

Inter and Intra Specific Variations between Nine Types of *Mentha* Grown in Bangladesh

Jasim Uddin Chowdhury and Nemai Chandra Nandi
BCSIR Laboratories, P. O. Chittagong Cantonment, Chittagong 4220.

Abstract

Nine types of *Mentha* belonging to the six species were studied for their growth, yield, oil content and composition of the oils. The highest plant height (34.6 cm.), herbage yield (1.0 Kg/m²) were obtained in *M. citrata* and oil content (1.3%) was obtained in *M. arvensis* (Sivalika). The varieties *M. arvensis* (Sivalika), *M. arvensis* (CIMAP) and local of *M. arvensis* contain menthol and isomenthone (77.0% and 11.0%), menthol and menthone (72.2% and 12.1%) and carvone and limonene (59.6% and 31.1%) respectively as major constituents. *M. piperita* contain menthyl acetate (29.8%), menthol (22.6%), menthofuranone (16.4%) and isomenthone (8.4%) as major constituents. Major constituents of *M. citrata* were linalool (41.8%) and linalyl acetate (31.3%). Local varieties of *M. spicata* contain carvone (55.0%), dihydrocarveol (17.9%), dihydrocarveol acetate (7.7%) and limonene (6.9%) and the exotic type contain carvone (73.3%) and D-limonene (7.6%) as major constituents. *M. cardiaca* contain as major constituents carvone (61.0%) and limonene (21.6%). *M. aquatica* contains a complex mixture of ledol (13.5%), menthofuranone (9.4%), neryl acetate (7.6%), caryophyllene (6.8%), caryophyllene oxide (5.8%) and mint furanone (5.0%) as major constituents.

সারসংক্ষেপ

নয় প্রকার পুদিনার (*Mentha*) উপর তাদের উৎপাদন, তৈলের পরিমাণ ও তৈলের রাসায়নিক উপাদান নির্ণয় করা হয়েছে। সর্বাধিক উচ্চতা (৩৪.৬ সে.মি.), গাছের ফলন (১.০ কেজি/ব.মি.) পাওয়া গেছে *M. citrata*-জাতে। সর্বাধিক তৈলের পরিমাণ (১.৩%) পাওয়া গেছে *M. arvensis* (Sivalika) জাতে। তৈলের রাসায়নিক উপাদান বিশ্লেষণে *Mentha arvensis*, *M. arvensis* (Sivalika), *M. arvensis* (CIMAP) ও স্থানীয় জাতের তৈলে যথাক্রমে menthol ও isomenthone (৭৭.০% ও ১১.০%), menthol ও menthone (৭২.২% ও ১২.১%) এবং carvone এবং limonene (৫৯.৬% ও ৩১.১%) প্রধান উপাদান হিসাবে আছে। *M. piperita*-র তৈলে প্রধান উপাদান হিসাবে পাওয়া গেছে menthyl acetate (২৯.৮%), menthol (২২.৬%), menthofuranone (১৬.৪%) ও isomenthone (৮.৪%)। *M. spicata*-র প্রধান উপাদান হল linalool (৪১.৮%) ও linalyl acetate (৩১.৩%)। *M. citrata* -র স্থানীয় জাতে প্রধান উপাদান হিসাবে পাওয়া গেছে carvone (৫৫.০%), dihydrocarveol (১৭.৯%), dihydrocarveol acetate (৭.৭%) ও limonene (৬.৯%) এবং বিদেশী জাতে পাওয়া গেছে carvone (৭৩.৩%) ও D-limonene (৭.৬%)। *M. cardiaca*-তে পাওয়া গেছে carvone (৬১.০%) ও limonene (২১.৬%)। *M. aquatica*-র তৈলে একক কোন উপাদানের প্রাধান্য নেই, প্রধান উপাদান হিসাবে ledol (১৩.৫%), menthofuranone (৯.৪%), neryl acetate (৭.৬%), caryophyllene (৬.৮%), caryophyllene oxide (৫.৮%) and mint furanone (৫.০%)।

Key words: *Mentha arvensis*, *M. spicata*, *M. citrata*, *M. piperita*, *M. cardiaca*, *M. aquatica*, essential oil, menthol, carvone, menthyl acetate, linalyl acetate, limonene.

Introduction

Mentha (family- Labiatae) is an important genus yields the important oils like Japanese mint (*M. arvensis*), Bergamot mint (*M. citrata*), Spearmint (*M. spicata* and *M. cardiaca*), Peppermint (*M. piperita*) etc. They yield the important constituents like menthol, piperitone, linalool etc of commercial importance. Among them *Mentha arvensis* L. commonly known as Japanese mint is the most important essential oil bearing crop and a potential source of natural menthol of commerce (Atal and Kapur 1982). *M. arvensis* is cultivated on large scales in Argentina, Australia, Brazil, South Africa, Angola, China, India and Japan (Mehra 1982, Singh 1982). Aerial parts of the plants are refrigerant, stomachic, carminative, stimulant and diuretic (Ghani 1998, Chopra *et al.* 1950). The oil is a valuable antineuralgic (Ghani 1998). The major constituents of Japanese mint oil are menthol, menthone, isomenthone and menthyl acetate (Mehra 1982, Guenther 1949, Kulreja *et al.* 1991) Menthol is used as a flavouring agent in toothpaste, candies, chewing gums, mouthwashes etc. Besides, it is used as an ingredient in a number of medicinal preparations, such as ointments, pain balms, cough syrups, cough lozenges and tablets and in a large number of other preparations like cosmetics (Reynolds 1982).

