EUCALYPTUS-BASED PRODUCTS RANGE AS AN EXAMPLE OF MODERN APPROACHES TO THE CREATION OF HERBAL DRUGS

Olha Khvorost[1], Tetiana Oproshanska[1], Kateryna Skrebtsova[1], Yuliia Fedchenkova[2], Anna Rudnik[3]

1 - National University of Pharmacy of Ukraine
2 - Nizhyn Mykola Gogol State University, Ukraine
3 - Zaporizhzhia State Medical and Pharmaceutical University, Ukraine

Introduction. The genus *Eucalyptus* L'Her. of the Myrtaceae family unites over 800 species. The Australian botanist-systematist W. F. Blakely in 1934 proposed an exhaustive classification of the genus. Then this classification was somewhat improved by the allocation of subgenera: *Angophora*, *Corymbia*, *Blakella*, etc. [1-4]. Eucalypts are essential oil plants. Mono- and sesquiterpenes dominate in the essential oil of eucalyptus [5, 6]. According to the qualitative composition of the essential oil, cineole species are distinguished (*Eucalyptus* (*E.*) *globulis* Labill., *E. viminalis* Labill., *E. australiana* Baker and Smith, *E. radíate* Sieber, *E. polybractea* R.T. Baker), phellandrene species (*E. australiana* var. "B" or *E. phellandra*), piperitone species (*E. dives* Schauer var. "A"), geranyl acetate species (*E. macarthur* Deane et Maiden), citronellal species (*E. citriodora* Hooker), limonene-citral species (*E. staigeriana* F. v. M.). The chemical profile of the essential oil depends on geographical, environmental, physiological and genetic factors, as well as on the conditions of harvesting and storage of raw materials [1, 7-9].

In the SPhU 2.0 there are monographs on eucalyptus raw materials: fresh leaves or fresh apical shoots with a high content of 1,8-cineole (the plant species is not specified) and on essential oil from fresh leaves mainly *E. globulus*, *E. polybractea* and *E. smithii* R.T. Baker [10-12]. The essential oil is obtained by steam distillation and rectification. The marker substance is the monocyclic monoterpene 1,8-cineole (eucalyptol) (formula – Fig. 1) [5, 7-8].

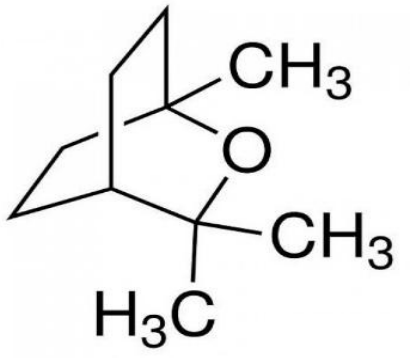

Fig.1 Formula of 1,8-cineole

Eucalyptus leaves are used as a medicinal product, which belongs to the pharmacotherapeutic group of the ATC A-01 A D11 “Drugs for use in dentistry”, and eucalyptus tincture – to the ATC R02A A20 “Drugs used in diseases of the throat. Antiseptics” [13-14].

Eucalyptus leaves exhibit a wide spectrum of pharmacological activity, which is shown in Fig. 2 [1, 15-19].

Given the popularity of eucalyptus leaves and various forms of BAS extracted from this type of raw material, and the current focus of pharmacological action [18-23], it is relevant to investigate the Ukrainian pharmaceutical market of eucalyptus raw materials and products based on it.

The purpose of the work is to investigate the Ukrainian market of eucalyptus-based products of pharmaceutical, food and cosmetic purposes.

Methods: content analysis of compendium information, literary sources, pharmacy websites, trading platforms, etc.

Results and discussion

Having conducted marketing research on products based on eucalyptus raw materials, we have generalized information on manufacturers of eucalyptus leaves, collections, herbal teas and teas based on it, and essential oil (both medicinal products and various food products) that sell their products in Ukraine. The results are presented in Table 1-2.

The market contains raw materials (whole, cut, ground and powder from leaves) from 23 manufacturers (Table 1), of which the majority are Ukrainian (up to 90%). Only 25% of manufacturers indicate the type of plant whose leaves they sell: *E. viminalis* (5 manufacturers) and *E. globulus* (1 manufacturer), the rest do not mention the species affiliation. In addition, there are collections, teas and herbal teas (a total of 12 items, Table 1) which, except to eucalyptus leaves, contain medicinal plant raw materials (MPM) belonging to 21 families (Fig. 3). The largest number of plant species that are sources of MPM belong to the families *Asteraceae* (5), *Lamiacae* (5), *Rosaceae* (4), *Fabaceae* (2) and *Ericaceae* (2). Of the 8 varieties of MPM (Fig. 4) of

DOI: 10.5281/zenodo.15011655

medicinal collections, herbal teas, and teas, the most common are leaves (11 plants), grass (5), flowers (5), and fruits (5).

