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Development of Sweet Potato Conditioner

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Abstract ***Domestic sweet potato-processed products are in a very poor condition. However, various processed products are sold in Japan. Therefore, it is very urgently required to develop various processed products in application of processing technology that is appropriate with a kind of sweet potato. Under these circumstances, the development of grain syrup with rich amount of antioxidants and dietary fiber in the use of sweet potato as a health food seems to be an appropriate alternative sweetener for contemporary men.***

It is intended to analyze nutrient of a developed product throughanalysis of sugar in the use of HPLC, sweet potato diastatic ingredients of sweet potato in the use of malt and enzyme process, and analysis of total flavonoid of sweet potato grain syrup.

New technical direction has been suggested though scientific analysis while diversifying materials of grain syrup as a traditional food by developing 100% sweet potato grain syrup that is standardized with quality with improved productivity after applying commercial enzyme with nutritionally outstanding sweet potato and enriched amount of dietary fiber and starch. In addition, it is intended to develop grain syrup with enriched amount of dietary fiber and antioxidants in the use of domestically produced sweet potato and export/commercialized them.

It is possible to increase the use of sweet potato, promote consumption of sweet potato, and enhance value-added by using by-products from processing sweet potato. At the same time, it is possible to help develop products in the use of nutritionally outstanding sweet potato to contribute to improve productivity of sweet potato grain syrup and also the quality of them.

Keywords**:** Dietary fiber, Starch, Enzyme,grainsyrup, Sweet potato sauce, Chromatogram

1.Introduction

Diet effect of sweet potato against obesity recently increased according to western diary life and function on prevention of constipation with sweet potato have been well-advertised to consumers promoting the consumption of it. However, according to the increasing trend of production of sweet potato, there is a concern on excessive production [1,2]. Domestically processed sweet potato product is in a very poor quality. However, domestic sweet potato-processed products are in a very poor condition. However, various processed products are sold in Japan. Therefore, it is very urgently required to develop various processed products in application of processing technology that is appropriate with a kind of sweet potato. Under these circumstances, the development of grain syrup with rich amount of antioxidants and dietary fiber in the use of sweet potato as a health food seems to be an appropriate alternative sweetener for contemporary men [3,4]. Sweet potato has a rich amount of dietary fiber and antioxidants. As sweet potato has rich amount of dietary fiber and starch, grain syrup developed in the use of nutritionally outstanding sweet potato is judged to be a competitive health food in domestic and also foreign market. For this, there is a necessity to conduct a research to improve productivity efficiency and standardize the quality of sweet potato grain syrup [5,6].

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2.Current Status of Development of Related Technology

It is estimated that the majority of the sweet potatoes are consumed in small quantities at home. Produced sweet potatoes are used not only as potatoes but also as brown rice or regular white rice. No specific statistics have been collected for grain syrup markets in foreign countries, but grain syrup is classified into group of malt. At the same time, is expected that they will be exported and consumed mainly in Asia (China, Japan) sharing similar food culture. As of now, no specific products as pure sweet potato syrup have been found. Although grain syrup has higher raw material costs and prices than other sugar substitutes, consumers are responding with higher functionality[7,8]. Domestic sweet potato products are developed by small companies mostly by adding about 20% of sweet potatoes to brown sugar, and 100% pure sweet potato grain syrup is not produced. In the case of commercially available rice syrup and sweet potato grain syrup, malt is used as a diastatic enzyme source. The maltose contains other enzymes besides the diastatic enzyme. At the same time, since the diastatic activity is not constant for each product, the diastatic process is has not been well standardized. In addition, since it is activated in a lower level compared to industrial enzymes, it takes much time for diastaticprocedure[9,10]. In the process of concentration after diastatic procedure, severe browning and nutrient destruction occurs due to the concentration method from heating by stirring for a long time at a temperature of 100°C or higher in a heating pot. In this study, it is feasible to standardize the product and the process by using purified industrial enzymes with constant enzyme activity, and the production time is shortened to the one-third compared with the conventional method. The browning rate and the destruction rate of nutrients are very low that they have outstanding merchantability[11,12].

3.Contents of Research Performance

HPLC analysis conditions for the sugar analysis in this

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study are as follows.

