APPROPRIATE DRYING AND STORAGE CONDITIONS
OF HEMPEDU BUMI (ANDROGRAPHIS PANICULATA NEES)

CHONG GUN HEAN

FK 2002 39
APPROPRIATE DRYING AND STORAGE CONDITIONS OF HEMPEDU BUMI (ANDROGRAPHIS PANICULATA NEES)

BY

CHONG GUN HEAN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Partial Fulfillment of Requirement for Degree of Master of Science

October 2002
Abstract of thesis presented to the Senate of Universiti Putra Malaysia in partial fulfillment of the requirements for the degree of Master of Science

APPROPRIATE DRYING AND STORAGE CONDITIONS OF HEMPEDU BUMI
(ANDROGRAPHIS PANICULATA NEES)

By

CHONG GUN HEAN

October 2002

Chairman : Associate Professor Dr. Mohd Nordin Ibrahim
Faculty : Engineering

In this study, the forced air thin layer dryer was used for determining the appropriate drying condition of *Andrographis paniculata*. The quality of dehydrated *A. paniculata* was evaluated with *andrographolide* as reference compound. High performance liquid chromatography was used for the determination of *andrographolide* contained in *A. paniculata*. A suitable storage condition for preserving *andrographolide* in ground dried *A. paniculata* was also determined over a three-month storage study period.

Three drying temperatures (55, 65 and 75°C) and air velocities (1.0, 1.5 and 2.0m/s) were utilized for the drying experiment with the observed air relative humidity of 66-80%. Drying temperature was found to be an important parameter affecting the drying time and the quality of *A. paniculata*. The *andrographolide* content was reduced by 37.54, 53.59 and 62.72% from the initial amount (17.5 ± 3.4 % wt/dry wt) for the drying temperatures of 55, 65 and 75°C, respectively. However, from the heating cost point of view, 75°C
temperature and 1.0m/s air velocity was the appropriate drying condition for
*A.paniculata*, since the cost per unit *andrographolide* remaining for that drying
temperature was the lowest. On the other hand, a larger amount of *andrographolide* can
be maintained with drying condition of 55°C drying temperature and 1.0m/s air velocity.

*Andrographolide* was satisfactorily maintained at three selected storage conditions
(5±2°C; 25±2°C with 60±5% RH; 30±2°C with 60±5%RH), which *A.paniculata* was
kept in air tight glass bottle; without any significant reduction of this compound after
three months. Therefore, ambient condition (30 ±2°C, 60±5% RH) is acceptable for
storage of *A.paniculata* with respect to *andrographolide* preservation.
Abstraks tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai separa memenuhi keperluan untuk ijazah Master Sains

KEADAAN PENGERINGAN DAN PENYIMPANAN YANG SESUAI BAGI HEMPEDU BUMI (ANDROGRAPHIS PANICULATA NEES)

Oleh

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Tiga suhu (55, 65 dan 75°C) dan kelajuan angin (1.0, 1.5 dan 2.0m/s) dipilih untuk mengeringkan A.paniculata dengan memerhatikan kelembapan udara 66-80%. Didapati suhu merupakan faktor utama yang memberikan kesan kepada masa pengeringan dan mutu A.paniculata. Andrographolide berkurang 37.54, 53.59 and 62.72% dari kuantiti asalnya (17.5 ± 3.4 % wt/dry wt) bagi suhu pengeringan 55, 65 dan 75°C masing-masing. Namun demikian, dari segi aspek kos pemanasan, suhu pengeringan 75°C dan...
merupakan keadaan pengeringan yang sesuai. Tetapi dari segi pengekalan kuantiti andrographolide yang tinggi, suhu 55°C dan 1.0m/s kelajuan angin merupakan keadaan pengeringan ideal.

Dalam penyimpanan selama tiga bulan, andrographolide didapati tidak mempunyai pengurangan yang jelas dalam keadaan penyimpanan yang dipilih (5±2°C; 25±2°C dengan 60±5% RH; 30±2°C dengan 60±5% RH), di mana A.paniculata disimpan dalam botol kaca bertutup. Dengan itu, keadaan ambien (30 ±2°C, 60±5% RH) boleh digunakan bagi mengekalkan kandungan andrographolide dalam A.paniculata.
ACKNOWLEDGMENTS

I wish to express my sincere thanks to Associate Professor Dr. Mohd Nordin Ibrahim, for his supervision, encouragement, untiring patience and endless support through the course of the study. Also, to Dr. Wan Mohamad Wan Abdullah and Dr. Djumali Mangunwidjaja, for their advice, guidance and their support as members of the supervisory committee.

