

序 言

台灣境內有高山、平原、丘陵乃至海濱等地形，更兼具溫帶、亞熱帶及熱帶等不同氣候環境，蘊育著極為豐富的生態與植物種原。近年來由於人爲的過度開發，珍貴的野生藥用植物種原瀕臨滅絕，對於珍稀植物種原的保護刻不容緩；又近來食品安全問題爲國人所重視，尤以國人常有食補養生之觀念，所需之藥材甚多；然而大多數之藥材多仰賴進口，導致藥材之基原、品質管控無法掌握，使民眾有安全之虞。因此，建立優質中草藥栽培體系，或以有機栽培方式生產中草藥，提供優質、安全之中草藥爲國人使用，爲當務之急。而中草藥基原植物之正確使用、優質栽培技術之建立、中草藥之有效成分分析、藥理作用、臨床療效及保健產品之研發與行銷等，對中草藥產業之發展極爲重要，也是未來台灣中草藥產業邁向國際化目標發展的努力方向。

行政院農業委員會花蓮區農業改良場舉辦「2009 國際中草藥產業發展研討會」，邀請美國、日本、國內大學、中醫藥界及農業專家就中草藥區域性產業現況、藥理作用、加工利用、產業發展等議題發表論文卓見，並作廣泛的討論，期能藉由此次研討會之舉行，結合國內外學界、產業界與農業界組成研發團隊，進行資源整合，研發高附加價值之保健產品；並透過優良農業操作（Good Agricultural Practice，簡稱 GAP）之優質栽培模式，生產高品質藥材，建立臺灣爲世界中草藥生產基地，及保健產品研發中心，提昇臺灣在全球中草藥市場的競爭力。

此次研討會由本場同仁之熱心協助，使研討會能圓滿達成。本論文專刊編印期間，承蒙每位作者充分配合，乃能順利付梓，在此一併感謝。惟本刊涵蓋內容甚廣，付印匆促，疏忽難免，期各界先進不吝指正。

行政院農業委員會花蓮區農業改良場

場長 **黃 鵬** 謹識

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The Current Situation of Japanese Medicinal Plants Industry and its Significance on the Pharmaceutical Industry

Ichiro Arai, Ph.D.

Tsumura & Co.

I. Current situation of crude drugs

I-1. Usage of crude drugs

Medicinal plants (crude drugs) have a wide array of applications in Japan including medicine, food, cosmetics, insect repellent, coloring, fragrance, bath products, etc. Since one drug may be used as medicine and/or food, statistical reports on the precise amount of medicinal plant utilization do not exist.

According to the domestic cultivation and importation data published in the “Annual Report of Pharmaceutical Production”¹⁾ by the Japan Kampo Medicines Manufacturer Association (JKMA), 97% of the 150 most frequently used crude drugs for medicine and food in 2002 relied on importation (56,221t importation vs. 1,723t domestic cultivation). The employment of these 150 crude drugs parallels the production rate of Kampo formulations, and since the sales of these formulations and health food are rapidly increasing in the recent years, demands for crude drugs are anticipated to proliferate also. Most commonly used drugs in descending order are Ginger (23,807t), Coix seed (7,021t), Capsicum (4,000t), Turmeric (3,727t), Glycyrrhiza

(2,016t), Cinnamon bark (1,259t), Cassia seed (1,203t) and Safflower (1,055t). Glycyrrhiza is unsurpassed in its usage in medicinal products.

The 2006 statistical data²⁾ from Japan Specialty Agriculture Products Association (JSAPA) of medicinal and non-medicinal crude drug importation reported that 58% were imported from China, 19% from Thailand, 13% from India, 2% from Sudan, and 1% from Taiwan. The actual proportion of importation from China is estimated to be higher if medicinal products are considered alone.

I-2. Distinction between drugs and foodstuffs

In Japan, medicinal plants are classified into two groups based on the list of characteristics in the “Distinction between drugs and foodstuffs”³⁾.

- (1) Medicinal plants that are used exclusively as medicine (ie., cannot be used as food):

232 plant-based species, 21 animal-based species, 58 other species, e.g., Japanese Angelica (root), Astragalus (root), Phellodendron (bark), Coptis (rhizome, fibrous root), Rhubarb (rhizome), Aconite (tuberous root), etc.

- (2) Medicinal plants that are considered non-medicinal unless medicinal efficacy is clearly stated (ie., can be used as food as long as therapeutic claims are not made) :

804 plant-based species, 65 animal-based species, 147 other species, e.g., Eleutherococcus senticosus (bark, root, root bark, leaf, flower, fruit), Bitter melon (fruit, root, leaf), Astragalus (stem, leaf), Phellodendron (leaf, berry), Coptis (leaf), Rhubarb (leaf), Ginseng (fruit, root, rhizome, leaf), etc.

I-3. Standard of quality control of The Japanese Pharmacopoeia (JP)

Crude drugs must meet The Japanese Pharmacopoeia (JP)⁴⁾ criteria to qualify as medicine. In 2001, 121 crude drug species and their 52 powdered forms were listed in JP 14th edition (JP14). However, revisions and new advances from the non-JP crude drug standards (internal regulations for approval) after 2006 led to the addition of Supplement I in JP 15 in 2007 which expanded the list to 153 crude drugs and their 54 powdered forms.

The following characteristics of crude drugs are standardized in the official monographs of JP:

- (1) Name, (2) Origin, (3) Medicinal part, (4) Preparation process, (5) Content of specific constituents (lower limit setting), (6) Description, (7) Identification, (8) Purity (includes heavy metals, arsenic, residual pesticides), (9) Loss of drying, (10) Total ash, (11) Acid-insoluble ash, (12) Extract content, (13) Assay.

Nonetheless, some characteristics have not been specified yet depending on the species.

Recent stringent provisions of original species have succeeded in eliminating loose nomenclatures such as “other species of the same genus” when referring to them. JP has permitted the Japanese experiential use of substituting crude drugs for Chinese species; hence, Japanese species must be differentiated from the Chinese species with identical characters. For example, the original Angelica plant that JP prescribes is *Angelica acutiloba* or *Angelica actiloba* Kitagawa var. *sugiyama* Hikino (*Umbelliferae*). In contrast, the Pharmacopoeia of the People’s Republic of China employs *Angelica sinensis*.

Some pharmaceutical companies devise their own in-house standards in addition to the legally minimal JP standards. Non-JP crude drug standards are used as a reference for drugs that are not listed in the JP, and each company must develop their own

approval standards for drugs that are not listed in the former references.

II. Current situation of crude drug products

II-1. Kampo medicines

Traditional medicine from China evolved uniquely in Japan and established itself as Kampo medicine. As with Traditional Chinese Medicine (TCM), Kampo medicine utilizes several crude drugs to prepare Kampo formulae. Nowadays, industrially manufactured dried extract formulations have outnumbered traditionally prepared decoctions, pills and powders.

Kampo formulations are available from physicians as prescriptions and as OTC formulations from regular pharmacies. Kampo formulations for prescription have fixed national drug prices and are covered by the national health insurance (NHI) which keeps patient payments fractional. Currently, 148 formulae are approved as prescriptions. In contrast, 210 OTC Kampo formulations have been authorized since 1975 by the internal regulations for approval⁵⁾. Several more formulae that have been approved before 1975 are available also.

Official data documenting the precise market sales of Kampo medicines in Japan are not available. Instead, production values, ie., amount of production x NHI price, are construed as the proximate data on market sales. For example, the 2004 production values of the top 8 formulations in descending order are as follows: Hochuekkito (Bu-Zhong-Yi-Qi-Tang; 7% of total production values of Kampo formulations), Dai-kenchuto (Da-Jian-Zhong-Tang; 6%), Saireito (Chai-Ling-Tang; 5%), Kamishoyosan (Jia-Wei-Xiao-Yao-Sa; 4%), Shosaikoto (Xiao-Chai-Hu-Tan; 3%), Bakumondoto (Mai-Men-Dong-Tang; 3%), Goshajinkigan (Niu-Che-Shen-Qi-Wan; 3%), and Rik-

kunshito (Liu-Jun-Zi-Tang; 3%)¹⁾. These formulations tend to have higher NHI prices also. However, formulations that are frequently administered by physicians including Kakkonto (Ge-Gen-Tang), Shakuyakukanzoto (Shao-Yao-Gan-Cao-Tang), Choreito (Zhu-Ling-Tang), Shoseiryuto (Xiao-Qing-Long-Tang) tend to have lower NHI price^{6, 7)}.

During the early approval stage of Kampo extract formulations, lack of regulation details led to products with less content of constituents than decoctions. In 1986, the government re-established the regulations for quality control and this became known as Marukan. The revised standards⁸⁾ required extract content products to contain homogenous amount of dried extract that was equivalent to the amount generated from standard decoctions prepared via traditional methods (note that each company devised its own standard decoctions). The amount of two or more indicator ingredients of extracts had to be comparable to the standard decoction also, and the accepted range for these ingredients was defined at $\pm 50\%$ mid-range. In contrast to the Traditional Chinese medicinal products that incorporate whole extracts in every production, and consequently vary in amount among the batches, Kampo extract formulations contain very stable and consistent amount of ingredients across all batches.

After 2006, the JP created a regulation list for Kampo extracts based on each company's standards. The following eight formulations were added and listed in the pharmacopoeia⁴⁾: Kakkonto (Ge-Gen-Tang), Daiokanzoto (Da-Huang-Gan-Cao-Tang), Kamishoyosan (Jia-Wei-Xiao-Yao-San), Ryokeijutsukanto (Ling-Gui-Shu-Gan-Tang), Hochuekkito (Bu-Zhong-Yi-Qi-Tang), Saireito (Chai-Ling-Tang), Hangekobokuto (Ban-Xia-Hou-Pu-Tang), Keishibukuryogan (Gui-Zhi-Fu-Ling-Wan). For each extract, the following sets of standards were defined:

- (1) Contents of indicator ingredients, (2) Method of preparation, (3) Description,
- (4) Identification, (5) Purity (heavy metals, arsenic, etc.), (6) Loss of drying, (7) Total ash, (8) Assay, (9) Container and Storage,

Each company devised their own regulations and standards in their approval documents for formulations and crude drugs. Even though these standards were independently implemented, they all fell within the wider range of JP standards.

In addition to the official GMP for medicine, JKMA established a self-imposed standard called “GMP for Kampo products” in 1988 for the manufacturing of Kampo extract formulations. They also established a crude drug control manager who oversaw the quality assurance of crude drugs, and included additional testing of aristolochic acid and residual pesticides in the 2007 revision ⁹⁾. Regulations such as GAP, GFCP, GACP had not been established in Japan yet.

II-1-1. Kampo formulations for prescription

With the advent of national health insurance coverage of Kampo extract formulations in 1976 and concerns about adverse effects from chemical drugs, the market sales (production value) of Kampo formulations¹⁾ for prescription soared dramatically, peaking 154 billion yen in 1992. From the end of 1991, however, newspapers and mass media reported increased mortality rate from interstitial pneumonia among patients who ingested Shosaikoto (Xiao-Chai-Hu-Tang) for chronic hepatitis. This incidence converted Kampo prescribing physicians, who regarded Kampo as safe medicines, into cautious and doubtful physicians. As a consequence, this led to a sharp decline in both Kampo formulation production and Shosaikoto prescription.

After reaching the lowest production value of 84 billion yen in 2000, however, each succeeding year demonstrated a steady recovery rate and growth of Kampo formulations for prescription. By 2004, that figure rose to 92 billion yen and now Kampo formulations comprise 1.2% of the production value of the entire Japanese pharmaceuticals.

The characteristic of Kampo medicine practice in Japan today is that physicians are capable of prescribing both the chemical drug and Kampo medicine. This is in

contrast with the Chinese system where two separate physician licensures are required to practice Western medicine and Traditional Chinese Medicine. Traditionally, very few colleges taught Kampo medicine education and the majority of physicians studied independently post graduation. In 2001, the guidelines for medical education promoted the “understanding of Wakan-yaku (Kampo medicines)” for all doctors. Since this announcement, many universities began teaching Kampo medicine and by 2004, all of the 80 medical schools integrated Kampo medicine into their curriculum.

According to the results from a physicians’ survey¹⁰⁾, 72% of respondents answered “currently prescribing Kampo medicines”, with 52.7% of physicians employing them for unidentifiable complaint and menopausal disorder, 50.8% for acute airway inflammation, and 48.4% for constipation. Many physicians reported familiarity with the following prescriptions and often used them as the first line of defense for treating diseases: Kakkonto (Ge-Gen-Tang; 51.6% of physicians prescribe this), Shakyakukanzoto (Shao-Yao-Gan-Cao-Tang; 45.7%), Hochuekkito (Bu-Zhong-Yi-Qi-Tang; 39.0%), Shoseiryuto (Xiao-Qing-Long-Tang; 32.9%), Kamishoyosan (Jia-Wei-Xiao-Yao-San; 31.8%) .

Application for manufacturing approval of Kampo formulations for prescription are based on the 1980 regulations⁸⁾, and no other formulations have been approved since that year. This is because the current regulation mandates astringent data submission that is comparable to a new drug application with rigorous clinical trials. Unlike China, Japan does not have a separate approving system that is lenient toward empirical, traditional medicines.

II-1-2. OTC Kampo formulations

OTC Kampo formulations have a production value of approximately 1/4 to 1/5 of Kampo formulations for prescription, and they comprise 2.9% of the entire OTC sales¹⁾. Along with the prescriptions, the OTC production value had reached its peak

of 30 billion yen in 1992 and dropped thereafter. Sales have only recently recovered in part due to heightened awareness of lifestyle-related diseases and great hope in Bofutsushosan (Fang-Feng-Tong-Sheng-San) as an anti-obesity drug.

In 2007, the pharmaceutical affairs law was revised as part of the national attempt to promote self-medication. This allowed non-pharmacist, registered salesman to sell Kampo medicines¹¹⁾. Due to these changes, the market is expected to show an upward trend in the coming years.

In 1975, 210 formulations were selected for OTC according to the internal regulations for “Guideline for OTC Kampo formulae”⁵⁾. These formulae had the potential for approval in the recent years if their effects and indications matched the Guideline, and if sufficient data proving equivalence in quality as standard decoctions were presented. In 2008, the outdated internal regulations were rearranged, added and/or revised to update the effects and indications of the OTC formulations.

II-1-3. Classical formulations (Decoctions)

For doctors and pharmacists who prefer a higher content of crude drugs than the pre-determined amount in extract formulations, crude drug pieces are available for sale for decoctions. Insurance will cover all prescriptions as long as they are prescribed by physicians and combine any of the 248 crude drugs that are listed in the NHI price list. Even so, some physicians opt for insurance-free practice.

II-2. Conventional crude drug products (non-Kampo crude drug products)

In Japan, crude drugs may be used in OTC products besides Kampo formulations, such as a product combining crude drugs with vitamins. Approval is granted as long as there is evidence of prior consent for using the drugs. Currently, statistical data of sales of non-Kampo crude drug products do not exist.

II-3. Health foods

Under the Japanese law, all products except drugs are traditionally considered as foods. However, many illegal sales of food and herbal products with false medicinal claims flooded the market and because of this, two new food categories were added in 2001¹²⁾- foods for specified health use (FOSHU) and foods with nutrient function claims (FNFC) (foods which consist of vitamins and/or minerals). FOSHU are products that can claim medicinal benefits if preliminary clinical data and scientific evidence are submitted. For example, Tochucha's (Eucommunia bark tea) health claim as the "beneficial food for people with high blood pressure" is approved by the FOSHU. As of November 7th. 2008, 806 types of FOSHU have been approved. These products contain plants such as soybean, tea, psyllium, wheat, guava, coffee, Eucommunia bark, seaweed, sesame seed, broccoli, and cabbage, etc. The FOSHU market growth is proportional to the increasing number of approved products, with 2007 sales reaching 680 billion yen (not all products contain herbs)¹³⁾. On the other hand, health foods that have not been approved by FOSHU and FNFC are still sold as "so-called health food" even after these regulations have been implemented. The 2007 market for these "so-called health food" have reached 1,100 billion yen¹⁴⁾.

III. Theme/subjects for Japanese medicinal plants industry

III-1. Rising crude drug prices and declining product values

Crude drug prices in Japan have increased in the recent years. The main factor for this increase is due to the rising labor costs in China.

The NHI price of prescription drugs in Japan are fixed and subject for re-evaluation every two years according to the actual trading price. However, the ac-

tual trading price is lower than the NHI price because they are determined by the negotiations between the medical institutions and wholesalers. As a result, the NHI price of most prescription drugs will decrease several % every two years. Kampo formulations are not exempted from this fluctuating market either, as reflected in their considerable price reduction over the past several decades. Western pharmaceutical companies compensate for NHI price reductions of existing products with new, high-value products. Since Kampo medicine companies do not make new products, price decrement inevitably leads to lower profit.

III-2. Stable procurement of crude drugs

The market sales of Kampo formulations for prescription have steadily increased in the recent years. However, the declining NHI price and reduction in weighted average sales price from greater usage of low-priced formulations have led to crude drug demand surpassing the actual sales of Kampo formulations. With every 8% increase in crude drug exigency each year, it is estimated that the amount that will be required in nine years will double from now.

China has always been the single, greatest source of crude drugs. However, in order to protect the environment and fertile land from turning into desert, the exportation of Glycyrrhiza and Ephedra Herba from China is currently limited. This foretells the potential risk in relying on one country as the main source of procurement. Domestic cultivation of medicinal plants in Japan is trekking a downward trend also due to aging farmers, greater profit from cultivation of other crops, and defeating price competition with Chinese suppliers.

Crude drugs that are mainly domestically cultivated (2002)¹⁾ include bamboo grass (*Sasa veitchii* ; 20t), Zedoary (20t), Cnidium Rhizome (12t), Artemisia (10t) and Zanthoxylum Fruit (10t). The Research Center for Medicinal Plant Resources – Na-

tional Institute of Biomedical Innovation publishes “Medicinal plants – cultivation and quality evaluation” (volumes 1-11 covering 58 medicinal plants/crude drugs)¹⁵⁾ with the purpose of promoting cultivation techniques. The following items are described in these documents:

(1) name and origin, (2) medicinal part, (3) (aspect) properties of plant, (4) (aspect) characteristics of crude drug and production area, (5) characteristics of cultivated species, (6) cultivation method, (7) quality evaluation of crude drug, (8) classification table of characteristics, (9) cultivation almanac, (10) data.

Breedings of medicinal plant seeds are performed by a small fraction of the industry and by the Research Center for Medicinal Plant Resources – National Institute of Biomedical Innovation. Registration and application of seeds can be found on the webpage of Ministry of agriculture, forestry and fisheries¹⁶⁾.

A better procurement system that relies less on China for import and more on domestic cultivation of medicinal plants must be actualized in the near future.

III-3. Countermeasure for contaminations of crude drugs

Public interest in “safe food procurement” has increased after the recent quagmire with Chinese agricultural products containing high residual pesticides. Additional limits are being created for residual pesticides, heavy metals and arsenic, and microorganisms of crude drugs and their products to ensure greater safety. More investments on tests that identify potentially dangerous substances will benefit the industry in the long run, even if the immediate profit of crude drug manufacturing companies may be affected. As we proceed into the future, the traceability of crude drugs must be further established by tracking, investigating and managing transportation from agricultural farms to the factory - all this in addition to the regular downstream inspection.

