山蘇葉等加工農產食品之安全性評估

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(接受日期：2005 年 11 月 26 日)

蔡孟君、廖俊旺、曾勝雄、全中和、吳聲舜、楊淑惠、王順成、黃振聲*　2005　山蘇葉等加工農產食品之安全性評估　植保會刊　47：403 – 418

我國加入世界貿易組織（WTO）後，國外各種農產食品進口之種類、數量及進口地區將擴大，為提昇國內農產品之競爭力與附加價值，宜朝向食品加工、精緻化、地域特殊性及多元化的方向發展。高價值的農產加工食品除要求品質優良，尚應注意衛生安全，另外農產食品本身之營養價值及保健功效等特性也應特別注意，如果加工產品之原料為傳統食用，而非以通常加工形式供食者，需進行相關之毒性測試，以確保加工食品之安全性。

本試驗配合農委會農產保健食品開發計畫，及各試驗場所有關地域性鄉土食品之研發，建立農產保健食品之安全性檢測技術，並進行一系列之安全性評估，以利農產保健食品推廣。本研究擬對欲研發之鄉土食品材料，先進行對大鼠口服急毒性試驗，初步評估該加工產品對人體食用之安全性，再隨保健食品研發之進展，依衛生署公告的健康食品安全性試驗及功能性需求，進行更進一步的毒性及功能性試驗，以確保研發加工鄉土食品的附加價值，亦可保障消費者的權益。希冀藉此提升農產保健食品之安全性，並提供政府及民眾對農產保健食品開發之管理及選用安全性之參考。

試驗主要依據行政院衛生署所頒佈「健康食品安全性」評估方法之毒性試驗

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準則[2]，並參考美國環保署農藥安全評估準則「口服急毒性」試驗規範[5]、「28 天餵食毒性」試驗規範[6]，及經濟合作與發展組織「口服急毒性」試驗規範[7]、「28 天餵食毒性」試驗規範[8]。

口服急毒性測試之加工農產食品，包括台中區農業改良場提供的蕎麥茶、薏仁魚腥草茶、薏仁香茹茶、薏山紅麴、山藥紅薏仁、山藥紅薏仁蜂膠粉等 6 種，花蓮區農業改良場提供的山藥葉片大葉種、山藥葉片小葉種、山蘇葉片及桑葉の茶等 4 種，茶葉改良場台東分場提供的佳葉龍茶、綠茶、杭菊包種茶、洛神花紅茶、肉桂紅茶、福鹿紅茶及食茱萸紅茶等 7 種，及農業試驗所鳳山分所提供之萬能薯地上部水萃液。供試袋茶樣品以正常使用為一包之建議沖泡水量（約 450 ml）之 10 倍劑量沖泡，並於沸水中煮沸 30 分鐘，最高投予劑量為沖泡物 15 g/kg body weight；固態樣品則以逆滲透去離子水配製，最高投予劑量為樣品 5 g/kg body weight。試驗時，以塑膠針管套上胃管（管徑大小 16 G，長度 3 英吋），強迫餵飼供試加工農產食品，每組處理 10 隻大鼠（5 雌、5 雄），每隻灌食體積為 10 或 15 ml/kg body weight。口服急毒性試驗觀察在處理後 1、2、4 小時記錄是否出現中毒症狀、症狀發生、復原及死亡時間，並自處理後第二天起，每日觀察一次，一直至處理後第 14 天為止；每週稱大鼠體重一次。試驗期間，若有死亡鼠隻立即解剖進行肉眼病理檢查。28 天餵食毒性試驗以國人較少食用之山蘇葉片水煮液及萬能薯地上部水萃液進行試驗，以最高投予劑量 15 g/kg body weight/day，連續餵飼大鼠 28 天，試驗步驟及觀察同口服急毒性試驗，除每週稱重一次外，並計算飼料消耗量。試驗結束後，自腹部大動脈採集血液，以血球計數儀（Sysmex K-4500, Toa Medical Electronics Co., Ltd., Chuo-Ku, Kobe, Japan）檢測血液相，以自動血清生化儀（Chiron Diagnostics Corporation, Oberlin, OH, USA）檢測血清生化值，並進行大體解剖檢查體內臟器之肉眼病理變化。所有實驗動物之使用與操作均依據『實驗動物管理與使用指南』之規範進行[9]。

試驗結果顯示所有供試樣品經口服急毒性及 28 天餵食毒性試驗，對照組及處理組之大鼠均無中毒症狀或死亡（表一）。口服急毒性試驗對大鼠體重變化：薏仁魚腥草茶處理組雌、雄鼠第 7 天體重較對照組顯著降低（表二），而肉桂紅茶、食茱萸紅茶處理組雌、雄鼠，及杭菊包種茶、洛神花紅茶、福鹿紅茶等水煮液處理組雌鼠之第 7 及 14 天平均體重較對照組顯著下降，洛神花紅茶及福鹿紅茶處理組雄鼠第 14 天之平均體重亦較對照組顯著下降（表二）。血液學分析結果，對照組及各處理組均無顯著異常現象（表三）。口服急毒性試驗對大鼠血清生化相關指標變化影響如表四，山藥紅薏仁、山藥紅薏仁蜂膠粉、薏山紅麴、洛神花紅茶、肉桂紅茶、福鹿紅茶、食茱萸紅茶處理組雌雄鼠之血清三酸甘油脂較對照組顯著降低；洛神花紅茶、肉桂紅茶、福鹿紅茶處理組雌鼠膽固醇值較對照組顯著降低；山藥小葉處理組雄鼠 AST、桑葉の茶處理組雄鼠 BUN、山蘇葉片處理組雌鼠 AST 值較對照組顯著降低，BUN 值則較對照組顯著上升（表四）。

