

# АКТУАЛЬНІ ПРОБЛЕМИ ТРАНСПОРТНОЇ МЕДИЦИНИ

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# АКТУАЛЬНІ ПРОБЛЕМИ ТРАНСПОРТНОЇ МЕДИЦИНИ:

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3

#### Адреса редакції:

вул. Канатна, 92, 65039, м. Одеса, Україна  
Тел.: +380-50-988-98-94, +380-48-753-18-04  
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#### The address of editorial office:

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<b>Зміст:</b>		<b>Content:</b>
ВИВЧЕННЯ ПРОПОЛІСУ ТА ЕКСТРАКТУ ВОСКОВОЇ МОЛІ ЯК ПРОФІЛАКТИЧНИЙ І ЛІКУВАЛЬНИЙ ЗАСІБ ПРИ ДЕЯКИХ ЗАХВОРЮВАННЯХ — <i>Лахманюк Ю. Р., Боднарюк Н. В., Устянська О. В., Еберле Л. В., Цісак А.О., Грицук О.І., Улізко І. В.</i>	106	STUDY OF PROPOLIS AND WAX MOTH EXTRACT AS A PREVENTIVE AND THERAPEUTIC MEANS FOR SOME DISEASES — <i>Lakhmanyuk Y. R., Bodnariuk N. V., Ustianska O. V., Eberle L. V., Tsisak A.O., Gritsuk O.I., Ulizko I.V.</i>
ПАТОГЕНЕТИЧНА РОЛЬ НІТРАТЕРГІЧНОЇ СИСТЕМИ ПРИ ЕКСПЕРИМЕНТАЛЬНОМУ ХРОНІЧНОМУ СТРЕСІ НА ТЛІ ГІПЕРТИРЕОЗУ — <i>Шнайдер С.А., Гавриченко Д.Г., Комлевої О.М., Федорченко Т.В., Гончарова Л.В., Дімова А.А.</i>	114	NITRATERGIC SYSTEM PATHOGENETIC ROLE IN EXPERIMENTAL CHRONIC STRESS ON THE BACKGROUND OF HYPERTHYROIDISM — <i>Shneider S.A., Gavrichenko D.G., Komlevoi O.M., Fedorchenko T.V., Goncharova L.V., Dimova A.A.</i>
ПАТОГЕНЕТИЧНІ ОСОБЛИВОСТІ ЗМІН ІМУННОЇ СИСТЕМИ В ДИНАМІЦІ РОЗВИТКУ ЕКСПЕРИМЕНТАЛЬНОЇ ПНЕВМОНІЇ І АДРЕНАЛІНОВОГО ПОШКОДЖЕННЯ МІОКАРДА — <i>Регада М.С., Шклярський Н.В.</i>	123	PATHOGENETIC FEATURES OF CHANGES IN THE IMMUNE SYSTEM IN THE DYNAMICS OF THE DEVELOPMENT OF EXPERIMENTAL PNEUMONIA AND ADRENALINE DAMAGE TO MYOCARDIA — <i>Regeda M.S., Shklyarskyi N.V.</i>
<b>Історія медицини</b>	<b>128</b>	<b>History of Medicine</b>
«ПАТОЛОГІЯ» У СИСТЕМІ ВИЩОЇ МЕДИЧНОЇ ОСВІТИ (кінець XVIII ст. — перша половина XIX ст.) — <i>Гоженко А.І., Васильєв К.К., Васильєв Ю.К., Сарахан В.М., Кузьменко І.А.</i>	128	"PATHOLOGY" IN THE SYSTEM OF HIGHER MEDICAL EDUCATION (end of the 18th century -first half of the 19th century) — <i>Gozhenko A.I., Vasiliev K.K., Vasiliev Yu.K., Sarakhan V.M., Kuzmenko I.A.</i>
ПРОФЕСОР ДАНИЛО МИХАЙЛОВИЧ ВЕЛЛАНСЬКИЙ (1774-1847) ЯК ПАТОЛОГ — <i>Гоженко А.І., Васильєв К.К., Васильєв Ю.К., Сарахан В.М.</i>	137	PROFESSOR DANILO MYKHAYLOVYCH VELLANSKY (1774-1847) AS A PATHOLOG — <i>Gozhenko A.I., Vasiliev K.K., Vasiliev Yu.K., Sarakhan V.M.</i>
<b>Рецензія</b>	<b>144</b>	<b>Review</b>
«МАГНІЙ ЯК ЕСЕНЦІЙНИЙ МІКРОНУТРИЄНТ: ГІГІЄНИЧНІ ТА МЕДИКО-БІОЛОГІЧНІ АСПЕКТИ» (автори - В.В. Бабієнко, А.В. Мокієнко, О.А. Полюлях, 2023 Р.) — <i>Андрусишина І.М.</i>	144	"MAGNESIUM AS AN ESSENTIAL MICRON-TRIENT: HYGIENE AND MEDICO-BIOLOGICAL ASPECTS" (authors - V.V. Babienko, A.V. Mokienko, O.A. Polyulyakh, 2023) — <i>Andrusyshina I.M.</i>
<b>Наші вітання!</b>	<b>146</b>	<b>Our Congratulations!</b>
60 РОКІВ ПРОФЕСОРУ ОЛЕКСАНДРУ МИКОЛАЙОВИЧУ СТОЯНОВУ	146	60 YEARS OF PROFESSOR ALEXANDR MYKOLAYOVYCH STOYANOV
<b>Правила для авторів</b>	<b>148</b>	<b>Rules for authors</b>

