Conservation and characterization of oregano (*Origanum vulgare* L.) wild populations in Europe

Genetic Structure and Variability of the Essential Oil

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Introduction

The main objectives of the project are to make an inventory of, and to survey native populations of wild oregano (*Origanum vulgare* L.), to characterize their genetic and chemical variability, and to find out the distribution pattern of taxonomically defined populations in European countries.

The data on characterization of plant material will be documented and will be available for exchange between all partners. This project aims at providing preliminary results and the background information for the establishment of future regional collection(s) (according to the AEGIS concept) of *Origanum vulgare* L. in Europe.

Project objectives

The specific objectives of this project are:

- Inventory, survey and characterization of habitats and of native populations of *Origanum vulgare* L. in European countries, members of ECPGR
- Collecting of herbarium specimens
- Study of genetic and chemical variability of oregano populations (task of our institute)
- Documentation
- Exchange of characterization data among partners.

The project consortium consists of 19 participants (countries) ranging geographically from Portugal to Israel and from Norway to Italy. In each country, 3 populations were sampled.

The present report focuses on the study of genetic and chemical variability (essential oil) of oregano populations. For chemical characterization the essential oil profiles will be analyzed. After DNA isolation, genetic variability within and among *Origanum vulgare* L. populations will be analyzed using microsatellites (Novak, Lukas, Bolzer, Grausgruber-Gröger & Degenhardt, 2008).

Material and Methods

Plant material

During the field work the above ground parts of individual plants of three *Origanum vulgare* L. (Lamiaceae) populations (habitats of wild oregano populations) were collected in each country at the beginning of flowering (Table 1, Figure 1). Turkey and Israel provided *O. onites* and *O. syriacum*, respectively, because *O. vulgare* is not present in this area. Geographical coordinates (latitude, longitude and altitude) were recorded. The plants were dried at room temperature and leaves/flowers separated from stems. The leaf/flower fraction was sent to Vienna for further analysis.

From each population, herbarium specimens were prepared and one specimen per population sent to Vienna to be stored centrally in the herbarium at the Faculty Centre of Biodiversity in Vienna.

Table 1: Sample origin – Countries, populations and geographical coordinates

No.	Country	Abbr.	Population	Latitude	Longitude	Species
1	Slovenia	SLO	1	46°18'12"	14°37'20"	*Origanum vulgare*
			2	45°55'42"	15°31'16"	*Origanum vulgare*
			3	45°58'30“	14°28'42"	*Origanum vulgare*
2	Portugal	PT	1	38°47'50"	07°25'50"	*Origanum vulgare*
			2	41°40'38"	08°11'45"	*Origanum vulgare*
			3	41°46'00"	08°37'00"	*Origanum vulgare*
3	Albania	AL	1	42°2'57"	19°29'51"	*Origanum vulgare*
			2	41°45'52"	19°39'29"	*Origanum vulgare*
			3	41°23'23"	19°56'37"	*Origanum vulgare*
4	Czech Republic	CZ	1	49°48'53"	17°12'25"	*Origanum vulgare*
			2	50°34'33"	14°7'16"	*Origanum vulgare*
			3	48°56'3"	16°37'34"	*Origanum vulgare*
5	Bulgaria	BG	1	42° 8'14"	25°52'13"	*Origanum vulgare*
			2	41°56'36"	24°51'59"	*Origanum vulgare*
			3	42°41'14"	25°14'57"	*Origanum vulgare*
6	Finland	FI	1	60°17'56"	21°35'4"	*Origanum vulgare*
			2	60°25'31"	22°6'54"	*Origanum vulgare*
			3	61°37'31"	28°11'45"	*Origanum vulgare*
7	Italy	IT	1	45°49'32"	10°56'26"	*Origanum vulgare*
			2	44°19'54"	9°19'39"	*Origanum vulgare*
			3	38°0'32"	14°47'24"	*Origanum vulgare*
8	Israel	ISR	1	32°59'52"	35°24'47"	*Origanum syriacum*
			2	33°5'53"	35°30'40"	*Origanum syriacum*
			3	32°32'38"	35°1'3"	*Origanum syriacum*
			4	32°38'57"	34°59'31"	*Origanum syriacum*
			5	30°49'58"	34°39'13"	*Origanum syriacum*
9	Latvia	LV	1	56°44'14"	25°46'18"	*Origanum vulgare*
			2	56°57'35"	26°18'6"	*Origanum vulgare*
			3	57°3'3"	22°55'1"	*Origanum vulgare*
10	Macedonia	MK	1	41°10'23"	20°57'12"	*Origanum vulgare*
			2	41°26'02"	20°49'23"	*Origanum vulgare*
			3	41°19' 25"	21° 03' 37"	*Origanum vulgare*
11	Norway	NO	1	58°29'47"	8°50'36"	*Origanum vulgare*

			2	59°45'13"	10°12'16"	*Origanum vulgare*
			3	63°22'31"	10° 8'19"	*Origanum vulgare*
12	Slovakia	SK	1	48°39'41"	18°46'16"	*Origanum vulgare*
			2	49°02'22"	18°10'23"	*Origanum vulgare*
			3	48°58'22"	20°6'47"	*Origanum vulgare*
13	Turkey	TR	1	38°37'39"	26°55'47"	*Origanum onites*
			2	38°36'34"	27°26'33"	*Origanum onites*
			3	38°4'59"	26°51'47"	*Origanum onites*
14	Croatia	HR	1	46°08'08"	16°19'41"	*Origanum vulgare*
			2	43°48'06"	15°42'29"	*Origanum vulgare*
			3	44°47'40"	14°43'50"	*Origanum vulgare*
15	Serbia	RS	1	45°9'0"	19°55'46"	*Origanum vulgare*
			2	43°50'48"	21°40'20"	*Origanum vulgare*
			3	43°20'44"	22°5'33"	*Origanum vulgare*
16	Spain	ESP	1	39°38'17"	5°25'21"	*Origanum vulgare*
			2	40°18'32"	4°30'19"	*Origanum vulgare*
			3	42°25'24"	1°27'52"	*Origanum vulgare*
17	Greece	GR	1	39°59'18"	22°34'09"	*Origanum vulgare*
			2	40°31'48"	23°45'45"	*Origanum vulgare*
			3	39°21'81"	23°3'59"	*Origanum vulgare*
18	Hungary	HU	1	47°43'43"	16°38'32"	*Origanum vulgare*
			2	47°35'03"	18°51'22"	*Origanum vulgare*
			3	48°02'18"	20°23'55"	*Origanum vulgare*
19	Lithuania	LT	1	54°40'37"	25° 2'36"	*Origanum vulgare*
			2	54°41'21"	25°39'40"	*Origanum vulgare*
			3	55°29'19"	25°50'48"	*Origanum vulgare*

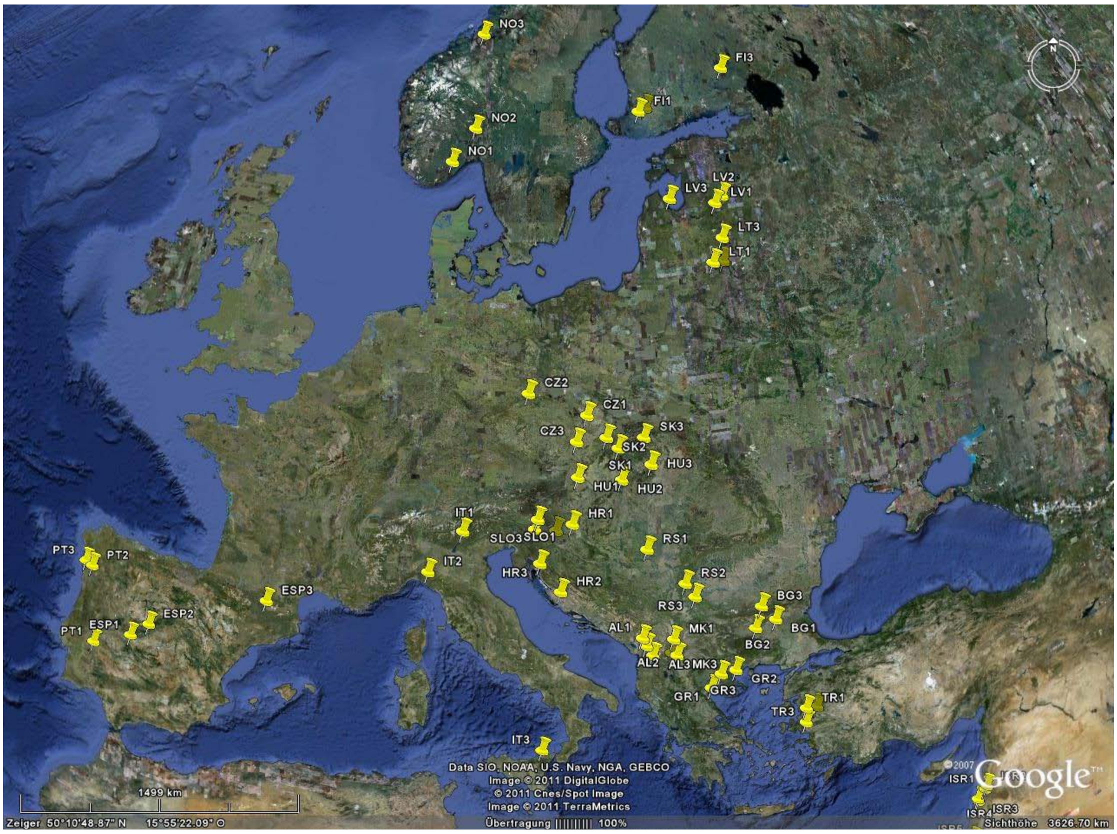

Figure 1: Oregano populations sampled

Genetic Structure

DNA Extraction

Genomic DNA was extracted from dried leaf samples using a modified CTAB-protocol (Doyle, 1991). This extraction included a mixture of 950µl CTAB-detergents, 0.95µl beta-mercaptoethanol, 41µl 10% sodium dodecyl sulphate, 4.1µl proteinase K and 10mg polyvinylpyrrolidone K30 per sample.

