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LAVENDER OIL – FLAVOURING OR ACTIVE COSMETIC INGREDIENT?

Review: Professor Zofia Żakowska, Ph.D., D.Sc.

Essential oils compose a heterogenic group of plant products known and used for centuries for cosmetic, disinfectant and therapeutical purposes. Our research considered one of the essential oils, lavender oil, recognized as an antiseptic and insecticide agent also used as an ingredient in bath salts and washing agents for centuries. We studied antibacterial and antifungal activity of pure essential oil as well as commercial cosmetic products: hair shampoo and bath salt, containing lavender oil. It has been shown that concentrations of lavender oil applied in tested cosmetics are too low and do not provide its aseptic activity.

1. Introduction

1.1. Botanic characteristic of lavender (*Lavandula* sp.)

Lavadula officinalis/angustifolia belongs to the family Lamiaceae (Labiatae). The taxonomy of lavender is complex because of the multiplicity of species.

Lavender is a flowering, strongly aromatic shrub that grows up to 1 m tall. In native conditions flowers are pinkish-purple, leaves are evergreen. Essential oil (3%) is located inside the oil gland placed on the flower calyx surface. Fitochemical analysis of the lavender indicates presence of numerous monotherpenes (cyneol, borneol, geraniol) and also organic acids, coumarines, mineral salts and tannins, which are responsible for lavender pharmacological activity.

Lavender oil is indigenous to mountain regions especially around the Mediterranean, but the native range extends as well to tropical countries. Lavender essential oil is also produced in France, Spain, Italy and Australia [1-3].

1.2. Chemical aspect of lavender essential oil

Lavender essential oil, a colorless or yellowish, clear liquid obtained from the aerial part of the plant, has very fresh, lightly camphorous, herbal aroma. Chemical composition of the oil was precisely explored, giving as a result over 300 components**,** including those with high biological activity. In chemical aspect essential oils are multiingredient mixtures of terpen compounds–phenyl propane derivatives as well as compounds containing sulphuric, nitric substances, acetylene derivatives and other. Compounds found in essential oils have hydrocarbon, alcohol, aldehyde, ketone, ester and ether character. Main components of lavender essential oil are: linalyl acetate (45.6%-60%) and linalool (30.8%) [1].

1.3. Biological activity of lavender oil

Depending on the chemistry, lavender oil found diversity in application [4]. Use of lavender oil is based on its prophylactic and topical administration. It has been used cosmetically, dermatologically and therapeutically to treat minor health problems [4-6]. The genus name is derived from the Latin word *lavare* which means wash, taking a bath [1]. It is widely employed in chemical industry in many types of soaps, shampoos, lotions, detergents, etc. Essential oil from *Lavandula* sp. is also recognized in aromatherapy as a holistic relaxant, antioxidant and antimicrobial agent [2, 4, 7]. Above all, lavender oil is known for its antibacterial, antifungal, carminative, antiflatulence, antiholic, sedative as well as antidepressive properties [2, 8]. It is used to disinfect skin and scalp, to treat burns, insect bites and many more [3, 5, 6].

Apart from its various effects, activities and uses, lavender oil demonstrated to possess antimicrobial activity, most importantly in situations when the infections are resistant to antibiotics and other drugs. It has also been proved that both oil as well as oil vapor has antifungal activity. When considering the bioactivity of lavender oil in situations, where the vapor or/and volatiles play a significant role, clinical studies and further investigations are essential [6, 9, 10]. Aromatherapeutic role of lavender oil applied in the cosmetics is undeniable. However, verification of sanitizing properties of cosmetic products containing this oil seems to be of interest. Presented study is an attempt to answer the question if lavender oil acts like an active agent in multiingredient commercial cosmetics.