28 天餵食毒性試驗結果，各試驗組大鼠每週平均體重、飼料消耗量及血液學相關指數與對照組比較均無顯著差異（表五、六、七）；萬能薯地上部水萃液 10 g/kg/day 劑量組雄鼠血清三酸甘油脂值較對照組顯著降低，5 g/kg/day 劑量組雌鼠血清 BUN 及三酸甘油脂值則較對照組顯著上升，但均在正常值範圍（表八）。

表一、加工農產食品口服急毒性對大鼠之臨床症狀觀察及死亡分佈

Table 1. Symptoms and time course of death of rats gavaged with processed agricultural foods

Group[1)]	Dose (g/kg)	Symptom	No. of rats observed[2)]													No. of deaths
			Hour			Day										
			1	2	4	1	2	3	4	5	6	7	14	21	28	
Acute oral toxicity																
BT	10	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
JT/HT	10	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
JT/SMT	10	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
Yam/JT	5	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
Yam/JT/BP	5	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
JT/Yam/MC	5	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
YL-S	10	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
YL-L	10	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
NF	10	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
ML	10	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
GABA tea	15	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
GT	15	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
CFPT	15	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
RBT	15	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
CBT	15	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
FLBT	15	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
ABT	15	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
CL	15	Normal	10	10	10	10	10	10	10	10	10	10	10	--	--	0
28-day oral toxicity																
CL	5	Normal	10	10	10	10	10	10	10	10	10	10	10	10	10	0
CL	10	Normal	10	10	10	10	10	10	10	10	10	10	10	10	10	0
CL	15	Normal	10	10	10	10	10	10	10	10	10	10	10	10	10	0
NF	15	Normal	10	10	10	10	10	10	10	10	10	10	10	10	10	0

[1)] BT, buckwheat tea bag; JT/HT, Job's tear and houttuyuis tea bag; JT/SMT, Job's tear and shitake mushroom tea bag; Yam/JT, yam and Job's tear powder; Yam/JT/BP, yam, Job's tear, and bee propolis powder; JT/Yam/MC: Job's tear, yam, and monascus crisps; YL-S, yam leaf, small type; YL-L, yam leaf, large type; NF, bird's nest fern; ML, mulberry leaf; GT, green tea; CFPT, *Chrysanthemi flos* paochung tea; RBT, roselle black tea; CBT, cinnamon black tea; FLBT, fu lu black tea; ABT, ailanthus prickly ash black tea; CL, *Cynanchum* leaf.

[2)] Ten rats were treated in each group (5 males and 5 females).

表二、加工農產食品口服急毒性對大鼠平均體重之影響

Table 2. Body weight changes of rats gavaged with processed agricultural foods

Sex	Group[1)]	Dose (g/kg)	Body weight (g)		
			Day 0	Day 7	Day 14
Male	Control	0	175.0±3.4a[2)]	193.6±5.0a	220.6±16.2a
	BT	10	174.4±3.4a	188.2±6.2ab	203.2±10.2a
	JT/HT	10	174.2±2.0a	185.6±2.4b	205.4±6.0a
	Control	0	164.8±4.1a	188.8±3.7a	239.2±13.1a
	JT/SMT	10	166.0± 3.9a	197.6±12.0a	240.0±15.2a
	Yam/JT	5	166.4±1.5a	190.6±13.9a	240.4±11.2a
	Yam/JT/BP	5	169.2±1.2a	190.2±13.2a	229.2±3.4a
	JT/Yam/MC	5	168.0±2.1a	197.0±3.8a	239.8±9.0a
	Control	0	186.0±3.3a	209.2±5.8a	234.0±6.3a
	YL-S	10	182.8±3.4a	200.2±9.6a	222.6±12.5a
	YL-L	10	185.8±2.6a	201.0±7.7a	220.6±9.7a
	NF	10	185.8±3.2a	197.0±8.0a	214.0±5.4a
	ML	10	171.2±2.7a	198.8±5.7a	216.6±5.9a
Female	Control	0	164.2±2.6a	182.0±4.6a	203.2±10.4a
	BT	10	164.4±3.0a	179.4±4.6ab	200.0±6.3a
	JT/HT	10	165.6±2.1a	173.6±4.5b	192.8±4.6a
	Control	0	155.0±2.8a	176.0±5.2a	198.0±10.9a
	JT/SMT	10	153.2±3.7a	166.4±13.9a	189.0±6.4a
	Yam/JT	5	158.6±1.7a	173.0±10.5a	190.2±7.9a
	Yam/JT/BP	5	157.0±3.1a	178.8±3.2a	200.8±5.3a
	JT/Yam/MC	5	157.0±1.8a	170.8±11.0a	194.6±9.8a
	Control	0	183.2±3.2a	198.8±4.0a	214.6±6.2a
	YL-S	10	181.0±1.1a	184.2±6.5a	199.0±6.9a
	YL-L	10	182.4±3.4a	182.8±9.0a	201.6±9.1a
	NF	10	183.0±2.9a	178.2±7.7a	185.4±10.6a
	ML	10	160.4±1.5a	172.2±1.7a	191.2±11.6a

[1)] Group codes are given in the footnotes to Table 1.

[2)] Mean±S.D., n = 5. Means in a column followed by different letters indicates a significant difference at the $p < 0.05$ level by the LSD test of one-way ANOVA.