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## STUDY OF PROPOLIS AND WAX MOTH EXTRACT AS A PREVENTIVE AND THERAPEUTIC MEANS FOR SOME DISEASES

*Lakhmanyuk Y. R., Bodnariuk N. V., Ustianska O. V., Eberle L. V.,  
Tsisak A. O., Gritsuk O. I.,<sup>1</sup> Ulizko I. V.*  
Odessa I. I. Mechnikov National University  
<sup>1</sup>Odessa National Medical University  
[olga2407152728@gmail.com](mailto:olga2407152728@gmail.com)

## ВИВЧЕННЯ ПРОПОЛІСУ ТА ЕКСТРАКТУ ВОСКОВОЇ МОЛИ ЯК ПРОФІЛАКТИЧНИЙ І ЛІКУВАЛЬНИЙ ЗАСІБ ПРИ ДЕЯКИХ ЗАХВОРЮВАННЯХ

*Лахманюк Ю. Р., Боднарюк Н. В., Устянська О. В., Еберле Л. В.,  
Цісак А. О., Грицук О. І.,<sup>1</sup> Улізко І. В.*  
Одеський національний університет імені І. І. Мечникова, м. Одеса  
<sup>1</sup>Одеський національний медичний університет, м. Одеса

## ИЗУЧЕНИЕ ПРОПОЛИСА И ЭКСТРАКТА ВОСКОВОЙ МОЛИ КАК ПРОФИЛАКТИЧЕСКОЕ И ЛЕЧЕБНОЕ СРЕДСТВО ПРИ НЕКОТОРЫХ ЗАБОЛЕВАНИЯХ

*Лахманюк Ю. Р., Боднарюк Н. В., Устянская О. В., Эберле Л. В.,  
Цисак А. А., Грицук А. И.,<sup>1</sup> Улизко И. В.*  
Одесский национальный университет имени И. И. Мечникова, г. Одесса  
<sup>1</sup>Одесский национальный медицинский университет, г. Одесса

106

### Резюме/Summary

The paper presents an analysis of the literature data of the last decade on the clinical use of such apiproducs as propolis and wax moth extract as therapeutic and prophylactic agents. Interest in apitherapy and its effectiveness are due to the high content of compounds with pronounced biological activity in bee products. These compounds are both actually of plant origin and are the products of their subsequent metabolism in the body of the bee. Numerous studies demonstrate the healing properties inherent in apiproducs associated with anti-inflammatory, antioxidant, anticarcinogenic, antidiabetic, antiatherogenic, immunomodulatory and other effects.

Biologically active substances of propolis, indirectly affecting the intra- and extracellular structures of tissues, correct the metabolism of cancer cells, causing, in this regard, inhibition of growth and progression of tumors. The results obtained to date convincingly indicate the advisability of using propolis and other apiproducs in oncology as additional therapeutic agents. An analysis of new publications on the study of the effects of wax moth extract, both in the experiment and in the clinic, indicates that this apiproducs has antimicrobial and immunomodulatory properties that can be effective in combating tuberculosis and other dangerous pathologies.