III-3-1. Residual pesticides

Based on the residual pesticide investigation of crude drugs in 1997, the total BHC and DDT limit of 0.2 ppm was established for Ginseng, Powdered Ginseng, Red Ginseng, Senna Leaf, and Powdered Senna Leaf. However, crude drugs were tested again in response to public demand, and the residual pesticides limit level was delineated in the 2006 JP15 as 0.2ppm for total BHC and total DDT each for the following crude drugs (in addition to the former ones in 1997):

Astragalus Root, Polygala Root, Powdered Polygala Root, Glycyrrhiza, Powdered Glycyrrhiza, Cinnamon Bark, Powdered Cinnamon Bark, Asiasarum Root, Cornus Fruit, Perilla Herb, Jujube, Citrus Unshiu Peel, Loquat Leaf, Moutan Bark, Powdered Moutan Bark

During 2005-2006, JKMA established the following self-imposed limit for Kampo extract formulations and non-Kampo crude drug products:

Organochloric pesticides (total BHC, total DDT: below 0.2ppm)

for Kampo formulations and non-Kampo crude drug products containing Ginseng, Senna Leaf, Astragalus Root, Polygala Root, Glycyrrhiza, Cinnamon Bark, Asiasarum Root, Cornus Fruit, Perilla Herb, Jujube, Citrus Unshiu Peel, Loquat Leaf, Moutan Bark.

Organophosphorus pesticides (Parathion : 0.5ppm, Methyl Parathion : 0.2ppm, Methidathion : 0.2ppm, Malathion : 1.0ppm)

for Kampo formulations and non-Kampo crude drug products containing Polygala Root, Cornus Fruit, Perilla Herb, Citrus Unshiu Peel.

Pyrethroid pesticides (Fenvalerate : 1.5ppm 、Cypermethrin : 1.0ppm)

for Kampo formulations and non-Kampo crude drug products containing Polygala Root, Perilla Herb, Jujube, Citrus Unshiu Peel, Loquat Leaf.

For crude drugs that are used as foods, the residual pesticide limit changed from its negative list to a positive list system in 2006, and uniform limit of 0.01ppm was

implemented for all residual pesticides of all food products that lack individual limit.

For pesticides that are not legally regulated, in-house limits are established by the company and testing is performed accordingly.

III-3-2. Heavy metals and arsenic

The 2006 JP 15 established limitations of heavy metals and arsenic for 40 varieties of crude drugs. Supplement I to JP15 (2007) added 65 more crude drugs to this list⁴⁾, and uniform standards for heavy metals (30ppm) and arsenic (3ppm) for eight Kampo extracts in JP were also implemented.

III-3-3. Microorganisms

The JP identifies acceptable limits for the following microorganisms in drugs as general information (and not as mandatory regulation): aerobic bacteria, molds and yeasts, enterobacteria and other gram-negative bacteria, *Escherichia coli*, *Salmonella*, *Staphylococcus aureus*. Category 1 lists established limits for crude drugs for extract formulations and decoctions which are manufactured at high temperature. Category 2 represents the more rigidly, regulating limits for powdered crude drugs, pills or powders which are manufactured without heat.

VI. Japanese association for Kampo/crude drugs

Industry organization

- Japan Kampo Medicine Manufacturers Association <<http://www.nikkankyo.org/>>
- Tokyo Crude Drugs Association <<http://www.aa.alpha-net.ne.jp/shouyaku/index.htm>>

Research institute

- Division of Pharmacognosy, Phytochemistry and Narcotics-National Institute of Health Science <<http://www.nihs.go.jp/dpp/index.html>>

- Research Center for Medicinal Plant Resources - National Institute of Biomedical Innovation <<http://www.wts9.nibio.go.jp/>>

Academic society

- The Japanese Society for Pharmacognosy <<http://www.jsphcg.gr.jp/>>
- Japanese Society of Breeding <<http://www.nacos.com/jsb/>>
- Crop Science Society of Japan <<http://www.soc.nii.ac.jp/cssj/>>
- The Japanese Society of Horticultural Science <<http://www.jshs.jp/>>
- The Japan Society for Oriental Medicine <<http://www.jsom.or.jp/html/index.htm>>
- Medical and Pharmaceutical Society for WAKAN-YAKU <<http://www.wakan-iyaku.gr.jp/>>

Other association

- Japan Speciality Agriculture Products Association <<http://www.jsapa.or.jp/index.html>>

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Chemistry and Biological Activities of Selected Popular Chinese Herbs in the US Market

Chi-Tang Ho^{1,2} and Mingfu Wang³

¹Department of Food Science, Rutgers University, New Brunswick, NJ 08901,
USA

²Graduate Institute of Food Science and Technology, National Taiwan University,
Taipei, Taiwan

³School of Biological Sciences, The University of Hong Kong, Pokfulam Road,
Hong Kong

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I. Introduction

Herbs have been used as medicines and functional foods in the Asian world for thousands of years. Before western medicines were introduced into Asia, herbs had been the main weapon in the treatment of diseases and even today remain a main

source of drugs in the primary health-care. Currently over half of the Chinese population use traditional herbal prescription, particularly when western medicines do not appear to be as effective as in the case of the treatment of chronic ailments such as age-related diseases. The Traditional Chinese Medicine (TCM) in China is undergoing a new renaissance as the current Chinese government has recognized that the TCM is a treasure for the nation and can provide both improved health care for its own citizens as well as serving as an excellent source of phytomedicines for the international export market when it is combined with modern science. As a national strategy, the Chinese government is placing much emphasis toward modernizing TCM. The push toward modernization in this field has led to an increase in the use of modern pharmacological experiments, standardization of the active components, identification and use of marker compounds in herbal prescription, establishing fingerprinting profiles (chemically and genetically) for single and blended herbs, and a wide range of other quality related issues that now face the international acceptance and use of TCM. The long history of TCM, and its associated assumption of safety, if not efficacy, has attracted much interest for the European and North American marketplace to examine and use of Chinese herbs for disease prevention and treatment. Consequently, due to perceived consumer demand for these products, many western companies have been importing, promoting and distributing a wide range of Chinese herbs in the western market and this business appears to be quite fruitful. Popular Chinese herbs including ginseng (*Panax ginseng* C. A. May), ginkgo (*Ginkgo biloba*), Dong quai (*Angelica sinensis* (Oliv.) Diels) and Siberian ginseng (*Eleutherococcus senticosius*) are among the top 20 selling herbs in the US market.

Herbal products are marketed in the United States as dietary supplements and not as medicinal plants or medicines. The US Food and Drug Administration (FDA) defines dietary supplements as: *A dietary supplement is a product taken by mouth that contains a "dietary ingredient" intended to supplement the diet.* The dietary supple-



ments are regulated by Dietary Supplement Health and Education Act (DSHEA). The passage of DSHEA has opened up opportunity for a plethora of new herbs onto the US marketplace, and while providing consumers a wider range of options. In this paper, we present general information on a number of popular Chinese herbs in the US market, discuss their current applications, chemistry and pharmacology. We focus our comments on four popular Asian herbs: *Angelica sinensis* (Oliv.) Diels, *Rhodiola rosea*, *Pueraria lobata* and *Panax ginseng* C. A. May. In addition, a popular dietary supplement, resveratrol will be discussed. Commercially, resveratrol is mainly derived from a common TCM, *Polygonum cuspidatum*.

II. *Angelica sinensis* (Oliv.) Diels (Dong Quai or Dang Gui, or Tang Kuei)

The whole root of this Chinese plant, *Angelica sinensis* (Family: Apiaceae) is used as an herbal medicine in China and is a well recognized tonic herb for women. Traditionally, Dong Quai is used to treat obstetric and gynecological problems and the herb drug acts as a mild laxative, a uterine tonic, antispasmodic, and alterative (blood purifying), increases blood circulation, relaxes the uterus, stabilizes pregnancy, and is used for the regulation of menstrual cycle (A Barefoot Doctors Manual, 1977). Currently, in the US, it is marketed for alleviating female disorders such as premenstrual syndrome, menstrual cramps and to help them with discomfort associated with menopause. Dong Quai is sold as a single herb or herbal extract, or combined with other herbs, such as black cohosh (*Cimicifuga racemosa*), chase tree berries (*Vitex agnus castus*), blue cohosh (*Caulophyllum thalictroides*) and astragalus (*Astragalus membranaceous*) in complex formulas in the US market.

A. Chemical Components

The investigation of the phytochemistry of *Angelica sinensis* root has revealed the

presence of several distinct groups of chemical compounds (1-9).

1. Amino acids: some 20 amino acids have been reported in *Angelica sinensis* with arginine and glutamic acid as the major ones.
2. Essential oils: forty-nine volatile aromatic compounds have been identified by GC-MS with ligustilides (Figure 1) reported as the major constituents.
3. Sterols: β -sitosterol, stigmasterol and β -sitosterol-D-glucoside has been identified.
4. Fatty acids and organic acids: palmitic acid, linoleic acid, stearic acid, arachidonic acid, ferulic acid and vanillic acid were present.
5. Coumarins: bergaptene, imperatorin, psoralen, osthole, oxypeucedanin, scopoletin, and umbelliferone were present.
6. Polysaccharides were identified.
7. Other components: E232, angelicide, brefeldin A, tetradecan-1-ol, tetramethylpyrazine were present.

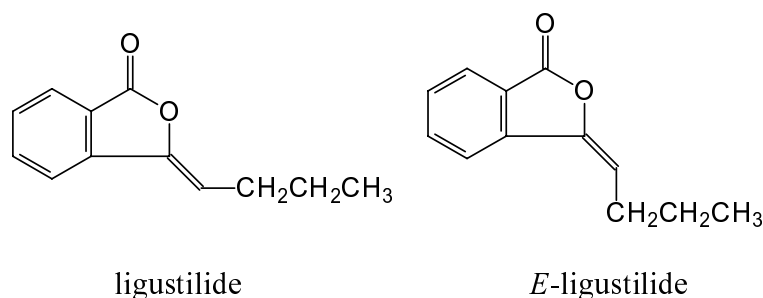


Figure 1. Structures of ligustilide and E-ligustilide

B. Biological activity

The extracts of *Angelica sinensis* showed antiarrhythmic effects on adrenaline induced arrhythmia in cats (10). Dong Quai was also found to improve the blood circulation of the injured nerve (11), to regulate LPS-induced elevation of Ca^{2+} intracel-



lular level of alveolar macrophages and may inhibit non-specific inflammation of airways in chronic bronchitis (12), to protect the human vascular endothelial cell from the effects of oxidized low-density lipoprotein *in vitro* (13), to enhance gastric ulcer healing in rats and promote wound repair in RGM-1 cells (14) and to stimulate the proliferation, alk. phosphatase (ALP) activity, protein secretion and particularly type I collagen synthesis of human osteoprecursor cells (OPC-1) (15).

The *Angelica sinensis* polysaccharides were found to decrease colony formation in spleen hematopoietic tissue of irradiated mice (16), to increase the proliferation of several types of precursor cells in healthy and anemic mice and increase hematopoiesis (17) and showed protective effects on gastrointestinal damage induced by ethanol or indomethacin in rats (18), protective effects on hepatic injury induced by acetaminophen in rodents (19), anti-anemic and immunofunction regulating activities (20), an extensive effect on immunocompetence (21), promoting gastric ulcer healing (22) and augmenting mice splenocyte proliferation, released IFN- γ and increased IFN- γ bioactivity (23).

Recent study also showed that Angelica root and its active components have the ability to inhibit the aggregated amyloid β -peptide (agg A β 1-40) induced damage of differentiated PC-12 cells (dPC-12), a well-known cell model for Alzheimer disease. Four compounds showing potent activity were identified as *Z*-ligustilide, 11-angeloylsenkyunolide F, coniferyl ferulate and ferulic acid. They were found to significantly inhibit A β 1-40 toxicity on dPC-12 cells at lower concentrations of 1–10 μ g/m (24)

III. *Rhodiola rosea* (Golden root, Roseroot, Hong Jing Tian)

The genus of *Rhodiola* consists of over 200 species, most found in Asia, and many used in traditional Chinese Medicine. In TCM, *Rhodiola* is used as a general

tonic in the treatment and invigoration of the human body. In the old traditional Chinese medicine pharmacopoeias such as the “Ben Cao”, *Rhodiola* was documented to prolong human life, to enhance the Qi in human body and keep human’s body light. In the US market, the best-known *Rhodiola* species is *Rhodiola rosea* L., also known as golden root or roseroot. *Rhodiola rosea* grows primarily in dry sandy ground at high altitudes in the Arctic areas of Europe and Asia. The plant is perennial with a thick rhizome, which is used as the herbal drug. *Rhodiola* was first introduced into the US market by Russians as extracts of the *Rhodiola rosea* root had been long researched and found to contain powerful adaptogens in Russia. In the US, *Rhodiola* is marketed and sold as a product to improve mental health, and adaptogenic, anti-stress and cardioprotective agents. *Rhodiola* is sold as single herbal extract though it can be found combined with other well known adaptogenic herbs such as ginseng and Siberian ginseng.

A. Chemical components

The investigation of the phytochemistry of *Rhodiola rosea* root has revealed the presence of several distinct groups of chemical compounds (25-28).

1. Phenylpropanoids: rosin, rosin, rosin were present (Figure 2).
2. Phenylethanol derivatives: salidroside (Figure 2), tyrosol were present.
3. Flavanoids: acetylrodalgin, kaempferol, kaempferol 7-rhamnoside, rodolol, rodolol, rodolol, tricin; tricin 5-glucoside, tricin 7-glucoside have been identified.
4. Monoterpenes: such as rosinol, rosinol were present.
5. Sterols: daucosterol, β -sitosterol were present.
6. Phenolic acids: chlorogenic acid, hydroxycinnamic acid, gallic acid have been identified.
7. Polysaccharides.
8. Tannins.

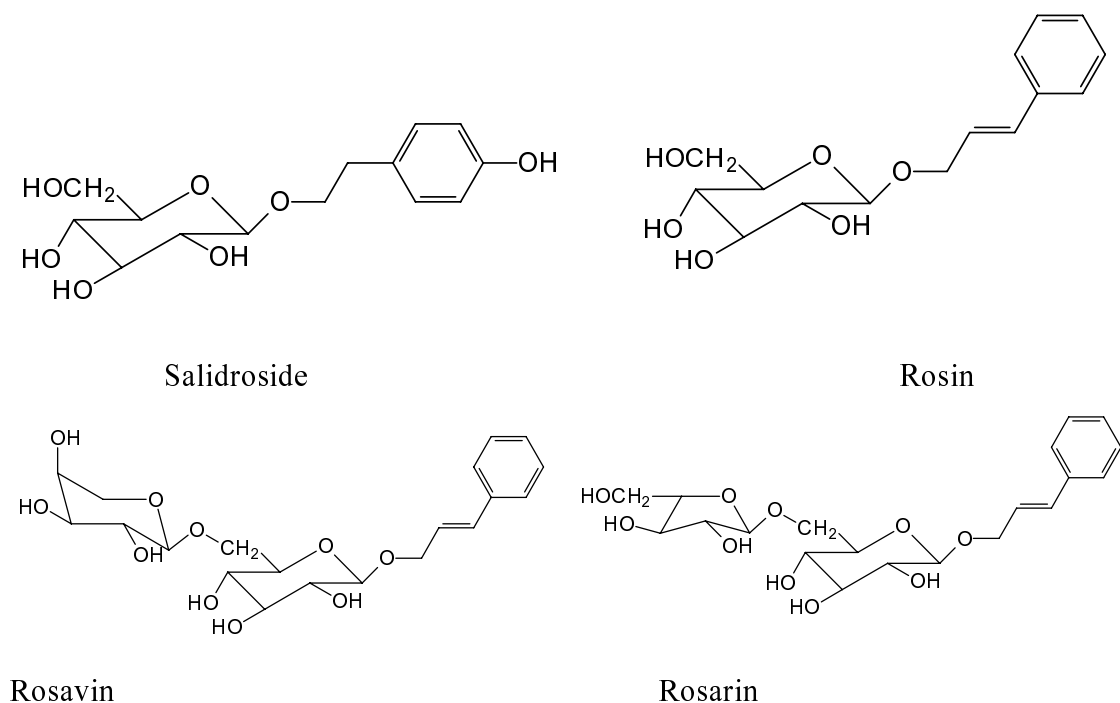


Figure 2. Structures of marker compounds in *Rhodiola rosea*

B. Biological activities

Extracts of *Rhodiola rosea* exhibited adaptogenic effects in mice and rabbits (29), cardio-protective and antiadrenergic activity during stress (30). One standardized extract SHR-5 was reported to significantly relieve stress-induced fatigue in a double blind cross-over study (31). An alcohol-aqueous extract (1:1) was found to improve learning and long-time memory in mice (32). *Rhodiola* extracts were also reported to prevent ischemic brain damage development (33), to scavenge free radicals (34), to show anti-tumor effect in experiments on inbred and noninbred mice and rats with transplantable NK/Ly tumor, Ehrlich's adenocarcinoma, melanoma B16 and Lewis lung carcinoma (35). In a small clinical trial with 12 superficial bladder patients, the

oral administration of *Rhodiola* extract was found to improve the characteristics of the endothelial tissue integration, parameters of leukocyte integrins and T-cell immunity and average frequency of relapses for these patients has been found to fall twice (36).

Neuroprotective effects of the major component of *Rhodiola*, salidroside have been studied. The salidroside was found to protect the PC12 cells against hypoglycemia and serum limitation-induced cytotoxicity possibly by the way of the modulation of apoptosis-related gene expression, the restoration of the mitochondrial membrane potential, and the inhibition of the intracellular ROS production (37). Similarly, the treatment of PC12 cells with salidroside can block H_2O_2 -induced apoptosis by regulating Bcl-2 family members and by suppressing cytochrome c release and caspase cascade activation (38). Recent research also suggested that the extract of *Rhodiola* significantly extend the lifespan of the fruit fly, *Drosophila melanogaster* (39).

IV. *Pueraria lobata* (Kudzu, Ge Geng)

Kudzu is one of the earliest medicinal plants that has been used in TCM thousands of years ago. The roots of kudzu have been used as anti-diarrhetic, antipyretic, diaphoretic, and anti-emetic agents and to treat alcohol-related problems (intoxication and alcohol-abuse). Currently, kudzu is marketed as a rich source of isoflavones, as an herb for women's health and as an anti-alcohol abuse plant material. As a plant for women's health, this herbal drug is formulated together with soy isoflavone extract, red clove isoflavone extract and chase tree berries.

A. Chemistry

The chemistry of kudzu has been studied extensively. The major components were isoflavones and saponins (40-48) including:



1. Isoflavones: Puerarin (Figure 3), daidzin, daidazein-4, 7-diglucoside, 6,7- dimethoxy-3',4'-methylenedioxyisoflavone, formononetin, mirificin, 3'-methoxy puerarin, genistein 8-C-glucoside, genistin, genistein, 6''-O-malonyldaidzin, 3'-hydroxy-4'-O- β -D-glucosylpuerarin and 3'-methoxydaidzin have been identified.
2. Chalcones: isoliquiritigenin was present.
3. Aromatic glycoside: pueroside-A and -B, but-2-enolides, sophoroside A.
4. Sterols: β -sitosterol, daucosterol have been identified.
5. Saponins: kudzusaponins A1, A2, A3, A4, A5, SA1, SA2, SA3, SA4, SB1 and C1, soyasaponins SA3, and I have been identified.
6. Tryptophan derivatives: PF-P was present.
7. Volatile compounds: such as methyl palmitate, dimethyl suberate and furfuryl alcohol were present.

