

Utilising technology for healthier poultry feed and salmonella control

The concept of food safety has become increasingly more evident in food production, mainly in relation to the export of products of animal origin, and it is a huge challenge for industries to ensure food safety.

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The demand for healthier and more natural additives in food has increased in Brazil and the world, resulting in more investment in technology and industry adhesion.

The technology used in the manufacture of products is fundamental, and integrates techniques for the standardisation of production, storage, distribution, and conservation of the nutritional potential of the raw material, which, in addition to improving productivity, enables an increasingly better quality level to be attained. Thus, establishing a link between good quality, nutritional value, and food safety is a task that has demanded a lot of research on the part of industry to ensure public health.

Brazil is one of the major world producers of meats, exporting to many diverse countries, and is also one of the major meat

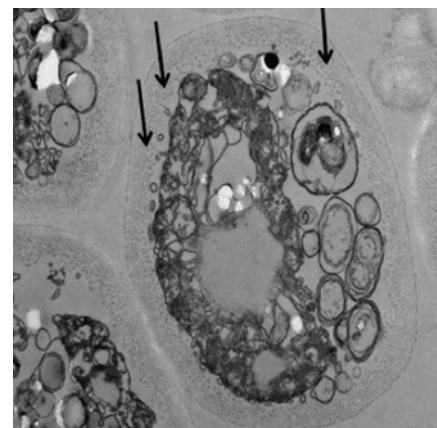
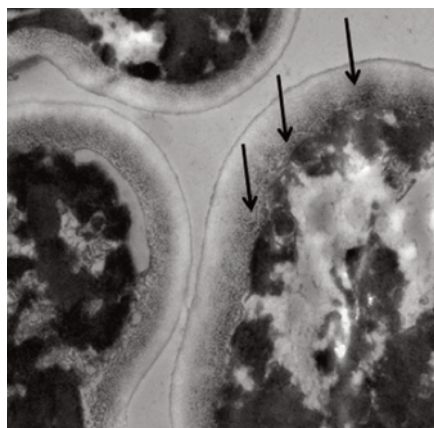


Fig. 1. Microscopic structural differences between Immunowall (left) and the yeast cell wall from primary fermentation 50% BG and 50% MOS (right). Light microscopy images performed at the Electron Microscopy Facility, Cellular & Molecular Medicine, University of California San Diego, 2016.

consumers, which shows the efficacy of the sanitary standards that act from the field up to the final product.

Global concern

There is a global concern about the quality of ingredients and additives used in animal feed as a result of the end consumer becoming aware of the relationship between

nutrition and health. Even with increased security and management, salmonella remains one of the primary causes of food poisoning in the world, and salmonellosis is considered an important public health problem.

Therefore, offering safe products, such as salmonella-free foods, to end consumers is one of the main objectives involving food production technology.

There is a long list of additives that act directly on salmonella or indirectly by modulating the microbiota and immune system response and improving the intestinal integrity of the host.

The yeast cell wall (*Saccharomyces cerevisiae*) is one of the solutions that can help in salmonella control, by reducing contamination and preventing the problem.

Innovative product

Based on this concept, Immunowall stands out from other products since it is composed of a dense yeast cell wall of *Saccharomyces cerevisiae* with a high concentration of mannan oligosaccharides (MOS) and β -glucans (BG), resulting in a feed additive with proven results and a great cost:benefit ratio. MOS is known for its ability to agglutinate pathogens.

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Table 1. Summary of the results of a study by Hofacre et al. (2017) showing the reduction in contamination by *Salmonella enteritidis* in commercial hens fed Immunowall.

Days after challenge	Parameters	Control	Immunowall	Reductions
Ovary				
7	Presence of SE	41.7%	33.3%	-20%
7	MPN/g ³	10 ¹	10 ⁰	-90%
14	Presence of SE	4.2%	2.1%	-50%
Caecum				
7	Presence of SE	97.9%	93.8%	-4.2%
7	MPN/g ^{3,4}	10 ³ b	10 ² a	-90%
14	Presence of SE	53.2%	47.9%	-10%

¹Infection of chickens at 16 weeks of age by *Salmonella enteritidis* (orally, 3.0 x 10⁹ CFU/nalidixic acid-resistant SE chicken). ²Immunowall supplemented from 10 weeks of age at 0.5/ton. ³MPN: most probable number (g of the organ). ⁴Means followed by different letters on the same line are significantly different to each other according to a Mann-Whitney test (P<0.05).

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It prevents pathogen colonisation in the gut by offering a binding site to harmful bacteria that possess type 1 fimbriae present in the intestinal tract and is excreted together with the faecal material.