Fig. 2 Pharmacological activity of eucalyptus leaves

On the pharmaceutical market of Ukraine, essential oil of eucalyptus is available from 21 manufacturers (Table 2), most of which do not indicate the name of the raw material from which this oil is obtained. Only 6 manufacturers indicated that it is essential oil of *Corymbia citriodora*, *E. radiata* and *E. globulus* (2 manufacturers for each type of raw material). Most often, oil is offered for sale in a volume of 10 ml, but there are options of 5 ml, 30 ml (ounce), and even 50 ml and 100 ml (*Aromatics*, Ukraine). 54% of manufacturers are Ukrainian, from foreign ones – products from 6 countries are presented, of which manufacturers from Switzerland and France dominate (11.5% each), the Czech Republic and India (7.7% each). There is information about 2 aroma compositions.

On the pharmaceutical market, there are medicines with eucalyptus leaf extracts, which are produced by manufacturers from 10 countries (Fig. 5). Two-thirds of the manufacturers are state (67.8%), German ones make up 10.8%, Pakistani ones – 7.5%. The rest are manufacturers from the USA (4.3%), India (3.2%), Turkey (2.2%) and Poland, Vietnam, Spain (1.1% each).

There are a number of essential oil-based medicines on the market (for example, capsules for bronchitis "*Respero Myrtal*" (Berlin-Chemie), "Eucalyptus Balm for Colds by Dr. Theiss", "Mixture for Inhalation" (Ternofarm, PJSC "PHYTOPHARM"), granules "Insti", "Insti Nova", "Insti with anise flavor", "Insti with cardamom flavor", "Insti with coffee flavor",

DOI: 10.5281/zenodo.15011655

"Insti with chocolate flavor" (*Herbion Pakistan Privat Ltd*, Pakistan).

