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Physiological Activities of *Prunus mume* as Raw Materials of Wine and Liqueur

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The *Prunus mume* is the fruit which is mostly and widely used for the raw materials of liqueur production in Korea, China and Japan. We investigated physiological activities on *Prunus mume* as raw materials of wine and liqueur. Antioxidant activity of *Prunus mume* was evaluated based on peroxide value(POV), thiobarbituric acid reactive substance, and electron-donating ability using DPPH mathod. POVs for soybean oil with 0.02% antioxidants were 276.93, 223.32, 217.38, 238.40 and 226.55 meq/kg in control, ascorbic acid, BHT, extract of dehydrated Maesil flesh, extract of dehydrated Maesil juice. Inhibitory effects by *Prunus mume* extracts on the growth of each cancer cell lines(SNU-16, SNU-C2A) were examined using cytotoxicity test. The treatment of ethylacetate extract resulted in the destruction of the SNU-16 and SNU-C2A cell lines at 100 and 72%, respectively. In liver function test, *Prunus mume* extract exhibited rapid recuperation of liver function. sGPT activity showed an apparent decreasing effect from 6th day, total cholesterol and alkaline phosphatase level from the 10th day compared to the control group in carbon tetrachloride-intoxicated rabbits respectively.

1. Physical and chemical characteristics of *Prunus mume*

Table. 1 Proximate composition of flesh and pomace of *Prunus mume* (g/100g)

	Flesh	Pomace
Moisture	89.94±0.11	91.39±1.63
Crude protein	0.92±0.01	0.86±0.02
Crude lipid	2.28±0.44	0.47±0.01
Crude ash	0.54±0.03	0.40±0.01

(Eun et al., 1999)

Table. 2 The contents of free sugar in flesh and pomace of *Prunus mume* (g/100g)

	Flesh	Pomace
Glucose	0.77±0.02	0.01±0.00
Fructose	0.47±0.02	0.09±0.02
Sucrose	-	-
Mannitol	0.35±0.09	0.38±0.04
Sorbitol	0.47±0.10	0.06±0.00

(Eun et al., 1999)

2. Antioxidant effects of *Prunus mume*

Antioxidant activity of *Prunus mume* was evaluated based on peroxide value(POV), thiobarbituric acid reactive substance, and electron-donating ability using DPPH method. POVs for soybean oil with 0.02% antioxidants were 276.93, 223.32, 217.38, 238.40 and 226.55 meq/kg in control, ascorbic acid, BHT,

Table. 3 The contents of organic acids in flesh and pomace of *Prunus mume* **(g/100g)**

	Flesh	Pomace
Citric acid	3.78±0.32	1.08±0.06
Malic acid	5.22±0.08	0.53±0.01
Oxalic acid	0.13±0.04	0.01±0.00
Succinic acid	-	-
Tartaric acid	-	-
Total	9.13±0.44	1.67±0.07

(Eun et al., 1999)

Table. 4 Changes of peroxide values in soybean oil substrates containing Maesil Extracts and other antioxidants during storage at 60℃ **(meq/kg)**

	Storage time (week)				
	0	1	2	3	4
Control	4.1±0.04	88.61±1.44	157.03±4.54	221.91±1.43	276.93±2.67
EDMJ[1)]	4.1±0.04	63.87±1.93	131.96±2.17	180.65±8.84	226.55±3.31
EDMF[2)]	4.1±0.04	67.20±0.79	136.50±0.90	185.58±1.45	238.40±2.83
BHT	4.1±0.04	58.59±1.01	128.57±0.61	178.75±3.02	217.38±4.97
Ascorbic acid	4.1±0.04	60.21±0.29	130.07±3.42	181.67±5.12	223.32±4.82

[1)] Extract of dehydrated Maesil juice.
[2)] Extract of dehydrated Maesil flesh

(Hwang et al., 2004)

extract of dehydrated Maesil flesh and juice(Table 4).

Antioxidant activities for TBA value were 29.94, 45.35, 13.81, and 25.00% in ascorbic acid, BHT, extract of dehydrated Maesil flesh and extract of dehydrated Maesil juice(Table 5). Electron-donating abilities by DPPH were 96.69, 77.82, 34.84, and 43.50% in ascorbic acid, BHT, extract of dehydrated Maesil flesh and extract of dehydrated Maesil juice at 0.01%(Table 6). The methanolic extract exhibited a potent scavenging effect on DPPH radical and $\cdot O_2^-$, and its AcOEt-, n-BuOH-, and H_2O-soluble portions also exhibited the inhibitory activity. Concentration required for 50% reduction of 40 μ M DPPH radical was 9.2, 10, 6.5, 15, 4.7 and 1.7 μ g/mL in MeOH extract, AcOEt-soluble portion, n-BuOH-soluble portion, H_2O-soluble portion, α -Tocopherol and (+)-Catechin(Table 7).

