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Simple Aging System for Japanese Rice Shochu, Using Laser Roasted Indigenous Wood Plate

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Abstract: Novel aging system was developed using laser roasted Japanese cedar, chestnut and cherry wood. Kuma shochu, a kind of rice shochu was properly aged with this simple aging system. Aged rice shochu shows desirable yellow to amber color. Shochu aged with chestnut wood treated with 30% roast strength shows darkest color. The rice shochu aged with chestnut wood roasted with 30% strength showed the highest value in absorbance at 430 and 480 nm, amount of total polyphenol compound and inhibitory activity of lipid peroxidation. DPPH radical scavenging activity of aged rice shochu was around 100 to 120 M Trolox equivalent. Variety of wood, roast strength nor aging periods did not have effects on DPPH radical scavenging activity of aged rice shochu. This aging system might be applicable not only shochu but to other alcoholic beverage such as whisky, brandy, wine and sake.

Key words: Aging of Alcoholic Beverage · Rice Shochu · Laser Roast · Roasted Wood · Antioxidant Activity · Polyphenolic compounds

INTRODUCTION

Shochu is a traditional Japanese spirits made from various carbohydrate materials such as rice, sweet potato, barley, corn, buck wheat, brown sugar and so on. Kuma shochu, produced in Kuma region, in Kyushu Island, located at the southern part of Japan is rice shochu *i.e*., distilled rice spirits. Cooked non-glutinous rice and microbial starter called *koji*, propagated yeast suspension and water was fermented in the vessel. The resulting shochu moromi, fermented mash was distilled with pot still just like whisky and brandy. Generally, shochu including rice shochu was drunk as "white liquor" without aging in the charred wood barrel, just like vodka and gin. Rice shochu had characteristic sweet flavor. Nowadays, dominant shochu still was not aged with barrel, however, barrel aged shochu was also developed and consumed.

In this study, we tried to apply simple aging system using laser roasted indigenous wood plate instead of charred wood barrel to rice shochu aging. Traditionally Japanese cedar wood is utilized for *taru, i.e.*, container of sake, chestnut is one of the special products of Kuma region and the cherry blossom is regarded as an iconic flower of Japan. We would like to utilize these special wood materials for shochu aging in the same way as other distilled beverage [1, 2].

MATERIALS AND METHODS

Rice Shochu: Rice shochu was purchased from Kuma Shochu Co. Ltd. (Hitoyoshi, Japan). Alcohol content of the rice shochu was 25% abv. Traditional name of Hitoyoshi area is Kuma region. Kuma shochu is a kind of rice shochu. Just like Scotch whisky, Cognac and Calvados, Kuma shochu took after its place name.

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A. Cedar

B. Chestnut

C. Cherry

Fig. 1: Pictures of non-roasted and roasted circle wood plate. Pictures A, cedar; B, chestnut; C, cherry. Upper right, non-roasted wood plate; left roasted with 10% roast strength; lower right, 30% roast strength; left, 60% roast strength.

Preparation of Circle Wood Plate for Aging Rice Shochu: Commercial Japanese cedar, chestnut and cheery wood was processed with an electronic saw machine, model ES-2000, Toshiba Co. Ltd (Tokyo, Japan) to prepare circle wood plate (90 mm in diameter and 10 mm in thickness). Resulting circle wood plate was roasted with electronic laser irradiator, model EL-100, Toshiba Co, Ltd (Tokyo, Japan). Maximum output power of EL-100 was 1000 W. Circle wood plate made from cedar, chestnut and cheery was roasted with the output power of 100, 300 and 600 W, respectively. For convenience, roast strength was designated as 10, 30 and 60% for the output power of 100, 300 and 600 W. Roasted circle wood plate was used for aging rice shochu. For comparison non-roasted, raw circle wood plate was also used for aging. Pictures of non-roasted and roasted circle wood plate were shown in Figure 1.