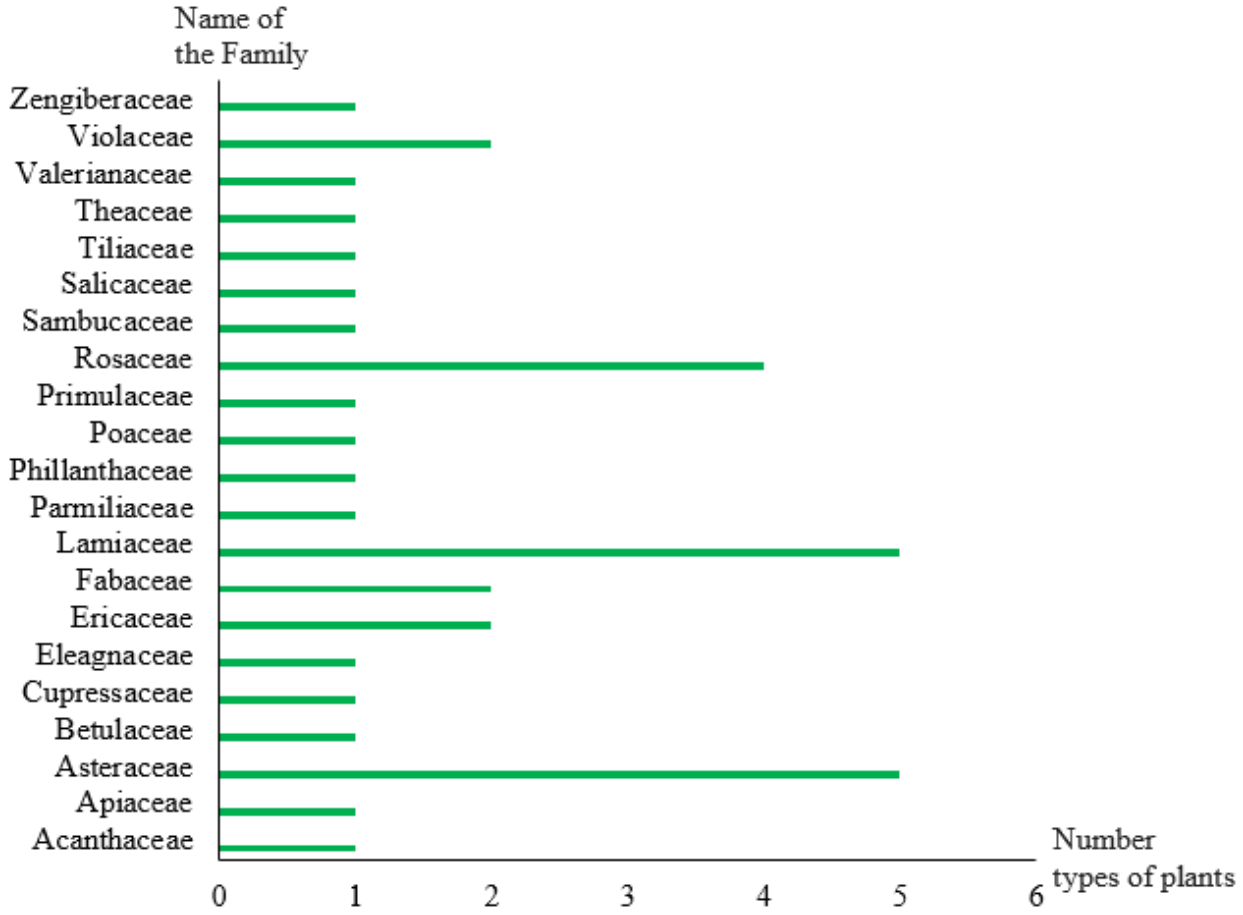

Fig. 3. Family diversity of MRM species included in medicinal collections, herbal teas and teas with eucalyptus leaves

In addition to eucalyptus essential oil, complex remedies often include about two dozen different essential oils: most often these are essential oils from the *Lamiaceae* family (mint, thyme, rosemary, lavender, sage), *Pinaceae* (cedar, pine, fir), as well as tea tree, lemon, nutmeg, and lemongrass. Menthol, camphor, turpentine, and methyl salicylate are also added to combined remedies.

The dominant type of forms with eucalyptus leaf extracts (Fig. 6) are soft (27%), of which there are more complex and combined balms and ointments: “Gevkamen”, “Bainvel” (ATX Code M02A X10 “Means used locally for joint and muscle pain”), “Eucalyptus balm for colds Dr. Thais”, ointment “Doctor MOM” (Code R05X “Other drugs used for coughs and colds”), suppositories “Evkolek” (ATX Code G01A X “Antimicrobial and antiseptic agents used in gynecology”).

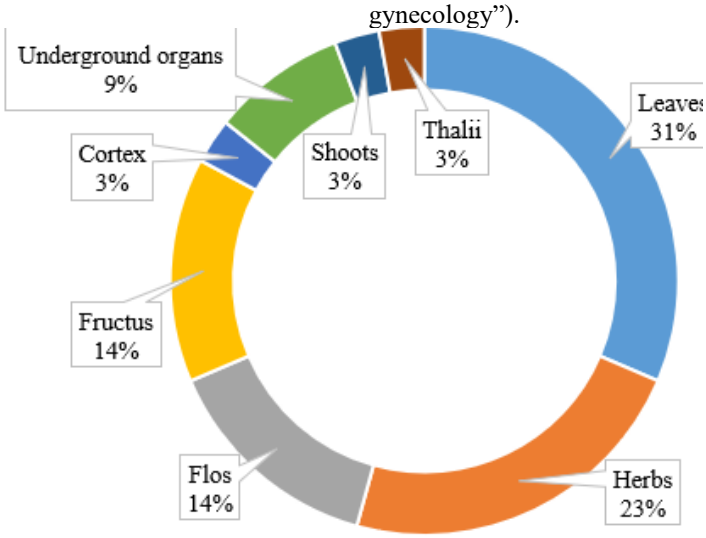

Fig. 4. Varieties of MPM families included in medicinal collections, herbal teas and teas with eucalyptus leaves

DOI: 10.5281/zenodo.15011655

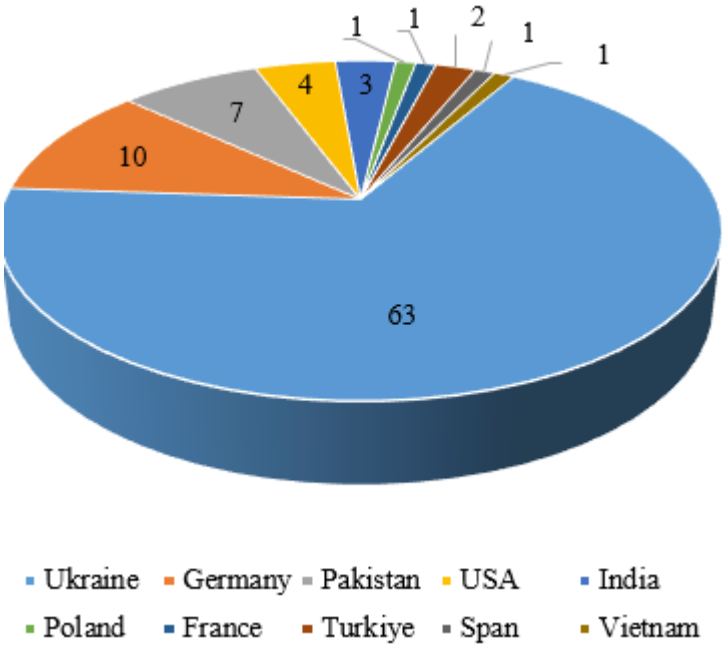

Fig. 5 Segmentation of the state pharmaceutical market of medicines with eucalyptus BAS by producing countries (number of medicines)