**Keywords:** *apitherapy, biologically active substances, propolis, wax moth extract, oncology, tuberculosis, therapeutic and prophylactic agents.*

В работе представлен анализ литературных данных последнего десятилетия по клиническому применению таких апипродуктов как прополис и экстракт восковой моли в качестве лечебных и профилактических средств. Интерес к апитерапии и ее эффективность обусловлены высоким содержанием в продуктах пчеловодства соединений с выраженной биологической активностью. Эти соединения имеют как собственно растительное происхождение, так и являются продуктами их последующего метаболизма в организме пчелы. Многочисленные исследования демонстрируют свойственные апипродуктам целебные свойства, ассоциирующие с противовоспалительными, антиоксидантными, антиканцерогенными, антидиабетическими, антиатерогенными, иммуномодулирующими и другими эффектами.

Биологически активные вещества прополиса опосредованно воздействуя на внутри- и внеклеточные структуры тканей, корректируют метаболизм раковых клеток, вызывая в этой связи, торможение роста и прогрессии опухолей. Полученные к настоящему времени результаты убедительно свидетельствуют о целесообразности использования прополиса и других апипродуктов в онкологии в качестве дополнительных терапевтических средств. Анализ новых публикаций по исследованию эффектов экстракта восковой моли как в эксперименте, так и в клинике, свидетельствует о наличии у данного апипродукта антимикробных и иммуномодулирующих свойств, которые могут быть эффективны в борьбе с возбудителями туберкулеза и других опасных патологий.

**Ключевые слова:** апитерапия, биологически активные вещества, прополис, экстракт восковой моли, онкология, туберкулез, лечебные и профилактические средства.

У роботі представлений аналіз літературних даних останнього десятиліття щодо клінічного застосування таких апіпродуктів як прополіс та екстракт воскової молі як лікувальні та профілактичні засоби. Інтерес до апітерапії та її ефективність обумовлені високим вмістом у продуктах бджільництва сполук із вираженою біологічною активністю. Ці сполуки мають як рослинне походження, так і є продуктами їх подальшого метаболізму в організмі бджоли. Численні дослідження демонструють властиві апіпродуктам цілющі властивості, що асоціюють із протизапальними, антиоксидантними, антиканцерогенними, антидіабетичними, антиатерогенними, імуномодулюючими та іншими ефектами.

Біологічно активні речовини прополісу опосередковано впливаючи на внутрішньо- і позаклітинні структури тканин, коригують метаболізм ракових клітин, викликаючи у зв'язку з цим гальмування росту та прогресії пухлин. Отримані на даний час результати переконливо свідчать про доцільність використання прополісу та інших апіпродуктів в онкології як додаткові терапевтичні засоби. Аналіз нових публікацій щодо дослідження ефектів екстракту воскової молі як в експерименті, так і в клініці свідчить про наявність у даного апіпродукту антимікробних та імуномодулюючих вла-

стивостей, які можуть бути ефективними у боротьбі зі збудниками туберкульозу та інших небезпечних патологій.

**Ключові слова:** апітерапія, біологічно активні речовини, прополіс, екстракт воскової молі, онкологія, туберкульоз, лікувальні та профілактичні засоби.

## Introduction

Today, the problem of maintaining and improving health is becoming increasingly acute. The influence of various anthropogenic environmental factors, the emergence of drug-resistant strains of pathogens, the emergence of expensive

and ineffective medicines: all this suppresses human immunity. That is why society often turns to medicines from the arsenal of alternative medicine, whose therapeutic properties are due to natural biologically active substances.

Apitherapy has been used since ancient times and is increasingly valued as a medical support by many doctors and scientists around the world. Numerous studies have attributed a wide range of properties to bee products, including antioxidant, antibacterial, anti-inflammatory, antiviral, anti-tumour, and many others.

For example, propolis is a bee product known since ancient times for its healing properties. Due to its wide variety of chemical compositions, it has a rich biological and pharmacological activity and is widely used in medicine, cosmetology and other areas of human activity. This api product is one of the most researched and richest in biologically active components. It has been documented by many researchers that propolis contains more than 500 compounds, including flavonoids, phenolic compounds, polyphenols, terpenes, terpenoids, coumarins, steroids, amino acids and aromatic acids. It is also rich in essential oils, vitamins (A, B, C and E complexes) and minerals such as aluminium, sodium, potassium, calcium, copper, magnesium, iron and zinc. Numerous preclinical and clinical studies have shown that a wide range of natural compounds in propolis are potential anti-diabetic, anti-apoptotic, anti-inflammatory, antioxidant, antibacterial, antiviral and anticarcinogenic agents. Various studies have examined the antiproliferative effects of propolis from different countries, and its cytotoxic effects have been attributed to its polyphenol content. These results show that this apiproduct is able to reduce the proliferation of cancer cells and may play a promising role in the development of new anti-cancer drugs in the future.