Aging of Rice Shochu, Kuma Shochu: Figure 2 shows simple aging system for rice shochu. Roasted or non-roasted circle wood plate was put in the glass container (100 mm in diameter and 90 mm in height) containing 400 ml of rice shochu with 30 glass beads, 15 mm in diameter as weight on it. After 1 and 3 months aging in room temperature, resulting matured rice shochu was analyzed.

Chemicals: The compound DPPH (1, 1-diphenyl-2-picrylhydrazyl) was purchased from Nacalai Tesque (Kyoto, Japan). Trolox (6-hydroxy-2, 5, 7, 8-tetramethylchroman-2-carboxylic acid) was purchased from Sigma-Aldrich Inc. (St Louis, Mo, USA) and BHT (2, 6-di-tert-butyl-p-cresol) was purchased from Tokyo Kasei Co. Ltd (Tokyo, Japan).

General Analytical Methods: The absorbance of matured rice shochu was measure at 430 and 480 nm with Hitachi model spectrophotometer U-3010 (Tokyo, Japan). The amount of total phenolic compounds, as gallic acid equivalent, was determined according to the Folin - Ciocalteu method [3, 4].

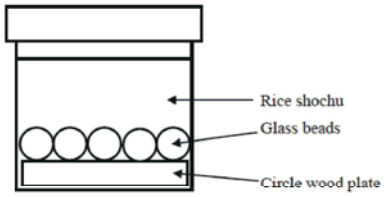

Fig. 2: Simple aging system for rice shochu, Japanese rice spirits using laser roasted wood plate. Roasted or non-roasted circle wood plate was put in the glass container (100 mm in diameter and 90 mm in height) containing 400 ml of rice shochu with 30 glass beads, 15 mm in diameter as weight on it.

Determination of Antioxidant Activity: The DPPH radical scavenging activity, as the Trolox equivalent, was measured based on the method of Yamaguchi *et al.* [6]. The lipid peroxidation inhibitory activity, as the BHT equivalent, was determined using β-carotene [4].

RESULTS AND DISCUSSION

Color and Absorbance of Rice Shochu Aged with Non-roast and Roasted Cedar, Chestnut and Cheery Wood: After 1- and 3-months aging, matured rice shochu was analyzed. Rice shochu was properly matured with simple aging system for Japanese rice shochu using laser roasted wood plate. Picture of various aged shochu was shown in Figure 3. Aged rice shochu showed desirable yellow to amber color and had smoky flavor. Shochu aged with chestnut wood treated with 30% roast strength shows darkest color.

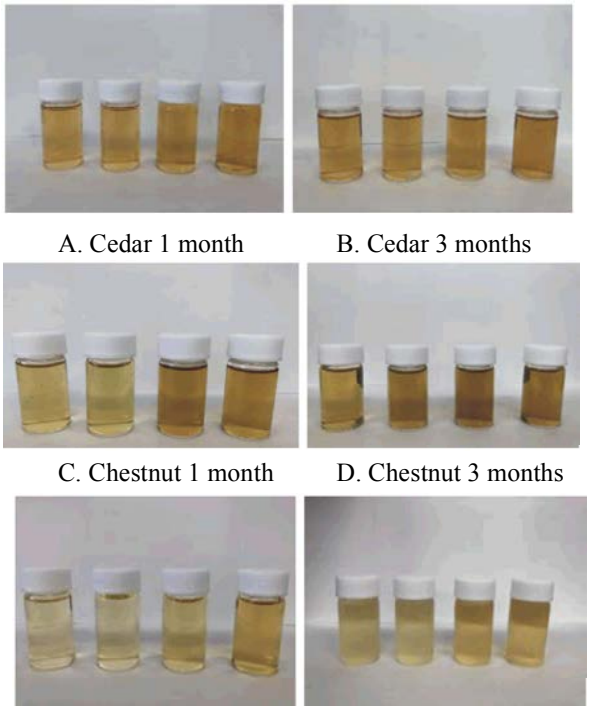

Fig. 3: Picture of rice shochu aged with cedar, chestnut and cherry wood.
A, Picture of rice shochu aged with cedar for 1 month. From left to the right non-roasted wood, roasted at 10% roast power, 30% roast power, 60% roast power. B, Picture of rice shochu aged with cedar for 3 months. C, with chestnut for 1 month. D, with chestnut for 3 months. E, with cherry for 1 month. F, with cherry for 3 months.

