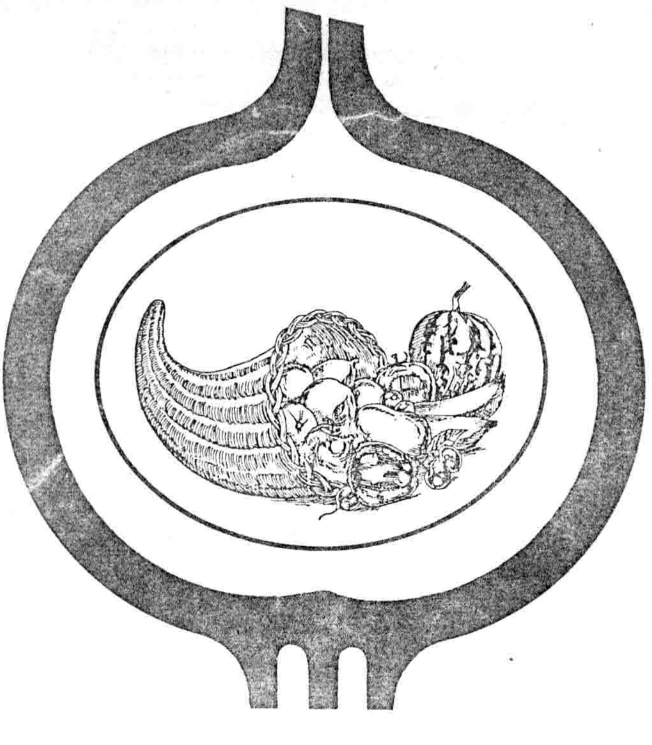
Developments in Food Science

37A

FOOD FLAVORS: GENERATION, ANALYSIS AND PROCESS INFLUENCE

Edited by
GEORGE CHARALAMBOUS



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4. DISCUSSION

Several important oxygenated monoterpene compounds, which possess lemon-like aroma, were present in high concentrations in lemon balm, catnip and dragonhead. However, there were quantitative differences in the composition of these compounds in each herb. Therefore, an attempt was made to assess mathematically the contribution of each of the oxygenated constituents to the aroma, and to compare this with the flavour composition of lemon oil.

The relative contribution of the main oxygenated compounds to lemon-like aroma was calculated according to the procedure of Rothe and Thomas [31] and Guadagni et al. [32] to give component odour units (U_o), which is the ratio of the concentration of the volatile component in a herb with its detection threshold value. The detection threshold values determined by Tamura et al. [33] were used for these calculations. The logarithmic values of odour units ($\log[U_o]$), the importance of which has been described by Buttery et al. [34] and Sugisawa et al. [35], were also calculated. The contribution of oxygenated monoterpene compounds in lemon balm, catnip and dragonhead to lemon-like aroma is given in Table 5.

Based on U_o and $\log[U_o]$ values, aldehydes citronellal, neral and geranial, are the main aroma constituents in lemon balm; the alcohols citronellol and nerol in catnip; and the following compounds in dragonhead: geraniol, geranyl acetate, neral and geranial. The $\log[U_o]$ values of most of the compounds in these herbs were of the same magnitude or higher than lemon oil [33]. As shown in Figure 2, the $\log[U_o]$ values of oxygenated compounds in lemon balm are very similar to those of lemon oil.

Chamblee and Clark [36] determined the important organoleptic compounds in Sicilian lemon oil. They determined which oxygenated compounds in their oil possessed lemon-like aroma, evaluated the average intensity factors and calculated the significance of each oxygenated constituent to lemon-like aroma by multiplying this factor by its concentration in the oil. The significance values of the main oxygenated compounds in these herbs were also calculated according to the method of Chamblee and Clark (Table 6). The significance values for lemon balm, catnip and dragonhead are much higher than those of lemon oil, because the concentrations of the compounds in these herbs were considerably higher than those of lemon oil. The most significant lemon-like aroma compounds in lemon balm are the same as those in lemon oil, i. e. geranial, neral and linalool. Citronellol, nerol and geraniol appear be the most significant lemon-like aroma compounds in catnip, and in dragonhead the most important were neral, geraniol and neral (significance value was not calculated for the major constituent in dragonhead, geranyl acetate, because the average intensity factor for this compound was not available).

5. CONCLUSIONS

1. The composition of lemon balm, catnip and dragonhead cultivated in Lithuania was examined and 66, 74 and 62 compounds, respectively, were identified and determined quantitatively. In lemon balm, catnip and dragonhead 17, 51 and 36 compounds, respectively, were not previously reported.

