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 22 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, apio, thuione, karvakoil 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, Artemissia 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 caraphylen, Erygeron canadensis upper part of the ground contain 0,93% essential oils and its main components are limonene and terpineol. It also contains alcaloids, 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-refuge 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, spasmylytic and other effects. Thus, the study of plants containing essential
oil 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%), Gymnospermae - 8 (0,44 %), Angiospermae 1768 (96,24%), Dictotyledone 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 scpecies 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, Polypodiaeae - 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.

| #  | Latin Name                  | Vital Form         | Distribution from sea level, m | Part of essential oils | Phytochemical content                                                                 |
|----|------------------------------|--------------------|--------------------------------|------------------------|----------------------------------------------------------------------------------------|
| 1  | Pterophyta                   | Perennial grass    | 50–1700                        | Underground part       | 0,025-0,045% Essential oils, carbohydrates, bitter substances, monoterpens              |
| 2  | Family Polypodiaeae          | Perennial grass    | 50–1700                        | Underground part       | 0,144-0,2% Essential oils, tanning substances, sapons, flavonoids, phenolic compounds, organic acids. macroelements: K, C, Mg, Fe; Zn, Se, Ba, Al, Fe |
| 3  | Family Cupressaceae          | Evergreen bush     | 1700–2200                      | Needle, buds           | 0,16-0,44% Essential oils, sugar, phinephoside, fatty oils, apple acids, antibiotic, bicicular |
| 4  | Family Cupressaceae          | Evergreen bush     | 1700–2200                      | Cones                  | 0,21-0,43% Essential oils, vitamin C, phytocytess, fatty oils, organic acids, α-pinen, cedrol |
| 5  | Family Cupressaceae          | 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              | 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, terpin, metiltimol, longicklen, izoborneol |
| 7  | Family Pinaceae              | Evergreen tree     | 800–2100                       | Needle, buds, cones    | 0,2–0,4% Essential oils, phinephoside, resins, salts, α-pinen, karen, kampen, mireen, fellandren, myrcen, terminien, cineol, Cr, Mn, Cu, Al, |
| No. | Family (Order) | Common Name | Plant Type | Stem Diameter | Parts Utilized | Main Constituents |
|-----|---------------|-------------|-------------|---------------|----------------|-------------------|
| 8   | Pinaeceae     | Pinus sosnovskii | Evergreen tree | 500–1100 | Needle, buds | 0.36% Essential oils tanning agents, vitamin C, carotenoids, flavonoids, α-pinene, β-pinene 40%, β-lemonene 40% |
| 9   | Magnoliophyta | Sambucus ebulus | Perennial grass | 50–2200 | Fruits | 0.32%, essential oils, tissue substances, bitter substances, organic acids |
| 10  | Apiaceae      | Anethum graveolens | Perennial grass | 50–2000 | Upper part of ground | 0.2-0.4% Sensitivopenic essential oils, Vitamin C and B. |
| 11  | Apiaceae      | Angelica adjarica | Perennial grass | 1200–1700 | Upper part of ground | 0.1-0.2% Essential oils, bitter substances, alkaloids |
| 12  | Apiaceae      | Apium graveolens | 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 |
| 13  | Apiaceae      | Carum carvi | Perennial grass | 50–1000 | Upper part of ground | 0.7-1% Essential oils, fats, 92% glycerides, 7.5% unconventional substances, alkaloids, vitamins A and C. |
