

## The Establishment of Optimum Conditions for Saccharification in Manufacturing Red Ginseng *Sikhye*

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**Abstract :** Red ginseng *sikhye* is one of Korean unique beverages with the addition of effective ingredients of ginseng. Considering economical and mechanical efficiency and quality of *sikhye*, the optimum conditions for saccharification is to saccharify at 90 degree celsius for 3 hours in the composition of 4% of malt, 20% of steamed rice, and 6% of red ginseng power. The red ginseng *sikhye* has high soluble solid content over 33% compared with conventional commercial *sikhye*. On the other hand, ginseng *sikhye*, which shows low pH, has more or less higher acidity than conventional commercial one. Especially the turbidity of the red ginseng *sikhye* is much higher than that of commercial *sikhye*, due to as high amount of rice as 20% compared with 3% in the commercial one. The use of high quantity of rice affected the level of turbidity in red ginseng *sikhye*. In this study, we wanted to establish optimum conditions for saccharification in manufacturing red ginseng *sikhye* which contains effective herbal medicinal ingredients maintaining the original taste of traditional *sikhye*.

**Key words :** red ginseng, *sikhye*, saccharification, optimum process, soluble solid content

### INTRODUCTION

*Sikhye* is one of traditional beverages in Korea<sup>1)</sup>. Drinking *sikhye* constantly promotes digestion, loses weight, and makes feel better<sup>2)</sup>. It was usually taken as a seasonal drink especially in winter time season to be served for dessert. Unlike tea and coffee, *Sikhye* is prepared through the complicated process. Therefore, it is hard to manufacture it in the house not only for the new generation, but also for the adult<sup>3)</sup>. On the other hand, red ginseng is a kind of ginseng with dark brown color. Korean red ginseng containing over 30 kinds of saponins are recognized as a health food for anti-diabetes, improvement of function of intestine, protection of liver function, anticancer, antiaging, improvement of sexual dysfunction, decrease of hangover, depressant of blood pressure and promotion of mental activity<sup>4-6)</sup>.

With the development of food processing technology, consumers have demanded traditional food made from natural resources. *Sikhye* is one of the beverages corresponding to the consumers' demand. However, mass-produced *sikhye* in industrial scale with home-made one due

to lack of quality improvements and industrial rationalization of processing. Most of all, the main problem of mass-produced *sikhye* is that it loses its native taste with the addition of sugar owing to a falling-off of sweetness through various processes. Most researches about *sikhye* are focused on the changes of ingredients during processes or recipe<sup>7-10)</sup>. On the other side, it is necessary to maintain its native taste and characteristics to increase competitiveness of *sikhye* within the country and to globalize it as the Korean traditional beverage. Because the traditional food of common knowledge could not be protected by law, it is better idea to integrate functional foods as well as modern manufacturing methods with traditional ones.

This study was performed to show fundamental data to establish manufacturing processes for the new-style beverage, red ginseng-*sikhye*, with *sikhye's* native taste and herbal medicinal characteristics of ginseng at the points of saccharification and quality changes by the addition of red ginseng.

### MATERIAL AND METHODS

#### Materials

The rice used in this study was Icheon-Rice which was

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cultivated near Icheon, Kyunggi-do and the malt was produced at Hamyang-Nonghyup which is a branch of NACF(National Agricultural Cooperative Federation) in Korea.

Ginseng was selected from 4-year-old fresh ginseng harvested at Geumsan, Chungcheongnam-do. For the study, ginseng was steamed at 95°C for 4 hours to make red ginseng and dried at 40°C in a hot air drying machine until moisture content reached 13% and then pulverized to #60~#80 mesh.

### Methods of manufacturing red ginseng *sikhye*

The amounts of red ginseng were 2, 4, 6, 8% (v/v) made up with 10, 15, 20, 25% (v/v) of rice and digested for 12 hours followed after putting 2-fold of water. After that, the mixtures of rice and red ginseng were steamed by an autoclave for 1 hour at 105°C and then cooled to be used as raw materials for saccharification of *sikhye*.