- -Instrument: HPLC
- -Model: Waters 600
- -Column: Sugar pak(Waters)
- -Column Temperature: 85℃
- -Slovent: Deionized Water
- -Flow rate: 0.6㎖/min
- -Detector: Waters R401 Differential Refractometer

3.1. HPLC analysis of D-glucose and maltose

Sigma's glucose and maltose for HPLC were used as a standard for the assay. 1% D-glucose and 1% maltose were prepared and injected with 20 μl each by HPLC followed by identifying the sugar contents by chromatography. Peak was observed about 8.25 minutes after injecting 1% glucose, and peak was also observed about 6.65 minutes after injection of maltose. In addition, when the same amount of each sample was mixed and injected, each peak was observed at the same time as shown in Fig. 1

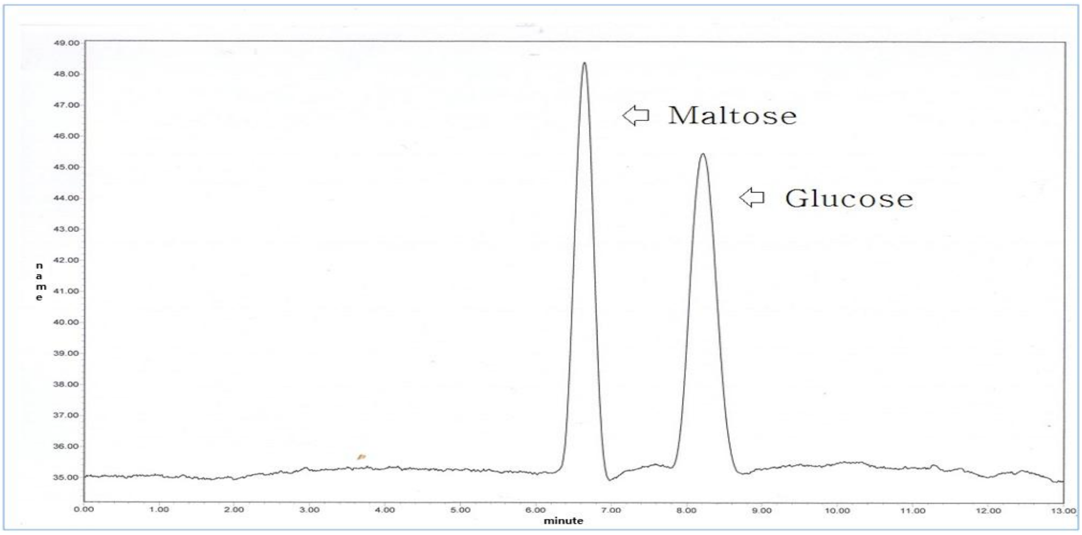

Figure 1. Chromatography ofD-glucose and maltose

3.2. Sugar analysis of sweet potato for processing appropriateness

The sugar analysis of red sweet potato and pumpkin sweet potato was performed using HPLC. Chromatograms of red sweet potato and pumpkin sweet potatoes turned out to be almost similar. Oligosaccharides eluted at 4th minute in both sweet potato samples, and maltose was eluted at the 6th minute, and glucose was hardly produced during fermentation of sweet potatoes. In addition, the sweetness of sweet potatoes was found to be from maltose. Based on the aforementioned results, it was found that pumpkin sweet potatoes are suitable for the production of sweet potato sauce s in this study as they had higher sugar amount yet with the same sugar contents contained in both types of potatoes. Figure 2indicates chromatogram of sugar analysis between red sweet potato and pumpkin sweet potato.

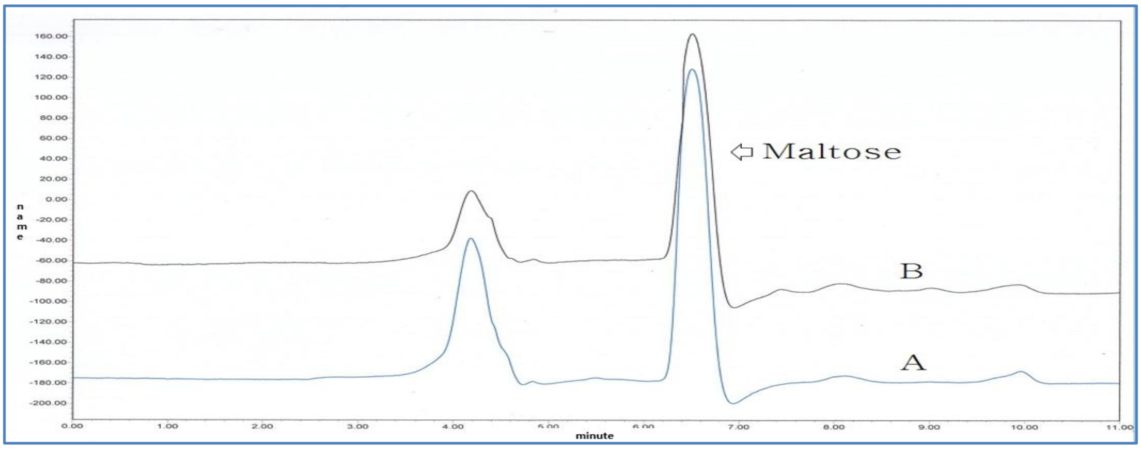

Figure 2. Chromatogram comparing the sugar analysis between red sweet potato and pumpkin sweet potato