表二、加工農產食品口服急毒性對大鼠平均體重之影響（續）
Table 2. Body weight changes of rats gavaged with processed agricultural foods (continued)

Sex	Group[1)]	Dose (g/kg)	Body weight (g)		
			Day 0	Day 7	Day 14
Male	Control	0	164.0±1.3a[2)]	202.6±4.0a	226.0±12.8a
	GABA tea	15	167.4±2.2a	197.4±13.9ab	212.0±15.0ab
	GT	15	166.6±2.6a	194.4±13.5ab	213.6±17.4ab
	CFPT	15	166.0±3.0a	194.8±23.5ab	213.6±16.5ab
	RBT	15	164.4±3.6a	186.2±15.4abc	185.0±17.4c
	CBT	15	168.8±1.9a	169.6±19.4c	177.8±11.8c
	FLBT	15	164.2±4.0a	191.0±8.9abc	194.8±2.6bc
	ABT	15	162.0±2.5a	178.0±16.3bc	187.6±9.5c
	Control	0	189.3±2.6	240.9±4.6	268.7±8.7
	CL	15	187.8±3.8	234.5±7.1	262.0±11.4
Female	Control	0	153.2±3.9a	182.0±8.0a	199.4±6.6a
	GABA tea	15	153.0±4.0a	176.4±7.5ab	186.8±12.3b
	GT	15	153.4±3.6a	181.2±14.6a	197.0±4.8ab
	CFPT	15	151.4±2.8a	163.6±10.2bc	185.2±5.0b
	RBT	15	157.6± .0a	164.0±2.8bc	159.6±9.3c
	CBT	15	155.8±3.0a	154.0±8.1c	156.2±6.8c
	FLBT	15	156.2±4.7a	159.2±14.6c	166.2±11.3c
	ABT	15	156.8±6.7a	161.0±11.5c	161.4±9.1c
	Control	0	158.5±2.8	211.1±4.9	224.0±8.3
	CL	15	156.2±1.8	206.8±7.3	219.8±5.7

[1)] Group codes are given in the footnotes to Table 1.

[2)] Mean±S.D., n = 5. Means in a column followed by different letters indicates a significant difference at the $p < 0.05$ level by the LSD test of one-way ANOVA.

表三、加工農產食品口服急毒性對大鼠之血液學變化

Table 3. Hematology of rats gavaged with processed agricultural foods

Sex	Group[1)]	WBC[2)] (10^3/μl)	RBC (10^6/μl)	Hb (g/dl)	Hct (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Male	Control	6.6±1.2a[3)]	8.1±0.3a	16.5±0.7a	47.4±1.3a	58.2±1.6a	20.2±0.7a	34.7±0.7a
	BT	4.9±0.7b	8.6±0.5a	16.9±0.8a	49.5±2.2a	57.8±1.2a	19.7±0.4a	34.2±0.1ab
	JT/HT	6.3±0.9ab	8.1±0.4a	16.3±0.6a	48.1±2.4a	59.4±1.6a	20.1±0.5a	33.8±0.5b
	Control	9.0±2.4a	6.8±0.4a	13.8±0.4a	41.5±1.4ab	61.3±2.3a	20.3±0.6ab	33.2±0.5a
	JT/SMT	9.1±2.2a	6.1±0.3b	13.2±0.4a	38.8±1.3b	63.2±2.1a	21.5±0.5c	33.9±0.6a
	Yam/JT	7.9±1.2a	6.7±0.5a	14.3±0.9a	42.0±2.2a	62.7±1.8a	21.4±0.6bc	34.0±0.7a
	Yam/JT/BP	6.7±1.3a	6.6±0.4ab	14.0±1.0a	41.2±2.7ab	62.5±2.8a	21.3±1.0bc	34.0± 0.0a
	JT/Yam/MC	8.6±2.5a	6.9±0.2a	14.0±0.4a	41.2±1.1ab	59.9±1.1a	20.3±0.3a	34.0±0.0a
	Control	7.0±0.5a	7.8±0.2abc	16.9±0.4a	45.8±1.3a	58.4±0.7a	21.5±0.2a	36.8±0.5a
	YL-S	6.4±1.5ab	8.1±0.5bc	17.0±0.6a	47.5±2.3ab	58.4±0.5a	20.9±0.5b	35.8±0.7b
	YL-L	4.5±0.8c	7.8±0.4ab	16.3±0.3a	45.4±0.4a	58.4±0.4a	20.9±0.4b	35.8±0.4b
	NF	5.1±1.6bc	8.3±0.3c	17.0±0.5a	48.0±1.4a	58.1±0.8a	20.6±0.4b	35.3±0.5bc
	ML	5.8±1.3abc	7.6±0.4a	14.9±0.9b	43.0±2.7b	56.5±0.8b	19.6±0.4c	34.8±0.3c
Female	Control	5.8±2.1a	7.2±0.5a	15.4±0.6a	42.5±2.1a	59.1±1.5a	21.4±0.7a	36.2±0.5a
	BT	6.7±1.3a	7.1±0.2a	15.4±0.4a	42.2±1.2a	59.5±0.8a	21.7±0.4a	36.4±0.7a
	JT/HT	5.3±1.1a	7.2±0.5a	15.0±0.6a	42.5±2.3a	59.0±1.8a	20.8±0.7a	35.3±0.5b
	Control	6.5±1.8a	6.8±0.3a	14.7±0.7a	41.5±2.2a	61.0±1.7a	21.6±0.7ab	35.4±0.5ab
	JT/SMT	6.5±2.0a	6.8±0.4a	14.5±0.3a	41.3±1.6a	60.5±1.6a	21.3±1.0a	35.2±0.8a
	Yam/JT	5.3±1.5a	6.8±0.5a	15.2±0.6a	42.0±2.1a	61.6±1.6a	22.3±0.7ab	36.2±0.4ab
	Yam/JT/BP	6.7±3.2a	6.9±0.2a	14.8±0.3a	41.2±0.8a	60.2±1.2a	21.7±0.7ab	36.0±0.7ab
	JT/Yam/MC	7.3±2.3a	6.8±0.4a	16.5±2.7a	41.0±1.4a	60.8±1.9a	24.4±3.7b	40.4±7.0b
	Control	7.4±1.0a	6.7±0.1a	15.6±0.4ab	39.9±1.2a	59.3±1.1a	23.3±0.5a	39.2±0.4a
	YL-S	6.3±1.1ab	6.9± 0.3a	15.5± 0.7b	40.2± 2.0a	58.4±0.8a	22.5±0.2a	38.5±0.4ab
	YL-L	6.2±1.5ab	6.7± 0.2a	15.0± 0.4ab	38.9± 0.9ab	58.5± 1.3a	22.5± 0.7a	38.5±0.7ab
	NF	6.1± 1.4ab	7.2± 0.2b	16.2± 0.5a	42.6± 1.2c	58.9± 1.1a	22.4± 0.8a	38.0± 0.7b
	ML	4.9± 1.6b	7.5± 0.2b	15.3± 0.5b	42.2± 1.5bc	56.3± 1.1b	20.4± 0.7b	36.3± 0.9c