Marker development

Four primer combinations, one microsatellite marker (SSROR210; (Novak et al., 2008)) and 3 SNP markers (SNP13, SNP14 and SNP32), were used for the genetic analysis. The 3 SNP primers were developed on the basis of available sequence information of a nuclear gene (SNP13 and SNP14, Lukas et al., in preparation) and from 454 sequence information (SNP32). In total, 51 markers could be found with the four primer combinations.

Table 2: Primer combinations used for the genetic analysis

Locus.	Primer		Primer sequence (5'-3')
1	SSROR210	Primer F	TTTGCTCCGACATCTTCAACC
		Primer R	AGCCTGCTGTGTTTGGATCAG
2	SNP13	Primer F	CGGCGAGTTGATCAAGAAAC
		Primer R	GAGATTTCCATCGAGCAAGC
3	SNP14	Primer F	TGTGTTTGTTTGTGCAGTGG
		Primer R	ATATGCTTCGGACTCAACCC
4	SNP32	Primer F	AGAGAGCAATCACTACCAACA
		Primer R	CCGAAGAAGTTCGGAGGAC

PCR

The PCR reactions were prepared at a volume of 10 µl and contained 2 µl HOT FIREPol® EvaGreen® HRM Mix (Solis BioDyne, Tartu, Estonia), 0.3 mM of forward and reverse primer and distilled water. 1 µl DNA solution (diluted 1:50 from the original extract) was added to each reaction. All reactions were done in duplicate.

The PCR cycling started with an initial phase of 12 min at 95 °C, then 50 cycles of 10 s at 95 °C, 20 s at 55 °C and a 20 s elongation step at 72 °C. High resolution melting was carried out immediately following PCR from 68 °C to 90 °C at steps of 0.07 °C, each step with a 1 s hold.

HRM analysis

Identification of genotypes was done by high resolution melting curve analysis with a RotorGene™ 6000 (Corbett Life Science, Sydney) and the associated software package. The quality of the PCR-reaction was checked before including a sample in curve analysis. Samples with Ct values more than 5 cycles above average Ct-values were omitted as well as samples with a significantly lower saturation level of fluorescence in the last cycle, because these deviations can lead to shifts of the melting curve (Schütz & von Ahsen, 2009).

Essential oil

Extraction: 200 mg dried plant material was extracted in 2 ml dichloromethane for 30 minutes in an ultrasonic water bath. The extracts were filtered with cotton pads on a Pasteur pipette.

FAST-GC/FID: The quantitative GC analyses were performed on an HP 6890 equipped with a FID and fitted with an Agilent DB-5 narrow bore capillary column (10 m x 0.1 mm, 0.17 µm film thickness). Helium was used as carrier gas. The front inlet was kept at 260°C in split mode (split ratio: 100:1). Temperature program: 60°C for 1 min.; from 60°C to 85°C with 4°C/min.; 85°C to 280°C with 12°C/min.

GC/MS: Analyses to identify the compounds were performed on an HP 6890 coupled with an HP 5972 MSD. Temperature program: 60°C for 4 min.; from 60°C to 100°C with 5°C/min.; 100°C to 280°C with 9°C/min.

Retention Indices (RI) of the sample components were determined on the basis of homologous n-alkane hydrocarbons under the same conditions. The quantitative composition was obtained by peak area normalisation, and the response factor for each component was considered to equal 1. The compounds were identified by comparing their retention indices and mass spectra with published data (Adams, 1995; McLafferty, 1989). The quantitative analysis of the oils was determined by GC–FID, using fenchone as the internal standard.

Data Evaluation

The results of the allele scan with HRM were computed with GenAlEx Version 6 (Peakall & Smouse, 2006) and GeneticStudio (Dyer, 2009) to assess parameters of allele frequencies, genetic distances, AMOVA, centrality and comparison between genetic covariance and geographical distances. Genetic distances were visualized with Neighbour-joining tree using MEGA (Tamura, Dudley, Nei & Kumar, 2007). Principal Component Analysis was calculated with SPSS for Windows version 14.0.1 (SPSS Inc.).

Results

Genetic Structure

Relationships based on Nei's genetic distance are shown in Figure 2 on the basis of populations and in Figure 3 on the basis of countries. A complex network of relationships is represented in Figure 4. Blue edges indicate a situation where the geographic distance between the two populations is much closer than could be expected from their genetic constitution (they are genetically distinct), red edges indicate the contrary and grey edges are neutral in the relation between the geographic distance and the genetic constitution. Detailed tables of genetic distances and pairwise population comparisons based on AMOVA (Analysis of Molecular Variance) are listed in Annexes 1 to 3 (Annex - Additional Figures and Tables.xls). The parameter PhiPT in the AMOVA can be regarded as equivalent to the F-value of ANOVA.

The dataset represents 51 populations from *Origanum vulgare* from almost all over Europe. From Turkey and Israel, *O. vulgare* was substituted by *O. onites* and *O. syriacum*, respectively, because *O. vulgare* is not present in this area. An advantage of having these two other species additionally in the sample set was that we could use them as outgroups to better understand relationships within the species.

At the species level *O. vulgare* seems to be closer related to *O. onites* than to *O. syriacum*. Interestingly, *O. syriacum* is far closer related to *O. vulgare* from the Iberian Peninsula than to the geographically closer *O. onites* from Turkey or *O. vulgare* from Greece (Figure 2, Figure 3).

The genus *Origanum* originates from the Eastern Mediterranean area. Therefore it could be expected to find a genetic radiation originating from this hotspot. In fact, a gradient could be observed from East to West (with the exception of *O. syriacum*, see above), but not from South to North. The gradient was better visible when calculating the distances country by country (Figure 3) than by population by population (Figure 2), where some populations (like e.g. MK3, HU1, SLO2) are not in strict conformity with this gradient.

The populations from Scandinavia and the Baltic states, however, are very closely related to populations from the West Balkan states and have their next relatives not – as we would expect – in populations from Central Europe. All three Norwegian populations are grouping quite closely together with AL1 and HR3. Finnish oregano populations, however, are more diverse and seem to originate from several Mediterranean sources. LT1 to LT3 as well as LV1 group together with SLO1, SLO3 and AL2. LV2 is not too distant from this group, while LV3 is already quite distant to this branch. The situation described for Northern European oregano is well visualized by a massive number of red edges in Figure 4 (genetically too close than could be expected by the geographical distance).

The oregano populations from the Iberian Peninsula are very closely related and all quite distant to the other European oreganos. Astonishingly, IT3 from Sicily falls into this group. IT2 can still be regarded as part of the Western Mediterranean group, closely related to the Spanish oregano from the Pyreneans (ESP3), the Spanish oregano geographically closest to IT2.

O. syriacum from Israel is too distant to *O. vulgare* to be considered in Figure 4. The grey line between Turkey and Greece indicates an intensive gene exchange between *O. onites* and *O. vulgare* (due to the species border we would have expected a blue line). The blue line between Turkey and Bulgaria, however, shows a strict (geographical?) crossing barrier.

In Central Europe, the population SK3 is quite distinct to the neighboring populations demonstrated by a star-like set of blue edges to the closest relatives. But also in Hungary, especially one population (HU1) is quite distinct to the position of the other two populations.

In the populations from Albania to Bulgaria and the Czech Republic, only slight directional changes could be observed, often broken by some populations.

