

Health claim's assessment process of herbs as supplemented food or functional ingredient for food in Taiwan

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A case study workshop: Health claim's regulatory assessment process

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**Junction for the health and preventive medicine
of the functionality of agricultural and foods**

**Non-communicable diseases (life style)
and Health !**

**CAM (complementary and alternative medicine):
1997, NCCAM (national center of CAM, USA)**

Non-communicable diseases and health

腳部痛風石



手部痛風石





The World Declaration of Nutrition and Global Plan of Action: Highlights Rome 1992

- Everyone has **right to get nutrition and safe food.**
- Nutrition is closely associated with **social development and is also the target of human progress.**

WHO/WHA 57

Resolution and strategy



WORLD HEALTH ORGANIZATION

GLOBAL STRATEGY

ON DIET, PHYSICAL ACTIVITY AND HEALTH

In May 2004, the 57th World Health Assembly (WHA) endorsed the World Health Organization (WHO) Global Strategy on Diet, Physical Activity and Health. The Strategy was developed through a wide-ranging series of consultations with all concerned stakeholders in response to a request from Member States at World Health Assembly 2002 (Resolution WHA55.23).

The Strategy, together with the Resolution by which it was endorsed (WHA57.17), are contained in this document.

Nutrition deficiency and Health

- **Overweight & Obesity**
- **Low vegetables fruits and dairy intake**
- **Low Vit B1, B2, B6, folic acid, Mg, K**
- **Low calcium**
- **High protein and lipid and low CHO**
- **High sweet drink and fried food**
- **Nutritional education and environment**

What is Nutrition?

- Vitamins, minerals?
- Carbohydrates, Lipids, Proteins?
- Phytochemicals?
- Nutritional supplement?
- Functional foods?
- Herbs?

■ **For Health.....!!**

**From individual to community, education,
policy**

Chance for agricultural and foods

- CAM as a group of diverse medical and health care systems, practices, and products that are not generally considered part of **conventional medicine** (also called Western or allopathic medicine)
- **herb, acupuncture, magnetic treatment, functional foods, nutraceuticals —evidence based (safety and effectiveness)**


Market status of functional food in USA, Europe and Japan

		USA	Europe	Japan
Marketing (USD)		26.18 billion	24.64 billion	19.25 billion
Points from consumers		What an ingredient does	---	
Law	Ordinary foods	Nutrition labeling and Education Act (1990)	ILSI-Europe opinion(CODE X Alimentarius)	Food for Specific Health Use Act(1991)
	Dietary supplements	Dietary Supplement Health and Education (1994)	X	Health food Manufactures Association
	Approved	X	X	V
Tren	Health benefits	Heart health and body weight reduction	Immune, digestion	Immune and digestion
	Popular materials and products	Vitamins, minerals, plant extracts	Probiotics, dietary finber	Dietary fiber, specific proteins
	Major types	Bar, cereal, drink	Dairy, drink	Special oils

Herbs allow to be used as food in Taiwan

According to the "discretionary staging" principle, so far has announced 215 kinds of "can provide food use of Chinese herbal medicines" items in Taiwan, as the followings:

- **Vegetables:** lily, lotus leaf, tremella, yam, ginger, lettuce, laminaria, leek (not including seeds), onion, xiebai, hu (Garlic), brassica (rapeseed), (cabbage), mustard, white mustard (does not contain seeds), turnip (speedwell), sulforaphane (radish) (not containing seeds), celery, chrysanthemum, coriander, carrot, basil, fragrant (anise), dill (cumin), pineapple, chayote, alfalfa, amaranth, portulaca oleracea, lettuce, cucumber cuisine, taro, taro, gan chip, bamboo shoots, sour bamboo shoots, grass-stone silkworm, eggplant, kettle lou, Wax gourd (does not contain seeds), pumpkin, zucchini, loofah, balsam pear, laver, stone flower, gelidium, carrageenan, dragon vegetable, lotus root, garlic (small garlic) burdock (root), fanyi lou (goose intestines vegetable), jew's ear, mustard, champignon, seaweed, konnyaku.
- **Fruit:** longan pulp, prune, olive, medlar, plum, plum, peach (not including seeds), chestnut, jujube, pear, mountain zha, ann pomegranate, tangerine, citrus, orange, pomelo, citric, kumquat, loquat, cherry, litchi (not including seeds), longan (without seeds), long lai, olive, coconut, pineapple luo mi, fig, Qin Yu (Pepper, peppers, tea, melon, watermelon, grapes, peach, sugarcane, sugar, red and white lotus, Ji (water chestnut), gorgon, oolong, apricot (fruit), persimmon, red dates.
- **Grains:** soybean, sesame, pine nut, walnut, mung bean, malt, flax, flax, wheat, barley (not including barley bud), buckwheat, Rice, japonica, indica (early rice), millet, millet, maize, Shu (glutinous), yellow soybeans, white beans, peas, cowpea, soya beans, tofu, rice, porridge, rice cakes, dumplings, steam cake, caramel, sauces, vinegar, wine , soju, wine, rice, lotus seeds, Chixiaodou (red beans), oat, broad bean, chestnut, salt, coix seed, black beans.
- **Fish, clam, shrimp, crab:** mussels, oysters (shells), snakehead fish, carp, trout, carp fish (grass carp), mussels, crucian carp, perch, shark, grouper, goldfish, puffer fish, sturgeon, eel fish, catfish (catfish), yellow croaker, dolphin fish, flounder, mackerel, squid, octopus, shrimp, abalone, roe, turtle, crab, clams。
- **Animals:** ragweed, dogs, sheep, gazelle, ox, horse, donkey, mule, yak, yak, wild horse, wild boar, goat, deer, rabbit, chicken, partridge, bamboo chicken, quail, pigeon, finch, turtle dove, shrike, ostrich, pheasant.
- **Other categories:** chrysanthemum, honey, yellow essence, mint, milk, gynostemma pentaphyllum, Cassia seed, Dendrobium, tangerine peel, nutmeg, grass cardamom, flower, anise, ginseng flowers.



Potential Herbs (45 items) and
allowed herbs for functional foods
(*) around the world

「研發健康食品可參考的中藥材品項」

*：目前已為國內健康食品材料者

建議為健康食品-中醫藥委員會已公告為可同時供食品使用之中藥材		
中藥材原料	各國健康食品使用情形分析	建議功效
*大蒜 (<i>Allium sativum</i> L.; 百合科植物的鱗莖)	在台灣、加拿大、美國及中國大陸可用於保護心血管，幫助減少高血脂，與新編中藥大辭典中記載之藥理作用一致。	保護心血管，調節血脂
山楂 (<i>Crataegus pinnatifida</i> Bge. var. <i>major</i> N.E.Br., <i>Crataegus cuneata</i> Sieb. et Zucc.; 薔薇科植物山楂或野山楂的果實)	在美國點花山楂(<i>Crataegus oxyacantha</i>)的宣稱功效中有益於維持心血管的健康，與新編中藥大辭典中記載之藥理作用一致；在中國大陸與其他成分併用用於調節血脂。	調節血脂、調節血壓
*苦瓜 (<i>Momordica charantia</i> L.; 葫蘆科植物苦瓜的果實)	在中國大陸可用於調節血糖，與新編中藥大辭典中記載的藥理作用一致；在美國與其他成分併用於維持血糖；在台灣與其他成分併用可用於降低血中總膽固醇。	調節血糖
小麥 (<i>Triticum aestivum</i> L.; 禾本科植物小麥的種子或其麵粉)	用於美國膳食補充品與日本的特定保健用食品皆含有大量纖維素可促進規律性蠕動、維持腸內狀況	胃腸功能改善
*靈芝 (<i>Ganoderma japonicum</i> (Fr.) Lloyd; <i>Ganoderma lucidum</i> (Leyss. Ex Fr.) Karst.; 為多孔菌科植物紫芝或赤芝的全株)	在台灣、中國大陸以及美國可用於調節免疫系統，與新編中藥大辭典中記載之藥理作用一致。	免疫調節功能
*人參 (<i>Panax ginseng</i> C.A.Mey.; 五加科植物人參的根)	在各國使用中主要可用來抗疲勞及免疫調節。	免疫調節、抗疲勞功能
*刺五加 (<i>Acanthopanax senticosus</i> (Rupr. et Maxim.) Harms, <i>Eleutherococcus senticosus</i> (Rupr. & Maxim) Maxim.; 五加科植物刺五加的乾燥根及根莖)	在中國大陸與加拿大皆可用來抗疲勞；在美國單方產品無宣稱功效，複方產品可用於緩解疲勞，在台灣與其他成分併用可用於調節免疫。	抗疲勞功能
*冬蟲夏草 (<i>Cordyceps sinensis</i> (Berk.) Sacc.; 麥角菌科植物冬蟲夏草菌的子座及其寄主蝙蝠蛾科昆蟲蟲草蝙蝠蛾等的幼蟲屍體的複合體)	在美國與台灣皆可用於減少疲勞。在中國大陸的宣稱功效有輔助抑制腫瘤及免疫調節。	抗疲勞功能
*西洋參 (<i>Panax quinquefolium</i> L.; 五加科植物西洋參的根)	在台灣與中國大陸用於緩解疲勞；在美國與其他成分併用可用於維持攝護腺健康。	抗疲勞功能

中藥材原料	各國健康食品使用情形分析	建議功效
紅花 (<i>Carthamus tinctorius</i> L.; 菊科植物紅花的花)	在中國大陸可用於耐缺氧、調節血脂,與新編中藥大辭典中記載之藥理作用一致。在美國與其他成分併用並無宣稱功效。	調節血脂功能
薄荷 (<i>Mentha haplocalyx</i> Briq., <i>Mentha haplocalyx</i> Briq. Var. <i>piperascens</i> (Malin. vaud) C. Y Wu et H. W. Li; 唇形科植物薄荷或家薄荷的全草或葉)	在加拿大(<i>Mentha x piperita</i> L. (Lamiaceae))可用於健胃,與新編中藥大辭典中記載之藥理作用一致;中國大陸與其他成分併用用於增強免疫力。	胃腸道功能改善
*薑黃 (<i>Curcuma longa</i> L., <i>Curcuma aromatic</i> Balisb.; 薑科植物薑黃或鬱金的根莖)	在加拿大用於幫助消化,與新編中藥大辭典中記載之藥理作用一致;在中國大陸及台灣皆與其他成分併用可用於保護肝臟,美國與其他成分併用可用於控制體重。	胃腸功能改善、助肝功能
*當歸 (<i>Angelica sinensis</i> (Oliv.) Diels; 繖形科植物當歸的根)	在加拿大 <i>Angelica archangelica</i> L.(弓角當歸)用於減緩支氣管方面的疾病、幫助消化、退燒及利尿,與新編中藥大辭典中記載之藥理作用一致;在中國大陸和其他藥材併用,可用於增強免疫力、改善貧血,在美國為女性健康的補充品。	胃腸功能改善
蒲公英 (<i>Taraxacum mongolicum</i> Hand Mazz.; 菊科植物蒲公英的帶根全草)	在加拿大西洋蒲公英(<i>Taraxacum officinale</i> F.H. Wigg.)可用於幫助消化,與新編中藥大辭典中記載之藥理作用一致,在美國為傳統苦味草藥,在中國大陸的宣稱功效為免疫調節及抗突變。	胃腸功能改善
車前子 (<i>Plantago asiatica</i> L., <i>Plantago depress</i> Willd.; 車前草科植物車前或平車前的種子)	在日本特定保健用食品可用於促進腸蠕動加速排便,與新編中藥大辭典中記載之藥理作用一致;美國與其他成分併用可用於維持腸道健康。	胃腸功能改善
*蜂膠 (<i>Apis cerana</i> Fabricius; 蜜蜂科昆蟲中華蜜蜂等所分泌黃褐色或黑褐色的黏性植物)	在中國大陸及台灣可用來增強免疫力與新編中藥大辭典中記載之藥理作用一致。	免疫調節
紅景天 (<i>Rhodiola sacra</i> (Prain ex Hamet) Fu; 景天科植物全瓣紅景天的全草)	在中國大陸可用於抗缺氧與抗疲勞、美國用於抗疲勞,與新編中藥大辭典中記載之藥理作用一致。	抗疲勞功能
辣椒 (<i>Capsicum frutescens</i> L.; 茄科植物辣椒的果實)	在加拿大櫻桃番椒(<i>Capsicum annuum</i> L.)可用於幫助消化、幫助支持末梢循環並當作發紅劑(rubefacient /counterirritant),美國用於維持消化道健康,與新編中藥大辭典中記載之藥理作用一致。	胃腸功能改善、幫助維持末梢循環
亞麻子 (<i>Linum usitatissimum</i> L.; 亞麻科植物亞麻的種子)	在中國大陸、美國與加拿大可用於提供必需脂肪酸以維持心血管系統的健康,與新編中藥大辭典中記載之藥理作用一致。	調節血脂
*綠茶 (<i>Camellia sinensis</i> O. Ktze.; 山茶科植物茶的芽葉)	在台灣與日本特定保健用食品均可用於調節血脂,在加拿大與美國均可用於抗氧化與幫助體重管理。	調節血脂、不易形成體脂肪