Liquid dosage forms are mainly represented by solutions for inhalation (8 variants), tinctures: simple (6) and complex (3). Of the solid dosage forms, granules (sachets) prevail – variants of "Insti" (Pakistan, R05X "Combined preparations used for coughs and colds"). Aerosols (mainly "Ingalipt" and "Kameton" (ATX code R02A A20 "Preparations used for throat diseases. Antiseptics") and sprays, which are produced exclusively by state enterprises. Cosmetics (9%) are represented by hydrolates, soap, foot serum, skin elixir, bath concentrate and perfume.

Thus, the pharmaceutical market of Ukraine contains raw materials and a wide range of products based on eucalyptus leaves (medicinal collections, herbal teas, teas) and extracts from it: essential oil, simple and complex tinctures, inhalation mixtures, tablets, capsules, granules (sachets), balms, ointments, gels, suppositories, aerosols and sprays, patches and products containing chlorophyll derivatives from eucalyptus leaves, the so-called chlorophyllipt [13-14], the marketing research of which we plan to conduct in the future), hydrolates, soaps, etc.

Research prospects.
Analysis of the market of MPM – eucalyptus leaves and products based on it (at the level of drugs, types of food products and cosmetics), despite the remarkable diversity of qualitative composition and type of products, demonstrated a number of unresolved issues. First, it is unclear which species of eucalyptus are the source of the leaves and it is unknown about the importing countries (this is quite understandable – because the plant is not found in our country), because manufacturers do not indicate this information. It can be assumed that the specification of MPM is also quite problematic.

Conclusions. The variety of products (pharmaceutical, food, cosmetic industries) based on raw materials, extracts from it and essential oil confirms its demand in healthcare, food and cosmetic industries. A certain drawback is the unclear segmentation of the market of pharmaceutical (medicines), food (herbal teas, teas) and cosmetic (hydrolates, extracts) direction, which creates difficulties in consumer orientation. However, the modern Ukrainian market of pharmaceutical products based on eucalyptus leaves and extracts from it presents a variety of dosage forms with different combinations of components, which may be the basis for creating an effective algorithm of approaches to the development of dosage forms of new types of APIs with the relevant direction of action.