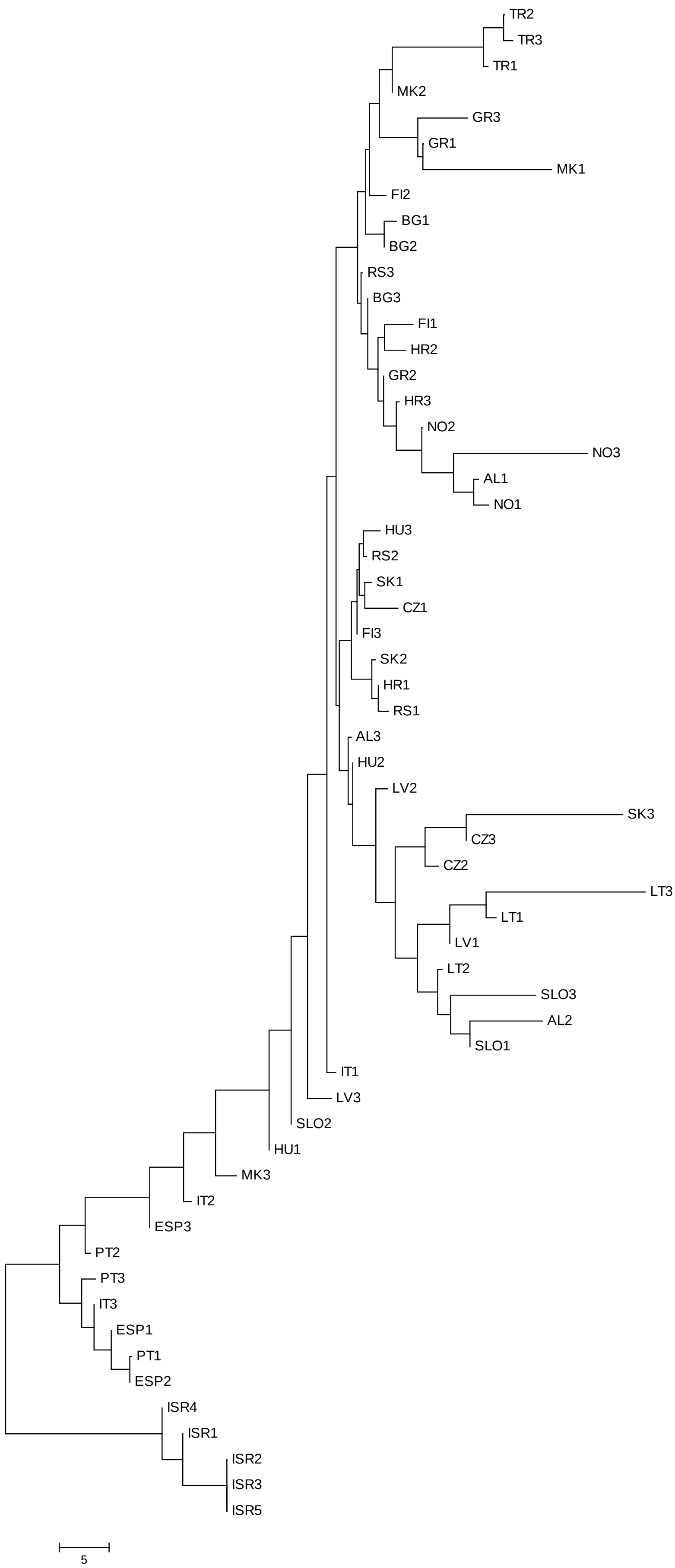

Figure 2: Neighbour-joining tree of the oregano populations based on Nei's genetic distances

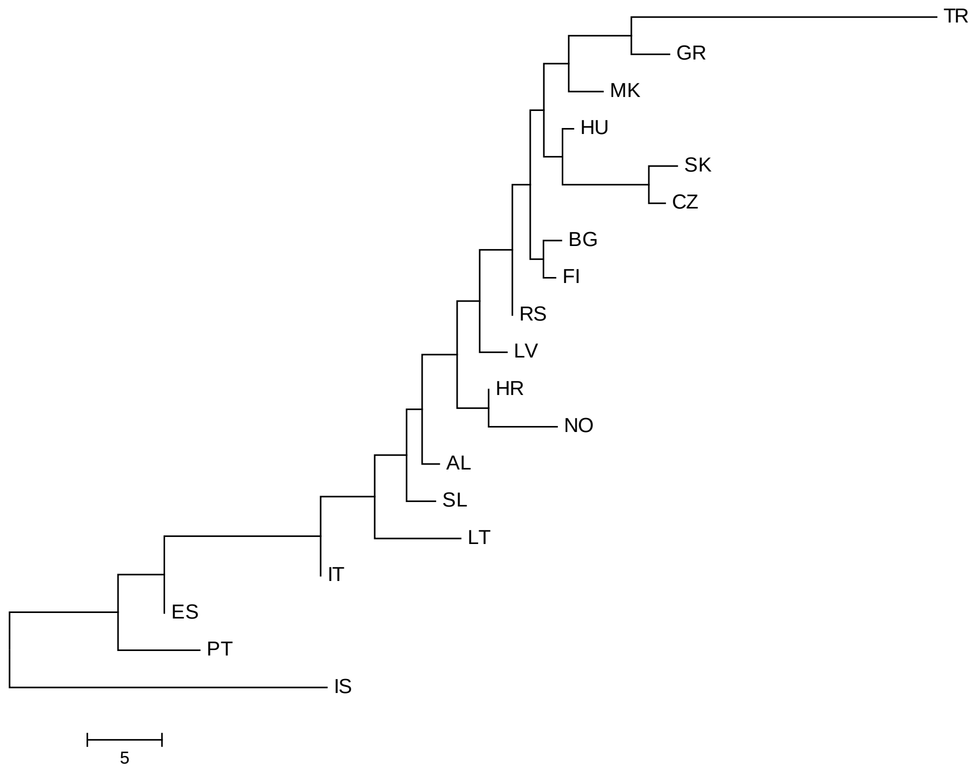

Figure 3: Neighbour- joining tree based on Nei's genetic distances, analysis by country

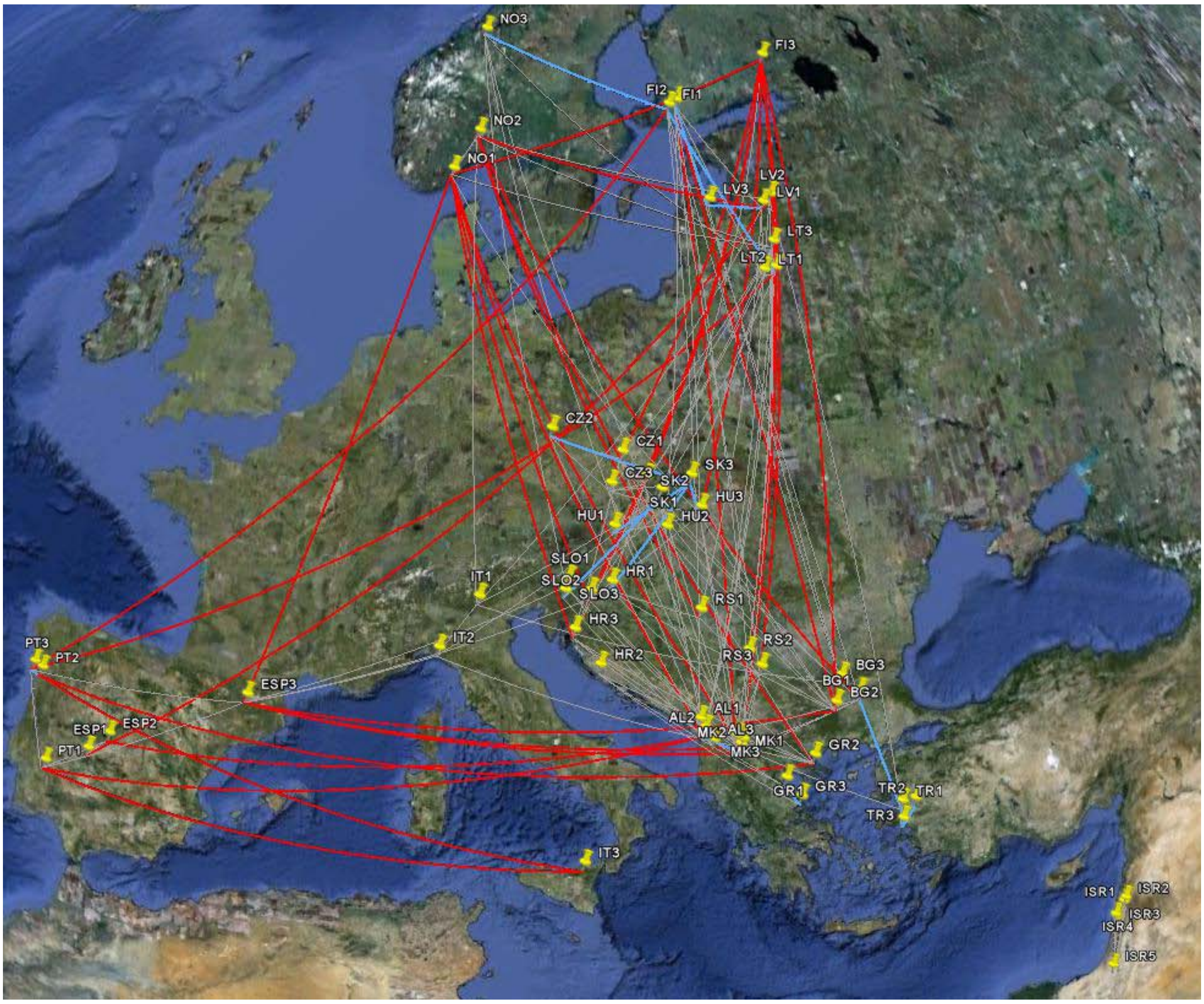

Figure 4: Representation of the genetic network. Red: set of edges that are significantly longer (physically) than would be predicted by the genetic covariance between the populations. Blue: set of edges that are significantly shorter (physically) than would be predicted by the genetic covariance between the populations. Grey: set of edges where physical distance is equal to the genetic covariance between the populations.