Mentha piperita L. popularly known as peppermint is a native of Mediterranean countries, naturalized in United States. It is cultivated in the temperate regions of Europe, Asia, North America and Australia. Peppermint oil is one of the most popular and widely used essential oils, employed for flavouring pharmaceuticals, dental preparations, mouth washes, cough drops, soaps, chewing gums, candies, confectionary and alcoholic liquors. It is widely employed in flatulence, nausea and gastralgia; as an external application in rheumatism, neuralgia, congestive headache and toothache (Anonymus 1962, Reynolds 1982, Singh *et al.* 1982b). It is rich in menthol (upto 89%), menthone (upto 75%) and menthyl acetate and can be treated as source of menthol (Singh *et al.* 1982b, Charles *et al.* 1990).

Mentha citrata Ehrh., commonly called bergamot mint is a native of Europe cultivated in United States (Guenther 1949). It can be served as a substitute of bergamot and lavender oil as it possess an odour of linalyl acetate, reminiscent of lavender (Singh *et al.* 1982a). It is cultivated in India and reported (Singh *et al.* 1982a) to contain linalool (40-80%), linalyl acetate (upto 82%) as the major constituents.

M. aquatica L. is a native of Europe and has become naturalized in several other countries. It is used as emetic, stimulant and astringent; useful as digestive, emmenagogue, in gall and stomach disorders, diarrhoea, severe cold and influenza, in difficult menstruation (Anonymus 1962, Grieve 1985). Miyazawa *et al.* (1998) reported promising inhibition of acetylcholinesterase activity by its essential oil and components. Presence of menthol, menthone, carvone, menthyl acetate, menthyl valerate, pulegone, menthofuranone (40%), piperitone, menthone and pulegone are reported (Grieve 1985, Miyazawa *et al.* 1998, Guenther 1949). Miyazawa *et al.* (1998) reported 3 types of oil in respect of chemical constituents. Felklova *et al.* (1992) reported presence of linalool (39-48%) and linalyl acetate (25-37.5%) as major constituents.

The two main types of commercial spearmint oil are obtained from the leaves of *Mentha spicata* L (native spearmint) and *Mentha cardiaca* L. (Scotch spearmint). Spearmint is indigenous to England grown all over the world produced mainly in the USA with some recent development in China and South America. It is available in many Southeast Asian countries. The major end uses are in toothpaste and mouthwashes, chewing gum and candy and food flavouring (Lee and Fred 1998, Atal and Kapur 1982). In Southeast Asian countries *M. spicata* is commonly used as culinary purposes and as digestive (Anonymus 1962). The herb is considered carminative, stomachic and antispasmodic, given in hiccup, flatulence, colicky pains, cholera etc (Reynolds 1982, Yusuf *et al.* 1994). Spearmint is characterized by high carvone content (60-70%) accompanied by limonene content.

Among the *Mentha* species reported in this paper one type of *Mentha arvensis* and another from *M. spicata* are of local origin collected from local markets and *M. aquatica* from Griffin, England. The rest of the types were collected from India and successfully grown in BCSIR Laboratories, Chittagong. The present work was undertaken to compare the various types of mint in respect of their growth and yield performances, oil content and chemical constituents of the oil.

Materials and Methods

All the species and varieties of *Mentha* (*M. arvensis* var. Sivalika, CIMAP and local; *M. cardiaca*; *M. spicata* exotic and local; *M. aquatica*; *M. piperita* and *M. citrata*) were collected from the experimental fields of BCSIR Laboratories, Chittagong.

Isolation of the oil

The oils were isolated from the fresh herbs by hydro-distillation for 4 hrs using a Clevenger type apparatus. The oil was dried over anhydrous sodium sulphate prior to analysis. The percentage of the essential oil was calculated on volume by fresh weight basis.

GC-MS analysis

The herb oil of nine types of *Mentha* were analyzed by GC-MS electron impact ionization (EI) method on GC-17A gas chromatograph (Shimadzu) coupled to a GC/MS QP 5050A Mass Spectrometer (Shimadzu); fused silica capillary column (30m x 2.5mm; 0.25 mm film thickness), coated with DB-1 (J&W); column temperature 100°C (2 min) to 250°C at the rate of 3°C/min; carrier gas, helium at constant pressure of 100Kpa. Acquisition parameters full scan; scan range

40-350 amu. The compounds were identified by comparing with the NIST library data.