2. The main compounds of lemon balm were caryophyllene oxide (23.5%), geranial (14.8%), neral (10%) and ß-caryophyllene (7.1%); while the flavour of catnip consisted mainly of nerol (22.7%), geraniol (16.7%) and citronellol (17.4%); and dragonhead contained geranyl acetate (36.2%), geranial (21.4%), neral (14.9%) and geraniol (12%).

Table 5
The contribution of oxygenated monoterpene compounds to the aroma of lemon balm, catnip and dragonhead

Compound	Detection threshold (ppm)[33]	Lemon balm			Catnip			Dragonhead			Lemon oil [33]
		Concentration (ppm)	U_o	$Log[U_o]$	Concentration (ppm)	U_o	$Log[U_o]$	Concentration (ppm)	U_o	$Log[U_o]$	$Log[U_o]$
Linalool	0.028	17.7	632	2.80	42.3	1511	3.18	59.5	2125	3.33	2.7
Citronellal	0.046	52.6	1143	3.06	97.5	2120	4.33				2.0
Citronellol	0.062	6.8	110	2.04	1449.9	23385	5.37				1.9
Nerol	0.690	9.3	13	1.11	1907.1	2764	3.44				1.5
Neral	0.100	188.5	1885	3.28	141.9	1419	3.15	1014.0	10140	4.01	3.1
Geraniol	0.010	9.8	980	2.99	1434.9	143490	5.16	932.8	93280	4.97	3.4
Geranial	0.100	275.1	2751	3.44	267.0	2670	3.43	1413.7	14137	4.15	3.3
Geranyl acetate	0.150	14.5	97	1.99				3177.9	21186	4.33	2.2

Table 6
Significance values of the main oxygenated compounds to lemon-like aroma

Compound	Intensity factor [36]	Lemon balm		Catnip		Dragonhead		Lemon oil [36]
		Conc., %	Significance	Conc., %	Significance	Conc., %	Significance	Significance
Linalool	26.7	1.09	291	0.67	179	1.02	272	48.1
Citronellal	7.2	2.79	201	1.32	94			9.4
Citronellol/nerol	11.3	1.25	141	40.09	4531			3.4
Neral	7.0	10.00	700	1.91	134	14.95	1044	88.2
Geraniol	10.8	0.45	49	16.72	1806	12.02	1298	2.2
Geranial	8.0	14.79	1183	3.65	292	21.39	1711	164.0

