The expanding role of S. cerevisiae yeast in filling the void left by AGPs

Despite a decade having passed since antibiotic growth promoters (AGPs) were first banned by the EU in 2006, the negative impact on poultry health and productivity continues to be felt across many parts of the world.

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A rise in digestive tract-borne diseases such as necrotic enteritis is a key concern for many poultry producers, but so too is the effect on young birds, where compromised immune response can significantly increase the risk of disease, growth checks and mortality.

It is well known that stress hormones like the glucocorticords and catecholamines, for example, act to reduce immune response and increase susceptibility to infectious micro-organisms.

The challenge for broiler producers is that many of the most stressful situations occur early in the production cycle, at a point when the young immune system is still developing.

Such reductions in immunity can have a substantial impact on bird health and performance, particularly without access to AGPs, and the knock-on effects can last through the bird's entire life.

When the resulting reductions in productivity are considered alongside the potentially higher costs of disease treatment, the overall impact on profitability can be substantial.

Improving intestinal health

As a result, the last 10 years have seen a rapid rise in the number of AGP alternatives that aim to help bolster health and performance.

Many of the most important bacterial threats enter via the digestive tract, so the majority of these alternatives have been developed to take advantage of the improvements in intestinal health and intestinal immune response that follow when beneficial gut microbial populations are enhanced at the expense of those that are pathogenic.

Acidifiers, for example, create conditions more favourable to beneficial gut microbes by reducing the pH of the intestinal tract, whilst also possessing antimicrobial activity against pathogenic Gram-negative bacteria.

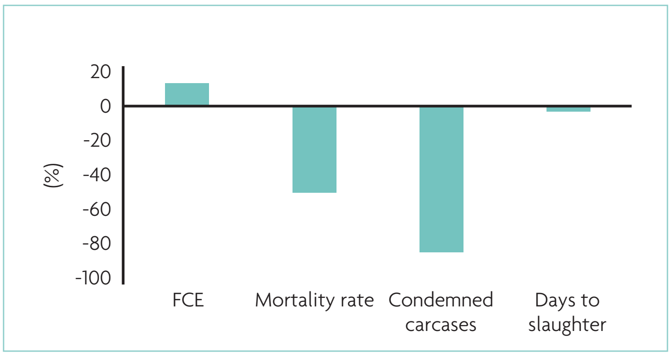
Certain plant extracts have also been used, such as carvacrol, thymol and anethole, which have both antimicrobial and antioxidant activity, plus can stimulate the secretion of digestive enzymes and saliva to improve overall nutrient digestibility.

This increases feed efficiency and reduces potential anti-nutritional effects, leading to benefits in terms of both productivity and resilience to infection. It can also trigger a beneficial shift in gut microbial populations by changing the end products of digestion which form the primary nutrient source for the microbes. Feed enzymes work in a similar way.

Another option is to use prebiotics to directly supply additional nutrients to the beneficial gut microbes, or probiotics to simply deliver additional beneficial microbes to the gut.

Common examples of the former include the mannan oligosaccharides (MOS) found in yeast cell walls and the fructo-oligosaccharides (FOS) present in many plant materials, whilst the latter typically include various species of lactic acid-producing bacteria such as lactobacilli and bifidobacteria, as well as certain yeast cultures.

Fig. 1. Impact of a supplement containing S. cerevisiae beta-glucans (ImmuGuard) on commercial broiler health and performance.



Increasing immune response

However, the bird can also be infected by other routes, such as via the respiratory tract.

For example, fowl cholera and mycoplasma caused by inhalation of Pasteurella spp. bacteria via the respiratory tract are responsible for considerable losses within the poultry industry, whilst skin damage caused by pecking can expose the bird to environmental pathogens.

Recent evidence that the entire immune system can be directly stimulated by the beta-glucans found within the cell walls of Saccharomyces cerevisiae yeast is therefore receiving considerable attention.

By improving the ability of the bird to tackle all infections, it is possible to generate much broader resilience to all pathogenic bacterial challenges, regardless of source. Such an approach can also boost the efficacy of the vaccines used to manage viral infections.

