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# The Effect of Adding Yeast Cell Wall Polysaccharides to Carp Feed on Intestinal Microbiota and Stress Resistance

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**ABSTRACT**
Yeast cell wall polysaccharides, as a natural immunomodulator, have attracted much attention in aquaculture. Its main components β-glucan and mannan oligosaccharides, can regulate the structure of intestinal flora in crucian carp, inhibit the adhesion of path bacteria, and enhance the immune function of crucian carp, which can effectively improve the resistance of crucian carp to a variety of stress states and reduce the negative of stress response. This paper summarizes the influence of yeast cell wall polysaccharides added to crucian carp feed on its intestinal flora and stress resistance, with expectation of providing a reference for the healthy breeding and feed optimization of crucian carp.

**KEYWORDS**
Crucian carp; Yeast cell wall polysaccharides; Intestinal flora; Anti-stress ability

## 1 The influence of yeast cell wall polysaccharides on the intestinal microbiota of crucian carp

The balance and health the animal intestinal microbiota directly affect the animal's physical health and growth level. Especially, the intestinal microbiota is a microbial community that has a symbiotic relationship animals, and animals have a direct relationship with the intestinal microbiota in terms of absorbing nutrients and regulating the immune system of the organism. Therefore, it is necessary to focus the cultivation and balance of the animal intestinal microbiota in the animal husbandry industry, and it has become the consensus of breeding farmers to improve the management of the animal intestinalota from controlling feed additives and food management. Yeast cell wall polysaccharides are macromolecular polysaccharide substances separated from yeast cell walls, and the βglucan, mannan, etc. in them are very important for improving the growth performance of animals and the microenvironment of the animal intestinal tract, and they have the of no toxicity and no residue. Adding yeast cell wall polysaccharides to animal feed can improve the balance and health of the animal intestinal microbiota from the perspective of food. Taking the freshwater aquaculture industry of crucian carp as an example, the diversified impact of yeast cell wall polysaccharides on the intestinal microbi of crucian carp is explored, which is of great value for optimizing the aquaculture feed of crucian carp and improving the aquaculture benefits of cruan carp.

### 1.1 Promote the proliferation of beneficial bacteria in the intestines

The application of yeast cell wall polysaccharides as additives in crucian carp aquaculture feed can promote the balance of theinal flora in crucian carp. In particular, mannose oligosaccharides in yeast cell wall polysaccharides can be digested and absorbed by bacteria in the intestinal flora of crucian carp, promoting the growth and proliferation of beneficial bacteria such as lactic acid bacteria and bifidobacteria in the intest flora of crucian carp, and depressing the generation of pathogenic bacteria while improving the growth and reproduction speed of beneficial bacteria.

At the same time, in the of crucian carp and the academic research of crucian carp breeding, it is clearly pointed out that moderate increase of yeast cell wall polysaccharide feed additive promote the proliferation of beneficial bacteria in the intestine. Among them, the reproduction of lactic acid bacteria in the intestinal tract of crucian carp can produce lactic, which can make the intestinal tract of crucian carp in an acidic environment to inhibit the colonization and growth of pathogenic bacteria. The reproduction and growth ofifidobacterium in the intestinal tract of crucian carp can produce a variety of antibacterial substances to inhibit the growth of pathogenic bacteria. At the same, the proliferation of such beneficial bacteria can continuously repair the intestinal mucosa of crucian carp and improve the health level of the intestinal tract of crucianp.

### 1.2 Favourable to inhibit the adhesion and colonization of pathogenic bacteria

The adhesion and colonization of pathogenic bacteria in the intestines of crucian carp can directly affect the stability of the intestinal microbi, while also damaging the intestinal mucosa of crucian carp, leading to intestinal diseases in

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crucian carp . It is known from studies that the type I fimbriae on the surface of common aquatic pathogens such as Escherichia coli and Salmonella can specifically recognize and bind to thenose receptors on the surface of intestinal mucosal epithelial cells. Mannose oligosaccharides in yeast cell wall polysaccharides can simulate such receptors bind to the type I fimbriae of pathogens, form complexes and be excreted with feces, thereby reducing the number of pathogens in the intestines. the research of crucian carp, it was also observed that after the addition of yeast cell wall polysaccharides, the number of pathogens such as Escherich coli in the intestines decreased significantly, reducing the risk of intestinal diseases in crucian carp.