An equally amazing medicine is the extract of wax moth larvae. Observations by scientists, apitherapists, and beekeepers

attest to their incredible medicinal properties.

Wax moth larvae are the only living creatures on the planet that feed on wax, but it is not pure wax, but honeycombs impregnated with all bee products, containing all vitamins and microelements, which makes it possible to restore a huge number of processes in the human body. By eating these bee products, the wax moth larva accumulates their biological potential. Many bacteria, viruses and protozoa have a protective shell that resembles wax in its properties and is resistant to chemical attack. The wax moth is the only living creature on Earth whose larvae have enzymes that can metabolise wax. More than 100 years ago, I. I. Mechnikov studied the properties of wax moth larvae on *Mycobacterium tuberculosis*. Studies have shown that the enzyme cerase in the alcohol extract of the wax moth is able to dissolve the lipid-wax component of the tuberculosis bacteria's membrane, making them less protected and more susceptible to drugs.

Additional studies of wax moth extract and propolis have proven their effectiveness and versatility in terms of clinical effects, which will open up new prospects for these bee products as an independent drug and a drug in the complex therapy of various pathological conditions.

**The aim of the study** is to analyse publications of the last decade on the clinical use of apiary products (propolis, wax moth larvae extract) as prophylactic and therapeutic agents for certain pathologies.

### **Results and discussion**

Propolis is a natural substance containing about 50 different compounds. It is composed of plant resins with organic acids (55%), balsams containing tannins, essential oils, aromatic aldehydes, phenolic carboxylic acids (8% each), as well as wax (22%) and pollen (5-11%). In addition, there are mechanical impurities and ash elements such as calcium, potassium, manganese, zinc, aluminium, sodium, phosphorus, iron, magnesium, copper, cobalt, va-

nadium, silicon and strontium.

Although propolis contains a small amount of nitrogenous substances such as proteins, amides, amines and amino acids, the total nitrogen content is less than 0.7%. The known amino acids present are tryptophan, phenylalanine, leucine, cystine, methionine, valine, serine, glycine, histidine, arginine, proline, tyrosine, threonine, alanine, lysine, aspartic and glutamic acids.

The key components of propolis are flavonoids (19 identified), as well as the secretion of the maxillary glands of bees, which includes acetoxymethylchavicol; 10-oxy-2-decenoic acid (2-8 %), which has antioxidant properties [1, 2].

Chromatographic analysis has revealed various components of propolis, including flavones (chrysin, tectochrysin, luteolin, apigenin, etc.), flavonols (quercetin, kaempferol, galangin, isialpinin, ramocitrin), flavonols (pinocombirin, pinostrobin, etc. ), phenolic acids (trans-caffeine, trans-coumarin, trans-ferulene, cinnamaldehyde, vanillin, etc.), as well as terpenoids,  $\beta$ -acetoxymethylchavicol, bisabolol and the aromatic aldehyde isoaniline (4-oxy-3-methoxybenzaldehyde) [3, 4].

Propolis has a variety of applications as a medicinal product, used both internally and externally, including in the form of inhalations and various preparations such as ointments, solutions, and candles [5, 6]. It has demonstrated effectiveness in the treatment of injuries, wounds, slow-healing postoperative wounds and burns.

For the treatment of trophic ulcers on the lower extremities, aerosols containing a 5% aqueous solution or an ointment containing 10-30% propolis are used.

In proctology, propolis is also used to treat anal fissures and haemorrhoids. For this purpose, ointment and suppositories containing 10% propolis are used. Propolis preparations can be recommended to patients after proctological operations.

In diseases of the upper respiratory tract and lungs, propolis is used due to its antibacterial, local anaesthetic, anti-inflam-

matory, regenerative and immunomodulatory properties. It also has the ability to enhance the effect of antibiotics, which makes it a valuable therapeutic agent for respiratory diseases [7, 8].