Special appreciation is extended to Dr. Johnson Stanslas, Mr. Srinivasa Rao Jada, Madam Siti Muskinah and Mr. Redzuan, from the Faculty of Medicine and Health Sciences, for their help in chemical analysis and their dedication to this research from the beginning to the end. I would like to thank Associate Professor Dr. Azni Idris and Dr. Katty, Department of Chemical and Environmental Engineering, for allowing me to use the equipment in their laboratory.

I also owe a debt of gratitude to Mr. Meor Nazri Meor Razlan, Mr. Annuar Ariffin, Mr. Kamarulzaman Dahlin, Mr. Nasharuddin Mohammad, Mr. Mansor Othman, Mr. Firdaus Kardi and Mr. Zakaria Suboh, for their laboratory assistance and helpful advice throughout my study. Their friendships have made this experience even more rewarding. I also would like to acknowledge Mr. Tajuddin and other staff members of Institute of Bioscience for their guidance and assistance.
Finally, I wish to thank my family members, friends and course mates for their encouragement and moral support. I would like to thank my parent for giving me the appreciation of the value of education and financial support. Also to my special person in my life, Chin Chin, for her encouragement and endurance with me throughout the course of my study. Many thanks to Chai Hong, Chai Ha and Chai Tuan, my sisters, for their great support and valuable suggestions throughout my graduate study.
I certify that an Examination Committee met on 18th October 2002 to conduct the final examination of Chong Gun Hean on his Master of Science thesis entitled “Appropriate Drying and Storage Conditions of Hempedi Bumi (Andrographis paniculata Nees)” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1980. The Committee recommends that the candidate be awarded the relevant degree. Members of Examination Committee for the candidate are as follows:

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I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any degree at UPM or other institutions.

(Chong Gun Hean)

Date: 13.11.2002
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LIST OF ABBREVIATIONS

AG: Andrographolide
AOAC: Association of Official Analytical Chemists
ASAE: America Society of Agricultural Engineers
HPLC: High performance liquid chromatography
TNB: Tenaga National Berhad
RH: relative humidity of air at ambient temperature
Imc: initial moisture content of *A. paniculata* (determined by oven method)
Fmc: final moisture content of *A. paniculata* (determined by oven method)
Mc: moisture content
wb: wet basis
cond.: drying condition
FAP: fresh *A. paniculata*
DAP: dried *A. paniculata*
SS: name of sub sample
WSS: weight of sub sample, g
DS: dry solid in sub sample, g
ce: crude extract, mg
rep: repetition of injection
Auc: area under curve
ConI average: concentration AG in injection, µg/ml
average: average concentration AG in injection, µg/ml
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CHAPTER 1
INTRODUCTION

1.1 Background

Nowadays, herbs are very popular in the field of medicine, health food and beverage. Herbs also are considered as alternative crops or “Crops For The Future” in Malaysia, recently, which have commercial potential but have not been fully exploited and cultivated on a large scale.

Actually, herbs have been used in a broad range of products such as pharmaceutical, health food and beverage, herbal traditional, health enhancing products, dietary supplements, flavors and fragrances, cosmetics and toiletries, detergents and other industrial chemicals.

In Malaysia, we have more than 20,000 plant species, which are considered as one of the richest biomes on earth. To date about 2,000 plant species have been reported to have medicinal values and this broad diversity represents a storehouse of valuable chemicals that can be used for healthcare. These can be regarded as a “goldmine” for the upcoming herbal industry (Ahmad and Jaganath, 1999).

From the statistical record, import figure of herbs for herbal medicine and flavors and fragrances had risen from RM141 million in 1986 to RM431 million in 1996. While in the health enhancing market, it increases 15% in one year, which is
evaluated from RM28 million in 1994 to RM45 million in 1995. These are very huge figures (Ahmad and Jaganath, 1999).

On average, herbs contain about 70-85% of water, so drying treatment must be done for storing and preserving the quality of it. Generally, herb is dried under the sun or in shaded place, but the drying condition is not controllable and time consuming. Due to that, the quality of herb will be reduced. No matter how perfect the herbs have been dried, the herbs will degrade unless they are kept properly. Therefore, knowledge of storage is very important for preserving the herbs.

Based on the situations mentioned above, the objectives of my research are to determine the appropriate drying condition and the suitable storage condition of a selected herb, that is Hempedu Bumi (Andrographis paniculata). With such information, the shelf life of the herb can be prolonged and also the quality of the herb can be maintained.

_A. paniculata_ is widely used in traditional medicine in India, Southeast Asia and China. It was used in combating the common cold, respiratory inflammations and etc. The therapeutic activity of this herb has been attributed to _andrographolide_ and its related diterpenoid compound (Cheung _et al_, 2001).
1.2 Objective

**General objective:** To determine the appropriate drying and suitable storage conditions to maintain the stability of bioactive ingredient *andrographolide* in *A. paniculata*.