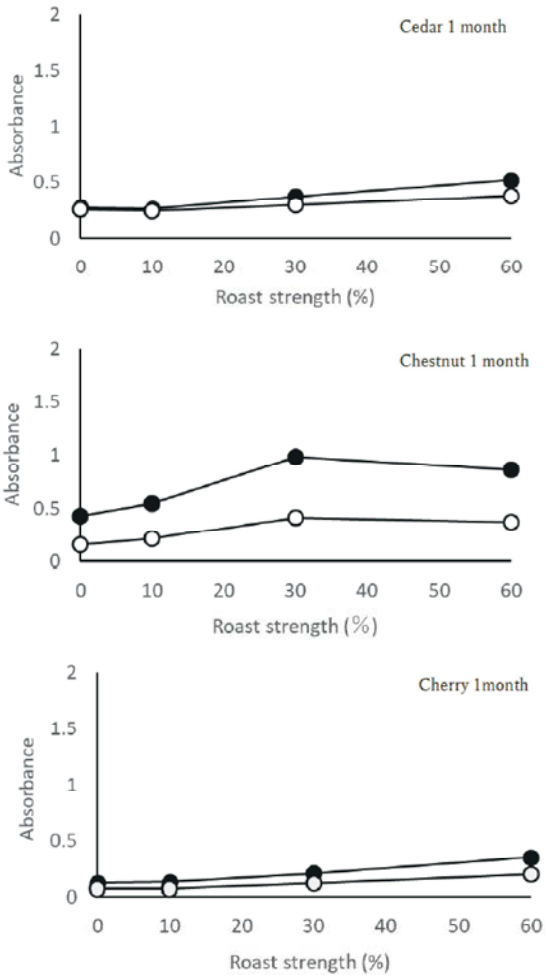

Fig. 4: Absorbance of rice shochu aged with cedar, chestnut and cherry wood for 1 month.
From the top to bottom, cedar, chestnut and cherry. ●, absorbance at 430 nm; ❍, 480 nm.

Absorbance at 430 and 480 nm of the matured rice shochu aged with various circle wood plate during 1 and 3 months was shown in Figures 4 and 5. Absorbance at 430 nm of rice shochu aged with chestnuts wood is much higher compared with rice shochu aged with cedar and cherry wood. As the roast strength increased, absorbance at 430 and 480 of the rice shochu aged with cedar and cherry wood gradually increased. On the contrary, absorbance of rice shochu aged with chestnut wood roasted with 30% strength is higher comparing with that of rice shochu aged with chestnut wood roasted with 60% strength. The surface of chestnut wood plate roasted with 60% strength was charred to be charcoal (Figure 1-B). Colored compounds extracted from roasted chestnut wood, therefore, might be re-adsorbed onto charcoal layer of the roasted chestnut wood.

