, encouraging the selection of multi resistant E.coli strains, decreasing absorption of macro- and micro elements, decreasing the effectiveness of organic acids and having heavy metal effect on the environment thus negatively affecting the agriculture and aquaculture industry. Together with the ban of antibiotics and the coming of medicinal zinc oxide ban, time is running out to find an alternative to zinc oxide.

A ban of medicinal dose of zinc oxide in piglet will come into force in Europe starting June 2022. This means that zinc oxide will no longer be allowed as a veterinary product but is still able to be used as a feed additive at a maximum level of 150ppm to meet the daily zinc requirements of piglets according to the Commission Implementing Regulation (EU) 2016/1095. In China, medicinal use of zinc oxide has also been restricted to 1600ppm in the first two weeks post weaning since July 2018 and in-feed zinc is only allowed to a maximum of 110ppm. By 2022, EU farmers will have to be prepared to grow their piglets without using medicinal levels of zinc and in the next few years, we can expect producers worldwide to have to start looking for alternatives to zinc oxide as seen in the trend of international AGP ban.

PIGLETS POST WEANING DIARRHOEA (PWD)

Piglets post weaning diarrhoea (PWD) is usually bacterial microbial scours and/or nutritional scours and remains a big problem for most swine farms worldwide. In severe cases, PWD increases piglet mortality causing direct economic impact to the farm. There is no doubt that a combination of zinc oxide and antibiotics is by far the most effective solution against PWD, but with the coming of medicinal zinc oxide ban and the international AGP ban, a possible alternative to medicinal zinc oxide and antibiotics for PWD would be a combination of feed additives – butyric acid derivatives and hydrolysable tannin.

BUTYRIC ACID DERIVATIVES

Butyric acid is well known for its beneficial effects on gut health, development and maintaining gut in-

tegrity. Butyric acid constitutes 15% of total short chain fatty acids produced in the intestinal lumen and is taken up by the intestinal epithelial cells to provide a source of ATP without undergoing the carboxylic acid cycle (also known as the citric acid cycle or the Krebs cycle). The energy produced drives a sodium pump which maintains osmotic balance in the gut, allowing water to be absorbed producing a more solid faecal matter.

Butyric acid not only provides energy to the intestinal epithelial cells but is also involved in processes such as cell differentiation, gut tissue development, gene expression, immune modulation, diarrhoea, and enteric pathogen control. The energy production of butyric acid consumes oxygen and produces carbon dioxide, leading to a hypoxic (low oxygen) environment, favouring anaerobic bacteria such as the Clostridium butyricum. The decrease in pH by butyric acid also suppresses growth of non-favourable bacteria such as salmonella and E. coli.

Furthermore, butyric acid is also utilized by the gut microbiota, the population of Clostridium butyricum, lactobacillus etc. allowing for increase in the population of these bacteria thus increasing gut fibre fermentation and further increasing butyric acid production in the gut – secondary acidification.

HYDROLYSABLE TANNIN

Tannins are a complex group of polyphenolic compounds found in a wide range of plant species and are characterized by astringent and tanning properties. Tannins are classified into two main types – the condensed tannins and hydrolysable tannins. Condensed tannins are non-hydrolysable and often associated with being anti-nutrients because of its ability to precipitate proteins, inhibit digestive enzymes and decrease utilization of vitamins and minerals. Condensed tannins are also known to inhibit several digestive enzymes such as amylases, cellulases, pectinases, lipases, and proteases.

Hydrolysed tannins, as the name suggests, can be hydrolysed by acids and enzymes, and are found in smaller amounts in plants compared to condensed tannins. In recent research, hydrolysable tannins have been proposed as an alternative to antibiotics because of its antimicrobial properties which can inhibit extracellular microbial enzymes, deprive microbes of substrates required for microbial growth and inhibit microbial metabolism.