DOI: 10.5281/zenodo.15011655

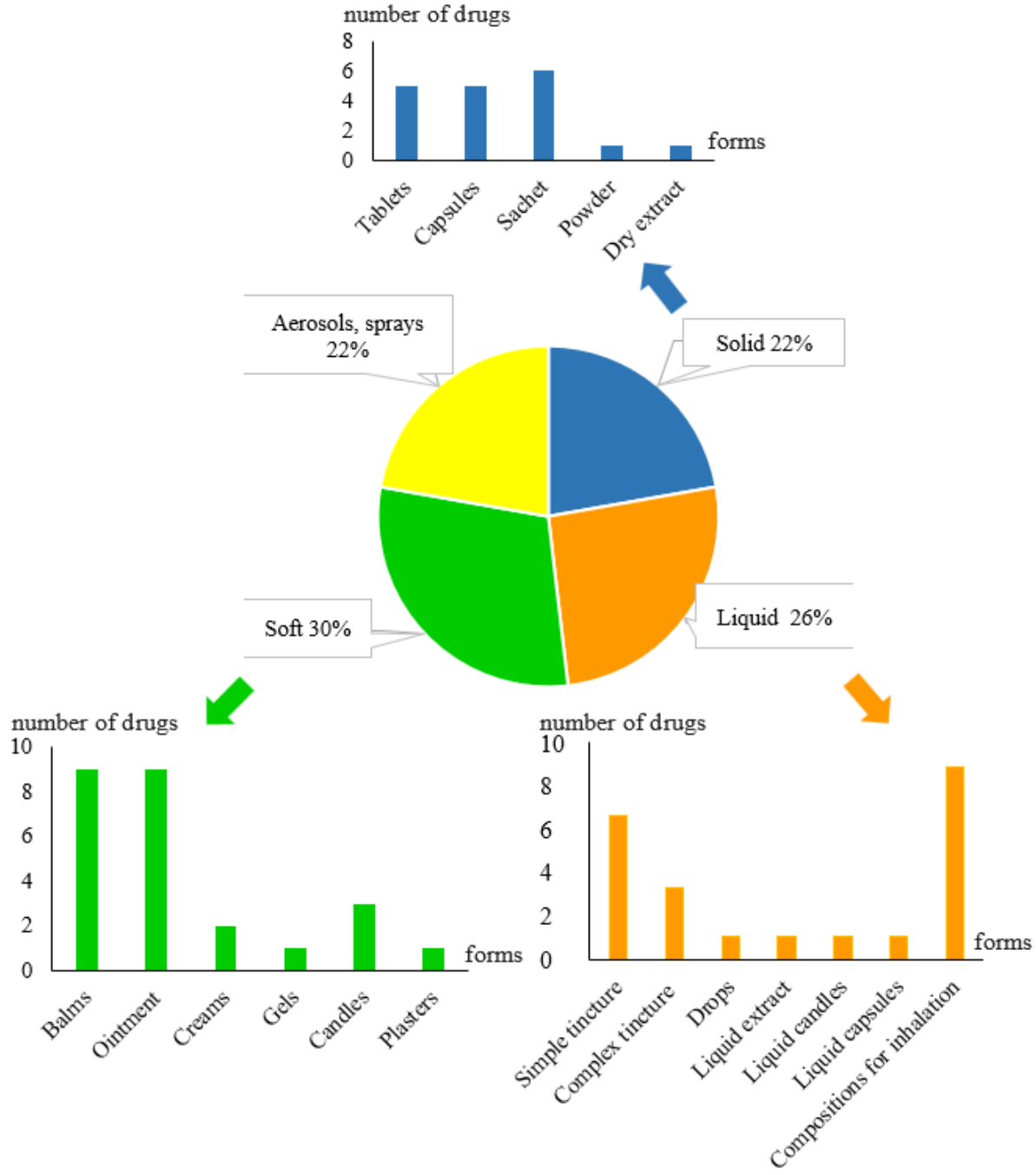

Fig. 6. Segmentation of the product range with different BAS complexes of eucalyptus leaves by shape

Table 1. Producers of eucalyptus leaves, collections, herbal teas and teas based on it

Product name	Manufacturer, packaging	Estimated price, UAH
Eucalyptus	Sednivski travy, Ukraine, 50 g according to TU U 10.8-3245610719-001: 2019	40,00
Eucalyptus leaves	FitiDim, own production, Ukraine, 500 g	198,00
Eucalyptus leaves (powder)	FitiDim, own production, 500 g, 1000 g	234,00/450,00
Eucalyptus leaves	«Ruchna robota» Manufacturer Eco herbs, Ukraine, 500 g	200,00
Eucalyptus leaves	Health- herbal collections, roots, fruits and plants, own production, Ukraine, 500 g	198,00-200,00

DOI: 10.5281/zenodo.15011655

Product name	Manufacturer, packaging	Estimated price, UAH
Dried eucalyptus leaf	Food Market, Ukraine, 50 г, 100 г, 250 g, 500 g, 1000 g	30,00/57,00/ 138,00/265,00/440, 00
Leaf of Eucalyptus viminalis	Private enterprise "Soyuz Afghan" own production, Ukraine, 50 g	25,00
Leaf of Eucalyptus viminalis	Fitodar, Ukraine,	46,00
Eucalyptus viminalis leaves	Liktravy, Ukraine, filter bags 2.5 g No. 20	47,27
Eucalyptus viminalis leaves	PJSC Lubnifarm, Ukraine, 75 g	35,82
Eucalyptus viminalis leaves	Online pharmacy Farmaco.ua. Ukraine, 50 g	40,70
Eucalyptus globulus	NarodFarma, Ukraine, 50 g	51,00
Dried eucalyptus leaf (fresh harvest)	Green Milya, Ukraine, 100 g	85,00
Eucalyptus leaves	PJSC PhF Viola, Ukraine, 50 g	67,00
Eucalyptus leaves Arbor Vitae	PJSC PhF Viola, Ukraine, 75 g in the pack	40,00
Eucalyptus leaves	Planeta trav, Ukraine, 50 г	35,00
Eucalyptus leaves	Myr trav, Ukraine, 100 g	100,00
Eucalyptus (leaves)	Dary Karpat, Ukraine, 50 g	100,00
Eucalyptus leaves	TM Herbs Zaporoje Ukraine, 1kg	500
Eucalyptus organic leaves dried mill	PL DOB, Poland, 5 kg	3677,00
Eucalyptus organic leaves dried mill	Poland, 1 kg	660,00
Leaf of Eucalyptus	4Friend, Ukraine, 100 g, 250 g	212,00/ 424,00
Eucalyptus leaves	Phyto Laurel, Ukraine, 100 g, 1 kg	51,00-418,00
Eucalyptus leaves	Khatyna travnyka, Ukraine, 50 g	30,00
Eucalyptus leaves	NewTea, China, 25 g	750,00
Sinufitol	PJSC «Liktravy», Ukraine, filter packs 1,5 g № 20	97,35
Elecasol	PJSC «Liktravy», Ukraine, filter packs по 1,5 № 20, 60 g, 75 g	42,78
Herbal tea Keys Health Eucalyptus viminalis leaves	LLC Klyuchi Zdorov'ya , Ukraine, 75 g	72,73
Herbal tea "Grass of the Caucasus" eucalyptus leaves	LLC Galenikas, Ukraine, pack 50 g	105,00
Herbal tea "Eucalyptus"	Mudrist′ pryrody, Ukraine filter packs № 20	35,00
Turkish eucalyptus tea (powder)	EM@M King, Turkey, 300 g	485,00
Black tea juniper-eucalyptus	Hello tea filter packs № 20	119,00
Mint + eucalyptus tea	Carpathian tea, Ukraine, filter packs by 135 g № 20	53,30
Oycha Tea "Evening Potion" (farmer's)	OYCHA з Zhygun-herbs 100 g	295,00
Herbal tea "Light Lungs" elderberry and eucalyptus	TM Zhygun Herbs, Ukraine, 40 g	119,00
Herbal tea "Karpaty"	"Podykh Karpat", Ukraine, 20 f/p x 1,25 g	28,80
Gripsil Tea powder	Biodil Laboratories Pvt. Ltd., India, powder 5 g No. 5 sachet	120,00