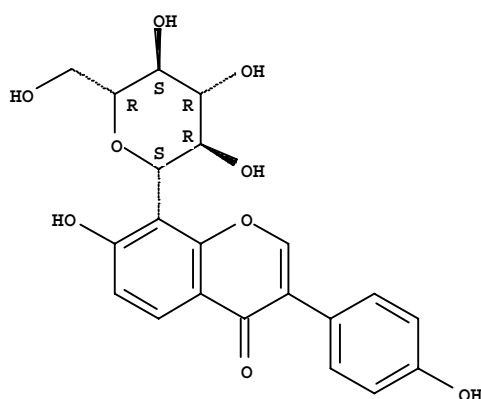


Figure 3. Structure of Puerarin

B. Biological activities

Kudzu extracts have shown antimutagenic activity (49), antidipsotropic activity (50) and suppressed alcohol preference in a pharmacogenetic rat model of alcoholism (51). The flavone extracts of kudzu affect coronary circulation, cardiac hemodynamics

and myocardial metabolism in dogs and show hypotensive effect on anesthetized dogs and unanesthetized, hypertensive dogs, decreased vascular resistance in anesthetized dogs, and increased peripheral and cerebral circulation (52,53). Puerarin showed stimulatory effect on α_{1A} -adrenoceptor to increase glucose uptake into cultured C₂C₁₂ cells of mice (54). Puerarin, daidzin and daidzein showed antiinebriation and the antidipsotropic effects (55). Biochanin A isolated from Kudzu root displayed the most active inhibition on arachidonic acid release in HT-29 human colon cancer cells, and exhibited its most potent suppression in RAW 264.7 cell without showing cytotoxicity (56).

V. Ginseng (*Panax ginseng* C. A. May)

Ginseng (*Panax ginseng* C. A. May) is the most valuable TCM herb. It is not only widely used by Asian countries, such as China, Korea and Japan, but also widely used in many western countries. For thousands of years, ginseng has been used as a tonic to increase nonspecific resistance against a wide array of various stress agents, to prevent and cure many health conditions, and has been used as an emergency medicine to save dying patients. In the US, it is marketed to improve mental performance in times of stress, to enhance overall health and vitality, to improve resistance to the damaging effects of stress, and to increase endurance. Ginseng is used and marketed as a major tonic, stimulant, and immune booster. Ginseng is available in the US market in a myriad of products as a powder, extract (7% ginsenosides and 15% ginsenosides extract), or combined with other herbs such as American ginseng, Rhodiola, Siberian ginseng and various vitamins. The dosage varies based upon each of its formulations.

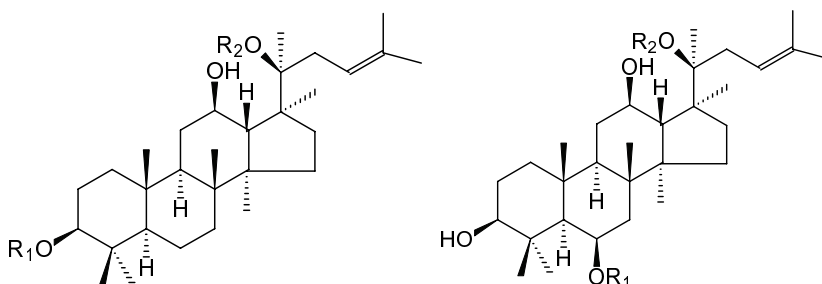
A. Chemical components

The chemistry of ginseng has been extensively studied, and the main components



include saponins and polysaccharides (57-59).

1. Saponins: about 30 saponins have been purified from the root of ginseng with Ginsenoside, Rg₁, Re, Rb₁, Rc, Rd and Rf as the major saponins (structures are shown in Figure 4) have been identified in root extracts.
2. Sterols: β -sitosterol, stigmasterol, campesterol were present.
3. Polyalkynes: heptadeca-1-en-4,6-diyne-3,9,10-triol, panaxynol, panaxynol, panaxydol, and panaxytriol, ginsenosynes A, B, C, D and E have been identified.
4. Fatty acids: linoleic acid, palmitic acid, oleic acid, and linolenic acid were present.
5. Amino acids.
6. Peptides.
7. Polysaccharides.



Rb1	Glc(2-1)Glc	Glc(6-1)Glc	Re	Glc(2-1)Rha	Glc
Rb2	Glc(2-1)Glc	Glc(6-1)Ara(p)	Rf	Glc(2-1)Glc	H
Rc	Glc(2-1)Glc	Glc6Ara(f)	Rg1	Glc	Glc
Rd	Glc(2-1)Glc	Glc			

Figure 4. Structures of the major ginsenoside in Asian ginseng root.

B. Biological activities

Extensive pharmacological studies have been reported on ginseng powder, ginseng extracts and ginseng components (58,59). Ginseng was found to improve different aspects of cognitive performance of healthy young adult (60), and to result in a reduction of bile flow and bile secretion of total lipids and cholesterol, while increase the secretion of proteins in a dose-dependent manner (61). The butanol fraction of ginseng was found to inhibit gastric damage (62). Ginseng saponins were discovered to contain components potentiating the apoptosis of MMS-exposed NIH3T3 cells via p53 and p21 activation, accompanied with by down-regulation of cell cycle-related protein expression (63), protecting hippocampal CA1 and CA3 cells against KA-induced neurotoxicity (64) and inhibiting EGF-induced cell proliferation via decrease of c-fos and c-jun gene expression in primary cultured rabbit renal proximal tubular cells (65). Ginsenoside Rb1, Rg3, and Panax ginseng butanol fraction showed strong inhibitory effects on inflammatory mediators from LPS-stimulated RAW 264.7 cells (66). Topical application of ginsenosides significantly attenuated ear edema induced by 12-*O*-tetradecanoylphorbol-13-acetate (TPA) and ginsenosides also suppressed expression of cyclooxygenase-2 (COX-2) and activation of NF- κ B in the TPA-treated dorsal skin of mice (67). The total ginseng saponins and ginsenoside Rb1 and Rg1 showed neuro-protective effects on spinal cord neurons, with Rb1 and Rg1 protecting spinal neurons from excitotoxicity induced by glutamate and kainic acid, as well as oxidative stress induced by H₂O₂ (68). Rb1 showed nootropic properties (69), ginsenoside Rb2 showed epidermis proliferative effect (70) and ginsenoside Rg(2) blocked the nicotinic acetylcholine receptors in bovine chromaffin cells (71). Ginsenoside Rg3 was found to modulate Ca²⁺ channel currents in rat sensory neurons (72) and to inhibit N-methyl-D-aspartate (NMDA) receptors (73).



V. Resveratrol and *Polygonum cuspodatum*

Resveratrol (3,5,4'-trihydroxystilbene) (Figure 5) is a compound found mainly in the skin of grapes, peanuts, mulberries, disease resistance to plants (74). The epidemiologic finding of an inverse relationship between consumption of red wine and mortality rates from cardiovascular disease and certain cancers has been called the “French paradox”. The growth-inhibitory effects of resveratrol are mediated through induction of apoptosis and cell cycle arrest in both rat and human cancer cells. Resveratrol-induced apoptosis has been repeatedly reported to be accompanied by increased caspase activity, up-regulation of p53, Bax, down-regulation of Bcl-2, Bcl-X_L, survivin, and cIAPs in a variety of human cancers. Resveratrol caused cell cycle arrest via up-regulation of p21, p27, p16, and down-regulation of cyclin D1, cyclin E, Cdk2, Cdk4, Cdk7 in human colon carcinoma cells (75). Resveratrol has also been shown to induce GSH synthesis through activation of Nrf2 (76). Furthermore, resveratrol induced S phase arrest through ATM/ATR-Chk1/2-Cdc25C pathway (77). Resveratrol treatment induced apoptosis in DMBA/TPA induced mouse skin tumorigenesis through mitochondrial pathway (78). On the other hand, in vitro and animal experiments have shown that it exhibits many biological effects such as protection against atherosclerosis, antioxidant activity, inhibition of platelet aggregation, and antimutagenic and anticarcinogenic properties (74, 79).

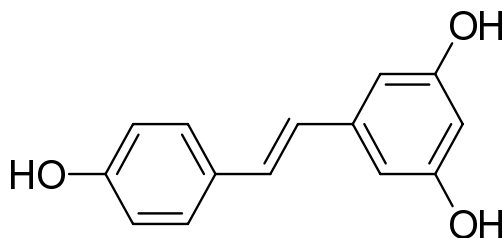


Figure 5. Structure of resveratrol

However, the main reason that resveratrol gains much popularity in the US market in the past two years is due to its reported anti-ageing activities. Wood et al. (80) reported that resveratrol activated sirtuins (Sir2) in the nematode *Caenorhabditis elegans* and the fruit fly *Drosophila*, and extend their lifespan. The capacity of resveratrol to increase lifespan was later verified in further studies (81-83).

Since the contents of resveratrol in grapes and peanuts are relatively small, the commercial source of resveratrol is obtained from a TCM plant, the dried roots of *Polygonum cuspidatum* Sieb. Et Zucc. Roots of *Polygonum cuspidatum* contain cis- and trans-resveratrols and their corresponding glucosides (84).

VI. Concluding remarks on TCM quality

As Chinese herbal medicines move into the US markets, and into the dietary supplement mainstream, the value of these products to the health care industry and to consumers will be predicated largely on their proper use, additional scientific studies using both animal and human studies to evaluate efficacy, and ensuring that a quality product reaches the consumer. Issues and problems that now surround these medicinal plants include lack of botanical authentication; lack of natural product standardization whether for a single, blended or complex herbal mix; and the spiking or adulteration of final products. Other product problems on Asian herbs such as the presence of undesired heavy metals, pesticides and nontarget plant debris in the final products are also part and parcel of such a QC imperative, though not addressed in this brief overview. All of these issues can be minimized or eliminated with a strong scientific-driven quality control program that if implemented can further promote Chinese Traditional Medicines to the mantle it richly deserves within an integrated western health care system.



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台灣中草藥產業面臨的困境與契機

李威著

台灣區製藥工業同業公會常務理事

台灣區製藥工業同業公會中藥委員會主任委員

勝昌製藥廠股份有限公司技術長

近年來全球植物藥市場蓬勃發展，估計每年平均以 10～20% 的速度迅速成長。預估到 2008 年底，全球將達到 800 億美元的規模。經濟部早在 2000 年便提出「中草藥產業技術發展五年計劃」，以提升中草藥產業技術研發，並希望能成功進軍國際市場。2008 年 5 月，台灣新政府上任後，馬總統提出了全民健康十項主張，其中第十項『醫藥生技產業研發補助倍增，加速中醫藥科學化』，所以衛生署中醫藥委員會於 97 年 6 月召開『訂定「建構中藥用藥安全環境」第二期計畫及落實「醫藥生技產業研發補助倍增，加速中醫藥科學化」專家座談會』，於會中就中醫藥科學化及中藥用藥安全等內容提出具體建議；而為了振興台灣經濟，經濟部長尹啓銘先生亦在 2008 年 8 月正式提出「天網計畫」，預計四年內可吸引民間重大投資可達新台幣 4 兆多元，首先就是 2008 年底將啟動「兩岸搭橋」專案，優先選擇中草藥產業為火車頭，以三年為期推動兩岸產業、並擴及跨國企業的合作。這些利多對於台灣的中藥產業而言，的確打入一劑強心針，但台灣的中草藥產業是否就從此一帆風順，期間所遇到的困境與未來可能的契機到底在哪裡呢？

壹、台灣早期的藥業發展

台灣中藥廠的 GMP 發展歷程實是一頁充滿血淚的中藥現代史，中藥行業由過去的中藥房師徒相承，祖傳秘方的製作，漸漸隨著台灣經濟的發展，民眾消費能力的提高、消費意識的抬頭，中藥的製作逐漸發展到大規模且有規範的生產型態；中藥產品的販售更可看出中藥廠發展的進程，中藥產業要永續經營，當然是以市場導向為依歸，中藥產製品銷售的基礎當然是民眾有所需求，從暢銷藥品的特性也可以看出民眾關心的健康取向。就像減肥藥與壯陽藥的銷售總是歷久不衰，劑型又以傳統的湯、丸劑最明顯，台灣在過去在資訊不發達的時代，藥品的銷售很多是靠夜市野台促銷的鄉野賣藥團體或是到府服務的掛藥包，其中又以鄉野賣藥團最能吸引一般民眾的注意，以單價較高的壯陽藥品為例，除了男性消費者自己購買之外，甚至也常有女性消費者買給另一半服用，相同的作用也發生在補陰的藥品上；傳統的藥補觀念也讓中藥廠的補養劑有不錯的銷售業績，最常見的十全大補藥酒在適用對象上可以補全家男女老少，在功能上則可以補心肝脾肺腎肺，無一不包無一不補，傳統醫學重視人體的整體觀，而台灣的鄉野百姓也傾向喜歡購買兼具滋補強身與療效廣泛的藥品，尤其是宣稱採用特殊藥材的補藥，如「參茸大補丸」、「虎骨木瓜酒」等，不過在近年國際動物保育的趨勢，而衛生行政單位也規定藥廠禁用保育類動物為藥材之後，此類藥品已漸漸減少。

除了補養用藥之外，坊間民眾其次最喜愛的是治療劑，最常見的有寄生蟲藥、腸胃藥與傷科用藥，幾乎家家都需要這類藥品，在過去環境衛生品質的低落與醫療資源的不足的時代；這些藥品的使用劑量、時間間隔與施藥方式，都由患者憑經驗自由心證，雖與西方醫藥管理背道而馳，卻也反映出傳統台灣民眾的實際醫藥使用經驗與當時醫療資源的不足。但是這些藥品大都不是正統的藥廠所製造，其製造者在日據時期民間通稱「中醫師」，其實大部分的製藥人員都不具備中醫師資格。台灣在日據時期中、西藥並行，西元 1901 年日本政府為了加強醫藥衛生管理並取締密醫，曾經舉辦過唯一一次的中醫考試，之後就堅持不再發中醫執照，至 1945 年，日人戰敗退出台灣之時，全台灣僅剩 30 到 40 個合法有照中醫師，但是以當時戰後

藥品的銷售量來推斷，坊間販售之大部分藥品都是由所謂的密醫製造出來的。由於中藥的發展由經驗累積而成，並無一定章法，因此造成管理上的困擾，為使中藥的管理上軌道內政部在 1967 年公布「固有成方調製丸、散、膏、丹管理辦法」，將日據時代的『漢方製劑』命名為『固有成方製劑』，到了 1973 年，內政部公佈的相關衛生法規將『固有成方製劑』定義為「我國固有醫藥習慣使用，具有療效之中藥處方，並經中央衛生主管機關選定公佈者」，『依固有成方調製（劑）成之丸、散、膏、丹』，並規定成方藥劑不得「拆封或改裝及沿途或設攤販賣」，只能由合法中藥商來販售，此一規定等於扼殺了坊間賣藥團體合法生存的空間，另外同法規中對於製藥執照也規定了新的登記證申請案，此舉迫使舊時許多藥廠因執照被吊銷而關門，相對其他想要永續經營的中藥廠則朝向 GMP 的國際規範靠攏。

貳、全球植物藥市場發展

近年來全球植物藥市場蓬勃發展，中草藥更是其中要角，估計每年平均以 10～20% 的速度迅速成長。在 2002 年，市場產值已超過 230 億美元；預估至 2006 年底，將達到 400 億美元的規模。龐大的商機帶動世界各國在中草藥領域的研發熱潮，而中藥在臺灣有其悠久的使用歷史背景，經濟部技術處於 2000 年提出「中草藥產業技術發展五年計劃」，將投入 50 億新臺幣，以提升中草藥產業技術研發，並成功進軍國際市場。

中草藥目前在國際上如何受到重視呢？在 2002 年 5 月，世界衛生組織 WHO 發佈史上第一份『傳統暨替代醫學的全球策略』，據 WHO 規劃，2002 到 2005 年之間，將致力協助各國在傳統醫學上：

- 一、鼓勵各國政府對傳統醫藥及替代醫藥的規範化管理並納入本國的衛生保健系統。
- 二、促進傳統醫藥及替代醫藥安全性、有效性及品質標準研究。
- 三、保證民眾對傳統醫藥及替代醫藥的可獲得性及費用可承受性。
- 四、促進傳統醫藥及替代醫藥的合理使用。

2006 年底，美國食品和藥物管理局（FDA）批准了德國公司 MediGene AG 公司的一種由綠茶的提取物製成新的處方藥，用於局部治療由人類乳突病毒引起的生殖器疣。這種被稱為 Veregen™（Polyphenon® E）新藥物是第一種經美國食品和藥物管理局根據 1962 年藥品修正案批准的植物藥，該法案要求所有的藥物在投放美國市場前必須經過證明是安全和有效的。美國通過中草藥草案一事，對國內外中草藥業界來說算是好消息，顯示中草藥等複方觀念已被 FDA 接受，但對後續中草藥新藥實際上市的助益，則有待評估。加上目前很多中草藥成分還在研究、確認療效階段，由此評估，短期內中草藥新藥可於美國上市的機會仍有限，但有助於提升傳統中藥在美國的地位，對後續發展仍持審慎樂觀態度。

植物藥發達的歐洲也是中草藥進軍國際的前線之一，面對龐大的歐洲市場，中藥出口面臨的形勢越來越嚴峻。《歐盟傳統草藥法》規定，2011 年 4 月後，草藥銷售將受到嚴格管理，進口到歐盟的中藥需證明在歐盟成員國應用達 15 年以上，同時證明在第三國應用 30 年以上，才能正式註冊，且中藥成分中只能包含植物和幾種礦物。而國內中藥一般包括植物藥、動物藥和礦物。4 年後歐盟對中藥實施嚴格的進口管理，將使國內中醫藥行業面臨內外夾擊的尷尬。此前，商務部駐英經商處官員發布調研報告稱，2011 年後，中藥出口歐洲市場「很不樂觀」。長期以來，幾乎所有中藥進入歐盟都無法以藥品形式通關。但是，若不儘早在歐盟完成藥品註冊，過渡期結束後將被歐盟拒於門外。

參、台灣經營環境的變化

台灣製藥產業依類別可分成原料藥、西藥製劑和中藥製劑三大類。近五年台灣製藥產業的平均營業額約為 600~650 億元新台幣，其中西藥製劑約佔製藥產業的七成五；原料藥與中藥分別佔一成與一成五。台灣中藥產業包括傳統中藥、濃縮中藥及西藥劑型中藥。1963 年在美國首先實施了藥廠 GMP 制度，到了 1983 年時全世界已有 103 個國家實施 GMP。台灣自 1982 年開始推行 GMP 制度，中藥製劑部分則分為兩階段實施，首先是中藥濃縮劑型與西藥劑型中藥在 1988 年底均須符合

GMP。丸散、膏、丹等傳統劑型則在 2005 年 3 月全面實施 GMP，中藥廠總數則由 1997 年的 218 家減少為目前的 113 家；GMP 儘管已經成為台灣中藥廠的入門階，但品質的提升並不是立竿見影，中藥濃縮廠與傳統製劑廠的品管研發能力仍有一段距離，絕大多數的藥廠都是以內銷為主，有外銷能力的中藥廠並不多，再加上近年來，部分媒體刻意放大中藥毒副作用品質問題，動輒以黑心中藥事件造成民眾消費信心喪失，尤以馬兜鈴酸事件造成的影響為甚，主流醫療界又動輒把中藥副作用與腎病症候群劃上等號，造成中藥產業營業額停滯不前，又常因不確定因素的干擾，造成消費者排斥服用中藥，不容易吸引低年齡層的消費者，反映出目前中醫藥是處於景氣低迷中。