Table. 5 TBA value of linoleic acid containing Maesil Extracts and other antioxidants

Group	TBA value(%)
Ascorbic acid	29.94±0.41
BHT	45.35±0.82
EDMF[1)]	13.81±3.08
EDMJ[2)]	25.00±3.29

[1)] Extract of dehydrated Maesil flesh
[2)] Extract of dehydrated Maesil juice

Table. 6 Comparison of electron donating ability of EDMF and EDMJ

Group	TBA value(%)
0.01% Ascorbic acid	96.69±0.00
0.01% BHT	77.82±3.31
0.01% EDMF[1)]	34.84±4.36
0.01% EDMJ[2)]	43.50±2.69
0.02% EDMF	53.21±1.51
0.02% EDMJ	59.19±0.30
F-value	204.61[3)]

(Hwang et al., 2004)

Table. 7 Radical scavenging activities of MeOH extract and AcOEt-, n-BuOH-, and H_2O-soluble portions from *Prunus mune*

Treatment	DPPH radical SC_{50}($\mu g/m\ell$)[a)]	.O2⁻ IC50($\mu g/m\ell$)
MeOH extract	9.2	1.7
AcOEt-soluble portion	10	3.1
n-BuOH-soluble portion	6.5	1.5
H2O-soluble portion	15	4.4
α -Tocopherol	4.7	-
(+)-Catechin	1.7	0.49

a) Concentration required for 50% reduction of 40 μ M DPPH radical (Hisashi et al., 2003)

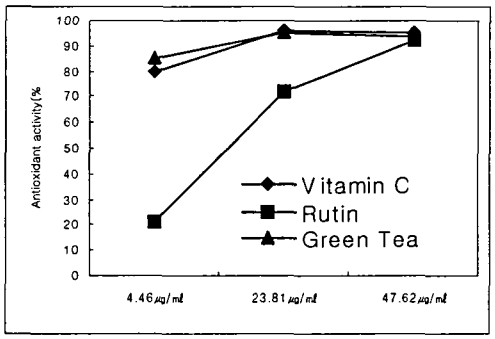

Fig. 1 Electron donating ability of rutin isolated from the *Prunus mume* and other compounds. (Han et al., 2001)

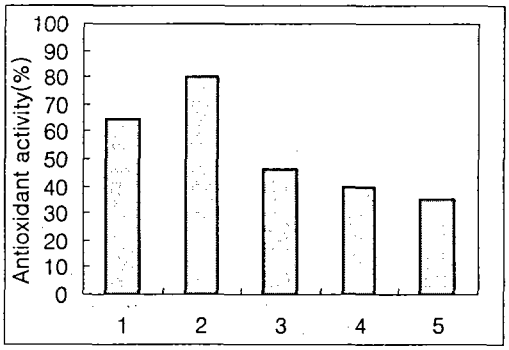

Fig. 2 Linoleic acid antioxidant ability of rutin isolated from the *Prunus mume* and other compounds (Han et al., 2001)
1. Vitamin C 2. BHT 3. Rutin
4. Green tea extract 5. Grape seed extract

3. Protective effects of *Prunus mume* extract against liver injury caused by carbon tetrachloride in rabbits

Rabbits were administered a single dose of carbon tetrachloride to induce acute liver injury. GPT level was markedly increased at 2 days post-treatment with carbon tetrachloride. administration of 200 and 800 mg/kg of *Prunus mume* extracts respectively, significantly reduced the CCl_4-induced acute elevation in the levels of GPT

Table. 8 Effect of *Prunus mume* extract on GPT activity in serum of Carbon tetrachloride- treated rabbits (Karmen units)

Groups	Dose mg/kg-body w.t.	Days				
		before	2	6	10	14
Control	-	44.63±3.14	265.40±11.35	189.75± 6.78	161.24±9.23	140.04±7.30
Group I	200	43.25±2.76	256.32± 8.75	165.35±10.40	140.15±7.88	120.18±6.75
Group II	800	41.50±2.13	243.17± 9.82	149.21±11.30	131.74±6.93	105.00±5.23

(Sheo et al., 1990)

Table. 9 Effect of *Prunus mume* extract on total cholesterol level in serum of Carbon tetrachloride- treated rabbits.

(mg/ml)

Groups	Dose mg/kg-body w.t.	Days				
		before	2	6	10	14
Control	-	55.15±3.73	163.14±9.73	130.19±7.93	119.24±8.75	101.15±7.21
Group I	200	61.33±4.16	150.13±8.15	124.54±8.77	109.27±7.33	86.41±6.37
Group II	800	58.78±3.11	149.33±10.13	113.18±6.75	100.14±6.44	79.35±5.25

Hepatoprotective activity of *Prunus mume* extracts were studied using carbon tetrachloride induced liver injury model in rabbits. *Prunus mume* extracts were decreased total cholesterol levels of serum. (Sheo et al., 1990)

Table. 10 Effect of *Prunus mume* extract on alkaline phosphatase level in serum of Carbon tetrachloride-treated rabbits.

