Comparison of essential oil composition between *Angelica gigas* and *Angelica acutiloba*

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ABSTRACT

Two kinds of Angelica belong to *Umbelliferae* collected, the one is *Angelica gigas* that is inhabitant in Korea and the other is *Angelica acutiloba* that is indigenous in Japan at the field of Snyder Research and Extension Farm Rutgers University, New Jersey and was analyszed by GC and GC/MS. The composition of the essential oil of the different aerial parts of the Angelica has been studied. The oil yields obtained upon hydrodistillation were 0.18% (v/w) in Korean Angelica and 0.44% (v/w) in Japanese Angelica on dry root weight basis. By the growing stage in the Rutgers greenhouse condition, leaf and root of essential oil content a little decreased on 9 months later than 4 months later except for *Angelica gigas* leaf. Both of Angelica showed that amounts of essential oil content presented in order of leaf > petiole > root according to different plant part. The analysis of the essential oil from Angelica root led to the identification of 14 constituents totaling 64% in Korean Angelica and 13 constituents totaling 68% in Japanese Angelica. The major constituents of the Angelica root essential oil were ligustilide (47%) and gamma terpi (14%) in Korean Angelica, and alpha pinei (32%) and nonane (25%) in Japanese Angelica

Key Word **:** *Angelica gigas, A. acutiloba, Umbelliferae*, Essential oil

INTRODUCTION

Angelica is one of most important medicinal plants very frequently and widely used for crude drug from Korea, China, and Japan including Viet Nam. There are three kinds of different Angelica species. One is *Angelica sinensis* that originated from China, and the other is *Angelica gigas* that is inhabitant in Korea and finally *Angelica acutiloba* that is indigenous in Japan. It is belong to *Umbelliferae*, phenotype is totally different as well as unlike species among these three. It was called in 'Danggui' in Korea, 'Dokai' in Japan, and 'Dong Quai' in China. *A. gigas* known as it's root containing main compound decursin, decursinol, nodakenin, α-pinene, β-eudesmol etc. and uses for suppression, alleviation of pain, urination, antibiotic, diarrhea, and articular rheumatism etc. for traditional preparation in Korea. While, *A. acutiloba* roots

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including bergaptem, hydrothalia,valerophenome etc. and it applied for anemia, convalescence after childbirth etc. from oriental medication.

Especially, *Angelica acutiloba* and *A. sinensis* are used for blood- forming medicine because they contains vitamin B12. However *A. gigas* is used to medicine for fever and pain reliever because it comprises high volatile compounds, and used to prescription for anticancer because it includes β-cisterol.

Recent reported some research results on Angelica spp. that essential oils extracted from *Angelica archangelica* inhibited the bactria growth, but had no effect on any fungi(Chao *et al.*, 2000). Polysaccharides from *Angelica sinensis* had the gastrointestinal protective effects(Cho *et al.*, 2000). From the roots of *Angelica acutiloba* found anti genic epitope for polyclonal antibody.(Wang *et al.*, 1999). Essential oils were obtained from the root of three *Angelica* species growing in France(Bernard and Clair, 1997).

Young leaves are edible for salads or 'Namul' (slightly boiled leaves mixed with various kinds of spices) and fresh roots were frequently used to manufacture for traditional alcoholic whisky.

This work deals with the composition of essential oils obtained by hydrodistillation from the different parts of *Angelica gigas* and *A. acutiloba* growing at Rutgers University greenhouse. We investigated the qualitative and quantitative changes in oil composition at different developmental stage of plant growth of two Angelica.

MATERIALS AND METHODS

Materials

In this initial study we evaluated two kinds of Angelica (Table1). Seeds of Korean(*Angelica gigas* NAKAI) and Japanese(*Angelica acutiloba*) Angelica were obtained from National Crop Experiment Station in Korea. Seeds were first planted in the Rutgers greenhouse and later investigated amounts and composition of essential oil 4 and 9 months later.