2. Experimental details

2.1. Microorganisms

In our research bacteria ***Bacillus subtilis*** ATCC 6633 and ***Escherichia coli*** ATCC 8793, yeast ***Candida mycoderma*** ŁOCK 0008 and mould ***Aspergillus niger*** ATCC 16404 were used. The strains originated from the American Type Culture Collection and the Collection of Pure Cultures of the Institute of Fermentation Technology and Microbiology, Technical University of Lodz, ŁOCK 105. Selected microorganism species can come into composition of an endemic saprophytic micro flora and be transmitted on the skin then inducted into cosmetic products

2.2. Antimicrobial activity assessment

Antimicrobial activity estimation of pure lavender essential oil and cosmetic products was based on impedimetric method with Bactometer M64 (bioMerieux) system usage. Bactometer M64 wells were filled with 1 mL of impedance medium respectively and inoculated with 0.1 mL samples of selected microorganisms. Impedimetric assays were applied to check the microbial susceptibility to proper agents diluted to obtain desired concentrations: 1, 10, 100 and 200 µL/mL.

Above mentioned assays were cultured in the following culture bioMerieux media at their optimal growth conditions: GPM Plus for bacteria in 30°C within 24h and YMM for fungi in 28°C within 48h. All tests were conducted in triplicate and the results are presented as their mean value. The Standard Deviation values (SD) did not exceed 0.2 logarithmic units. The results supported by impedimetric method were analyzed and compared with count plate method. Viable cells were counted as CFU/mL.

2.3. Lavender oil

The pure lavender oil was the commercial specimen, purchased from Avicenna – Oil, Wroclaw, Poland. Lavender essential oil was accompanied by the manufacturer declaration on the fulfillment of the European Pharmacopoeia Commission 5.0 (2005) [11] requirements concerning its chemical composition.

2.4. Cosmetics

The hair shampoo – Baby Shampoo with Natural Lavender - was purchased from Johnson & Johnson, Warsaw, Poland. It consists of: Water, Coco-Glucoside, Sodium Lauroamphoacetate, Sodium Laureth Sulfate, Citric Acid, ***Lavandula***

angustifolia, PEG-80 Sorbitan Laurate, PEG-4 Rapeseedamide, Polyquaternium-10, Polysorbate-20, PEG-150 Distearate, Lactic Acid, Glucose, Tetrasodium EDTA, Propylene Glycol, Sodium Benzoate, Potassium Sorbate, Parfum.

The bath salt – Aromatic Herbal Bath Lavender – was purchased from Dresdner Essenz, Dresden, Germany. It consists of: Sodium Sulfate, Sodium Methyl Oleoyl Taurate, Silica, Lavandula Angustifolia Oil, Sodium Chloride, Linalool, Citrus Medica Limonum Peel Oil, Tocopheryl Acetate, Allantoin, Panthenol, Isopropyl Palmitate, Polysorbate 20, PEG-7 Glyceryl Cocoate, Menthol, Parfum, Geraniol, Limonene, Citral, Cl 42090, and Cl14700.

3. Results and discussion

The lavender essential oil in the concentrations of 100 and 200 µL/mL represses growth of all tested microorganism strains but in the concentration of 10 µL/mL only *Bacillus subtilis* and *Aspergillus niger* (Table 1).

Comparison of the antimicrobial activity of the essential oil of *Lavandula angustifolia*, obtained in different studies, is rather difficult because of different oil chemotypes and varied methods of assessment. Previously published data mostly provides generalizations about the antibacterial or/and antifungal activity of lavender oil [12]. Available publications have documented the minimal inhibitory concentrations (MICs), minimal cidal concentrations (MCCs) and minimal fungicidal concentrations (MFCs) of this oil for various microorganisms. The MIC value against *Escherichia coli* and *Candida* sp. are in the range of 0.25-0.5 % (2.5-5 µL/mL) and the MCC value is 0.25 % (2.5 µL/mL) for *Escherichia coli* and 1.0 % (10 µL/mL) for *Candida* sp. [12-14]. Comparing to the literature data, pure lavender oil tested in the presented study is less effective against both *Escherichia coli* and *Candida mycoderma*.