Essential Oil Variability

Essential Oil Content

The essential oil content (Table 3) presents the wide range of variability of oregano in Europe. The countries which are known for their high-quality essential oil oregano showed – as could be expected – the highest essential oil content. These countries were Greece (39-46mg/g), Israel (28-47mg/g; *O. syriacum*) and Turkey (36-32mg/g; *O. onites*).

However, two populations from Italy (IT2 and IT3 with 14 and 26mg/g, respectively), two populations from Croatia (HR2 and HR3 with 37 and 43mg/g, respectively), two populations from Portugal (PT1 and PT3 with 13 and 10mg/g, respectively) and one population from Slovenia (SLO1 with 16mg/g) showed also interestingly high levels of essential oils.

Outstandingly high inner population variability was found in one population from Albania (AL3), one from Israel (ISR5) and one from Turkey (TR2). 7 populations with maximum values above 50mg/g demonstrate the high selection potential for maximizing essential oil content. The highest essential oil content was found in TR2 from Turkey with 69mg/g.

Table 3: Mean, standard deviation, minimum and maximum values of the essential oil content of the different oregano populations [mg/g DM]

Population	mean	std.dev.	min.	max.
AL1	6.5	2.5	4.0	10.4
AL2	4.5	1.2	3.1	6.2
AL3	8.3	10.8	2.5	38.5
BG1	1.5	0.6	0.5	2.4
BG2	1.7	0.4	1.4	2.8
BG3	1.8	0.7	0.7	3.0
CZ1	2.0	0.8	1.1	3.3
CZ2	1.5	0.7	0.8	2.8
CZ3	2.8	0.9	1.9	4.3
ESP1	8.5	2.1	6.5	13.7
ESP2	8.1	2.5	5.0	11.0
ESP3	5.0	2.4	0.0	9.4
FI1	3.1	1.3	1.5	5.6
FI2	3.7	1.1	1.9	5.8
FI3	4.7	2.2	1.6	9.1
GR1	43.9	8.2	31.3	57.8
GR2	39.5	9.8	23.8	52.0
GR3	45.7	8.2	35.9	62.3
HR1	4.0	1.4	1.8	5.6
HR2	36.6	4.8	28.7	44.8
HR3	42.9	6.5	32.2	53.0
HU1	2.3	0.9	0.9	3.7
HU2	2.4	1.5	1.2	5.8
HU3	2.9	0.9	1.4	4.5
ISR1	28.3	4.0	20.3	34.1
ISR2	31.1	7.5	23.7	45.6
ISR3	41.2	7.6	31.9	56.2
ISR4	41.1	7.5	24.8	50.8
ISR5	47.0	11.1	24.8	60.9
IT1	2.7	1.1	1.3	4.4
IT2	13.6	4.6	6.8	18.9
IT3	26.3	6.8	17.5	37.9
LT1	7.8	2.0	4.6	10.3
LT2	7.7	2.3	4.7	10.9
LT3	7.3	2.4	3.6	10.4
LV1	4.4	1.9	2.0	7.2
LV2	3.2	1.4	1.6	5.3
LV3	1.9	1.3	0.7	4.4

MK1	1.9	1.0	0.8	4.0
MK2	1.9	0.3	1.4	2.2
MK3	2.0	0.4	1.2	2.6
NO1	5.5	1.9	3.1	8.9
NO2	6.0	2.8	2.2	10.4
NO3	5.1	2.0	1.7	8.1
PT1	13.1	4.8	5.2	18.9
PT2	3.1	1.2	1.5	5.0
PT3	10.3	2.2	6.4	13.3
RS1	2.9	1.3	0.9	5.2
RS2	3.3	1.2	1.5	5.0
RS3	3.4	1.2	1.9	5.2
SK1	4.8	1.5	3.6	8.5
SK2	6.8	2.1	4.8	10.7
SK3	4.5	1.5	3.3	8.3
SLO1	15.6	3.1	11.2	21.0
SLO2	2.1	1.3	0.9	4.9
SLO3	8.9	4.3	1.2	15.5
TR1	26.8	3.9	20.8	33.2
TR2	26.7	15.3	16.1	68.5
TR3	31.6	5.4	22.3	38.0

Essential Oil Composition

The essential oil composition was extremely variable with obvious appearances of different chemotypes (

Table 4 to Table 7).

Carvacrol/Thymol type

The carvacrol and/or thymol types were in good correlation to high essential oil yielding populations. All Greek, Turkish and Israelian populations can be classified into this chemotype. Additionally, two populations from Italy (IT2 and IT3) and two from Croatia (HR2 and HR3) can be regarded as rich in thymol or carvacrol. This type can be further classified into thymol-'pure' (GR1, GR3, ISR3, IT2, IT3), carvacrol-'pure' (GR2, HR3, TR1-TR3) and thymol/carvacrol mixed (HR2, ISR1, ISR2, ISR4, ISR5) populations.

ESP1 and PT3 showed contents of thymol and carvacrol only between 10 and 20%. However, due to higher contents of compounds from the same pathway like *p*-cymene, γ-terpinene and carvacrol methyl ether, they can be classified into this group. Especially PT3 is an interesting population due to an unusually high content of carvacrol methyl ether of 5%.

Linalool type

Three populations, one from Spain (ESP2) and two from Portugal (PT1 and PT2) contained high amounts of linalool ranging from 39% to 76%.

Sesquiterpene type

All other populations can be regarded as rich in sesquiterpenes with the main predominant sesquiterpene compounds *β*-caryophyllene, germacrene D, germacrene D-4-ol and caryophyllene oxide.

Noticeable are higher sabinene contents of above 10% in populations from the Czech Republic, Finland, one population from Croatia (HR1), Hungary, Norway, Serbia, Slovakia and Serbia.

Principal Component Analysis (PCA)

PCA analysis as visualized in Figure 5 complements graphically the chemotype structure of the oregano with a deeper insight into population structure and geographical gradients. The high thymol/carvacrol and linalool types form a gradient from Greece/Turkey/Israel via Italy to the Iberian Peninsula that is clearly separated from the sesquiterpene types. The sesquiterpene types group all together in a complex cluster.

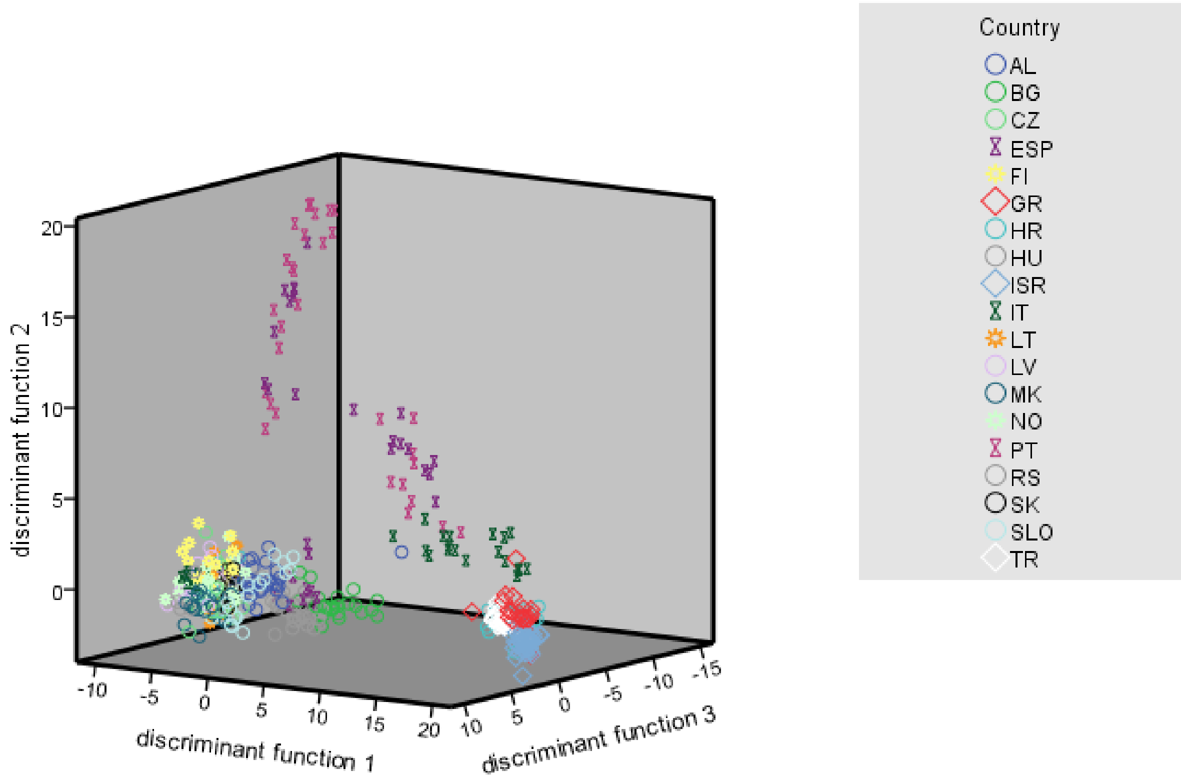

Figure 5: 3D-scatter plot of the first three discriminant functions of the essential oil composition of oregano populations (by country)