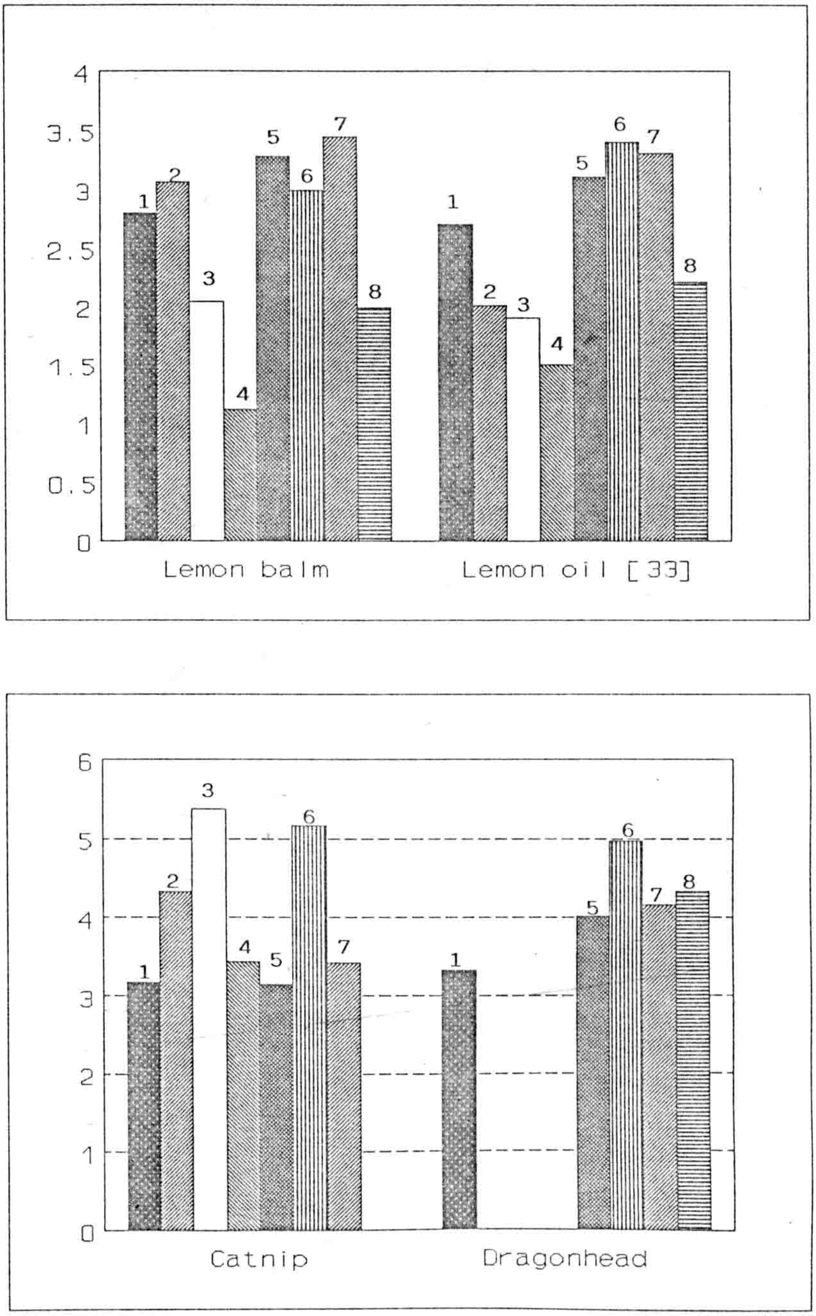

Figure 2. Log[U_o] values of oxygenated compounds: linalool (1), citronellal (2), citronellol (3), nerol (4), neral (5), geraniol (6), geranial (7), and geranyl acetate (8).

3. All three herbs were rich in oxygenated compounds which have been found in lemon oil. The significance values of the main oxygenated, lemon-like aroma compounds, were calculated and compared with published data for lemon oil. According to these significance values, the oxygenated monoterpene fraction of lemon balm was similar to that of lemon oil (i.e. geranial, neral and nerol were the most significant compounds). Citronellol, nerol and geraniol were most important in catnip; while in dragonhead geranial, geraniol, neral and geranyl acetate were the most significant components.

4. Lemon balm, catnip and dragonhead are valuable sources of lemon-like aromas. Approximately 12, 91 and 21 litres per hectare of essential oil could be obtained from lemon balm, catnip and dragonhead, respectively.

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G. Charalambous (Ed.), Food Flavors: Generation, Analysis and Process Influence

GLC Analysis and comparison of the flavor of different populations of basil

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Abstract

Essential oils were obtained by a Clevenger hydrodistillation apparatus from nine greek populations of basil and analysed by GLC Chromatography. Major flavor components indentified were linalool, methyl chavicol, methyl cinnamate, eugenol, cineole and gerariol. Large variations in the chemical composition of the essential oils among groups of these populations were noted that permit to classify these basil oils in three types, named "Kinos", "Sgouros" and "Mauromytikos". The chemical composition, commercial value and use of these three types is discussed. The comparison of these types with the four known international commercial types of basil oil named European, Réwnion, Methyl Cinnamate and Eugenol is discussed, too. The concusion is that the majority of greek basil oils belong to the sweet basil (European Type)that is suitable for flavor purposes and less to Methyl Cinnamate Type that lends itself to perfume work.

1.INTRODUCTION

Basil (*Ocimum basilicum L.*) is an annual plant, a popular contiment in Europe, that is grown in Greece in gardens but in the last few years on effort is being made for it to be used as an alternative crop in large plantations as this annual permits seasonal adjustments in acreadge according to the fluctuations and demand for the oil.

It is well known that polymorphism in the species of *Basilicum* is responsible for the very great number of populations varieties and forms (1). Futhermore, the basil flowers although hermaphrodite, show an abundant cross-pollination, with subsequent hybridization into abnormal and subnormal forms or strains of unstable character (1).

Because of the impossibility of ascribing the different types of basil oil to definite plant varieties it seems appopriate to classify these oil types according to their chemical composition and geographical source (1,2).

Four international commercial types of basil oil, named: European Type of Sweet Basil, Réwnion Type of Basil, Methyl Cinnamate Type and Eugenol Type, have been described (1).