建議為健康食品-中醫藥委員會已公告為可同時供食品使用之中藥材		
中藥材原料	各國健康食品使用情形分析	建議功效
蕁麻 (<i>Urtica cambabina</i> L., <i>Urtica angustifolia</i> Fisch. ex Hornem.; 蕁麻科植物蕁麻葉蕁麻、狄葉蕁麻等的全草)	在加拿大異株蕁麻(<i>Urtica dioica</i> L.)可用於利尿(當利尿劑只能偶爾使用)及減緩季節性過敏症,與新編中藥大辭典中記載之藥理作用一致,在美國當作草本的補充劑。	輔助調節過敏體質
*茯苓 (<i>Poria cocos</i> (Schw.) Wolf; 多孔菌科植物茯苓的乾燥菌核)	在台灣根據動物及體外實驗證實可以調節免疫系統,與中國大陸的宣稱功效相符。在美國與其他成分併用用於穩定月經期間與更年期期間的情緒。	免疫調節功能
杜仲 (<i>Eucommia ulmoides</i> Oliv.; 杜仲科植物杜仲的樹皮)	杜仲(樹皮)在中國大陸可用於輔助降血壓,與新編中藥大辭典中記載之藥理作用一致。在日本杜仲葉為特定保健用食品,適合血壓相對較高的人服用;在美國與其他成分併用用於能量補充。	輔助調節血壓
何首烏 (<i>Polygonum multiflorum</i> Thunb.; 蓼科植物何首烏的塊根)	在中國大陸可用於調節血脂,與新編中藥大辭典中記載之藥理作用一致;美國與其他成分併用可用於抗氧化。	調節血脂功能
黃耆 (<i>Astragalus membranaceus</i> (Fisch.) Bge., <i>Astragalus mongholicus</i> Bge., <i>Astragalus chrysopterus</i> Bge., <i>Astragalus floridus</i> Benth., <i>Astragalus tongolensis</i> Ulbr.; 為豆科植物黃耆或內蒙古黃耆等的乾燥根)	在美國可用於保護肝臟及心血管保護作用,與新編中藥大辭典中記載之藥理作用一致;在中國大陸與其他成分併用可用於降血糖,加拿大主要用於滋補脾臟與增強活力。	護肝功能、心血管保護
黨參 (<i>Codonopsis pilosula</i> (Franch.) Nannf.; 桔梗科植物黨參的根)	在中國大陸用於抗疲勞與新編中藥大辭典中記載之效用一致;在美國與其他成分併用可用於維持健康。	抗疲勞功能
龍膽 (<i>Gentiana scabra</i> Bge., <i>Gentiana triflora</i> Pall.; 為龍膽科植物龍膽或三花龍膽等的根及根莖)	在加拿大淡黃花龍膽(<i>Gentiana lutea</i> L. (Gentianaceae))可用於幫助消化、促進食慾及增進膽汁分泌,與新編中藥大辭典中記載之藥理作用一致;在美國與其他成分併用可用於保護肝臟與維持消化道健康。	胃道功能改善

適合國外功效宣稱之保健食品(國內健康食品無此功效分類)-中醫藥委員會已公告為可同時供食品使用之中藥材		
中藥材原料	各國健康食品使用情形分析	建議功效
薑 (<i>Zingiber officinale</i> Rosc.; 為薑科植物薑的鮮根莖)	在美國與加拿大可用於減輕腸胃不適,與新編中藥大辭典中記載之藥理作用一致;在中國大陸用於調節血脂與抗疲勞。	減輕腸胃不適(祛風劑)
海藻 (<i>Sargassum fusiforme</i> (Harv.) Setch., <i>Sargassum pallidum</i> (Turn.) C. Ag.; 為尾藻科植物羊栖菜或海蒿子的全草)	在中國大陸用於補碘作用,與新編中藥大辭典中記載之藥理作用一致;在美國與其他成分併用用於調節膽固醇維持心血管的健康。	補碘作用
枇杷葉 (<i>Eriobotrya japonica</i> (Thunb.) Lindl.; 為薔薇科植物枇杷之乾燥葉)	日本與中國大陸均有上市的健康食品,在中國大陸用於清咽潤喉,與新編中藥大辭典中記載之效用一致。	潤肺、鎮咳
*甘草	在加拿大可用於減緩氣管的症狀如粘膜炎、咳嗽	減緩氣管

適合國外功效宣稱之保健食品(國內健康食品無此功效分類)-中醫藥委員會已公告為可同時供食品使用之中藥材

中藥材原料	各國健康食品使用情形分析	建議功效
(<i>Glycyrrhiza uralensis</i> Fisch., <i>Glycyrrhiza glabra</i> L., <i>Glycyrrhiza kansuensis</i> Changet Peng, <i>Glycyrrhiza inflata</i> Batal.; 豆科植物甘草的根及根狀莖)	及支氣管炎, 緩和消化道炎症的狀況如成人的胃炎; 中國大陸可用於清咽潤喉, 與新編中藥大辭典中記載之藥理作用一致; 美國甘草單方的產品無宣稱功效; 台灣根據動物試驗結果: 具有降低血清 GOT、GPT 值。	的症狀、清咽潤喉
胡蘆巴 (<i>Trigonella foenum-graecum</i> L.; 豆科植物胡蘆巴的種子)	在加拿大傳統上可用來當作通便劑與催乳劑, 與新編中藥大辭典中記載之藥理作用一致; 在美國標示為傳統的古印度草藥。	通便、催乳
娑羅子 (<i>Aesculus chinensis</i> Bge., <i>Aesculus wilsonii</i> Rehd.; 七葉樹科植物七葉樹或天師粟的果實或種子)	在加拿大與美國猴七葉樹 (<i>Aesculus hippocastanum</i> L.) 皆可用於幫助治療靜脈曲張, 與新編中藥大辭典中記載之藥理作用一致。	治療靜脈曲張
假前芥 (<i>Nepeta cataria</i> L.; 唇形科植物假前芥的全草)	在加拿大可用來當作祛風劑與新編中藥大辭典中記載之藥理作用一致; 在美國與其他成分併用來幫助放鬆。	減輕胃脹氣消化不良 (祛風劑)
迷迭香 (<i>Rosmarinus officinalis</i> L.; 唇形科植物迷迭香的全草)	在加拿大可用於減輕消化不良及可當作溫和的抗菌劑, 與新編中藥大辭典中記載之效用及藥理作用一致; 在美國與其他成分併用於抗氧化與維持心臟與免疫系統的健康。	減輕消化不良 (祛風劑)
金盞菊 (<i>Calendula officinalis</i> L.; 菊科植物金盞菊的花、根)	在加拿大可用於減緩消化系統的炎症反應、減緩嘴或喉嚨的黏膜發炎、幫助傷口癒合, 與新編中藥大辭典中記載之藥理作用一致, 在美國與其他成分併用於維持消化道、泌尿系統的健康及當作皮膚修復劑。	減緩消化系統的炎症反應、減緩嘴或喉嚨的黏膜發炎
麝香草 (<i>Thymus vulgaris</i> L.; 唇形科植物麝香草的全草)	加拿大與日本均有上市的健康食品, 在加拿大可用於祛痰、減緩支氣管炎、上呼吸道的黏膜炎及抗菌, 與新編中藥大辭典中記載之藥理作用一致。	減緩氣管的症狀
啤酒花 (<i>Humulus lupulus</i> L.; 桑科植物啤酒花的雌花序)	在加拿大可用於鎮靜及幫助睡眠, 與新編中藥大辭典中記載之藥理作用一致; 美國與其他成分併用於幫助睡眠。	鎮靜、幫助睡眠
貫葉連翹 (貫葉金絲桃) (<i>Hypericum perforatum</i> L.; 為藤黃科植物貫葉連翹的全草或帶根全草)	在加拿大與美國均可用於鎮靜減輕心神不定。	可鎮靜、減輕心神不定
纈草 (<i>Valeriana officinalis</i> L.; 敗醬科植物纈草的根及根莖)	在中國大陸、加拿大及美國具有鎮靜安眠作用, 與新編中藥大辭典中記載之藥理作用一致。	鎮靜安眠類
越橘 (<i>Vaccinium vitis-idaea</i> L.; 杜鵑花科植物越橘的葉)	美國與中國大陸可用於緩解視力疲勞, 與新編中藥大辭典中記載之藥理作用一致; 加拿大 <i>Vaccinium myrtillus</i> L. (黑果越橘) 主要用於減緩腹瀉, 減輕嘴及喉嚨的黏膜發炎與抗氧化。	緩解視力疲勞
檸檬 (<i>Citrus limonia</i> Osbeck., <i>Citrus limon</i> Burm.; 芸香科植物檸檬或洋檸檬的果實)	在中國大陸與美國皆可用於補充維生素。	補充維生素
蘆薈	在中國大陸、加拿大與美國皆可用於通便, 與新	通便

適合國外功效宣稱之保健食品(國內健康食品無此功效分類)-中醫藥委員會已公告為可同時供食品使用之中藥材

中藥材原料	各國健康食品使用情形分析	建議功效
(<i>Aloe vera</i> L., <i>Aloe ferox</i> Mill., <i>Aloe vera</i> L. var. <i>chinensis</i> (Haw.) Berger; 百合科植物庫拉索蘆薈、好望角蘆薈或斑紋蘆薈葉中的液汁經濃縮的乾燥品)	編中藥大辭典中記載之藥理作用一致, 符合篩選條件。	
大黃 (<i>Rheum palmatum</i> L., <i>Rheum tanguticum</i> Maxim. ex Reg., <i>Rheum officinale</i> Baill.; 蓼科植物掌葉大黃、唐古特大黃或藥用大黃的根莖)	在中國大陸用於潤腸通便與新編中藥大辭典中記載之藥理作用一致; 在美國則與其他成分併用於緩與更年期有關的症狀。	通便
番瀉葉 (<i>Cassia angustifolia</i> Vahl., <i>Cassia acutifolia</i> Del.; 豆科植物狹葉番瀉或尖葉番瀉的小葉)	在加拿大可用於緩解便秘, 與新編中藥大辭典中記載之藥理作用一致; 在美國與其他成分併用於緩解便秘。	通便

係特別指出上述所列中藥材及健康食品之各國管理情形及各產品

Definition of health food in USA

Dietary Supplement :

Any product taken by mouth that contains a so-called “dietary ingredient” and its label clearly states that it is a dietary supplement. The dietary ingredients may include vitamins, minerals, herbs, and amino acids as well as substances such as enzymes, organ tissues, metabolites, extracts or concentrates.