In the preparation of malt, the supernatant extracted hourly (0~4 hour) from steamed mixture at 60°C of malt (40~55%) and water (5-fold of malt volume) mixed to raw materials for saccharification. The temperature of saccharification processes was increased every 10°C ranged from 60 to 90°C for 6 hours. We had analyzed soluble solid content, pH, total acidity and transparency during saccharification processes for red ginseng-*sikhye* as temperature changes.

### Quality analysis

Soluble solid content of *sikhye* measured by refractometer(Hand refractometer, Atago, Japan) was expressed to °Bx. The pH value was measured at room temperature by pH meter (PP-50, Eyela, Japna). Total Acidity(% w/v) was measured from 10 ml of sample by adding 0.1N NaOH until reached to pH 8.3 and then converting the amount of used NaOH to acetic acid according to the AOAC method<sup>11)</sup>. Turbidity measured transmittance(%) using spectrophotometer(shimadzu UV-1601) at the wavelength of 675 nm.

## RESULTS AND DISCUSSION

### Optimum condition for malt extraction

Fig. 1 shows the result of soluble solid content measurements from malt extractions every hour from 0 to 4 hours at 60°C at the conditions of malt preparation ranged from 40 to 55% of malt with 5-fold water. Malt concentration was plateau between 2 to 3 hour after extraction because of starch residue. Soluble solid content increased but

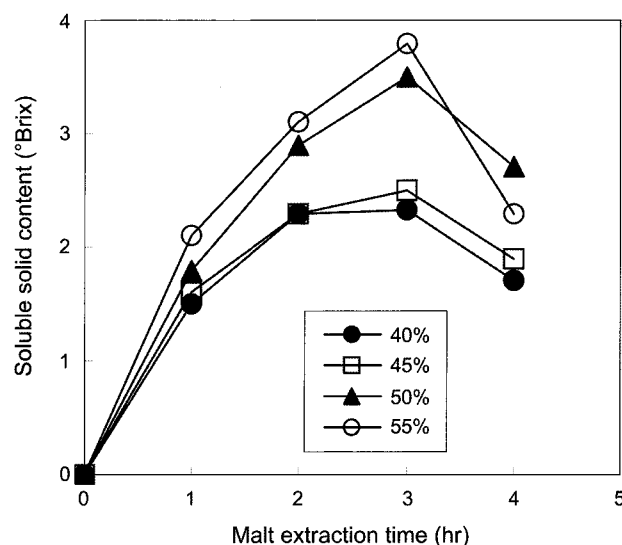


Fig. 1. Effect of the various malt contents and malt extraction time on the soluble solid content of malt *sikhye*.

started to decrease after 3 hour. Generally, the more malt the less processing time. But, high malt price reduces the amount of malt added. It is the same as beer brewing process in which corn or rice is added in order to less the amount of malt. It is also better to less malt usage because free amino acids, which cause amino-carbonyl reaction, are abundant in malt<sup>12)</sup>.

In general, bitter taste diminishes as the malt content of *sikhye* increases, while the strength of turbidity, saccharinity, and viscosity of *sikhye* increases. Considering the economical efficiency and saccharinity of the malt content, our results indicate that the optimum condition for red ginseng *sikhye* processing is the extraction of 40% of malt for 2 hours.

