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Known and unknown products from raw materials of plant origin

Justyna A. Dąbrowska

Institute of General Food Chemistry, Lodz University of Technology,
4/10 Stefanowskiego Str., 90-924 Lodz, Poland

E-mail address: justyna.alicja.dabrowska@dokt.p.lodz.pl

ABSTRACT

The products from raw materials of plant origin are a great source of the biologically active compounds with a wide range of activities and properties, especially antimicrobial, antioxidant, and anti-inflammatory. Typically, bioactive compounds of plants are produced as secondary metabolites and are sourced mostly as essential oils and hydrosoles. Lately, new, unique and innovative product name fluidolat® are developed by Śmigielski and his co-workers at the Technical University of Lodz [1,2]. These are components which unquestionably has many positive aspects, mostly high application potential, health benefit, biological activity and sensory value. In this article general characteristic of essential oils, hydrosoles, and fluidolat®, as well as a few words about their application and biological activity are presented.

***Keywords*:** essential oil, hydrosol, fluidolat®, plant material, hydrodistillation, biological activity

1. INTRODUCTION

All chemical compounds of a biological system of the plant can be assigned to two areas: primary and secondary metabolites. The primary metabolites such as carbohydrates, amino acids, proteins, and lipids are involved directly in growth and metabolism [3,4]. This is a unique plant survival mechanism which determines the most significant processes in plants like photosynthesis and respiration. So it is involved directly in growth and metabolism. On

the other hand, the secondary metabolites play an important role in plant defense and survivability. Theirs absent not result in death.

Typically, bioactive compounds of plants are produced as secondary metabolites. Some of these substances have biological properties, and in that, they are desirable for industry, medicine, and humankind. Until now, the secondary metabolites are sourced as essential oils and hydrosoles. Lately, a new component named fluidolat® has produced by Śmigielski and his co-workers at the Lodz University of Technology [1,2].

2. PRODUCTS INCLUDE BIOLOGICALLY ACTIVE COMPOUNDS

2. 1. Essential oils

Essential oils have been known to mankind since ancient times. These oils were called essential because they were considered to represent the quintessential essence of odour and flavour. In the light of scientific development they are defined like liquid mixtures of volatile organic compounds (the secondary metabolites) produced by living organisms (aromatic plants, essential oil-bearing plants), obtained by physical means only (mostly by steam distillation, hydrodistillation, and cold pressing) from a whole plant or plant part of known taxonomic origin such as the flowers, leaves, peels, stems, roots, resins, bark, seeds, pericarps, which are a composition of complex mixtures of chemicals compounds: mono- and sesquiterpenoids, benzenoids, phenylpropanoids, and their derivatives. These products are mainly valued for its biological activity, primarily antibacterial, antiviral, antifungal, insecticidal, antiparasitic activities. The Health and Human Services Public Health Services adopted the essential oils as safe which widened the scope of their advantages and ipso facto pave the way for their utilisation in cosmetics and food industry [5,6].

The essential oils are secondary metabolites of the plant which include volatile, liquid, lipophilic, and odoriferous components [7]. These components give plants their characteristic flavour and other properties and play an important role in plant protection on the grounds of contents of compounds possessing antimicrobial properties against viruses, bacteria, and fungi. The essential oils are produced by a wide variety of annual, biennial or perennial, evergreens, and deciduous, herbaceous plant, shrubs, and trees. These metabolites perform following functions: defence against herbivores, animals and microbial pathogens, the attraction of pollinators and seed dispersers, insect repellents, reduction of abiotic stress, interplant signalling, allelopathy [8,9]. The allelopathy revolves around secreting of secondary metabolites with the aim of survival and adaptation of the plant to the environment (Miranda, 2014). For instance, extraction into soil substances which possess toxic activity against other plants settles of the same environmental. So more, thanks to essential oils plants protecting themselves from heat or cold and healing their organ wounds [10].

The essential oils are stored in plant either in external secretory structures (epidermal cells, glandular hairs, glandular trichomes), which are found on the surface of the plant, or internal secretory structures (secretory cavities, secretory cells, and secretory ducts), which are found in the plant material [8].