Table 2. Eucalyptus essential oil manufacturers

Name	Producer	Estimated price, UAH
Lemon Eucalyptus Natural Essential Oil Eucalyptus citriodora	Pranorom, 5 ml Homeopathic aromatherapy by Dr. K.Tsvietkova	270,00
Eucalyptus Radiata Natural Essential Oil	Pranorom, 10 ml	296,00
Eucalyptus essential oil	Fito Product, Ukraine, 10 ml	100,00
Eucalyptus oil	Earth's Care, USA, 1 ounce (30 ml)	389,62
Essential oil Deutsche Ole Eucalyptus	Deutsche Ole, Germany, 11 ml	75,60
Eucalyptus essential oil	Adverso, Ukraine, 20 ml	136,00
Natural Eucalyptus essential oil Vivasan Switzerland	Elixan Aromatica, Switzerland, 10 ml	643,00-720,00
Essential oil « Eucalyptus » natural – Mayur	Mayur, Ukraine, 5 ml	50,00

DOI: 10.5281/zenodo.15011655

Name	Producer	Estimated price, UAH
Eucalyptus essential oil	Aromatics, Ukraine, 100 ml	345,00
Organic eucalyptus essential oil ECOCERT	Aromatics, Ukraine, 50 ml	410,00
Eucalyptus essential oil (Eucalyptus Essential Oil)	Indus Valley, India, 15 ml	719,00
Eucalyptus essential oil	Aroma Inter, 5 ml, 10 ml	37,00-49,00/56,00-75,00
Eucalyptus essential oil	Pharmacom, Ukraine, 10 ml	41,40
Eucalyptus essential oil 911	Green Pharm Cosmetic, Ukraine, 10 ml	65,70
Organic Eucalyptus Radiata Essential Oil Born to Bio	Laboratories Bio Seasons, France,10 ml	312,00
Organic Eucalyptus globulus essential oil	Laboratories Bio Seasons, France, 10 ml	234,00
Organic Lemon Eucalyptus Essential Oil	Laboratories Bio Seasons, France, 10 ml	198,00
Eucalyptus essential oil	Flora Secret, 10 ml, 25 ml	151,00/256,00
Eucalyptus essential oil	Just/ Just, Switzerland, 10 ml	495,00
Essential oil DR.NICE (Dr. Nice) eucalyptus	LLC Multispray, Ukraine, 10 ml	102,00
Eucalyptus essential oil	Kvita, Ukraine, 5 ml	72,00
Organic Eucalyptus essential oil	Terra gaia, Czech Republic, 10 ml,30 ml	250,00/500,00
Eucalyptus essential oil KFP Eucalyptus	Kerala, India, 60 ml	200,00
Eucalyptus essential oil	Hemani, 30 ml	127,00
Eucalyptus "Madeira"	Vivasan, Switzerland, 10 ml	715,00

Eucalyptus-based product range as an example of modern approaches to creating herbal drugs

Olha Khvorost, Tetiana Oproshanska, Kateryna Screbtsova, Yuliia Fedchenkova, Anna Rudnik

