

Biodiversity of Medicinal Plants Containing Essential Oil and Their Spreading in Adjara

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Abstract Adjara (South Kolkheti), located in the southwestern part of Georgia, it is characterized by warm and humid climate and subtropical climate, which is due to the proximity of the Black Sea. Adjara is remarkably rich in the diversity of flora not only in Georgia, but throughout the Caucasus. At present there are 1837 plant species in the flora of Adjara, 72 of which contain essential oils, they are distributed in 22 families and in 52 genera. Plants containing essential oil belongs: Lamiaceae - 18 species, Asteraceae-17 types, Apiaceae - 9, Cupressaceae-3, Pinaceae-3, Myrtaceae-3. Vital forms are 7 species of trees, 5 species of bushes, 1 species of tree or bushes, 49 species of perennial grass, 6 species of annual grass. According to the geographical coordinates from the sea level up to 0-500 m are spread 36 species containing essential oils, from the sea level up to 500-1000 m 28 species, from the sea level up to 1000 m 2200 m 33 species. According to the origin of species, 48 species are wild relatives, 7 is cultivated as vegetables, 3 species are introduced, 3 species are invasive. According to the percentage content of essential oils there are: 1 species - 0,025-0,04%, 4 species - 0,1-0,44%, 37 species - 0,2-0,4%, 21 Species - 0,7-1,0%, 7 species - 1,0-3,0%, 3 species - 4,0-6,0%. In the studied species the essential oils structure is complex and diverse. Monoterpens are distributed in 10 species, Sesquiterpences in 5 species, α -pinene in 7 species, β -pinene in 3 species, α - and β - pinene in 16 species, cineol in 8 species, menthol in 6 species, lemonene in 3 species, in single species are found geraniol, borneol, apiol, thujone, karvakrol and others. In the studied species has been identified 3 prospective invasive species, which are distinguished by great resource, not used Georgia as per officinal medicine, but in their home countries (USA, Japan, China) are valuable medicinal plants, these species produced oils containing quantitative analysis, analysis revealed that, *Artemisia vulgaris* of upper part of the ground contain 0,9% essential oils, with components korizin, tuion, cineol. *Perilla nancinensis* of upper part of the ground contain 0,88% essential oils; the main component of the essential oil are perilla-ceton and carophylen, *Erygeron canadensis*

upper part of the ground contain 0,93% essential oils and its main components are limonene and terpineol. It also contains alcaloyds, flavonoids and tanner materials

Keywords Adjara Flora, Essential Oil, Family, Medicinal Plants, Biodiversity

1. Introduction

Adjara is located in the south western part of Georgia. It is characterized by warm and humid subtropical climate. Flora of Adjara is unique, diversity and among them are many endemic. The distinguishing nature of the flora determines that Kolkheti was the shelter-refugee of ancient plant species (relics) during the ice age. Adjara also rich in invincible, invasive and wild relatives species. Adjara is a mountainous region and its flora is characterized by vertical lobes of spread. At present, there are 1837 species registered in the floristic region of Adjara, which include 159 families and 742 genera, from them used for medicinal purposes - 180 species. Among the medicinal plants, there are plants containing essential oils. They contain up to twenty organic compounds, including hydrocarbon mixtures and oxygen-containing components: alcohol, aldehydes, acute esters, phenols, carbonic acids, oxides and lactones. Essential oils are located in special glands, which are located in leaves, flowers, fruits, seeds, roots. The quantitative content of essential oils from 0.01% to several percent of the plant. Its content depends on the type of plant, on the development stage, on the natural conditions and the plant's age. At the end of vegetation, the content of essential oils are always reduced and collected in the seed. The function of essential oils in the plant is the drawing of insect suppressor, and they regulate the plant's heat transfer. Essential supplements in medicine are used as antibacterial and antimicrobial means, have sedative, spasmolytic and other effects. Thus, the study of plants containing essential

oils is one of the most important problems.

2. Method

The major method of the research is the traditional expedition-excursion method-collecting plants for herbarium and cameral processing. We identified plants according to the plant indexes of Adjara [3.4], Crops international descriptors (International crop descriptors), Peculiarities of crop international collecting (International collecting descriptors) [2.6]. We made the photochemical analysis according to the methods of hydro-distillation and air-liquid chromatography [1].