Table 4: Essential oil composition I – Albania to Finland

Compound	AL1	AL2	AL3	BG1	BG2	BG3	CZ1	CZ2	CZ3	ESP1	ESP2	ESP3	FI1	FI2	FI3
α-thujene	,6	,5	,8	,1	,2	,2	,9	1,1	1,3	,8	,1	,5	1,8	,5	,2
α-pinene	,7	,7	,5	,7	,4	,6	1,0	1,1	1,0	,5	,2	,6	1,4	,6	,5
camphene	,5	,7	,4	,3	,6	,3	,5	,1	,2	,2	,2	,7	1,3	,2	,1
sabinene	5,5	3,0	5,5	6,0	6,1	10,2	16,8	10,9	20,4	,3	1,2	5,6	10,5	11,1	13,4
1-octen-3-ol	,6	,4	,6	1,1	,6	,3	1,5	1,4	1,1	,2	,1	,1	1,2	,3	,7
β-pinene	,4	,4	,5	,2	,5	,1	2,0	1,5	1,1	,5	,7	1,0	1,1	1,4	1,0
myrcene	,9	,7	,8	,9	,8	,4	2,8	1,2	,6	1,2	,7	1,1	,2	1,1	1,1
α-terpinene	,5	,3	,4	,4	,1	,5	,1	,1	,1	1,2	,0	,2	,1	,2	,1
p-cymene	,9	,7	1,1	,7	2,4	,8	1,3	1,9	2,2	5,9	,3	3,0	1,8	3,2	1,6
limonene/β-phellandrene	,9	,5	,7	,8	,5	1,1	,9	1,0	,9	,3	,2	,6	,7	,6	,8
1,8-cineole	1,6	,9	,9	3,8	2,7	3,8	4,1	4,7	3,0	,0	,0	,5	5,3	1,4	3,9
trans-β-ocimene	3,7	1,7	1,4	1,7	3,2	2,2	5,5	5,5	2,4	2,9	7,4	4,3	1,3	5,7	4,6
cis-β-ocimene	5,9	3,2	1,7	1,7	1,9	1,1	3,3	1,9	2,5	,6	2,0	4,8	1,3	3,2	2,8
γ-terpinene	2,7	2,3	3,2	,2	,0	,2	,2	,2	,6	24,3	,5	,0	,1	1,7	,5
trans-sabinene hydrate	,6	,4	,6	,3	,9	,3	,8	,8	,6	,6	,1	2,0	1,3	,1	,6
cis-linalool oxide F	,1	,0	,0	,3	,1	,2	,1	,1	,0	,0	,7	3,9	,0	,0	,0
trans-linalool oxide F	,1	,1	,0	,0	,0	,0	,1	,1	,1	,0	1,1	,0	,0	,1	,0
cis-sabinene hydrate	,1	,1	1,1	,3	2,2	,6	1,1	,9	1,4	,1	,2	2,4	3,7	,1	,2
linalool	1,0	1,1	1,0	,0	,0	,0	1,1	1,0	,3	4,1	50,4	,0	,7	,4	,9
unknown	,5	,1	,2	,3	,2	,1	,1	1,0	,2	,0	,0	,0	,2	,1	,1
sabina ketone	,0	,0	,0	,3	,2	,2	,6	,5	1,0	,0	,0	,2	,8	,3	,4
borneol	,5	,7	,1	,3	,4	,2	,3	,2	,1	,1	,2	,4	,1	,1	,1
terpinene-4-ol	,0	,1	,0	,5	,2	,2	,1	,2	,1	,1	,1	,2	,0	,0	,2
unknown	4,1	3,0	3,8	,4	,3	,1	1,3	,9	,8	,0	,4	,3	,0	,0	,0
α-terpineol	,0	,0	,0	1,2	,7	1,0	,0	,2	,2	,1	3,8	8,8	,9	,5	1,3
thymyl methyl ether	,3	,4	,2	,5	,3	,3	,1	,2	,2	1,0	,5	,1	,2	,1	,1
carvacrol methyl ether	,1	,1	,2	,3	,1	,2	,2	,1	,1	5,9	,2	,2	,1	,6	,1
carvone	,0	,0	,0	,3	,0	,1	,0	,0	,0	,0	,0	,0	,0	,1	,0
thymoquinone	,1	,0	,0	,5	,1	,2	,0	,1	,0	,5	,0	,1	,0	,0	,0
unknown	7,9	2,7	2,6	,5	,3	,3	,1	,2	,2	,0	,0	,1	,2	,1	,0
thymol	1,5	,4	,4	,1	,1	,1	,1	,3	,0	11,9	1,2	,0	,0	,2	,4
carvacrol	,2	,0	5,6	,2	,2	,2	,2	,4	,0	13,6	,3	,5	,0	1,3	,3
α-copaene	,2	,2	,0	,3	,2	,2	,6	,5	,6	,1	,1	,1	,4	,4	,5
β-bourbonene	,6	,8	,6	,5	1,3	1,1	2,4	4,7	2,1	,4	,3	,9	1,4	,9	1,2
β-elemene	,2	,2	,2	,4	,2	,3	,4	,5	,6	,0	,1	,4	,4	,4	,5
β-caryophyllene	11,0	21,6	19,0	11,3	10,6	11,8	8,0	6,0	9,1	6,3	7,6	6,5	5,6	8,1	9,0
aromadendrene	,0	,1	,1	,2	,2	,1	,3	,4	,3	,0	,0	,1	,3	,1	,5
unknown	,0	,0	,0	,6	,2	,2	,2	,2	,1	,0	,0	,1	,1	,0	,1
α-humulene	1,8	3,6	2,8	2,2	2,1	2,3	1,1	,9	,9	,9	1,2	1,0	1,1	1,1	1,1
allo-aromadendrene	,5	,5	,5	,2	,2	,2	,7	,9	,6	,0	,1	,6	,9	,9	1,5
γ-muurolene	,0	,1	,1	,3	,1	,1	,1	,0	,0	,3	,0	,1	,0	,1	,1
germacrene D	21,3	28,5	21,7	13,0	13,3	10,4	6,8	7,7	15,2	4,8	5,7	12,8	4,8	7,6	7,2
unknown	,3	,2	,1	,0	,0	,0	,2	,1	,1	,0	,1	,0	,3	,2	,2
bicyclogermacrene	2,0	1,7	1,0	,0	,0	,2	1,3	1,3	,8	3,3	1,7	,1	,2	4,9	1,5
EE-α-farnesene	4,2	2,0	2,2	1,6	2,2	2,3	,8	1,5	1,4	,4	1,1	4,8	,7	3,4	2,2
β-bisabolene	2,5	1,4	3,2	,7	,9	,9	,3	,5	1,1	1,4	1,7	2,0	1,0	,3	,2
δ-cadinene	,2	,5	,6	,3	,1	,3	,3	,4	,1	,4	,1	,1	,5	,2	,4
unknwon	,2	,1	,1	,2	,3	,2	,3	,2	,1	,1	,0	,0	,2	,5	,5
unknown	,1	,4	,7	1,1	1,3	1,2	,7	1,0	,7	,0	,1	,3	1,4	,5	,8
unknown	,1	,0	,0	,4	,4	,3	,2	,4	,1	,2	,0	,1	,6	,1	,0
germacrene D-4ol	4,6	5,0	5,1	,7	1,3	1,0	2,0	2,4	3,6	,2	,7	4,0	2,3	5,6	7,5
spathulenol	,8	,4	,3	1,5	1,8	1,4	3,5	3,0	,7	1,4	1,8	3,3	1,0	8,7	3,5
caryophyllene oxide	1,4	2,7	3,3	8,5	12,5	13,2	11,5	13,0	9,1	,7	2,1	4,4	24,8	10,7	10,9
viridiflorol	,3	,2	,1	,4	,2	,3	,4	1,0	,5	,0	,0	,3	,6	,3	,6
humulene epoxide II	,0	,0	,1	1,7	1,8	1,8	,2	,4	,3	,0	,0	,5	,2	,0	,2
1,10-di-epi-cubenol	,2	,4	,2	,5	,3	,2	1,3	1,6	,7	,1	,3	,0	2,9	1,0	1,7
unknown	,0	,1	,1	,5	,1	,3	,2	,2	,2	,1	,0	,0	,3	,2	,4
unkown	,2	,4	,3	1,0	,8	,7	1,3	1,4	,9	,1	,2	,7	,5	,7	,7
α-cadinol	,2	,2	,1	,6	,4	,4	,2	,5	,4	,0	,1	,1	,4	,2	,4
unknown	,2	,2	,1	,3	,6	,9	1,3	,6	,5	,1	,1	,5	1,5	,7	1,8
unknown	,5	,6	,6	,5	,7	,7	2,5	4,3	2,4	,0	,2	1,9	5,7	3,7	5,8