(A: Red sweet potato B: Pumpkin sweet potato)

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3.3. Analysis of sweet potato diastatic substances from enzyme process

3.3.1. Analysis of Termamyl L type 120 L processing sample

As shown in Fig. 3, 120 g of Termamyl L type, which corresponded to about 0.15% of the weight of sweet potato, was added to the paste suspension of sweet potatoes and reacted at 95°C for 1 hour and centrifuged at 13,000 rpm for 10 minutes. According to the results, oligosaccharide and the maltose turned out to be the major products on the fourth and sixth minute, respectively, and the glucose was almost not produced at all as it was a tiny amount on the eighth minute.

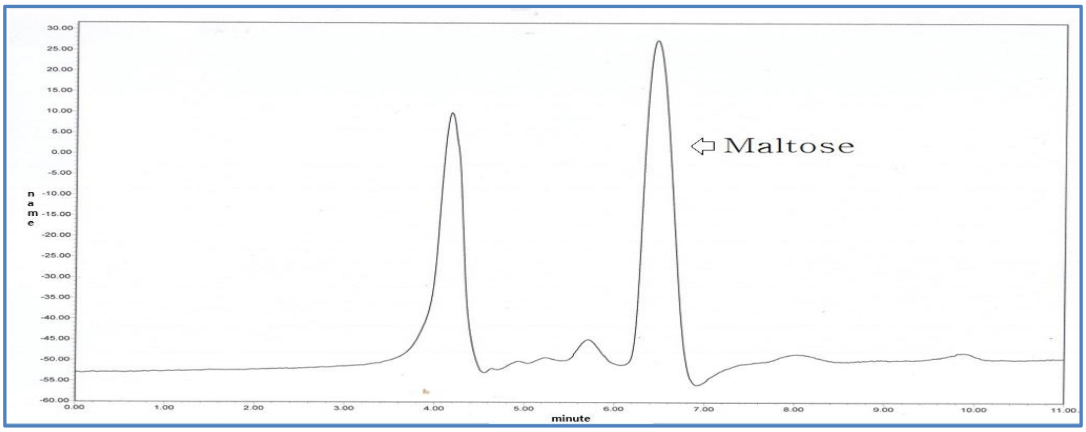

Figure 3. Chromatogram of sweet potato diastatic treated with Termamyl L type 120 L

3.3.2. Analysis of Fungamyl 800L processing sample

As shown in Fig. 4, Fungamyl 800L, which corresponds to about 0.15% of the weight of sweet potato, was added to the paste suspension of sweet potatoes and reacted at 60°C for 12 hours. After centrifugation at 13,000 rpm for 10 minutes, the supernatant was analyzed. As a result, Fungamyl800L turned out not to be significantly different from the result of Termamyl L type 120 L treatment in the overall chromatogram as a enzyme for manufacturing high maltose syrup.