### 1.3 Beneficial to regulate the diversity of intestinal flora

Intestinal microbiota diversity refers to the richness and balanced state of microbial species in the intestine, which directly affects the basic physiological functions disease prevention functions of crucian carp, especially for regulating the function of the immune system. Yeast cell wall polysaccharides have an important role in regulating the diversity intestinal microbiota in crucian carp because of their unique chemical structure and biological activity.

Among them, mannan oligosaccharides contained in yeast wall polysaccharides are an effective prebiotic, which can be absorbed and utilized by beneficial bacteria in the intestine, promoting the mass reproduction of beneficial bacteria, and the effect on some specific bacteria, specifically improving the diversity of beneficial bacteria in the intestine of crucian carp.

Meanwhile, in the breeding process of crucianp, intestinal microbiota disorders are prone to occur due to the abuse of antibiotics or stress issues. It is mainly manifested by the increase of the proportion of harmful bacteria in theine of crucian carp and the significant decrease in the number of beneficial bacteria. The application of yeast cell wall polysaccharides can improve the intestinal microbiota imbalance of crucian carp by promoting the proliferation of beneficial bacteria and inhibiting the colonization of harmful bacteria, reduce the growth of harmful bacteria pathogens, and repair the intest mucosa, restoring the advantage of beneficial bacteria.

### 1.4 Improve intestinal microbiota metabolites

The intestinal flora will form different metabolites such as short-chain fatty acids, ammonia, and indole in the metabolic, and various metabolites may affect the health status of the host. Among them, short-chain fatty acids such as acetic acid, propionic acid, and butyric acid belong to one of the important products of intestinal flora metabolism, which can provide energy for intestinal epithelial cells, ensure the effective growth and repair of the original damaged intest mucosa, and thus improve intestinal barrier function, and can also regulate immunity and inhibit inflammation to a certain extent. The application of yeast cell wall polysaccharides can the generation and accumulation of short-chain fatty acids, especially mannan oligosaccharides and beta-glucans, which provide high-quality energy for the growth and of bacteria in the carp intestine, promote the proliferation of beneficial bacteria, and promote the synthesis of such beneficial metabolites by beneficial bacteria.

In addition, under the condition intestinal flora imbalance, a variety of harmful bacteria proliferate and produce harmful metabolites, such as endotoxin, hydrogen sulfide, ammonia, etc. which have a serious impact on the intestinal mucosa of carp, and may also affect the function of other organs of carp through the circulatory system of carp The application of yeast cell wall polysaccharides can promote the growth advantage of beneficial bacteria and enhance the intestinal barrier function by using beta-glucans and mannan oligaccharides, prevent harmful bacteria from adhering to the intestinal mucosa, and inhibit the proliferation and colonization of harmful bacteria, and at the same time, promoting the growth advantage of beneficial bacteria, make beneficial bacteria and harmful bacteria compete for nutrients, reduce the proliferation of harmful bacteria, and then inhibit the production of harmful metabolites

## 2 The effect of yeast cell wall polysaccharides on the anti-stress ability of crucian carp

When breeding carp, it is inevitable to face various stress factors, such as water temperature changes, water quality deterioration, high density, transportation stimulation, etc . Different stress factors may cause physiological and biochemical changes in carp, such as increased levels of glucocorticoids, decreased immune function, metabolic disorders,., which will ultimately have an adverse effect on the growth and health of carp, and even serious problems such as carp death may occur. Yeast cell wall polysacides can effectively enhance the stress resistance of carp, ensuring that the adverse effects of stress response on carp are minimized.