| 14  | Apiaceae      | Coriandrum sativum | 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. |
| 15  | Apiaceae      | Foeniculum vulgare | Annual grass | 50–2000 | Upper part of ground | The roots contain 0.1% of essential oils, mucus, microelements: potassium, calcium, iron, phosphorus. Seeds contain essential oils, fatty oils, vitamin C and provitamin A. Leaves contain tannins, ascorbic acid, difficult essential oils, flavonoids, mineral salts, microelements, vitamin K |
| 16  | Apiaceae      | Petroselinum sativum | Annual grass | 50–2000 | All parts | 0.84% essential oils, inulin, nitrates, organic acids, carotene, vitamins C, K, α-pinene, sabinen |
| 17  | Apiaceae      | Peucedanum caucasicum (Bieb.) | Perennial grass | 1200–1500 | Upper part of ground | 0.7-1% Essential oils, protein substances |
| 18  | Apiaceae      | Trachyspermum ammi | Perennial grass | 400–1000 | Upper part of ground | 0.2-0.4% Essential oils, glycosides, flavonoids, 20% fats, α-pinene |
| 19  | Acoraceae     | Acorus calamus | Perennial grass | 0–25 | Radicel | 1-2.2% of essential oils, bitter glycoside, ascorbic acid (150 mg%), tonsilitis, alkaloids |
| 20  | Aristolochiaceae | Asarum intermedium (C.A.Mey.) Grossh | Perennial grass | 500–700 | Upper part of ground | 0.2-0.4% Essential oils, alkaloids, phenols, β-pinene, β-filandren |
| 21  | Asteraceae    | Achillea bissarata | Perennial grass | 400–1200 | Flowers | 0.85% essential oils, alkaloid, amylene, inulin, aspiragine, nitrates, organic acids, carotene, vitamins C, K, B |
| 22  | Asteraceae    | Achillea biebertei | Perennial grass | 500–2000 | Flowers | 0.83% Essential oils, alkaloid amylene, inulin, aspiragine, nitrates, organic acids, carotene, vitamins C, K, B |
| 23  | Asteraceae    | Achillea nobilis | Perennial grass | 500–2000 | Flowers | 0.84% essential oils, inulin, nitrates, organic acids, carotene, vitamins C, K, B, A, sabinen |
| 24  | Asteraceae    | Achillea neilreichi | Perennial grass | 500–2000 | Flowers | 0.7%, essential oils, alkaloid amylene, inulin, aspiragine, nitrates, organic acids, carotene, vitamins C, K, α-pinene, sabinen |
| #  | Family                  | Type                | Height | Part      | Active Components                                                                 |
|----|------------------------|---------------------|--------|-----------|-----------------------------------------------------------------------------------|
| 26 | Family Asteraceae      | Perennial grass     | 500–2000 | Flowers   | 0.6% essential oils, alkaloids, flavonoid, rutin, inulin, asparagine, nitrates, organic acids, vitamins C, K, B |
| 27 | Achillea fillipendullina | Perennial grass     | 500–2000 | Flowers   | 0.72% essential oils, alkaloid amylene, flavonoids, apple acid, carotene, vitamins C, K, sabinen |
| 28 | Achillea latiloba      | Perennial grass     | 500–2000 | Flowers   | 0.85% essential oils, alkaloid, amylene, flavonoids, apple acid, carotene, vitamins C, K, α-pinene (3.6-8.0), β-pinene (18.4-33.9) |
| 29 | Achillea millefolium   | Perennial grass     | 50–800   | Flowers   | 0.9% essential oils, alkaloid, amylene, flavonoids, apple acid, carotene, vitamin C, α-pinene, sabinene, β-pinene |
| 30 | Achillea satacea       | Perennial grass     | 50–200   | upper part of ground | 0.72% essential oils, alkaloid, amylene, flavonoids, apple acid, carotene, vitamins C, K |
| 31 | Artemisia absinthum    | Perennial grass     | 50–1800  | upper part of ground | 0.8% Essential oils, tanning and mucous substances, sugars, carotene, ascorbic acid |
| 32 | Artemisia vulgaris     | Perennial grass     | 50–1800  | upper part of ground | 1.1% Essential oils, alkaloids, flavonoids, monoterpenes, tansins, sesquiterpens, sabinen |
| 33 | Erigeron Canadensis    | Perennial grass     | 50–2000  | upper part of ground | 0.2-0.4% Essential oils, flavones and flavono glycosides, saponins, sterol, carotene, vitamins C and K, sodium, potassium, iron salts, monoterpen: α-pinene, β-pinene, limonene, sesquiterpen |