Table 5: Essential oil composition II – Greece to Israel

Compound	GR1	GR2	GR3	HR1	HR2	HR3	HU1	HU2	HU3	ISR1	ISR2	ISR3	ISR4	ISR5
α-thujene	,6	,6	,6	,5	,6	,9	,6	,4	,5	,5	,4	,6	,6	,5
α-pinene	,5	,6	,5	,8	,4	,5	,7	,5	,7	,6	,6	,6	,7	,7
camphene	,1	,1	,1	,5	,3	,3	,0	,1	,0	,1	,1	,1	,1	,1
sabinene	,0	,0	,1	14,1	,1	,6	9,2	12,6	8,2	,0	,0	,0	,0	,0
1-octen-3-ol	,1	,1	,1	,5	,2	,2	,9	,2	1,0	,1	,1	,1	,1	,1
β-pinene	,3	,2	,2	1,8	,4	,4	1,2	1,5	1,4	,1	,1	,3	,2	,1
myrcene	1,2	1,1	1,2	1,2	,5	,9	2,4	,8	1,1	1,2	1,4	1,4	1,7	1,6
α-terpinene	1,1	,9	,9	,1	,4	,4	,1	,1	,1	1,4	1,3	1,9	1,9	1,8
p-cymene	5,2	5,8	3,6	,8	14,4	2,2	,8	2,1	1,7	7,0	5,2	8,4	7,3	7,6
limonene/β-phellandrene	,3	,3	,3	,8	,2	,3	,9	,4	1,0	,4	,4	,5	,5	,5
1,8-cineole	,0	,0	,4	2,0	,0	,2	1,7	1,8	4,9	,0	,0	,0	,0	,0
trans-β-ocimene	,0	,0	,0	6,5	,0	,1	5,4	4,2	5,8	,0	,0	,0	,0	,0
cis-β-ocimene	,1	,0	,6	3,7	,1	,3	3,0	2,5	4,3	,0	,0	,0	,1	,0
γ-terpinene	7,1	6,1	4,7	,3	2,7	1,9	,2	,3	1,1	6,5	4,8	7,4	8,0	7,7
trans-sabinene hydrate	,6	,5	,6	,5	,5	1,1	1,7	,3	1,6	,7	,6	,7	,7	,7
cis-linalool oxide F	,0	,0	,0	,2	,0	,0	,0	,1	,1	,0	,0	,0	,0	,0
trans-linalool oxide F	,0	,0	,0	,0	,0	,1	,1	,1	,0	,1	,1	,1	,1	,1
cis-sabinene hydrate	,2	,2	,2	,7	,2	,4	10,2	,5	4,7	,2	,2	,2	,2	,2
linalool	,0	,0	,0	2,4	,0	,0	,5	1,1	1,4	,0	,0	,1	,1	,1
unknown	,0	,0	,0	,1	,0	,0	,5	,1	,0	,0	,0	,0	,0	,0
sabina ketone	,0	,0	,0	,5	,0	,0	,2	,8	,3	,0	,0	,0	,0	,0
borneol	,3	,3	,3	,9	,5	,7	,0	,3	,0	,1	,1	,1	,1	,1
terpinene-4-ol	,2	,2	,2	,0	,2	,3	,2	,0	,1	,3	,3	,3	,3	,3
unknown	,0	,0	,0	,0	,0	,0	,6	,5	1,2	,1	,1	,1	,1	,1
α-terpineol	,1	,1	,2	,8	,1	,2	,0	,1	,0	,0	,1	,0	,0	,0
thymyl methyl ether	,2	,0	,0	,0	,5	,0	,1	,1	,0	,0	,0	,0	,0	,0
carvacrol methyl ether	,4	,4	,0	,1	,4	,7	,1	,0	,0	,0	,0	,0	,0	,0
carvone	,0	,0	,0	,0	,0	,0	,0	,0	,0	2,2	1,1	,0	,2	,0
thymoquinone	,7	2,0	,5	,0	2,4	,3	,1	,0	,0	,3	1,3	2,7	1,7	2,7
unknown	,0	,0	,0	,0	,0	,0	1,5	,1	,0	,0	,0	,0	,0	,0
thymol	70,7	,4	70,7	,3	16,6	,3	,0	,2	,1	58,1	19,2	65,6	52,6	36,3
carvacrol	3,5	73,9	8,9	1,9	45,7	82,0	,0	,1	,0	15,1	57,7	3,4	18,8	33,8
α-copaene	,0	,0	,0	,4	,0	,0	,5	,6	,3	,0	,0	,0	,0	,0
β-bourbonene	,0	,0	,0	1,7	,1	,1	3,8	2,4	1,7	,0	,0	,0	,0	,0
β-elemene	,0	,0	,0	,4	,0	,0	,4	,5	,2	,0	,0	,0	,0	,0
β-caryophyllene	2,3	1,6	1,6	9,6	,9	,6	8,7	10,8	13,0	1,6	1,6	1,5	1,3	1,3
aromadendrene	,1	,0	,0	,3	,0	,0	,5	,3	,1	,7	,4	1,0	,5	,6
unknown	,4	,9	,2	,0	2,8	,3	,0	,0	,0	,1	,0	,0	,0	,0
α-humulene	,3	,3	,2	1,2	,2	,1	1,1	1,9	1,3	,0	,2	,2	,1	,1
allo-aromadendrene	,0	,1	,0	,9	,1	,0	,5	,9	1,1	,0	,0	,0	,0	,0
γ-muurolene	,0	,0	,0	,1	,1	,1	,0	,1	,0	,0	,0	,0	,0	,0
germacrene D	,0	,0	,0	13,5	,0	,1	15,3	10,5	9,9	,0	,0	,0	,0	,0
unknown	,0	,0	,0	,2	,1	,0	,2	,1	,1	,1	,0	,0	,1	,0
bicyclogermacrene	,2	,1	,1	1,7	,1	,0	,6	,9	,6	,1	,1	,1	,1	,1
EE-α-farnesene	,0	,0	,0	1,8	,3	,0	1,1	,7	1,8	,0	,0	,0	,0	,0
β-bisabolene	1,1	,5	1,4	,4	,8	1,3	,2	,7	,5	,0	,0	,0	,0	,0
δ-cadinene	,1	,1	,1	,2	,3	,2	,3	,3	,2	,0	,0	,0	,0	,0
unknwon	,0	,0	,0	,1	,0	,0	,0	,1	,0	,0	,0	,0	,0	,0
unknown	,0	,0	,0	,5	,0	,0	,8	1,3	,7	,9	1,0	,9	,8	1,3
unknown	,2	,7	,1	,1	2,6	,1	,3	,2	,1	,0	,0	,0	,0	,0
germacrene D-4ol	,0	,0	,0	6,0	,1	,1	1,7	4,0	6,0	,1	,1	,0	,0	,0
spathulenol	,2	,1	,1	3,0	,2	,0	1,4	2,1	,8	,0	,0	,0	,0	,0
caryophyllene oxide	,4	,4	,3	6,9	1,0	,2	11,0	17,0	10,0	,3	,2	,3	,2	,2
viridiflorol	,0	,0	,0	,4	,0	,0	,4	,5	,6	,0	,0	,0	,0	,0
humulene epoxide II	,0	,0	,0	,3	,0	,0	,1	,2	,1	,0	,0	,0	,0	,0
1,10-di-epi-cubenol	,0	,1	,0	,8	,1	,0	1,7	2,3	1,0	,0	,0	,0	,0	,0
unknown	,0	,0	,0	,1	,0	,0	,3	,2	,1	,0	,0	,0	,0	,0
unkown	,0	,0	,0	,7	,1	,1	,6	1,0	,8	,1	,0	,1	,1	,1
α-cadinol	,0	,0	,0	,5	,0	,3	,4	,6	,2	,0	,0	,0	,0	,0
unknown	,0	,0	,0	,7	,1	,0	,4	,4	,3	,0	,0	,0	,0	,0
unknown	,0	,0	,0	2,9	,1	,0	1,7	4,4	3,7	,0	,0	,0	,0	,0