Management of functional food

- **statement of nutrition support** “**This statement has not been evaluated by the FDA. This product is not intended to diagnose, treat, cure or prevent any disease.**”

Examples of Claims

- Structure/Function Claim
Calcium builds strong bones.
- Health Claim
Calcium may reduce the risk of osteoporosis.
- Drug Claim
Calcium will prevent osteoporosis.

Logos



保健食品标志
(天蓝色)




Functional Food ?

Food type, common use: including animal, plant and microbiological organism

Nutraceuticals ?

Powder, tablet or capsule (medicine like)

Definition of health food in Taiwan

 **Providing special nutrient or health benefit, claim or label on food. The purpose is not for disease therapy.**

Toxicity and Function

- **Safety evaluation pass first:**
microbial and animal systems
- **Function evaluation:**
Animal system
Human clinical
Both animal and human design

Preclinical Trial: discovery

- Molecular structure
- Best combination
- ...screening design, cluster analysis, discriminant analysis, factor analysis

- By animal:
 - 1. Dose-related response (regression)
 - 2. Pharmacological activity

Next step: **toxicology**

- Genetic toxicity
- Animal toxicity
- Reproductive toxicity
- Carcinogenic toxicity
- Dose-relationship (regression)

Further ... **ADME**

- Absorption
 - Distribution
 - Metabolism
 - Elimination
-
- Formulation (to the site of action) and **indicator compound(s)**

Formulation

- How to reach site of action: tablet, capsule, powder, liquid
- Lotion
- Cream
- Gel
- → Investigational New Drug Application, **IND**---For clinical trial
- **indicator compound(s) is very critical for the quality control...**



Clinical Trials

- Phase I
- Phase II
- Phase III
- Phase IV

Phase I

- Time to maximum concentration (**T-max**)
- Maximum concentration (**Cmax**)
- Area under the curve (**AUC**)
- Bioequivalence
- Bioavailability

- Subjects: 30~40y **Health participants** (n=20~80)



Phase II

- Subjects: **patients**
- Safety
- Efficiency
- **Dose ranging**
- Other pharmacological and pharmacokinetics

Phase III:

adequate and well control

- **Pivotal placebo-controlled study**
- **Active control study**
- Further evaluation for the safety and efficiency
- Short term (wks) and long term(1-2y)
- Including elderly (>65y), or liver or kidney patients

After phase III

- New drug application (**NDA**)
- **Commercialized**
- Statistically valid

Phase IV

- After commercialized..
- **Adverse event**
- Pharmacological effect
- Elderly, child, pregnant
- **Morbidity**
- **Mortality**
- Indication (new purpose)



Experimental design (**statistics**)

- Identity
- Strength
- Quality
- purity

Parallel and Cross-over

- **Ethics**: cross-over > parallel
- Cross-over: carry-over effect....washout period
- Cross-over: longer time (drop-out)
- Cross-over: phase I
- Parallel: phase II~IV
- **Parallel are highly recommended**



Single versus Multicenter trials

- Most by multicenter trials: easy to enroll subjects
- Single center: difficult enrolled (e.g. congestive heart failure)
- Center effect: treatment-by-center interactions

Blinding and open-label

- Single blind: subjects don't know, but researchers know that. (**based on ethics**)
- Double blind: subjects and operators don't know, randomization schedule
- Always by **short-term double blind**, and then **open-label**


Randomized and Nonrandomized

- Most by randomized design
- **Completely randomized** design: subjects from all centers
- **Randomized block design**: subjects from each center



Placebo-controlled and active-controlled

- Phase II: placebo-controlled
fewer placebo subjects than experiment
- Phase III: active-controlled (ethical), longer duration

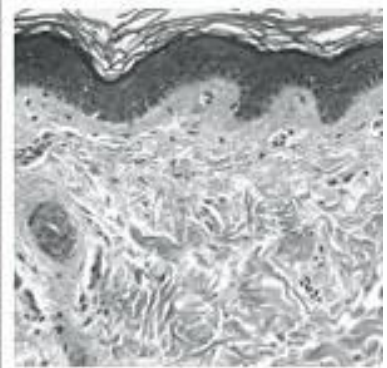
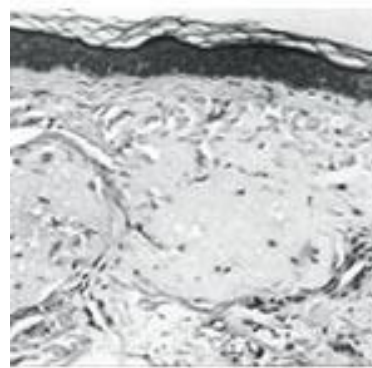
- 
- Evidence-based
 - The new hope for medical treatment
 - Scientific and stable significance
----- **Challenge**



Anti-aging Effect of *Ganoderma lucidum* :
A clinical trial





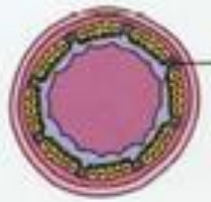




Lymph Nodes
Lymph nodes contain cells (lymphocytes) of the immune system, which work to recognize and destroy invading microorganisms.



White Blood Cells
Circulating white blood cells attack germs in the blood and other body tissues.




Respiratory System
Cells with cilia on their surface line the airways and clear away mucus that traps inhaled germs.



Spleen
The spleen helps to protect the body against bacterial infections.

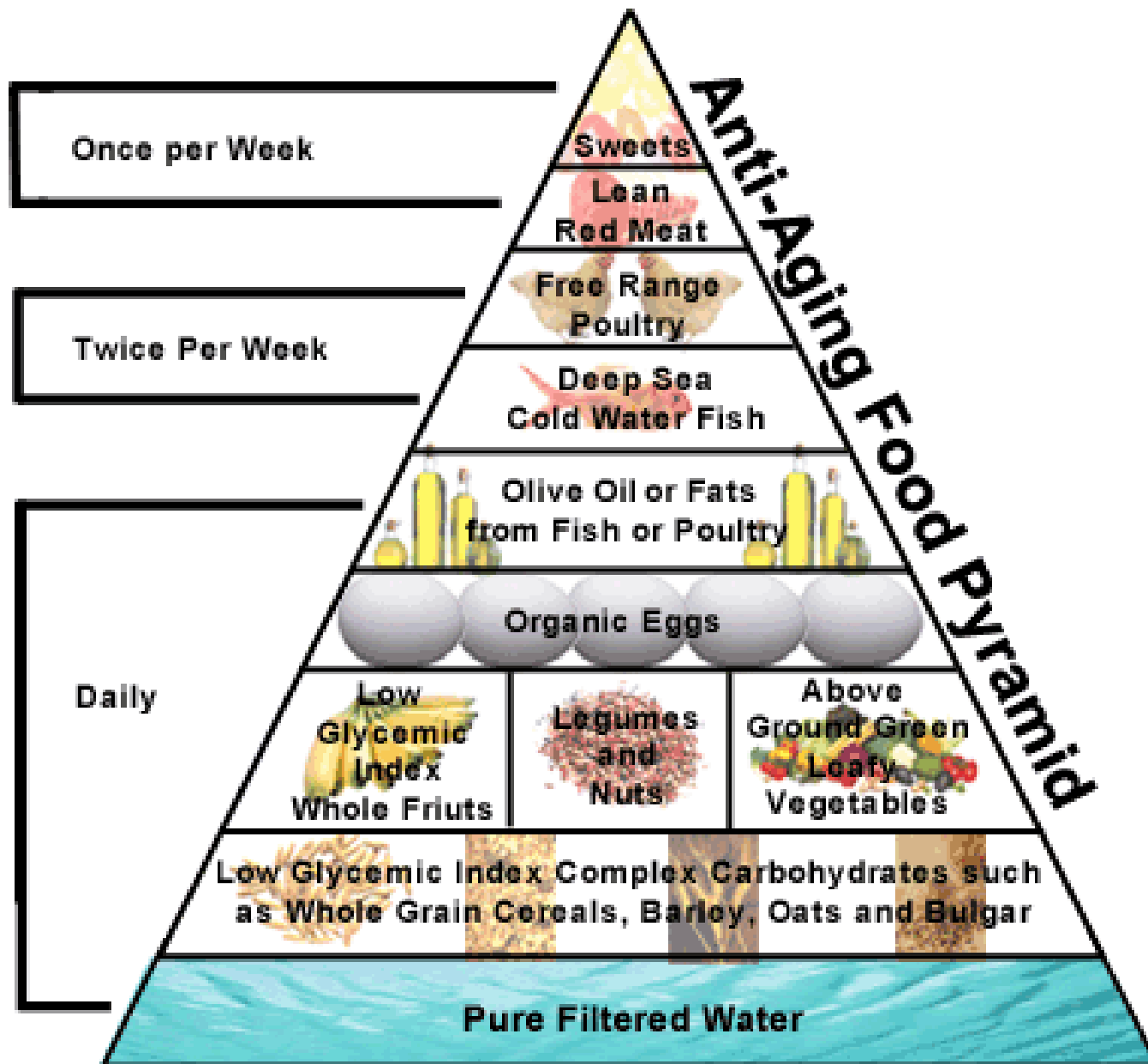


Skin
The skin provides a barrier against germs.



Stomach and Intestines
Stomach acid kills many harmful bacteria, and antibodies secreted by intestinal cells attack viruses and other microorganisms traveling through the gastrointestinal tract.

The human body has several lines of defense against infection, which work to prevent germs from invading the body or to destroy them once they find their way in.



Growth of *G. lucidum*

<1> 16 weeks after inoculation



<2> stem proliferation, 17 weeks



<3> mushroom cap proliferation, 18 weeks



<4> Mushroom cap growth, 19 weeks



<5> 21 weeks



<7> Harvesting



<6> End of mushroom cap growth, 24 weeks



Ganoderma tsugae



Ganoderma formosanum

- **Highly used in Asian area for health promotion and diseases prevention.**
- **Mild pharmacological effect**
- **Classification: texture, color, and had been used as traditional herb**



Composition of *Ganoderma* fruiting body

Nutrient composition	Percentage	Nutrient composition	Percentage
Cellulose	54~56%	Polysaccharide	1.0~1.2%
Lignin	13~14%	Sterol	0.14~0.16%
Water	12~13%	Ash	0.022%
Monosaccharide	4.5~5.0%	Total phenol	0.08~0.12%
Fat	1.9~2.0%	Protein	0.08~0.12%

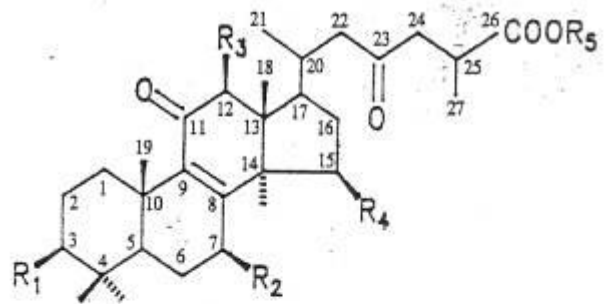
Functional components

	Compounds
CHO	· Polysaccharide , Glucan ·Ganoderan
Triterpenoids	·Ganoderic acid ·Lucidenic acid ·Lucidone
Protein	· Ling Zhi-8 ·Glycoprotein
Nucleic acid	·RNA, Adenosine ·Adenine, Uracil
Minerals	· Ge-132 , K, Ca ·P, Mg