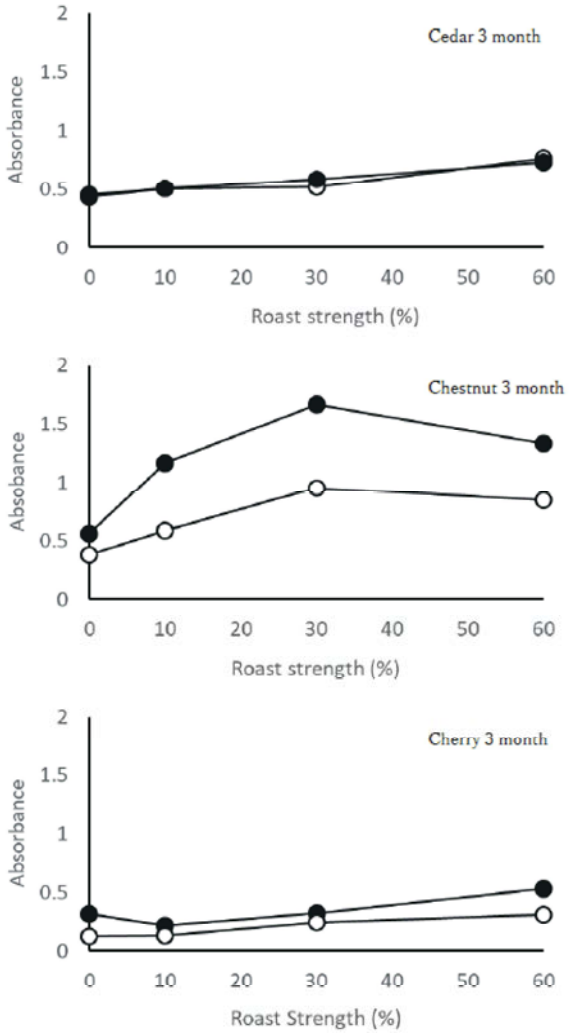

Fig. 5: Absorbance of rice shochu aged with cedar, chestnut and cherry wood for 3 months.
From the top to bottom, cedar, chestnut and cherry. ●, absorbance at 430 nm; ❍, 480 nm.

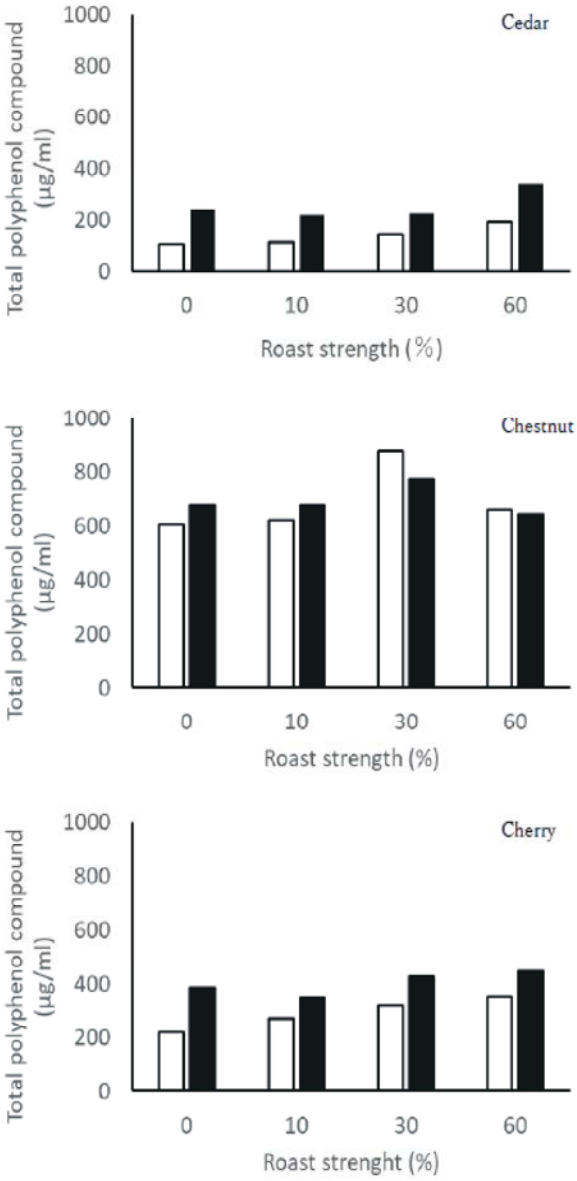

Fig. 6: Total polyphenol compound of rice shochu aged with cedar, chestnut and cherry. Open bar shows total polyphenol content of rice shochu aged for 1 month and closed bar shows that in shochu aged for 3 months.