Table 6: Essential oil composition III – Italy to Norway

Compound	IT1	IT2	IT3	LT1	LT2	LT3	LV1	LV2	LV3	MK1	MK2	MK3	NO1	NO2	NO3
α-thujene	,5	,7	,4	,3	,2	,4	,4	,8	,6	,2	,3	1,2	,7	,5	,3
α-pinene	,5	,3	,2	,5	,7	,8	,9	,9	,4	,6	,6	1,0	,6	,6	,7
camphene	,4	,0	,0	,1	,1	,1	,6	,1	,0	,2	,6	1,5	,3	,1	,0
sabinene	9,5	,2	,1	19,0	7,9	10,0	6,0	8,7	13,4	13,1	4,9	8,2	7,5	11,6	8,0
1-octen-3-ol	,6	,1	,1	,6	1,4	1,1	1,3	1,2	,3	,4	,7	,5	,5	,4	1,0
β-pinene	2,1	,6	,1	1,4	1,1	1,0	1,0	1,6	1,3	1,8	1,1	1,9	,6	1,9	1,6
myrcene	1,2	,9	,6	2,1	3,1	2,4	,7	,3	,3	,6	,5	1,3	1,4	1,2	5,0
α-terpinene	,0	1,1	,6	,1	,1	,2	,0	,1	,1	,0	,0	,1	,0	,0	,1
p-cymene	2,4	2,7	4,0	,5	,4	1,0	1,1	1,9	1,8	,2	1,4	,6	1,0	,4	2,5
limpnene/β-phellandrene	,4	,2	,1	,9	1,3	1,5	,6	,4	,5	1,0	,7	,7	,8	,8	,9
1,8-cineole	,1	,1	,0	1,6	6,7	7,6	7,9	2,2	1,2	4,6	5,0	,3	,3	,9	3,4
trans-β-ocimene	7,2	1,9	,7	8,5	7,4	5,6	5,0	2,4	1,1	3,2	2,3	4,7	4,1	6,1	6,4
cis-β-ocimene	3,1	,3	,1	3,1	4,1	6,5	2,3	,6	,4	1,9	2,1	2,2	3,5	3,7	6,6
γ-terpinene	,2	10,5	4,5	,4	,3	,6	,2	,8	,5	,1	,7	,2	1,5	,2	,7
trans-sabinene hydrate	,8	,6	,4	,4	,8	,9	2,1	4,9	2,2	,7	,7	,9	1,0	,5	,4
cis-linalool oxide F	,1	,0	,0	,1	,1	,1	,2	,4	,1	,0	,0	,0	,1	,0	,0
trans-linalool oxide F	,0	,0	,0	,0	,1	,0	,2	,2	,2	,2	,1	,1	,1	,0	,0
cis-sabinene hydrate	,9	,1	,2	,4	,5	1,6	4,3	1,8	,3	,3	,3	4,1	20,2	12,2	,3
linalool	,4	,0	,3	,8	2,8	1,1	1,0	2,5	,7	,3	,6	1,6	,1	,2	1,1
unknown	,4	,0	,0	,1	,1	,1	,2	,1	,2	,0	,0	,1	,0	,1	,2
sabina ketone	,6	,0	,0	,3	,2	,2	,3	1,4	1,2	,1	,1	,1	,0	,2	,2
borneol	,6	,0	,1	,2	,1	,1	1,1	,1	,1	,3	,3	1,6	,1	,1	,0
terpinene-4-ol	,1	,1	,1	,0	,0	,0	,1	,0	,2	,0	,1	,1	,0	,0	,0
unknown	,2	,1	,0	,0	,0	,0	1,4	1,0	,4	1,3	2,3	11,9	,0	,0	,1
α-terpineol	,1	,1	,1	,6	1,9	1,9	,0	,3	,1	,1	,1	,0	,4	,5	1,3
thymyl methyl ether	,1	,7	1,4	,0	,0	,0	,0	,1	,0	,2	,1	,1	,0	,0	,0
carvacrol methyl ether	,1	1,7	1,5	,0	,0	,0	,1	,1	,0	,1	,1	,1	,1	,0	,2
carvone	,0	,0	,0	,0	,0	,0	,0	,0	,0	,0	,1	,0	,0	,0	,0
thymoquinone	,0	,6	,4	,0	,0	,0	,0	,0	,0	,1	,1	,0	,0	,0	,1
unknown	,0	,0	,0	,0	,0	,0	,0	,1	,0	,1	,2	,1	,0	,0	,3
thymol	1,4	51,9	74,5	,8	,2	,3	,2	,2	,1	,0	,0	,0	,1	,1	,0
carvacrol	,2	3,3	1,2	,0	,1	,1	,2	,2	,1	,0	,0	,1	,6	,3	1,4
α-copaene	1,1	,1	,1	,3	,3	,3	,5	1,2	,7	,3	,2	,7	,0	,2	,3
β-bourbonene	4,9	,1	,1	1,0	,9	1,0	,7	1,7	2,1	2,0	1,9	2,2	,8	,7	,7
β-elemene	,5	,0	,0	,3	,2	,2	,3	1,0	,6	,2	,2	,1	,1	,2	,2
β-caryophyllene	4,6	5,3	,9	10,0	11,4	6,1	9,2	6,1	11,6	10,4	12,9	11,5	15,3	10,4	7,9
aromadendrene	,7	,0	,0	,2	,2	,3	,2	,7	1,0	,1	,2	,2	,0	,3	,1
unknown	,0	,0	,8	,0	,0	,0	,1	,2	,2	,2	,2	,1	,1	,0	,0
α-humulene	,7	,8	,2	1,4	1,7	,8	1,3	,9	2,3	1,9	2,0	1,7	2,1	1,8	1,4
allo-aromadendrene	1,2	,0	,1	1,1	1,0	1,3	1,4	1,2	2,4	2,4	1,8	,6	,6	1,3	1,2
γ-muurolene	,1	,5	,4	,1	,1	,1	,0	,0	,0	,7	1,0	,1	,0	,1	,0
germacrene D	9,9	5,1	,3	12,2	11,6	15,0	7,0	15,3	14,0	8,5	10,2	19,5	10,7	8,3	7,8
unknown	,2	,1	,0	,3	,2	,3	,1	,1	,1	,1	,2	,1	,1	,3	,7
bicyclogermacrene	2,7	1,1	,3	2,7	2,4	1,0	1,1	1,9	,9	,7	2,1	1,2	4,4	3,8	1,6
EE-α-farnesene	2,1	1,0	,1	2,3	2,6	3,5	1,5	2,1	1,0	,5	,9	,8	,9	1,1	,9
β-bisabolene	,1	3,1	1,5	,8	1,1	1,2	,5	1,9	2,0	,4	3,0	1,8	2,7	,9	1,2
δ-cadinene	,5	,9	,7	,3	,3	,4	,4	,4	1,1	,4	,5	,5	,1	,5	,6
unknwon	,2	,2	,1	,0	,1	,1	,0	,1	,6	,0	,2	,2	,1	,1	,1
unknown	,8	,0	,0	,3	,5	,3	,8	,5	,8	,9	,8	,1	,3	,4	,4
unknown	,4	,2	,3	,0	,0	,1	,1	,1	,5	,3	,1	,1	,0	,0	,1
germacrene D-4ol	4,4	,3	,1	7,7	5,4	6,7	3,7	4,1	3,1	8,7	8,9	2,6	5,5	3,9	4,3
spathulenol	9,5	,5	,2	2,4	2,1	3,6	1,4	3,7	3,3	2,1	2,1	1,3	1,4	3,3	3,2
caryophyllene oxide	4,9	,5	,4	4,3	6,5	3,2	13,9	4,5	9,7	9,7	11,2	4,3	4,9	7,6	11,5
viridiflorol	,6	,0	,0	,3	,3	,5	,4	,6	,5	1,2	,8	,1	,2	,2	,4
humulene epoxide II	,6	,0	,0	,2	,2	,3	,2	,4	,2	,6	,4	,0	,0	,1	,2
1,10-di-epi-cubenol	,9	,0	,0	,5	,9	,6	,9	,8	1,4	1,4	1,4	,3	,5	,8	1,4
unknown	,4	,0	,0	,1	,1	,1	,1	,1	1,4	,5	,2	,2	,1	,1	,0
unkown	1,9	,0	,1	,7	,8	,9	,5	,4	,8	,7	,5	,3	,2	,5	,6
α-cadinol	1,2	,1	,1	,3	,4	,6	,3	,6	1,7	,5	,3	,1	,1	,4	,6
unknown	1,2	,1	,1	3,1	2,8	,7	7,9	4,6	1,4	,9	,6	,1	,2	6,9	3,8
unknown	5,3	,0	,1	1,7	2,2	3,3	3,8	6,5	3,7	8,7	5,8	1,0	1,1	1,3	3,1

