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Comparative analysis of the spectrum of antibacterial activity of oils from ungurahui fruits, black cumin seeds and kukui nut

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Abstract. The work is devoted to the study of the antibacterial activity of oils from the fruits of ungurahui, black cumin seeds and kukui nuts. Based on the studies conducted, the authors concluded that their use is promising in the process of creating natural biologically active oil-based preparations.

1 Introduction

The relevance of the study is that in recent years there has been a trend towards naturalization in the field of healthy eating, medicine and cosmetology [10]. This is due to a global reassessment of views on the widespread use of synthetic ingredients in terms of damage to human health and the environment [7]. The desire to maintain health and improve the condition of the body pushes modern consumers to choose products made using "green" technologies based on natural raw materials [9]. Black cumin seed oil, kukui nut oil and ungurahui oil are organically pure products and have unique properties that can find wide application in medicine, cosmetology and the food industry.

Black cumin seeds are traditionally used in cooking to add flavor to baked goods. Black cumin oil has a fairly high concentration of biologically active substances, including: thymoquinone and dihydrothymoquinone (antioxidant and neuroprotective effects), thymol and carvacrol (antibacterial, immunomodulatory, hepatoprotective and cardioprotective effects), p-cymene, α-thujene, α-pinene, β-pinene, t-anethole and other aromatic hydrocarbons with antimicrobial properties. Black cumin seed oil is widely used not only in the modern food industry, but also in the medicine of the world's most ancient civilizations in the treatment of asthma, bronchitis, colds, hypertension, and headaches [6].

In world practice, kukui nut oil is used to treat neuroallergodermatoses, atopic dermatitis, psoriasis, acne, eczema and other skin diseases. Due to the high concentration of retinoids

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and tocopherols, it helps maintain skin health and reduce the negative effects associated with the appearance of stretch marks and scars.

Kukui nut oil is well absorbed by sensitive and dry skin due to the complex of unsaturated fatty acids that help maintain the natural lipid barrier of the stratum corneum of the epidermis, promoting its regeneration and renewal. With a slight sunscreen effect (SPF 10), it is an excellent base for cosmetics and medicinal products for the skin.

Ungurahui oil has antioxidant, sunscreen and regenerating properties due to the high content of tocopherols. Ungurahui oil also has high biological and nutritional value due to the content of replaceable (asparagine, glutamine, proline, glycine, alanine, arginine, serine) and essential amino acids (leucine, threonine, valine, lysine, isoleucine and tyrosine). In South American cuisine, ungurahui fruits are used to make juices and sweets, and in traditional medicine, ungurahui oil is part of expectorants and antitussives.

Thus, the use of biologically active oils can be a promising direction for the environmentally friendly development of cosmetology, medical and food industries.

2 Materials and Methods

The object of the study is oils from ungurahui fruits, black cumin seeds and kukui nuts.

Subject of the study is the effect of active components of oils from ungurahui fruits, black cumin seeds and kukui nuts on bacterial test cultures.

The purpose of the study is to analyze the antimicrobial activity of oils from ungurahui fruits, black cumin seeds and kukui nuts in relation to bacterial test cultures.

The bactericidal activity of the selected samples was assessed using standard test strains of *Pseudomonas aeruginosa, Bacillus cereus, Escherichia coli* and *Staphylococcus aureus.*

The antimicrobial activity of the oils was assessed according to with General Pharmacopoeia article 1.2.4.0010.18 “Determination of antimicrobial activity of antibiotics by the agar diffusion method” [3].

3 Results

The biologically active properties of oils from ungurahui fruits, black cumin seeds and kukui nuts are largely determined by their fatty acid composition. The average fatty acid composition of the oils under study is shown in Fig. 1-3.

As can be seen from Figure 1, the biologically active basis of kukui nut oil consists of unsaturated fatty acids, among which a special place is occupied by oleic acid (C:18:1, Omega-9), linoleic acid (C:18:2, Omega-6) and α-linolenic acid (C:18:3, Omega-3).