Table 1

Viability of microorganisms in the presence of lavender oil

Concentration of agent [µL/mL]	Microorganism [CFU/mL]			
	Escherichia coli	*Bacillus subtilis*	*Candida mycoderma*	*Aspergillus niger*
0	4.04×10^{9}	7.50×10^{9}	8.01×10^{8}	3.81×10^{7}
1	1.03×10^{8}	4.27×10^{8}	1.05×10^{8}	1.35×10^{5}
10	2.14×10^{0}	0	5.54×10^{5}	0
100	0	0	0	0
200	0	0	0	0

The hair shampoo with the lavender oil represses the growth of ***Bacillus subtilis*** and ***Aspergillus niger*** starting from 10 and 100 µL/mL respectively (Table 2). The hair shampoo in the range of analyzed concentrations is not affecting *Candida mycoderma* and only reduces the population of *Escherichia coli* by about 4 logarithmic units (Table 2).

Table 2

Viability of microorganisms in the presence of hair shampoo containing lavender oil

Concentration of agent [µL/mL]	Microorganism [CFU/mL]			
	Escherichia coli	*Bacillus subtilis*	*Candida mycoderma*	*Aspergillus niger*
0	$4.04x10^9$	$7.50x10^9$	$8.01x10^8$	$3.81x10^7$
1	$1.60x10^9$	$3.35x10^9$	$8.01x10^8$	$4.02x10^5$
10	$7.08x10^8$	0	$7.98x10^8$	$1.82x10^4$
100	$5.82x10^7$	0	$7.90x10^8$	0
200	$1.12x10^5$	0	$7.90x10^8$	0

The bath salt with the lavender oil has no disinfectant activity. The bath salt does not repress growth of ***Escherichia coli*** and *Candida mycoderma*. Elevating its concentration to 100 µL/mL and 200 µL/mL results in limitation of number of ***Bacillus subtilis*** cells by 5 logarithmic units and ***Aspergillus niger*** by less than 3 logarithmic units (Table 3).

Table 3

Viability of microorganisms in the presence of bath salt containing lavender oil

Concentration of agent [µg/mL]	Microorganism [CFU/mL]			
	Escherichia coli	*Bacillus subtilis*	*Candida mycoderma*	*Aspergillus niger*
0	$4.04x10^9$	$7.50x10^9$	$8.01x10^8$	$3.81x10^7$
1	$2.13x10^9$	$3.25x10^9$	$8.00x10^8$	$3.02x10^7$
10	$2.13x10^9$	$3.02x10^8$	$7.90x10^8$	$1.41x10^7$
100	$2.43x10^9$	$9.01x10^6$	$7.90x10^8$	$4.84x10^6$
200	$2.31x10^9$	$6.25x10^4$	$7.80x10^8$	$6.53x10^4$

With regard to the fact that manufacturers do not provide the information concerning the amount of lavender oil included in tested cosmetics, the relation of the activity of oil in the hair shampoo and bath salt to its pure specimen is difficult to investigate. Previous studies show that the concentration of essential oils included in the cosmetics and accepted by consumers usually does not exceed 10 µL/mL [15]. Tested cosmetics are designated by the manufacturers as preparations containing the lavender oil as an active substance, therefore it has been assumed that its concentration come to 10 µL/mL. With this assumption, 100 µL of shampoo or 100 µg of bath salt contains 1 µL of pure lavender oil. The comparison of the activity of pure lavender oil and cosmetic preparations has been shown in the Figure 1.