Introduction. Given the popularity of eucalyptus leaves and various forms of BAS extracted from this type of raw material, and the current focus of pharmacological action, it is relevant to investigate the Ukrainian pharmaceutical market of eucalyptus raw materials and products based on it. **The purpose of the work** is to investigate the Ukrainian market of eucalyptus-based products of pharmaceutical, food and cosmetic orientation. **Methods:** content analysis of information from the compendium, literary sources, pharmacy websites, trading platforms, etc. **Results and discussion.** The market contains raw materials (whole, cut, ground and leaf powder) from 23 manufacturers, of which the majority are state (up to 90%). Only 25% of manufacturers indicate the type of plant whose leaves they sell: *E. viminalis* (5 manufacturers) and *E. globulus* (1 manufacturer), the rest do not mention the species affiliation. In addition, there are collections, teas and herbal teas (a total of 12 items) which, except to eucalyptus leaves, contain medicinal plant raw materials (MPM), belonging to 21 families. On the pharmaceutical market of Ukraine, essential oil of eucalyptus is available from 21 manufacturers, most of which do not indicate the name of the raw material from which this oil is obtained. Only 6 manufacturers indicated that it is essential oil of *Corymbia citriodora*, *E. radiata* and *E. globulus* (2 manufacturers for each type of raw material). Most often, oil is offered for sale in a volume of 10 ml, but there are options of 5 ml, 30 ml (ounce), and even 50 ml and 100 ml (Aromatics, Ukraine). 54% of manufacturers are Ukrainian, from foreign ones – products from 6 countries are presented, of which manufacturers from Switzerland and France dominate (11.5% each), the Czech Republic and India (7.7% each). There is information about 2 aroma compositions. On the pharmaceutical market, there are medicines with eucalyptus leaf extracts, which are produced by manufacturers from 10 countries (Fig. 5). Two-thirds of the manufacturers are state (67.8%), German ones make up 10.8%, Pakistani ones – 7.5%. The rest are manufacturers from the USA (4.3%), India (3.2%), Turkey (2.2%) and Poland, Vietnam, Spain (1.1% each). The dominant type of forms with eucalyptus leaf extracts are soft (27%), of which more complex and combined balms and ointments. Liquid dosage forms are represented mainly by inhalation solutions (8 options), tinctures: simple (6) and complex (3). Granules (sachets) predominate among solid dosage forms. Cosmetics (9%) are represented by hydrosols, soap, foot serum, skin elixir, bath concentrate and perfume. **Conclusions.** The variety of products (pharmaceutical, food, cosmetic industries) based on raw materials, extracts from it and essential oil confirms its demand in healthcare, food and cosmetic industries. A certain drawback is the unclear segmentation of the market of pharmaceutical (medicines), food (herbal teas, teas) and cosmetic (hydrolates, extracts) direction, which creates difficulties in consumer orientation. However, the modern Ukrainian market of pharmaceutical products based on eucalyptus leaves and extracts from it presents a variety of dosage forms with different combinations of components, which may be the basis for creating an effective algorithm of approaches to the development of dosage forms of new types of APIs with the relevant direction of action.

Keywords: eucalyptus, leaves, collections, drugs

Conflict of interest. Missing.