Propolis has been found to be useful in the treatment of upper respiratory tract and lung diseases due to its antibacterial properties; it also has local anaesthetic, anti-inflammatory, regenerative and immunomodulatory effects. It can also increase the effectiveness of antibiotics when used together [9, 10].

Propolis preparations are used in gastroenterology to treat diseases such as gastric and duodenal ulcers, gastritis, colitis, hepatitis, and biliary dyskinesia [11, 12].

In gynaecological practice, they are used to heal and eliminate inflammation, treat various diseases, such as cervical erosion, colpitis (vaginitis), endocervicitis, and poorly healing wounds after gynaecological operations.

In addition, in dermatology, propolis preparations are widely used in the treatment of various skin diseases: eczema, neurodermatitis, psoriasis, dermatomycosis, pustular processes and herpes simplex [13, 14].

Various studies by clinics and laboratories from different countries [15-18] have demonstrated the potential of propolis as a promising treatment for various types of cancer. Cancer is a heterogeneous disease, with two characteristic features being uncontrolled cell proliferation and insufficient apoptosis. Various studies have specifically focused on human breast cancer cells and found that propolis has a significant anti-tumour effect. It induces apoptosis; it has the ability to exhibit low toxicity to normal cells while selectively targeting tumour cells. This selectivity makes it a potentially outstanding treatment for breast cancer [17].

Scientists Benguedouar L. Lahouel M. Gangloff S. et al. studied the effect of an ethanolic extract of Algerian propolis on melanoma tumour growth. The researchers

found that one of the key compounds (galangin) present in propolis plays a significant role in inducing apoptosis and inhibiting melanoma cells in vitro. This suggests that propolis may be effective in the fight against melanoma, a type of skin cancer [18].

Various studies have examined the antiproliferative effects of propolis, a natural bee product from different countries, and its cytotoxic effects have been attributed to its polyphenol content. Turkish scientists Demir S. Aliyazicioglu Y. Turan I. et al. have shown the cytotoxic effects and possible mechanisms of action of ethanolic extract of Turkish propolis (EEP) on human lung cancer cell line (A549). The cytotoxic activity of EEP on A549 cells was detected by MTT assay. Then, the mechanisms involved in the cytotoxic effect of EEP on A549 cells were investigated in terms of apoptosis, mitochondrial membrane potential and cell cycle using flow cytometry, endoplasmic reticulum stress using RT-PCR and caspase activity. EEP showed selective toxicity to A549 cells compared to normal fibroblast cells. Scientists determined that EEP arrested the cell cycle of A549 cells in G1 phase, induced endoplasmic reticulum stress, caspase activity and apoptosis, and reduced mitochondrial membrane potential. These results show that Turkish propolis is able to reduce the proliferation of cancer cells and may play a promising role in the development of new anticancer drugs in the future [17, 19].

Everyone knows about the healing properties of bees, but the big wax moth (*Galleria mellonella*) can be considered an equally important and useful insect. It is a member of the subfamily Galleriinae of the family Pyralidae of the order Lepidoptera. This species of insect is a cosmopolitan, meaning that it can easily adapt to environmental conditions. Currently, the wax moth is found on all continents of the Earth (except Antarctica).

Wax moth extract stands out for its unique composition. It is a unique source of enzymes, trace elements and vitamins

that surpasses many conventional medicines. The tincture contains 20 of the 28 essential and nonessential amino acids necessary for a healthy and fulfilling life. These amino acids play specific roles that correspond to their functions in the body. For example, the valine, leucine and isoleucine contained in the tincture are essential for recovery from injury, muscle mass and protein absorption. Tryptophan, phenylalanine and methionine have a positive effect on heart function and strengthen the immune system. Arginine helps regulate growth, improves blood supply and stimulates the production of growth hormones.

The extract also contains serotonin-like substances, peptides, enzymes, xanthine, hypoxanthine, high molecular weight proteins, nucleotides, nucleosides, steroid hormones, a significant amount of essential trace elements such as copper, potassium, manganese, magnesium, selenium, zinc, iron, chromium, molybdenum and cobalt, as well as various vitamins.