### 2.1 Enhance immune function, improve disease resistance

Crucian carp immune function declines and disease resistance weakens due to stress factors. The breeding farmers should focus on enhancing the immune function of crucian carp and improving their disease resistance. The application of yeast cell wall polysaccharides as additives in crucian carp aquaculture feed can enhance immune function of crucian carp in multiple ways. For example, specific beta-glucan receptors in yeast cell wall polysaccharides can recognize and activate various immune in the crucian carp body.

Among them, macrophages are the core cells of the natural immune system of crucian carp. By using the betaglucan in yeast cell wall polysaccharides to bind to the receptors on the surface of macrophages, it can promote the activity of macrophages and release the lysozyme, enhance the immune function of macrophages, and effectively eliminate bacteria and viruses in the body of crucian carp.

At the same time, cell wall polysaccharides can promote the secretion of anti-inflammatory cytokines, such as interleukin and tumor necrosis factor, by activating local reactions, and maintain the immune balance of the crucian carp body.

### 2.2 Regulate stress-related hormone levels

When carp are exposed to stressful stimuli, the hypothalamus-pituitary-adrenal axis (HPA axis) will be activatedously, resulting in the large secretion of corticotropin-releasing hormone (CRH), adrenocorticotropic hormone (ACTH) andisol and other hormones. Among them, cortisol can effectively enhance the ability of fish to cope with stress response, moderate increase in cortisol can help fish through shortterm stress, but too much cortisol or too long time of improvement may damage the organism, resulting in carp with poor immune function or metabolic reduction and other issues .

The application of yeast cell wall polysaccharides regulates the activity of HPA axis through multiple pathways, such as the application of yeast cell wall polysaccharides improve the intestinal flora metabolite based, through the promotion of short-chain fatty acids and other beneficial metabolites, inhibiting the excessive excitement state of the hypothalam.

### 2.3 Improve metabolic status and maintain homeostasis of the organism

The stress response can lead to metabolic disorders in crucian carp, which are manifested by elevated blood glucose, accelerated protein decomposition, and abnormal metabolism. Metabolic disorders will consume a large amount of energy and nutrients, affecting the subsequent growth and development of crucian carp. However, yeast cell wall polysacchar can effectively regulate the intestinal flora, enhance the immune function of crucian carp, and ultimately improve the metabolic status of crucian carp under stress.

ly, yeast cell wall polysaccharides can optimize the proliferation of beneficial bacteria in the intestine, ensuring that the intestine absorbs and digests more nutrients, providing more and nutrients for the host, and ensuring that the energy consumption during stress is effectively supplemented . Secondly, yeast cell wall polysaccharides can reduce the inflammatory response by stress, ensuring that the metabolism of crucian carp is not affected by inflammatory factors. For example, adding yeast cell wall polysaccharides to crucian car under stress can maintain stable blood glucose levels, while reducing the products of protein decomposition metabolism such as urea nitrogen, improve the utilization rate of fat in the body of cruan carp, and minimize the growth inhibition caused by metabolic disorders.

### 2.4 Protect the intestinal barrier function

The intestinal barrier can ensure that fish effectively resist the invasion of harmful substances from the outside world, which can be refined into different dimensions such physical barrier, chemical barrier, biological barrier, immune barrier, etc. Stress factors may destroy the intestinal barrier to a certain extent, increasing intestinal permeability and providing opportunities for harmful substances such as pathogenic bacteria and toxins to enter the fish body, eventually triggering a systemic inflammatory response in fish or causing other diseases.