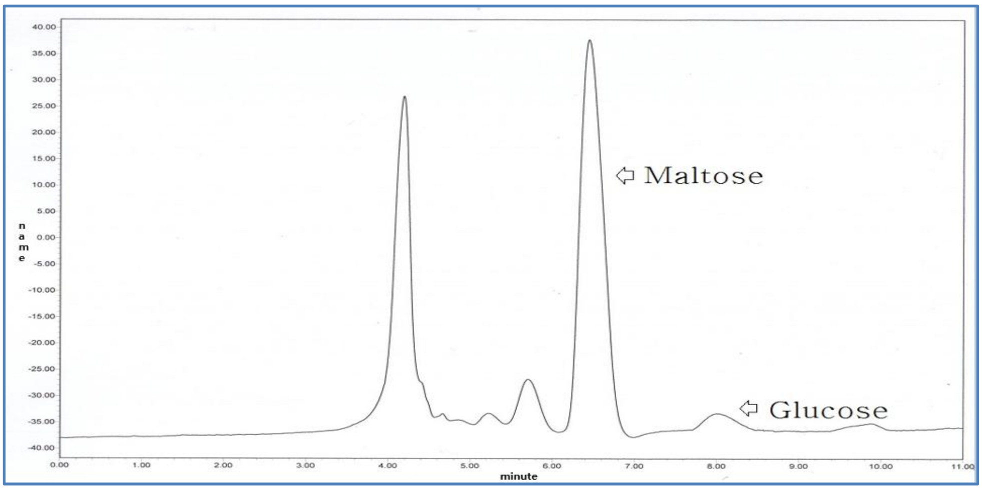

Figure 4. Chromatogram of sweet potato diastatic treated with Fungamyl 800L

3.3.3. Analysis of diastatic substances in the use of malt

First of all, 5% of the sweet potato weight was immersed in warm water for 1 hour in advance and filtered with a nonwoven fabric. Afterwards, filtrate was added to the sweet potato paste suspension. The diastatic reaction proceeded at 60°C for 24 hours. After the diastatic reaction, the nonwoven fabric was again filtered and centrifuged at 13,000 rpm for 10 minutes, and the supernatant was analyzed. Figure 4 shows the result of sugar content analysis of sweet potato carbohydrate prepared with malt. Compared with the previous chromatograms, glucose and maltose showed a similar pattern to the chromatogram of the sweet potato glycation solution treated with the combination of Termamyl 120L and AMG 300L. In maltose and maltotriose, a similar result was shown when treated with the combination of combination of Termamyl 120Land Fungamyl 800L, respectively.

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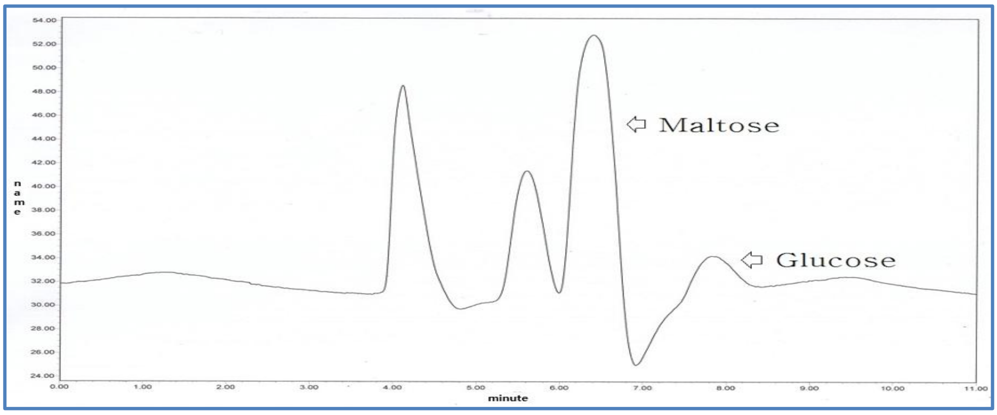

Figure 4. Chromatogram of sweet potato diastatic solution treated with Termamyl 120L andFungamyl 800L

In this study, diastatic substances containing maltose as a main component were obtained by separately using or simultaneously treating Termamyl 120L and Fungamyl 800L, and the combination of Termamyl 120L and Fugamyl 800L together with AMG 300L resulted in maltose and glucose applied as the main components. On the other hand, the result when using the traditional rice syrup was treated with the malt was similar to that of the combination of Termamyl 120L and Fungamyl 800L. Termamyl 120L and Fungamyl 800L were mixed with sweet potato diastatic solution and Termamyl 120L and AMG 300L. The results showed that sweet potato diastatic solution treated with Termamyl 120L and AMG 300L turned out to be sweeter and softer, In this study, enzyme for the production of sweet potato starch was decided to be used and produced by treating Termamyl 120L and AMG 300L in order.Figure 5 indicates chromatogram analyzed per sweet potato sauce developed in this study.