Table 7: Essential oil composition IV – Portugal to Turkey

Compound	PT1	PT2	PT3	RS1	RS2	RS3	SK1	SK2	SK3	SLO1	SLO2	SLO3	TR1	TR2	TR3
α-thujene	,2	,1	,4	,5	,3	,4	,6	,3	,6	,6	,5	,6	,7	,6	,5
α-pinene	,0	,2	,2	1,0	1,1	,5	,9	,8	,8	,7	1,2	1,5	,5	,4	,4
camphene	,1	,2	,1	,1	,5	,4	,2	,0	,0	,5	1,0	1,4	,3	,1	,1
sabinene	,0	1,7	1,1	11,1	8,3	9,7	16,2	10,2	8,0	7,4	15,2	14,3	,0	,0	,0
1-octen-3-ol	,0	,2	,2	,3	1,6	,2	1,3	1,2	1,0	,6	,6	1,7	,1	,1	,1
β-pinene	,1	,3	,2	,3	,4	,5	1,1	1,2	1,7	1,2	1,7	1,2	,1	,1	,1
myrcene	,3	,5	,8	,9	,8	,9	1,3	1,4	2,4	1,2	,9	1,3	1,3	1,2	1,1
α-terpinene	,1	,0	,5	,0	,1	,1	,2	,2	,1	,5	,1	,2	,7	,9	,6
p-cymene	,1	,3	4,5	1,0	,2	,9	1,0	,7	,8	2,5	1,1	,4	2,5	3,0	2,9
limpnene/β-phellandrene	,0	,1	,1	,6	1,4	,6	1,7	1,2	1,3	,9	1,2	2,3	,3	,3	,3
1,8-cineole	,0	,0	,9	1,7	5,8	,5	8,0	2,6	3,2	1,2	2,9	7,3	,0	,0	,0
trans-β-ocimene	3,5	1,8	1,6	2,7	3,6	3,8	4,6	7,6	6,9	4,4	2,4	1,9	,0	,0	,0
cis-β-ocimene	,4	2,6	2,0	1,5	2,2	2,1	5,8	5,2	6,6	4,2	4,0	4,3	,0	,0	,0
γ-terpinene	,5	,2	7,7	,1	,2	,1	,6	,4	,2	7,5	,4	,4	3,4	5,2	3,0
trans-sabinene hydrate	,1	,6	,5	,4	,3	,5	1,8	1,6	1,3	1,6	,9	6,5	,6	,6	,5
cis-linalool oxide F	,4	,6	,0	,2	1,9	,1	,0	,0	,0	,0	,1	,0	,0	,0	,0
trans-linalool oxide F	,2	,3	,0	,0	,0	,0	,0	,1	,1	,0	,2	,1	,1	,1	,1
cis-sabinene hydrate	,0	,2	,1	1,6	1,4	3,2	2,3	4,4	13,8	8,7	,4	9,3	,2	,2	,2
linalool	76,4	38,5	7,1	,0	,0	,0	,7	1,0	1,2	,4	,3	,3	,0	,0	,0
unknown	,0	,8	,1	,2	,2	,2	,0	,0	,0	,0	,0	,2	,0	,0	,0
sabina ketone	,0	,0	,0	,2	,1	,2	,4	,1	,1	,0	,2	,1	,0	,0	,0
borneol	,0	,2	,2	,2	,6	,3	,2	,0	,0	,7	1,3	1,6	1,0	,5	,7
terpinene-4-ol	,0	,1	,1	,3	,0	,4	,0	,1	,0	,0	,1	,1	,3	,3	,3
unknown	,0	,2	,0	,3	,1	,3	1,6	1,1	1,1	,5	1,0	2,4	,1	,1	,1
α-terpineol	,5	,9	,6	1,0	1,3	,3	,0	,0	,0	,0	,1	,0	,0	,0	,0
thymyl methyl ether	,1	,2	1,2	,1	,2	,2	,0	,0	,0	,5	,1	,0	,0	,0	,0
carvacrol methyl ether	,5	,5	5,1	,1	,0	,1	,0	,0	,0	1,5	,0	,0	,2	,1	,2
carvone	,0	,1	,0	,1	,0	,1	,0	,0	,0	,0	,0	,0	,0	,0	,0
thymoquinone	,0	,0	,6	,1	,1	,0	,0	,0	,0	,1	,0	,0	,5	,9	,6
unknown	,0	2,2	,1	,3	,1	,1	,0	,0	,0	,0	,1	,0	,5	,6	,5
thymol	,6	1,0	19,1	,1	,1	,0	,1	,1	,1	1,9	,2	,0	,2	,2	,3
carvacrol	3,0	,3	18,6	,1	,1	,1	,0	,0	,0	5,1	,1	,1	79,4	76,9	79,2
α-copaene	,0	,1	,0	,1	,1	,1	,0	,0	,1	,1	,3	,1	,0	,1	,0
β-bourbonene	,1	,4	,2	1,8	1,2	,8	,8	,8	1,6	,7	2,5	,9	,0	,0	,0
β-elemene	,0	,1	,1	,4	,4	,2	,4	,2	,1	,1	,2	,1	,0	,0	,0
β-caryophyllene	,8	5,6	6,0	14,5	11,8	12,6	10,3	12,6	9,5	8,9	11,1	8,8	1,0	1,2	1,2
aromadendrene	,0	,1	,3	,1	,0	,0	,1	,1	,1	,1	,1	,1	,1	,1	,2
unknown	,0	,0	,0	,1	,1	,2	,0	,0	,0	,0	,0	,1	,0	,0	,0
α-humulene	,2	1,1	,7	2,4	1,6	2,1	1,2	1,1	1,0	1,3	2,0	1,2	,1	,1	,1
allo-aromadendrene	,0	,1	,0	,3	,9	1,0	,6	,7	,6	,9	,4	,4	,0	,0	,0
γ-muurolene	,0	,1	,1	,1	,2	,1	,0	,0	,0	,1	,1	,0	,0	,0	,0
germacrene D	4,1	4,3	3,5	15,7	15,5	18,2	10,2	16,4	12,2	14,3	20,3	13,7	,1	,1	,1
unknown	,0	,1	,2	,0	,0	,0	1,0	1,9	,1	,2	,2	,2	,0	,0	,0
bicyclogermacrene	2,8	1,5	2,0	,1	,0	,1	,8	1,9	1,2	2,0	1,2	1,3	,1	,1	,1
EE-α-farnesene	,9	,6	1,7	2,2	3,1	2,9	1,8	2,9	,7	2,9	1,1	2,5	,0	,0	,0
β-bisabolene	,7	1,3	2,4	,3	1,4	2,1	1,5	,7	,3	1,0	,2	,4	,9	1,1	1,0
δ-cadinene	,1	,1	,4	,0	,1	,1	,1	,2	,1	,4	,2	,2	,1	,0	,1
unknwon	,0	,2	,1	,3	,1	,2	,0	,0	,1	,5	,7	,1	,0	,0	,0
unknown	,0	,4	,0	,8	,3	,4	,6	,3	,6	,1	1,9	,5	1,1	1,3	1,5
unknown	,0	,1	,1	,1	,1	,2	,0	,1	,1	,0	,3	,0	,0	,1	,1
germacrene D-4ol	,0	,5	,1	2,1	5,1	6,1	2,5	5,4	2,5	5,0	2,3	2,7	,0	,0	,0
spathulenol	1,5	10,1	3,6	,4	,2	1,1	2,1	2,5	2,3	,4	1,5	,9	,1	,1	,2
caryophyllene oxide	,1	10,3	2,2	9,9	5,6	6,4	8,3	4,4	7,2	1,2	6,2	2,2	,3	,4	,4
viridiflorol	,0	,2	,0	,1	,2	,3	,3	,3	,3	,2	,1	,1	,0	,0	,0
humulene epoxide II	,0	,1	,1	1,2	,9	,9	,1	,1	,0	,1	,2	,1	,0	,0	,0
1,10-di-epi-cubenol	,0	1,3	,3	,1	,1	,1	,7	,5	,9	,2	,9	,2	,0	,0	,0
unknown	,0	,2	,1	,1	,1	,1	,0	,0	,0	,1	,5	,1	,0	,0	,0
unkown	,1	,5	,3	,5	,4	,3	,7	,6	,7	,2	,7	,5	,0	,0	,0
α-cadinol	,0	,4	,2	,4	,3	,2	,2	,3	,3	,1	,5	,2	,0	,0	,0
unknown	,0	,3	,3	,4	,5	,6	,2	,3	,4	2,9	,5	,2	,0	,0	,0
unknown	,0	1,1	,2	,7	1,7	1,8	2,1	1,6	1,9	,6	1,4	,5	,0	,0	,0

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