琉球大学学術リポジトリ

Coryneform bacteria strain C-8 の生成する粘質多糖の利用に関する研究 : 多糖を安定剤として含む水羊羹の物理的性質(農芸化学科)

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Studies on the Application of Polysaccharide Produced by Coryneform Bacteria Strain C-8
1. Physical properties of sweet bean jelly containing the polysaccharide as a stabilizing agent

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Summary

Water-holding capacity, hardness and adhesiveness of sweet bean jelly containing polysaccharide produced by coryneform bacteria strain C-8 as stabilizing agent was investigated.

Rate of syneresis of 0.5% polysaccharide C-8 showed the lowest value. This result implied that water-holding capacity of polysaccharide C-8 was superior to those of other polysaccharides.

Hardness of the sweet bean jelly containing polysaccharide C-8 showed higher value than that of guar gum. On the other hand, adhesiveness of it showed lower value than that of guar gum.

From these results, it seems that polysaccharide C-8 is probably effective on stabilizing of the gel.

Introduction

Various fundamental and applied studies on bacterial polysaccharide have been done since dextran by *Leuconostoc mesenteroides* was applied in many industries. Especially as for the xanthan gum produced by *Xanthomonas campestris* NRRL B-1459, its uses for various purposes have been developed and put to practical use[1]. Harada et al. have reported on succinoglucan[2] and curdlan[3] produced by *Alcaligenes faecalis*, and Ninomiya et al. on the polysaccharide produced by *Bacillus polymyxa*[4].

Nagahama et al. screened bacteria which produced viscous polysaccharide in the factories of sweet potato starch manufacturing, located in Kyushu districts. They separated the bacteria which produced high viscous polysaccharide and identified that it was coryneform bacteria strain C-8. And they clarified the chemical compositions of polysaccharide C-8 in a ratio of D-mannose : D-glucose : D-galactose : D-glucuronic acid : pyruvic acid = 1 : 1 : 1 : 3 : 1[5].

In previous papers[6, 7], authors reported on the rheological properties of polysaccharide C-8 produced by coryneform bacteria strain C-8. The viscosity of polysaccharide C-8

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showed as high as the value of guar gum which was one of the highest viscous polysaccharide, and seemed to be essentially independent on pH 6~9, and was insensitive to heating for 30 minutes at 80 ℃. Polysaccharide C-8 was excellent in characteristic of emulsion-forming and filming. The behavior of non-Newtonian flow and dynamic viscoelasticity of polysaccharide C-8 were consistent with that of guar gum. The viscosity and dynamic voscielasticity of a mixed solution of polysaccharide C-8 and gelatin showed higher values than polysaccharide C-8 itself[8].

The present paper describes physical properties of sweet bean jelly containing polysaccharide C-8 as stabilizing agent.

Materials and Methods

1. Preparation of polysaccharide

Coryneform bacteria strain C-8 was inoculated into a liquid culture medium (3.0% glucose, 0.25% yeast extract, 0.1% KH_2PO_4, 0.1% $MgSO_4 \cdot 7H_2O$, 100 ml) in a conical flask from agar slant, and cultivated on the rotary shaker (245 rpm) for 24 hrs. at 35 ℃ for a seed culture. The composition of a preparative culture medium was 4.0% of soluble starch and the others were as same as seed except glucose, and cultivated from a 5% seed in a 15-liter jar-fermentor (Kanto Rikaki) with a working volume of 10 liter. It was aerated on 1 vvm, and was stirred at 100 rpm for 24 hrs. and after that increased to 340 rpm at 32 ℃. As for the culture, 25g of calcium carbonate was added first, 50g of it was added 24 hrs. later, and further 15 ml of soy bean oil was dropped.

After being cultivated for 96 hrs., the culture broth was diluted with double volume of water and continually centrifuged at 10,000 rpm. Then equal volume of aceton was added to the supernatant solution, and the precipitate was filtered off and dried in vacuo. During the purification of polysaccharide, crude polysaccharide solution (0.2 %) was centrifuged after heating at 80℃ for 20 min. and solid was removed. The supernatant was filtered off through Celite 545 layer, and cation was removed through Amberlite IR 120(H) then neutralized with 0.1 N NaOH. Then in the presence of 1.0% NaCl, double volume of ethanol was added, and polysaccharide was precipitated and was dried in vacuo.

