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Studies on the Components of Korean *Panax Ginseng* C.A. Mayer

Part. I On the Content of Starch, Size Frequency Distribution of Starch Granules, Amylose Content and Blue Value.

by

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한국인삼 성분에 관한 연구

제 1 보 전분함량, 전분의 입경분포, amylose함량 및 blue value에 대하여

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Abstract

The variation of the amount of starch, size and shape of the starch granules, amylose content, and blue value of the starch in the Korean ginseng roots from one year old to five year old cultivated at Kumsan was studied. The results obtained were as follows;

1) The starch content of the ginseng root(dried) was increased with the age of the root; that is, 9.62% for one-year-old roots, 10.35% for two-year-old root, 15.50% for three-year-old root, 17.05% for four-year-old root, and 18.32% for five-year-old root.
2) The shape of the ginseng starch granules was round or short oval, and in the latter case the ratio of minor axis to major axis was 1 to 1.1. Diameter of the starch granules was in the range of 1.48 μ to 8.14 μ and the most frequent granule size was 3 μ (32.1~35.7%). The number of big size starch granules was increased during the five years of growing, while, the number of small size granules was decreased.
3) The amylose content in the ginseng starch was varied with the age of the root, in the range of 53.6~70.5%.
4. The blue value of the ginseng starch was in the range of 0.60 to 0.71.

Introduction

Panax Ginseng C.A. Mayer has been known as the elixir of life and occupies a particular rank in the oriental medicine as a so called panacea tonic.

Studies on the various effective components in Panax ginseng have been carried out by many authors since Garriques[1] who separated ginseng saponins from *Panax Quinquefolium* L. in the year of 1854. Triter-

pene glycosides of dammarane series known as the effective components and other specific components of the ginseng were discussed by many researchers. But a few studies were performed on components other than ginseng saponins, especially on the starch.

This paper describes the chemical properties of Korean ginseng starch which is the main component other than saponins in ginseng roots.

Materials and Methods

1. Determination of starch

After grinding a dried and composite sample of Korean Panax ginseng to pass a 60 to 80 mesh screen,[2] weigh 3 grams of the flour into a 500ml centrifuge tube. Add 200ml of hot 80% ethyl alcohol, stir thoroughly, and centrifuge after 10 minutes standing. Decant and discard the alcoholic solution. Repeat this washing treatment until qualitative test with Anthrone (2 grams of anthrone in 1 liter of cold 95% sulfuric acid) is negative.

To the residue after final centrifugation add 200ml of 2.5% hydrochloric acid solution, and hydrolyze for 2.5 hours.

After filtration, neutralize the filtrate with 10% NaOH solution, and dilute to 500ml. Pipet 20ml of the diluted solution and determine the glucose amount according to the Somogyi method. Multiply the glucose content found by 0.9 to convert to starch.

2. Determination of size and shape of starch granules

Size and shape of the ginseng starch granules are determined according to the microscopical method described by MacMasters.[3]

A mount of starch in distilled water is prepared. The slide is placed on the stage of a compound microscope equipped with a micrometer eyepiece, and observed for more than 200 granules at a magnification of 1,000X to determine the diameter.

3. Preparation of amylose and amylopectin

Amylose and amylopectin were prepared by the improved butanol method of Schoch.[4]

A 10g sample of purified ginseng starch is gelatinized in a mixture of 500ml of boiling water and 50ml of butanol, then autoclaved for two hours at 18—20 Lb. pressure. After centrifuging, filter with No. 4 glass filter, add 25ml of butanol and 25ml of isoamyl alcohol, and heat to 92—95°C. The mixture is allowed to cool slowly to room temperature, the container being wrapped with cloth to retard rapid cooling.

The mixture is stirred at room temperature for several hours to break up the crystalline mass, which is then centrifuged in 250ml bottles at 15,000 r.p.m. (Beckman Model J—21B). The supernate is decanted carefully, and the precipitated material resuspended in cold water previously saturated with butanol and then centrifuged. This washing procedure is repeated until the supernatant liquid is substantially free of solids, as indicated by the absence of turbidity when treated with excess methanol.

The crude precipitated fraction may be furder purified by recrystallization from boiling water in the presense of excess butanol. The recrystallized product is seperated by centrifuging.

The non-precipitated fraction is flocculated from the original supernate by the addition of a large volume of methanol. The precipitate is dehydrated with alcohol and ether, and dried in a vacuum drier.

4. Determination of amylose content

Amylose is determined according to the procedure of McCready et al.[5] One hundred mg of purified ginseng starch is introduced into a 100ml volumetric flask, wetted with 1ml of ethanol and 10ml of water. The starch is dissolved by adding 2ml of 10% sodium hydroxide and heating on a water-bath until a clear solution formed.

The flask with its contents is cooled and diluted to the mark. A 5 ml portion (equivalent to 5mg) of the alkaline starch solution is introduced into a 500ml volumetric flask, about 100ml of water added and slightly acidified with 3 drops of 6 N-hydrochloric acid. The contents are well mixed by shaking the flask, 5ml of the iodine-potassium iodide reagent(0.2% I_2 in 2% KI) added and diluted to the mark. After 20 minutes, determine the intensity of the blue colours with light of 660 nm wave length.