3. Results

Plants spreaded in Adjara and contain essential oils are Pterophyta which is belonged by 1 family with 2 races and 2 species; Pinophyta - 2 families, 4 races and 6 species; Magnoliophyta - 46 races and 64 species of 19 families. The richest families are Lamiaceae - 18 species, Asteraceae - 17 species, Apiaceae - 9 species. 7 species of plant containing essential oil are trees, 1 species - tree or bushes, 5 species of bushes, perennial grasses - 49 and annual grasses - 6 species.

We can find out 4 important species: *Artemissia vulgaris*, *Erygeron Canadensis*, *Melissa officinalis*, *Perilla nancinensis*.

4. Discussion

The above is strengthened by the fact that WWF's initiative on "100 hotpots of European forests" (i.e. 100 unprotected forest plots requiring protection) priority was given to unique Kolkheti relict forests of Adjara [5]. Flora of Adjara includes 1837 wild relative species, which are united in 159 family and 742 genus. Ferns are 61 (3,32%), Gimnospermae - 8 (0,44 %), Angiospermae 1768 (96,24%), Dicotiledone are 1372 (74,67%), monocotiledone 396 (21,55%); wild relatives of grasses are 1660 species [3.4.7].

According to the analysis of flora of Adjara, we have established the fact that 72 types of plants in Adjara contain essential oils [8.9.10]. 7 species of plant containing essential oil are trees, 1 species - tree or bushes, 5 species of bushes, perennial grasses - 49 and annual grasses - 6 species. With the high diversity of species are distinguished the following families: Lamiaceae - 18, Asteraceae - 17, Apiaceae - 9, Cupressaceae - 3, Pinaceae-3, Myrtaceae-3, Polypodiaceae - 2, Adoxaceae - 2, Fabaceae, Acoraceae, Aristolochiaceae, Cyperaceae, Geraniaceae, Oleaceae, Lauraceae, Oleaceae, Liliaceae, Ruscaceae, Primulaceae, Scrophulariaceae, Valerianaceae, Violaceae - 1. There are four species containing important peculiarities: *Artemissia vulgaris*, *Erygeron Canadensis*, *Melissa officinalis*, *Perilla nancinensis*. Their annotated list and meaning is given in the table 1.

Table 1. List of plants having essential oils in Adjara

#	Latin Name	Vital Form	Distribution from sea level, m	Part of essential oils	Phytochemical content
1	Pterophyta Family Polypodiaceae <i>Pteridium tauricum</i>	Perennial grass	50–1700	Underground part	0,025-0,045% Essential oils, carbohydrates, bitter substances, monoterpens
2	Family Polypodiaceae <i>Dryopteris filix mas</i>	Perennial grass	50–1700	Underground part	0,144-0.2% Essential oils, tanning substances, sapons, flavonids, phenolic compounds, organic acids. macroelements: K, C, Mg, Fe; Zn, Se, Ba, Al, Fe
3	Pinophyta Family Cupressaceae Pinophyta <i>Juniperus Sabina</i>	Evergreen bush	1700–2200	Needle, buds	0,16-0,44% Essential oils, sugar, phinephoside, fatty oils, apple acids, antibiotic, bicicular
4	Family Cupressaceae <i>Juniperus rufescens</i> Link	Evergreen bush	1700–2200	Cones	0,21-0,43% Essential oils, vitamine C, phytocytes, fatty oils, organic acids, α -pinen, cedrol
5	Family Cupressaceae <i>Juniperus communis</i>	Evergreen bush	1200–1450	Cones	0,21-0,42% Essential oils, fatty oils, vitamin C, organic acids, α -pinen 27.2%, β -pinen 22,4%, 3-Karen 7%, β -felandren 5,7%.
6	Family Pinaceae <i>Abies nordmaniana</i>	Evergreen tree	1800–2050	Cones	0,19-0,4% Essential oils, resins, phytochemicals, vitamins C and B, α -tuion, β - tuion, 1,4-cineol, cisocimen, α -pinen, β -pinen, terpinen, metiltimol, longciklen, izoborneol
7	Family Pinaceae <i>Picea orientalis</i>	Evergreen tree	800–2100	Needle, buds, cones	0,2–0,4% Essential oils, phinephoside, resins, salts, α -pinen, karen, kampen, mirceen, fellandren, myrcen, terminien, cineol, Cr, Mn, Cu, Al,