The purpose of this work was the technological evaluation of the essential oil of different greek populations of basil in order to investigate its quality that determine its commercial value and possible use.

2.MATERIALS AND METHODS

Seeds from the nine most representative Greek populations of basil (B_1 = Platyphyllos Ioanninon, B_2 = Mauromytikos Macedonias, B_3 = Stenophyllos, B_4 = Platyphyllos Macedonias, B_5 = Sgouros Platyphyllos, B_6 = Platyphyllos Cretes, B_7 = Mauromytikos Cretes, B_8 = Sgouros Leptophyllos and B_9 = Mesophyllos Attikis) have been cultivated in pods 20cm in diameter (one plant per pod). The plants harvested at the stage of full bloom and dried at 40°C for 48 hours. A composite sample of 100 gr. from this dried material after slicing in small pieces was taken for each population and placed in a 2 liter round - bottomed flask containing 1000 ml of distilled water. A Clevenger hydrodistillation apparatus was used and distillations lasted for approximately two hours. The produced essential oil from each treatment counted, was collected separately in 5 ml flask and put until its analysis to -5°C in absent of daylight. Analyses were performed with a Perkin Elmer gas liquid chromatography equipped with a flame ionization detector on sample 0.2 μl. Seperation was made using a 10% Carbowax 20m on 80/100 surelcoport column. Injector and manifold temperature 50°C and column programmed from 50°C to 150°C at 2,5°C/min. Compounds were indentified by comparison their GLC retention times of known standards.

3.RESULTS AND DISCUSSION

From the first results of the chemical composition of the studied population oils it was clear that these oils could be classified in three types named "Kinos", "Sgouros" and "Mauromytikos" following the classification of our previous work (3) of the studied populations in three ecotypes.

These three types of the greek basil oils could be described as follow:

(i) Type of "Kinos" (common) Basil Oil. The B_1,B_3,B_4,B_6,and B_9 population oils belong to this type of basil oil. Fig.1 is a typical GLC chromatogram of this type of oil. According to this chromatogram the three predominant flavor compunds are: linaloöl (peak 23,82) 54,4%, eugenol (54,19) 7,3% and methyl chavicol (29,87) 6,4%, while camphor is present only in traces. The odor of this type of oil, because of its chemical composition, is pleasant and sweet and it is suitable for flavor purposes (1) particularly of grease foods, because of its quite rich content of eugenol that according to Farag and others (4) is a very good antioxidant. Akgül (5) reported the above chemical composition for an oil from a turkish population of basil.

(ii) Type of "Sgouros" (curly) Basil Oil. The B_5 and B_8 populations produce oil of this type. Fig.2 is a typical GLC chromatogram of this oil. According to this chromatogram the three predominant flavor compounds are: linaloöl (23,79) 41%, methyl chavicol (29,86) 13% and geraniol (37,17) 9% while camphor is present also in traces. As linaloöl and methyl chavicol is in better balance than in "Kinos" Type, the odor is very pleasant and sweet and is more suitable for all kinds of flavor including those of confectionary, baked goods, condimentary, dental and oral products.

(iii) Type of "Mauromytikos" Basil Oil. The oil of the B_2 and B_7 populations belong to this type. Fig.3 is a typical chromatogram of this oil. The three predominant flavor compounds according to the above chromatogram are: methyl cinnamate (47,78) 37,8%, linaloöl (23,82) 22,6% and cineole (8,37) 7,9%, while camphor is absent. Its odor, because of the high content of methyl cinnamate, is very lasting and lends itself to perfume work, but not employment in flavors. The substantial amounds of methyl cinnamate make it doubtful as to whether the plants of the B_2 and B_7 populations are true *Ocimum basilicum* L.

But should be emphasized that a futher study is needed to relate the identified compounds of the above three types of oil to aroma threshold levels and evaluate the effects of processes on these volatiles.

Comparing the above described, three types of greek basil oils with the four known international commercial types which were mentioned in the beginning observed are the following:

"Sgouros" and less "Kinos" are quite close to the European Type of Sweet Basil Oil and particularly to the American Version instead of the French one, where in the first version linaloöl is in higher percentage than methyl chavicol and vice versa in the second one (1).

"Mauromytikos" is very close to Methyl Cinnamate Type and particularly with that of the Indian version as described by Rakshit (6).

The conclusion drawn from this work is that the majority of the Greek types of basil oil must be considered as belonging to European Sweet Basil Type that is more suitable for flavor purposes and less to Methyl Cinnamate Type that lends to perfume work.