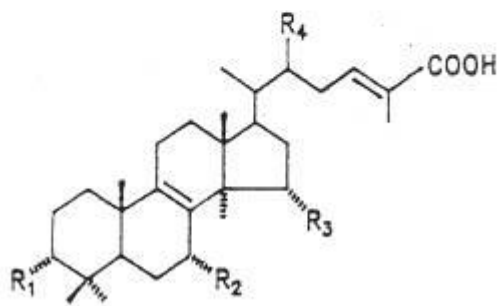
Triterpenoids

- Bitter taste source of *G. tsugae* and *G. lucidum*
- Liver protection
- Blood pressure regulation
- Suppression on cancer cells
- Inhibition on histamine release
- Anti-allergy
- Blood lipid down regulation
- Improvement on liver function

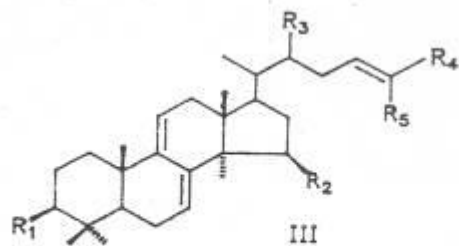
(Hitoshi et al., 1977; Kim et al., 1980; Miyazaki et al., 1981; Toth et al., 1983; Shimizu et al., 1985; Chen et al., 1997; Lai et al., 1997; Park et al., 1997)



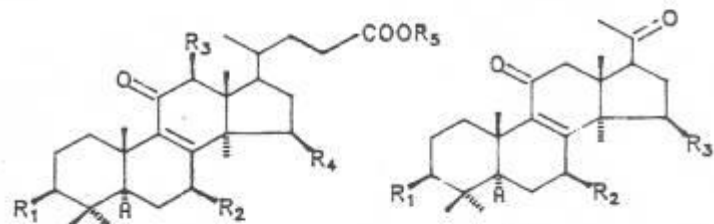
I



II

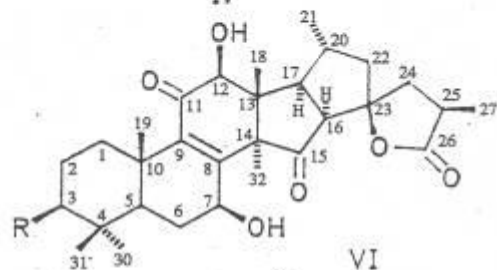


III

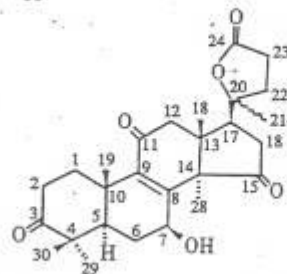


IV

V



VI

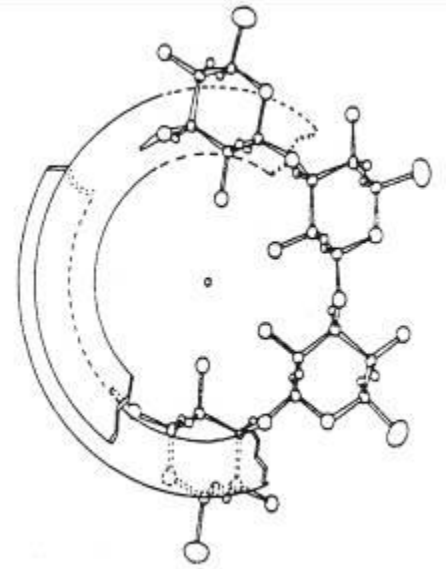
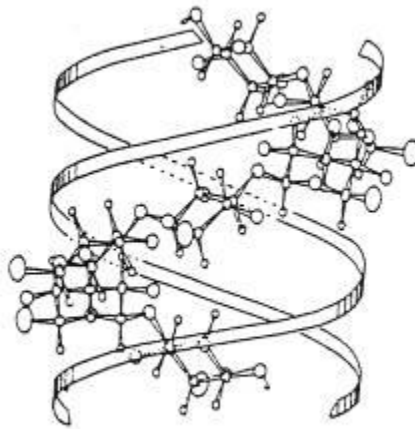
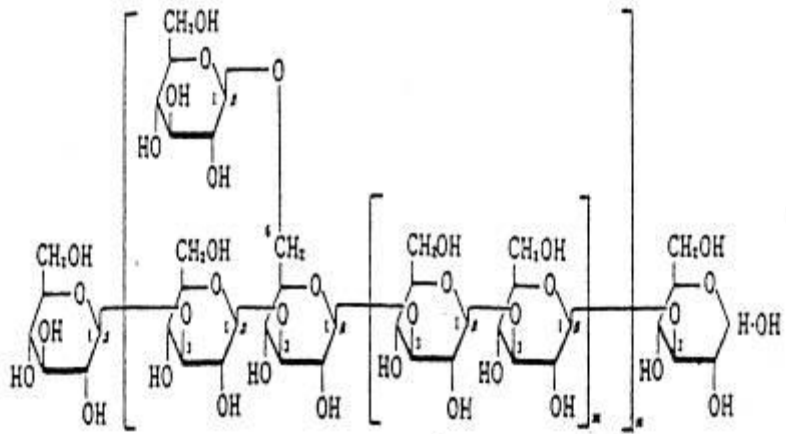
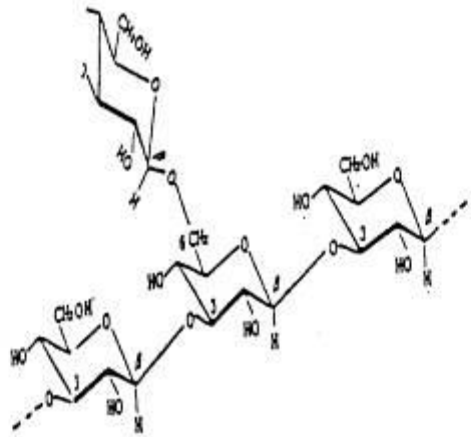


VII

Polysaccharides

- More than 200 polysaccharides have been isolated from *Ganoderma* species
- Linkage with protein moiety (polysaccharide peptide)
- Anticancer
- Immune promotion
- Antioxidation
- Promote the production of interleukin-1, -2 and IFN- γ)

(Kino et al., 1989; Xia et al., 1989; van der Hem et al., 1995; Wang et al., 1997, Lai et al., 1997; Lin et al., 2000)