The components of essential oil belong predominantly into two groups: terpene compounds and aroma compounds. Among these groups, we can distinguish monoterpenes, sesquiterpenes, phenylpropanoids and their oxygenated derivatives, as well as aromatic and aliphatic constituents including alcohols, esters, aldehydes, ketones, ethers, peroxydes, and

phenols [6,9]. Hydro- and steam-distillation are the most commonly used methods for the extraction of bioactive compounds from plants [11]. For certain plant products enfleurage, maceration, solvent extraction, and mechanical pressing are used. Enfleurage is applied when the essential oil content of fresh plant parts is so small that oil removal is not commercially viable. For example, in the case of flower petals. Maceration is adaptable when oil yield from distillation is too poor. For the citrus family, mechanical pressing like cold expression is applied.

Chemical composition of essential oils varies according to many factors, it is geographic location of plants cultivation, environmental, weather and climatic conditions in the identified geographical area, plant variety and ecotype, adaptation plants to environmental changes, plant spacing, time of harvest, availability of nourishing factor, plant protection products, stress, harvests and subsequent works, sorting, drying, during storage operations, transport, extraction processes [6,9]. Also, chemical composition, as well as biological and medicinal properties of the essential oil can be dependent on parts of the plant which are used as raw material for hydrodistillation. For instance, essential oil from green parts and roots of sneezewort includes a lower level of monoterpenes than essential oil from the flower of the same plant.

2. 2. Hydrosoles

Hydrosoles are also known as hydrolates, hydrolats, floral waters, and plant waters [12]. The name hydrosoles descended from Latin and is made up from two Latin words: *hydro* and *sol*, meaning *water* and *solution*, respectively. Hydrosoles are produced by hydrodistillation of fresh leaves, fruits, flowers, roots, bark, wood, branches, needles, seeds and other plant materials. Their flavours are delicate, soft, gentle, and subtle when collated to their essential oil counterpart. These aromatic products usually have a scent similar to their essential oil, but also can have a greener note. This comes from the water soluble constituents in the plant material that are not present in the essential oil.

According to Catty [12] definition of hydrosoles reads as follows: “Hydrosoles are the condensate water coproduced during the steam- or hydro-distillation of plant material for aromatherapeutic purposes.” Within next part of this definition, we can chase down prime guidelines on the hydrodistillation issue. The key elements, as specified in this description include (1) usage solely certified organic or pesticide- and chemical-free plant material, (2) application only composition of particular independent botanical species, (3) sustainable manner of hydrodistillation, (4) slow and long-standing hydrodistillation carry out under low or atmospheric pressure, (5) usage pure and contamination-free water, (6) work towards to preserve all the therapeutic value of the plant material.

The hydrosol includes the volatile chemical compounds from plant material [13]. The composition of the biologically active compound has impact on their bioactivity and scent. According to Prusinowska et al. (2015) [14], hydrolates have much softer and delicate aroma than corresponding essential oil.

2. 3. Fluidolat

Fluidolat® is something unique, new and innovative. This is a natural product which is developed by Śmigielski and his co-workers at the Technical University of Lodz [1,2]. The cutting-edge technology of fluidolat® production base upon procedure of removing water

from herbs. The methodology includes drying herbs in a fluidized or dynamic bed with a closed air cycle and a heat exchanger. According to Śmigielski fluidolat® are the mixture of volatile compounds that are normally lost in traditional processes of hydrodistillation. Fluidolat® is condensed water from the plant and content a lot of biologically active compounds. And may be applicable as an additive to food, cosmetic, and pharmaceutical products.

3. BIOLOGICAL ACTIVITY

The biological activity of essential oils is a synergistic effect of their several chemical constituents. Besides, the overall activity cannot be attributed to any of the major constituents or any individual compound. In the case of essential oil, we are dealing with the synergic action of a lot of chemical compounds, and even compounds in trace levels have a huge meaning and play a role in shaping activity [15]. Among multitude properties, the following activities of essential oil are often distinguished: antibacterial and antifungal (e.g. essential oil of sage, oregano, thyme, black pepper, dill, celery, and cumin), antiviral (e.g. essential oil of oregano, garlic, onion), antiprotozoal (e.g. essential oil of tea tree and black pepper), anti-lice and antidandruff (tea tree essential oil), anti-insect and anti-mosquito (essential oil of giant catmint), antioxidant (essential oil of rosemary, lavender, and celery), antimutagenic (tee tree essential oil), anti-inflammatory (cinnamon essential oil), as well as anticancer (ginger essential oil) [5,15].