對於 GMP 與 cGMP 的問題也是台灣藥廠經營環境的挑戰，國外衛生主管機關對於中藥 GMP 的要求各有不同，如日本厚生省將逐漸要求增加確效作業，澳大利亞 TGA 參考 PIC/S 模式查廠，許多國家則只要出具衛生署的 GMP 證明即可，顯現出各國步調相差極大；要擴展或延續原有外銷市場，就要符合當地藥政管理新制度，如技術層級無法達到或是變成不敷成本的時候，外銷市場肯定是要撤回的，但是以國內中藥廠的韌性，只要不是流血輸出的慘況，大多數外銷廠還是會堅持到底的，而這些實施 cGMP 的經驗，雖不一定符合國內西藥廠實施的模式，但將是國內中藥首先實施確效作業的尖兵，待實施範圍擴大到一定規模時，再參考各廠經驗來制定專屬於中藥的 cGMP，或許較為實際與可行。

世界景氣普遍受到大環境影響，台灣也不能自外於地球村，2008 年起的一連串金融風暴，更是讓製造業的景氣雪上加霜，台灣的中藥產業所需的能源需求、原物料都同步受到全世界景氣衰退、物價上漲的影響，再加上全球股市崩盤，上市上櫃公司在資本市場籌資更形不易，傳統藥廠也不易受到銀行大量資金的融通，中藥廠建廠的成本已經是 1988 年的兩倍以上，但國內的中藥製劑市場受到健保總額給付的壓縮，健保大餅有限，近年來整體營業額已經很難突破 50 億台幣的瓶頸，只依賴內銷的中藥廠將越來越難生存，有能力外銷的中藥濃縮廠或是中藥貼布廠尚能苟延殘喘，只期待在千里之外另創一個台灣奇蹟，但是各種主客觀的環境評估之下，目前中藥產業的確處於景氣低迷韜光養晦的時候。

中藥產業的命脈就是優良的中藥材，但是藥材講究道地，台灣所使用的中藥材百分之九十以上仰賴中國大陸的生產與供應，但是藥材的價格常淪於炒作，儘管在大陸藥材市場有公開的盤價，但是資訊的發達，中國大陸的農民已經懂得市場經濟法則，藥材囤積惜售所在多有；台灣的中藥產業已經不易像過去取得低廉卻品質好的中藥材，再加上地球的溫室效應，氣候上聖嬰現象與反聖嬰現象交替出現，中藥材產區因地震、雪災、洪水等大自然因素受到嚴重破壞，更造成中藥材售價節節升高，中藥產業採購原料的成本更年年高漲，造成中藥產業的經營環境更加嚴峻。

肆、台灣中藥產業法規面的影響

2004 年起「台灣區製藥工業同業公會」承辦衛生署中醫藥委員會「中藥用藥安全五年計畫」一系列計畫中，其中『強化法律規章適用及教育宣導計畫』項目，其中選定最優先需編修之法規及篩選不合時宜法規條文加以修正建議，而「藥品優良製造規範」亦將列入討論；中、西藥品在本質及觀念上，原本就大不相同，硬是將兩者所需遵守的 GMP 條文放在同一規範內，一定產生不適用的情形。GMP 條文的爭議可以回歸到藥事法來看，「藥事法」是藥品的根本大法，其中並未把中藥明確定義，大多數的爭議官方多年來多以規章或是行政函釋來解決，藥事法歷經多年以來的修改仍未能全然適合所有相關產業，近年來衛生署積極爭取加入國際藥廠稽查公約組織 (PIC/S)，所以在修法上，將以符合 PIC/S 相關規定為原則，如此一來，對於中藥及醫療器材業將可能造成更不適應的情形，與其難以兼顧的修法方式，不如將各產業法規予以獨立，制定專屬中藥的「中藥藥事法」較為貼切適用。

中草藥的品質標準對於確保中藥產品的安全、有效、均一具有絕對關鍵。中藥不同於西藥，也不完全等同於植物藥，目前國際上還沒有公認的中藥標準。因此建立符合中醫藥特點的國際公中藥標準是非常必要的。2004 年 5 月 1 日，台灣的第一部中藥典『中華中藥典』正式出爐，後來因為行政院正名運動改名為『台灣傳統藥典』，這讓過去在台灣苦無法律地位的中藥材，正式由『農產品』的層次進入到『藥』的層次，『中華中藥典』目前收載 200 種常用中藥材品項，尚無法涵蓋中藥

產業所有常用藥材，目前已朝向修訂內容並增加藥材品項方式進行，期待未來可滿足中藥產業的完整需求，成為製藥業界最重要的參考工具書。但藥典所收載的藥材品項，常因其基原（來源）眾多，對於藥材品質規格仍無法予以明確規範，與西藥明確的主成分相較，要進行其成分檢測是非常困難。且中藥材大部份來自中國大陸，即使同種基原的植物藥材，會因其產地、採收季節、採收後處理方法、炮製因素差異，造成藥材品質不一的情形，內含的指標成分常常相差頗大。不同於西藥的單一成分。而中藥的有效成分要能完全闡明有其先天限制的背景。

在中藥新藥的發展上，不同於西藥，在台灣西藥以新複合藥物、新療效、類新藥等新藥，藥物傳輸技術、特殊劑型代工等新劑型藥品及學名藥為發展的重點產品，中醫藥屬於經驗醫學。而中藥之臨床試驗在沒有成熟的動物或臨床模式之前，僅得援引比照西藥現有模式來運作，故中藥新藥臨床試驗施行之規範係遵循衛生署公布之藥品優良臨床試驗準則，與西藥並無二致。而中藥新藥之審查體制，仍援引西藥而來。自從衛生署公佈「中藥新藥臨床試驗作業準則」（IND）及「中藥新藥查驗登記申請須知」（NDA）多年後，「壽美降脂一號膠囊」是第一件依照行政院衛生署公告 IND 規定，進行中藥臨床試驗，歷經一年多之時間完成臨床試驗，並通過 NDA 各項審查作業的中藥新藥，該藥在 2005 年 3 月 30 日取得處方藥藥品許可證，但是，當試驗順利完成取得製造許可證後，在市場行銷通路遇到很大的阻礙，中醫師很難以處方藥開立該方，如果要給西醫師使用，同類型的降血脂西藥在健保給付中享有成分優勢，中藥新藥的給付價格難以符合廠商的開發成本，讓該藥變成台灣中草藥新藥的烈士，無法真正回饋原開發廠商對中藥新藥投入的熱情與投資，這對後續有心投入中藥新藥研發的產業會有不良的影響。

伍、台灣中藥 GMP 藥廠品管現況與展望

有關中藥製劑的使用，藥品的品質還是最主要的訴求，而中藥製劑的製造、品質與管制，與中藥製劑的安全性、有效性、均一性均息息相關，目前中藥濃縮製劑製造時的品質管制，包括『道地藥材的選擇』、『中草藥產地 GAP 的落實』、『藥材

的基原鑒定技術』、『炮製標準』、『生菌數、農藥殘留量及重金屬含量的管控』、『乾燥減重、水抽提物、稀醇抽提物、精油、灰分、酸不溶灰分測定』、『化學指紋圖譜』等足以保障中藥製劑製造安全的規範。

在道地藥材的選擇上。道地藥材通常是具有地區特色的優質品種，所含有效成分高，臨床療效顯著。生長在一個特定的區域，離開了這個特定區域，改變了生長環境，有效成分含量就會降低，直接影響中藥製劑品質。正如梁代陶弘景所說：「諸藥所生，皆地有境界。」如眾所周知的寧夏的枸杞，甘肅岷縣的當歸，四川石柱縣的黃連，浙江寧波的浙貝母，杭州的菊花、白芷，河南懷慶縣的地黃、牛膝、山藥，吉林的人參，廣東陽春的砂仁，安徽亳縣的白芍，山東東阿的阿膠，陝西的秦皮，山西的黨參，新疆的紫草、阿魏，山東的北沙參、金銀花，湖北的茯苓，河北的知母，雲南的三七，等都屬道地藥材。它們性狀特徵明顯，品種優良，質量好，有效成分含量高，而其他地方產的品種各方面就與之有顯著差異。目前中藥製劑的品質上，道地藥材的正確使用影響中藥製劑品質甚巨。

道地藥材則需要 GAP 的基地來長期培植，GAP（Good Agricultural Practice）為國際要求的優良種植規範，主要分三個體系：藥材質量體系、操作規範及後期加工標準。從育種土壤開始，到施肥、農藥、栽培、採集等各個環節都需要有標準規範。至於加工的程式、藥材風乾炮製等二次加工標準，也需要有嚴格控制，以防止藥材被污染。GAP 是要有效生產優質、道地、無污染的藥材，考慮的項目有種植地點的選擇、品種標準化、栽培管理一致化和炮製包裝規格化等。質量標準化分為兩個方向，一是藥材商品規格化，以標準藥材（地道藥材）為對照品，以外觀性狀鑒別建立量化的標準規格。另一方面，用指標或活性成分進行定性定量的分析，利用 TLC、GC、HPLC 等建立化學指紋圖譜，著重內在成分測定，再將此二項結果作為藥材品質管控的基礎和依據。

不過，由於臺灣 95% 以上的藥材是由大陸進口的乾燥品，其來源多由大盤商採購，或由藥廠自行進口，除了種植之外，有許多藥材在採集地仍是野生或半野生的狀態，近年來則利用組織切片法或粉末鏡檢以顯微鏡觀察植物解剖和細胞學的形態特徵來區分，由於藥材飲片已經不是活組織，所以組織切片技術對中藥飲片真偽

的鑒別的地位是不可替代的，雖然此法需要很好的切片技巧與生藥學訓練，但對藥材基原的鑒別是一項很關鍵的技術。也是能維護中藥製劑製造安全的關鍵技術。

有關中藥製劑的定量管控，臺灣衛生署爲了提升中藥濃縮製劑的品質，自 2001 年 1 月 1 日起，已有葛根湯等 20 種中藥製劑，查驗登記新案及藥品許可證有效期間展延時，應制訂指標成分定量方法。美國 FDA 亦於 2004 年 6 月公佈，「Guidance for Industry (Draft) Botanical Drug Products」，提出中草藥新藥研發，需以 CMC 加以管制。目前在藥廠要開發中草藥複方，必須要有獨立完成複方 CMC 的能力，何謂 CMC 呢？CMC 就是 Chemistry、Manufacturing、Control，就是對中草藥複方產品的化學、管制與製造，是中草藥複方要朝臨床試驗前所需必備的條件，是爲了確保中草藥複方產品的安全性、有效性、均一性與再現性，目前衛生署中醫藥委員會所制訂我國中草藥 CMC 規範，是參考了美國 FDA 及歐洲 EMEA 對植物性規範要求，並符合中草藥複方的組方特性，針對中草藥複方要進軍國際所規範的一有效武器。

CMC 的 checking list 主要專案包括基原確認（鑒定每一種藥材的來源，確認其學名，正本清源，以免誤用），型態的描述（一般性狀、大小、觸感、表面特徵、色澤、斷面特徵、氣味），乾燥減重（檢查藥材所含的水分比例，乾燥程度），水抽提物（檢查藥材親水性成分的含量），稀醇抽提物（檢查藥材親脂性的成分含量），精油（主成分爲揮發性精油之藥材檢驗），灰分（檢查藥材中所含的雜質或夾帶的砂土），酸不溶灰分（檢查藥材中所含的無機元素），TLC（檢查藥材中是否含有有效成分，定性檢查），HPLC（檢查藥材中有效成分的含量，定量檢查），GC（檢查藥材中是否有農藥的殘留），原子吸收光譜儀（檢查藥材中是否有過量的重金屬，可彌補比色法的不足），微生物檢測（檢查藥材中的微生物含量是否超過標準），防腐劑的檢測（檢查是否燻硫，硫化物殘留的檢驗），化學指紋圖譜（可比較藥材的來源，中草藥複方產品每批次的均一性），藥材是否屬於 ERA（Endangered Species Act）或 CITES 規定瀕臨絕種的動物。

中藥濃縮製劑是台灣中草藥產業發展的最大特色之一，濃縮製劑約佔中藥製劑總產值 70%，2008 年 9 月 15 日衛生署公佈了所有濃縮製劑總重金屬 $\leq 100\text{ppm}$ ，

其中 10 個消費量最大的濃縮製劑，包括了加味逍遙散、疏經活血湯、葛根湯、辛夷清肺湯、川芎茶調散、獨活寄生湯、麻杏甘石湯、小青龍湯、六味地黃丸、龍膽瀉肝湯，其總重金屬必須 $\leq 50\text{ppm}$ 、砷必須 $\leq 5\text{ppm}$ 、好氧性總生菌數不得超過 10^5cfu/g 、沙門氏菌 (*Salmonella species*)：不得檢出/g、大腸桿菌 (*Escherichia coli*)：不得檢出/g，對中藥濃縮製劑而言有害物質的管制已經正式走出重要的一步，未來衛生署在保障國民用藥安全的前提之下，陸續會對中藥的傳統製劑與磨粉中藥展開進一步的管制與發證，更有可能全面把中藥飲片納入正式的管理。

在三聚氰胺事件重創國內食品業之後，源頭的管制突然變成顯學，在第一期用藥安全五年計畫當中，衛生署曾經委請「台灣公定化學家協會」研議中藥材境外管制機制的可能性，可惜此機制出師未捷便受到政治力的干涉而束之高閣，此機制乃藉由民間法人機構與大陸中央及地方之中藥相關主管機關及檢驗單位聯繫，依兩岸相關法規規範，協商兩岸授權及文書認證之對口單位及其作業程序，進而規劃實驗室評估之認可作業程序，同時研訂中藥材規格，確保輸入之中藥材符合訂定之檢驗項目，使集散地之中藥材經由我國認可具有國際公信力（如經 TAF 認可）的大陸國家級或地方級檢驗單位檢驗後，使可以輸入台灣，且對於輸入境內之中藥材，亦研擬中藥材品質落地追蹤檢查機制（如農藥、重金屬、微生物和黃麴毒素等），對市售中藥材進行品質調查，不定時回報市場異狀，如此，將可建立臺灣成為高品質中藥材的世界供應貨源中心，提振台灣的中草藥產業地位。



中藥材資源考察 與原料生產



中藥精華 · 盡在順天

順天堂藥廠顧問

莊武璋 博士

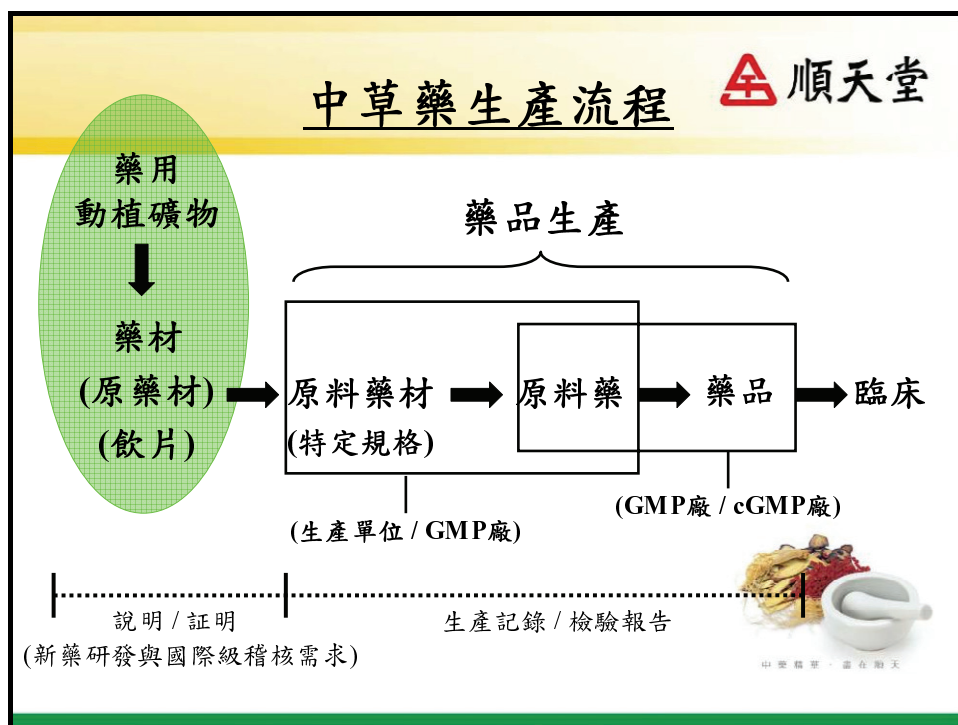
2009/1/8

中藥材資源考察與原料生產

- 中草藥品質管控
- 藥材產地與資源考察
- 藥材原料生產



順
天
堂





市售藥材(台灣藥材商)

 順天堂

	通草(正常品)	通草(異常品)	摻雜異物
鈉(Na), ppm	290	120	300
鎂(Mg), ppm	2100	1000	120
鋁(Al), ppm	7000	94000 *	130000 *
鋇(Ba), ppm	0.12	57 *	5.8 *
砷(As), ppm	0.16	0.29	0.77
鎘(Cd), ppm	0.69	0.43	0.09
汞(Hg), ppm	0.003	0.006	0.004
鉛(Pb), ppm	0.65	0.54	0.52



中藥精華 · 盡在順天

市售藥材(亳州藥市)

 順天堂

黃耆(正常品)



黃耆(異常品)



	黃耆(正常品)	黃耆(異常品)
鈉(Na), ppm	550	560
鎂(Mg), ppm	2400	25000 *
鋁(Al), ppm	500	620
汞(Hg), ppm	0.007	0.009
鉛(Pb), ppm	0.19	0.42



中藥精華 · 盡在順天

「透過兩岸合作，加強源頭管理， 以確保中藥材之品質」



中醫藥委員會新聞稿 (97.10.31)

中藥材之管理，衛生署極重視，為落實此項之工作，已責成其所屬中醫藥委員會分三階段實施：

第一階段為推動中藥材之包裝標示，以確認產品責任之歸屬；

第二階段為針對重金屬、污穢物質及黃麴毒素等，陸續訂定各種限量標準，以確保其無安全之疑慮；

第三階段則將要致力於完備中藥材之源頭管理機制，包括進口產品文書認證及落地追蹤等工作。



順天堂藥廠之品質控管



原料藥材標準化



嚴謹規範製造流程



成品安全、有效、均一、安定



[專業的藥材採購]