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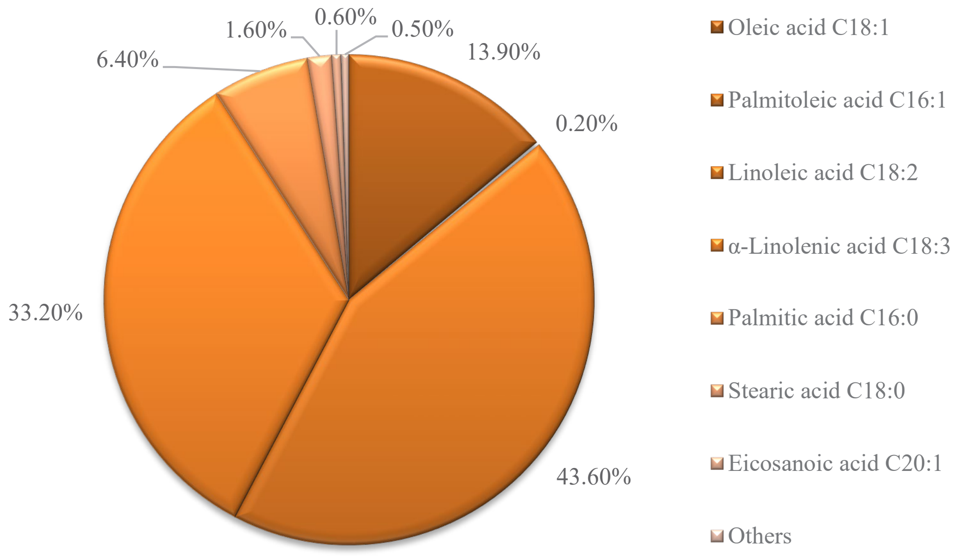

Fig. 1. Fatty acid composition of kukui nut oil

As can be seen from Figure 2, the biologically active basis of black cumin seed oil consists of unsaturated fatty acids, among which a special place is occupied by linoleic acid (C:18:2, Omega-6) and oleic acid (C18:1, Omega-9), as well as saturated fatty acids, among which a special place is occupied by palmitic acid (C16:0) and stearic acid (C18:0).

