Whitepaper

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Mannan Oligosaccharides (MOS): Not every yeast cell wall is created equally

Yeast cell walls, commonly referred to as MOS, are widely used by the animal feed industry as performance improving specialty ingredients. However, their effect in farming conditions varies significantly due to differences in composition and structure. These variations are influenced by factors such as yeast fermentation conditions, strain selection, and production processes.

To ensure consistent performance and reliability, it is essential to treat yeast cell walls as dedicated ingredients rather than by-products, with a focus on robust and standardized production practices. This shift will secure their role as trusted ingredients for improving animal health and performance.

By Dr. Dina Krüger, Article Date: 20/01/2025

Introduction

Yeast cell walls, commonly referred to as MOS, are valued in animal feed for their rich content of mannan oligosaccharides (MOS) and β-(1,3)(1,6)-D-glucan, two polysaccharides known for their ability to support animal health. Research demonstrates their benefits in improving daily weight gain, feed conversion ratios, and overall animal well-being (1, 2).

As the use of antimicrobial growth promoters in animal production continues to decline, alternative solutions to combat bacterial infections have become critical. Yeast cell walls have emerged as a popular option in the animal feed industry, offering natural health benefits supported by substantial scientific evidence (3).

However, the performance of yeast cell walls in practical farming conditions has been shown to be inconsistent. Despite their proven potential in improving animal well-being, variability in composition and quality threatens their reliability, underscoring the need for a closer look at the factors driving this inconsistency.

What are yeast cell walls?

Yeast cell walls are a product of the yeast extract production process. During production, yeast cells are lysed through autolysis or hydrolysis, separating the soluble yeast extract from the insoluble yeast cell wall fraction (Fig. 1).

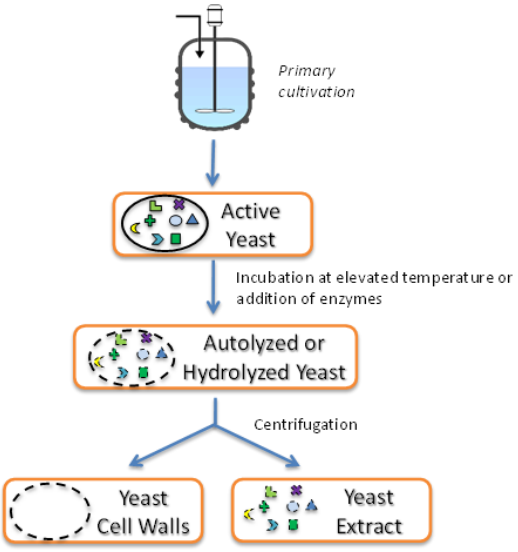

Figure 1: *Production of Yeast Cell Walls*

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Initially, yeast cell walls were sold locally in liquid form due to their protein content and appeal as a feed ingredient or palatants for pigs. Today, they are processed into dried products for global distribution. More recently, spent yeast from breweries, distilleries, or bioethanol plants has been used to meet growing demand.

Yeast cell wall composition is highly variable

Yeast cell walls contain three main components: β-glucan, mannoproteins (MOS), and chitin (Table 1).

Yeast cell walls are highly variable in composition as well as in structure (4, 5). Factors influencing this variability include:

i. Growth conditions of the yeast
Fermentation conditions such as carbon source, temperature, pH, and oxygen availability significantly affect the composition and structure of yeast cell walls. For instance, β-glucan and MOS content can vary by up to 100% under different conditions (4-8).

Moreover, not only the total amount of cell wall sugars change, but also the structure of these polymers (i.e. degree of polymerization, degree of branching, length of the branches, etc.) are affected by the growth conditions, as well as the yeast cell wall mass as a percentage of total cell mass (4, 6, 9).

Table 1: *Composition of yeast cell walls*

Macromolecule	Content (% DM)	DP*
Mannoproteins	25-70	200
Glucan	30-60	1500
Chitin	1-8	190

*Degree of Polymerisation
** 4, 5, 8.

ii. Yeast species and strain
Different species or proprietary yeast strains used in production lead to variations in composition (7). As yeast extract producers, breweries and bioethanol producer all use their own, mostly proprietary, production strains this will undoubtfully result in variations. Bioethanol production with wild yeast strains further complicates consistency (10).

iii. Production process
In general, there are two different production processes by which yeast cell walls are produced: autolysis and hydrolysis (use of exogenous enzymes incl. proteases) (11).
Yeast cell walls produced through autolysis retain higher MOS content, while hydrolysis (used increasingly for bioethanol spent yeast) often results in up to 50% lower MOS levels due to enzymes releasing the mannoproteins that are present on the outside of the cell wall (Fig 2). Additionally, the extent of washing during processing impacts purity, and content of the different components.