Antiaging and long life

Aging

Age dependent

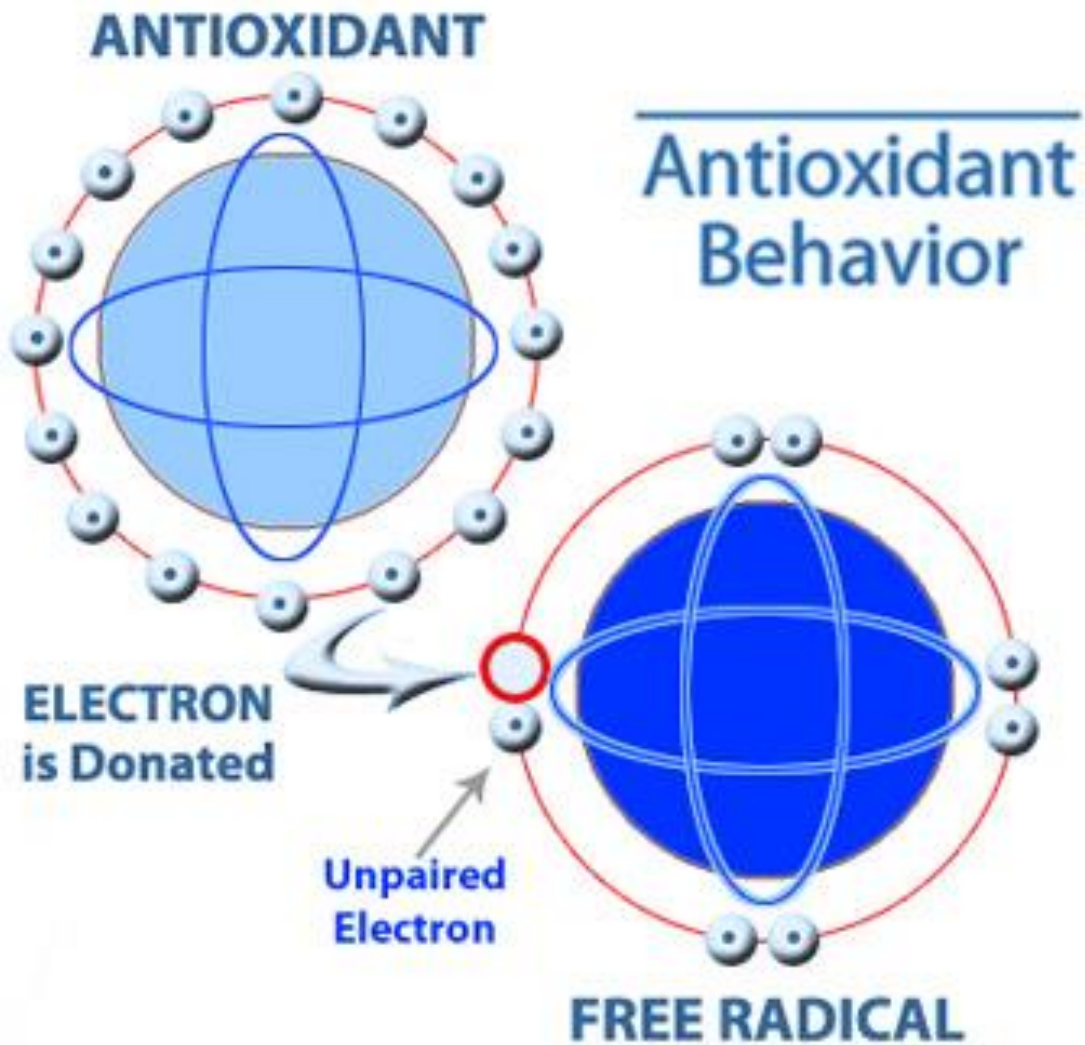
Physiological activity

Body function

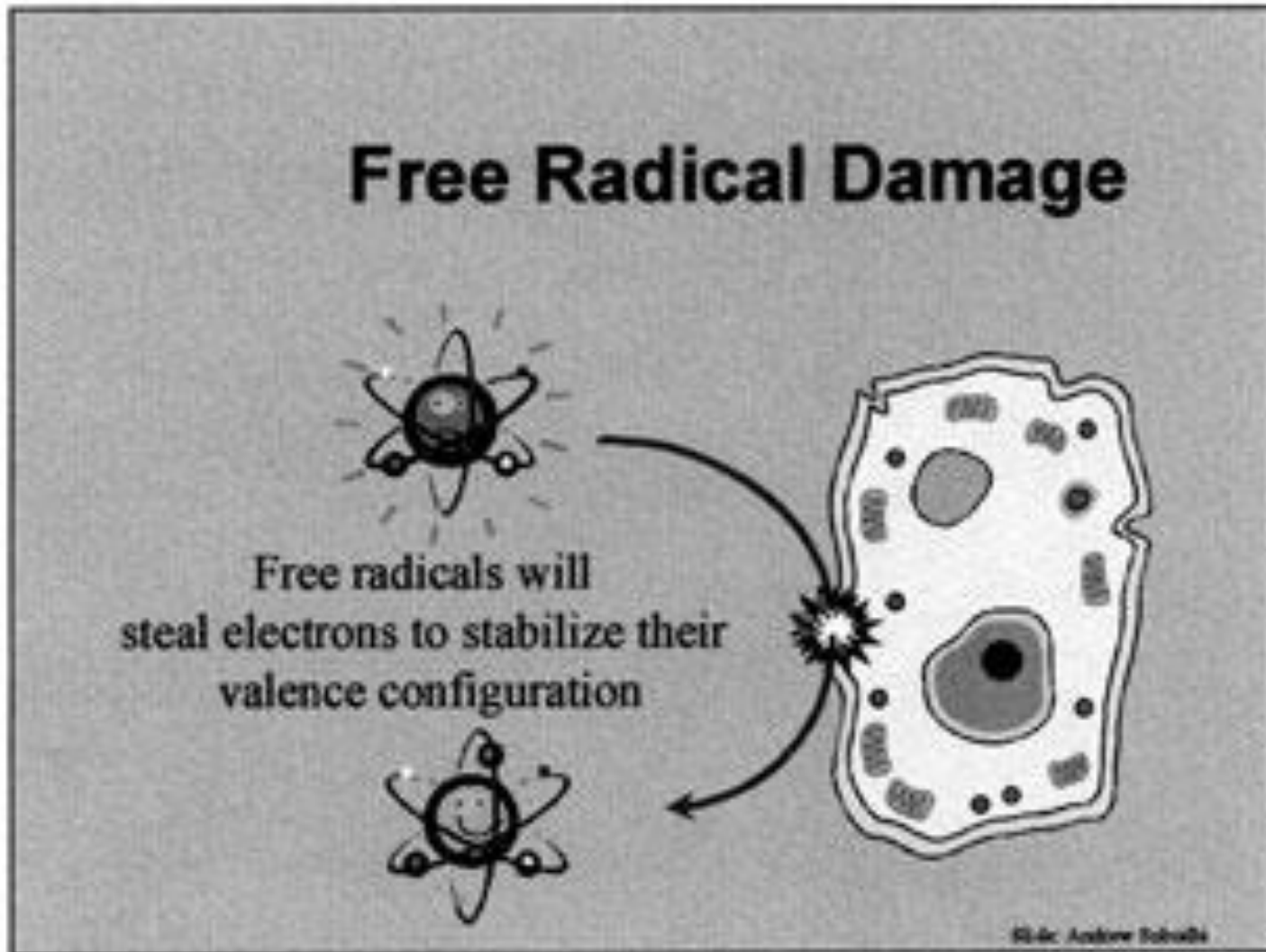
Cell death or damage

Survival

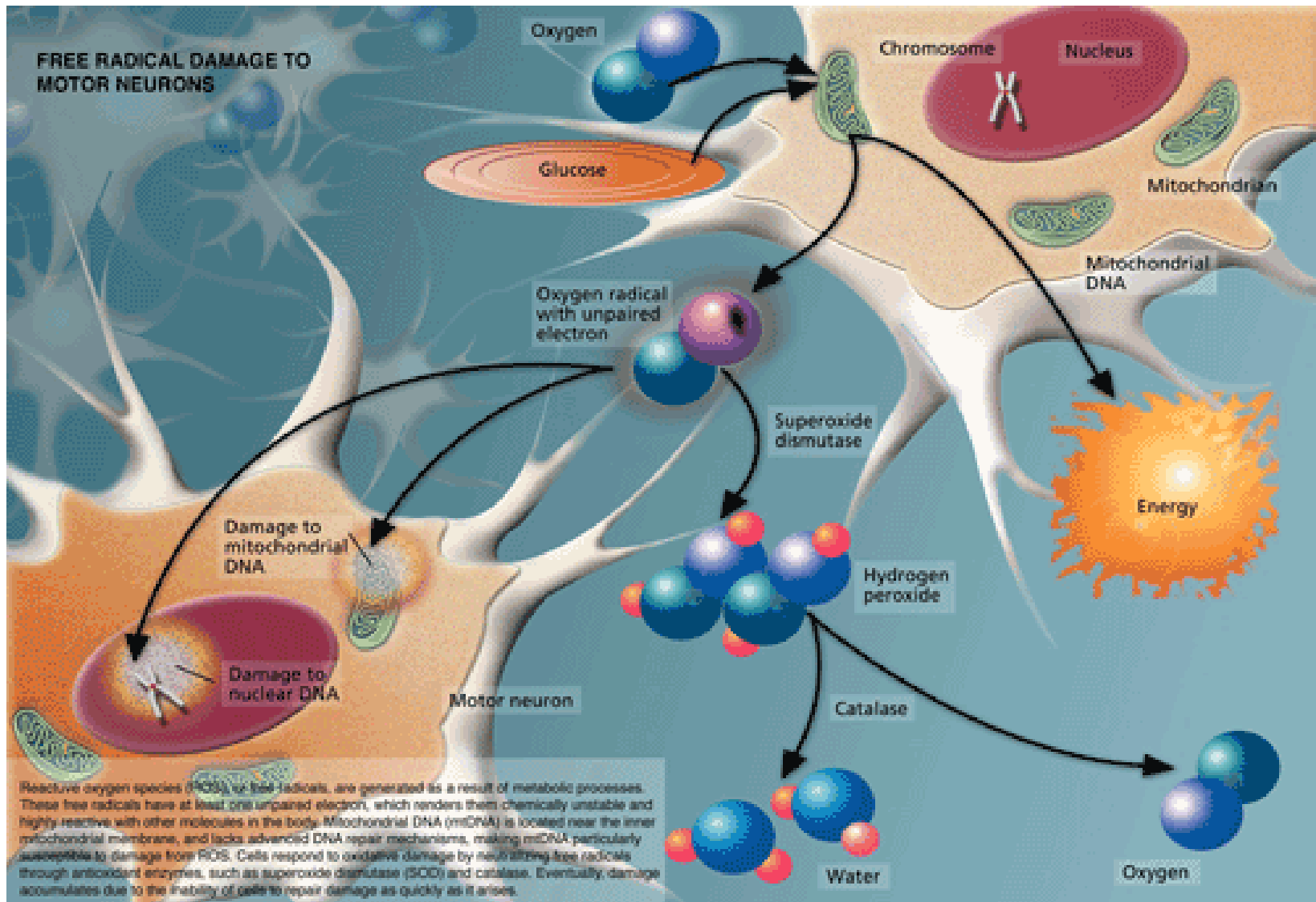
Free radicals



Free radicals damage



Free radicals



Antioxidation and antiaging

ROS (reactive oxygen speices), free radicals

VS diseases, aging

Antioxidation:

1. Oxidant indicator
2. Antioxidant enzymes

Organ indicator: liver function



Purpose

To evaluate the antiaging effect of *Ganoderma* extracts by human subjects by measuring the antioxidant status and liver function.



Anti-aging—animal model

Learning ability

Memory

Antioxidant status

Shelf life



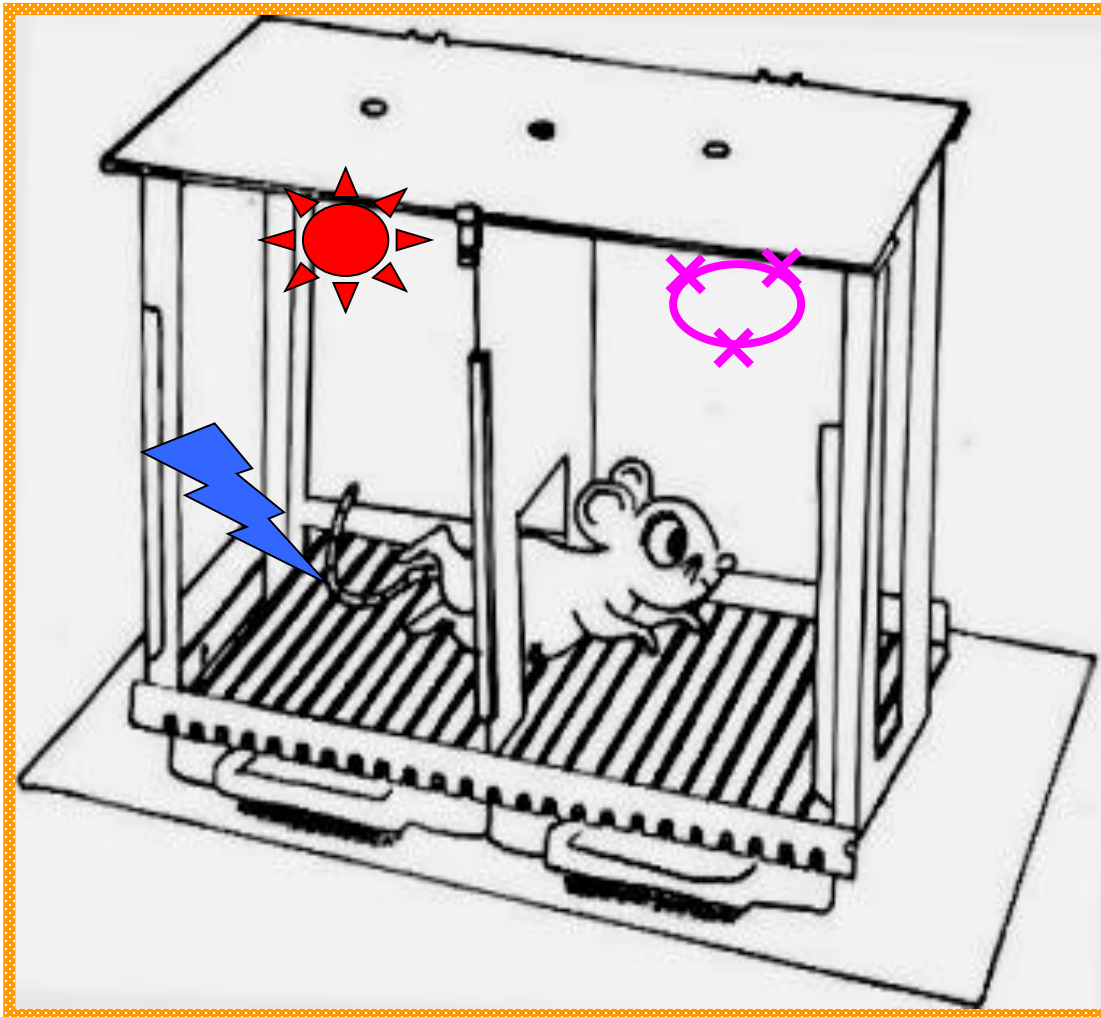
SAMP8 (Senescence accelerated mice)

- Memory degression
- Short life: avg. 10 months
- **Defect of learning and memory**
- **Suitable for aging study**

■ Aging:

1. Reactivity
2. Skin glossiness
3. Periophthalmic lesion
4. Spine lordokyphosis
5. Retard on body weight
6. Hair loss
7. Contract
8. Beta amyloid protein
9. Poor immune

Active shuttle avoidance test



stay in case for 10 sec.

