UNIVERSITI PUTRA MALAYSIA

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

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BY

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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 a*ndrographolide* 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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Dalam kajian ini, pengering lapisan nipis digunakan untuk menentukan keadaan pengeringan yang sesuai bagi mengeringkan *Andrographis paniculata. Andrographolide* digunakan sebagai rujukan untuk menentukan mutu *A.paniculata* selepas pengeringan. Manakala *andrographolide* dalam sampel ditentukan dengan menggunakan high performance liquid chromatography. *A.paniculata* yang sudah dikering dan dikisar, digunakan untuk menentukan keadaan penyimpanan yang sesuai.

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* berkurangan 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, a*ndrographolide* 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 a*ndrographolide* dalam *A.paniculata.*

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LIST OF ABBREVIATIOS

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	concentration AG in injection, µg/ml
average	average concentration AG in injection, µg/ml

%AGI	percentage AG in injection
AGCE	AG in crude extract, mg
AGS	AG in sub sample %, wt/dry wt
Mean	mean of AG in sample %, wt/dry wt
Dup	duplication

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 prostrate 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).