8	Family Pinaceae <i>Pinus sosnovskii</i>	Evergreen tree	500–1100	Needle, buds	0,36% Essential oils tanning agents, vitamin C, carotenoids, flavonoids, α -pinen, β - pinen 40%, β -lemonen 40%
9	Magnoliophyta Family Adoxaceae <i>Sambucus ebulus</i>	Perennial grass	50–2200	Fruits	0.32%, essential oils, tissue substances, bitter substances, organic acids
10	Family Apiaceae <i>Anethum graveolens</i>	Perennial grass	50–2000	Upper part of ground	0,2-0.4% Sensivitopenic essential oils, Vitamins C and B.
11	Family Apiaceae <i>Anethum graveolens</i>	Perennial grass	50–2000	Upper part of ground	0,2-0.4% Essential oils, vitamins C, B,
12	Family Apiaceae <i>Angelica adjarica</i>	Perennial grass	1200–1700	Upper part of ground	0.1-0.2% Essential oils, bitter substances, alkaloids
13	Family Apiaceae <i>Apium graveolens</i>	Long-standing grass	50–2000	All parts of the plant	0,1% essential oils, 3% sugars, glycosides, mucous, potassium, calcium, phosphorus and sodium salts, acidic acid, vitamins C, B, PP, glycosides, limonen (up to 70%), terpenic hydrocarbons
14	Family Apiaceae <i>Carum carvi</i>	Perennial grass	50–1000	Upper part of ground	1% essential oils, fats, protein substances, carvone 45 - 60%, carvacrol, limonen
15	Family Apiaceae <i>Coriandrum sativum</i>	Annual grass	50–2000	Upper part of ground	0,7-1% Essential oils, fats, 92% glycerides, 7.5% unconventional substances, alkaloids, vitamins A and C.
16	Family Apiaceae <i>Foeniculum vulgare</i>	Annual grass	50–2000	Upper part of ground	The fruits contain 4- 6.5% essential oils, 12-18% fats. The leaves contain 0,62-1,54% essential oils, vitamins C, B, nicotine and amber acid, mineral salts, microelements: Ca, K, P, seeds contain up to 18% fatty oil.
17	Family Apiaceae <i>Petroselinum sativum</i>	Annual grass	50–2000	All parts	The roots contain 0,1% of essential oils, mucus, microelements: potassium, calcium, iron, phosphorus. Seeds contain essential oils, fatty oils, vitamin C and pro-vitamin A. Leaves contain, tannins, ascorbic acid, difficult essential oils, flavonoids, mineral salts, microelements, vitamin K
18	Family Apiaceae <i>Peucedanum caucasicum</i> (Bieb.)	Perennial grass	1200–1500	Upper part of ground	0,7-1% Essential oils, protein substances
19	Family Apiaceae <i>Trachyspermum ammi</i>	Perennial grass	400–1000	Upper part of ground	0,2-0.4% Essential oils, glycosides, flavonoids, 20% fats, α - pinen
20	Family Acoraceae <i>Acorus calamus</i>	Perennial grass	0–25	Radicele	1-2,2% of essential oils, bitter glycoside, ascorbic acid (150 mg%), tonsillitis, alkaloids
21	Family Aristolochiaceae <i>Asarum intermedium</i> (C.A.Mey.) Grossh	Perennial grass	500–700	Upper part of ground	0,2-0.4% Essential oils, alkaloids, phenols, β -pinen, β -filandren
22	Family Asteraceae <i>Achillea bisserata</i>	Perennial grass	400–1200	Flowers	0,85% essential oils, alkaloid, amylene, inuline, asparagine, nitrates, organic acids, carotene, vitamins C, K, B
23	Family Asteraceae <i>Achillea biebersteinii</i>	Perennial grass	500–2000	Flowers	0.83% Essential oils, alkaloid amylene, inuline, asparagine, nitrates, organic acids, carotene, vitamins C, K, B
24	Family Asteraceae <i>Achillea nobilis</i>	Perennial grass	500–2000	Flowers	0,84% essential oils, inulin, nitrates, organic acids, carotene, vitamins C, K, B,A, sabinen
25	Family Asteraceae <i>Achillea neilreichii</i>	Perennial grass	500–2000	Flowers	0,7%, essential oils, alkaloids amylene, inulin, asparagine, nitrates, organic acids, carotene, vitamins C, K, α -pinen, sabinen