Furthermore, hydrolysable tannins could be used in lieu of antibiotics because bacterial such as Clostridium perfringens cannot develop resistance to them. Besides that, hydrolysable tannin has also been reported to have antioxidant properties, chelate metals, and antibacterial properties which enable it to prevent conditions such as diarrhoea and gastritis. Hydrolysable tannins have also been revealed to improve intestinal microbial ecosystem and enhance gut health hence increasing production performance

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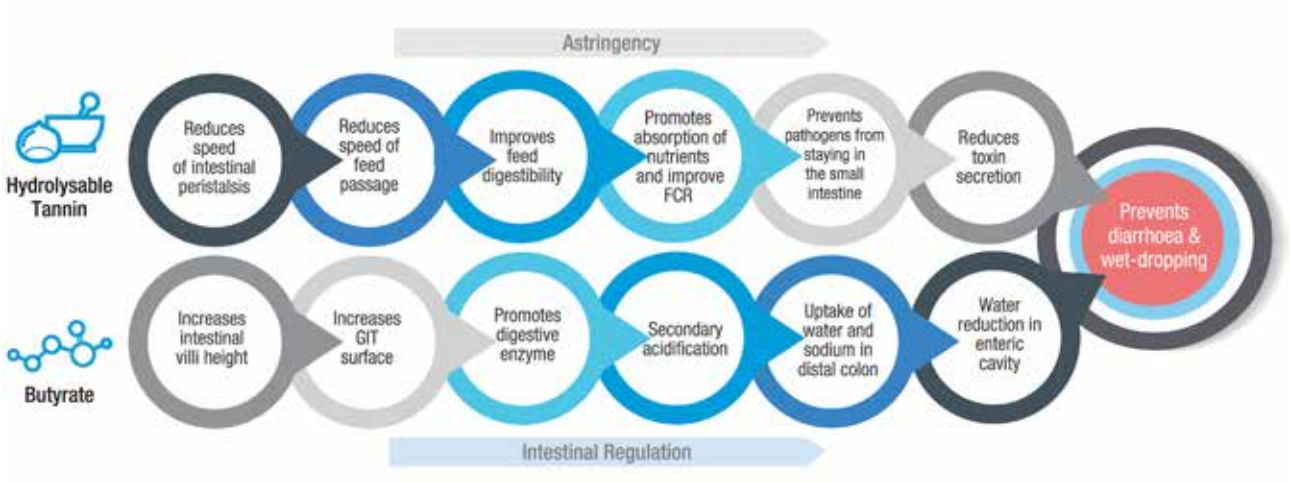


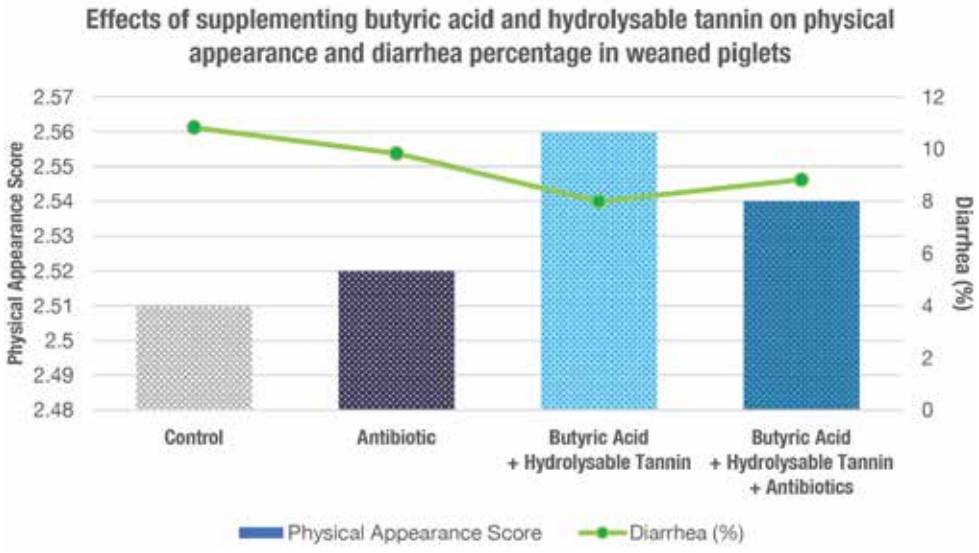
Figure 1. Synergistic effects of hydrolysable tannin and butyric acid derivatives on diarrhoea and wet droppings.