Prepare a standard curve using the mixture of purified amylose and amylopectin as that in the sample starch aliquots. And use this calibrated curve to determine the amylose content in ginseng starch.

5. Determination of Blue value

Blue value determination is made by the method of

Gilbert and Spragg;[6]

To a 50 ml flask is added 1.0 ml of an aqueous solution containing 2 mg of ginseng starch. 0.5ml of N-sodium hydroxide is added, and the mixture is warmed 3 minutes in a boiling water bath. After cooling, an equivalent amount of N-hydrochloric acid is added, followed by 0.08 gram of potassium hydrogen tartrate. Water is added to a volume of about 45ml and then 0.5ml of iodine solution. (2 mg of iodine/ml; 20 mg of KI/ml). The solution is made up to 50ml, mixed and allowed to stand 20 minutes at room temperature.

The absorbance is measured at 680 nm in a spectrophotometer (Bausch & Lomb spectronic 700) using a 1 cm cell. For the reference solution, an iodone solution of equal concentration is used. Blue value is calculated from the equation;

$$\text{Blue value} = \frac{\text{Absorbance} \times 4}{\text{c(mg/dl)}}$$

in which C refers to the carbohydrate content of the solution.

Results and discussion

1. Starch content

As the panax ginseng is a perennial plant, the chemical components of the root are variable according to their age.

Hong et al[7] reported that the total sugar of the Korean ginseng was increased according to the age of the root and the total sugar contents were 6.63% to 8.87% for three-year-old root to seven-year-old root.

As shown in Fig. 7, starch content of the Korean ginseng root(dried) was increased a little within the limit of one to five-year-old root. That is, the starch concentration was 9.62% for one-year-old root, 10.35% for two-year-old root, 15.50% for three-year-old root, 17.05% for four-year-old root, and 18.32% for five-year-old root.

2. Granule size, shape, and frequency distribution

The shape of the Korean ginseng starch granules was round or short oval, and in the latter case, the ratio of minor axis to major axis was 1 to 1.1.

Diameter of the starch granules was in the range of 1.48 μ to 8.14 μ and the most frequent granule size was 3 μ (32.1—35.7%). Some of the smallest starch granules in 95% ethyl alcohol passed through the No. 84 round filter paper. (Toyo Co., Japan)

As shown in Fig. 6, the number of large size starch granules increased while the small size starch granules

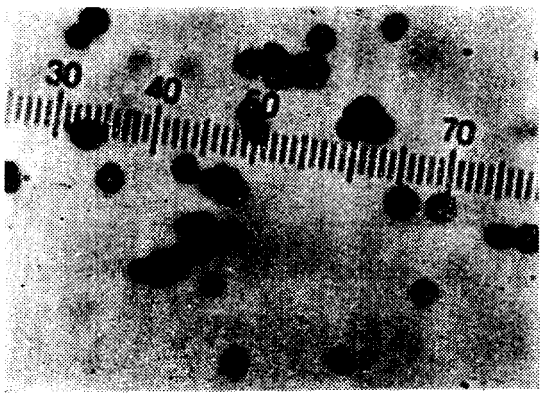

Fig. 1. The photomicrograph of Korean ginseng starch granules(One-year-old root, 1,000x)

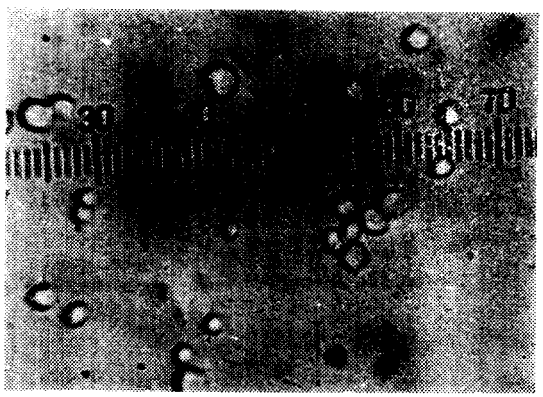

Fig. 2. The photomicrograph of Korean ginseng starch granules(two-year-old root, 1,000x)

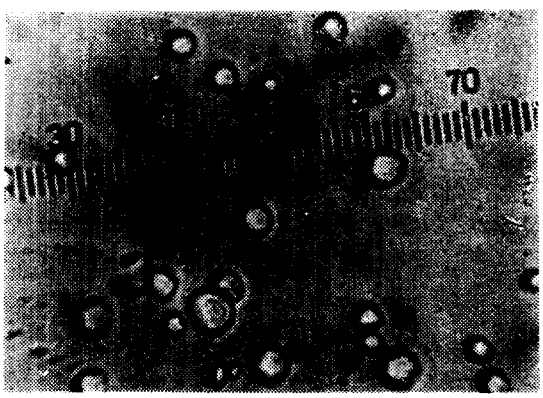

Fig. 3. The photomicrograph of Korean ginseng starch granules (Three-year-old root, 1,000x)