References

1. Chandorkar, N., Tambe, S., Amin, P., Madankar, C. A systematic and comprehensive review on current

DOI: 10.5281/zenodo.15011655

understanding of the pharmacological actions, molecular mechanisms, and clinical implications of the genus *Eucalyptus*. Phytomed. Plus. 2021, 1, 100089.
2. Coppen J.W. Eucalyptus: The Genus *Eucalyptus*. Taylor & Francis, 2002. 464 p. https://doi.org/10.1201/9780203219430
3. Thornhill A. H., Crisp M. D., Kulheim C. A dated molecular perspective of eucalypt taxonomy, evolution and diversification // *Australian Systematic Botany*. 2019. Vol. 32. P. 29-48. DOI: 10.1071/SB18015
4. Brooker M. I. H. A new classification of the genus *Eucalyptus* L'Her. (Myrtaceae) // *Australian Systematic Botany*. 2000, 13, 79-148. DOI: 10.1071/SB98008
5. Dhakad A.K., Pandey V.V., Beg S., Rawat J.M., Singh A. Biological, medicinal and toxicological significance of *Eucalyptus* leaf essential oil: a review // J. Sci. Food Agric. 2017. Vol. 98. Pp. 833-848. DOI: 10.1002/jsfa.8600.
6. Maurya AK, Aggarwal G, Vashisath S, Kumar V, Agnihotri VK. Chemodiversity and α-Glucosidase Activity of Eucalyptus Species from Northwestern Himalaya, India. *Chem Biodivers*. 2023, 20(8), e202300223.
7. Aldoghaim, F.S.; Flematti, G.R.; Hammer, K.A. Antimicrobial Activity of Several Cineole-Rich Western Australian Eucalyptus Essential Oils. Microorganisms 2018, 6, 122. https://doi.org/10.3390/microorganisms6040122
8. Mieres-Castro D., Ahmar S., Shabbir R., Mora-Poblete F. Antiviral Activities of *Eucalyptus* Essential Oils: Their Effectiveness as Therapeutic Targets against Human Viruses // Pharmaceuticals. 2021, 14, 1210. DOI: 10.3390/ph14121210.
9. Elaissi A, Moumni S, Roeleveld K, Larbi Khouja M. Chemical Characterization of Five Tunisian Eucalyptus Essential Oils Species. *Chem Biodivers*. 2020;17(1):e1900378. doi:10.1002/cbdv.201900378
10. TheState Pharmacopoeia of Ukraine. Vol. 3. (2014). Kharkiv: DP «Naukovo-ekspertnyi farmakopeinyi tsentr». (in Ukrainian).
11. TheState Pharmacopoeia of Ukraine. Vol. 1. (2015). Kharkiv: DP «Naukovo-ekspertnyi farmakopeinyi tsentr». (in Ukrainian).
12. State register of medicines. Available at: // http://www.moz.gov.ua/ua/portal/mtph_register_medicines/.
13. Compendium // https://compendium.com.ua/uk/akt/69/163/eucalyptus-viminalis/
14. Khvorost O. P., Skrebtsova K. S., Oproshanska T. V. Assortment of medicinal products with BAC eucalyptus on the domestic market. "Modern achievements of pharmaceutical technology", mat. XI International scientific and practical conference, Kharkiv, November 27, 2024 Kh.: 2024. P. 112.
15. Pan, M.; Pan, M.; Lei, Q.; Zhang, H. Prediction and confirmation of active ingredients in *Eucalyptus globulus* Labill leaves. *Ind. Crops Prod.* 2020, *154*, 112631 https://doi.org/10.1016/j.indcrop.2020.112631
16. Palma A., Jesus Diaz M., Ruiz-Montoya M., Morales E., Giraldez I. Ultrasound extraction optimization for bioactive molecules from *Eucalyptus globulus* leaves through antioxidant activity // Ultrason. Sonochemistry. 2021. Vol. 76. P. 105654. DOI: 10.1016/j.ultsonch.2021.105654.
17. Wong J.H., Lau K-M., Wu Y-O., Cheng L., Wong C-W., Yew D. T-W., Leung P-C., Fung K-P., Hui M., Ng T-B., Lau C.B-S. Antifungal mode of action of macrocarpal C extracted from *Eucalyptus globulus* Labill (Lan An) towards the dermatophyte Trichophyton mentagrophytes // Chinese Medicine. 2015. Vol. 10. DOI: 10.1186/s13020-015-0068-3.
18. Kolpakova K., Zymonė K., Marksa M., Ivanauskas L., Liaudanskas M., Janulis V. Qualitative and quantitative analysis of Eucalyptus (*Eucalyptus globulus* L., *Eucalyptus viminalis* L.) Leaf Essential oil // The Vital Nature Sign. Kaunas, 2018. P. 50.
19. Gupta P.K., Priyanka V., Hiremath L., Kumar N.S., Srivastava A.K. Extraction of Phytochemicals from Eucalyptus Spp. & Withania Somnifera and Their Biological Testing // American Journal of Microbioligal Research. 2018. Vol. 6. Pp. 115-123. DOI: 10.12691/ajmr-6-4-1.
20. Ossipov V., Koivuniemi A., Mizina P., Salminen J.P. UPLC-PDA-Q Exactive Orbitrap-MS profiling of the lipophilic compounds product isolated from *Eucalyptus viminalis* plants // Heliyon. 2020. Vol. 6. e05768. DOI: 10.1016/j.heli-yon.2020.e05768.
21. Salehi B., Sharifi-Rad J., Quispe C., Llaique H., Villalobosc M., Smeriglio A., Trombetta D., Ezzat S.M., Salem M.A., Zayed A., Salgado Castillo C.M., Yazdi S.E., Sen S., Acharya K., Sharopov F., Martins N. Insights into *Eucalyptus* genus chemical constituents, biological activities and health-promoting effects // *Trends Food Sci Technol*. 2019. Vol. 91. P. 609-624. DOI: 10.1016/j.tifs.2019.08.003.
22. Li JS, Liu YN, Li JY, Lei C, Hou AJ. Acylphloroglucinol-monoterpene meroterpenoids from Eucalyptus tereticornis and their inhibitory activity against ATP citrate lyase. *Phytochemistry*. 2023, 207, 113565. doi:10.1016/j.phytochem.2022.113565
23. Hansen CC, Sørensen M, Bellucci M, et al. Recruitment of distinct UDP-glycosyltransferase families demonstrates dynamic evolution of chemical defense within Eucalyptus L'Hér. *New Phytol*. 2023, 237(3), 999-1013. doi:10.1111/nph.18581

DOI: 10.5281/zenodo.15011655