Use of B Vitamins in Pharmacotherapy of Tuberculosis: Retrospective and Marketing Analysis

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Abstract. The article provides a comprehensive summary of research findings on the application of group B vitamins in the pharmacotherapy of tuberculosis. This study is grounded in both retrospective and marketing analyses, spanning from 1950 to 2024 and utilizing prominent scientific databases. The findings indicate a significant potential benefit of antioxidant vitamins in the prevention and treatment of tuberculosis, attributed to their antioxidant properties and beneficial effects on the immune system. The marketing analysis highlights the broad availability and popularity of group B vitamins in the Ukrainian market, enhancing the accessibility and economic feasibility of these products. The research offers crucial insights for medical practice and lays a foundation for future studies aimed at advancing tuberculosis prevention and treatment, particularly under conditions of heightened infection risk. Additionally, the article underscores the importance of integrating these vitamins into therapeutic protocols, which could lead to more effective management strategies for tuberculosis and possibly other infectious diseases. By identifying gaps in current treatment approaches and highlighting the economic advantages of group B vitamins, the study also paves the way for public health initiatives to incorporate these findings into broader health policies. This comprehensive approach ensures that both the medical community and policymakers are informed, facilitating a coordinated effort in combating tuberculosis on multiple fronts.

Keywords: tuberculosis, vitamins, antioxidants, B vitamins, thiamin, riboflavin, pantothenic acid, pyridoxine, cyanocobalamin.

Introduction. Tuberculosis is one of the leading infectious causes of death in the world. In fact, every year 10 million people get sick with tuberculosis and 1.5 million people die from tuberculosis [1-3].

Vitamins play an important role in vital functions due to their antioxidant, pro-oxidant, anti-inflammatory and metabolic functions [4-10].

Tuberculosis is a serious public health problem. The World Health Organization estimated that in 2008 there were 9.4 million cases of tuberculosis and 1.8 million deaths from tuberculosis worldwide. Enhancing the immune response to Mycobacterium tuberculosis could potentially allow shortening of antimicrobial therapy in drug-susceptible disease or improve outcomes in drug-resistant disease [11].

Multidisciplinary research of post-traumatic stress, depressive, nervous system, covid, post-covid, long-covid and other disorders during war among patients, primarily combatants, record the discovery of tuberculosis as a comorbid disease [12-17].

The article continues the author's research on the chosen topic [18-21].

Antioxidants may protect against the oxidative stress associated with tuberculosis disease. However, direct evidence of a protective relationship between dietary antioxidants and the incidence of tuberculosis in humans is lacking. The relationship between the intake of antioxidant vitamins (vitamins A, B, C, D and E) and individual carotenoids (α-carotene, β-carotene, β-cryptoxanthin, lycopene and lutein) and the incidence of tuberculosis was investigated in the Singapore Chinese Study Health Care. Scientists found that a lower risk of tuberculosis was observed among vitamin C users only among smokers. Other vitamins and carotenoids were not associated with the risk of developing tuberculosis. These results suggest that vitamin C may reduce the risk of tuberculosis among current smokers by attenuating oxidative stress, while vitamin A and β-carotene may have additional antimycobacterial properties [22].

Certain antioxidant vitamins may be prescribed to maintain general health and to enhance the effectiveness of tuberculosis treatment. They help to strengthen the immune system and contribute to the overall recovery of the body. Major antioxidant vitamins that may be useful in the treatment of tuberculosis include:

- ✓ *Vitamin A:* supports the immune system and the health of mucous membranes, which help protect the body against infections.
- ✓ *Vitamins of the B group:* important for energy metabolism and the nervous system. Vitamin B6 (pyridoxine) may be especially helpful when taking isoniazid to prevent peripheral neuropathy.
- ✓ *Vitamin C:* powerful antioxidant that supports the immune system and can enhance the effects of anti-tuberculosis drugs.
- ✓ *Vitamin D:* important for the immune system and can help fight infections and improve the results of tuberculosis treatment.
- ✓ Vitamin E: an antioxidant that protects cells from damage and supports the immune system.

These vitamins are not the main treatments for tuberculosis, but can help improve the patient's general health and support the main therapy. The appointment of vitamins should be carried out by a doctor, taking into account the individual needs of the patient.

The purpose of the study was to discuss and summarize the evidence and still open questions regarding the use of vitamin B antioxidants in pharmacotherapy as a preventive measure in those at high risk of Mycobacterium tuberculosis infection and active tuberculosis. It was of interest to additionally conduct a retrospective and marketing analysis of group B antioxidant vitamins that can be used in the pharmacotherapy of tuberculosis.