Methods

All of trials were conducted from July of 2001 to March of 2002 under controlled greenhouse conditions with supplemental light by 16 hrs using the Cook College/Dept. of Biology greenhouses. All of seeds were sowed on July 19, 2001 to the nursery. Plants were transplanted one and half month after germination to 12 cm pot with peatmoss and perlite media. Plants were collected 4 months later, harvested 9 months later, investigated plant growth, and analyzed essential oils. The dry plant material was hydrodistilled for 3 hours using a Clevenger type apparatus. The oil obtained was dried over anhydrous sodium sulfate in a yield of 1.0 to 2.6 %(v/w) on dry weight basis according to plant parts. The oils were analyzed by gas chromatography coupled to a mass and FID detectors. (Agilent GC System 6890 Series, Mass Selective Detector, Agilent 5973 Network, FID detector). Samples were injected with an auto sampler (Agilent 7683 Series). The inlet temperature was 180℃, HP5- MS (30m, 0.25 ID, 0.25μm) column, programmed temperature, 60℃ 1min, 4℃ 1min, 200℃ 15min. The helium flow rate was 1ml/min. Individual compound identifications were made by matching spectra with those from mass spectral library (Wiley 275.L), the identity of each compound was confirmed by its' Kovats index (Jennings and Shibamoto, 1980).

Table 1. List of Korean medicinals screened in the current study

Common name	Scientific name	Variety	Korean name
Korean Angelica	*Angelica gigas* NAKAI	Korean local	Danggui
Japanese Angelica	*Angelica acutiloba* KITAKAWA	Korean local	Ildanggui

RESULTS AND DISCUSSION

A. gigas had a dark green stem color while *A. actiloba* red violet. And both of them had a special aroma from plants. But *A. gigas* had strong scent only come out from the roots in the other hand, *A. actiloba* had a rich aroma from all of the plant parts(Fig. 1). Plant growth character illustrated very different between two species that plant height, shoot and root weight under the greenhouse condition. *A. gigas* showed large standard deviation on shoot and root weight compare to *A. actiloba* (Fig. 2).

Both of Angelica showed that amounts of essential oil content presented in order of leaf > petiole > root according to different plant part. By the growing stage, leaf and root of essential oil content a little decreased on 9 months later than 4 months later except for *Angelica gigas* leaf(Table 2). Generally, *Angelica gigas* and ligustilide leaves were used to vegetable as a salad when it grow around 4 months. There are two types for Angelica cultivation methods, one is conventionally seeding to field nursery on fall and transplanting next

Fig. 1. Comparison of plant growth between Korean Angelica(Left) and Japanese Angelica(Right) grown in the Rutgers greenhouse 9 months after planting.

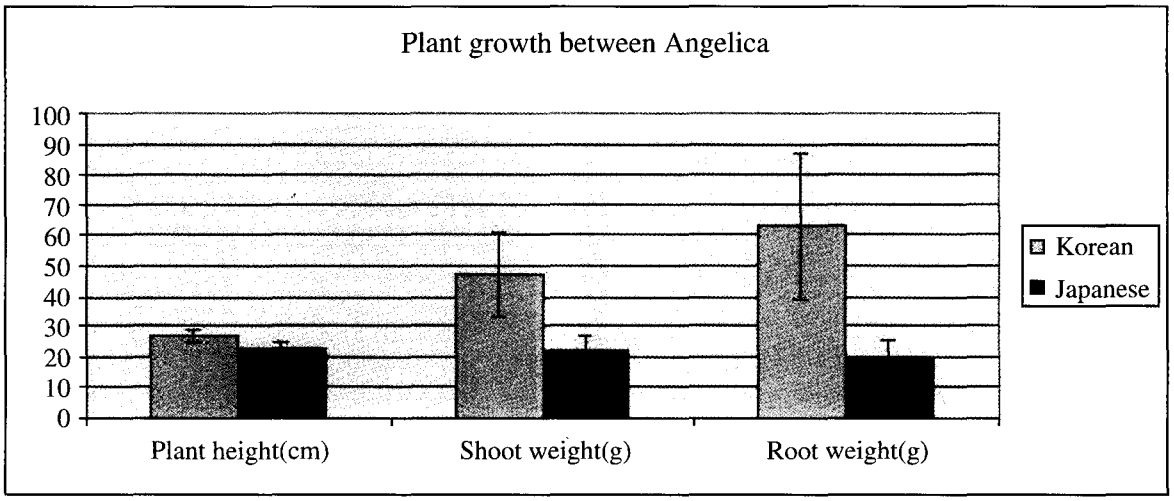

Fig. 2. A comparison of plant height and plant weight of two *Angelica* species grown at the Rutgers greenhouse during the 9 months from July 2001 to March 2002.