| 34 | Helicrysum graveolens  | Perennial grass     | 2000–2200 | Flowers   | 0.2-0.4% Ethers, flavones and flavonogenic glycosides, saponins, sterol, carotene, vitamins C and K, tanning substances, microelements, cadinene, monoterapns |
| 35 | Helicrysum poliphylum  | Perennial grass     | 2000–2200 | Flowers   | 0.2-0.4% Essential oils, lactones, inulin, starch, polysaccharides, resins, carbohydrates, sesquiterpenes, sabinen |
| 36 | Inula helenium         | Perennial grass     | 1700–2100 | Underground part | 0.2-0.4% Essential oils, lactones, inulin, starch, polysaccharides, resins, carbohydrates, sesquiterpenes, sabinen |
| 37 | Matricaria chamomilla var. recuitita | Annual grass | 600–1000 | Flowers   | 0.8% - Essential oils, lactones, matricarin, organic acids, resins, polysaccharides, flavonoids, carotenoids, ascorbic acid |
| 38 | Pyretrum parthenifolium | Annual grass       | 1500–1800 | Flowers   | 0.6% Essential oils, lactones, matricarin, organic acids, resins, polysaccharides, flavonoids, carotenoids, ascorbic acid |
| 39 | Pyretrum roseum        | Perennial grass     | 600–1000 | Flowers   | 0.8% Essential oils, matricarin, organic acids, resins, flavonoids, polysaccharides, carotenoids, ascorbic acid |
| 40 | Capsella bursa-pastoris | Annual grass       | 50–2000  | upper part of ground | 0.16-0.44% Essentials, glycosides, saponins, alkaid, wine, apple and lemon acids, vitamin C (200 mg %), carotene, mineral salts, iciccular |
| 41 | Raphanus sativus       | Annual grass        | 25–500   | Underground part | 0.2-0.4% Essential oils, A, B, C vitamins, organic acids, simple carbohydrates, sesquiterpenes |
| 42 | Cyperus radius         | Perennial grass     | 23–500   | Underground part | 0.23-0.45% Essential substances, coumarines, β- selinen, α-cyperon, cyperen, |
| 43 | Trifolium pretense     | Perennial grass     | 25–1900  | Upper part of ground | 0.24-0.44% Essential oils, phenols, carbohydrates, monoterpenes, isoprenoid |
| 44 | Geranium robertianum   | Perennial grass     | 1000–2200 | Upper part of ground | 0.2-0.4% Essential oils, alkaloids, phenols, isoprenoid |
| No. | Family | Species | Main Parts | Location | Main Chemical Constituents |
|-----|--------|---------|------------|----------|---------------------------|
| 44  | Lamiaceae | Calaminthia grandiflora | Perennial grass | 1000–2200 | Upper part of ground | 0.3–0.8% Essential oils, carbohydrates, flavonoids |
| 45  | Lamiaceae | Glechoma hederacea | Perennial grass | 50–2000 | Upper part of ground | 0.2–0.4% Essential oils, 8% tannins, bitter substances, choline |
| 46  | Lamiaceae | Lavandula vera | Evergreen bush | 30–100 | Upper part of ground | 0.162–0.38% Essential oils, organic acids, carotine, flavonoid hepperidine |
| 47  | Lamiaceae | Leonurus quinquelobatus Gilib | Perennial grass | 1600–1900 | Upper part of ground | 0.2–0.4% Essential oils, alkaloids, tanning agents, flavonoids, α-pinene, pipertion |
| 48  | Lamiaceae | Melissa officinalis | Perennial grass | 25–1000 | Upper part of ground | 0.2% Essential oils, tissue substances, mucus, cytal |
| 49  | Lamiaceae | Mentha aquatica | Perennial grass | 500–2400 | Upper part of ground | 0.4–0.8% Essential oils, carbohydrates, glycosides, α-pinene, β-pinene, pipertion, menthol, terpinen, menthofuran |
| 50  | Lamiaceae | Mentha longifolia | Perennial grass | 500–2400 | Upper part of ground | 0.3–0.8% Essential oils, flavonoids, α-pinene, β-pinene, terpenin |
| 51  | Lamiaceae | Mentha pulegium | Perennial grass | 50–1000 | Upper part of ground | 0.2–0.4% Essential oils, vitamins C, B, chromotids, simple carbohydrates, menthol, limonene |
| 52  | Lamiaceae | Mentha piperita | Perennial grass | 50–200 | Upper part of ground | 2.5%–4.6% Essential oils, 40–70% organic acids, carotine and flavonoids, hepperidine, α-pinene, β-pinene, terpinen, menthol 40–70% |