Light and sound stimulation in one side

If no moving, electric shock every 5 seconds until to the other side

5 tests per time, four times every day, total 4 days

Record the electric shock times

Table Active shuttle avoidance test^{1,2}

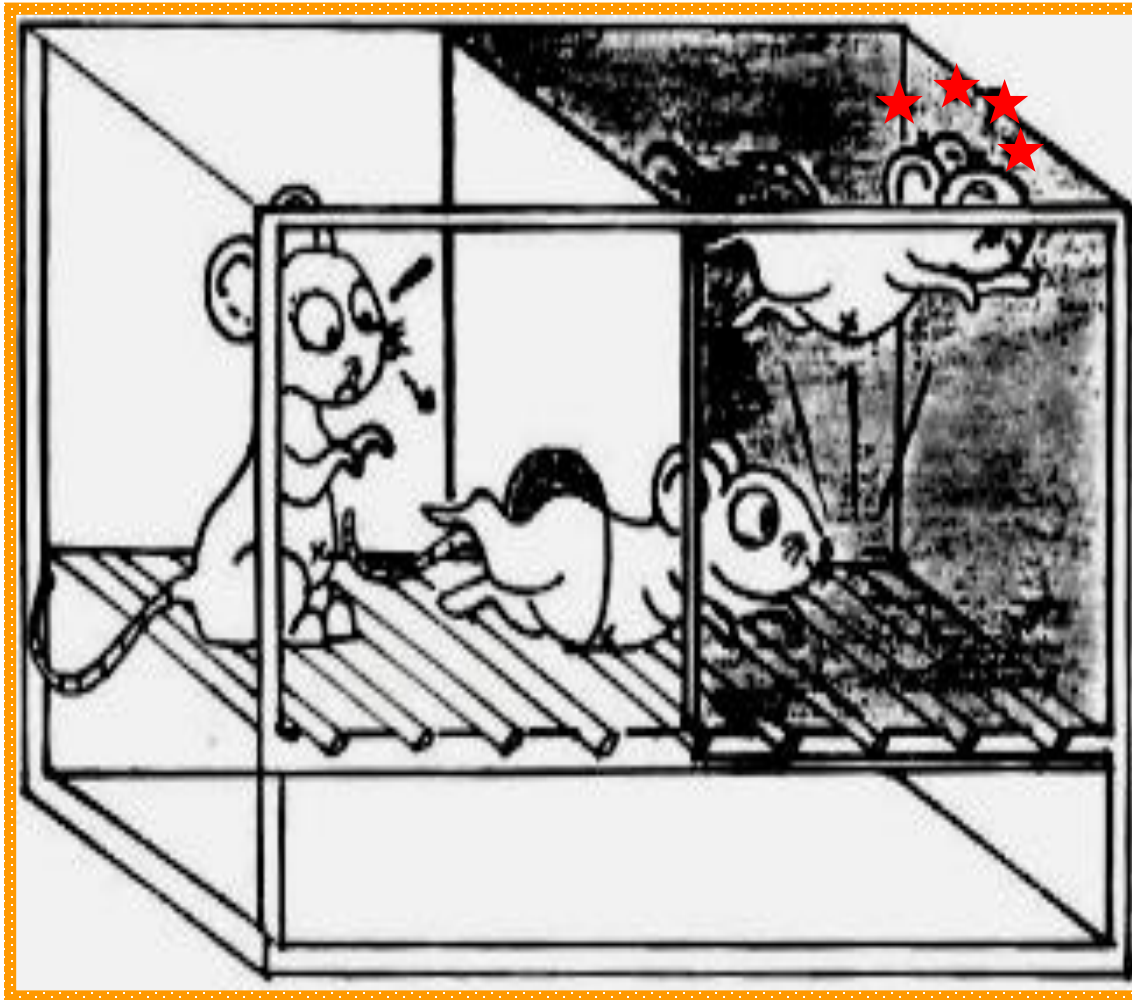
Group Male	Day 1	Day 2	Day 3	Day 4
	frequency			
Control	14.13±0.53^a	10.80±0.34^a	9.20±0.46^a	7.27±0.44^a
A	8.93±0.41^b	6.40±0.51^b	4.53±0.31^b	2.80±0.31^b
B	8.60±0.32^b	5.07±0.33^b	4.20±0.34^b	2.27±0.32^b
C	7.93±0.40^b	4.93±0.37^b	2.93±0.33^b	1.53±0.27^b
Group Female	Day 1	Day 2	Day 3	Day 4
	frequency			
Control	12.20±0.50^a	8.87±0.36^a	6.27±0.27^a	4.27±0.36^a
A	9.73±0.42^{bc}	5.20±0.37^a	3.47±0.26^b	2.31±0.24^a
B	8.27±0.30^b	4.07±0.27^b	2.67±0.35^b	1.80±0.26^b
C	6.80±0.30^c	3.60±0.45^b	2.27±0.28^b	1.53±0.24^b



¹Values were mean ±S.E.M.

²Mean in the same column followed by different letters are significantly different(P<0.05)

Single-trial passive avoidance test



→ stay at light space for 10 seconds

→ electric shock when going into dark space for continuous 3 times

→ 24h, 48h, 72h, 7day for test (no electric shock)

→ record the time to stay in light space

Table Single trial passive avoidance test^{1,2}

Group	trial	24 hr	48 hr	72 hr	Day 7
Male					
		time(sec)			
Control	14.47±1.30 ^a	29.40±2.45 ^a	30.53±2.63 ^a	16.67±1.30 ^a	10.00±0.65 ^a
A	16.47±1.94 ^{ab}	40.80±2.63 ^b	40.27±2.36 ^b	29.53±2.04 ^b	18.33±1.75 ^b
B	15.73±1.59 ^{ab}	49.67±3.73 ^c	42.60±3.58 ^b	27.73±2.64 ^b	17.47±1.73 ^b
C	19.80±1.01 ^b	55.53±2.03 ^c	47.80±1.93 ^b	31.07±2.01 ^b	20.00±1.27 ^b
Female					
		time(sec)			
Control	18.07±1.48 ^a	32.07±1.99 ^a	26.40±1.65 ^a	15.13±1.21 ^a	12.73±0.80 ^a
A	17.27±1.38 ^a	50.47±2.31 ^b	47.47±2.19 ^b	24.67±1.58 ^b	18.60±1.28 ^b
B	24.07±1.62 ^b	54.67±2.10 ^b	51.33±3.88 ^b	34.67±2.45 ^c	19.00±1.29 ^b
C	25.33±2.70 ^b	62.47±2.43 ^c	55.20±2.83 ^b	33.53±2.08 ^c	19.67±1.13 ^b



¹Values were mean ±S.E.M.

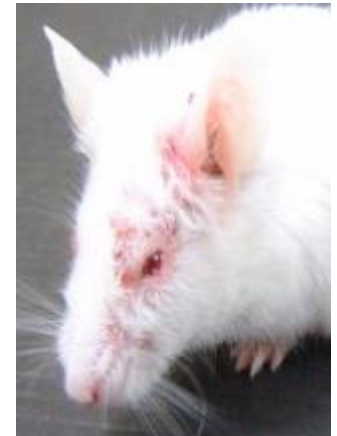
²Mean in the same column followed by different letters are significantly different(P < 0.05)

Aging score (ranking from 0~4)

🍅 Behavior [reactivity
passivity



🍅 Skin [glossiness
coarseness
hair loss
ulcer



🍅 Eyes — periophthalmic lesion

🍅 Spine — spine lordokyphosis



Table Aging score

Group	Behavior		Skin				Eyes	Spine	Total
	Male	Reactivity	Passivity	Glossiness	Coarseness	Hair loss	Ulcer	Periophthalmic lesion	
Control	1.33±0.13 ^a	1.33±0.13 ^a	1.20±0.11	1.53±0.13 ^a	1.40±0.13 ^a	0.53±0.17	0.53±0.13	0.60±0.19	8.47±0.32 ^a
A	1.07±0.12 ^{ab}	1.20±0.14 ^a	1.13±0.09	1.53±0.13 ^a	1.20±0.11 ^{ab}	0.40±0.13	0.47±0.13	0.47±0.13	7.47±0.40 ^{ab}
B	1.20±0.14 ^{ab}	1.07±0.12 ^{ab}	1.00±0.17	1.20±0.11 ^b	1.13±0.17 ^{ab}	0.33±0.13	0.33±0.13	0.53±0.13	6.80±0.39 ^{bc}
C	0.87±0.22 ^b	0.80±0.14 ^b	1.20±0.11	1.13±0.09 ^b	0.93±0.12 ^b	0.20±0.11	0.40±0.13	0.33±0.13	5.87±0.52 ^c
Group	Behavior		Skin				Eyes	Spine	Total
	Female	Reactivity	Passivity	Glossiness	Coarseness	Hair loss	Ulcer	Periophthalmic lesion	
Control	1.07±0.15	1.13±0.17	1.20±0.14	1.07±0.12	1.13±0.19	0.60±0.19	0.60±0.13	0.87±0.17	7.67±0.43 ^a
A	0.93±0.15	1.07±0.15	1.20±0.14	1.00±0.14	1.20±0.14	0.47±0.13	0.53±0.13	0.73±0.15	7.13±0.35 ^{ab}
B	0.87±0.17	1.00±0.14	1.07±0.18	0.80±0.14	0.87±0.13	0.47±0.13	0.47±0.13	0.60±0.13	6.13±0.42 ^{bc}
C	0.87±0.17	0.80±0.14	0.87±0.17	0.73±0.15	0.80±0.14	0.47±0.13	0.40±0.13	0.47±0.13	5.40±0.31 ^c

¹Values were mean ±S.E.M.

² Mean in the same column followed by different letters are significantly different (P<0.05)

Sacrifice (12 wk)

Biochem.

Total protein
Albumin
Triglyceride
Total cholesterol
HDL
LDL

Oxidation

Protein Carbonyl
TBARS
Total thiol

Enzyme

SOD
CAT
GSH-Px

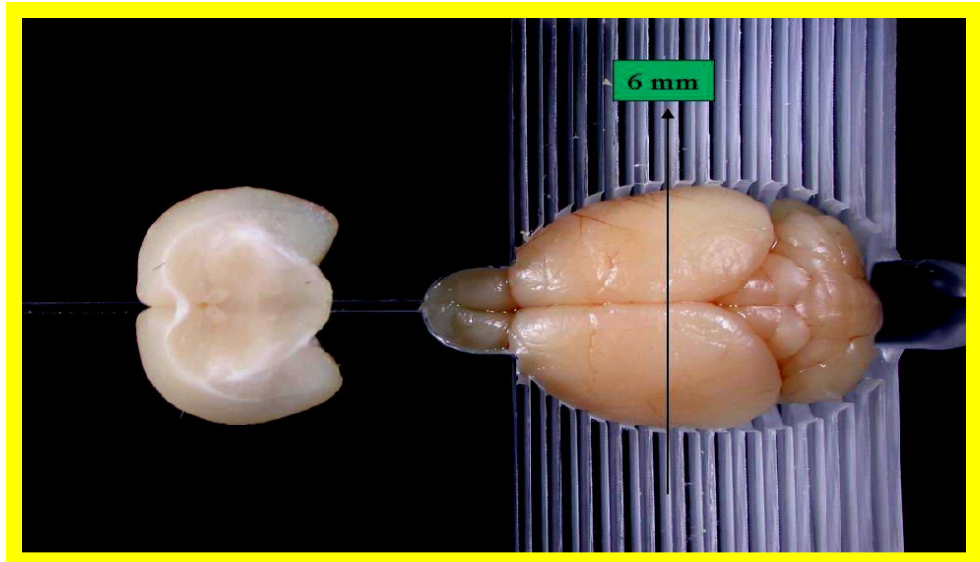
Brain biopsy

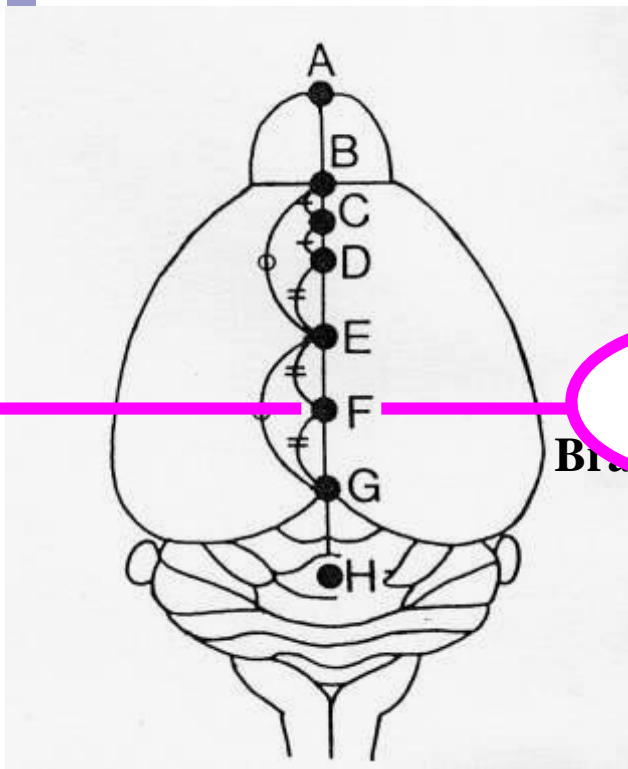
β -amyloid
protein deposition

TBARS: thiobarbituric acid reactive substances
SOD: superoxide dismutase
CAT: catalase
GSH-Px: glutathione peroxidase