The viscosity of polysaccharide C-8 showed 550 cp at 0.5% concentration, and the molecular weight was calculated about 251,000 by viscometric method[6].

2. Control polysaccharides

Guar gum, sodium alginate, carrageenan and xanthan gum (Taiyo Chemical Eng. Co. Ltd.) were used as control.

3. Measurement of water-holding capacity[9]

The water-holding capacity of polysaccharide C-8 was carried out by ascending paper chromatography. This experiment was also carried out on guar gum, sodium alginate, carrageenan and xanthan gum.

The end of filter paper (No. 51, 2×400mm, Toyo Roshi) was dipped in 0.5 % polysaccharide solution and developed for an hour. The moistured length from the starting line

on the filter paper was measured.

4. Preparation of sweet bean jelly

Polysaccharide C-8 and guar gum were used as stabilizing agents respectively. Sweet bean jelly was prepared as follows: 110g of powder of Azuki (Hashimoto Food Industry), 150g of sucrose (Meiji Sugar Mfg.) and 4g of agar were heated with 375 ml of water, Then 25g of base of sweet bean jelly was added in an aluminium-cup (diameter; bottom, 5.0 cm, top, 5.6 cm) which contained 5 ml of polysaccharide C-8 and guar gum solution to give final concentration of 0.1, 0.2 and 0.3 %, and viogrously stirred, respectively. Then the jelly was left for three hrs. at room temperature.

5. Measurement of hardness and adhesiveness

A texturometer (Zenken, Model GTX-2) was used to measure hardness in a Kg unit and adhesiveness in a texturometric unit (T.U.).

Conditions for measurements were as follows:

Nickel plunger; 12mm in diameter
Clearance; 1mm
Voltage; 1.0V
Chart speed; 750mm/min.
Height of sample; 18mm.

Results

1. Water-holding capacity

The filter paper was dipped in solutions of 0.5% polysaccharide and developed for an hour, then the length of moisture on the filter paper was shown in Table 1.

Table 1 Rate of Syneresis of Polysaccharide C-8

Polysaccharide	Rate of syneresis, % *
Polysaccharide C-8	3.0
Carrageenan	4.3
Guar gum	4.6
Xanthan gum	5.5
Sodium alginate	7.7

* developed length of moisture/full length of filter paper
Rates of syneresis of polysaccharides were measured in 0.5% aqueous solutions of them.

Absorption factor of water of polysaccharide C-8 showed the lowest value(3.0%), and guar gum showed lower value(4.6%) than those of xanthan gum(5.5%) and sodium alginate(7.7 %).

2. Rate of syneresis

Since it was proved that water-holding capacity of polysaccharide C-8 was superior to those of the control polysaccharides, sweet bean jelly was prepared by adding polysaccharide C-8, or guar gum to estimate the effect on water-holding capacity. Rate of syneresis of sweet bean jelly was measured as follows: sweet bean jelly containing each concentration of polysaccharide C-8 was put on seven pieces of overlapped filter paper (diameter; 8.0cm, Toyo Roshi) for an hour. Increased weight of the filter paper was weighed and shown in Fig. 1. At 0.05% of polysaccharide C-8 and guar gum, absorption factor of

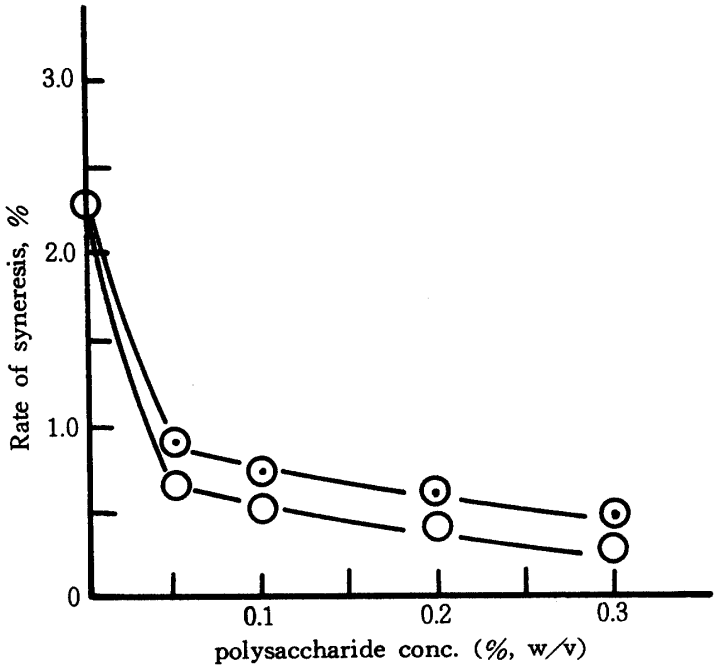

Fig. 1. Rate of syneresis of sweet bean jelly containing polysaccharide C-8
○: polysaccharide C-8
⊙: guar gum