[1)] Group codes are given in the footnotes to Table 1.

[2)] WBC, white blood cells; RBC, red blood cells; Hb, hemoglobin; Hct, hematocrit; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration.

[3)] Mean±S.D., $n = 5$. Means in each column followed by different letters indicates a significant difference at the $p < 0.05$ level by the LSD test of one-way ANOVA.

表三、加工農產食品口服急毒性對大鼠之血液學變化（續）

Table 3. Hematology of rats gavaged with processed agricultural foods (continued)

Sex	Group[1)]	WBC[2)] (10^3/μl)	RBC (10^6/μl)	Hb (g/dl)	Hct (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Male	Control	7.1±1.8a[3)]	7.1±0.4a	15.5±0.7a	44.5±1.9a	63.1±2.0a	22.0±0.4a	34.9±0.8a
	GABA tea	4.8±1.2b	7.4±0.4ab	15.6±0.7a	44.9±2.4a	60.7±0.9b	21.1±0.4b	34.7±0.4ab
	GT	5.2±2.2ab	7.6±0.5bc	15.9±1.3ab	46.2±3.5ab	60.7±1.0b	20.9±0.5b	34.4±0.3abc
	CFPT	4.6±1.3b	7.5±0.4abc	15.9±0.8ab	46.1±2.2ab	61.6±0.6ab	21.3±0.3b	34.5±0.5abc
	RBT	3.5±1.0b	8.0±0.4cd	17.0±0.8bc	50.1±1.9c	62.6±0.9a	21.2±0.3b	33.8±0.4c
	CBT	4.1±1.1b	7.9±0.2bcd	16.6±0.5abc	48.9±1.1bc	62.0±0.7ab	21.1±0.3b	34.0±0.3c
	FLBT	3.6±0.8b	7.7±0.1bc	16.4±0.6abc	48.1±1.4bc	62.6±1.3a	21.3±0.6ab	34.1±0.2bc
	ABT	4.5±1.1b	8.2±0.5d	17.3±0.8c	50.5±2.3c	61.3±1.8ab	21.0±0.9b	34.2±0.7abc
	Control	6.4±1.4	7.7±0.2	15.2±0.4	44.5±1.0	57.6±1.7	19.6±0.8	34.1±0.4
	CL	4.0±1.5	7.7±0.8	15.6±1.5	44.7±4.6	58.4±1.2	20.3±0.6	34.8±0.5
Female	Control	7.0±1.5a	6.7±0.2a	14.9±0.4a	40.4±1.4a	60.0±1.0ab	22.2±0.1a	36.9±0.6a
	GABA tea	6.0±1.6ab	7.0±0.2ab	15.0±0.3a	42.0±1.7ab	60.0±1.5a	21.4±0.5b	35.8±0.8b
	GT	6.7±0.7ab	7.2±0.1bcd	15.4±0.2ab	43.7±1.1bc	60.7±0.9abc	21.4±0.6b	35.3±1.0bc
	CFPT	7.2±2.7a	7.1±0.4abc	15.2±0.6ab	42.9±1.7b	60.8±1.2abc	21.5±0.6ab	35.4±0.3bc
	RBT	4.4±1.1b	7.7±0.5e	16.4±0.7cd	47.4±2.3d	61.9±1.5c	21.4±0.4b	34.6±0.4c
	CBT	4.7±1.5ab	7.4±0.2cde	15.9±0.3bc	45.8±1.3cd	61.7±1.0bc	21.4±0.3b	34.6±0.3c
	FLBT	6.0±2.0ab	7.6±0.1de	16.3±0.4cd	46.4±1.6d	60.8±1.4abc	21.3±0.4b	35.2±0.6bc
	ABT	6.2±2.0ab	7.7±0.3e	16.7±0.8d	47.5±2.3d	62.0±1.5c	21.8±0.7ab	35.1±0.5bc
	Control	6.0±0.5	6.6±0.2	14.3±0.6	38.7±1.7	58.9±0.9	21.8±0.3	37.0±0.2
	CL	4.9±1.6	6.8±0.4	14.7±0.5	40.3±1.6	59.0±1.0	21.6±0.7	36.6±0.6

[1)] Group codes are given in the footnotes to Table 1.

[2)] WBC, white blood cells; RBC, red blood cells; Hb, hemoglobin; Hct, hematocrit; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration.

[3)] Mean±S.D., $n = 5$. Means in each column followed by different letters indicates a significant difference at the $p < 0.05$ level by the LSD test of one-way ANOVA.