| 53  | Lamiaceae | Origanum vulgare | Perennial grass | 200–500 | Upper part of ground | 0.5–1.2% Essential oils, tissue substances, vitamin C 565 mg%, carvacrol, menthol |
| 54  | Lamiaceae | Osimum basilicum | Annual grass | 50–1000 | Upper part of ground | 0.2–0.4% of essential oils, tannins, difficult carbohydrates, carotene, vitamins C, B2, K, linalol (17.7%), methyl chavicol (28.0%) and eugenol (36.2%) |
| 55  | Lamiaceae | Perilana nankinensis | Perennial grass | 30–600 | Upper part of ground | 0.21–0.42% essential oils, flavonoids, procoumarines, carbohydrates, |
| 56  | Lamiaceae | Salvia glutinosa | Perennial grass | 400–1200 | Upper part of ground | 0.23–0.44% Essential oils, organic acids, carotenoids, α-pinene, Sabinin, β-pinene, limonene, terpine |
| 57  | Lamiaceae | Salvia solarea | Perennial grass | 1100–15000 | Upper part of ground | 1.2% essential oils, alkaloids, tissue substances, organic acids, vitamin B, pinene, linalol, thymol, carvacrol, |
| 58  | Lamiaceae | Satureia laxifloral. | Perennial grass | 200–1300 | Upper part of ground | 0.17–0.41% Essential oils, procoumarines, ascorbic acid, terpinen, thymol, carvacrol, microelements, |
| 59  | Lamiaceae | Scutellaria galericulata | Perennial grass | 500–1700 | Upper part of ground | 0.2–0.4% Essential oils, procoumarines, ascorbic acid, carbohydrates, carvacrol, microelements, |
| 60  | Lamiaceae | Thymus grossheimi | Perennial grass | 500–1700 | Upper part of ground | 0.17–0.57% Essential oils, flavonoids, 1,8-cineole |
| 61  | Lamiaceae | Stachys sylvatica | Perennial grass | 600–1700 | Upper part of ground | 0.2–0.4% Essential oils, flavonoids, procoumarines, mineral salts, |
| 62  | Lauraceae | Laurus nobilis | Evergreen tree or bush | 50–1000 | Leaf | 4.5% Essential oils, organic acids, polysaccharides, 1,8-cineole (40%), pinene, linalol, limonene, eugenol, |
| 63  | Liliaceae | Allium ursinum | Perennial grass | 130–1900 | Bulbs, leaves | 0.2–0.4% Essential Oils, vitamins C and B, phinocytens |
| 64  | Ruscaceae | Ruscus ponticus | Perennial grass | 400–1000 | Upper part of ground | 0.2–0.4% Essential oils, sucrose, monotarpens |
| 65  | Myrtaceae | Eucaliptus cinerea | Evergreen tree | 50–300 | leaves | 2.5% essential oils, tannins, procoumarines, organic acids, cineol, aldehydes |
| 66  | Myrtaceae | Eucaliptus globules | Evergreen tree | 50–300 | leaves | 2.7% Essential oils, tannins, procoumarines, organic acids, cineol, aldehydes, |
| 67  | Myrtaceae | Eucalyptus wiminalis | Evergreen tree | 50–300 | leaves | 2.5% essential oils, tannins, procoumarines, organic acids, cineol, aldehydes, |
|   | Family | Type       | Height | Part of Plant | Essential Oil Content | Active Constituents                                      |
|---|--------|------------|--------|---------------|-----------------------|--------------------------------------------------------|
| 68 | Oleaceae Jasminum officinale | Crawling bush | 50–500 | Flower        | 0.2-0.4% Essential oils, carotenoids, benzylacetate, benzyl alcohol, indoline, krezol, vitamin A, B, 4-terpineol |
| 69 | Primulaceae Primula sibthorpia | Perennial grass | 50–1000 | Upper part of ground | 0.2-0.4% Essential oils, carotenoids, saponins, vitamins C, B, cineol, aldehydes, mineral salts, |
| 70 | Scrophulariaceae Linaria vulgaris | Perennial grass | 1700–2300 | Upper part of ground | 0.2-0.4% Essential oils, flavonoids, alkaloids, α-pinene, limonen, piperiton, microelements, |
| 71 | Valerianaceae Valeriana eriophylla | Perennial grass | 2000–2100 | Underground part | 0.19-0.36% Essential oils, alkaloids, tannins, sugars, α-pinene, limonen, piperiton, cymol, |
| 72 | Violaceae Viola arvensis 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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