water of them rapidly decreased, however, as increasing the concentration of polysaccharide, they gradually decreased and showed 0.25% (polysaccharide C-8) and 0.5% (guar gum) at 0.3% concentration, respectively. From these results, it was found that water-holding capacity of polysaccharide C-8 was superior to that of guar gum.

3. Hardness and adhesiveness

Hardness and adhesiveness of sweet bean jelly containing polysaccharide C-8 was measured with a texturometer and shown in Fig. 2(A) and (B). Hardness(A)of sweet bean jelly containing polysaccharide C-8 showed higher value (8.0 Kg)than that of the guar gum one (6.3Kg) at 0.3% polysaccharide concentration. On the other hand, adhesiveness(B) of it containing polysaccharide C-8 showed lower value (0.35 T.U.) than that of the guar gum one (0.42 T. U.).

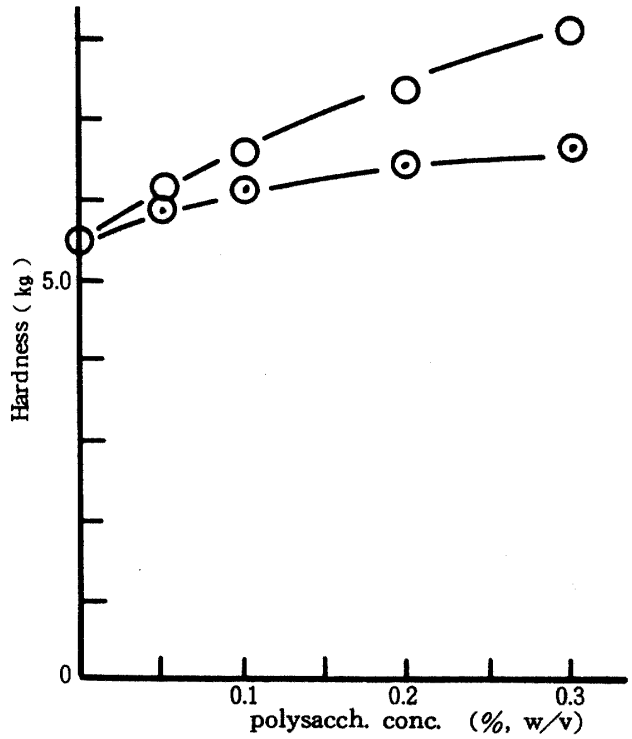

Fig. 2(A). Hardness of sweet bean jelly containing polysaccharide C-8
○ : polysaccharide C-8
⊙ : guar gum

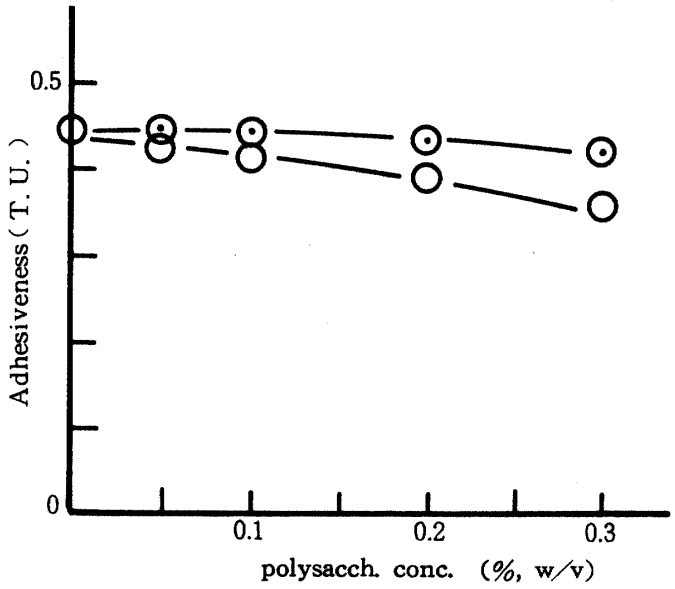

Fig. 2(B). Adhesiveness of sweet bean jelly containing polysaccharide C-8
○ : polysaccharide C-8
⊙ : guar gum

Discussion

Food gels usually contain substantial amounts of polysaccharides which has important functional effects on the gel. In the formation of gel, polysaccharides act as a plasticizer to allow greater separaption of the polymer chains, and it compete with the polymer for water, thereby reduces the solubility of the polymer. In the cases when those effects are complementary, the result is to increase the elastic properties of the gel.