From by-product to co-product

Yeast cell walls were once considered low-value by-products. But their ability to positively influence microbial infections in animal husbandry or aquaculture has elevated their importance, especially since the ban on sub-therapeutic antibiotic use in animal feed.

Their growing significance demands a shift in perspective: yeast cell walls must be regarded as valuable co-products, requiring consistent quality and robust production methods. By addressing variability in composition and structure, the feed industry can ensure these ingredients remain reliable for improving animal health and performance.

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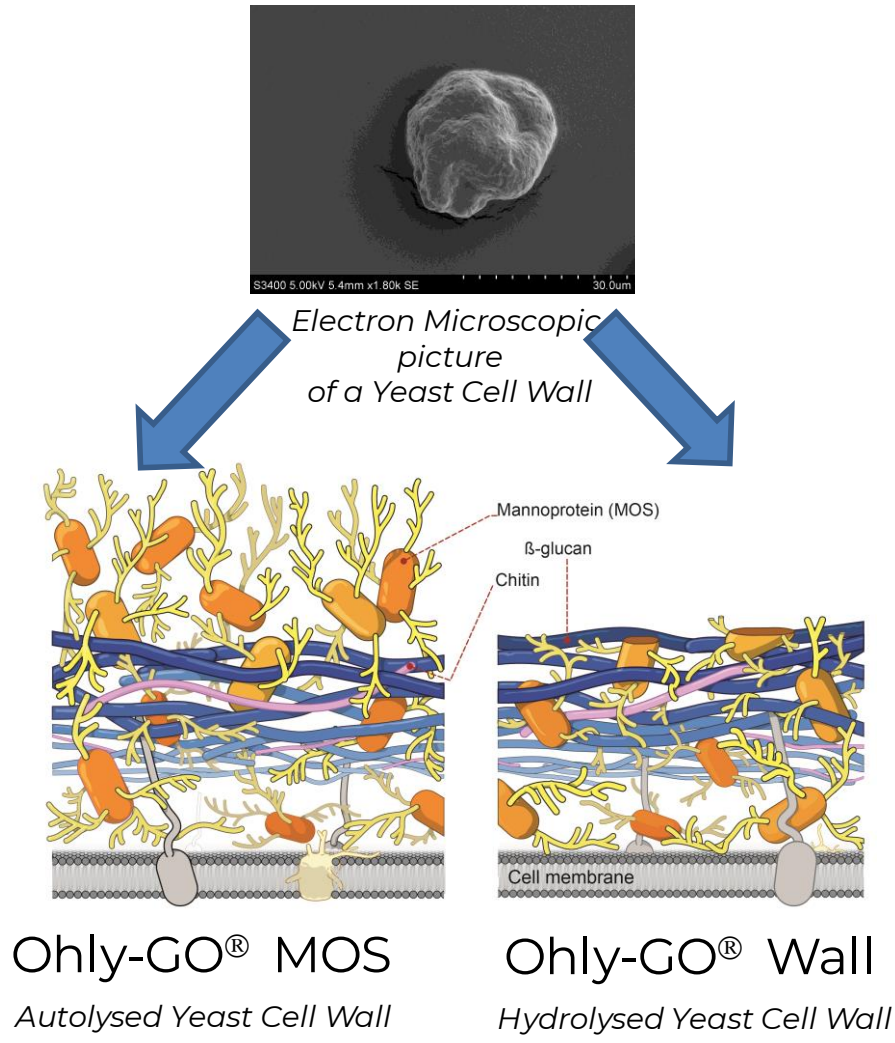

Figure 2: *Difference in structure between autolyzed and hydrolyzed yeast cell walls (EM Picture by SGS Institute Fresenius).*

Conclusion

Yeast cell walls, rich in mannan oligosaccharides and β-glucans, have emerged as essential natural alternatives in animal nutrition, particularly following the reduction of antibiotic use in feed. Significant variability in their composition and structure (due to growth conditions, yeast strains, and production processes) limits their reliability and performance in practical applications. Recognizing yeast cell walls as valuable co-products rather than low-value by-products necessitates standardized production methods and a focus on consistency. By addressing these challenges, the feed industry can fully harness the health benefits of yeast cell walls, ensuring their continued role in improving animal health and productivity.

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