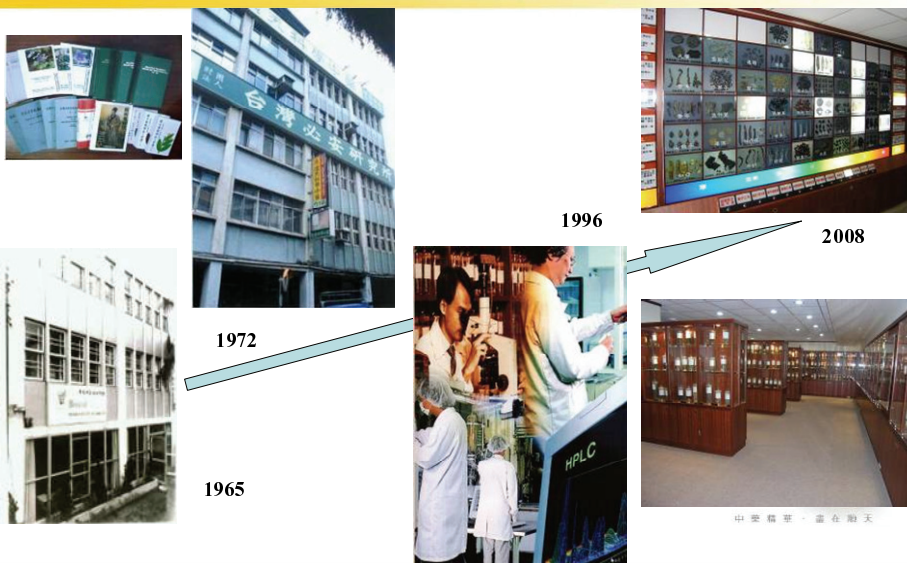
順天堂

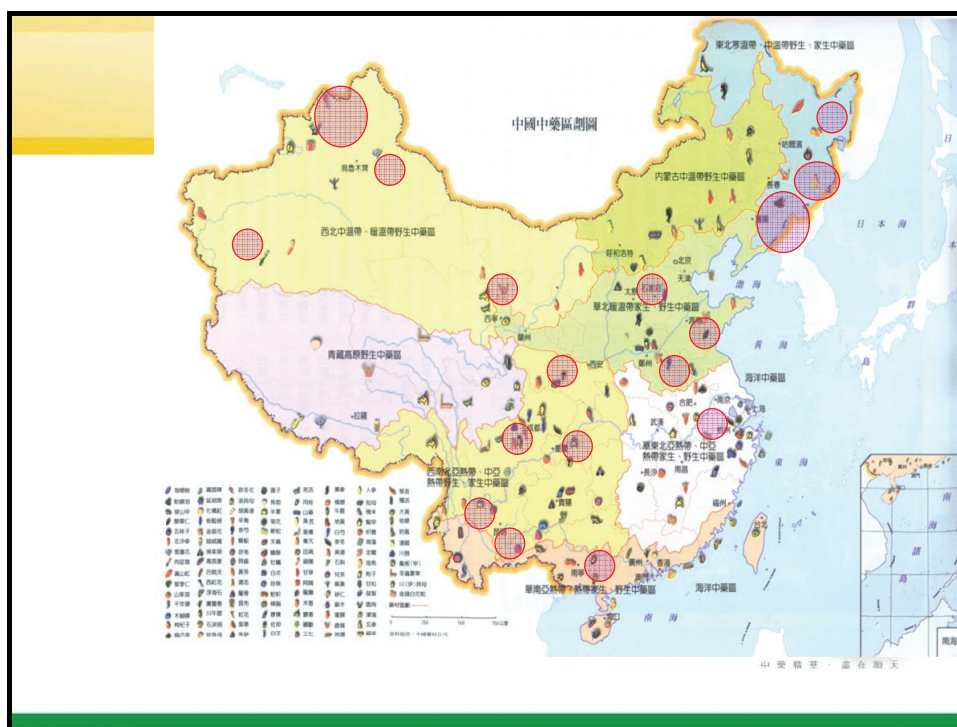
1. 為加強原料藥材品質，順天堂藥廠在中國大陸多處地區建立良好的藥材供應關係，除直接自產地採購藥材外，也細心監控藥材加工過程，著力於源頭管控。
2. 另於2008/4將藥材採購單位自管理部獨立出來，成立藥材小組，直屬於總經理室，工廠品保與研發單位全力支援該小組之運作。



中草藥專業研發

順天堂





本草文獻考察——大黃藥材

順天堂



經史證類大觀本草



經史校定經史證類備急本草



本草綱目



植物名實圖考



本草圖說



本草圖考



中藥精華·雷在順天

順天堂

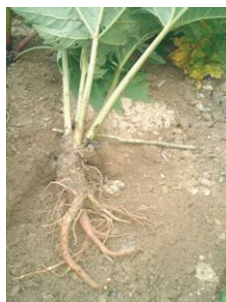


大黃
種植基地



中藥精華，盡在順天

大黃
產地考察



中藥精華，盡在順天

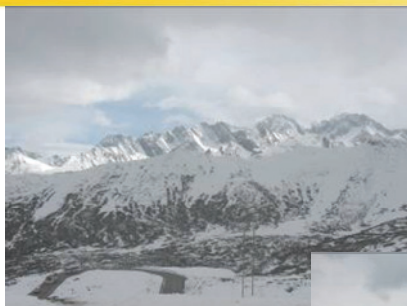
大黃產地考察與稽核

 順天堂



中藥精華 · 盡在順天

 順天堂



大黃產區考察



中藥精華 · 盡在順天



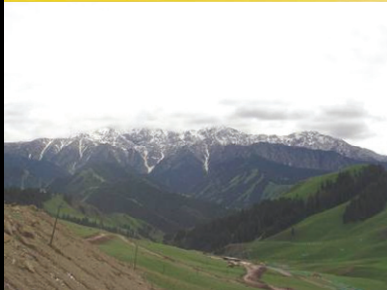
產地考察—藥典收載之正品大黃藥材品種

順天堂

藥用大黃 <i>Rheum officinale</i>	掌葉大黃 <i>Rheum palmatum</i>	唐古特大黃 <i>Rheum tanguticum</i>
		
		

中藥藥學·圖在圖大

新疆紫草產地考察與稽核



海拔2300~4000米，年均溫-5~1℃。







枸杞產地考察與稽核

 順天堂



中藥精華 · 盡在順天

 順天堂



中藥精華 · 盡在順天

人參產地考察與稽核

 順天堂



中藥精華 · 盡在順天



亳州芍藥



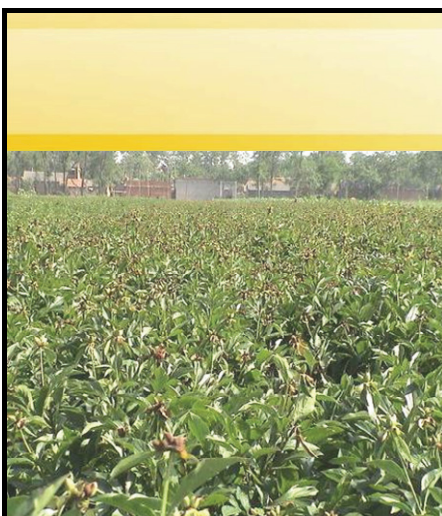
一年生芍藥(混種)



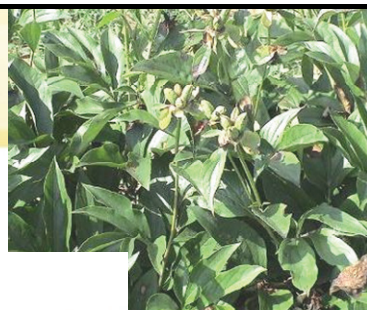
二年生芍藥(混種)



中藥精華 · 盡在藥天



三年生芍藥



中藥精華 · 盡在藥天



倉庫及生產車間



中藥精華，盡在順天

 順天堂

原料倉庫
(不合格區)

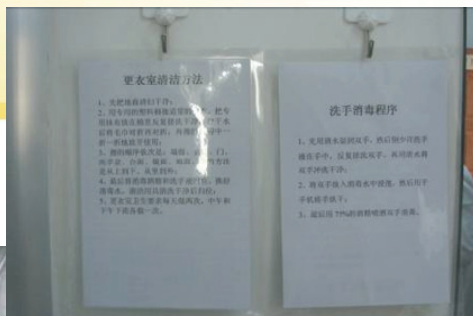


原料倉庫
(合格區)



中藥精華，盡在順天

生產車間



中藥精華 · 盡在藥天

清洗藥材/蒸製藥材/ 浸潤藥材



烘乾藥材



中藥精華 · 盡在藥天



 順天堂



挑揀選藥材

裁切藥材



中藥精華 · 盡在順天

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清洗裁切設備

包裝前複檢



中藥精華 · 盡在順天



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留樣品室

乾燥減重測定



中藥藥學 · 雷在順天

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灰分/酸不溶性灰分 測定

含量測定



中藥藥學 · 雷在順天

品質管控

＝ 技術＋適用規範＋管理文件

品質管控 **GXP (GACP, GLP, GMP, GCP, GSP)**

＝ 技術 (種植、藥材加工、檢驗分析、
藥品生產、臨床試驗、銷售)

＋ 適用規範 (**CCMP, ISO, PIC/S, EMEA, FDA**)

＋ 管理文件 (操作標準書與記錄)





中藥材水活性及保存性質之探討

馮臨惠

國立宜蘭大學食品科學系副教授

摘 要

中藥材主要來自天然的植物、動物及礦物，除作為醫療用途外，中藥材也是膳食補養的食材。中藥材受到原有生產地採後處理不良，或在包裝、運輸、貯存過程不當的措施造成品質劣變或微生物污染，影響藥材之使用功能。尤其，微生物污染會造成藥材成分降低或改變，甚至微生物產生的毒素，影響藥材之安全性。因此，藥材從栽種的環境、採收後處理、包裝後的儲藏等過程可能都會影響中藥材之安全品質。尋求最適化的中藥材包裝和貯存條件對維持藥材品質而言是重要課題。本文探討中藥材的水活性與保存性質兩者的相關性。由文獻試驗資料得知：中藥材的保存性質，除了與中藥材本身的屬性有關以外，也受儲存環境的溫度與相對溼度的影響。因此，水活性可用為研究中藥材保存的重要因子。因此，中藥材的水活性是指，在密閉空間，中藥材平衡蒸氣壓與相同溫度純水飽和蒸氣壓的比值。此外，也可將中藥材水活性與平衡水分含量繪製水分等溫吸濕曲線。水分等溫吸濕曲線是一項非常有價值的工具，可以作為預測中藥材在儲存時可能的性質改變。也可作為包裝系統選擇計算的依據。為瞭解食用中藥材水活性與等溫吸濕性質，針對 10 種中藥材（白芍，白果，黃芩，杏仁，川芎，山楂，柴胡，陳皮，丹參及大黃），進行水活性及等溫吸濕性質測試。結果顯示：10 種市售中藥材形態都為薄片型植物的片狀物或球狀乾燥果實。樣品水分含量及水活性測試結果顯示：除濕式白果外，其餘九種中藥材的水活性均低於 0.7，屬於中低水活性產品。水分等溫曲線（25℃）測試結果顯示：若以水活性 0.6 為界，大部份中藥材的平衡水分含量在 10~15% 附近。

除了杏仁，為高油脂類的中藥材，其平衡水分含量不高為 4.5%。

關鍵字：中藥材、水活性、保存性質

Key Word：Chinese herbal medicine, Water activity, preservation

壹、前言

中藥材主要來自天然的植物、動物及礦物，除作為醫療用途外，國內消費者也以中藥材為膳食補養的食材。近年來世界各國皆十分重視傳統草藥製藥產業，尤其中國大陸藉由中藥材產地的優勢，正積極的經由研究發展推廣等方式，建立生產規範以擴大產業發展。而世界各國之研究單位亦不斷發表傳統醫學的相關文章，據資料更顯示全球有半數以上之人口使用中草藥，發展中草藥製藥產業將是未來最具潛力的產業之一^(17,19)。中藥材受到原有生產地採後處理不良，或在包裝、運輸、貯存過程不當的措施造成品質劣變或微生物污染，影響藥材之使用功能。尤其，微生物污染會造成藥材成分降低或改變，甚至微生物產生的毒素，影響藥材之安全性。因此，藥材從栽種的環境、採收後處理、包裝後的儲藏等過程可能都會影響中藥材之安全品質。目前國內法規對中藥材並無特定規定的包裝貯藏條件，廠商多半以簡易包裝方式儲存與流通，因此，尋求最適化的中藥材包裝和貯存條件對維持藥材品質而言是重要課題（周鳳英等，1999）。

由於，國內有關中藥材包裝貯藏方面的技術資料甚缺，對於每種中藥材的保存條件也僅簡易記載，不利後續有關包裝中藥材發展推廣工作的需要。在收集彙整國內、外有關中藥材包裝與保存條件之研究發展文獻技術資料方面，發現有關中藥材的包裝與保存條件之學術研究資料非常有限。有關中藥材包裝與保存之條件散見於中藥材炮製學的章節。其中，有關中草藥材變質的現象與原因被分為十種，包括：蟲蛀、發霉、變色、泛油、散氣、風化、潮解溶化、粘黏、失潤及腐敗等。

資料也顯示中藥材飲片傳統均採用麻袋、PP 編織袋、木箱、紙箱等大劑量包裝，包裝的規格雜亂無章，沒有統一的標準，藥材耗損、飲片污染，甚至霉變、蟲



蛀等現象時有發生，使中藥材飲片品質難以保證。進一步分析有關單一藥材的保存條件的細部條件（如環境溫度、濕度等）的資料則非常有限，大部分的書籍僅就保存的條件僅僅說明“置通風乾燥處”或再加上“防蟲蛀”或“防霉”等。少數特殊的藥材或飲片（如巴豆霜）會列有特殊的保存要求。考量其原因是：自古中藥材都是以“乾燥”為主要的保存技術，乾燥加工法是以降低中藥材的水分含量為控制的主要項目，以傳統的工藝技術而言，只要控制得當，是一種有效且務實的方法。但當儲存環境條件改變，例如儲存地點的大氣濕度提高（雨季或初春的潮濕空氣），就很容易造成中藥材吸水回潮，進而造成儲存期間的發霉、潮解、粘黏及腐敗等現象。以現代天然物品保存技術的角度來看，這些問題均可用產品“水活性”(water activity)控制解釋。又由包裝保存技術而言，包裝中藥材或飲片要得到適當的保存期限，只要包裝前將產品加工調整到適當的水活性，再藉包裝阻隔控制水分的遷移（防潮），就可以達到保存之目標。然而，有關中藥材水活性的研究資料仍非常有限。因此，本文擬探討中藥材的水活性與保存性質兩者的相關性。

貳、中藥材的含水量、保存環境條件與變質的相關性

各類中藥材都含有一定的水分，由於水分會引起中藥材之生物性、化學性及物理性的反應，因此水分含量的多寡自然會影響中藥材的品質。王虹等（1992）將 12 種中藥飲片分成四類（澱粉類、纖維類、油脂類、含糖類），貯存在溫度 25 及 35℃，相對濕度 75、84 及 100% 的環境，測試分析中藥材的吸水性（表一）、安全水分含量（表二）及霉變情況（表三及四）。結果顯示：吸水性高低的順序為含糖類 > 纖維類 > 澱粉類 > 油脂類。安全水分含量的大小為含糖類 > 澱粉類 > 纖維類 > 油脂類。霉變的發生的容易性為含糖類 > 纖維類 > 油脂類 > 澱粉類。楊容根（1997）的觀察（表五）也顯示：隨季節的室溫不同（平均室溫由 13.1 到 28.5℃）及相對濕度的不同（由 56 到 89%）試驗之四種中藥材的總霉菌數也由 16 升到 86 個／克。由以上的試驗與觀察得知：中藥材的保存性質，除了與中藥材本身的屬性有關以外，也受儲存環境的溫度與相對溼度的影響。

表一 十二種飲片在觀察時間內吸水量的變化 ($\bar{X} \pm SD\%$)

Table 1. Moisture uptake of 12 Chinese herbal medicines at different conditions.

樣品	原含水量 (%)	R.H 75.3%		R.H 84.3%		安全水份 (%)
		25 °C	35 °C	25 °C	35 °C	
山藥 Doiscorea opposita	12.58	3.89±0.54	2.06±0.25	4.01±0.65	4.97±0.14	16
天花粉 Trichosanthes kirilowii	16.14	0.20±0.15	1.62±0.34	7.40±3.19	4.97±0.50	16
半夏 Pinellia ternate	11.94	5.01±0.64	1.23±0.18	18.00±8.01	2.49±0.67	17
甘草 Glycyrrhiza uralensis	8.64	8.15±6.75	2.55±0.40	9.90±2.95	13.31±4.38	16
黃芪 Astragalus membranaceus	6.23	7.59±1.46	3.84±0.28	29.20±12.2	11.64±11.56	14
金銀花 Lonicera japonica	13.92	2.62±0.48	5.76±0.27	11.79±4.10	9.47±6.21	14
桃仁 Prunus persica	5.47	0.88±0.31	1.00±0.00	36.29±20.89	3.24±1.88	6
杏仁 Prunus armeniaca	6.04	0.72±0.23	1.58±1.00	5.35±1.72	2.73±0.44	6.5
柏子仁 Platycladus orientalis	6.67	4.69±3.28	1.01±0.62	2.73±0.44	1.50±1.16	7
黨參 Codonopsis pilosula	17.07	17.00±16.2	-7.34±7.42	12.39±5.38	3.15±9.9	19
枸杞 Lycium barbarum	14.21	19.32±7.33	8.34±8.23	26.67±10.32	-0.25±2.90	18
懷牛膝 Achyranthes bidentata	17.20	18.17±13.46	6.49±0.68	14.72±6.49	0.44±9.1	19

(王虹, 1992)

表二 山藥在不同條件下吸水量 (%)

Table 2. Moisture uptake of Chinese yam at different conditions.

溫度	觀察日數(天)	2	3	4	6	8	10	15	17	19	24	28
25 °C	R.H 75.3%	2.63	3.93	3.82	3.72	3.92	3.89	3.88	3.87	3.80	4.5	4.88
	R.H 84.3%	3.21	3.42	3.45	3.68	3.79	3.99	3.98	3.93	4.41	4.92	5.34
35 °C	觀察日數(天)	5	7	9	11	13	18	21	24	28		
	R.H 75.3%	1.97	1.73	1.96	1.88	2.28	2.61	2.18	1.97	2.01		
	R.H 84.3%	4.94	5.26	4.87	4.73	4.99	4.98	5.01	4.94	4.99		

(王虹, 1992)



表三 十二種飲片不同條件下黴變情況（溫度 35℃）

Table 3. Mold growth of 12 CHMs at different %RH (Temperature = 35℃)

藥材 名稱	R.H 75.3%		R.H 84.3%		R.H 100%	
	天數	霉變情況	天數	霉變情況	天數	霉變情況
山藥	28	無黴菌發展	28	無黴菌發展	3 28	酵母、根霉、毛霉 開始生長 霉菌生長一般
天花粉	28	無	4 28	阿姆斯特丹麴黴生長 藥材大部分生黴	3 28	酵母開始生長 酵母發展很好
半夏	28	無	28	無	6 28	酵母開始生長 生長很好
甘草	28	無黴菌發展	9 28	阿姆斯特丹麴黴開始 生長 全部黴變，生長很好	5 6 28	酵母開始生長 匐限麴黴，煙麴黴 開始生長 黴菌生長一樣
黃芪	28	無	11 28	阿姆斯特丹麴黴開始 生長 全部生黴，黴菌生長好	3 28	酵母生長 生長很好
金銀花	28	無	28	阿姆斯特丹麴黴開始 生長，部分藥材生黴	3 5 28	黑麴黴開始生長 黃麴黴 生長很好
桃仁	28	無	28	無	9 28	酵母、黃麴黴生長 黴菌生長
杏仁	28	無	10 28	阿姆斯特丹麴黴 霉菌生長不好	5 28	似青黴、染色麴黴 黴菌生長不好
柏子仁	12 28	黃麴黴、黑麴黴 藥材大部分生 黴、生長一般	4 28	黃麴黴、黑麴黴 全部生黴、生長一般	9 28	可見黃黃麴黴、煙 麴黴 黴菌較好
黨蔘	4 8	可見極少菌絲 菌絲生長一般	3 28	阿姆斯特丹麴黴 部分生黴、生長一般	3 28	根黴、毛黴、酵母 生長較好
枸杞	17 28	酵母開始生長 全面生長，長勢 一般	10 18 28	酵母開始生長 阿姆斯特丹麴黴 全部生黴，生長一般	3 28	酵母開始生長 生長較好
懷牛膝	20 28	阿姆斯特丹麴黴 大部分生黴，生 長一般	12 28	煙麴黴、阿姆斯特丹麴 黴 全部生黴，生長一般	7 28	煙麴黴、匐限麴 黴、黃麴黴 生長很好

(王虹, 1992)

表四 十二種飲片不同條件下黴變情況（溫度 25℃）

Table 4. Mold growth of 12 Chinese herbal medicines at different %RH (Temperature = 25℃)

藥材 名稱	R.H 75.3%		R.H 84.3%		R.H 100%	
	天數	霉變情況	天數	霉變情況	天數	霉變情況
山藥	28	無黴菌發展	24 28	可見阿姆斯特丹麴黴 黴菌生長不好	3 28	根霉迅速發展 生長很好
天花粉	28	無	14 28	可見阿姆斯特丹麴黴 黴菌生長不好	3 28	酵母生長好 酵母生長很好
半夏	28	無	28	無黴菌生長	20 28	酵母生長為主 酵母生長很好
甘草	28	無	14 28	阿姆斯特丹麴黴開始生長 黴菌生長不好	3 4 28	酵母開始生長 可見毛黴 黴菌生長極好
黃芪	28	無	16 28	可見赤麴黴 黴菌生長不好、不顯著	3 28	黑根黴生長為主 生長極好
金銀花	28	無	16	阿姆斯特丹麴黴	5	可見交鏈孢黴、毛黴
桃仁	28	無	23 28	可見阿姆斯特丹麴黴、黑麴黴 生長一般	6 28	黑麴黴開始生長 生長較好
杏仁	28	無	16 28	阿姆斯特丹麴黴、米麴黴 生長較差	5	酵母生長為主
柏子仁	13	根霉開始生長	10 28	黑麴黴、褶青黴 生長一般	3	根霉、毛黴、酵母
黨蔘	28	無黴菌生長	16	阿姆斯特丹麴黴、毛黴	2 11	根黴迅速生長 可見煙麴黴
枸杞	28	無	18 28	阿姆斯特丹麴黴 生長較好	2 3	根黴、毛黴生長 可見煙麴黴
懷牛膝	28	無	18 28	黑麴黴生長 生長一般	5 6 28	黑麴黴、煙麴黴 圓弧青黴、黃麴黴 黴菌生長較好

(王虹, 1992)



表五 四種藥材不同月份黴菌總數觀察

Table 5. Observation of mold count of 4 Chinese herbal medicines at various month.