In one commercial-scale trial, the performance of one 20,000 broiler house receiving a supplement containing S. cerevisiae beta-glucans (ImmuGuard) was compared to a similar control house, also containing 20,000 broilers.

Feed conversion efficiency (FCE) was improved by 13 points, mortality reduced by 50%, carcase condemnation lowered by 86% and the birds required on average three days less to reach 2.4kg final weight (see Fig. 1).

Understanding beta-glucans

However, critical to the efficacy of the beta-glucans in stimulating an immune response is their physical structure, which differs considerably from one source to the next.

The beta-glucans derived from plant cell walls, for example, consist primarily of glucose molecules linked linearly, with little or no side

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chains. Not only is the presence of side chains in S. cerevisiae beta-glucans important in generating the required response, but so too is the frequency and length of those branches. The length of the glucose backbone, the purity of the beta-glucans and the particle size also appear critical.

All affect the ability of the beta-glucans to interact with elements of the immune system such as macrophages following absorption into the epithelium of the gut. It is this interaction that triggers the cascade of activation events leading to an overall increase in immune activity, which is then available to more effectively tackle pathogens, including those introduced as vaccines. The effects of supplementation with S. cerevisiae beta-glucans on the immune response in chicks has been observed in salmonella challenge trials.

In one study, the level of Salmonella enteriditis in the liver and spleen was evaluated using 150 day old broilers split into three groups: one group received salmonella inoculation and no beta-glucans (negative control, NC), the second received only the inoculation (SE), and the third both the inoculation and beta-glucans (SE+BG).

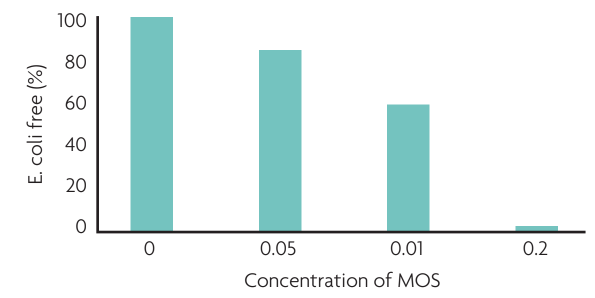

Fig. 2. In vitro adsorption of E. coli by S. cerevisiae mannan-oligosaccharides (MOS).

The addition of the beta-glucans reduced contamination from 76% to just 7%. Furthermore, concerns regarding the potential energy cost of such an enhanced immune response, and the possible impact on bird performance, have proven unfounded.

Expanding yeast role

This immune response activity is in addition to the more traditional use of supplements based on S. cerevisiae as pre- and probiotics.

Yeast mannan-oligosaccharides (MOS) have for many years proven to be highly effective in positively influencing the microbiome, acting as a nutrient source for beneficial species of gut microbes, such as bifidobacterium and lactobacilli, at the expense of pathogenic organisms, including salmonella, Escherichia coli and clostridium.

The MOS can also bind with pathogenic bacteria (see Fig. 2), and have been shown to indirectly improve gut wall integrity as a result of the increase in lactic and butyric acid production by the beneficial microbes.

The net result is a substantial reduction in the ability of pathogenic bacterial populations to grow and subsequently enter into the bird's bloodstream.

Intestinal immune response

In addition, there is evidence of further benefits from the use of S. cerevisiae MOS, such as indirect stimulation of the intestinal immune system and the ability to bind with many mycotoxins, including aflatoxin, trichothecenes and ochratoxin A. When the whole S. cerevisiae yeast organism is applied as a probiotic the metabolic activity of the yeast suppresses aerobic pathogenic organisms by scavenging oxygen, whilst the yeast itself has been shown to degrade non-adsorbable mycotoxins into less toxic metabolites.

The overall potential impact of yeasts such as S. cerevisiae is therefore considerable, offering an opportunity to both directly tackle the increased bacterial challenge faced when AGPs are removed from the diet, and to enhance all aspects of the bird's immune response.

The availability of supplements like ImmuGuard that combine the full benefits available from S. cerevisiae yeasts therefore represents an opportunity that is sure to appeal to poultry producers no longer able, or willing, to use AGPs. ■