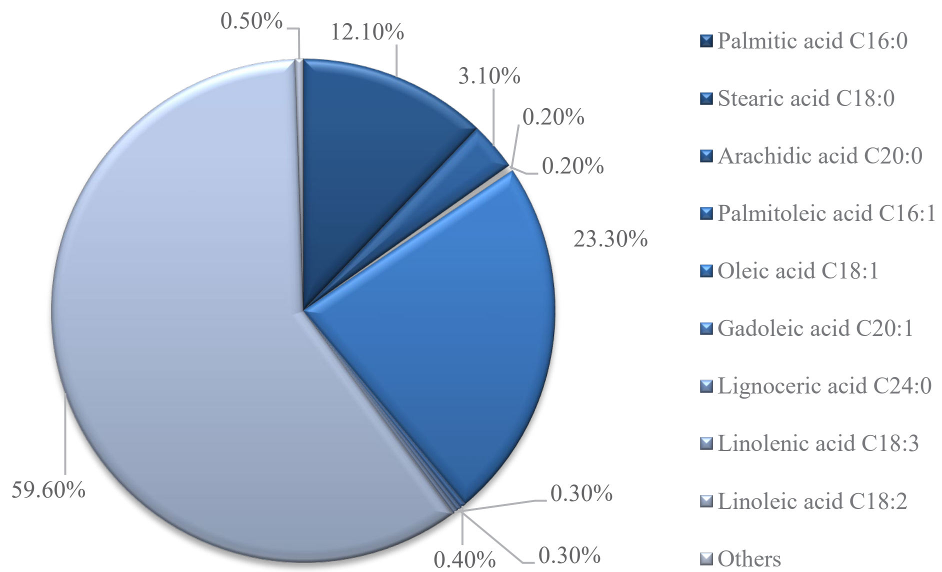

Fig. 2. Fatty acid composition of black cumin seed oil

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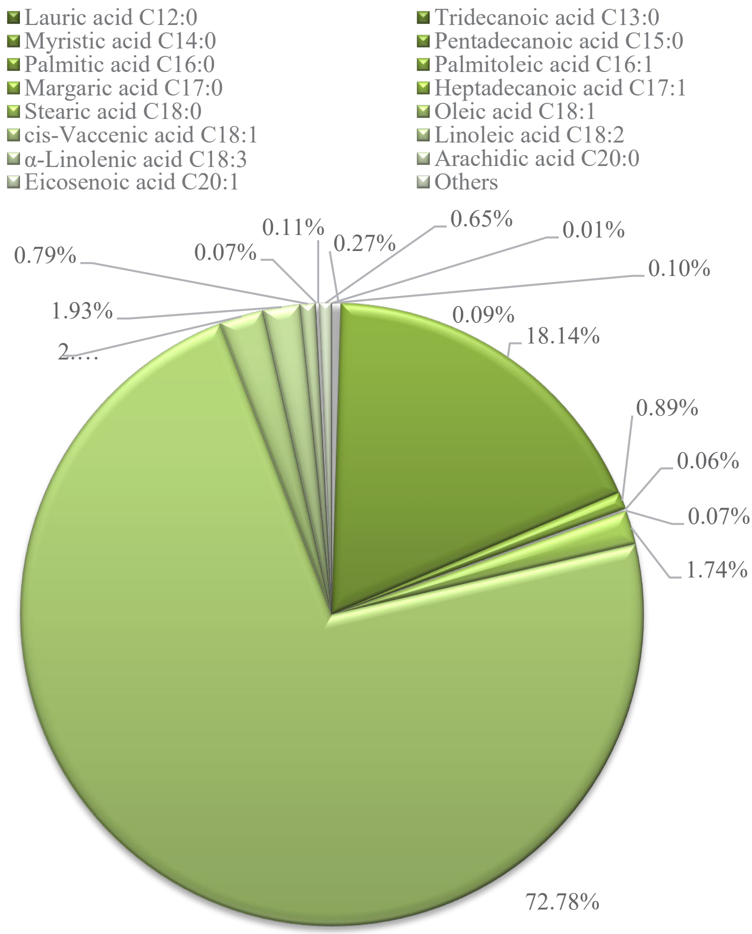


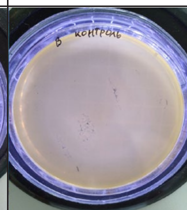
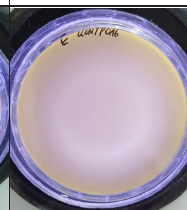
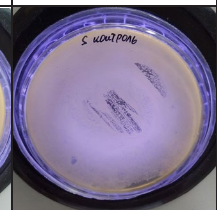
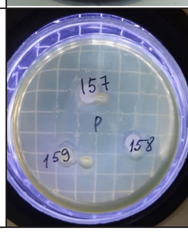
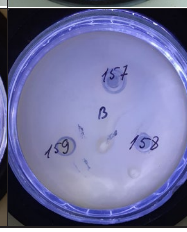
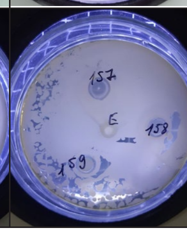
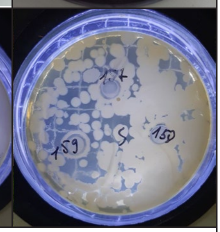
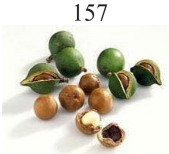
Fig. 3. Fatty acid composition of ungurahui oil

As can be seen from Figure 3, the biologically active basis of ungurahui oil consists of unsaturated fatty acids, among which oleic acid (C18:1, Omega-9) occupies a special place, as well as saturated fatty acids, among which palmitic acid (C16:0) occupies a special place.

It should be noted that the fatty acid composition of ungurahui oil is more diverse compared to kukui nut oil and black cumin seed oil.

The results of studies of the antibacterial activity of oils from ungurahui fruits, black cumin seeds and kukui nuts on nutrient media seeded with test strains of *Pseudomonas aeruginosa, Bacillus cereus, Escherichia coli* and *Staphylococcus aureus* are presented in the table. 1.

Table 1. Antibacterial activity of oils from ungurahui fruits, black cumin seeds and kukui nut

Analysis parameters	*Pseudomonas aeruginosa*	*Bacillus cereus*	*Escherichia coli*	*Staphylococcus aureus*
Pure test culture				
Samples of bioactive oils				
Diameter of the growth inhibition zone (d, mm)				
157  kukui nut oil	13	5	5	5
158  ungurahui oil	11	5	0	0
159  black cumin seed oil	14	0	0	0

Interpretation of results:
d = 0 mm – no antibacterial effect;
0 mm < d ≤ 5 mm – presence of bacteriostatic effect;
5 mm < d < 10 mm – presence of mild antibacterial effect;
10 mm ≤ d – presence of antibacterial effect.