26	Family Asteraceae <i>Achillea filipendulina</i>	Perennial grass	500–2000	Flowers	0,6% essential oils, alkaloids, flavonoid, rutin, inulin, asparagine, nitrates, organic acids, vitamins C, K, B
27	Family Asteraceae <i>Achillea latiloba</i>	Perennial grass	500–2000	Flowers	0,72% essential oils, alkaloid amylen, flavonoids, apple acid, carotene, vitamins C, K, sabinen
28	Fam. Asteraceae <i>Achillea millefolium</i>	Perennial grass	500–2000	Flowers	0,85 % essential oils, alkaloid, amylen, flavonoids, apple acid, carotene, vitamins C, K, α -pinen (3.6-8.0), β -pinen (18.4-33.9)
29	Family Asteraceae <i>Achillea satacea</i>	Perennial grass	50–800	Flowers	0,9% essential oils, alkaloid, amylen, flavonoids, apple acid, carotene, vitamin C, α -pinene, sabinene, β -pinene
30	Family Asteraceae <i>Artemisia absinthum</i>	Perennial grass	50–200	upper part of ground	0,72% essential oils, alkaloid, amylen, flavonoids, apple acid, carotene, vitamins C, K
31	Family Asteraceae <i>Artemisia vulgaris</i>	Perennial grass	50–1800	upper part of ground	0,8% Essential oils, tanning and mucous substances, sugars, carotene, ascorbic acid
32	Fam. Asteraceae <i>Erigeron Canadensis</i>	Perennial grass	50–2000	upper part of ground	1,1% Essential oils, alkaloids, flavonids, monotarpens, tonsils, sesquiterpaces, sabinen
33	Family Asteraceae <i>Helicrysum graveolens</i>	Perennial grass	2000–2200	Flowers	0,2-0.4% Essential oils, flavones and flavono glycosides, saponins, sterin, carotene, vitamins C and K, sodium, potassium, iron salts, monotarpens: α -pinene, β -pinene, limonene, sesquiterpens
34	Family Asteraceae <i>Helicrysum poliphylum</i>	Perennial grass	2000–2200	Flowers	0,2-0,4% Ethers, flavones and flavonogenic glycosides, saponins, sterin, carotene, vitamins C and K, tanning substances, microelements, cadinene, monotarpens
35	Family Asteraceae <i>Inula helenium</i>	Perennial grass	1700–2100	Underground part	0,2-0,4% essential oils, lactones, inulin, starch, polysaccharides, pectinous substances, resinous substances, vitamin E, ash, pinene, sabinene
36	Family Asteraceae <i>Matricaria chamomilla</i> var. <i>reicutita</i>	Annual grass	600–1000	Flowers	0,8% - Essential oils, lactones, matricarin, organic acids, resins, polysaccharides, flavonoids, carotenoids, ascorbic acid
37	Family Asteraceae <i>Pyretrum parthenifolium</i>	Annual grass	1500–1800	Flowers	0,6% Essential oils, lactones, matricarin, organic acids, resins, polysaccharides, flavonoids, carotenoids, ascorbic acid
38	Family Asteraceae <i>Pyretrum roseum</i>	Perennial grass	600–1000	Flowers	0,8% Essential oils, matricarin, organic acids, resins, flavonoids, polysaccharides, carotenoids, ascorbic acid
39	Family Brassicaceae <i>Capsella bursa-pastoris</i>	Annual grass	50–2000	upper part of ground	0.16-0,44% Essentials, glycosides, saponins, alkaloid. wine, apple and lemon acids, vitamin C (200 mg /%), carotene, mineral salts, iciccular
40	Family Brassicaceae <i>Raphanus sativus</i>	Annual grass	25–500	Underground part	0,2-0.4% Essential oils, A, B, C vitamins, organic acids, simple carbohydrates, sesquiterpens
41	Family Cyperaceae <i>Cyperus badius</i>	Perennial grass	23–500	Underground part	0,23-0,45% Essential substances, coumarines, β -selinen, α -cyperon, cyperen,
42	Family Fabaceae <i>Trifolium pretense</i>	Perennial grass	25–1900	Upper part of ground	0,24-0,44% Essential oils, phenols, carbohydrates, monotarpens, isoprenoid
43	Family Geraniaceae <i>Geranium robertianum</i>	Perennial grass	1000–2200	Upper part of ground	0,2-0.4% Essential oils, alkaloids, phenols, isoprenoid