Results and Discussion

Nine types of *Mentha* belonging to the six species were studied for their growth, yield, oil content and composition of the oils. Table-1 shows the physiological data and Table-2 shows the major constituents of the essential oils. The highest plant height (34.6 cm.), herbage yield (1.0 Kg/meter²) were obtained in *M. citrata* and highest oil content (1.3%) was obtained in *M. arvensis* (Sivalika). The varieties Sivalika, CIMAP and local of *M. arvensis* contain menthol & isomenthone (77.0% and 11.0%), menthol & menthone (72.2% and 12.1%) and carvone and limonene (59.6% and 31.1%) respectively as major constituents. *M. piperita* contain menthyl acetate (29.8%), menthol (22.6%), menthofuranone (16.4%) & isomenthone (8.4%) as major constituents. Major constituents of *M. citrata* were linalool (41.8%) and linalyl acetate (31.3%). Local varieties of *M. spicata* contain carvone (55.0%), dihydrocarveol (17.9%), dihydrocarveol acetate (7.7%) and limonene (6.9%) and the introduced type contain carvone (73.3%) and D-limonene (7.6%) as major constituents. *M. cardiaca* contain as major constituents carvone (61.0%) and limonene (21.6%). *M. aquatica* contains a complex mixture of ledol (13.5%), menthofuran (9.4%), neryl acetate (7.6%), caryophyllene (6.8%), caryophyllene oxide (5.8%) and mint furanone (5.0%) as major constituents. Among the major compounds present the highest amount of menthol, carvone and limonene were found in *M. arvensis* (Sivalika), *M. spicata* (exotic) and *M. arvensis* (local) respectively. The compounds menthol, carvone, limonene, linalool and linalyl acetate can be isolated as commercial raw materials.

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Table 1. Comparison of Physiological data*

Parameters	<i>M. arvensis</i> (CIMAP)	<i>M. arvensis</i> (Sivalika)	<i>M. arvensis</i> (Local)	<i>M. cardiaea</i>	<i>M. spicata</i> (Exotic)	<i>M. spicata</i> (Local)	<i>M. aquatica</i>	<i>M. piperita</i>	<i>M. citrata</i>
Plant Height (in cm)	33.0	30.2	31.4	24.8	21.6	30.0	29.0	33.8	34.6
Herbage yield per meter ² (in Kg.)	0.47	0.41	0.38	0.45	0.31	0.72	0.82	0.50	1.01
Leaf area per shoot (in cm ²)	419.0	481.8	139.62	107.0	84.9	70.6	110.4	57.0	175.1
Leaf-shoot ratio (in gm)	9.5/5.4	16.4/6.7	3.3/2.1	2.8/1.9	1.9/1.3	2.4/1.5	3.1/2.9	1.2/1.5	6.6/3.6
Oil content (%)	1.15	1.29	0.3	0.41	0.33	0.28	0.06	0.25	0.58
Specific gravity of the oil	0.8898	0.8966	0.9132	0.9301	0.9582	0.9055	0.9035	0.9582	0.9212

* Data collected on 1st harvest at the age of 4 months. Average of five replications.

Table 2. Major Chemical constituents of different *Mentha* tribes.

<i>M. arvensis</i> (CIMAP)	<i>M. arvensis</i> (Sivalika)	<i>M. arvensis</i> (Local)	<i>M. piperita</i>	<i>M. citrata</i>
Isomenthone 5.5%	Isomenthone 11.0%	Carvone 59.6%	Eucalyptol 1.1%	Geraniol 1.3%
Limonene 1.4%	Menthol 77.0%	Dihydrocarvone 2.3%	Isomenthol 4.9%	Geranyl acetate 3.7%
Menthol 72.2%	Menthyl acetate 2.3%	Limonene 31.1%	Isomenthone 8.4%	Ledol 2.5%
Menthone 12.1%	Newmenthol 2.1%	Pulegone 1.5%	Limonene 3.2%	Linalool 41.8%
Newmenthol 2.2%	β -Pinene 1.5%		Menthofuranone 16.4%	Linalyl acetate 31.3%
Patchouli alcohol 2.2%			Menthol 22.6%	Neryl acetate 1.9%
			Menthyl acetate 29.8%	β -Ocimene 3.9%
			Mint furanone 1.4%	Terpinyl acetate 6.1%
			Pulegone 4.3%	

Table 2. Continued.

<i>M. cardiaca</i>	<i>M. spicata</i> (Exotic)	<i>M. spicata</i> (Local)	<i>M. aquatica</i>
Carveol	1.4%	β-Bourbonene	Borneol
Carvone	60.9%	Carveol	Bornyl acetate
Limonene	21.6%	Carveyl acetate	Caryophyllene
Eucalyptol	2.2%	Carvone	Caryophyllene oxide
Menthione	1.4%	Dihydrocarvone	Isomenthol
-Myrcene	1.1%	Eucalyptol	Ledol
		Dihydrocarveol acetate	Menthofuranone
		D-Limonene	Menthol
		2-Naphthol, 1,2,3,4,4a-5	
		6,7-octahydro-4a-methyl	
		Trans-Sabinenehydrate	Mint furanone
			β-Myrcene
			Neryl acetate
			Octyl cyclobutane carboxylate
			Trans-Nerolidol
			2.3%
			3.4%
			6.8%
			5.8%
			1.7%
			13.5%
			9.4%
			1.6%
			5.0%
			1.8%
			7.6%
			4.6%
			1.7%