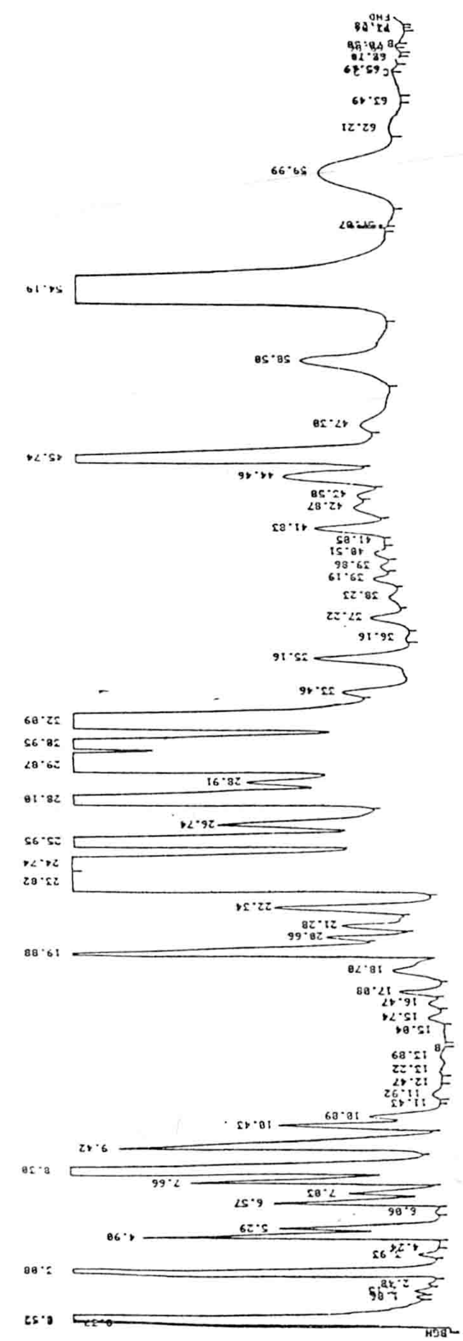

Figure 1. Typical GLC.chromatogram of "Kinos" Basil Oil.

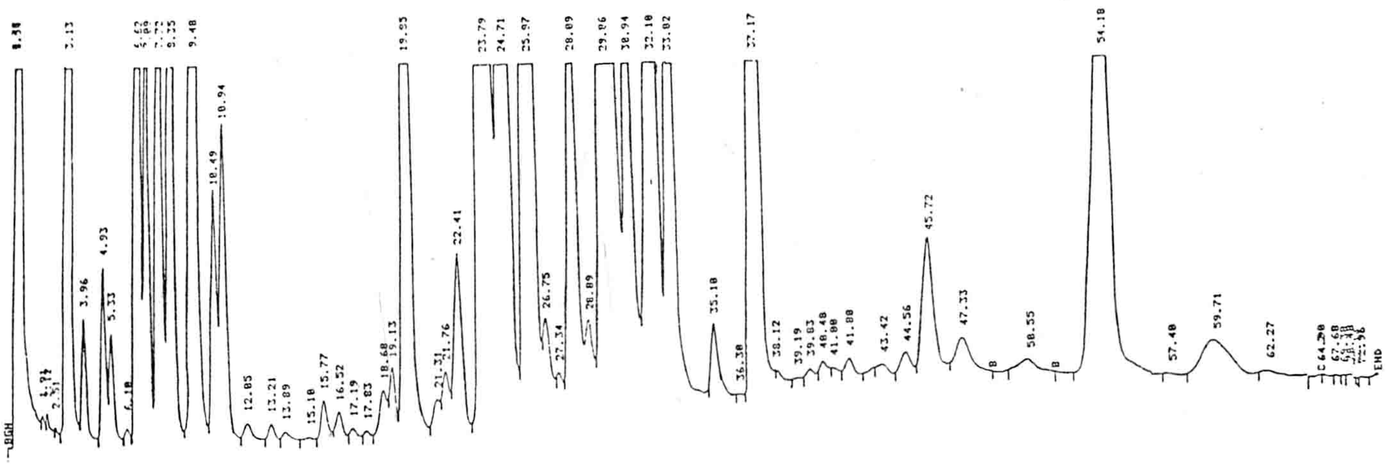

Figure 2. Typical GLC chromatogram of "Sgouros" Basil Oil.