44	Fam. Lamiaceae <i>Calamintha grandiflora</i>	Perennial grass	1000–2200	Upper part of ground	0,3-0.8% Essential oils, carbohydrates, flavonoids
45	Family Lamiaceae <i>Glechoma hederaceae</i>	Perennial grass	50–2000	Upper part of ground	0,2-0.4% Essential oils, 8% tannins, bitter substances, choline
46	Family Lamiaceae <i>Lavandula vera</i>	Evergreen bush	30–100	Upper part of ground	0.162-0.38% Essential oils, organic acids, carotene, flavonoid hepperidine
47	Family Lamiaceae <i>Leonurus quinquelobatus</i> Gilib	Perennial grass	1600–1900	Upper part of ground	0,2-0.4% Essential oils, alkaloids, tanning agents, flavonoids, α -pinen, piperiton
48	Family Lamiaceae <i>Mellisa officinalis</i>	Perennial grass	25–1000	Upper part of ground	0,2% Essential oils, tissue substances, mucus, cytral
49	Family Lamiaceae <i>Mentha aquatica</i>	Perennial grass	500–2400	Upper part of ground	0,4-0.8% Essential oils, carbohydrates, glycosides, α -pinen, β - pinen, piperiton, menthol, terpinen, menthofuran
50	Family Lamiaceae <i>Mentha longifolia</i>	Perennial grass	500–2400	Upper part of ground	0,3-0.8% Essential oils, flavonids, α - pinen, β -pinen, terpinen
51	Family Lamiaceae <i>Mentha pulegium</i>	Perennial grass	50–1000	Upper part of ground	0,2-0.4% Essential oils, vitamins C, B, chromotids, simple carbohydrates, menthol, limonene
52	Family Lamiaceae <i>Mentha piperita</i>	Perennial grass	50–200	Upper part of ground	2,5% -4,6% Essential oils, 40-70% organic acids, carotene and flavonides, hepperidine, α -pinen, β -pinen, terpinene, menthol 40–70%
53	Family Lamiaceae <i>Origanum vulgare</i>	Perennial grass	200–500	Upper part of ground	0,5-1,2% Essential oils, tissue substances, vitamin C 565 mg /%, carvacrol, menthol
54	Family Lamiaceae <i>Osimum basilicum</i>	Annual grass	50–1000	Upper part of ground	0,2-0,4% of essential oils, tannins, difficult carbohydrates, carotene, vitamins C, B2, K, linalool (17.7 %), methyl chavicol (28.0 %) and eugenol (36.2 %)
55	Family Lamiaceae <i>Perillana nankinensis</i>	Perennial grass	30–600	Upper part of ground	0,21-0,42% essential oils, flavonoids, procourmaries, carbohydrates,
56	Family Lamiaceae <i>Salvia glutinosa</i>	Perennial grass	400–1200	Upper part of ground	0,23-0,44% Essential oils, organic acids, carotenoids, α -pinen, Sabinen, β -pinen, limonene, terpinene
57	Family Lamiaceae <i>Salvia solarea</i>	Perennial grass	1100–15000	Upper part of ground	1,2% essential oils, alkaloids, tissue substances, organic acids, vitamin B, pinene, linalool, thymol, carvacrol,
58	Family Lamiaceae <i>Satureia laxiflora</i> L.	Perennial grass	200–1300	Upper part of ground	0,17-0,41% Essential oils, procourmaries, ascorbic acid, terpinen, thymol, carvacrol, microelements,
59	Family Lamiaceae <i>Scutellaria galericulata</i>	Perennial grass	500–1700	Upper part of ground	0,2-0,4% Essential oils, procourmaries, ascorbic acid, carbohydrates, carvacrol, microelements,
60	Family Lamiaceae <i>Thymus grossheimi</i>	Perennial grass	500–1700	Upper part of ground	0,17-0,37% Essential oils, flavonids, 1,8-cineole
61	Family Lamiaceae <i>Stachys sylvatica</i>	Perennial grass	600–1700	Upper part of ground	0,2-0,4% Essential oils, flavonids, procourmaries, mineral salts.
62	Family Lauraceae <i>Laurus nobilis</i>	Evergreen tree or bush	50–1000	Leaf	4-5% Essential oils, organic acids, polysaccharides, 1,8-cineol (40%), pinen, linalool, limonene, eugenol,
63	Family Liliaceae <i>Allium ursinum</i>	Perennial grass	130–1900	Bulbs, leaves	0,2-0,4% Essential Oils, vitamins C and B, phinocytes
64	Family Rusceae <i>Ruscus ponticus</i>	Perennial grass	400–1000	Upper part of ground	0,2-0,4% Essential oils, sucrose, monotarpens.
65	Family Myrtaceae <i>Eucaliptus cinerea</i>	Evergreen tree	50–300	leaves	2,5% essential oils, tannins, procourmaries, organic acids, cineol, aldehydes
66	Family Myrtaceae <i>Eucaliptus globules</i>	Evergreen tree	50–300	leaves	2,7% Essential oils, tannins, procourmaries, organic acids, cineol, aldehydes,
67	Family Myrtaceae <i>Eucalyptus wiminalis</i>	Evergreen tree	50–300	leaves	2,5% essential oils, tannins, procourmaries, organic acids, cineol, aldehydes,