**Specific objectives:**

i. To determine the appropriate drying condition.

ii. To determine the suitable storage condition.
CHAPTER 2
LITERATURE REVIEW

2.1 Description of *A. paniculata*

This herb belongs to the family Acanthaceae (Ridley, 1923). It also known as king of bitter. It is found at China, Malaysia, India, Indonesia and Sri Lanka. Normally *A. paniculata* grows in the coastal and plain area. This herb has several names, depending where it is found. In the North of Peninsular Malaysia it is known as *pokok cerita* while at the South is known as *Hempedu Bumi*. In Jawa Island, it is called *samilata*, and *nilavembu or shiratkuchi* is the local name in India (Norhaida, 1994).

This herb can grow to a height of 0.3-0.9 meter with a taproot (Kirtikar et al, 1975). Branching is profuse, leaves are green, lanceolate, 3-7 x 1-2.3 cm glabrous with slightly undulate margin; its apex is acuminate with a tapering base. Flowers are small and solitary; corolla is whitish or light pink in color, hairy. It has a very bitter taste (Backer and Bakhuizen, 1965).

The most active component is *andrographolide*. It is a colorless, bitter crystalline compound. Other compounds such as *neoandrographolide*, *flavonoid*, *andrographanin*, *andropanoside* and *paniculide* are also found. *Andrographolide*, *neoandrographolide*, *andropanoside* and *andrographanin* can been extracted by using methanol (Norhaida, 1994), while *flavonoid* can be extracted by using ether petroleum (Gupta et al, 1982).
2.2 Uses of *A. paniculata*

*A. paniculata* is a herb commonly used in China by herb doctors in the treatment of a large variety of illnesses, which include acute hepatitis, bacillary dysentery, meningitis, and many other acute inflammatory conditions (Chang *et al.*, 1991). Below are the some uses of *A. paniculata* scientifically and traditionally:

i. **Cancer**

*A. paniculata* is a potent stimulator of immune response through two mechanisms:

a) Antigen-specific response, that is, where antibodies are made to counteract an invading microorganism, and

b) Nonspecific immune responses, where the body's macrophage cells scavenge and destroy intruders. These mechanisms make *A. paniculata* effective against a variety of infectious and cancer-causing agents (Anon., 1995(c)).

It was found to inhibit human breast, liver and prostate cancer cells (Anon., 1995(c); Basak *et al.*, 1999; Campbell, 1999)

ii. **HIV**

The activities of andrographolide in combination with the well-known anti-HIV drug *Azidothymidine*(AZT) have confirmed a significant level of synergy
between the two compounds. With the addition of andrographolide, the study showed, AZT levels could be cut in half while still remaining the same anti-HIV effect (Campbell, 1999).

As reported by Chang et al (1991), a succinyl derivative of andrographolide, dehydroandrographolide succinic acid monoester (DASM), is inhibitor to the growth of human immunodeficiency virus (HIV) at concentration nontoxic to the human cells.

iii. Liver protection

Anon. (2001(e)) reported that *A. paniculata* is equal to and in some cases superior to *Silymarin* in its ability to protect the liver from various chemicals. As a choleretic (something that increases bile) it was found to be more potent than Silymarin. Puri et al (1993) and Basak et al (1999) also reported that the *A. paniculata* is very good in liver disorders and acute hepatitis respectively.

iv. Restenosis

Stenosis means a narrowing and in this context a narrowing of an artery as occurs in angina pectoris. One of the treatments used in this condition is angioplasty in which a balloon is inserted into the artery. It is then inflated which opens the stenosis. Unfortunately, in around half the cases the stenosis occurs again (Restenosis) within several months of the operation. *A. paniculata* is apparently the only substance known to prevent this according to research done in China. It
does so by inhibiting platelet aggregation and smooth muscle proliferation. A study comparing *A. paniculata* with fish oil in this condition showed that after 4 weeks, 57% of the controls had severe Restenosis as did the fish oil group. The *A. paniculata* treated subjects have only a minor incidence in a small subset of subjects (Anon., 2001(e)).

v. Colds and flu

Nordic countries have been using this substance as their primary treatment for colds for the last decade or more. It reduces inflammation and fever. A study in Chile showed that tiredness was reduced by 30%, shivering by 50%, muscular aches by 48% and sinus pain and headache by 30% compared to the placebo. It also great response in earache, sleeplessness, nasal drainage and sore throat (Anon., 2001(e)).

vi. Traditional uses

In traditional medicine, *A. paniculata* can been used to relief:

a) Bite of cobra (Perry, 1980; Md Salleh, 1991; Selvanayagam *et al*, 1994).

b) Diabetes (Md Salleh, 1991; Norhaida, 1994; Zaridah *et al*, 2001)

c) Dysentery (Basak *et al*, 1999)

d) Diarrhea (Huang, 1993)

e) Dyspepsia (Basak *et al*, 1999)

f) High blood pressure (Zaridah *et al*, 2001).