An analysis of Table 1 allows us to conclude that oils from ungurahui fruits (d = 11 mm), black cumin seeds (d = 14 mm) and kukui nut (d = 13 mm) have an antibacterial effect against *Pseudomonas aeruginosa*.

With respect to the remaining test strains, kukui nut oil and ungurahui oil showed a bacteriostatic effect, suppressing the growth of *Bacillus cereus* (samples 157 and 158) and *Escherichia coli* (sample 157) locally under the cylinder. It should be noted that none of the oils tested had an active effect on the growth of *Staphylococcus aureus*. Some slowdown in growth directly under the cylinder was observed only in sample 157 (kukui nut oil).

Thus, it can be concluded that, due to the content of biologically active components, the highest antibacterial activity among the studied samples is possessed by black cumin seed oil, the diameter of the growth inhibition zone of which is 14 mm relative to *Pseudomonas aeruginosa*. At the same time, the greatest breadth of cultural coverage is possessed by kukui nut oil, which exhibits varying degrees of antimicrobial activity on all four test strains.

4 Discussion

The characteristics of fatty acid oils from ungurahui fruits, black cumin seeds and kukui nuts were considered in the works of such authors as: G. Vargas-Arana [2], M. A. Hannan [4] and N. Ogen-Shtern [8] and S. Krist [5]. The positive effect of biologically active components of natural oils on metabolic processes was reflected in the works of Zhilich E. L. [11].

5 Conclusion

The results obtained from the study allow us to conclude that the biologically active properties of oils from ungurahui fruits, black cumin seeds and kukui nuts are largely due to their fatty acid and antioxidant composition.

The biologically active basis of kukui nut oil consists of retinoids and tocopherols, as well as unsaturated fatty acids, among which a special place is occupied by oleic acid (C: 18: 1, Omega-9), linoleic acid (C: 18: 2, Omega-6) and α-linolenic acid (C: 18: 3, Omega-3). Black cumin oil has a fairly high concentration of biologically active substances, including: thymoquinone and dihydrothymoquinone (antioxidant and neuroprotective effects), thymol and carvacrol (antibacterial, immunomodulatory, hepatoprotective and cardioprotective effects), p-cymene, α-thujene, α-pinene, β-pinene, t-anethole and other aromatic hydrocarbons with antimicrobial properties, unsaturated fatty acids, among which a special place is occupied by linoleic acid (C: 18: 2, Omega-6) and oleic acid (C18: 1, Omega-9), as well as saturated fatty acids, among which a special place is occupied by palmitic acid (C16: 0) and stearic acid (C18: 0). The biologically active basis of ungurahui oil consists of tocopherols, oleic acid (C18:1, Omega-9) and palmitic acid (C16:0).

The results of studies of the antimicrobial activity of the experimental mixture on nutrient media seeded with test strains of *Pseudomonas aeruginosa, Bacillus cereus, Escherichia coli* and *Staphylococcus aureus* showed that oils from ungurahui fruits (d = 11 mm), black cumin seeds (d = 14 mm) and kukui nuts (d = 13 mm) have an antibacterial effect against Pseudomonas aeruginosa.

In relation to the remaining test strains, the bacteriostatic effect was demonstrated by kukui nut oil and ungurahui oil, suppressing the growth of *Bacillus cereus* (samples 157 and 158) and Escherichia coli (sample 157) locally under the cylinder.

It should be noted that none of the studied oils had an active effect on the growth of *Staphylococcus aureus*. Some growth retardation directly under the cylinder was observed only in sample 157 (kukui nut oil).

Thus, it can be concluded that due to the content of biologically active components, black cumin seed oil has the highest antibacterial activity among the studied samples, the growth retardation diameter of which is 14 mm relative to *Pseudomonas aeruginosa*. At the same time, the greatest breadth of cultural coverage is demonstrated by kukui nut oil, which exhibits antimicrobial activity on all four test strains. The conducted studies allow us to conclude that oils from ungurahui fruits, black cumin seeds and kukui nuts can have a wide range of applications both in medicine and cosmetology, and in the process of creating natural biologically active additives on an oil basis.

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