Total Polyphenol Content of Aged Rice Shochu: Total polyphenol content of aged rice shochu was shown in Figure 6. Total polyphenol content extracted in rice shochu aged with cedar and cherry wood is approximately 100 to 300 and 200 to 450 µg/ml, respectively. Those in rice shochu aged with chestnut wood were much higher, which recorded approximately 600 to 900 µg/ml. The absorbance of rice shochu aged with chestnut wood roasted with 30% strength is highest.

DPPH Radical Scavenging Activity of Aged Rice Shochu: DPPH radical scavenging activity [1] of aged rice shochu aged with cedar, chestnut and cherry were shown in Figure 7. DPPH radical scavenging activity of aged rice shochu was around 100 to 120 M Trolox equivalent. Variety of wood, roast strength nor aging periods did not have effects on DPPH radical scavenging activity of aged rice shochu.

Aoshima *et al.*, reported that polyphenol derivatives in aged whiskey had high radical scavenging activity [1]. Generally, polyphenolic compounds said to had relationship between radical scavenging activity.

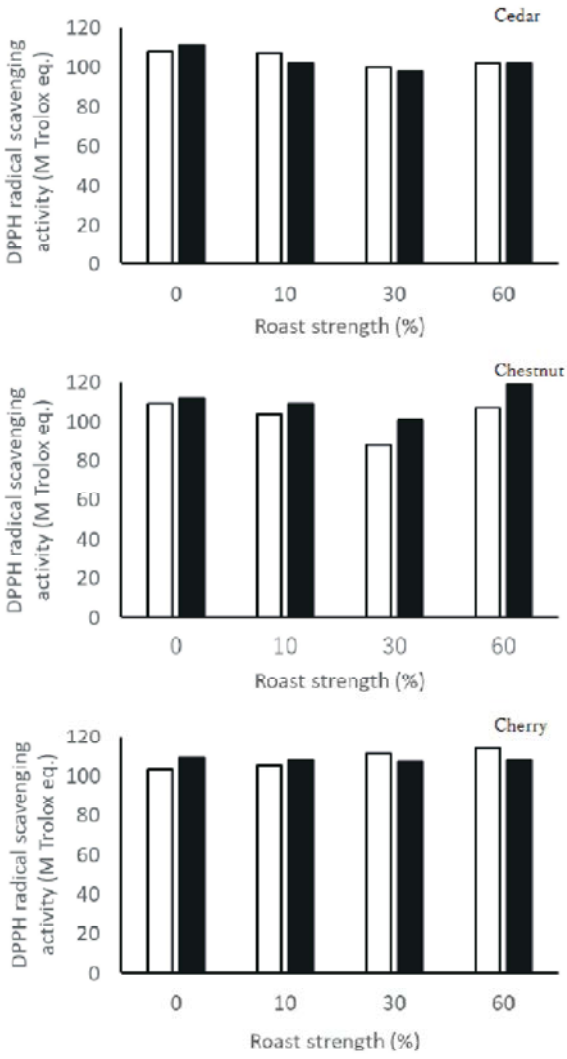

Fig. 7: DPPH radical scavenging activity of rice shochu aged with cedar, chestnut and cherry. Open bar shows DPPH radical scavenging activity of rice shochu aged for 1 month and closed bar shows that in shochu aged for 3 months.