表四、加工農產食品口服急毒性對大鼠之血清生化值影響

Table 4. Serum biochemistry of rats gavaged with processed agricultural foods

Sex	Group[1)]	ALT[2)] (U/l)	AST (U/l)	BUN (mg/dl)	Cholesterol (mg/dl)	Creatinine (mg/dl)	Triglyceride (mg/dl)
Male	Control	37.6±7.8a[3)]	103.6±19.5a	22.8±5.1a	64.6±9.8a	0.64±0.1a	30.4±11.6a
	BT	41.7±8.4a	99.1±11.6a	21.5±1.5a	67.2±8.1a	0.52±0.0b	25.6±14.5a
	JT/HT	36.0±6.9a	93.3±6.7a	21.1±2.2a	66.2±7.0a	0.54±0.1b	21.4±6.1a
	Control	58.8±9.3a	95.1±6.0ab	18.3±2.2a	62.2±5.9a	0.6±0.1a	92.6±12.3a
	JT/SMT	47.9±6.7a	78.7±11.8a	19.6±2.9a	64.2±10.1a	0.5±0.0b	69.0±18.8b
	Yam/JT	53.5±9.7a	83.0±9.9a	19.7±3.6a	63.8±7.6a	0.5±0.0b	61.8±7.6bc
	Yam/JT/BP	45.1±6.1a	84.4±11.5ab	20.2±2.2a	65.2±12.5a	0.5±0.0b	44.4±17.9cd
	JT/Yam/MC	50.7±9.4a	101.4±14.1b	15.9±2.1a	68.4±2.4a	0.5±0.0b	38.8±7.0d
	Control	35.6±8.2a	90.2±8.4ab	16.0±2.6ab	60.8±4.7a	0.6±0.1ab	42.6±2.7ab
	YL-S	31.1±8.1a	71.8±3.0c	16.6±2.0ab	63.4±5.6a	0.5±0.0ab	33.4±8.5b
	YL-L	30.7±4.3a	96.6±7.1a	14.5±2.5b	60.6±4.1a	0.5±0.1ab	35.0±9.7b
	NF	34.8±5.8a	81.6±13bc	18.5±2.7a	63.8±6.7a	0.6±0.1a	25.4±8.0b
	ML	38.9±4.7a	79.9±6.3bc	10.6±1.5c	54.8±10.7a	0.5±0.0b	55.2±22.9a
Female	Control	26.0±5.0a	80.5±12.0a	18.9±1.8a	86.8±9.5a	0.7±0.0a	37.4±24.1a
	BT	24.9±7.0a	74.3±7.7a	18.5±5.7a	84.8±13.0a	0.5±0.1b	35.6±17.6a
	JT/HT	22.5±4.7a	71.3±12.8a	19.1±4.9a	81.8±4.4a	0.5±0.1b	37.2±33.5a
	Control	37.4±8.2a	83.2±6.7ab	20.3±3.5ab	78.6±10.3a	0.5±0.0a	58.0±15.8a
	JT/SMT	40.9±9.1a	77.2±11.4a	28.3±8.3b	67.4±8.7b	0.4±0.0a	60.8±20.2a
	Yam/JT	33.8±3.6a	78.0±6.4a	18.1±3.8a	72.8±6.2ab	0.5±0.0a	33.2±8.7b
	Yam/JT/BP	43.1±8.4a	94.8±14.0b	24.1±4.7ab	74.4±3.6ab	0.5±0.1a	35.6±12.7b
	JT/Yam/MC	35.9±4.0a	88.3±8.2ab	24.0±4.1ab	82.0±1.3a	0.5±0.1a	34.0±4.3b
	Control	22.8±3.0ab	80.7±4.6a	17.1±1.5a	76.0±14.3a	0.6±0.1a	42.0±15.7ab
	YL-S	23.8±2.2ab	83.8±9.5a	15.8±2.6a	91.2±13.6a	0.6±0.1a	45.8±7.5ab
	YL-L	21.3±2.4b	72.57.7ab	20.0±2.4a	83.4±14.3a	0.7±0.1a	34.0±8.6ab
	NF	24.5±4.4ab	67.3±8.4b	27.4±9.1b	85.2±15.8a	0.6±0.1a	30.4±4.6b
	ML	27.4±4.3a	83.8±7.9a	21.2±4.3ab	77.0±15.0a	0.6±0.0a	48.0±17.0a

[1)] Group codes are given in the footnotes to Table 1.

[2)] ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen.

[3)] Mean±S.D., $n = 5$. Means in each column followed by different letters indicates a significant difference at the $p < 0.05$ level by the LSD test of one-way ANOVA.

表四、加工農產食品口服急毒性對大鼠之血清生化值影響（續）

Table 4. Serum biochemistry of rats gavaged with processed agricultural foods (continued)

