ORIGINAL

Antioxidative and Antimicrobial Activities of Extracts from Petals of the Tulip (*Tulipa gesneriana* L.)

Makoto OYAIZU^{*1}, Hirokazu OGIHARA^{*2}, and Uhei NARUSE^{*3}

^{*1} Musashino Nutrition College (3-12-5, Minami, Ikebukuro, Toshima-ku, Tokyo, 〒171)

^{*2} College of Bioresource Sciences Nihon University
(3-34-1, Shimouma, Setagaya-ku, Tokyo, 〒154)

^{*3} Kamakura Woman's College (1420, Iwase, Kamakura-shi, Kanagawa-ken, 〒247)

Abstract : A variety of pigments (β -carotene, vitamin E, etc) can be found in plants and their physiological roles are quite important.

In this study, the tulip was selected as the focal point of attention. Samples were extracted from the petals with water and ethanol and antioxidative and antimicrobial activity was assessed.

Determination was also made of extract content, color, pH, α -tocopherol content and absorption spectra. The antioxidative activity of the water extracts showed the following order : red petals > white petals > yellow petals > purple petals > pink petals, and in the ethanol extracts : purple petals = yellow petals > white petals > red petals. The water and ethanol extracts were antibiotic to essentially the same extent.

Key words : tulip, antioxidative activity, antimicrobial activity

1 Introduction

The antioxidative and antimicrobial activity of substances extracted from several plants^{1),2)} was preciously reported. Plants contain many vitamins and pigments and may possibly function to prevent lipid peroxidation and inhibit the formation of lipid peroxides^{3)~5)}.

In this study, examination was made of the flowers of various plants and the tulip was selected as the focal point of attention and the antioxidative and antimicrobial activity of substances extracted from tulip petals was determined.

2 Experimental

2.1 Sample

Petals of tulip (*Tulipa gesneriana* L.) cultivated in Tonami City, Toyama in Japan from late April to the middle of May, 1992 were used. Their colors were red, purple, pink, yellow and white.

2.2 Materials (crude extract preparation)

The extraction was conducted using water and ethyl alcohol (ethanol). The water extracts were prepared by adding distilled water to minced tulip petals, followed by grinding filtrating and freeze drying with a vacuum lyophilizer so that the crude extract would be in powder form. To obtain ethanol extracts, ethanol was added to minced petals, and after standing overnight in a cool dark place, the filtrate was vacuum concentrated to give the crude extract in paste form.

2.3 Crude extract analysis

Crude extract color, content, pH, α -tocopherol content and absorption spectra were determined⁴⁾. α -Tocopherol content was measured by high performance liquid chromatography

Corresponding author : Makoto OYAIZU

(HPLC). The absorption spectra was measured at 380~800 nm with a Spectrophotometer (Hitachi).

2.4 Measurement of antioxidative activity

The degree of antioxidation of the crude extract was estimated based on oxygen absorption (Lu) by using the Warburg manometric method⁴⁾.

2.5 Measurement of antimicrobial activity

Antimicrobial activity of the crude extract was assessed by the disk method, by which inhibition rings⁵⁾ can be measured. The sensitivity of *Staphylococcus aureus* was measured as a gram-positive bacteria, and that of *Escherichia coli*, as a gram-negative bacteria.

All crude extracts were prepared as 0.5 wt% solutions and the disks were moistened during preparation.

The diameter of the circle of inhibition was measured and antimicrobial activity was rated as ; (-) : negative (0 mm), (+) : positive (1~3 mm), (++) : moderately positive (4~6 mm), (+++) : strongly positive (7~10 mm).

3 Results and Discussion

The properties of the crude extracts such as color, content, pH, α -tocopherol content, absorption spectra are shown in Table 1.

The weight of the crude water extract was 1.12~0.65% and 2.55% to 1.21% for the ethanol extract. The pH of all ethanol extracts was less the that of any water extract, and acidic in all cases. α -Tocopherol content of the ethanol extract was 1.31 to 0.50 mg/100 g.

Absorption spectra of the water extracts peaked at 597 nm, and the ethanol extracts peaked at different wavelengths.

Crude extract colors were pale yellow, violet and red, thus suggesting the presence of flavonoid pigments in the yellow extracts⁶⁾ and polyphenol pigments, including anthocyanin^{7),8)}, in the yellow and violet extracts. The crude extracts appeared to contain a wide range of substances hydrophobic or hydrophilic, and thus may have been mixtures poornessing many different pigments.

Crude extracts antioxidative activity data are shown in Table 2.

The order of this parameter for water extracts was as follows : red petals > white petals > yellow petals > purple petals > pink petals, while for ethanol extracts, : purple petals = yellow petals > white petals > red petals. These orders appeared due to carotenoids, flavonoids, or phenols and α -tocopherol possessing OH, based on measurement data. From the present study, antioxidative activity would appear due to low-molecular substances, principally polyphenol compounds⁹⁾, that function in a complex manner, and substances with antioxi-

Table 1 Chemical Analysis of Extracts from Petals of Tulip.

Tulip	Solvent	Extracts color	Extracts content (%)	pH	α -Tocopherol (mg/100 g)	Absorption wave (380~800 nm)
Red	Water	Violet	1.00	5.60	—	597, 513
	Ethanol	Red	2.55	4.65	1.31	587, 568
Purple	Water	Red	1.12	6.00	—	597
	Ethanol	Reddish-violet	2.25	4.85	0.60	546, 597
Pink	Water	Pale pink	0.96	5.00	—	597
	Ethanol	Pale pink	1.75	4.60	0.80	532
Yellow	Water	Pale yellow	0.65	5.20	—	597, 485, 453
	Ethanol	Yellow	1.21	4.80	0.50	597, 460, 435
White	Water	Pale pink	1.00	5.60	—	597
	Ethanol	Pale pink	2.55	4.80	0.70	597

Table 2 Antioxidative Activity of Extract from Petals of Tulip.

