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高活菌数复合益生菌发酵乳工艺优化

Optimization of fermentation conditions of milk with blend probiotic strains based on high viable count

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中文摘要:

益生菌发酵乳中的活菌数是保证其功能特性的关键因素，为提高益生菌发酵乳中的活菌总数，以干酪乳杆菌和双歧杆菌复合菌种为试验对象，以发酵过程中的pH值和吸光度平均值值为试验指标，在单因素试验的基础上，利用 Box-Benhnken中心组合试验和响应面分析法研究了接种量、益生菌接种比例、发酵温度、葡萄糖添加量以及大豆多肽添加量对发酵乳pH值和活菌数的影响，并建立了复合益生菌发酵模型。响应面优化试验结果表明复合益生菌发酵的最佳工艺条件是脱脂乳乳固体质量分数为12%,接种量为6%，干酪乳杆菌：双歧杆菌接种体积比为3∶1，葡萄糖添加量为2.9%，大豆多肽添加量为0.8%，发酵温度为34℃，在此条件下预测值为1.076，验证试验得到实际值为1.087，与理论预测值相比，相对误差为1.0%。发酵乳最大活菌数为4.1×1011 cfu/mL，与已有研究相比，活菌数提高了1-2个对数级。在4℃条件下贮藏21 d后，发酵乳的活菌数仍然保持在4.7×1010 cfu/mL。研究结果为工业化生产高活菌数的益生菌饮料提供参考。

英文摘要:

Abstract: The viable probiotic count is the key factor to functionality of fermented milk. It is very important for the milk industry to improve the number of viable bacteria in its final products. Lactobacillus casei and Bifidobacterium were blended using them as a starter culture for fermented milk to achieve a high viable probiotic count. Lactobacillus casei and Bifidobacterium were studied and a high density culture technology of Lactobacillus was applied to increase the number of viable bacteria in the fermentation system. Determination of the absorbance method was used to assess the viable count of probiotics in fermented milk in which the calcium ion would combine with salt under alkaline conditions to make fermented milk dispersed evenly in a solution state. Ethylenediamine Tetraacetic Acid (EDTA) was selected as a chelating agent to chelate the calcium ion in the fermented milk, and to make the solution clarify. The OD value of the bacteria did not change significantly after entering the stable phase, and the number of viable probiotics count in the fermented milk achieved the maximum. The OD value of fermented milk in this study did not change significantly from the second day of fermentation. On this basis, OD value was measured for three consecutive days from the second day, and the average OD value was used as indicator of the viable probiotic count.Inoculation volume、ratio of probiotics strains、added glucose,、added soybean peptide, and fermentation temperature were studied as a single factor affecting the number of viable bacterium in the fermented milk. Results show that the average OD value at different inoculation volume was not significant (P<0.01) while the other four factors were highly significant (P>0.01). The ratio of probiotics strains in blend culture、glucose level、soybean peptide level, and fermentation temperature were further studied using a Box-Benhnken design to optimize the fermentation technology. The results were analyzed with the software Design Expert to 8.0. Results indicated that the fermentation system model had an extremely significant effect on predicting the result of the test. The studied factors had significant effects on the average OD value of fermented milk. Results of the response surface optimization test showed that the optimal fermentation condition was: inoculation volume was 6%, the mass fraction of kim milk solid was 12%, the ratio of Lactobacillus casei and Bifidobacterium in blend culture was 3:1, glucose level was 2.9%, soybean peptide level was 0.8%, and fermentation temperature was at 34℃. The predicated average OD value was 1.076 with the optimal fermentation condition, and the verification tests demonstrated that the actual value was 1.087, the relative error was 1.0% compared with the predicated value. The verification tests also showed that the coagulation state of fermented milk was uniform, with less whey separation, and that there was a rich fermented milk flavor, pure without a peculiar smell. The maximum number of viable probiotics count was 4.1×1011 cfu/mL., which is 78.3% higher than the maximum number of viable count (2.3×1011 cfu/mL) before the optimization process. When stored under 4℃ after 21 d, the number of viable probiotics count remained at 4.7×1010 cfu/mL. The research result could be used as a probiotic fermentation technology applied to production of probiotic beverages. In addition, it was applied to the industrialized production of probiotic strains used in common acid milk production. Thus, the result greatly increased the viable count of probiotic in the fermented milk and improved functional properties of the product.

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