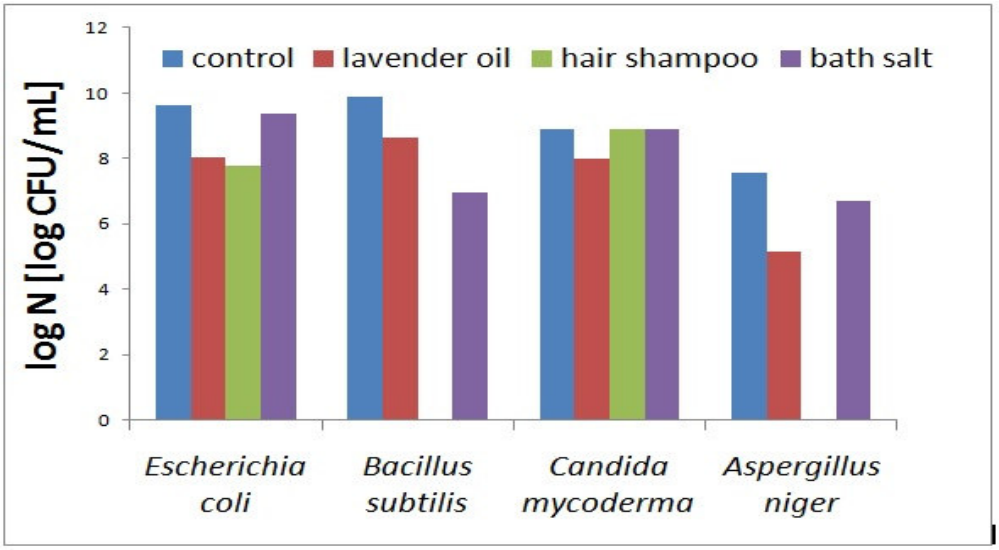

Fig. 1. Antimicrobial activity of lavender oil versus cosmetics with approximate lavender oil concentration of 1 µL/mL

Pure lavender oil in the concentration of 1 µL/mL particularly does not affect *Candida mycoderma* and restricts the population of other microorganisms only by 0.9- 2.3 logarithmic units. The portion of 100 µL/mL hair shampoo contributing 1µL of lavender oil demonstrates lethal effect to *Bacillus subtilis* and *Aspergillus niger*. Furthermore, similarly to the lavender oil, the shampoo does not affect the *Candida mycoderma* and reduces slightly the viability of *Escherichia coli*. The elimination of *Bacillus subtilis* and *Aspergillus niger* in the presence of hair shampoo implicates an opinion that its aseptic activity is generated by other ingredients of the formulation, such as citric and lactic acids or even EDTA.

The bath salt in the concentration of 100 µg/mL insignificantly reduces the viability of tested microorganism populations at the similar level of activity as pure lavender oil in the concentration of 1 µL/mL.

Published data proved the effectiveness of lavender oil in the sphere of aseptic activity of an oil-in-water type cream base with the concentration of 15 µL/mL [16]. Moreover, the incorporation of 5 µL/mL lavender oil into the body lotion does not repress the number of *Candida mycoderma* and only slightly reduces the number of *Aspergillus niger* [15]. The results of our research are compatible with above mentioned data, since the lavender oil in the 5-15 times lower concentration than indicated in the literature has poor stabilizing effect on tested micro flora. Previous studies indicate that antimicrobial activity of cosmetic preparations have consequence on effect of the synergistic activity of different components within this formulation. Both essential oils and chemical compounds are demonstrating their aseptic activity, such as ethanol or methyl p-hydroxybenzoate [15,17,18]. Our research allowed us to confirm the advanced thesis.

4. Conclusions

In regard to the intensive scent, employment of lavender oil used in cosmetic preparation is limited by the consumer approval. In practice, conventional concentrations of this particular oil are too low and do not provide its aseptic activity. Lethal effect of tested hair shampoo towards Gram-positive ***Bacillus subtilis*** bacteria and ***Aspergillus niger*** mould is most likely derived from the presence of antimicrobial agents, other than lavender oil. The presence of lavender oil in tested cosmetics does not constitute a significant antimicrobial component and acts as flavoring ingredient and aromatherapeutic factor.

In conclusion; past and present studies are both conforming that lavender oil has its place as therapeutic supplement in the developing field of medicine – cosmetic dermatology.

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OLEJEK LAWENDOWY – DODATEK ZAPACHOWY CZY AKTYWNY SKŁADNIK KOSMETYKÓW?

Streszczenie

Olejki eteryczne stanowią heterogenną grupę produktów roślinnych znanych i stosowanych od dawna w celach kosmetycznych, dezynfekujących i leczniczych. Przedmiotem prezentowanych badań jest olejek eteryczny – olejek z lawendy, z łac. *Oleum Lavandulae officinalis/angustifolia.* Podjęta została próba porównania aktywności przeciwbakteryjnej i przeciwgrzybiczej czystego olejku eterycznego oraz wyrobów kosmetycznych: szamponu do włosów i soli do kąpieli, zawierających olejek lawendowy. W pracy wykazano, że stężenie olejku lawendowego zawartego w testowanych komercyjnych preparatach kosmetycznych jest zbyt niskie i nie zapewnia działania aseptycznego kosmetyku.

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