Materials and methods. The term of the study is April 2024 – June 2024. A retrospective documentary search was conducted on the topic of the article on the websites of PubMed, Scopus, Google Scholar, EMBASE, Cochrane Library, WHO, Crossref, Copernicus. Search depth from 1950 to 2024. Articles discussing the role of B vitamins and tuberculosis were highlighted. The State Formulary of Medicinal Products 16th issue of Ukraine [23] and the State Register of Medicinal Products of Ukraine [24] were also studied in order to conduct a marketing analysis of the vitamin-antioxidant market of Ukraine.

The research of the article is a fragment of research works of Private Scientific Institution "Scientific and Research University of Medical and Pharmaceutical Law" on the topic "Multidisciplinary research of post-traumatic stress disorders during war among patients (primarily combatants)" (state registration number 0124U002540, implementation period 2024-2028); Lviv Medical Institute LLC on the topic of "Improving the system of circulation of drugs during pharmacotherapy on the basis of evidentiary and forensic pharmacy, organization, technology, biopharmacy and pharmaceutical law" (state registration number 0120U105348, implementation period 2021-2026); Kharkiv Medical Academy of Postgraduate Education on "Improving the organizational and legal procedure for providing patients with drugs from the standpoint of forensic pharmacy, organization and management of pharmacy" (state registration number 0116U003137, terms 2016-2020) and "Pharmaceutical and medical law: integrated approaches to the system of drug circulation from the standpoint of forensic pharmacy and organization of pharmaceutical business" (state registration number 0121U000031, terms 2021-2026); Luhansk State Medical University "Conceptual interdisciplinary approaches to pharmaceutical provision and availability of drugs, taking into account organizational and legal, technological, analytical, pharmacognostic, forensic and pharmaceutical, clinical and pharmacological, pharmacoeconomic, marketing, social and economic competencies" (state registration number 0123U101632, terms 2023-2027); Petro Mohyla Black Sea National University on the topic "Conceptual interdisciplinary approaches to the drug circulation system, taking into account organizational and legal, technological, biopharmaceutical, analytical, pharmacognostic, forensic and pharmaceutical, clinical and pharmacological, pharmacoeconomic, pharmacotherapeutic aspects" (state registration number 0123U100468, implementation period 2023-2028).

Research and discussion. Vitamins are key participants in metabolic processes in the body, including the skin and other organs and systems. Vitamins such as pyridoxine, pantothenic and ascorbic acids, riboflavin, thiamine, retinol, tocopherol (vitamin E) and vitamin F are necessary for proper metabolism in the skin. A deficiency of some of these vitamins can cause serious skin problems such as atrophy of the epidermis, follicles hair and sebaceous glands (pyridoxine, pantothenic and nicotinic acids), hyperkeratosis (retinol) [25].

Tuberculosis is a serious disease that requires a complex approach to treatment. Antioxidant vitamins can play an important role in maintaining general health and the effectiveness of the main treatment of tuberculosis [26-33].

Next, the author studied in more detail each vitamin-antioxidant group B separately.

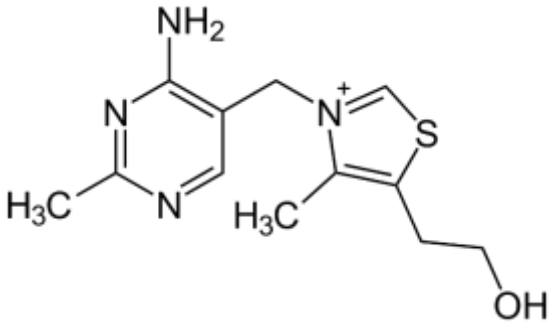

Fig. 1. Thiamine (Vitamin B1).

Thiamine, also known as vitamin B1, is an important water-soluble vitamin that plays a key role in maintaining metabolism, especially of carbohydrates, and in the functioning of the nervous system. The main active metabolite of thiamine is the coenzyme cocarboxylase (thiamine pyrophosphate), which is necessary for the activation of redox processes in the body.

Biological role of thiamine

Thiamine is critical for energy metabolism because it helps convert carbohydrates into glucose, which the body uses for energy. It also participates in the synthesis of nucleic acids and neurotransmitters, supporting the function of the nervous system. Thiamine deficiency can lead to neuralgia, cardiovascular system dysfunction, and other serious metabolic and neurological disorders. Thiamine is found in foods such as milk, nuts, liver, yeast, and brown bread.

The benefit of Thiamine in the pharmacotherapy of tuberculosis

Tuberculosis is an infectious disease. Requires long-term treatment and supportive therapy. Thiamine is one of the antioxidant vitamins that can be useful in the pharmacotherapy of tuberculosis. Contributes to general strengthening of the body and increasing the effectiveness of basic therapy.