(KA units)

Groups	Dose mg/kg-body w.t.	Days				
		before	2	6	10	14
Control	-	24.35±4.75	82.14±6.54	75.25±6.43	58.75±2.65	48.73±6.72
Group I	200	26.72±3.98	78.15±5.94	69.45±4.35	52.34±4.32	44.37±5.49
Group II	800	23.45±3.17	80.56±6.71	65.23±5.22	42.33±4.25*	33.45±4.42*

(Sheo et al., 1990)

Compared with control group, Group II with administration of 800 mg/kg of *Prunus mume* extracts was markedly decreased Alkaline phosphatase level

Table. 11 Effect of *Prunus mume* extract on total bilirubin levels in serum of Carbon tetrachloride- treated rabbits.

(mg/ml)

Groups	Dose mg/kg-body w.t. (P. O.)	Days				
		before	2	6	10	14
Control	-	0.48±0.04	1.43±0.07	1.37±0.03	1.23±0.05	1.19±0.06
Group I	200	0.52±0.05	1.44±0.06	1.32±0.05	1.18±0.06	1.44±0.05
Group II	800	0.58±0.04	1.35±0.07	1.26±0.08	1.14±0.04	1.98±0.06*

With carbon tetrachloride-induced acute liver injury in rabbits, Treatment of rabbits with *Prunus mume* extract (800mg/kg) reduced levels of total bilirubin levels. (Sheo et al., 1990)

4. Cytotoxic effects of *Prunus mume* extracts

The cellular lethality rate by *Prunus mume* hexane extract on SNU-16 was 38% at 250 μ g/mL, 64% at 500 μ g/mL and 93% at 1000 μ g/mL. The *Prunus mume* ethylacetate extract showed the largest cytocidal effect in which the number of cell decreased significantly starting at the concentration of 250 μ g/mL and all cells were destroyed at 1mg/mL, after 72hr of incubation(Table 12). The *Prunus mume* ethylacetate extract showed the most significant cytotoxic effect on SNU-C2A. The cytocidal rates by *Prunus mume* ethylacetate extract were 32, 61, 72% at 250, 500 and 1000 μ g/mL(Table 13).

Table. 12 Cytotoxic effect of extracts from Prunus mume on the growth of SNU-161)

sample concentration (μg/mL)		Cell number (×104 cells/mL)	Cytotoxic effect(%)
control		12.0±1.37	0
Hexane extract	250	7.5±0.70	38
	500	4.3±0.85	64
	1000	0.9±0.35	93
Chloroform extract	250	10.0±0.70	17
	500	6.0±1.26	50
	1000	3.7±1.24	69
Ethylacetate extract	250	5.0±1.06	58
	500	2.4±0.60	80
	1000	0±0	100
Methanol extract	250	10.6±1.25	12
	500	7.0±1.15	42
	1000	3.6±1.08	70
Hot water extract	250	10.8±0.89	10
	500	8.7±0.95	28
	1000	6.1±1.13	49

[1] The SNU-16 was incubated with each extract for 72hrs (Jung et al., 2002)

Table. 13 Cytotoxic effect of extracts from *Prunus mume* on the growth of SNU-C2A1)

sample concentration (μg/mL)		Cell number (×104 cells/mL)	Cytotoxic effect(%)
control		10.0±2.66	0
Hexane extract	250	7.0±0.96	30
	500	4.2±0.78	58
	1000	4.0±1.04	60
Chloroform extract	250	8.6±1.13	14
	500	7.3±0.95	27
	1000	5.4±0.66	46
Ethylacetate extract	250	6.8±0.56	32
	500	3.9±1.15	61
	1000	2.8±0.44	72
Methanol extract	250	8.8±0.36	12
	500	8.5±0.66	15
	1000	6.4±0.75	36
Hot water extract	250	8.6±0.94	14
	500	7.5±0.79	25
	1000	5.2±1.21	48

[1] The SNU-C2A was incubated with each extract for 72hrs (Jung et al., 2002)

5. Effects on fluidity of blood spiked with the fruit juice concentrate of *Prunus mume*

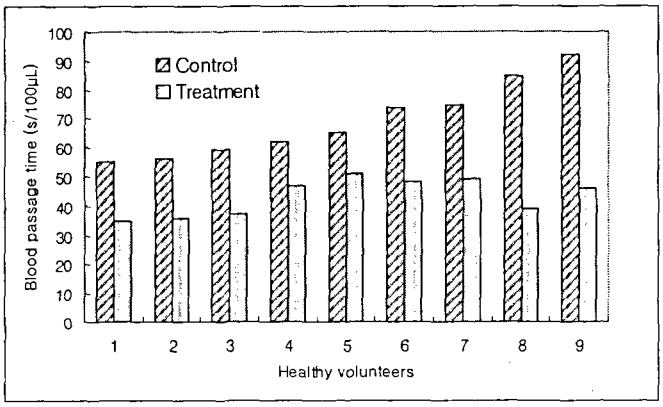

Fig. 3 Effects on Fluidity of blood spiked with the fruit juice concentrate of *Prunus mume*; control, whole blood spiked with saline only; treatment, whole blood spiked with fruit juice concentrate.(Yoshihiro C. et al., 1999)

Control blood fluidity presented individual values, the activity that improves blood fluidity was marked for all subjects; the addition of fruit-juice concentrate to the blood samples reduced the blood passage time to 48-89% that of the control flow.