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植物乳杆菌ST-Ⅲ脱脂乳的发酵工艺优化

Optimization of fermentation process in skim milk with ST-Ⅲ Lactobacillus plantarum

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中文摘要:

为研发富含植物乳杆菌ST-Ⅲ新型益生菌发酵乳制品，该试验尝试用植物乳杆菌ST-Ⅲ和嗜热链球菌共发酵，并对植物乳杆菌ST-Ⅲ发酵乳的工艺进行了优化研究。通过单因素试验分析了大豆多肽添加量、葡萄糖酸锰添加量、嗜热链球菌的接种量和发酵温度对发酵乳的pH值和植物乳杆菌ST-Ⅲ活菌数的影响。通过响应面法优化并确定了最佳工艺条件：大豆多肽添加质量分数11 g/kg；葡萄糖酸锰添加质量分数11 mg/kg；嗜热链球菌的接种量106 CFU/g；植物乳杆菌ST-Ⅲ的接种量106 CFU/g；发酵温度为37 ℃。在此优化最佳工艺条件下，发酵乳的植物乳杆菌ST-Ⅲ的活菌数为1.88×109 CFU/mL，有效地提高了发酵乳中植物乳杆菌ST-Ⅲ的活菌数。研究结果可为拓展植物乳杆菌ST-Ⅲ在乳制品领域的应用提供参考。

英文摘要:

Abstract: Fermented milk is increasingly used as a carrier of probiotics for their potential health functions. Because the concentration of viable probiotics is the key factor to health functions, it should be higher than the recommended concentration for probiotics (106 CFU/g). However, there are many products with low viability of probiotics in the market. It is very important and necessary for the milk industry to increase the count of viable probiotics in yogurt. In addition, survival during the passage through the gastrointestinal tract is generally considered a key feature for probiotics to preserve their expected health functions. However, the traditional yogurt starters (Streptococcus thermophilus and Lactobacillus bulgaricus) have weak tolerance to acid and bile salt and hence limit therapeutic effects. Lactobacillus plantarum has been demonstrated that it can survive in the human intestine and tolerate acid and bile salt. Moreover, it has a lot of precious therapeutic effects, such as precipitating and assimilating cholesterols, lowering blood sugar, diminishing inflammation and improving immunity. Hence, L.plantarum has become one of research hotspots in recent years. Lactobacillus plantarum ST-Ⅲ strain (CGMCC No.0847) is a probiotics and has ability to tolerate acid and bile salts as well as grow in the lower intestinal tract. It also be proved to have ability to precipitate and assimilate cholesterols in vitro and in vivo. However L.plantarum ST-Ⅲ strain is auxotrophic and has weak ability to grow in skim milk and clot milk by acidification. In this study, to increase the concentration of viable L.plantarum ST-Ⅲ and elucidate the factors restricting growth of L.plantarum ST-Ⅲ in skim milk, the fermentation conditions were researched and optimized.The effects of soybean polypeptide concentration, manganese gluconate concentration, inoculum size of S. thermophilus and fermentation temperature on the pH and living cell count of L.plantarum ST-Ⅲ of fermented milk were evaluated by single-factor experiment. The results showed that soybean polypeptide concentration, manganese gluconate concentration and inoculum size of S. thermophilus could significantly affect the growth and metabolism of L.plantarum ST-Ⅲ ($P<0.05$). However, the effect of fermentation temperature (35-39℃) on the growth of L.plantarum ST-Ⅲ was not significant ($P>0.05$). Soybean polypeptide concentration, manganese gluconate concentration and inoculum size of S. thermophilus were further studied using a three-variable, three-level Box-Benhnken design to optimize the fermentation conditions. The date was analyzed with the software Design Expert 8.0. The results indicated that the fermentation conditions model had an extremely significant effect on predicting the result of the test. Moreover, a significant interaction between soybean polypeptide concentration and manganese gluconate concentration was observed. Results of the response surface optimization test showed the optimal fermentation conditions were: soybean polypeptide concentration was 11 g/kg; manganese gluconate concentration was 11 mg/kg; inoculum size of S. thermophilus was 106 CFU/g; fermentation temperature was 37 ℃. In this optimal fermentation conditions, the verification tests demonstrated that the actual living cell count of L.plantarum ST-Ⅲ was 1.88×109 CFU/mL. In addition, the verification tests showed that in the optimal fermentation conditions the fermented milk with L.plantarum ST-Ⅲ had the best sensory properties, such as uniform coagulation state, less whey separation, pure and strong flavors. The optimal fermentation conditions greatly increased the living cell count of L.plantarum ST-Ⅲ in fermented milk and improved health functions of fermented milk.

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