月份	1	2	3	4	5	6	7	8	9	10	11	12
溫度(°C)	13.1	14.7	17.8	21.8	25.5	27.3	28.5	28.2	27.1	23.8	19.3	15.2
溼度(%)	56	61	68	82	85	89	81	77	68	64	41	58
黴菌總數 (個/克)	17	20	32	45	81	86	78	83	61	47	19	22

(楊容根, 1997)

參、中藥材的水分吸附與水活性

水分是中藥材成分的一種。但水分與其他成分不同的是水分可以自空氣吸附或脫除到空氣。也就是中藥材的水可以和四周空氣的水互相交換。這種可以交換的水被稱為“自由水”(free water)。相對於自由水，中藥材中不能移除的水，被稱為“結合水”(bond water)。由於中藥材大都含有一定比例的自由水，可以與四周空氣交換。因此表一的實驗才會顯示在一定溫度及溼度時，有些中藥材會吸水，有些則會脫水。這些試驗都是在密閉的控制環境進行，經過一段長時間的儲存，直到中藥材的水分含量維持恆定為止。環境箱的相對溼度(relative humidity, RH)是恆定的。(75 或 84%)，相對濕度的定義是

$$\%RH = \frac{P_{H_2O}}{P_o} * 100$$

P_{H_2O} 是環境箱內空氣中水氣的分壓。 P_o 是相同溫度下，空氣中的飽和水蒸汽分壓。 P_o 是溫度的函數，在工程圖表參考書可以查到。在 100%RH 時， $P_o = P_{H_2O}$ 。

假設在上述相同的試驗條件，若將黨參與枸杞放在一起。由表一可知在 75%RH, 35°C 時，黨參會脫水 (-7.34g) 而枸杞會吸水 (8.34g)。那兩者放在一起時，他們是否會交換水分，直到兩者的水分含量相同為止？或是不會交換水分？為什麼呢(Bell and Labuza, 2000)？事實上，當試驗達到平衡狀態時，兩者的各有自己的水分含量，且水分含量也

不會再變動。原因是在平衡狀態，空氣中的水氣與黨參及枸杞的自由水達成化學勢能相等的狀態。在動態互相交換的水分子，吸附的量與脫除的量相等，以致於，空氣及兩種中藥材的水分含量，各自維持固定不變。這種熱力學的平衡狀態可表示為 $\mu = \mu_0 + RT \ln(a)$ ，其中 μ_0 代表在標準狀態的化學勢能 (J/mol)，R 是氣體常數，T 是絕對溫度 (K=°C+273.15)。而 a 是熱力學活性常數 (activity constant)，是一種物質的特性常數。由化學勢能的定義可知 μ 是溫度的函數，若溫度固定，則 μ 值固定。由前述範例可知 $(\mu)_{\text{黨參}} = (\mu)_{\text{枸杞}} = (\mu)_{\text{空氣}}$ 。因為溫度相同，所以 $(a_w)_{\text{黨參}} = (a_w)_{\text{枸杞}} = (a_w)_{\text{空氣}}$ 。這種化學勢能的相同且活性常數相同的意義是系統中三個物質相互交換水分的驅動力是相同的。也就是三個物質的水分活性是相同。或簡稱水活性相等。若類比於空氣的相對濕度定義。將中藥材在 100%飽和狀態的水活性定義為 1。則水活性可表示為

$$a_w = \frac{P_{H_2O}}{P_o}$$

因此

$$a_w = \frac{\%RH}{100}$$

由於以上的定義都假設是在熱力學平衡的狀態。因此水活性是一種平衡狀態的性質。此時，中藥材所含的水分含量稱為平衡水分含量 (equilibrium moisture content, EMC)。總而言之，中藥材的水活性 (Water Activity, a_w) 是指在密閉空間中 (如密閉容器或包裝容器)，中藥材的平衡蒸氣壓與相同溫度純水飽和蒸氣壓的比值。所以，純水的水活性等於 1.0。

肆、水活性與中藥材保存

由於水活性是測定中藥材可以自由進出水分子與四周環境交換的能力，而這類水分子，對微生物的生長和存活是必需的。在日常生活中，大部份生鮮的食品水活性是 0.99，新鮮食品可藉由添加糖或鹽等物質降低食品的水活性至 0.95-0.75，烘烤食品也可將水活性降至 0.75-0.65，乾燥加工製成的脫水食品 (水果乾、肉乾) 可進一步將水活性降至



0.65-0.60，甚至更低。如乾麵條（水分含量 12%，水活性 0.5）、香辛料（水分含量 10%，水活性 0.5）、餅乾與麵包粉（水分含量 3-5%，水活性 0.3）及奶粉（水分含量 2-3%，水活性 0.2），在這種水活性條件微生物已不再增殖。低水活性食品的保存期限也因此可以延長，不會產生微生物腐敗的現象。因為大部分的細菌、酵母菌、黴菌及耐滲透壓酵母菌生長的最低水活性需求都高於 0.6。因此如果將加工食品或中藥材的水活性降至 0.5 以下，這類產品就沒有機會讓微生物繁殖造成腐敗。

由於每種微生物都有一個極限水活性值（limiting a_w ），低於極限值微生物就不會生長、生成孢子或產生毒素。表六與七列出各類常見微生物的生長極限及產生毒素水活性範圍。水活性可以影響微生物四個主要的生長循環增殖期（growth cycle phases）：誘導期（lag phase）、對數增殖期（logarithmic growth phase）、定常期（stationary phase）及減衰期（decline phase），包括影響微生物的萌芽時間、誘導期的長短、對數增殖速率、定常期的微生物量及減衰速率。一般而言，降低水活性會延長誘導期，降低對數增殖速率及定常期的微生物最大量（Robertson, 2005）。其他外在的因素包括溫度、氧氣濃度及炮製處理等，相對於水活性，也會影響中藥材的微生物腐敗。這些因素可以相互的作用形成複雜的關係影響微生物的生長或死滅或產生毒素。

伍、中藥材飲片的水活性與等溫吸濕曲線

若將中藥材在不同水活性的平衡水分含量資料繪製圖表，如圖一，可得到該中藥材的吸溼曲線。而如前所述中藥材的水活性是溫度的函數。因此，每一個溫度都可以繪製一條曲線，被稱為該中藥材在該溫度的水分等溫吸濕曲線（moisture sorption isotherm）。對大部分的中藥材而言，這條曲線呈現 S 型的形狀，是一種第二型的等溫吸附曲線（type II isotherm）。這條特殊的 S 曲線是由中藥材與水分子吸附的依數效應（colligative effect）、毛細效應（capillary effect）及表面與水交互作用（surface-water interaction）等物理作用合併產生的。在曲線中有兩個彎曲點（bend），一個在 a_w 0.2-0.4，另一個在 0.65-0.75。兩者是由水分子的不同物理化學效應形成，也就是在這兩點水的吸附方式有顯著性的改變（Bell, 2000）。水分等溫吸濕曲線是一項非常有價值的工具，可以作為預

測中藥材在儲存時可能的性質改變。也可作為包裝系統選擇計算的依據。由表六與七結果可知微生物生長極限的水活性及產生毒素的水活性範圍。再配合中藥材儲存溫度的水分等溫吸濕曲線可以得知大部分的中藥材，若水活性控制在 0.6-0.7 以下，是可以防止微生物引起之腐敗問題。再由水分等溫吸濕曲線也可以估計中藥材保存的最高水分含量容許值。

為瞭解中藥材包裝的合適性，馮等（2008）曾測試十種市售中藥材：白芍，白果，黃芩，杏仁，川芎，山楂，柴胡，陳皮，丹參及大黃等的天然性質。樣品的水分含量及水活性測試結果如表八。結果顯示：除濕式白果以外，中藥材的水活性均低於 0.7，屬於中及低水活性物品。十種市售中藥材測試的等溫曲線，在室溫 25℃，如圖二。結果顯示：有九種中藥材飲片的水分等溫吸濕曲線非常類似，且糾集一起，僅杏仁為油脂類中藥材，其水分等溫吸濕曲線較偏下，也就是不易吸水。若以水活性 0.6 為界，大部份的水分含量為 10% 附近，但杏仁雖然水分含量不高（4.54%），但若再吸收的水分，即有機會發霉或腐敗。乾白果也有類似的結果。反觀含糖量較高的中藥材，如山楂，雖然水分含量高（14.3 %），若適當的控制環境的相對濕度，產品不再進一步吸水，仍可以有適當的保存期限。

表六 食品微生物生長之最低水活性

Table 6. Minimal a_w for Growth of Food Microorganisms

a_w	Microorganisms Inhibited at this a_w
0.95	<i>Bacillus</i> , <i>Clostridium perfringens</i> , <i>Escherichia</i> , <i>Klebsiella</i> , <i>Proteus</i> , <i>Pseudomonas</i> , <i>Shigella</i> , some yeasts
0.91	<i>Clostridium botulinum</i> , <i>Lactobacillus</i> , <i>Pediococcus</i> , <i>Salmonella</i> , <i>Serratia</i> , <i>Vibrio parahaemolyticus</i> , some molds, yeasts
0.87	<i>Micrococcus</i> , many yeasts
0.80	<i>Debaryomyces</i> , most <i>Saccharomyces</i> , <i>Staphylococcus aureus</i>
0.75	Most halophilic bacteria
0.65	Xerophilic molds
0.60	Osmophilic yeasts, few molds
≤ 0.50	No microbial growth

(adapted from Beuchat, 1981)

表七 食品病原菌成長與產生毒素之最低水活性

Table 7. Minimum a_w for the Growth of and Toxin Production from Selected Pathogenic Food Microorganisms

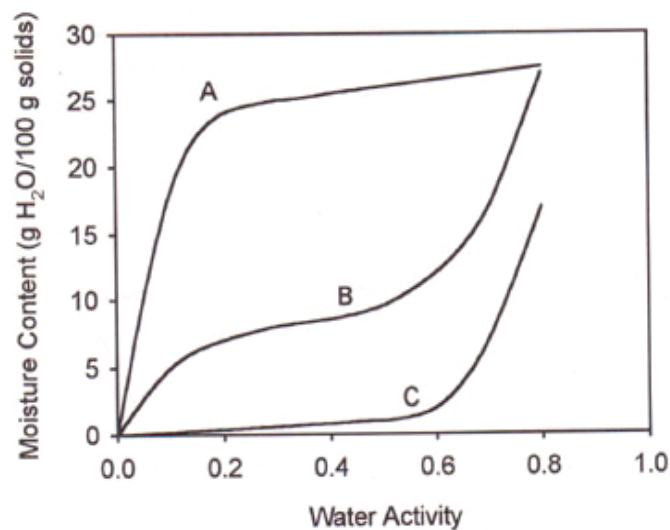
Microorganisms	Growth	Toxin Production
<i>Aspergillus clavatus</i>	0.85	0.99 (patulin)
<i>Aspergillus flavus</i>	0.78-0.80	0.83-0.87 (aflatoxin)
<i>Aspergillus ochraceus</i>	0.76-0.83	0.83-0.87 (ochratoxin)
<i>Aspergillus parasiticus</i>	0.82	0.87 (aflatoxin)
<i>Bacillus cereus</i>	0.93-0.95	
<i>Clostridium botulinum</i> (type A)	0.93-0.95	0.94-0.95
<i>Clostridium botulinum</i> (type E)	0.95-0.97	0.97
<i>Clostridium perfringens</i>	0.93-0.95	
<i>Penicillium expansum</i>	0.83-0.85	0.99 (patulin)
<i>Penicillium patulum</i>	0.81-0.85	0.95 (patulin)
<i>Salmonella spp.</i>	0.92-0.95	
<i>Staphylococcus aureus</i>	0.86	0.87-0.90 (enterotoxin A)
<i>Vibrio parahaemolyticus</i>	0.94	

(p adapted from Beuchat, 1981)

表八 市售中藥材水活性與水分含量分析

Table 8. Water activity and moisture content of ten Chinese herbal medicines from local market.

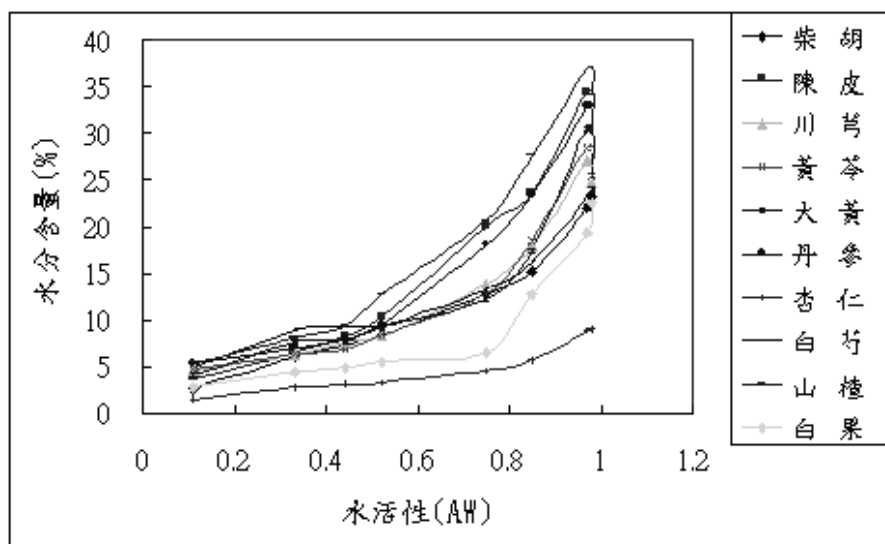
中藥材	白芍	白果	黃芩	杏仁	川芎
水活性 A_w	0.71	0.94	0.56	0.51	0.65
水分含量 (%)	12.39±0.01	30.91±1.08	8.32±0.29	2.65±0.44	10.56±0.17
中藥材	山楂	柴胡	陳皮	丹參	大黃
水活性 A_w	0.61	0.57	0.45	0.60	0.64
水分含量 (%)	14.26±0.83	8.48±0.20	7.81±0.06	11.19±0.35	10.72±0.84



圖一 水分等溫吸濕曲線的分類 (A：第一型、B：第二型、C：第三型)
(摘自 Bell & Labuza, 2000)

Figure 1. Classification of moisture sorption isotherm:

A = type I, B = type II, C = type III (adapted from Bell & Labuza, 2000)



圖二 市售十種中藥材等溫吸濕曲線圖

Figure 2. Moisture sorption isotherms of ten Chinese herbal medicines from local market.



陸、結 語

中藥材主要來自天然植物、動物及礦物，若藥材處理不良，在包裝、運輸、貯存過程中會造成品質劣變或微生物污染，影響藥材之使用功能。微生物滋生會造成藥材成分變質，甚至產生毒素，影響藥材安全性。中藥材都含有一定水分，會引起或促進中藥材生物性、化學性及物理性反應，因此水分含量會影響中藥材品質。中藥材的保存性質與中藥材本身屬性有關，也受儲存環境溫度與相對溼度影響。在熱力學平衡狀態，由化學勢能平衡的概念可以推出中藥材的水活性： a_w 是指在密閉空間，中藥材的平衡蒸氣壓與相同溫度純水飽和蒸氣壓的比值。由於每種微生物都有一個極限水活性值（limiting a_w ），低於極限值微生物就不會生長、生成孢子或產生毒素。降低水活性會延長誘導期，降低對數增殖速率及定常期的微生物最大量。其他外在因素（包括溫度、氧氣濃度及炮製處理等），相對於水活性，也會影響中藥材的微生物腐敗。這些因素可以相互的作用形成複雜的關係，進而影響微生物的生長或死滅或產生毒素。將中藥材之水活性與平衡水分含量資料可繪製中藥材的水分等溫吸濕曲線（moisture sorption isotherm）。而如前所述中藥材的水活性是溫度的函數。因此，每一個溫度都可以繪製一條曲線，被稱為該中藥材在該溫度的水分等溫吸濕曲線（moisture sorption isotherm）。等溫吸濕曲線（moisture sorption isotherm）。水分等溫吸濕曲線是一項非常有價值的工具，可以作為預測中藥材在儲存時可能的性質改變。也可作為包裝系統選擇計算的依據。種市售中藥材的水分含量及水活性測試結果顯示：除濕式白果以外，中藥材的水活性均低於 0.7，屬於中及低水活性物品。十種市售中藥材的等溫曲線結果顯示：有九種中藥材飲片的水分等溫吸濕曲線非常類似，僅杏仁水分等溫吸濕曲線較不易吸水。若以水活性 0.6 為界，大部份的水分含量為 10% 附近。若適當的控制環境的相對濕度，產品不再吸水，仍可以有適當的保存期限。

中藥材自古即以乾燥成低水活性的產品得以長期保存，由十種中藥材的等溫吸濕曲線及現有產品的水活性分析，簡易實用的聚乙烯或聚丙烯塑膠袋包裝隔絕外界的水氣入侵已經足夠。若能在藥材乾燥或炮製後，適當的控制原料的總微生物數量及水活性在 0.5 以下，並控制包裝製程的環境條件（如相對濕度（50% 以下、空氣中微生物量、溫度、工作人員衛生條件等），則可避免長途運輸中微生物大量滋生，可以延長產品保存期限、

保持藥材品質。對於含有油脂的中藥材（如杏仁等）則應考慮使用具有氣體阻隔性的積層塑膠袋（如 Nylon/LLDPE、Nylon/EVOH/LDPE 類），並適當的使用吸氧劑小包，可以延緩中藥材的油耗味，若要完全防止中藥材的泛油現象，低溫冷藏貯藏仍是較佳的方法。



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Study on Water Activity and Preservation of Chinese herbal medicines

Abstract

Chinese herbal medicines (CHMs) were made from natural materials. The quality of CHMs has deteriorated with microbial contamination by improperly postharvest handling, packing, transporting and storing. Those would affect the functions or properties of CHMs. Especially, the toxin production by the microbial growth would cause safety issue of CHMs. Therefore, the research on the proper conditions for packaging and storing CHMs is a important topic to preserve the quality of CHMs. The correlation between the water activity and preservation of CHMs will be discussed in this presentation. Data from literature search showed that the quality preservation of CHMs was affected by the temperature and relative humidity of storage environment besides the natural properties of CHMs. So, the water activity of CHMs is a important parameter need to be studied, since the definition of water activity is the ratio of the water vapor pressure of the CHMs to the vapor pressure of pure water at the same temperature. Also, the equilibrium moisture content of CHMs could be plotted against the corresponding water activity at constant temperature, a moisture sorption isotherm results. The moisture sorption isotherm is an extremely valuable tool to predict potential changes in CHMs stability, as well as to select packaging for CHMs. Ten of traditional CHMs, including Rhei Rhizoma, Crataegus Fructus, Ligustici Rhizoma, Salvia miltiorrhizae Radix, Paeoniae Radix Alba, Ginkgo biloba, Armeniacae Semen, Bupleurum spp., Citri Reticulatae Pericarpium, Scutellariae Radix were selected to study the the water activity and moisture sorption isotherm. The results showed that, besides Ginkgo biloba packed in water, the water activities of nine



CHMs were below 0.7 which could be classified as low aw products. The results of moisture sorption isotherm studies (at 25°C) showed that the equilibrium moisture content were between 10 to 15% at water activity 0.6 for nine of ten CHMs. The equilibrium moisture content was 4.5% at water activity 0.6 for Armeniacae Semen which is high oil content CHMs.