68	Family Oleaceae <i>Jasminum officinale</i>	Crawling bush	50–500	Flower	0,2-0.4% Essential oils, carotenoids, benzylacetate, benzyl alcohol, indoline, krezol, vitamin A, B, 4-terpineol
69	Family Primulaceae <i>Primula sibthorpii</i>	Perennial grass	50–1000	Upper part of ground	0,2-0.4% Essential oils, carotenoids, sapons, vitamins C, B, cineol, aldehydes, mineral salts,
70	Family Scrophulariaceae. <i>Linaria vulgaris</i>	Perennial grass	1700–2300	Upper part of ground	0,2-0.4% Essential oils, flavonoids, alkaloids. α -pinen, limonen, piperiton, microelements
71	Family Valerianaceae <i>Valeriana eriophylla</i>	Perennial grass	2000–2100	Underground part	0,19-0.36% Essential oils, alkaloids, tannins, sugars, α -pinen, limonen, piperiton, cymol
72	Family Violaceae <i>Viola arvensis</i> Murr	Perennial grass	50–2000	Upper part of ground	Essential oils, flavonoid, carotenoids, polysaccharides, mucous substances, isobutanol, butanol

From the table 1, there is evident that 50 species contain essential oils are medical; they are used as sedative and digestive system of means. 17 - species have decorative quality, 13 - species are used as food, 9 - species are weeds, the essential oils are piling up in the ground parts and in the 38 species - in upper parts of the ground, 12 - in the flowers, 8 - in the leaves and 4 - species in the fruits.

5. Conclusions

In above mentioned species spread in the flora of Adjara we can distinguish 4 species having important peculiarities: *Artemisia vulgaris*, *Erygeron Canadensis*, *Melissa officinalis*, *Perilla nancinensis*. In order to study the content of essential oils of these species, we made the qualitative and quantitative photochemical analysis; afterwards we proved that: *Melissa officinalis* (upper ground part) contain 0,02-0,03% essential oils; *Artemisia vulgaris* (upper part of the ground) contain 0,5-0,7% essential oils; *Perilla nancinensis* (upper part of the ground) contain 0,28% essential oils; *Erygeron canadensis* (upper part of the ground) contain 0,33-0,66% essential oils.

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