### Effect of malt and rice on soluble solid content

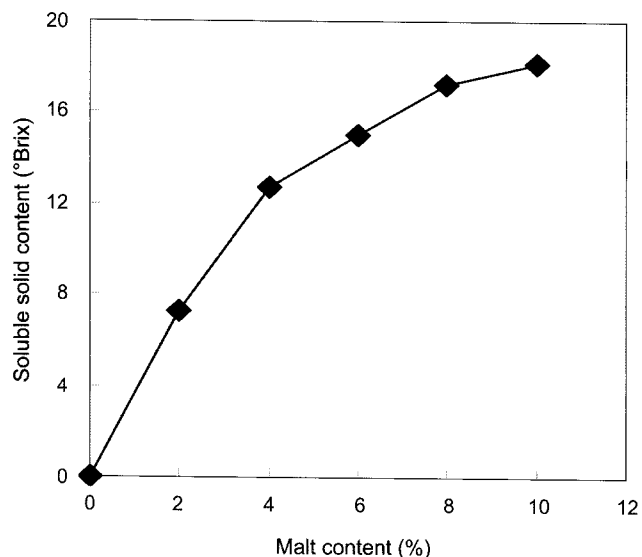
Two hundreds grams of rice corresponding to 20% of total weight was saccharified at 60°C for 6 hours with combinations of 2, 4, 6, 8 and 10% of malt. Fig. 2 shows the changes of soluble solid content following the addition of malt. As the amount of malt was increased, soluble solid content was positively increased. However, it was adequate to use 4% of malt to saccharify 200 g of steamed rice in the consideration of malt price, the time required, and flavor. In other side, we fixed the amount of malt extraction to 4% and varied the amount of steamed rice to 10%, 15%, 20%, and 25% respectively. The time required to process was set to 6 hour.

Fig. 3 shows changes of soluble solid content on steaming rice content in saccharification process. As the

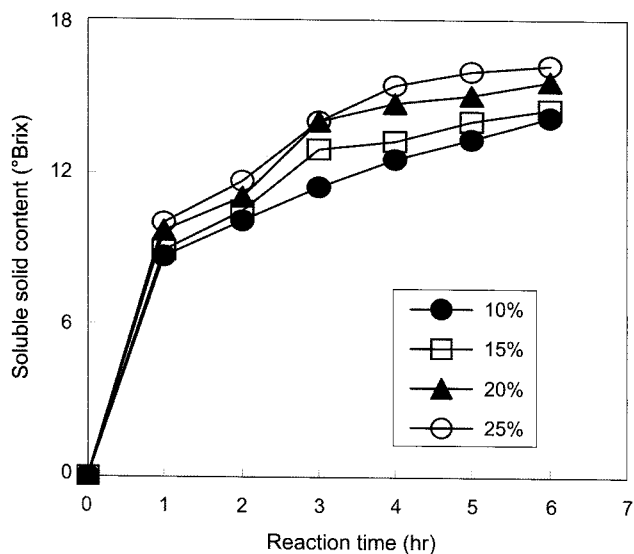
amount of steamed rice was increased, the soluble solid content was increased. Nam and Kim<sup>13)</sup> reported that turbidity, soluble solid content, and viscosity was increased and bitterness was decreased when the amount of steamed rice was increased. The addition of 20% of steamed rice was optimum in this study considering the benefits of economical efficiency and sweetness.

**Effect of soluble solid content on addition of red ginseng**

Red ginseng was added by 1%, 3%, 6%, and 8%, respectively at the optimum condition of 4% of malt, 20%

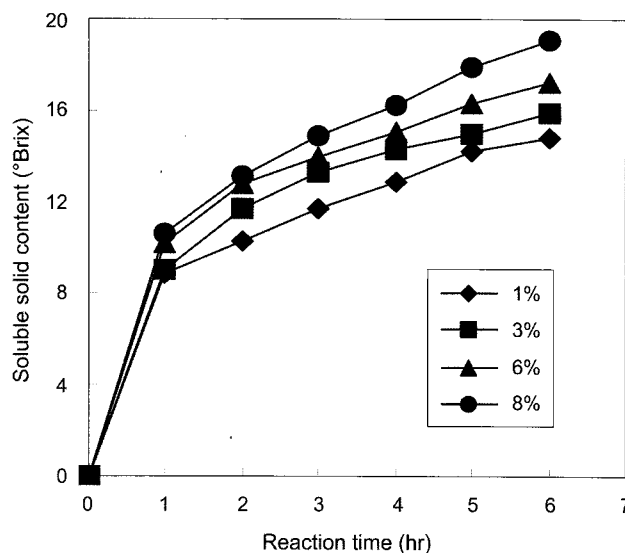


**Fig. 2.** Effect of malt contents on soluble solid content of saccharification of steaming rice. The reaction was performed at 60 for 6hrs by adding 20% of rice.