Yeast cell wall polysacchar can effectively maintain the balance of intestinal flora, while improving the development level of intestinal mucosa, to achieve the effect of protecting the function of intestinal barrier., it is reflected in the fact that beneficial bacteria can multiply in large quantities with the assistance of yeast cell wall polysaccharides, to block the colonization of pathogenic bacteria avoid damage to the intestinal biological barrier. Secondly, it is shown that beneficial bacteria can produce short-chain fatty acids, and such metabolites will increase the reproduction rate of epit cells in the intestinal mucosa, while promoting repair, so that the intestinal physical barrier is more perfect. Finally, it is shown that yeast cell wall polysacchar can increase the rate of development of intestinal mucosal immune system, so that antibodies such as immunoglobulin A (IgA) are further secreted, optimizing the function of intestinal immune barrier. When carp are

faced with stressful conditions, the addition of yeast cell wall polysaccharides can effectively reduce the degree of damage to intestinal barrier, reduce intestinal permeability, and thus reduce the invasion of harmful substances, to comprehensively resist the damage situation of carp affected by stress response

## 3 Factors affecting the action of yeast cell wall polysaccharides

The application effect of yeast cell wall polysaccharides in crucian carp feed is not fixed, but is affected by different factors and it is particularly important to clarify the impact of various factors. Among them, the addition dose of yeast cell wall polysaccharides is one of the important influencing, too low addition dose may lead to the expected regulation of intestinal flora, enhance the anti-stress ability and other effects are difficult to achieve, too high addition dose may the cost of feed, and even may cause problems such as poor growth of crucian carp. From the past research, the optimal addition dose of yeast cell wall polysacides is different, and this situation is related to the growth stage of crucian carp, breeding environment, feed composition and other factors.

Generally speaking, the intest and immune system of juvenile crucian carp are not fully developed, and the addition dose of yeast cell wall polysaccharides does not need to be too high to achieve effects. However, the addition dose of crucian carp needs to be moderately increased. In the actual breeding process, the best addition dose should be determined first according to the situation. For example, adding 0.1% - 0.3% yeast cell wall polysaccharides to crucian carp feed can effectively improve the structure intestinal flora of crucian carp, and at the same time enhance the anti-stress ability, but when the addition dose exceeds 0.5%, the of the effect is not obvious, and even there may be a problem of decreased growth performance.

## 4 Conclusion

To sum up, the addition of yeast cell wall polysaccharides in the crucian carp feed can effectively optimize the intestinal fl of the crucian carp, and improve the stress resistance of the crucian carp. Yeast cell wall polysaccharides can regulate the structure of intestinalora, promote the reproduction of beneficial bacteria, inhibit the adhesion of pathogenic bacteria, and maintain the balance of intestinal microecology. On this basis, it can also the immune system, enhance the immune response, and improve the resistance of crucian carp to a variety of stressors, and reduce the problems such as growth inhibition and susceptibility to disease caused by stress reactions. Therefore, the relevant farmers also need to explore in depth the application of yeast cell wall polysaccharides, in order to guarantee the farming situation of crucian carp to be continuously optimized.

## References

[1] Luo L ,Meng X ,Wang S , et al. Effects of dietary ginger (Zingiber officinale) polysaccharide on the growth, antioxidant, immunity response, intestinal microbiota, and disease resistance to Aeromonas hydrophila in crucian carp (Carassius auratus). [J]. International journal of biological macromolecules, 2024, 275 (P2): 133711.

[2] Yang L ,Chen H ,Kaziem E A , et al. Effects of Exposure to Different Types of Metal-Organic Framework Nanoparticles on the Gut Microbiota and Liver Metabolism of Adult Zebrafish. [J]. ACS nano, 2024, 18, 37, P25425–25445.

[3] Huang Y ,Chen Y ,Xie H , et al. Effects of Inducible Nitric Oxide Synthase (iNOS) Gene Knockout on the Diversity, Composition, and Function of Gut Microbiota in Adult Zebrafish. [J]. Biology, 2024, 13 (6): 372-372.

[4] Méndez F C L ,Gil G B ,Guerrero A , et al. Effects of Dietary Agavin on the Gut Microbiota of the Nile Tilapia (Oreochromis niloticus) Reared at High Densities [J]. Current Microbiology, 2024, 81 (11): 386-386.