Table 2. Comparison of essential oil contents according to growing time and different plant part between *Angelica gigas* and *A. acutiloba*

Plant parts	*A. gigas*		*A. acutiloba*	
Growing time	4 months	9 months	4 months	9 months
Leaf	0.42 ml	0.54 ml	0.81 ml	0.62 ml
Petiole	-	0.31 ml	-	0.45 ml
Root	0.36 ml	0.18 ml	0.59 ml	0.44 ml

Table 3. Comparisons of essential oil compositions according to different plant parts of Angelica

Components	RT	*Angelica gigas*			*Angelica acutiloba*		
		Leaves	Petiole	Roots	Leaves	Petiole	Roots
nonane	5.627	10.75	8.85	-	-	-	24.85
alpha pinei	6.539	33.07	40.59	-	-	-	31.59
camphene	6.922	1.99	3.73	-	-	-	3.70
myrcene	7.997	5.48	6.38	-	-	-	4.81
para cyme	9.029	-	-	4.26	-	-	-
beta phella	9.162	5.75	7.52	-	-	-	-
gamma terpi	10.080	1.53	3.44	14.08	-	-	1.26
(e) caryop	21.867	2.94	-	-	-	-	0.38
germacrer	23.746	10.05	0.46	-	-	-	0.38
alpha farn	24.453	6.87	0.30	-	-	-	0.80
caryophyll	26.747	-	-	0.55	3.31	-	-
unknown	27.377	-	-	-	8.09	24.81	-
butylidne p	29.193	-	-	3.26	7.29	10.76	-
ligustilide	30.984	-	-	46.63	11.61	-	-
unknown	33.434	-	-	10.91	57.21	28.46	-

spring to cultivating field, and the other is recently developed direct seeding to field on spring and harvest fall at same calender year. Later method prefered by most of Korean farmers because it needs to less labor and efforts for cultivation even though a little root yield comparatively. Four months collected one stands for vegetable leaf uses, and 9 months harvested one stands for one year grown plants.

The main components of leaf and petiole of *A. gagas* determined alpha pinei as 30.07 and 40.59 %, while the root contained ligustilide 46.63% mainly. By the comparisons of *A. actiloba*, showed quite different as not detected monoterpene components from leaf and petiole. And the major component of *A. actiloba* root determined to alpha pinei as 31.59%(Table 3).

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REFERENCES

1. Bernard C., G. Clair. Essential oils of three Angelica species growing in France. 1. Root oils. 1997. Journal of Essential Oil Research 9(3):289-294.
2. Chao, S.C., D.G. Young, C.J. Oberg. 2000. Screening for inhibitory activity of essential oils on selected bacteria, fungi and viruses. Journal of Essential Oil Research 12(5):639-649.
3. Cho, C.H., Q.B. Mei, P. Shang, S.S. Lee, H.L. So, X. Guo, Y. Li. 2000. Study of the gastrointestinal protective effects of polysaccharides from *Angelica sinensis* in rats. Planta Medica 66(40): 348-351.
4. Lee C.B. 1982. Enclypidea of Korean plants. Hangmunsa.
5. Lee S.T. 1994. Korean medicinal plants cultivation. Rural Development Administration, Korea
6. Mun G.S. 1984. Useful compounds and traditional directions of Korean medicinals. Scientific Dictionary.
7. Wang N.L., H. Kiyohara, M.H. Sakurai, H. Yamada. 1999. Antigenic epitope for polyclonal antibody against a complement activating pectin from the roots of *Angelica acutiloba* Kitakawa. Carbohydrate Polymers. 39(30):257-264.

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