Effects of *Vitis coignetiae* on the Quality and Antihypertension of *Vitis hybrid* Red Wine

Jang, Jeong-Hoon¹, Sung-Hun Yi², Jae-Ho Kim², Dae-Hyoung Lee³, and Jong-Soo Lee¹*

¹Dept. of Life Science and Genetic Engineering, Paichai University, Daejeon 302-735 Korea
²Korea Food Research Institute, Seongnam 463-746, Korea
³Gyeonggi-do Agricultural Research and Extension Services, Hwasung 449-702, Korea

Received: February 9, 2011 / Revised: April 28, 2011 / Accepted: April 29, 2011

The goal of this study was to develop a high value Korean red wine possessing antihypertension activity. The effects of some medicinal plants and grapes on the alcohol fermentation process and the angiotensin I-converting enzyme (ACE) inhibitory activity of *Vitis hybrid* red wine were investigated. Various *Vitis hybrid* red wines were vinified by the fermentation of a mixture of *Vitis hybrid* must and some medicinal plants and grapes at 25°C for 10 days. Of these red wines, the *Vitis hybrid*-*Vitis coignetiae* red wine exhibited a high ethanol content of 12.0% and had a good level of acceptability. It also showed a high antihypertensive ACE inhibitory activity of 68.5%. After post-fermentation of 60 days, the ACE inhibitory activities of the *Vitis hybrid*-*Vitis coignetiae* red wine exhibited the highest ACE inhibitory activity of 80.7% (IC₅₀: 28 mg/mL) and also had the best acceptability. The C₁₈ solid phase extracts of the *Vitis hybrid*-*Vitis coignetiae* red wine, after 60 days post-fermentation, showed clear antihypertensive effects on spontaneously hypertensive rats. Our results reveal that the *Vitis hybrid*-*Vitis coignetiae* red wine has the potential to become a new functional red wine due to its good acceptability and high antihypertensive activity.

Key words: Quality, antihypertension, *Vitis hybrid*-*Vitis coignetiae* red wine

Introduction

Various fruits, medicinal plants and herbs have recently received attention because they contain nutraceuticals with health-stimulating properties. Grapes in particular contain 0.3% to 0.5% of various organic acids; they also have some free sugars and a large amount of polyphenol compounds such as flavonoids containing anthocyanin and proanthocyanidins [5, 30], and phenolic acids [27]. It has recently come to light that phenolic compounds have numerous biological health benefits such as the following: antioxidant activity [8] due to the scavenging of active harmful oxygen radicals [5, 7, 25, 29] inhibition of oxidation on lipoprotein [26, 27] low density lipoprotein [17, 28] platelet aggregation inhibition [2] anti-inflammatory action [18] the lowering of blood cholesterol by the resveratrol of grapes; and antimicrobial activity [15].

Many research results on the health benefits of red wine have been reported [5, 23]. Kimura *et al*. [11] and Kinsella *et al*. [12] reported that red wine may reduce the mortality rate from coronary heart disease. Furthermore, some studies have focused on the vinification of various korean grape varieties and reported on their quality and acceptability [13, 16], and the antioxidant activity of wines [3, 13] and the cardiovascular and antidementia functionalities of red wines [20]. Korean red wine, however, has not been developed with excellent acceptability and high-value physiological functionality.

In this study, for the improvement of acceptability and antihypertension of *Vitis hybrid* red wine by addition of medicinal plants, we selected grapes (Campbell Early, wild grape) and medicinal plants (*Robus coreanus*, Tea plant, Gugija, Mulberry) which were known its some functionality and good flavor and taste [9, 21, 22]. Effect of medicinal plants and grapes on the quality and antihypertensive angiotensin I-converting enzyme (ACE) inhibitory activity
of new *Vitis hybrid* (Sheridan) red wine were investigated.

**Materials and Methods**

**Materials and Chemicals**

Various medicinal plants and grapes harvested in 2010, namely *Rubus coreanus*, *Camellia sinensis* (Tea plant), *Lycium fructus* (Fruits of Gugija), *Morus alba* (Mulberry fruit), *Vitis labruscana B* (Campbell Early), *Vitis coignetiae* (Wild grape) and *Vitis hybrid* (Sheridan), were purchased from the commercial market. *Saccharomyces cerevisiae* KCTC 7904 from the Laboratory of Food Biotechnology at Paichai University (Daejeon, Republic of Korea) was used for preparing the red wines.