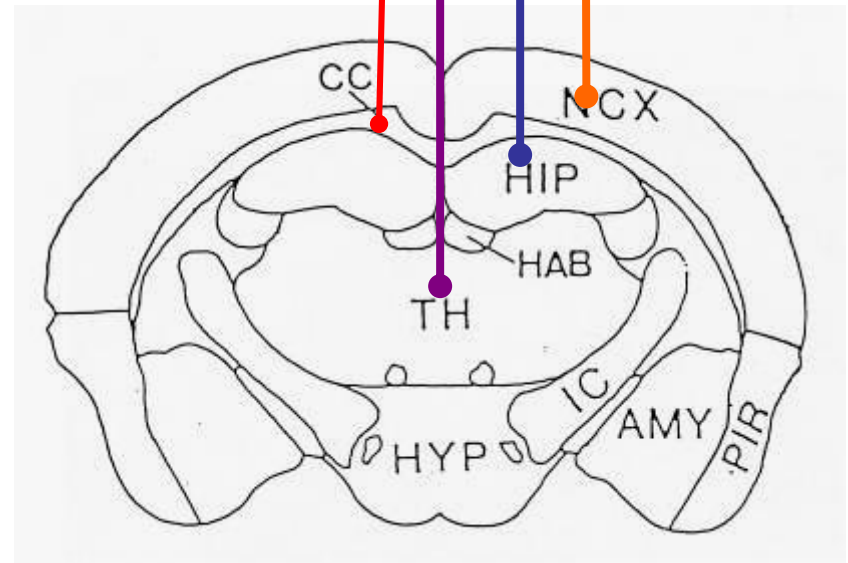
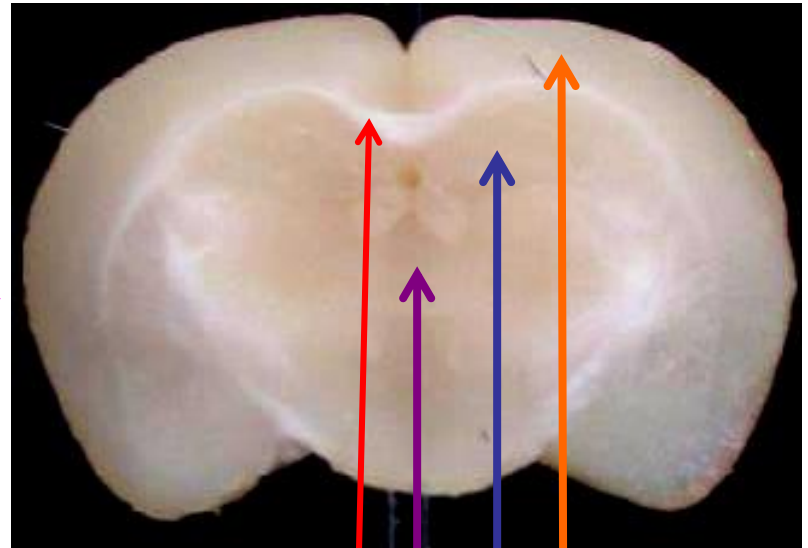
Hippocampus (HIP)

- Center for learning
- Accepting the sensory messages
- Long term memory formation
- Damage of HIP will lead to memory defects





Brain F



Structure of whole brain

Memory related parts :

NCX : Neocortex

CC : Corpus callosum

HIP : Hippocampus

TH : Thalamus

Brain F section

β -Amyloid deposition



20X



400X

Table β -amyloid deposition in the brain ^{1,2}

Group	Percentage of Aβ	Number of Aβ
Male	in brain (%)	in brain (n)
Control	0.74 \pm 0.07^a	30.20 \pm 4.77
A	0.57 \pm 0.03^b	24.60 \pm 5.54
B	0.40 \pm 0.05^c	25.00 \pm 5.41
C	0.39 \pm 0.06^c	20.20 \pm 3.34

Group	Percentage of Aβ	Number of Aβ
Female	in brain (%)	in brain (n)
Control	0.85 \pm 0.06^a	75.60 \pm 8.84^a
A	0.59 \pm 0.04^b	52.40 \pm 7.90^{ab}
B	0.55 \pm 0.05^{bc}	60.00 \pm 6.30^{ab}
C	0.42 \pm 0.07^c	42.20 \pm 7.90^b

¹Values were mean \pm S.E.M.

²Mean in the same column followed by different letters are significantly different (P < 0.05)

Increasing antioxidant status

- Lower Malondialdehyde (**MDA**)
- Increasing total thiol groups
- Increasing activities of antioxidant enzymes in liver
 - Catalase**
 - SOD**
 - G-6-PD**



Shelf life

Table Survival of SAMP8 mice

		Life months									
group		6	7	8	9	10	11	12	13	14	15
male											
control	(N/N)	20/20	17/20	14/20	12/20	9/20	8/20	4/20	1/20	0/20	0/20
	(%)	100	85	70	60	45	40	20	5	0	0
A	(N/N)	20/20	18/20	16/20	13/20	12/20	9/20	7/20	5/20	0/20	0/20
	(%)	100	90	80	65	60	45	35	25	0	0
B	(N/N)	20/20	19/20	19/20	16/20	14/20	13/20	9/20	6/20	0/20	0/20
	(%)	100	95	95	80	70	65	45	30	0	0
C	(N/N)	20/20	20/20	19/20	17/20	17/20	14/20	12/20	9/20	5/20	1/20
	(%)	100	100	95	85	85	70	60	45	25	5
Female											
control	(N/N)	20/20	18/20	16/20	13/20	9/20	7/20	3/20	0/20	0/20	0/20
	(%)	100	90	80	65	45	35	15	0	0	0
A	(N/N)	20/20	19/20	17/20	14/20	11/20	11/20	8/20	6/20	1/20	0/20
	(%)	100	95	85	70	55	55	40	30	5	0
B	(N/N)	20/20	20/20	19/20	17/20	16/20	14/20	11/20	9/20	4/20	1/20
	(%)	100	100	95	85	80	70	55	45	20	5
C	(N/N)	20/20	20/20	19/20	18/20	17/20	15/20	12/20	10/20	8/20	4/20
	(%)	100	100	95	90	85	75	60	50	40	20



Human clinical trial

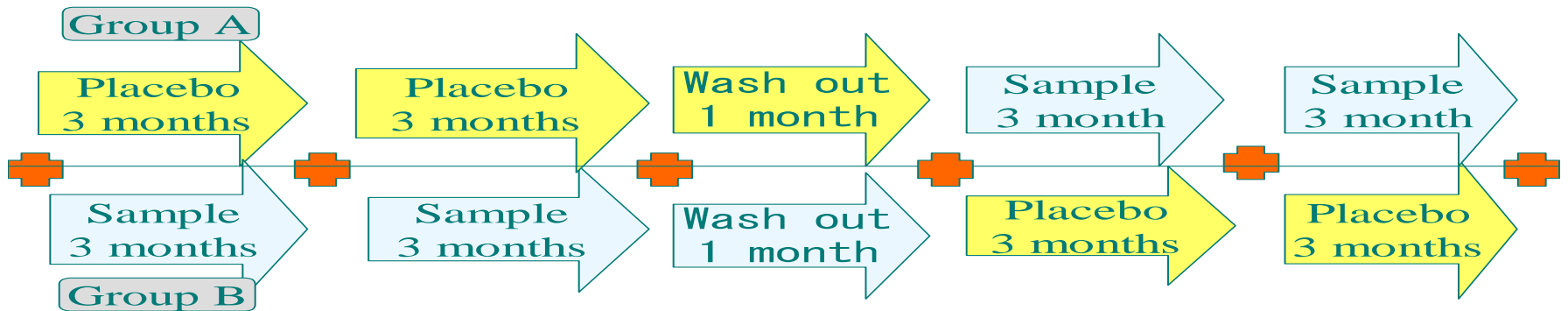
Study design

Double blind and crossover design

2.7 g *Ganoderma* extract/day (*Double Crane Divine Ganoderma*)

6.5% triterpenoids (ganoderic acid; 14.6mg/cap.)

6.0% polysaccharide peptide (13.5mg/cap.)



Ganoderma extracts

Clinical evaluation

- 1.Length
- 2.Body wt.
- 3.Body fat
- 4.BMI
- 5.Abdominal ultrasonic exam.
- 6.GOT, GPT

Oxidant indicator

- 1.Total antioxidant status
- 2.TBARS
- 3.Total thiols and glutathione
- 4.8-OH-dG

Antioxidant enzyme

- 1.SOD
- 2.G6PD
- 3.Catalase
- 4.GSH Px
- 5.GSH Rd

Table Anthropometric measurements of subjects

	Group A Initial	Group A 3 months	Group A 6 months	Group B Initial	Group B 3 months	Group B 6 months
Age	46.6±18.77	46.6±18.77	46.6±18.77	44.74±17.07	44.74±17.07	44.74±17.07
Length(cm)	165.93±9.24	165.93±9.24	165.93±9.24	164.53±7.93	164.53±7.93	164.53±7.93
Body wt.(kg)	65.29±10.26	64.99±10.04	65.05±9.99	62.13±11.57	61.29±11.33	61.87±11.94
Body fat (%)	26.27±8.4	27.19±8.16	27.61±8.98	24.43±8.27	25.79±8.82	26.05±8.95
BMI(kg/m²)	23.63±2.6	23.54±2.63	23.56±2.52	22.87±3.35	22.55±3.5	22.78±3.58

Values are means±SD



Oxidant indicator (in plasma)

Total antioxidant capacity

TBARs

Total thiols

Glutathione

8-OH-dG

Table 1. The total antioxidant capacity of plasma

	Placebo	Sample
	(%)	
Initial	80.70±5.04^a	79.33±4.95^b
3 months	80.97±3.98^a	83.93±3.87^a
6 months	80.24±3.79^a	84.04±3.74^a

Values are means±SD

Data within the same column sharing different superscript letters were significantly different ($p<0.05$)

Table 2. The contents of plasma TBARS

	Placebo	Sample
	(μ mol/L)	
Initial	3.26±1.09 ^a	3.37±1.03 ^a
3 months	3.32±0.73 ^a	3.28±0.81 ^a
6 months	3.30±0.88 ^a	2.47±0.68 ^b

Values are means±SD

Data within the same column sharing different superscript letters were significantly different ($p < 0.05$)

Table 3. The contents of total thiol groups in plasma

	Placebo	Sample
	(mM)	
Initial	0.21 ± 0.08^a	0.19 ± 0.06^b
3 months	0.20 ± 0.07^a	0.20 ± 0.05^b
6 months	0.19 ± 0.06^a	0.28 ± 0.05^a

Values are means ± SD

Data within the same column sharing different superscript letters were significantly different ($p < 0.05$)