Sex	Group[1)]	ALT[2)] (U/l)	AST (U/l)	BUN (mg/dl)	Cholesterol (mg/dl)	Creatinine (mg/dl)	Triglyceride (mg/dl)
Male	Control	32.0±0.4a[3)]	85.0±7.8a	16.2±0.8abc	75.6±7.6a	0.5±0.0a	51.8±24.5a
	GABA tea	35.4±1.7ab	77.8±12.4a	13.7±1.4ab	74.8±7.4a	0.4±0.1a	35.4±4.2ab
	GT	36.1±5.2ab	86.0±7.5a	18.7±3.6bcd	82.0±7.3a	0.5±0.0a	36.4±17.9ab
	CFPT	26.4±6.1a	79.9±13.4a	21.9±5.6d	95.4±15.1b	0.6±0.1b	35.4±14.1ab
	RBT	35.3±3.3ab	88.3±15.4a	19.9±5.8cd	76.4±8.3a	0.5±0.1ab	26.8±7.7b
	CBT	44.3±21b	92.4±43.9a	18.6±1.7bcd	72.6±7.9a	0.5±0.1a	18.2±4.0b
	FLBT	30.1±5.3a	91.9±8.2a	13.3±1.5a	72.2±7.2a	0.5±0.0a	25.0±6.3b
	ABT	36.0±4.8ab	89.6±13.2a	19.9±4.5cd	74.0±6.2a	0.4±0.1a	19.2±8.0b
	Control	42.9±6.5	96.9±8.0	21.1±2.2	54.6±6.9	0.5±0.1	78.0±19.0
	CL	34.1±11.3	88.9±11.6	25.6±2.6	60.2±9.8	0.5±0.0	44.4±2.6
Female	Control	28.4±3.6a	79.2±10.5a	18.3±2.6a	81.4±2.4bc	0.5±0.1a	45.2±17.4ab
	GABA tea	30.9±8.7a	87.1±15.4a	18.5±1.6a	82.4±9.5b	0.5±0.0a	58.6±13.3a
	GT	26.1±2.6a	76.0±5.9a	16.0±2.2a	98.2±11.9a	0.5±0.0a	54.6±6.4a
	CFPT	26.0±2.9a	80.3±4.7a	16.3±1.5a	101.4±17a	0.5±0.1a	36.4±4.8bc
	RBT	32.4±5.4a	85.7±6.4a	16.6±3.5a	56.6±9.9de	0.5±0.0a	27.2±5.7cd
	CBT	34.5±5.0a	88.8±7.1a	16.8±2.4a	53.8±6.3e	0.5±0.1a	34.2±5.1bc
	FLBT	64.6±43.7b	79.8±10.7a	19.0±1.6a	56.6±6.4de	0.5±0.1a	40.2±13.6bc
	ABT	22.7±4.0a	73.4±5.6a	24.9±3.4b	68.0±6.1cd	0.5±0.1a	19.8±3.4d
	Control	35.1±5.2	94.0±18.1	39.6±2.5	78.0±11.7	0.6±0.1	61.4±6.9
	CL	30.7±5.7	82.8±6.5	28.7±12.8	71.2±7.6	0.6±0.1	59.2±11.3

[1)] Group codes are given in the footnotes to Table 1.

[2)] ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen.

[3)] Mean±S.D., $n = 5$. Means in each column followed by different letters indicates a significant difference at the $p < 0.05$ level by the LSD test of one-way ANOVA.

表五、萬能薯地上部水萃液及山蘇水煮液 28 天餵食毒性對大鼠之平均體重影響

Table 5. Body weight changes of rats after 28 days of feeding with *Cynanchum* leaf and bird's nest fern

Sex	Group[1)] (g/kg)	Body weight change (g)				
		Day 0	Day 7	Day 14	Day 21	Day 28
Male	Control	169.2±7.4a[2)]	263.2±12.9a	315.2±15.9a	350.4±19.5a	375.6±22.0a
	CL (5)	171.4±8.9a	270.4±18.9a	335.2±21.3a	374.1±20.9a	399.7±23.4a
	CL (10)	170.2±10.1a	266.0±10.9a	325.1±13.4a	363.0±24.4a	379.9±24.6a
	CL (15)	170.4±10.3a	261.2±8.6a	320.1±11.4a	356.8±13.9a	382.7±19.5a
	NF (15)	168.8±6.0a	261.9±13.5a	322.5±16.4a	359.5±22.1a	386.6±24.2a
Female	Control	142.5±5.9a	197.8±8.7a	221.4±15.8a	243.9±17.2a	257.9±15.0a
	CL (5)	141.8±5.7a	190.7±6.7a	223.1±15.1a	228.9±15.4a	243.5±18.5a
	CL (10)	142.3±7.1a	193.8±7.6a	225.6±13.6a	239.1±15.1a	248.6±14.9a
	CL (15)	144.7±8.7a	192.4±14.5a	216.3±22.8a	228.3±21.0a	237.4±19.1a
	NF (15)	143.0±6.2a	194.3±4.6a	223.6±11.2a	235.7±14.6a	248.1±10.9a

[1)] CL, *Cynanchum* leaf; NF, bird's nest fern.

[2)] Mean±S.D., $n = 5$. Means in a column followed by different letters indicates a significant difference at the $p < 0.05$ level by the LSD test of one-way ANOVA.

表六、萬能薯地上部水萃液及山蘇水煮液 28 天餵食毒性對大鼠飼料消耗量影響

Table 6. Feed consumption changes of rats after 28 days of feeding with *Cynanchum* leaf and bird's nest fern

Sex	Group[1)] (g/kg)	Feed consumption (g)			
		Week 1	Week 2	Week 3	Week 4
Male	Control	188.9±16.6a[2)]	197.4±15.5a	187.6±13.9a	170.8±11.4a
	CL (5)	186.5±19.4a	212.2±15.0a	204.6±7.9a	183.4±9.8a
	CL (10)	180.8±2.9a	212.7±6.0a	202.9±19.3a	183.2±13.9a
	CL (15)	173.5±7.3a	202.3±9.6a	200.2±11.3a	180.0±11.6a
	NF (15)	186.1±15.5a	213.9±6.8a	202.1±10.4a	186.3±9.6a
Female	Control	145.5±13.7a	162.2±40.0a	142.5±4.7a	147.0±28.7a
	CL (5)	144.5±11.6a	167.1±28.9a	141.5±22.6a	125.2±11.2a
	CL (10)	151.8±4.7a	156.3±14.4a	146.2±14.9a	138.1±7.0a
	CL (15)	140.9±13.2a	145.8±22.9a	137.6±15.4a	121.8±7.8a
	NF (15)	150.7±8.9a	155.3±26.1a	146.5±11.2a	148.8±25.4a

[1)] CL, *Cynanchum* leaf; NF, bird's nest fern.

[2)] Mean±S.D., $n = 5$. Means in a column followed by different letters indicates a significant difference at the $p < 0.05$ level by the LSD test of one-way ANOVA.

