

CONSTITUENTS OF WHITE AND BLACK PEPPER OILS: A POTENTIAL IN OLFACTORY STIMULATION

Tsutomu Ishikawa¹ Takeshi Ohmori² Isamu Murakoshi^{1,3} Chanida Palanuvej⁴ Nijsiri Ruangrungsi^{4,5,*}

¹Graduate School of Pharmaceutical Sciences, Chiba University, Japan ²National Research Institute of Police Science, Kashiwa, Chiba, Japan ³IM-Research Laboratory, Chiba, Japan ⁴College of Public Health Sciences, Chulalongkorn University, Bangkok ⁵ Faculty of Pharmaceutical Sciences, Chulalongkorn University, Bangkok

ABSTRACT: Commercial white and black peppers were studied for their essential oil constituents by hydrodistillation and gas chromatographic-mass spectrometric analysis. It was found that white pepper oil (ca. 1.3 %, dried wt.) and black pepper oil (ca. 1.6 %, dried wt.) composed of the same volatile constituents but in the different quantities. Monoterpenes especially 3-carene were detected as rich components in white pepper, whereas sesquiterpenes especially β -caryophyllene were much rich components in black peppers. It has been reported that there are significantly improved sensory and reflexive motor movement of swallowing in the elderly by black pepper oil.

Keywords: *Piper nigrum*, white pepper, black pepper, essential oil, dysphagia, aspiration pneumonia

INTRODUCTION: Pepper, one of the oldest and the most widely used spices in the world, is produced from the berries of the plant *Piper nigrum* Linn. in the family Piperaceae¹. Dried peppers are usually white or black in commerce. The white pepper is produced from fully ripe fruits, free of the pericarp by soaking, rubbing for removing the outer soft rind then drying. The black pepper is produced from the unripe but fully developed fruits. The fruits are dried in the sun or by machine for several days until it turns black². Both white and black peppers have the characteristics of pepper aroma and flavor due to their chemical substances especially the volatile oil. Pepper oil has been used in the food industries as improving and/ or enhancing flavor quality of various products. A previous randomized, controlled study using black pepper oil in older people with swallowing dysfunction was found that nasal inhalation of black pepper oil significantly improved the sensory and reflexive motor movement of swallowing in the elderly^{3,4}. For the application of pepper oils utilization as well as the quality control and standardization, this study aimed to compare the chemical constituents

between the essential oils from white and black peppers available in the food market.

MATERIALS AND METHODS: The white and black peppers were purchased from local market in Bangkok during January 2007. Authentication was achieved by one of us (N.R.). Voucher specimens were deposited at College of Public Health Sciences, Chulalongkorn University.

Essential oils obtained by water-vapor distillation of each pepper were subjected to GC-MS analysis [6890 GC / 5973 MS system (Hewlett Packard)] by injection of a sample solution (1 μ l) prepared by dilution of sample oil (1 ml) with acetone (1 ml)

(A) Conditions of GC

column: DB-5MS (30 m x 0.25 mm) (J&W)
column temperature: 40 °C (1 min) to 300 °C
(5 °C / min)
Injection temperature: 250 °C
Transfer line temperature: 250 °C
carrier gas: He (1 ml / min)
split ratio: 20 : 1

*To whom correspondence should be addressed.
E-mail: nijsiri.r@chula.ac.th, Tel. 0 2218 8201

(B) Conditions of MS

Temperature of ion source: 230 °C

Ionization method: *electron impact*

Ionization current: 34.6 mA

Ionization volt: 70 eV

Spectrum range: *m/z* 40-600

RESULTS AND DISCUSSION: The yields (v/w) of essential oils were 1.3 and 1.6 % for white and black peppers respectively. The data were shown in Table 1. Total fourteen components (nine monoterpenes and six sesquiterpenes) were identified, among which six monoterpenes **2**, **4**, **5**, **6**, **8** and **9**, and two sesquiterpenes **11** and **14** were observed as common components in the both samples. Three monoterpenes, α -Thujene (**1**), Sabinene (**3**), and 3-carene (**7**) were detected as rich components in white pepper, whereas three sesquiterpenes, β -caryophyllene (**10**), β -Selinene (**12**), and α -Selinene (**13**) in black pepper. Especially, 3-carene (**7**) and caryophyllene (**10**) were much rich components in white and black peppers, respectively. The other study from M. Plessi and colleagues using a head space – solid phase micro extraction - GCMS showed the much higher 3-carene and slightly higher β -caryophyllene in white than in black *Cannamela*[®] peppers⁵. G.A. Agbor and colleagues measured the concentration of polyphenols in black and white peppers from a local market in Cameroon and found that the extracts of black pepper contained significantly more polyphenols compared with those of white pepper⁶. The physiological activities of black pepper oil were recently reported. Inhalation of black pepper oil can activate the insular or orbitofrontal cortex, resulting in improvement of the reflexive swallowing movement and benefit older poststroke patients with dysphagia regardless of their level of consciousness or physical and mental status³. In addition, olfactory stimulation with black pepper oil facilitated oral intake in a subset of pediatric patients on long-term enteral nutrition⁷. From this analytical study of the pepper oils, we postulate that white pepper oil may also be potential in olfactory stimulation and useful for dysphagia patients.