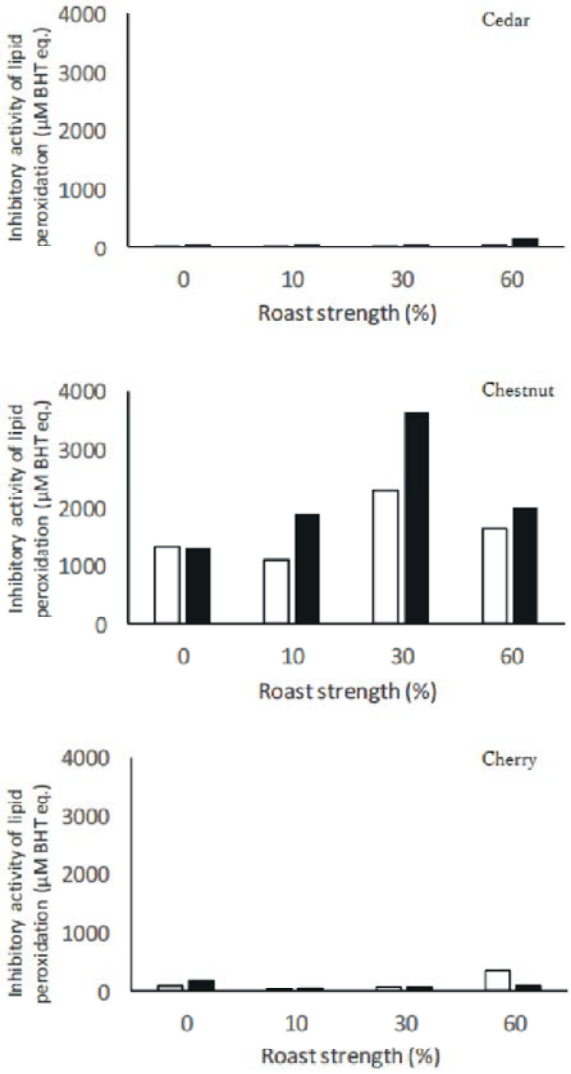

Fig. 8: Inhibitory activity of lipid peroxidation of rice shochu aged with cedar, chestnut and cherry. Open bar shows inhibitory activity of lipid peroxidation of rice shochu aged for 1 month and closed bar shows that in shochu aged for 3 months.

In the case of herbal wine, the highest DPPH radical scavenging activity and total phenolic compound were detected from herbal wines making from the bud of *Nymphaea lotus* [7]. However, in the case of aged rice shochu, relationship between total polyphenolic compounds and DPPH radical scavenging activity was not observed (Figures 6 and 7).

Inhibitory Activity of Lipid Peroxidation of Rice Shochu: Inhibitory activity of lipid peroxidation of rice shochu aged with cedar, chestnut and cherry were shown in Figure 8. Inhibitory activity of lipid peroxidation of rice shochu aged with chestnut and cherry wood were lower, around 10 to 350 μM BTH equivalent. Inhibitory activity of lipid peroxidation of rice shochu aged with chestnut wood roasted at 30% roast strength is highest. As the aging period increased, inhibitory activity of lipid peroxidation of rice shochu aged with chestnut wood increased.

Simple Aging System for Japanese Rice Shochu Using Laser Roasted Wood Plate: Absorbance at 430 and 480 nm, amount of total polyphenol compound and

inhibitory activity of lipid peroxidation of rice shochu aged with chestnut wood roasted with 30% strength showed highest value. Chestnut wood showed unique characteristics for aging rice shochu. Shochu aged with non-roasted and roasted cedar wood had aroma characteristics of *taru* sake kept in Japanese cedar *taru* container. Chips of cherry wood are utilized for smoking meet and to making bacon. Rice shochu aged with roasted cherry wood had good smoky flavor. Flavor of aged shochu had unique characteristics of various roasted and non-roasted circle wood plate, however, the taste of aged shochu need improvement.

Aged shochu had DPPH radical scavenging activity and inhibitory activity of lipid peroxidation. Here we produced aged shochu having antioxidant activity. We also developing novel alcoholic beverages having unique characteristics such as herbal wine [7] and colored rice wine [5] having antioxidant activity.

CONCLUSION

Simple aging system using laser roasted wood plate was applicable for aging rice shochu. Analysis of shochu matured with various wood materials, various aging condition and various aging periods would be done quickly and regularly using this aging system. Selection of barrel material, charring condition, aging periods would be simulated with this simple aging system using laser roasted wood plate. This aging system might be applicable to other alcoholic beverage such as whisky, brandy, wine and sake. We would like to develop a novel type of aged Kuma shochu having antioxidant activity and a regional specialty using this aging system.

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