表七、萬能薯地上部水萃液及山蘇水煮液 28 天餵食毒性對大鼠之血液學變化

Table 7. Hematology of rats after 28 days of feeding with *Cynanchum* leaf and bird's nest fern

Sex	Group[1)] (g/kg)	WBC[2)] ($10^3/\mu l$)	RBC ($10^6/\mu l$)	Hb (g/dl)	Hct (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Male	Control	7.7±0.9a[3)]	7.4±0.3a	15.7±0.5a	46.9±2.4a	63.1±1.3a	21.2±0.6ab	33.6±1.0ab
	CL (5)	5.5±1.2a	7.4±0.3a	15.6±0.5a	46.7±1.8a	63.1±2.1a	21.0±0.5ab	33.3±0.6ab
	CL (10)	6.5±1.5a	7.7±0.1a	15.8±0.3a	47.7±1.2a	62.0±1.0a	20.5±0.4a	33.1±0.5a
	CL (15)	5.9±2.0a	7.4±0.3a	15.7±0.2a	46.7±0.9a	63.2±1.7a	21.2±0.7ab	33.5±0.5ab
	NF (15)	7.3±2.3a	7.5±0.3a	16.2±0.6a	47.6±2.0a	63.1±1.5a	21.5±0.7b	34.1±0.5b
Female	Control	4.2±0.6a	6.9±0.4a	14.7±0.3a	41.9±1.0a	60.7±2.8a	21.3±1.0a	35.1±0.5a
	CL (5)	4.6±0.5a	7.1±0.3a	15.2±0.8ab	42.5±2.3a	60.2±1.4a	21.4±0.6a	35.6±0.4a
	CL (10)	7.7±2.2b	7.0±0.3a	15.2±0.3ab	42.7±0.7a	60.7±1.8a	21.7±1.1a	35.7±1.0a
	CL (15)	5.5±2.1ab	7.2±0.2a	15.6±0.3b	44.0±1.5a	60.9±2.0a	21.6±0.7a	35.5±0.8a
	NF (15)	5.3±1.7ab	7.1±0.3a	15.7±0.6b	43.8±1.8a	61.9±1.1a	22.2±0.6a	36.0±0.6a

[1)] CL, *Cynanchum* leaf; NF, bird's nest fern.

[2)] WBC, white blood cells; RBC, red blood cells; Hb, hemoglobin; Hct, hematocrit; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration.

[3)] Mean±S.D., $n = 5$. Means in a column followed by different letters indicates a significant difference at the $p < 0.05$ level by the LSD test of one-way ANOVA.

表八、萬能薯地上部水萃液及山蘇水煮液 28 天餵食毒性對大鼠之血清生化值影響

Table 8. Serum biochemistry of rats after 28 days of feeding with *Cynanchum* leaf and bird's nest fern

Sex	Group[1)] (g/kg)	ALT[2)] (U/l)	AST (U/l)	BUN (mg/dl)	Cholesterol (mg/dl)	Creatinine (mg/dl)	Triglyceride (mg/dl)
Male	Control	36.4±7.7ab[3)]	72.0±11.6a	22.0±1.2a	96.8±6.1a	0.6±0.0a	50.8±8.9a
	CL (5)	42.2±5.9b	85.0±10.3a	23.0±1.7a	102.0±4.2a	0.5±0.1ab	44.0±14.4ab
	CL (10)	34.2±8.0ab	72.6±12.0a	20.0±10.0a	99.4±5.8a	0.5±0.1b	32.6±8.8b
	CL (15)	34.1±4.2ab	79.4±5.0a	20.0±2.5a	102.4±2.8a	0.6±0.1ab	47.2±6.3a
	NF (15)	32.2±2.2a	82.4±3.4a	20.0±2.1a	100.8±2.6a	0.6±0.1ab	37.4±7.2ab
Female	Control	33.4±2.4a	104.1±10.6a	23.7±1.7a	100.4±3.0a	0.6±0.1a	30.6±3.0ab
	CL (5)	34.4±5.0a	99.5±12.1a	28.5±3.8b	104.4±2.2a	0.7±0.1b	40.2±8.1c
	CL (10)	28.1±5.0a	96.1±6.5a	24.0±3.0a	104.4±2.9a	0.6±0.1ab	28.4±3.6a
	CL (15)	31.2±2.7a	112.4±24.9a	26.0±3.6ab	106.8±2.7a	0.6±0.1ab	38.6±7.7bc
	NF (15)	31.2±6.7a	93.6±14.2a	23.7±2.8a	106.0±3.2a	0.7±0.0b	33.4±7.4abc

[1)] CL, *Cynanchum* leaf; NF, bird's nest fern.

[2)] ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen.

[3)] Mean±S.D., $n = 5$. Means in a column followed by different letters indicates a significant difference at the $p < 0.05$ level by the LSD test of one-way ANOVA.

綜合以上試驗結果，上述供試加工農產食品經強迫餵飼大鼠後均無中毒症狀或死亡，解剖檢查體內臟器亦無明顯肉眼病理變化，對大鼠之口服急毒性 LD_{50} 值大於 5 g/kg body weight。28 天餵食毒性試驗，萬能薯地上部水萃液 5、10、15 g/kg/day 及山蘇 15 g/kg/day 處理組鼠隻均無中毒症狀或死亡，體重、飼料消耗量與對照組比較無顯著差異，血液學及血清生化學無明顯異常現象，顯示萬能薯地上部水萃液及山蘇葉片 28 天餵食試驗之無毒害作用劑量（no observed adverse effect level, NOAEL）大於 15 g/kg body weight/day。