Table 1 Comparison of components of black and white peppers*

	Compounds	Kovat's Index	Peppers	
			White	Black
1	α -Thujene	931	+++	+
2	α -Pinene	939	++	++
3	Sabinene	976	+++	+
4	β -Pinene	980	++	++
5	β -Myrcene	991	++	++
6	α -Phellandrene	1005	++	++
7	3-Carene	1011	++++	+
8	o-Cymene	1022	++	++
9	D-Limonene	1031	++	++
10	β -Caryophyllene	1418	+	++++
11	α -Caryophyllene	1454	++	++
12	β -Selinene	1485	+	+++
13	α -Selinene	1494	+	+++
14	β -Bisabolene	1509	++	++

*+: poor component; ++: common component;

+++: rich component; ++++: much rich component

ACKNOWLEDGEMENTS: We are very much grateful to Prof. Dr. T. Sakai and K. Nohara, Graduate School of Dentistry, Osaka University, Japan for their cordiary advice and suggestion on these works.

REFERENCES:

1. Prabhakaran Nair, KP. 2004. The agronomy and economy of black pepper (*Piper nigrum* L.) - The "King of Spices". *Advances in Agronomy* 82: 271-389.
2. Krishnamurthi A. 1969. *The Wealth of India: A Dictionary of Indian Raw Materials and Industrial Products*. Raw Materials Vol. III: Ph-Re. Publications & Information Directorate, CSIR, New Delhi, pp. 107-8.
3. Ebihara T, Ebihara S, Maruyama M, Kobayashi M, Itou A, Arai H, *et al.* 2006. A randomized trial of olfactory stimulation using black pepper oil in older people with swallowing dysfunction. *J Am Geriatr Soc* 54(9):1401-6.
4. Private Communication from Prof. T. Sakai and K. Nohara, Osaka University (Graduate School of Dentistry).
5. Plessi M, Bertelli D, Miglietta F. 2002. Effect of microwaves on volatile compounds in white and black pepper. *Lebensmittel-Wissenschaft und-Technologie* 35(3): 260-4.

6. Agbor GA, Vinson JA, Oben JE, Ngogang JY. 2006. Comparative analysis of the *in vitro* antioxidant activity of white and black pepper. *Nutrition Research* 26: 659-63.

7. Munakata M, Kobayashi K, Niisato-Nezu J, Tanaka S, Kakisaka Y, Ebihara T, *et al.* 2008. Olfactory stimulation using black pepper oil facilitates oral feeding in pediatric patients receiving long-term enteral nutrition. *Tohoku J Exp Med* 214: 327-332.

องค์ประกอบทางเคมีของน้ำมันระเหยจากพริกไทยอ่อนและพริกไทยดำที่มีศักยภาพในการกระตุ้นด้วยกลิ่น

ซีโทมู อธิกา¹ ทาเคชิ โอโมริ² อิชามู มูราโกชิ^{1,3} ซนิตา พลาหุเวช⁴ นิจศิริ เรืองรังษี^{4,5,*}

¹คณะเภสัชศาสตร์ มหาวิทยาลัยชิบะ ²สถาบันวิจัยนิติวิทยาศาสตร์ ชิบะ ³ห้องปฏิบัติการวิจัยไอเอ็ม ชิบะ ประเทศญี่ปุ่น

⁴วิทยาลัยวิทยาศาสตร์สาธารณสุข ภาควิชาเภสัชเวท คณะเภสัชศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

บทคัดย่อ: สกัดน้ำมันระเหยจากเมล็ดพริกไทยอ่อนและผลพริกไทยดำโดยการกลั่นด้วยน้ำ ได้ผลผลิตประมาณ ร้อยละ 1.3 และ 1.6 โดยน้ำหนักแห้ง ตามลำดับ วิเคราะห์องค์ประกอบทางเคมีโดยวิธีแกสโครมาโทกราฟี – แมสสเปกโตรเมตรี พบว่าน้ำมันระเหยจากพริกไทยทั้งสองมีองค์ประกอบทางเคมีชนิดเดียวกัน แต่สัดส่วนแตกต่างกัน พริกไทยอ่อนมีกลุ่มโมโนเทอร์ปีนในสัดส่วนสูงกว่า โดยเฉพาะ 3-carene พบมากที่สุด ขณะที่พริกไทยดำมีสารกลุ่มเซสควิเทอร์ปีนในสัดส่วนสูงกว่า โดยพบ β -caryophyllene มากที่สุด มีรายงานวิจัยระบุว่าน้ำมันระเหยจากพริกไทยดำสามารถเพิ่มความรู้สึกอยากอาหารและช่วยให้ผู้สูงอายุกลืนอาหารได้ดีขึ้น

คำสำคัญ: พริกไทยอ่อน พริกไทยดำ น้ำมันระเหย การกลั่นลำบาก ปอดบวมจากการสำลักอาหารและน้ำเข้าปอด

*ติดต่อได้ที่ nijisiri.r@chula.ac.th โทรศัพท์ 0 2218 8201 โทรสาร 0 2255 2177