It is well known that agar is used as a gelling agent in a food, however, its gelling capacity is not so high that a food containing it occurs syneresis easily. Consequently, such supplemental polysaccharides are generally used for food gels[10]. As guar gum is used as stabilizing agent for food gels, we used it as one of the control polysaccharide in this experiment.

Rate of syneresis of 0.5% polysaccharide C-8 showed the lowest value. This result implies that water-holding capacity of it is superior to those of other polysaccharides. Since it was proved that water-holding capacity of polysaccharide C-8 was superior to that of other polysaccharides, sweet bean jelly was prepared by adding polysaccharide C-8 as stabilizing agent and measured its physical properties of the jelly. Water-holding capacity of sweet bean jelly containing polysaccharide C-8 was superior to that of guar gum. Hardness of sweet bean jelly containing polysaccharide C-8 showed higher value than that of guar gum. On the other hand, adhesiveness of the former showed somewhat lower value than that of the latter. These results imply that texture of sweet bean jelly containing polysaccharide C-8 is more favorable than guar gum. It seemed that polysaccharide C-8 was able to be applied in the food industry.

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References

1. Jeanes, A., Pittsley, J. E. and Senti, F. R. 1961 A new hydrocolloid polyelectrolyte produced from glucose by bacteria fermentation, J. Applied Polymer Science, **5**: 519~526
2. Harada, T., Yoshimura, T., Hidaka, H. and Koreeda, A. 1965 Production of a new acidic polysaccharide, succinoglucan by *Alcaligenes faecali* var. *myxogenes*, Agr. Biol. Chem., **29**: 757~762
3. Harada T., Masada, M., Fujimori, K. and Maeda, I. 1966 Production of a firm, resilient gel-forming polysaccharide by a mutant of *Alcaligenes faecalis* var. *myxogenes* 10C3, ——————— **30**: 196~198
4. Ninomiya, E., Kizaki, S. and Hanada, K. 1968 High viscous polysaccharide produced by a spore-forming bacterium, Nippon Nogeikagaku Kaishi, **42**: 178~184
5. Nagahama, T., Fujimoto, S. and Kanie, M. 1977 Isolation of the viscous producing coryneform bacteria and their bacteriological characteristics, Agr. Siol. Chem., **41**: 9~16
6. Tako, M., Nagahama, T. and Nomura, D., 1977 Some rheological properties of the vis-

cous polysaccharide produced by coryneform bactera strain C-8, Nippon Nogeikagaku Kaishi **51** : 389～395

7. ———— 1977 Flow properties of the viscous polysaccharide produced by coryneform bacteria strain C-8, ———— **51** : 397～403
8. ———— 1977 Synergistic effect of gelatin on the viscous polysaccharide produced by coryneform bacteria strain C-8, Nippon Shokuhin Kogyo Gakkaishi, **24** : 565～569
9. Ninomiya, E., kizaki, T. and Hanada, K. 1967 Properties of a new microbial polysaccharide, ———— **14** : 438～443
10. Glicksman, M. 1969 Food science and technology, P 46, New York, Academic Press

Coryneform bacteria strain C−8 の生成する粘質多糖の利用に関する研究−多糖を安定剤として含む水羊羹の物理的性質

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要　　約

Coryneform bacteria strain C−8 の生成する多糖を安定剤として含む水羊羹の保水性，硬さおよび粘着性について調べた。

0.5 %C−8多糖水溶液の離水率は最も低かった。このことは，C−8 多糖は対照多糖類に比較して保水性が高いことを示している。C−8 多糖を含む水羊羹の硬さは対照 のグアーガムのそれより高い値を示し，一方，粘着性は低い値を示した。

これらの結果から，C−8 多糖は食品工業への利用の可能性が示唆された。

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