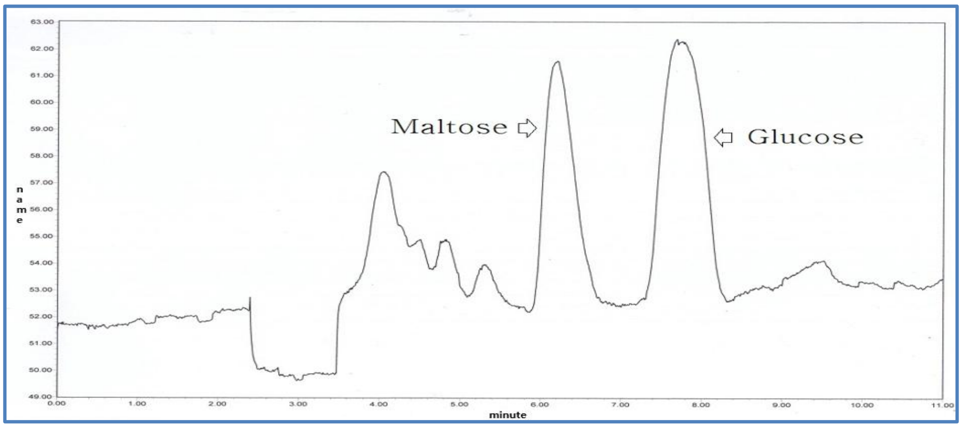

Figure5. Chromatogram analyzed per sweet potato sauce developed in this study

3.3.4.Analysis of total flavonoid of sweet

Total flavonoid was prepared by adding 0.1 ml of 10% aluminum nitrate (Sigma-Aldrich Co.), 0.1 ml of 1 M potassium acetate (Sigma-Aldrich Co.) and 4.3 ml of 80% ethanol to 0.5 ml of the sample according to the method of Moreno et al. followed by leaving them at room temperature for 40 minutes and measuring absorbance at 415 nm. As a standard, quercetin (Sigma-Aldrich Co.) was prepared at a concentration of 0 to 100 μg / ml and analyzed in the same manner as the sample. Total flavonoid content of the extract was calculated from the standard calibration curves.

The total flavonoid content of sweet potatoes prepared in this study turned out to be 8.8 mg / 100g. The total flavonoid content of sweet potatoes purchased from the market turned out to be 2.3 mg / 100g. Showed a high total flavonoid content close to 4 times

3.4. Browning Rate Measurement

The chromaticity of the sweet potatoes prepared in this study was adjusted to the same concentration in the identical container with the sweet potato paste and the traditional rice syrup, Afterwards, using the colorimeter (TES-135A, TES electrical electronic corp, Taiwan) corrected with the standard white board (L=95.07, a=-1.350, b=1.222), lightness (L), redness/greenness (a), and yellowness/blueness (b) were measured. According to the results of comparing chromaticity of three samples as shown in the table 1, there was a huge difference on lightness, and there was a significant difference in redness/greenness and yellowness/blueness.

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The browning rate was determined by appropriately diluting each sample to the same concentration according to the method of Kim et al. (Kim, Yoon Sook et al., 2009). Afterwards,absorbance was measured and compared in the scope of measurement for browning at 420nm by using a spectrophotometer (Gene Spec II, Naka Instrument Co. Ltd. Japan). The rate of increase of absorbance was 27% for sweet potatoes and 79% for traditional rice syrups. Therefore, the low temperature decompression concentration process at 52℃ in the sweet potato production process utilized in this study is lower than the chewing process at 100 ℃ It was found that the browning rate was remarkably low as the temperature rapidly progressed.

Table 1. Comparison of absorbance and chromaticity among sweet potato paste, sweet potato grain syrup, and traditional rice grain syrup.

Sample	Absorbance (420nm)	Chromaticity		
		L	a	b
Sweet potato paste	0.153	30.01	2.19	19.64
Sweet potato grain syrup	0.195	11.38	-6.60	7.39
Traditional rice grain syrup	0.274	9.52	4.32	5.80

4. Conclusion

The purpose of this study is to develop the processing technology of sweet potatoes specifically by using commercial enzymes. By utilizing the byproducts made out of sweet potatoes, it is possible to improve the utilization of sweet potatoes, promote the consumption of sweet potatoes and enhance the value-added, contribute to an increase of production yield as well as quality of sweet potatoes. In addition, sweet potato can be applied to the farmyard processing site of grain syrup to improve the productivity and quality improvement as well as the farm income. Therefore, the technologies adopted for farming use will be applied to farming-type processing technology field. At the same time, after the field application verification test, it is scheduled to support farming field with new technology pilot project and apply/transfer the technology to the food industry.By applying the technology developed in this study to other starch foods including rice, it is feasible to improve the utilization of the cereal grains as well as the added value. This will help improve the farm income as well. In addition, since it has the effect of alleviating the severe browning, a disadvantage of the existing control, and greatly reducing the high production cost, it can be anticipated to have a positive effect in the field application. In addition, dietary fiber and antioxidants are abundant. Therefore, it is expected to expand the scope of application to the whole food industry including bakery as well as sales of it as a substitute sweetener to general consumers.

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