The β -glucans act as modulators of the immune response of the animals since they are natural stimulants of the innate immune system. When phagocytic cells are in contact with β -glucans, these cells are stimulated, and cytokines are produced. The production of cytokines triggers a chain reaction, inducing a higher immune status in animals, making them better able to resist opportunistic infections.

The yeast culture can be obtained from the primary fermentation process involved in brewing, baking or the production of ethanol. For many years, yeast strains were highlighted as the most important factor in processing.

Nowadays, we know that the fermentation environment is more important than the yeast strain and it is the fermentation environment that will indeed provide fundamental differences in the final product's composition.

Produced in a challenging environment

ImmunoWall stands out by being produced in a challenging environment during the sugar cane fermentation process to obtain ethanol. The yeast culture passes through numerous fermentation cycles, which makes the yeast cell wall much denser, and results in a higher carbohydrate content and lower fat content, making it less digestible in the intestinal tract.

The process technology of ImmunoWall involves aggressive conditions during ethanol fermentation which leads the yeast to protect itself and, therefore, to strengthen its cell wall.

Given that β -glucans are like the yeast cell wall 'skeleton', it is important to note the ratio between β -glucans and MOS to measure its effectiveness.

The higher the β -glucans concentration,

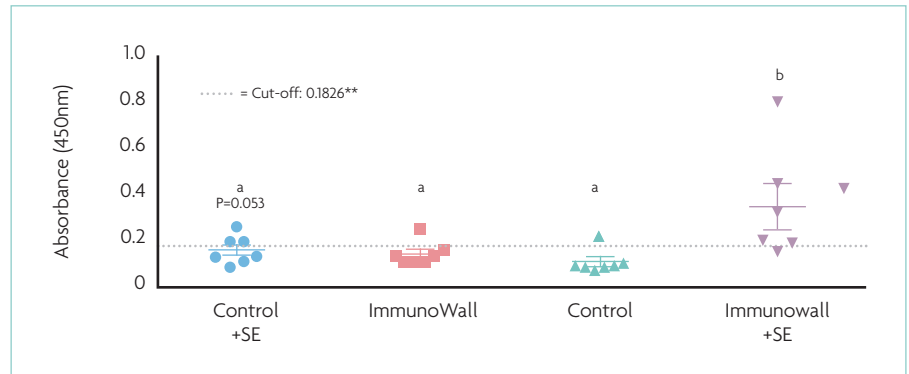


Fig. 2. Relative IgA quantification in reagent serum against bacterial LPS. The cut-off line is shown. Different letters above each group indicate statistical significance according to an ANOVA test with a Tukey post-test ($P < 0.05$, except when otherwise indicated).

the lower the cell wall degradation in the gastrointestinal tract, and thus, the better its efficiency as functional fibre. The yeast cell wall has a BG:MOS ratio close to 2:1, whereas primary yeast cell walls have a 1:1 BG:MOS ratio (Fig. 1).

A recent study by Beirão et al. (2018), in which broilers were given ImmunoWall (0.5kg/ton) and infected at two days of age with *Salmonella enteritidis* (SE) (orally at 10^8 CFU/broiler), showed that ImmunoWall supplementation resulted in a higher production of anti-salmonella IgA at 14 days of age.

This indicates that the immune system of the broilers given ImmunoWall had a faster and stronger specific response, thus using less energy and nutrients, since the inflammatory response seemed to be shorter.

Activating the immune system

SE can be a problem for broilers that do not yet have a mature immune system since they cannot fully control the infection. For this reason, most of the improved responses found in this study were observed up to day 14. Therefore, β -glucans supplementation can help broilers activate their immune system and have an earlier and faster innate immune system response, thus minimising

the damage caused by pathogens and, consequently, performance impairment.

This type of response is especially important in animals at early developmental stages, during reproduction, and periods of stress and environmental challenges; β -glucan supplementation thus acts as a prophylactic agent, increasing animals' resistance, and thus minimising losses.

In the study published by Hofacre et al. (2017), for the first time in an in vivo experiment, the efficacy of a yeast derived product in reducing the colonisation and presence of *Salmonella enteritidis* (SE) in the ovary and caecum of commercial hens was demonstrated.

Table 1 shows that commercial hens contaminated by SE at a high dosage and supplemented with ImmunoWall (0.5kg/ton) had a reduction in intestinal and ovarian colonisation by SE compared to the control group (at 7 and 14 days after the challenge).

ImmunoWall, in addition to being a 100% natural additive, has proven to be a viable solution at low dosages to improve intestinal health and food safety, resulting in an excellent cost:benefit ratio and helping in the reduction of the use of antibiotics. ■

References are available from the authors on request