The ACE used in this study was extracted overnight from rabbit lung acetone powder (Sigma Chemical Co., St. Louis, USA) using 100 mM sodium borate buffer (pH 8.3) containing 300 mM NaCl at 4°C, and hippuric acid-histidine-leucine were also purchased from Sigma Chemical (St. Louise, MO). Unless otherwise specified, all the chemicals were of analytical grade.

**Vinification of Various *Vitis hybrid* (Sheridan) Red Wines**

*Vitis hybrid* was crushed, and filtered to prepare juice, and then supplemented with various medicinal plants and grapes (10%, w/v), except *Rubus coreanus* (5%, w/v). The mixture was again crushed and then adjusted to 24°brix by the addition of sugar. After adding 150 ppm of K$_2$S$_2$O$_5$, we left the mixture to settle for 5 h and then inoculated with 1% *Saccharomyces cerevisiae* KCTC 7904 which was incubated in must for 24 h. The complex musts were fermented for 10 days at 25°C and filtered and then stored at 4°C for 90 days as post-fermentation [24].

**General Analysis and Sensory Evaluation**

The pH values were measured with a pH meter (Fisher Scientific, Colorado, USA). The titratable acidity was estimated after titration with 0.1 N NaOH to pH 7.0 and calculated the tartaric acid percentage from this value. The ethanol content was determined with an alcoholic meter (Ceti Optical Instruments, Belgium) after water distillation [10]. After the distillation of red wines, we determined the volatile acid in terms of titratable acidity. The reducing sugar content was determined according to the DNS method.

Total anthocyanin and phenol content were determined by the method of Morris *et al.* [19]. The color of the red wines were determined by using Hunter colorimeter (Hunter Associates Laboratories, Reston, USA) and ascribed the values of L (for lightness-darkness), a (for redness-greenness), and b (for yellowness-blueness).

The sensory evaluation of the *Vitis hybrid* red wines was estimated by 10 experienced tasters on the basis of a quantitative descriptive analysis [10]. The taste and odor of the red wines were evaluated on a scale of 1 to 5, where 5 was the best score. The mean scores were obtained and plotted as a polygonal graph. The overall acceptability according to the taste and odor was evaluated by using the mean value of a hedonic scale with scoring values from 1 (extremely disliked) to 9 (extremely well liked).

**Assay of ACE Inhibitory Activity**

The ACE inhibitory activity was assayed according to a modified method of Cushman and Cheung [4]. A mixture containing 100 mM sodium borate buffer (pH 8.3), 300 mM NaCl, 3 units of ACE, and 50 µL of sample (1 mg of the freeze-dried extracts was dissolved in 50 µL of 100 mM sodium borate buffer, pH 8.3) was preincubated for 10 min at 37°C. The reactions was initiated by the adding 50 µL of hippuric-histidine-leucine at a final concentration of 5 mM and terminated after 30 min of incubation by adding 250 mL of 1.0 N HCl. The hippuric acids liberated was extracted with 1 mL of ethyl acetate, and 0.8 mL of the extracts was evaporated until dry using a Speed Vac Concentrator (EYELA, Tokyo, Japan). The residue was then dissolved in 1 mL of the sodium borate buffer, and the absorbance at 228 nm was measured to estimate the ACE inhibitory activity. The inhibition activity was calculated using the following equation.

\[
\text{Inhibition activity (\%)} = \left[1 - \left(\frac{A - B}{C - D}\right)\right] \times 100
\]

Where A is the absorbance of the solution containing ACE, substrate and sample, B is the absorbance of the solution containing ACE and sample without the substrate, C is the absorbance of the solution containing ACE and substrate without the sample, D is the absorbance of the solution containing only substrate.

**C$_{18}$ Solid Phase Extraction**

ACE inhibitor of *Vitis hybrid-Vitis coignetiae* red wine