Key Word: Chinese herbal medicine, Water activity, preservation



東部地區中草藥產業發展之現況與展望

張同吳

行政院農業委員會花蓮區農業改良場

摘 要

行政院生物技術產業策略會議等會議中，許多專家學者評估，藥用及保健植物是台灣最具競爭力的生技產業之一。東部地區工業化程度較低，農作生產環境優良，很適合中草藥之發展。目前台灣每年自國外進口大量中藥材，唯品質有安全之虞，建立本土化之中草藥生產，以優良農業操作之栽培模式，生產安全、優質之中草藥，為目前重要之課題。東部地區目前已積極進行本地之中草藥栽培生產，種類包括當歸、黃芩、丹參、山藥、柴胡、土肉桂、仙草等，部份並有保健加工產品上市。有機農業與有機中草藥產業是目前台灣積極推動發展與極具有未來潛力之產業，建立東部地區成為台灣有機中草藥生產基地，並配合產官學研究團隊平台之建立，研發高附加價值之保健產品，可促進中草藥產業之蓬勃發展，進軍國際市場，提升台灣中草藥產品在全球中草藥市場的競爭力。

關鍵字：當歸、黃芩、丹參

壹、前 言

台灣植物之種類，據調查指出共 296 科 1766 屬 5,669 種。東部地區地形狹長，北起宜蘭，南至台東，地形由山地、河川、蘭陽平原及縱谷平原所組成，山地由西部中央山脈和東部海岸山脈所構成，從海濱、平原、丘陵乃至高山皆有分佈，氣候

更兼具溫帶、亞熱帶及熱帶之不同氣候，因此蘊育著極為豐富的植物種原。行政院生物技術產業策略會議等會議中，許多專家學者評估，藥用及保健植物是台灣最具競爭力的生技產業之一。東部地區工業化程度較低，農作生產環境優良，適合中草藥之生長，建立本土化之中草藥生產，以優良農業操作之栽培模式，生產合乎安全標準之「道地藥材」，確保中草藥藥材品質（張，2002）。

有機農業與中草藥產業都是目前台灣積極推動發展與極具有未來潛力之產業。在有機農業部份，台灣自 1994 年開始積極推動有機農業以來，已建立完整之有機農業操作系統，包括土壤及水源安全之檢測與管控、有機農業可使用之有機肥料與病蟲害防治等資材範圍與標準，有機作物栽培之環境如隔離帶寬度等、及有機作物商品上市前與上市後安全管控機制都已有完整之規範。目前農委會更進一步推動作物生產履歷制度，並制定 TGAP 之標準作業準則，目前已有紅棗、山藥、牛蒡、落神葵、葉用枸杞、仙草及金線連等藥用或保健相關作物已建立有機栽培或一般慣行栽培之 GAP 模式供農民使用，以生產安全優質之農產品。

在中草藥產業方面，台灣民間普遍有食補之觀念，日常飲食與藥膳中常使用中草藥，健康食品、傳統中藥與科學中藥使用普遍，目前每年自中國大陸進口大量中藥材，本地中草藥產業未來發展潛力大。在臺灣目前已有部份地區已進行本地之中草藥栽培生產，種類包括當歸、黃芩、丹參、山藥、綬草、柴胡、土肉桂、仙草等多種中藥材，部份並有加工產品上市。因此推動有機栽培農民與中藥公司、保健產品公司合作，以製作方式結合生產之上下游，可有效解決產銷問題，創造一個高附加價值、優質的有機中草藥產業。

貳、東部地區中草藥發展優勢

宜蘭、花蓮及台東縣位於台灣東部，地形由山地、河川、蘭陽平原及縱谷平原所組成，山地由西部中央山脈和東部海岸山脈所構成，河川流域主要為蘭陽溪、花蓮溪、秀姑巒溪及卑南溪等四大流域。耕地水旱田面積為 122,209 公頃，其中水田面積，宜蘭縣有 16,959 公頃，花蓮縣有 13,246 公頃，台東縣有 13,337 公頃，合計



43,336 公頃；旱田面積則分別為 10,332 公頃、34,196 公頃及 34,345 公頃，合計 78,873 公頃。

東部地區之地理環境優勢為其空氣品質、水質及土壤條件良好，農村勞動力充沛及農業研究資源豐富。

一、空氣品質

環保署各縣市空氣品質監測項目以臭氧及懸浮微粒為主，東部縣市之空氣品質均為良好。以花蓮縣為例，環保署監測報告顯示花蓮縣空氣污染指標均低於 50，屬良好狀態。花蓮鳳林以南無影響空氣品質之工廠，空氣品質更為良好，適合中草藥之種植。

二、河川水質

東部地區之蘭陽溪、花蓮溪、秀姑巒溪及卑南溪，環保署水質監測資料顯示，溶氧量高，BOD、COD、懸浮固體、氨氮、總磷均低，水質良好，適合中草藥之種植。

三、土壤條件

東部三縣之土壤因無大型工廠、養豬場等污染源，土壤環境良好，適合中草藥之生長。

四、農村勞動力充沛

東部三縣之農業人口比例分別為宜蘭縣 26.55%、花蓮縣 17.65%、台東縣 26.94%，高於全台平均比例之 14.26%，顯示農村勞動力充沛，有利於中草藥之推廣栽培。

五、中草藥研究資源豐富

東部地區除了擁有豐富的植物資源之外，並有國立宜蘭大學、國立東華大學、慈濟大學、慈濟醫院及生技公司及農業改良場等相關研究單位，積極投入中草藥之各項基礎研究，以促進東部地區中草藥產業之升級與發展。

參、東部地區中草藥發展策略

東部地區工業化程度較低，農業耕作環境相當優良，並且爲了舒緩東部地區農地休耕之壓力，提高農民之收入，推動台灣保健作物優良農業操作之農業生產模式，生產安全、優質的中草藥，建立東部地區成爲中草藥優良農業操作之生產基地及集散中心，擴大保健作物栽培面積，舒緩農地休耕之壓力，開拓保健作物產品市場，厚植台灣中草藥產業發展實力及全球競爭力，並且爲因應農業之轉型，針對植物之特性利用生物科技加工利用爲多樣化保健植物產品，同時將健康、休閒、旅遊、養生的經營理念，結合保健植物資源注入休閒農業中，善用東部地理、環境優勢，推動與人文及觀光遊憩資源結合，形成兼具生態、生活及生產三生一體具地方特色之保健及養生休閒產業，具體策略爲：

一、在研發方面：整合相關大學及研究機構，建立東部中草藥研發中心

（一）建立中草藥成分及藥理研究中心：進行中草藥之抗氧化能力、有效成分之分析技術平台，整合資源，與轄區各大學等相關研究單位合作，建立中草藥指標成分分析、萃取及藥理研究中心，確保中草藥之品質，並進而開發植物新藥。

（二）研發保健產品：利用產學合作計畫之模式，與生技公司合作，針對市場及不同消費族群之需求，研發保健作物多樣化產品如茶包、飲品、藥膳、美白美容保養品及保健菇菌類等產品，並從中草藥中萃取、分離、純化具保健功效之化合物成分，提昇保健作物產品之附加價值，促進中草藥



產業升級。

二、在生產方面：建構東部成為台灣中草藥生產基地

（一）保健植物種原蒐集及利用性評估：

經由保健植物種原蒐集與調查，建立種原保存圃，對植物種原進行保育及觀察試驗，篩選具有發展潛力之種類，評估其利用性，並針對植物之特性予以開發利用。

（二）保健植物基源鑑定：建立保健植物之種原資料庫，利用 DNA 指紋圖譜、指標成分分析技術，確立保健植物基源之正確性。

（三）保健作物之優良農業操作栽培體系之建立：建立台灣中草藥優良農業操作栽培體系，擴大中草藥栽培面積，生產安全、優質之保健作物，使東部地區成為台灣中草藥之生產基地。

（四）整合當地中草藥產銷班，引薦西部 cGMP 中藥廠與之進行製作栽培，確保產銷秩序。

三、在行銷方面：建立中草藥集散中心及養生休閒農村

（一）設置中草藥集散中心：設置中草藥之清洗、分級、烘乾、切片、包裝等前處理之初級加工場，建立東部地區保健作物在地品牌，品質管制中心，供應優質之中草藥予 cGMP 中藥廠、中藥商之原料需求及廣大消費市場之需求，建立行銷體系，拓展通路。

（二）輔導設置養生休閒中心：利用東部地區豐富之文化、農業、醫療及中草藥資源，輔導設置中草藥養生中心，並配合有機村之營運，形成兼具生態、生活及生產三生一體之多功能休閒、體驗、教育、養生特色及休閒農村，促進中草藥產業發展。

肆、東部地區中草藥發展現況

一、東部地區中草藥栽培現況

東部地區由於具備優良之農業環境，適合中草藥之種植與發展，以花蓮縣為例，目前花蓮縣之中草藥主要栽培作物為當歸、丹參、土肉桂等，種植地區以花蓮縣境之吉安、鳳林、光復、瑞穗、玉里及卓溪等地區為栽培面積較大之地區（表 1）。

表 1 花蓮縣藥用作物種類及面積統計表

作物種類	面積 (ha)	種植地區
當歸	50	吉安、壽豐、光復、瑞穗、玉里、卓溪
丹參	10	光復、瑞穗、玉里
黃芩	10	瑞穗、玉里
山藥	30	吉安、壽豐、新城
台灣天仙果	40	花蓮全縣
小葉黃鱔藤	10	花蓮全縣
三葉五加	30	花蓮全縣
土肉桂	30	鳳林、光復
山葡萄	5	全縣
香水茅	5	瑞穗、玉里
其他藥用作物	30	全縣
合 計	250.0	

二、中草藥優良農業操作栽培體系之建立

台灣的氣候較高溫多濕，在農作物的栽培上較易罹病蟲害，在以往，為了增加產量，大量使用化學合成農藥及肥料，造成農業生態環境日益惡化，許多農藥也因為農藥殘留，蓄積在人體中，危害人體健康，因此，近幾年來農政單位致力於有機農業之推展，希望合理的施用有機質肥料或利用生物性藥劑，少施或不施化學農藥及肥料，來生產優質、安全之農產品。在保健植物方面，目前正推行優良農業操作



（Good Agricultural Practice；簡稱 GAP）的栽培方式，期能透過 GAP 的栽培模式的建立，生產符合市場所需，與世界接軌之安全及高品質之保健植物原料及產品。目前在東部地區選擇當歸、黃芩等保健作物，從基源植物之鑑定、栽培繁殖體系之建立，包括播種、育苗、種植、施肥、病蟲害管理、收穫適期、成分分析及收穫後之調製、加工、貯藏及包裝等，建立一個符合 GAP 之標準化模式，生產高品質、安全之藥材。

三、有機中草藥產業之推動

有機農業與中草藥產業都是目前台灣積極推動發展與極具有未來潛力之產業。在有機農業部份，目前全臺灣有機農業面積已超過 2,130 公頃，並已有 4 家經認證之有機協會負責有機商品之驗證，經多年之宣導，消費者對有機商品之接受度與認同度高。農委會更進一步推動作物生產履歷制度，並制定 TGAP 之標準作業準則，在保健作物方面目前已有紅棗、山藥、牛蒡、桑椹、枇杷、洛神葵、葉用枸杞、仙草、及金線蓮等藥用或保健相關作物已建立有機栽培或一般慣行栽培之 GAP 模式供農民使用（表 2），以生產安全優質之農產品。目前在東部地區推動之中草藥方向為逐步朝有機栽培之方向，未來經由有機相關單位檢驗，取得有機中草藥認證，使東部地區之中草藥能邁向全球化之目標。

表 2 台灣地區已建立 TGAP 規範之中草藥種類

種類	一般栽培	有機栽培
山藥	✓	✓
紅棗	✓	✓
牛蒡	✓	✓
桑椹	✓	✓
枇杷	✓	
洛神葵	✓	
葉用枸杞	✓	
仙草	✓	
金線蓮	✓	

四、花蓮區農業改良場研發現況

花蓮區農業改良場近年來積極推動中草藥產業之發展，從中草藥優良栽培管理模式之建立、有效成分分析與藥理研究平台之建立、中草藥抑制腫瘤細胞試驗、至保健植物產品之開發利用等，均已建立一套準則，以推動中草藥產業之發展。茲分述如下：

（一）保健作物之栽培管理

■ 當歸

當歸 (*Angelica* spp.) 為繖形科多年生草本植物，《神農本草經》中將之列為中品藥，利用部位為根部，有活血補血、調經止痛及潤腸通便等功效。常用的當歸種類有中國當歸 (*A. sinensis*)、大和歸 (*A. acutiloba*)、韓國當歸 (*A. gigas*) 等 (顏, 1985)。其主要成分為揮發油、阿魏酸 (ferulic acid)、藁本內酯 (ligustilide)、butylidenephthalide、醣類、氨基酸及 bergaptene 等。上述三種不同種類當歸之阿魏酸、藁本內酯等成分，其含量亦因品種間的不同而有差異存在。當歸的重要成分阿魏酸 (ferulic acid) 屬於酚類化合物，具有抗氧化、抗菌、抗發炎、抗癌及抗血栓等生理功能。當歸傳統上不僅有補血、活血化瘀的作用，更有抗菌、抗發炎、調整免疫系統的作用。因此當歸在目前有多元化的應用；它不僅是傳統大補氣血的中藥，同時也是現代人保養身體及女性保養皮膚常使用的草本藥材之一，其進口數量佔所有進口中草藥數量前三位，在中草藥市場上有其發展潛力。花蓮地區種植之當歸種類屬於大和歸 (*A. acutiloba*)，在東部地區之種植結果顯示，其抗氧化能力優於市售當歸，顯示其清除自由基能力較佳，且其鐵含量高於市售當歸，其他諸如鉀、鈣、鎂、錳、銅等元素含量之分析結果亦較市售者為佳 (表 2)。有效成分含量亦佳，適合東部地區推廣種植。



表 3 花蓮地區種植之當歸與市售當歸根部微量元素含量比較

當歸來源	Ca (%)	Mg (%)	P (%)	Fe (ppm)	Mn (ppm)	Cu (ppm)	Zn (ppm)
市售	0.28	0.21	0.6	260	0.29	6.05	38.3
花蓮地區	0.54	0.36	0.90	282	68	21.0	24.8

當歸之栽培管理：當歸為多年生草本植物，全株具濃厚之辛香氣味，利用種子繁殖，發芽適溫為 15-20℃，性喜冷涼氣候，忌高溫及陽光直射，平地地區種植之植株由於溫度較高及日照較強，使其生育情形較差，有提早開花之現象。當歸於種植後至翌年才採收其根部，開花後種子逐漸成熟，俟種子成熟後植株即死亡。其栽培管理方法介紹如後：

◆種植方式：

利用種子繁殖，可採種子直播與育苗種植二種方式。採種子直播方式為整地、作畦後將種子直接播於土中即可。採育苗方式則將種子播種於育苗盤或育苗床，約 2-3 星期後種子開始發芽，待葉片長至 4-6 片後，移植田間定植。

◆選地：

平地種植之植株在生育中期適逢夏季，陽光較強，溫度亦較高，植株生長不佳或提早開花，影響根部產量及品質，故當歸之栽培地理位置以海拔高度為 500~800 公尺之平坦、通風良好之地點為佳，土壤以排水良好、富含有機質之砂質壤土為宜。

◆定植

當歸於種植前施用有機質肥料，整地時土壤宜深耕並細碎，作畦栽培，栽培行株距為 100×30 公分，利用不織布、雜草抑制蓆或稻草等材料覆蓋畦面，可保持土壤濕潤及防除雜草。於翌年 1~2 月定植於田間，定植時應小心

避免幼苗根部受損，影響植株移植存活率及根部生長發育。定植後應即澆水或噴灌灑水，以提高幼苗成活率。

◆收穫適期：

當歸植株抽花苔前為收穫適期，此時收穫之當歸根部品質最佳。植株開花後採收之根部，由於根部已逐漸木質化，此時收穫之品質稍差。種子成熟後，植株根部漸漸萎縮，此時之根部，不具商品價值。

■黃芩

黃芩 (*Scutellaria baicalensis*) 為唇形科植物，利用部位為其根部，具清熱燥濕、瀉火解毒、止血、安胎等功效。其味苦、性寒。歸肺、心、肝、膽、大腸經，對於人體之心血管之保健有所助益。其主要有效成分為黃芩素、黃芩苷及漢黃芩素等成分，具有抗菌、消炎等藥理作用。目前在花蓮地區之種植結果其有效成分黃芩素、黃芩苷及漢黃芩素等成分含量佳，適合東部地區推廣種植。

■丹參

丹參 (*Salvia miltiorrhiza* Bge.) 為唇形科草本植物，使用部位為根（或全草），為一傳統之中藥材，神農本草經列為上品生藥，廣泛用於婦女月經失調、失眠、關節炎及心血管、血液類等之疾病。現代之研究顯示其對於抗腫瘤、抗菌、冠心病、特別是心血管方面如心絞痛（*angina pectoris*）、和心肌梗塞（*myocardial infarction*）有良好的治療功用。丹參之重要成分為丹參酮（*Tanshinone*）I、II、IIA，羥基丹參酮（*Hydroxytanshinone*），甲基丹參酮，異丹參酮（*Isotanshinone*）I、II，異隱丹參酮（*Isocryptotanshinone*），酚二萜類（*phenolic di terpene*），鼠尾草酚（*Salviol*）及丹參酚酸等成分，對於身體之保健有所助益。