據前人動物試驗及細胞試驗結果顯示，農產品除食用之營養價值外，尚兼具保健功效，例如：薏仁具降低過敏反應[10]、抑制腫瘤生成[11, 12]及降低血清脂質等功效[1, 13, 14]；茶葉具降低血清膽固醇值、降低心血管疾病發生[3, 15, 16]、增加抗氧化活性[3, 17, 18]，並可抑制腫瘤生成等功效[19, 20, 21]。依據本實驗口服急毒性中體重結果顯示，部份農產保健食品處理組大鼠體重及血清中之膽固醇、三酸甘油脂較對照組顯著降低，顯示此類農產品應具有降低血中膽固醇及三酸甘油脂之效用；此外，萬能薯（*Cynanchum taiwanianum* Yamazaki）為南台灣特產之一，一般以食用其塊根為主，經研究證實其具有護肝之保健功效[4, 22]，山蘇（*Asplenium australasicum* (J.Sn.) Hook.）葉片亦為民間常用的食材之一，唯此二種植株之水萃取液安全性並未被證實。本試驗以萬能薯地上部水萃液及山蘇葉片水煮液投予大鼠連續 28 天，結果顯示其對大鼠之 28 天餵食毒性 NOAEL 值大於 15 g/kg body weight/day，唯萬能薯與山蘇之品種繁多，不同品種間之毒性與功效是否具顯著差異，則仍待實驗證實。

具有保健功效食品可作為疾病治療之輔助食品，有益人體健康，目前各種農產保健食品開發日益增多，唯部份加工農產品食用安全性仍未知。由於民眾醫學專業知識的不足，加上炒作和誇大宣傳，藥用與保健植物及保健農產食品品質良莠不齊。由於農產品被當作保健食品而經加工濃縮後，主要成份含量提高，加上消費者長期大量攝取之飲食習慣，將提高毒性風險，且自然界植物常存在數種植物鹼（pyrrolizidine alkaloids），如 senkirkine 及 symphytine，經試驗證實具肝毒性，甚至造成大鼠肝腫瘤產生[23]，因此，加工農產品作為保健食品而被長期食用之安全性乃不容忽視。

(關鍵詞：加工農產品、口服急毒性、28 天餵食毒性)

謝　辭

本試驗由行政院農業委員會藥物毒物試驗所科技計畫經費補助，計畫編號：93 農科-5.1.3-藥-P1。試驗期間蒙彭明霞、邱秀英、黃淑珍、劉清標、湯秀枝及高鳳凰等協助，謹此誌謝。另本報告編入行政院農業委員會藥物毒物試驗所發表論著第 9419 號。

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ABSTRACT

Tsai, M. C.[1], Liao, J. W.[2] Tseng, S. H.[3], Chuan, C. H.[4], Wu, S. S.[5], Yang, S. H.[6], Wang, S. C.[7], and Hwang, J. S.[1]* 2005. Safety evaluation of processed agricultural foods. Plant Prot. Bull. 47: 403-418. ([1] Applied Toxicology Division, Taiwan Agricultural Chemicals and Toxic Substances Research Institute, Council of Agriculture, Wufeng, Taichung 413, Taiwan (ROC); [2] Institute of Veterinary Pathology, National Chung Hsing University, Taichung 402, Taiwan (ROC); [3] Taichung District Agricultural Research and Extension Station, Council of Agriculture, Tatsuen, Changhua 515, Taiwan (ROC); [4] Hualien District Agricultural Research and Extension Station, Council of Agriculture, Chi-an, Hualien 973, Taiwan (ROC); [5] Taitung Branch, Tea Research and Extension Station, Council of Agriculture, Luye, Taitung 955, Taiwan (ROC); [6] Department of Management and Utilization, Fengshan Tropical Horticultural Experiment Station, Agricultural Research Institute, Council of Agriculture, Fengshan, Kaohsiung 830, Taiwan (ROC); [7] Department of Environmental Engineering and Management, Chaoyang University of Technology Taichung 413, Taiwan (ROC))

The aim of this study was to evaluate the acute oral toxicity and 28-day oral toxicity of processed agricultural foods for health care. Eighteen processed agricultural food products from an agricultural research institute and various extension stations of the Council of Agriculture were submitted to acute oral toxicity studies at a limited dose of 15 g/kg body weight for liquid substances and 5 g/kg body weight for solid substances. Toxicity testing was performed according to the guidelines of Health Food Control announced by the Department of Health. Tea products were boiled in reverse-osmosis water for 30 min. Solid or powder products were suspended in reverse-osmosis water. Results revealed that all treated rats survived the 14-day inspection. No gross lesions were found in any organs of treated rats. In addition, body weight in the test groups treated with Job's tears and nouttuyuis tea bag (JT/HT), *Chrysanthemi flos* paochung tea (CFPT), roselle black tea (RBT), cinnamon black tea (CBT), fu lu black tea (FLBT), and ailanthus prickly ash black tea (ABT) showed a significant decrease compared to the control group. Serum cholesterol in the RBT, CBT, and FLBT groups and triglyceride in the yam/JT, yam/JT/bee propolis powder (BP), JT/yam/monascus crisps (MC), RBT, CBT, FLBT, and ABT groups showed significant decreases compared to the control group ($p < 0.05$). The LD_{50} values of the acute oral toxicity of the tested processed agricultural foods were greater than 5 g/kg body weight. In the 28-day oral toxicity tests, water extracts of *Cynanchum taiwanianum* Yamazaki were used at doses of 5, 10, and 15 g/kg body weight/day, and bird's nest fern (*Asplenium australasicum*) was used at a

dose of 15 g/kg body weight/day. Results revealed that all treated rats survived 28 days of treatment. Body weight and feed consumption showed no differences compared to the control group. Hematological and serum biochemical parameters were all within normal ranges. The no observed adverse effect level (NOAEL) of the 28-day feeding test for both products were greater than 15 g/kg body weight/day. The results provide useful data for safety evaluation of local processed agricultural foods for health care.

(Key words: processed agricultural foods, acute oral toxicity, 28-day oral toxicity)

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