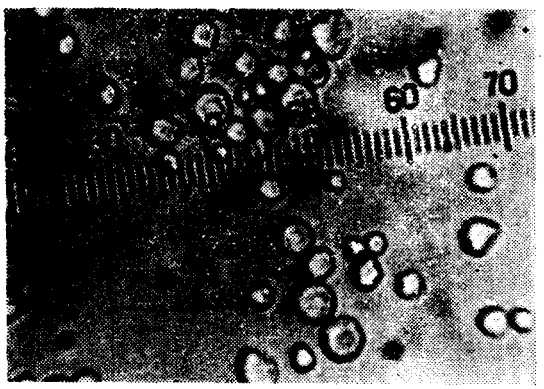

Fig. 4. The photomicrograph of Korean ginseng starch granules (Four-year-old 1,000x)

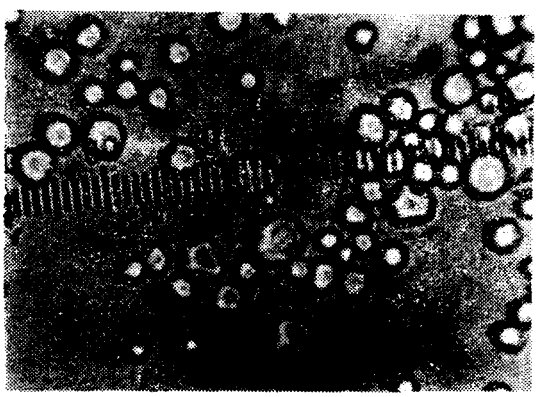

Fig. 5. The photomicrograph of Korean ginseng starch granules(Five-year-old root, 1,000x)

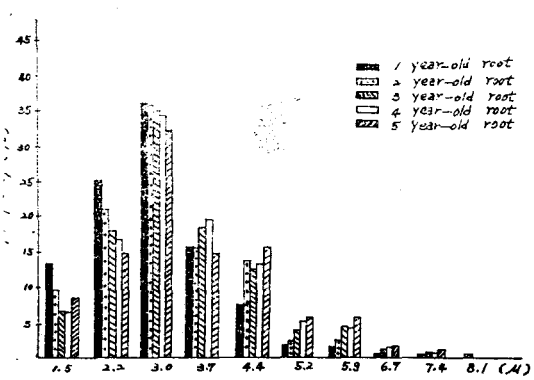

Fig. 6. Size frequency distribution of Korean ginseng starch granules(1 to 5 year-old root)

decreased during the growing year. But the size of the starch granules could not become a real and fine barometer to determine the age of roots because the size of Korean ginseng starch granules was more variable according to the grown area, humus content, and climate etc.

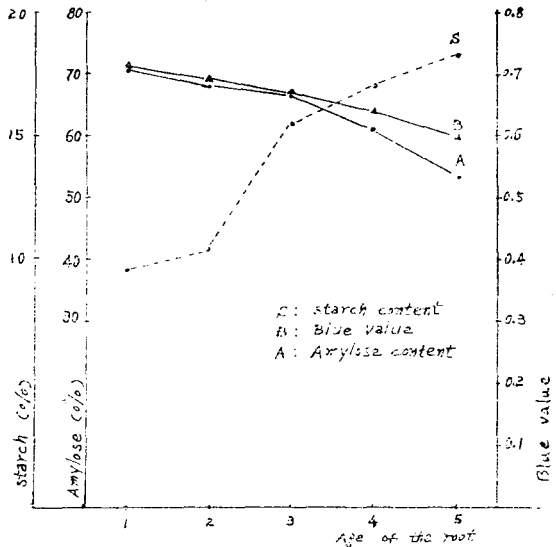

Fig. 7. Comparison of starch content, amylose content, and blue value of the Korean ginseng (*Panax ginseng* C.A. Mayer, 1 to 5 year-old root)

3. Amylose content

A much higher concentration of amylose was observed in Korean ginseng starch in comparison with the 27.5—30.5% for barly starch[8], 25—32% for wheat starch[9], 17.0—21.8% for rice starch[10], 19.0% for potato starch[11].

The amylose content in the Korean ginseng starch by the colourimetric method described by MacCready et al[5] was varied with the age of the root as shown in Fig. 7. The starch in the root of one-year-old Korean ginseng contained 70.5% of amylose, 68.0% for two-year-old root, 66.3% for three-year-old root, 61.0% for four-year-old root, and 53.6% for five-year-old root.

Amylose content in Korean ginseng starch seems to be similar to that of wrinkled-seed peas. MacCready et al[2] and Peat et al[12] reported that the starch of wrinkled-peas was high in amylose and the highest content encountered was 72—98%.

It seems that the decrease of the amylose content in Korean ginseng starch with the age is a unique and special phenomenon to be observed.

4. Blue value of Korean ginseng starch

Blue value determined by the method of Gilbert and Spragg[6] varied with the age of roots as shown in Fig. 7. The value was 0.71 for one-year-old root,

0.69 for two-year-old root, 0.66 for three-year-old root. 0.64 for four-year-old root, and 0.60 forfive-year-old root.

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