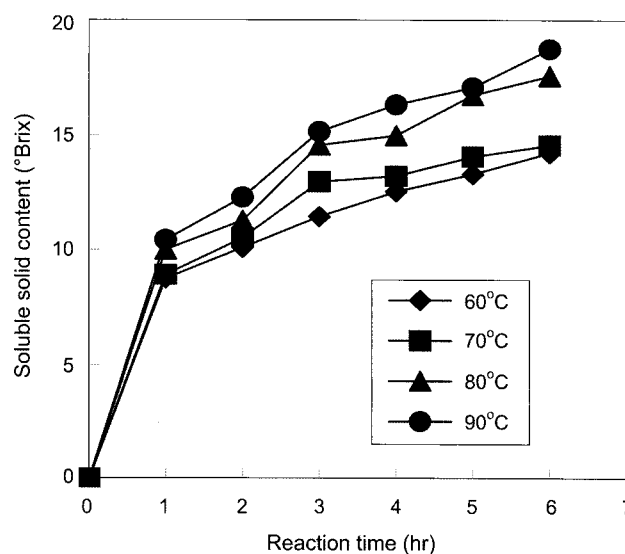


**Fig. 3.** Effect of the various steamed rice contents and the reaction time on the saccharinity of malt *sikhye*.

of steamed rice for 6 hour at 60°C from the previous study. Fig. 4 shows that soluble solid content was increased by addition of red ginseng and time required. Generally soluble solid content of commercial *sikhye* are 11.6~12.5 °Brix, yet home made is 18.7 °Brix. Sugar degrees of fruit juices and nectar sold at market are 12~14 °Brix<sup>14)</sup>. Therefore, the optimum concentration of red ginseng is 3% to 6% considering time required for process-



**Fig. 4.** Effect of soluble solid content on the contents of red ginseng in manufacturing red ginseng *sikhye*. The reaction was performed at 60°C for 6hr by adding 20% of rice and 4% of malt.



**Fig. 5.** Effect of soluble solid content on the different saccharification temperature in red ginseng *sikhye*. The reaction was performed by adding 20% of rice, 4% of malt, and 6% of red ginseng.

ing, unit cost of production, and chromaticity.

**Effect of temperatures on soluble solid content red ginseng sikhye**

Generally speaking, the optimum temperature for saccharification of *sikhye* is 60°C<sup>7)</sup>. In order to observe the optimum temperature for saccharification in the addition of red ginseng the *sikhye* was saccharified for 6 hours at 60°C, 70°C, 80°C and 90°C. Fig. 5 shows the change of soluble solid content at the various saccharification tem-

peratures of red ginseng *sikhye*. As seen from Fig. 5, soluble solid content increased with the increase of temperature. Especially, soluble solid content was over 12°Brix after 3 hours saccharification at 90°C. Consequently, the time required could be shortened by increasing temperature and the optimum temperature was ranged from 80 to 90°C in the addition of red ginseng power.