Tulip	Antioxidative activity (%) ^{*1}	
	Water extract ^{*2}	Ethanol extract ^{*2}
Red	14.2	25.0
Purple	5.0	31.8
Pink	1.5	2.3
Yellow	10.0	31.8
White	12.5	27.2

*1 Antioxidative activity value were measurement at 60 min.

$$\frac{\text{Blank [oxygen uptake(uL)]} - \text{Sample [oxygen uptake(uL)]}}{\text{Blank [oxygen uptake (uL)]}} \times 100$$

*2 Added 10% extract material

Table 3 Antimicrobial Activity of Extract from Petals of Tulip.

Tulip.	Water extract		Ethanol extract	
	Strains			
	<i>E. coli</i>	<i>S. aureus</i>	<i>E. coli</i>	<i>S. aureus</i>
Red	++* ¹	++	++	++
Purple	++	++	++	++
Pink	++	+	++	+
Yellow	++	++	++	++
White	+++	+++	+++	+++

*1 (-) : negative (0 mm), (+) : positive (1~3 mm), (++) : moderately positive (4~6 mm), (+++) : strongly positive (7~10 mm)

tive activity in the water extracts may contain vitamin C¹⁰⁾ and tannins.

Antimicrobial activity data for the crude extracts are presented in **Table 3**.

Petals are reproductive tissues and may contain the greatest amount of the antibiotic substances¹¹⁾ and this may explain crude extracts in the present study expressed antimicrobial activity toward gram-negative, gram-positive bacteria. The effects of substances from white petals, especially those extracted with water and ethanol, may possibly be due to pigments which possessing phenolic polyphenol, low-molecular, and polyphenol compounds.

4 Conclusion

Antioxidant and antibiotic properties of substances extracted with water and ethyl alcohol from red, purple, pink, yellow and white tulip petals were examined and the following results were obtained.

- 1) The antioxidative activity of the water extracts showed the following order : red petals > white petals > yellow petals > purple petals > pink petals, and in the ethanol extracts : purple petals = yellow petals > white petals > red petals.
- 2) All of the water and ethanol extracts had essentially the same antibiotic activity.

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日本油化学会誌本号掲載 論文要旨

[総説]

高度不飽和油脂の自動酸化に対する
含窒素リン脂質の酸化防止効果

戸 谷 洋一郎

成蹊大学工学部 (〒180 東京都武蔵野市吉祥寺北町 3-3-1)

非水系と乳化系における魚油の 30℃ 自動酸化条件下に、大豆起源のホスファチジルコリン (PC) とホスファチジルエタノールアミン (PE) を用いて、含窒素リン脂質の酸化防止効果を研究した。また、ホスファチジルモノメチルエタノールアミン (PMME)、ホスファチジルジメチルエタノールアミン (PDME)、ホスファチジルセリン (PS)、エチルアミン、*n*-ブチルアミン、スペルミン、セリンのような他のアミノ化合物の酸化防止能についても評価した。

試験した含窒素化合物はトコフェロール混合物と比較して、わずかしき酸化防止能を持っていなかった。しかしながら、トコフェロールに対して PE の顕著な酸化防止相乗作用が上述の両系における魚油の自動酸化において観察された。アミノ化合物の第一級アミノ水素はトコフェロールに対する優れた水素ラジカル供試体として働くと考えられた。

(連絡者：戸谷洋一郎) Vol. 46, No. 1, 3 (1997).

[報文]

チューリップ (*Tulipa gesneriana* L.)
花卉抽出物質の酸化防止性及び抗菌性について小 柳 津 周^{*1}・荻 原 博 和^{*2}・成 瀬 宇 平^{*3}^{*1} 武蔵野栄養専門学校 (〒171 東京都豊島区南池袋 3-12-5)^{*2} 日本大学生物資源科学部 (〒154 東京都世田谷区下馬 3-34-1)^{*3} 鎌倉女子大学 (〒247 神奈川県鎌倉市岩瀬 1420)

植物には、色素やビタミン剤 (β-カロテンやビタミン E など) が多様に存在し、それらが生理活性作用に深く関与していることが知られるようになった。

本研究では、チューリップを選じた。試料はチューリップ花卉から水とエタノールで抽出した、そして酸化防止性と抗菌性を評価した。抽出物質は、含有量、色調、pH、α-トコフェロール量及び吸収スペクトルをそれぞれ測定した。酸化防止性は、水抽出物質で赤色花卉 > 白色花卉 > 黄色花卉 > 紫色花卉 > 桃色花卉、エタノール抽出物質では紫色花卉 = 黄色花卉 > 白色花卉 > 赤色花卉 > 桃色花卉の順であった。さらに、抗菌性は水及びエタノール抽出物質ともに同様の効果を示した。

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[報文]

乳化系におけるリン脂質の酸化防止効果

渡 邊 将 人・原 節 子・戸 谷 洋一郎

成蹊大学工学部 (〒180 東京都武蔵野市吉祥寺北町 3-3-1)

大豆リン脂質から調製したホスファチジルコリン (PC)、ホスファチジルエタノールアミン (PE) 及び PC 濃縮リン脂質 (PC-70) の酸化防止作用とトコフェロールに対する酸化防止相乗効果について、30℃ の自動酸化条件下に精製魚油/水 (3/7, vol/vol) の乳化系を用いて検討した。