The wax moth larva is a highly concentrated product, with free amino acids accounting for more than 50% of its weight, high molecular weight substances for 2%, and nucleotides and nucleosides for 1.5%. It also contains from 2 to 4.7% of monosaccharides and disaccharides, 0.1% of fatty acids and 7.1-9.1% of minerals. The extract contains peptides, proteins, carbohydrates, lipids and fatty acids (including essential linoleic and linolenic acids), purine derivatives, vitamins, important micro- and macroelements. Based on chromatography-mass spectrometry data, 48 individual substances were identified in the *Galleria mellonella* larvae tincture. Among them are glycerol, butan-1-ol, N,N-dimethylaminoethanol, phenylacetaldehyde, ethyl palmitate, ethyl linoleate and 6-aminobenzothiazole. This makes it similar to a living "tablet" of nutrients [20].

Indications for cardiovascular use of the extract include conditions associated with myocardial ischaemia and heart failure. It is also useful in chronic bronchopulmonary diseases, including chronic inflamma-



tory processes. The extract can treat sexual function disorders, such as infertility, miscarriage, menopausal symptoms in women, low sex drive, slow sperm motility and prostate adenoma in men. It has also been shown to have a positive effect in various immunodeficiency states, hypotrophy, anaemia of various origins, and anaemia during pregnancy [21].

Literature data indicate that the extract can be effective in the complex therapy of hypertension and gastrointestinal diseases, including duodenal ulcers, as well as to prevent scarring at the site of an ulcer. Scientists have found benefits in hepatitis, cholecystitis, pancreatitis, and gastritis of various etiologies. The extract has an antioxidant and strengthening effect, improves microcirculation, reduces thrombosis in varicose veins, and has anti-stress, adaptogenic and antioxidant properties [22].

It has been established that wax moth extract obtained from freshly collected larvae under certain conditions has healing properties, in particular in the treatment of tuberculosis. This extract contains biologically active substances, consisting of two main components - the serine protease enzyme and chitosan [23].

The idea of using wax moths in the treatment of tuberculosis was first mentioned by the great Nobel Prize-winning scientist I. I. Mechnikov. He suggested that the larvae may contain special enzymes capable of destroying the waxy outer layer of *Mycobacterium tuberculosis*, known as the Koch's bacillus. This concept was further developed by other scientists who proposed the "lipase concept" for treating TB using wax moths: the protective lipid layer of mycobacteria could be damaged, making them more susceptible to drugs and the human immune system [23].

Further studies have confirmed that serine protease (cerase enzyme) contained in wax moth tincture has the ability to dissolve the membranes of *E. coli*. This is a digestive enzyme that occurs naturally in

wax moth larvae and can be effectively extracted and preserved in an ethanol-based larval extract. In addition to breaking down waxy lipids, this enzyme also promotes lung tissue regeneration and promotes new cell growth.

Another useful component of wax moth tincture is chitosan, which has antibacterial and anti-tuberculosis effects. Studies have shown that as little as 10 minutes of interaction between mycobacterial cells and chitosan can lead to an antibacterial effect [24]. Chitosan binds to the surface of the cell membrane of tuberculosis bacteria and destroys it, which ultimately leads to the death of the bacterial cell.

Wax moth extract has significant pharmacological and therapeutic effects, offering a number of benefits with low toxicity and stable storage. It is well tolerated and does not cause undesirable side effects. However, it should be borne in mind that the use of bee products can be dangerous for people with allergies and intolerances to these products.

The extract has a multifaceted biostimulating effect on the body, combining adaptogenic, cardioprotective, hypotensive, hypocoagulant, antibacterial and other properties [24].

### **Conclusions**

The problem of finding effective drugs for the treatment and prevention of various diseases remains important. This problem is especially relevant in connection with the phenomenon of polypharmacy, excessive and not always appropriate use of pharmacological drugs.

Propolis and wax moth extract have attracted considerable attention in recent years as potential candidates for the prevention and treatment of dangerous diseases. Based on numerous modern studies, these bee products have been analysed for their anticarcinogenic, anti-inflammatory, immunomodulatory and many other properties.

According to the results of studies in many clinics around the world, wax moth

extract has demonstrated great potential in the treatment of malignant tumours and tuberculosis due to its antibacterial and anticarcinogenic effects. Despite the promising preliminary findings, more extensive research, including clinical trials, is needed to determine the effectiveness of these natural substances in the treatment of particularly dangerous diseases.

In summary, propolis and wax moth extract have a powerful potential as a complement to conventional treatments for dangerous diseases, thanks to their various biologically active compounds. The joint efforts of scientists, physicians and beekeeping experts will be crucial to explore the potential of these natural remedies and turn them into safe and effective treatments for cancer, tuberculosis and other serious pathologies.

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