Table 4. The contents of plasma glutathione

	Placebo	Sample
	(μ M)	
Initial	6.90 \pm 2.00 ^a	6.00 \pm 1.72 ^b
3 months	6.66 \pm 1.63 ^a	7.30 \pm 1.66 ^a
6 months	6.63 \pm 1.39 ^a	8.05 \pm 1.42 ^a

Values are means \pm SD

Data within the same column sharing different superscript letters were significantly different ($p < 0.05$)

Table 5. The contents of erythrocyte 8-OH-dG

	Placebo	Sample
	(pg/mL)	
Initial	14.70±3.00^a	15.99±2.39^a
3 months	15.19±2.99^a	14.49±2.72^a
6 months	15.77±3.07^a	11.98±1.79^b

Values are means±SD

Data within the same column sharing different superscript letters were significantly different ($p < 0.05$)

Antioxidant enzyme

Super oxide dismutase (SOD)

Glucose 6-phosphate dehydrogenase (G6PD)

Catalase (CAT)

Glutathione peroxidase (GSH Px)

Glutathione reductase (GSH Rd)

Antioxidant enzyme

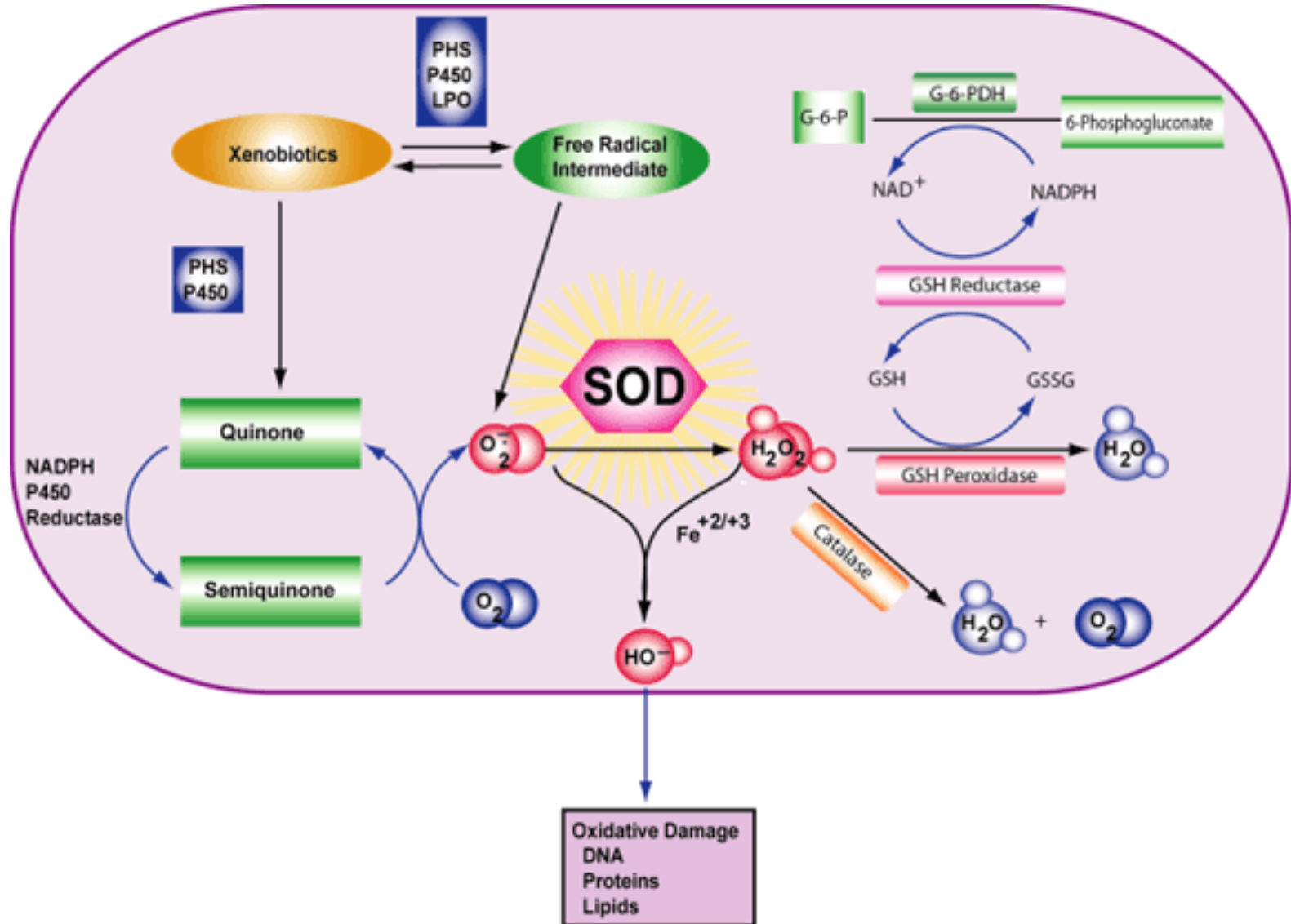


Table 6. The activity of superoxide dismutase in erythrocytes

	Placebo	Sample
	(IU/g Hb)	
Initial	1143.95 ± 170.14 ^a	1155.98 ± 150.11 ^c
3 months	1141.25 ± 155.46 ^a	1244.73 ± 149.46 ^b ↑
6 months	1144.60 ± 150.73 ^a	1385.63 ± 139.01 ^a ↑

Values are means±SD

Data within the same column sharing different superscript letters were significantly different ($p < 0.05$)

Table 7. The activity of glucose-6-phosphate dehydrogenase in erythrocytes

	Placebo	Sample
	(IU/g Hb)	
Initial	11.83 ± 2.11^a	11.99 ± 1.99^b
3 months	11.93 ± 2.19^a	12.40 ± 2.26^b
6 months	11.94 ± 2.03^a	13.56 ± 2.11^a ↑

Values are means ± SD

Data within the same column sharing different superscript letters were significantly different ($p < 0.05$)

Table 8. The activity of catalase in erythrocytes

	Placebo	Sample
	(kIU/g Hb)	
Initial	245.83 ± 32.43^a	246.26 ± 28.08^b
3 months	244.86 ± 31.80^a	268.87 ± 28.22^{ab}
6 months	242.97 ± 28.32^a	279.21 ± 26.18^a

Values are means ± SD

Data within the same column sharing different superscript letters were significantly different ($p < 0.05$)

Table 9. The activity of glutathione peroxidase in erythrocytes

	Placebo	Sample
	(IU/g Hb)	
Initial	12.64 ± 1.43^a	13.16 ± 1.71^b
3 months	13.07 ± 1.53^a	14.39 ± 1.20^b ↑
6 months	12.63 ± 1.78^a	15.44 ± 1.17^a ↑

Values are means ± SD

Data within the same column sharing different superscript letters were significantly different (p < 0.05)

Table 10. The activity of glutathione reductase in erythrocytes

	Placebo	Sample
	(IU/g Hb)	
Initial	3.95 ± 0.64^a	4.00 ± 0.61^a
3 months	3.99 ± 0.63^a	4.29 ± 0.66^a
6 months	3.99 ± 0.64^a	4.53 ± 0.68^a

Values are means \pm SD

Data within the same column sharing different superscript letters were significantly different ($p < 0.05$)



Clinical evaluation on liver

Abdominal ultrasonic exam.

GOT, GPT



Normal Liver, Fatty Liver, and Cirrhosis



Table 11. Biochemical analyses of serum GPT

	Placebo	Sample
	(U/L)	
GPT		
Initial	20.05 ± 20.44^a	22.58 ± 18.92^a
3 months	20.25 ± 20.10^a	16.85 ± 12.64^b
6 months	21.33 ± 20.10^a	13.08 ± 9.92^c



Table 11. Biochemical analyses of serum GOT

	Placebo	Sample
	(U/L)	
GOT		
Initial	19.65 ± 9.24^a	20.65 ± 11.43^a
3 months	20.45 ± 9.72^a	19.85 ± 9.63^a
6 months	19.90 ± 11.16^a	15.05 ± 9.30^b

Values are means±SD

Data within the same column sharing different superscript letters were significantly different (p < 0.05)



Abdominal ultrasonic examination





Fatty liver (mild)



Normal





Ball bladder polyp



Conclusion

The above clinical evaluation clearly showed that:

- **The total antioxidant status, total thiols and glutathione contents were significantly increased.**
- **TBARS and 8-OH-dG contents were reduced**
- **Activities of GSH Px, SOD, G6PD and CAT were increased.**
- **Down regulation for subjects with higher GPT and GPT.**
- **Improvement on parenchyma liver disease and fatty liver.**

Triterpenoids and polysaccharide peptides-enriched *Ganoderma lucidum*: a randomized, double-blind placebo-controlled crossover study of its antioxidation and hepatoprotective efficacy in healthy volunteers

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PHYTOTHERAPY RESEARCH

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Effect of Citronellol and the Chinese Medical Herb Complex on Cellular Immunity of Cancer Patients Receiving Chemotherapy/Radiotherapy

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Effects of a Chinese medical herbs complex on cellular immunity and toxicity-related conditions of breast cancer patients

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Improvement of Liver Function in Humans Using a Mixture of *Schisandra* Fruit Extract and Sesamin

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This was a randomized, parallel, and placebo-controlled study. Forty subjects were divided into a test group and a placebo group. The study was focused on the potential effects of a mixture of *Schisandra* fruit extract and sesamin (hereinafter called 'SCH') in the subjects with borderline high levels (40–60 U/L) of alanine aminotransferase (ALT) or aspartate aminotransferase (AST). Twenty subjects taking SCH (four tablets per day) and 20 subjects taking a placebo (four tablets per day) were studied. The effects of SCH on ALT, AST, total bilirubin, direct bilirubin, free radical levels, total antioxidant status, glutathione peroxidase, glutathione reductase, and the lag time for low-density lipoprotein oxidation were determined. The total test period was 5 months. Intervention of SCH clearly reduced the levels of ALT and AST, but it made no change in the total bilirubin and direct bilirubin. Intake of SCH also greatly increased the antioxidant capacity and decreased the values of thiobarbituric acid reactive substances, total free radicals, and superoxide anion radicals in the plasma. The activities of glutathione peroxidase and reductase in the erythrocytes were significantly increased. In addition, the lag time for low-density lipoprotein oxidation, an inflammatory marker, was evidently increased. Fatty liver was found to have been significantly improved in this study. SCH proved to have the effects of antioxidation and improving liver function. Copyright © 2012 John Wiley & Sons, Ltd.

Keywords: *Schisandra* fruit extract; sesamin; SCH; liver dysfunction; LDL oxidation.



Chung Shan Medical University (Medical Center)



Chung Shan Medical University

- **CAM Center**
- **Clinical Trial Center**
- **IRB (Institute of Reviewing Board)**
- **Toxicity evaluation center**
- **R & D Center**
- **Incubation Center**

256 slice CT



SIEMENS Somatom Sensation256

Positron Emission Tomography (PET)

A PET scan can be used in early diagnosis of cancer, helping physicians determine the best method for treatment.



**CSMUH's Positron Emission Tomography Center :
the largest in Southeast Asia**

Cyclotron Center



Tomo Therapy



Gamma Knife

The Gamma Knife, a well-established treatment method, is not really a knife at all but a non-invasive treatment used for the brain problems.



Hyperbaric Oxygen Therapy Center



HBO Treatment Center : The only managed by diving medicine faculty doctors in the middle of Taiwan

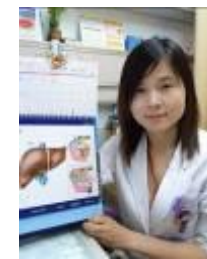


Laboratory Medicine



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中山醫學大學105年度國際週活動

主辦單位：國際事務暨校友服務處國際組



Research Team

Thanks for your attention



酒浓醇香

<http://323497730.qqzone.qq.com>