**Manufacturing process for red ginseng sikhye**

The objective of this study was to establish the manu-

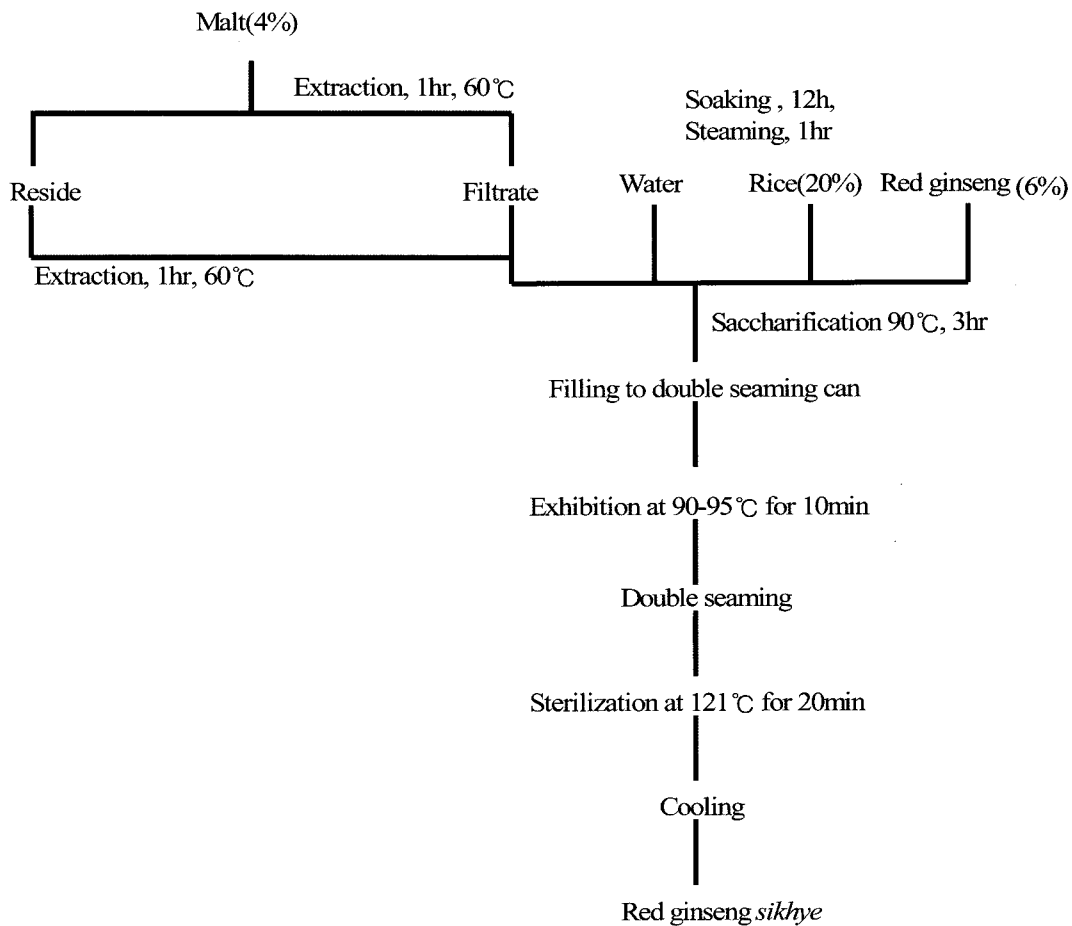


Fig. 6. Optimum process manufacture of the red ginseng *sikhye*.

Table 1. Comparison of soluble solid content, pH, total acidity and transparency in commercial *sikhye* and red ginseng *sikhye*

Sample	Soluble solid content (°Brix)	pH	Total acidity (%)	Transparency (%)
Red ginseng <i>sikhye</i>	18.7	5.71	0.051	5.4
A <sup>1)</sup>	12.5	5.93	0.004	21.5
B	11.8	6.78	0.006	20.4
C	11.7	6.32	0.004	19.7
D	11.8	6.75	0.007	27.9

<sup>1)</sup> A~D : Different commercial *sikhye*

facturing process for red ginseng *sikhye* maintaining natural taste of *sikhye* with saponin which is active ingredient of ginseng. Fig. 6 shows the optimum condition for manufacturing red ginseng *sikhye*, which is 4% of malt extraction, 2 hour required for extraction, 20% of steamed rice, 6% of red ginseng, and temperature at 90°C.

#### The comparison to commercial *sikhye*

Table 1 shows the comparison of sugar degree, pH, acidity, and turbidity to 4 kinds of commercial *sikhye*. The °Brix of red ginseng *sikhye* (18.7 °Brix) was higher than that of commercial *sikhyes* (11.7~12.5 °Brix). In this study, increased addition of malt and steamed rice raised sugar degree. Nam and Kim<sup>13</sup> already reported similar result.

Red ginseng *sikhye* showed lower pH (5.71) than commercial one. This result is thought to be due to the high level of organic acid production by the increase of malt added. Turbidity of red ginseng *sikhye* (5.4%) had more opacity than market *sikhye*. This result comes from the more use of steamed rice because turbidity is thick by using of the amount of steamed rice and malt as well. The reason of high level of turbidity was due to the amount of steamed rice used to red ginseng *sikhye* (20%) compared to that of commercial *sikhye* (1.3~3.2%).

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