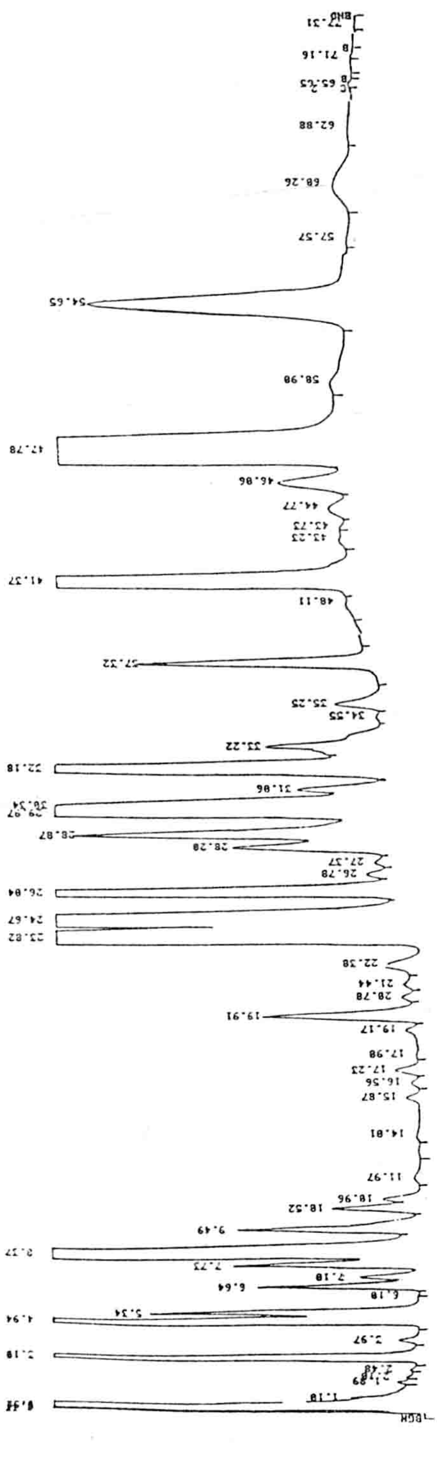

Figure 3. Typical GLC chromatogram of "Mauromytikos" Basil Oil.

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G. Charalambous (Ed.), Food Flavors: Generation, Analysis and Process Influence

MICROWAVE EXTRACTION OF BASIL AROMA COMPOUNDS

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Abstract

Microwawe heating was proven to allow aroma extraction from vegetables. In the case of basil, the process mechanism mainly implies stripping of aroma compounds through an in situ distillation. The aroma profile established by GC/MS reveals thath the main extracted compounds are linalool, cineole, camphor, eugenol and metoxy-eugenol, as expected from the mediterranean cultivar considered. Their extraction yield depends on the irradiation time and the microwave power used.

1. INTRODUCTION

Basil aroma that can be easily extracted via steam distillation from fresh leaves has always been greatly appreciated in the mediterranean area and is nowadays worldwide accepted as a normal component of the flavour in a number of foods. Basil aromatized olive oil prepared by long standing infusion at room and high temperature is commercially available, and a number of sauces (*e.g.*, ligurian pesto) and dishes (*e.g.*, pizza) contain basil extracts coming from leaves mixed with other ingredients. In the present work basil extracts were obtained with microwave irradiation of fresh leaves. Microwave heating was proven to allow aroma extraction from vegetables.

In previous works (1, 2) the microwave treatment was indeed found to enhance the extraction of the main garlic aroma compounds because of a selective interaction between relevant molecules and MW radiation. The extraction yield was found to increase according to a fickian law to reach a maximum after 6 minute treatment, and then decrease because of chemical rearrangements of the diallyl disulphide (the main garlic aroma compound). The results obtained were therefore in line with a naïve expression (3) of the ΔT', the shorthand (and maybe misleading) symbol for the ratio between the heating rate of a given aroma compound, A, and that of water, w, when exposed to microwaves:

$$\Delta T' = \frac{(dT/dt)_A}{(dT/dt)_w} = \frac{\rho(w)Cp(w)\times\exp[-2\alpha(A)z]}{\rho(A)Cp(A)\times\exp[-2\alpha(w)z]}$$

where ρ, Cp, α and z stand for density, heat capacity at constant pressure, extinction parameter and depth from the MW exposed surface, respectively.