花蓮地區種植之丹參生長適應性良好，無病蟲害情形發生，根部之產量佳且品質優良。保健作物除了產量與品質之外，其有效成分之含量亦為重要之一環，針對花蓮地區種植之丹參之指標性成分丹參酚酸及丹參酮含量進行分析，發現其含量較市售者為高。在抗氧化能力方面亦較市售之丹參為佳，



此顯示花蓮地區生產之丹參品質佳，加上栽培環境都經過嚴格之篩選及控管，因此生產的丹參品質安全有保障。

■ 柴胡

柴胡 (*Bupleurum* spp.) 爲繖形科植物，目前在台灣當作中藥材使用之柴胡主要爲北柴胡 (*B. chinense*)、三島柴胡 (*B. falcatum*) 及台灣原生之特種高氏柴胡 (*B. kaoi*)。柴胡在『神農本草經』中列爲上品生藥，爲『傷寒論』少陽病之主藥，有解熱、鎮痛、解毒、消炎等效用，主治胸脅苦滿、往來寒熱、黃疸、肝炎、胃腸炎、膽囊炎等，著名方劑爲小柴胡湯，用於肝膽疾病、增強肝機能、增強免疫功能等，利用的部位以根部爲主，根部含柴胡皂素 (saikosaponin)、黃酮類 (flavonoid)、醣類、脂肪、固醇 (sterol) 等成分。研究指出高氏柴胡之根部所含之柴胡皂素量爲三島柴胡之 2~3 倍，爲進口北柴胡之 10 倍，保肝效果最佳，高氏柴胡地上部分 (莖葉) 亦含有少量柴胡皂素，全株皆可供爲藥用植物資源 (林和顏，1999)。

柴胡栽培地理環境以排水良好之砂質壤土爲佳，利用種子繁殖，播種適期爲春季 3-4 月及秋季之 9-10 月，播種方法採種子直播或以育苗盤育苗，後者較前者爲佳。種子播種後，苗長 10 公分即可移至田間定植，定植前本田先行整地碎土，作畦，行距 1.2 公尺，一畦兩行，株距 30 公分。地上部漸枯萎時爲收穫適期，採收後之植株，除去地上部莖葉，根部用水洗淨後烘乾，即可供爲藥材使用。

(二) 有效成分分析與藥理研究

爲建立保健作物的有效成分分析技術，與東部地區各大學等相關研究單位合作，進行中草藥抗氧化能力及有效成分及藥理研究，以提升中草藥之品質。

1. 抗氧化能力分析平台之建立：

生物體中存在之自由基是細胞老化及許多疾病的原因之一，植物之萃取物具抗氧化能力，可清除人體之自由基，達到保健之目的。在保健植物之抗氧化能力分析，已建立 DPPH 等方法分析保健作物之清除自由基能力分析平

台。在丹參、山柰、馬藍、仙茅、地黃、十大功勞、半枝蓮、茜草、苦參等保健作物進行抗氧化能力試驗，分析結果顯示：以仙茅之抗氧化能力最佳，地黃次之、其次依序為丹參、馬藍、仙茅、十大功勞、半枝蓮、苦參、茜草，抗氧化能力較低者為山柰（圖 1）。

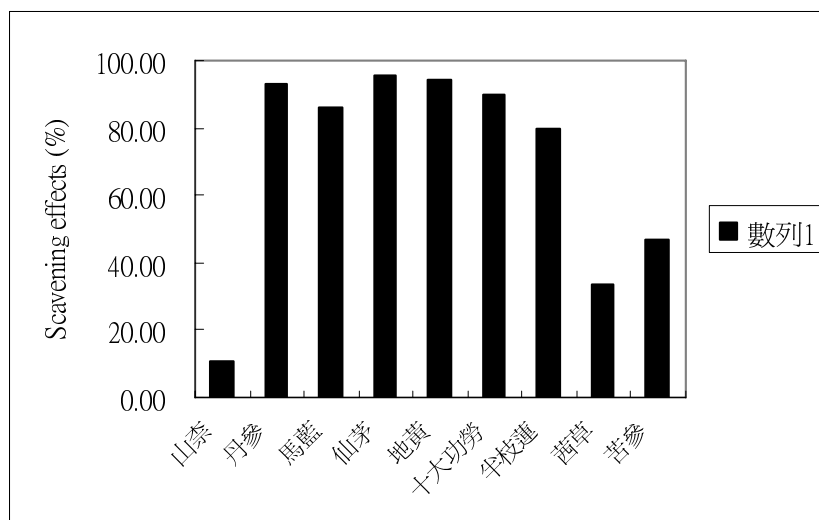


圖 1 保健作物抗氧化能力之比較

2. 中草藥有效成分分析平台之建立

中草藥有效成分為保健作物品質之最重要因素之一，目前已利用氣相層析（GC）、高效能液相層析（HPLC）建立中草藥指紋圖譜當歸（圖 2）、黃芩（圖 3）、丹參（圖 4）等有效成分分析技術，進行中草藥品質管制，提升中草藥之品質。

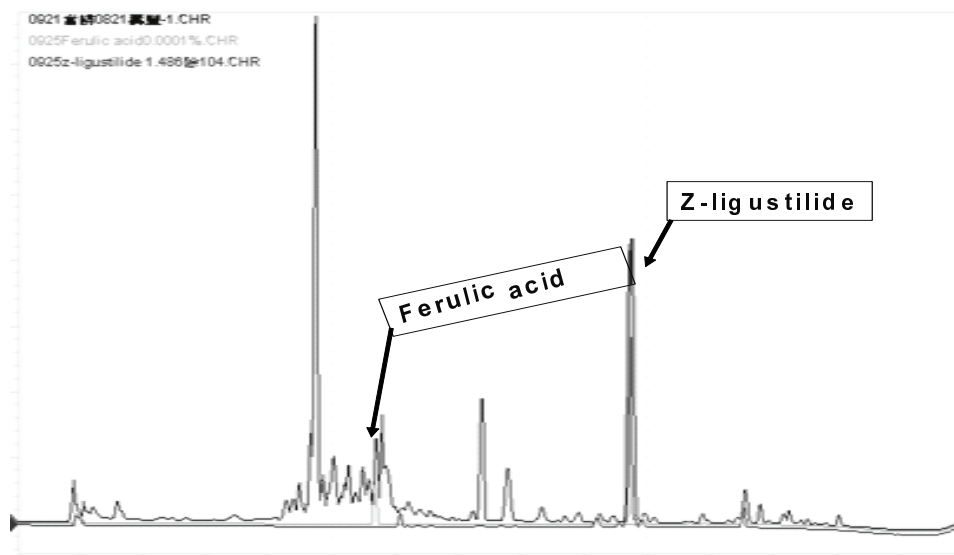


圖 2 當歸 HPLC 指紋圖譜

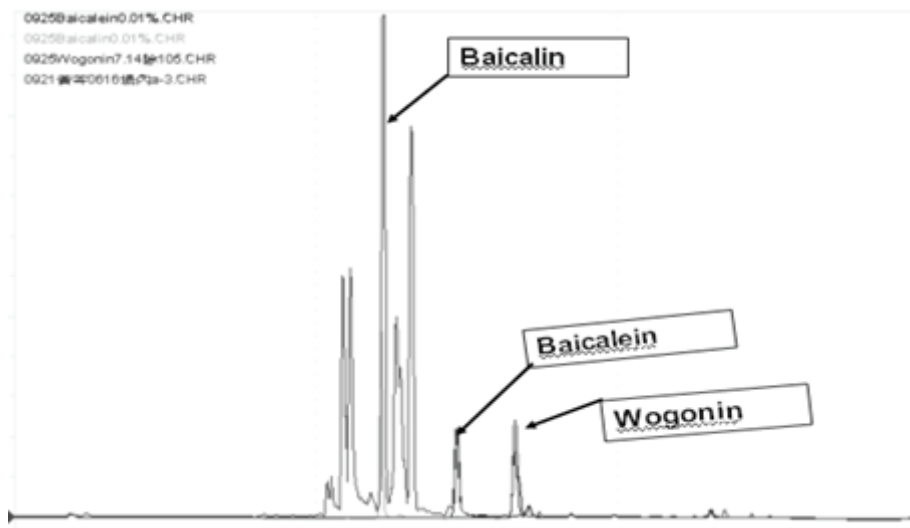


圖 3 黃芩 HPLC 指紋圖譜

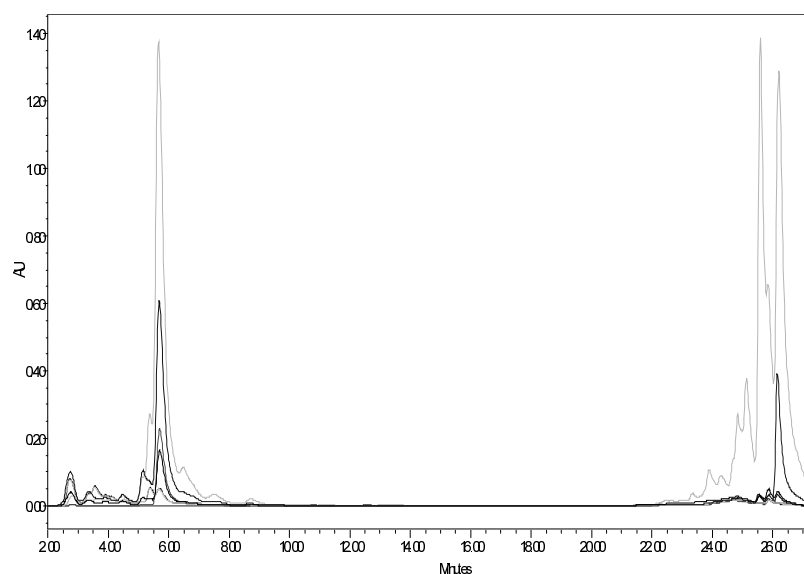


圖 4 丹參 HPLC 指紋圖譜

3. 中草藥抑制腫瘤細胞試驗平台之建立

為進一步瞭解中草藥之生理活性，與慈濟大學進行中草藥萃取成分對抗腫瘤細胞之合作，建立試驗分析平台，試驗結果顯示丹參萃取物可有效抑制腫瘤細胞之生長（圖 5）。

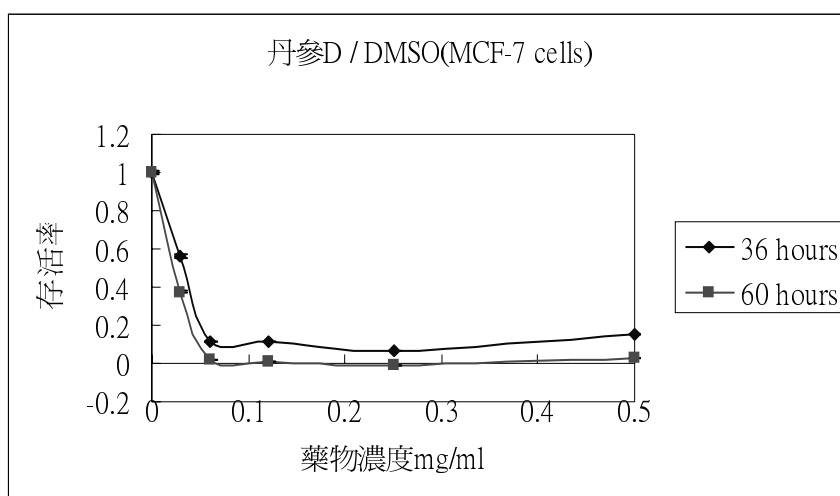


圖 5 丹參萃取物可抑制腫瘤細胞之生長



4.保健產品之開發利用

◆保健菇菌類牛樟芝等產品研發

牛樟芝為多孔菌科 (Polyporaceae)、薄孔菌屬 (Antrodia)，為臺灣特有的保健菇蕈物種。牛樟芝，因為色澤鮮紅又具有民俗的療效，所以有林中的紅寶石之稱。近年來之研究發現其具有抗氧化 (Song and Yen, 2002)、保肝 (戴，2001)、抑癌 (劉，2002；宋，2002)、免疫 (劉，2002)、抗病毒 (Lee et al, 2002)、殺菌 (簡等，1997)、抗發炎 (Chen and Yang, 1995) 及降血糖 (嚴，2001)。牛樟芝的生理活性成分包含有三萜類 (triterpenoids)、多醣體 (polysaccharides)、維生素、礦物質等，這些有效成分會因菌株的及培養條件的不同而有變異，目前已篩選優良菌株，建立最適化的標準生產流程，並開發進行複方保健產品及美容保養品等產品，研發之產品在酪胺酸酶的抑制性實驗中，牛樟芝醱酵液能抑制酪胺酸酶活性，此顯示牛樟芝醱酵液具抑制黑色素形成的物質，可抑制黑色素之形成，對於美白有一定之效果，提昇牛樟芝之附加價值 (圖 5)。

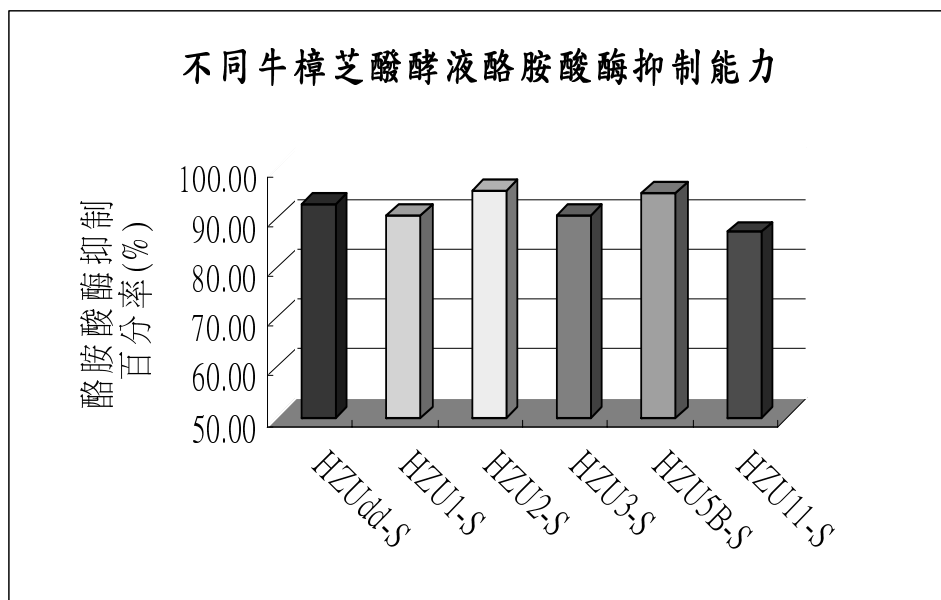


圖 5 牛樟芝不同菌株發酵產物對酪氨酸酶抑制能力之比較

◆機能性保健食品之研發

花蓮區農業改良場為因應農業之轉型，近年來積極針對東部地區具特色之保健作物進行相關產品之研發，使中草藥由生產轉型升級至保健產品之研發。利用東部地區優質、安全的花蓮當歸、丹參、寒梅、金絲桃、白花野牡丹及山苦瓜等保健作物，與生物科技公司進行產學合作計畫開發保健作物多樣化產品，目前已成功開發了當歸複方保健茶包、當歸保健飲品、當歸酒類飲品、當歸藥膳即食餐包、丹參複方保健茶包、丹參保健飲品、丹參藥膳即食餐包、寒梅茶包、寒梅飲品、金絲桃飲品、白花野牡丹保養品及山苦瓜錠等產品，此一系列保健產品經過營養成分分析、重金屬檢測及安全性評估，為具保健價值、安全及優質等特性之產品，不僅可滿足消費者之需求，亦可提升農產品之附加價值，增加農民之收益，帶動東部地區中草藥產業之發展。

伍、東部地區發展中草藥產業之展望

傳統的醫學是以治療疾病為主，但現今由於對身體保健之重視，使得預防醫學的觀念日益受到重視，在古代中藥典籍中對於預防醫學已有記載，例如『黃帝內經』是中國最古老的醫學典籍，在『黃帝內經』中有「不治已病治未病，不治已亂治未亂」的「治未病」理論，著重預防勝於治療的觀念。而目前所注重的中草藥產業亦是強調保健產品之研發，期望從日常生活攝取這些保健產品，提昇身體之免疫力及促進健康，因此可預見市場之商機無限，這也是中草藥產業在未來發展之重要契機。

在中草藥產業方面，台灣民間普遍有食補之觀念，日常飲食與藥膳中常使用中草藥，健康食品、傳統中藥與科學中藥使用普遍，目前每年自中國大陸進口大量中藥材，本地中草藥產業未來發展潛力大。在臺灣目前已有部份地區已進行本地之中草藥栽培生產，目前包括當歸、黃芩、丹參、山藥、綬草、柴胡、土肉桂、仙草等多種中藥材，提供市場所需。而山藥、紅薏仁、桑椹、明日葉、諾麗果、三葉五加、石蓮花、山葡萄、木鱉子等保健或中草藥相關作物，已有經台灣有機協會驗證合格



之農民栽培，屬於有機之保健作物，惟栽培面積還不大。目前東部地區中草藥栽培因考量安全性，已採用接近有機之栽培，使用有機質肥料與不使用農藥，可說是推動有機中草藥之契機。

目前台灣已有完整之有機農業操作與驗證制度，也有本地生產之中草藥產業，如果要發展有機中草藥相當可行，且成功機會高，消費者對有機中草藥接受度與消費能力都高，但行銷通路可能是比較需規畫與考慮之重點。因此推動有機栽培農民與中藥公司、保健產品公司合作，並獎勵中藥廠及生技公司等相關業者，至東部投資設廠，以契作方式結合生產之上下游，可有效解決產銷問題，逐步推動有機中草藥栽培面積，未來將可創造一個高附加價值、優質的有機中草藥產業。

保健植物產業之研發，須由各領域專家組成研發團隊，就種原蒐集、栽培技術體系建立、有效成分分析、臨床試驗、產品行銷等方面協力分工合作，可針對提高人體免疫力及目前西醫較難根治如糖尿病、高血壓等慢性疾病之相關保健產品進行研發。因此，在短期目標為建立中草藥 GAP 栽培模式，進而朝有機栽培之方式生產中草藥，建立品牌與品質管制，使東部成為台灣中草藥生產基地。中期目標為成立東部中草藥研發中心，整合資源，利用東部地區生產之優質安全之中草藥，進行保健產品及健康食品之研發。長期目標則利用中草藥之萃取與分離技術，篩選植物中的有效化合物成分，並進行臨床試驗，開發植物新藥，帶動其他相關產業之發展。因此，建立東部地區成為符合 GAP 之中草藥生產基地，成立東部中草藥研發中心，生產高品質之中草藥藥材及保健產品，促進中草藥產業升級與發展，並配合養生休閒農村之設立，將可活絡地區產業之發展，提升台灣在全球中草藥市場的競爭力。

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東部地區積極推廣當歸等保健作物



花蓮地區種植之當歸品質優良



黃芩適合在花蓮地區種植



黃芩之根部採收情形



花蓮地區大面積栽培丹參情形



花蓮地區生產之丹參品質優良



花蓮區農業改良場研發之各項保健作物產品，可提昇中草藥之附加價值