Essential oils exhibit antimicrobial activity, which is valuable particularly in the case of pathogenic, foodborne, and antibiotic-resistant bacteria [15]. Compounds of essential oils are able to penetrate of bacterial membranes, which leads to inhibition of proper exhibit and growth. Their hydrophobic components bring about increased permeability by separation of cell lipids and mitochondria. So more, phenolic compounds harm the cell membrane, cause leakage of the contents of the bacterial cell, and eventually cell death [6,9]. It is commonly known that Gram-positive bacteria are less sensitive than Gram-negative bacteria, which come from the difference between structure and composition of the cell wall and membrane their bacteria. Gram-negative bacteria possess a hydrophilic cell wall, which are barriers for protection from hydrophobic compounds. Another mechanism of action involves denaturation of cytoplasmic proteins and enzymes which lead to bacterial cell death [15]. Certain essential oils express synergistic effects with antibiotics, so may be combined with them in treatment against antibiotic-resistant strains.

Antiviral activity of essential oils is associated with inhibition of viral replication by chemical constituents of essential oils [15]. In the case of antifungal activity, we are dealing with inhibition of membrane ergosterol and signalling pathways, as well as blocking cell cycle, loss of ions, and leakage of cytoplasmic contents.

The essential oils possess health and prevention dimension and are commonly used against many diseases in psychological and emotional realms, such as anxiety, agitation, stress, challenging behaviors, suicidal ideation, fatigue, difficulty sleeping, mental exhaustion, burnout, memory loss, pain management [5]. In an alternative and folkloric medicine, these compounds are used in the treatment of many diseases like Alzheimer, cardiovascular, cancer and labor pain in pregnancy, even in cancer therapy.

According to Prusinowska et al. (2015) [14], hydrosoles possess antibacterial and antifungal activities, but lower than the corresponding essential oils.

4. APPLICATION

Plant essential oils possess medicinal and industrial value and are used as food flavourings as well as in the manufacture of perfumes and cosmetic preparations for skin care. In cosmetics, essential oils play various roles, not only the role of natural odorants but also skin protecting substances. Owing to the anti-oxidant and anti-microbial activities they may replace synthetic preservatives. Also, essential oils are commonly used in pharmaceutical industry and in all branches of medicine such as in pharmacy, balneology, massage, and homeopathy [15].

Furthermore, they are used in air fresheners and deodorizers. Essential oils are also natural sources of substrates for chemical synthesis. Also, aromatherapy and aromachology benefit from essential oil biological and sensory properties. These health factors are administrated or introduced into the human body towards inhalation, local application, and baths [5]. Thanks to very high biological activity and synergistic effects with antibiotics, essential oils can be used as alternatives to antibiotics or as support medical preparation.

On the grounds of contents of small quantities of essential oil and water-soluble (hydrophilic) chemical components of the plant, hydrosols possess considerable application potential in industry and have a wide range of therapeutic and bioactive benefits. Fluidolates® are characterized by similar and even better antioxidant activity than the corresponding hydrolates, and they could be used as the natural cosmetic ingredients [1,2].

5. CONCLUSIONS

The known and unknown products from raw materials of plant origin are a great source of the biologically active compounds with a wide range of activities and properties, especially antimicrobial, antioxidant, and anti-inflammatory. The essential oils, hydrosoles, and fluidolates are or may be useful non-medical alternatives for aromatherapy, medicine, pharmacology, as well as food, and cosmetics industries. Nowadays these products are very promising options, particularly because interest in natural and non-synthesized products has heightened. On account of anticancer properties the essential oils, they may be used in future medical and pharmaceutical researches.

These compounds are already used as the major therapeutic agents to treat several diseases in the traditional medicine and aromatherapy area. So more, essential oils, hydrosoles, and fluidolates® have a huge potential as alternatives to conventional antimicrobials against food spoilage bacteria, pathogenic bacteria, and, most importantly, against antibiotic-resistant bacteria and fungi. The essential oils could be used as the alternative prospect for insect pest control. Moreover, hydrosols and fluidolates® can form a flavouring and therapeutic ingredients for the cosmetic industry.

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