when properly applied in monogastric diets. The astringency properties of hydrolysable tannin would be able to reduce the speed of intestinal peristalsis thus improving feed digestibility and absorption which leaves less undigested feed for pathogen utilisation thus reducing toxin secretion and diarrheal issues.

BUTYRATE ACID DERIVATIVES + HYDROLYSABLE TANNIN: THE ALTERNATIVE TO ZINC OXIDE

Given the pros of butyric acid derivatives and hydrolysable tannin described above, using the two compounds together could produce a synergistic effect (Figure 1). When considering diarrhoea reduction, hydrolysable tannins' astringency properties which reduces digesta flow rate combined with butyric acid's properties to improve hindgut villi morphology which increased water and sodium reabsorption would be able to reduce water content in faeces. When considering gut health promotion, hydrolysable tannin is hydrolysed into tannic acid in the stomach and ileum which contributes to its bactericidal and bacteriostatic effects. Butyric acid on the other hand plays a role in secondary acidification which increases the amount of butyric acid in the gut, also contributing to bactericidal and bacteriostatic effects in the gut.

An experiment was done in Fujian, China where zinc oxide usage has already been restricted since July 2018. The experiment compared the effects of using antibiotics versus using a combination of butyric acid derivatives with hydrolysable tannin in weaned piglets (Graph 1). It can be seen from the graph below that diarrhoea incidences were reduced



Graph 1. Effects of supplementing butyric acid derivatives and hydrolysable tannin on physical appearance and diarrhoea percentage of weaned piglets.

in weaned piglets when they were supplemented with a combination of butyric acid derivatives and hydrolysable tannin and physical appearance scores have also improved. Although the faecal appearance was not significantly different from each other, it was noted that the faeces in pens that were supplemented with the combination of butyric acid and hydrolysable tannin stayed more intact when caretakers hosed down the pens during cleaning. This further showed that supplementation of a combination of butyric acid derivatives and hydrolysable tannin in weaned piglets was able to improve faecal score and reduce moisture in faeces.

MANUKA BIOTECH'S PWD SOLUTION

Although butyric acid derivatives and hydrolysable tannin seems to be a promising solution for resolving diarrheal and wet dropping issues, both these components have individual challenges to be overcome before it can be easily incorporated in animal feed. Butyrate salts are known to have a pungent smell that makes it hard to work with and easily releases butyric acid when dissolved causing less butyric acid to be able to reach the hindgut. Hydrolysable tannin on the other hand, also has its own sets of challenges such as being easily oxidized and having a bitter taste that could negatively impact feed palatability.

At Manuka Biotech, we are equipped with the capability to produce a butyrate salt and hydrolysable tannin combination with our unique matrix-coating that overcomes the challenges of both raw materials. Our unique matrix-coating ensures slow release of tannin and butyric acid at the same time throughout the gastrointestinal tract to bring out synergistic effects of both components throughout the gastrointestinal tract.

References are available upon request.

About Kayla Wong

In 2019, Kayla completed her master's in animal science at Massey University, New Zealand, researching in the area of meat science. Serves as the Technical Specialist in Manuka Biotech, a business unit of Singao based in Malaysia. Singao is the pioneer in the field of fatty acid nutricine, she hopes of bringing the best technology to improve animal well-being and productivity.

Before her role at Manuka Biotech, she was a dairy farm manager for a new farm of 500 cows. Working with a team of 25, they managed to improve milk yield, milk protein fat ratio, heat detection and reproductive performances of the cows. During her time at Massey University, she received a scholarship and successfully published and presented her research at the NZSAP conference.*

**New Zealand Society of Animal Production*