Thiamine and energy metabolism

With tuberculosis, the body needs additional energy to fight the infection and restore damaged tissues. Thiamine, as an important component of carbohydrate metabolism, ensures the efficient production of energy necessary for the normal function of cells and organs. This is especially important for patients with tuberculosis. They often experience decreased energy levels and exhaustion.

Thiamine and the nervous system

Thiamine plays an important role in maintaining the function of the nervous system, which can be impaired in tuberculosis. Especially in cases of meningitis or other neurological complications. Promotes the synthesis of neurotransmitters. Improves the transmission of nerve impulses. Supports cognitive functions.

Antioxidant effect

Thiamine also acts as an antioxidant. Helps protect cells from damage caused by free radicals, which are formed during the inflammatory processes in tuberculosis. This helps reduce oxidative stress and improves the general health of patients.

Thiamine and the cardiovascular system

Thiamine supports the health of the cardiovascular system, which can be especially beneficial for patients with tuberculosis. Chronic infection can lead to heart failure. Vitamin B1 helps to normalize the heart rhythm and improves the overall function of the heart.

The use of thiamine in tuberculosis treatment

Thiamine can be prescribed as part of complex therapy for tuberculosis to support the general health of patients, strengthen the nervous and cardiovascular systems, reduce oxidative stress, and increase energy levels.

Conclusion

Thiamine (vitamin B1) is an important component of supportive therapy in the treatment of tuberculosis. Its role in energy metabolism, support of the nervous system and antioxidant action contribute to the improvement of the general condition of patients, increase the effectiveness of the main pharmacotherapy. The inclusion of thiamine in the complex treatment of tuberculosis can help in reducing symptoms, improving the quality of life, and accelerating the recovery of patients.

Marketing analysis of thiamine preparations

Marketing research was conducted according to the methodology developed at the Kharkiv Medical Academy of Postgraduate Education, Luhansk State Medical University, Petro Mohyla Black Sea National University under the leadership of Professor V.O. Shapovalova. [34-39].

The marketing analysis was conducted for thiamine drugs that are in circulation on the pharmaceutical market of Ukraine according to Trade name/dosage form, Composition of active substances, Manufacturer/Country, No. of the registration certificate, Validity from/to is given in Table 1.

Table 1. Marketing analysis of Thiamine (Vitamin B1).

Trade name/dosage form	Composition of active substances	Manufacturer/ Country	No. of the registration certificate	Validity from/to
THIAMINE CHLORIDE (VITAMIN B1) solution for injection	1 ml of solution contains thiamine hydrochloride 50 mg	Private joint-stock company "Lekhim - Kharkiv", Ukraine	UA/12783/01/01	unlimited from 24.01.2018
THIAMINE HYDROCHLORIDE pulveris	thiamine hydrochloride not less than 98.5% and not more than 101.0%, calculated on the anhydrous substance	Jiangxi Tianxin Pharmaceutical Co., Ltd., China	UA/14650/01/01	unlimited from 23.04.2020
THIAMINE HYDROCHLORIDE pulveris	of thiamine hydrochloride not less than 98.5% and not more than 101.0% on the anhydrous basis	DSM Nutritional Products GmbH, Germany	UA/17916/01/01	06.02.2020 06.02.2025
THIAMINE HYDROCHLORIDE pulveris	of thiamine hydrochloride not less than 98.5% and not more than 101.0%, calculated on the anhydrous substance	Huazhong Pharmaceutical Co., Ltd., China	UA/18259/01/01	17.08.2020 17.08.2025

THIAMINE HYDROCHLORIDE pulveris	thiamine hydrochloride from 98.5% to 101.0% on an anhydrous basis	Jiangxi Tianxin Pharmaceutical Co., Ltd., China	UA/18358/01/01	07.10.2020 07.10.2025
THIAMINE CHLORIDE-DARNYTSYA (VITAMIN B1-DARNYTSYA) solution for injection	1 ml of solution contains thiamine hydrochloride 50 mg	PrJSC "Pharmaceutical firm "Darnytsia", Ukraine	UA/5489/01/01	unlimited from 22.11.2016
ROKOT THIAMINE MONONITRATE 33 1/3 % pulveris	1 g contains: thiamine mononitrate - 333 mg, a mixture of mono- and diglycerides of food fatty acids - 667 mg	DSM Nutritional Products, USA	UA/5988/01/01	unlimited from 22.12.2016
THIAMINE CHLORIDE-HEALTH solution for injections	1 ml of solution contains thiamine hydrochloride 50 mg	Limited liability company "Pharmaceutical company "Zdorovya", Ukraine	UA/7787/01/01	unlimited from 20.09.2017

Marketing analysis of the market showed that vitamin B1 is produced in different forms: solution for injections, powder, which provides a wide range of applications. The main data of the analysis are presented in the following points:

1. Trade names and release forms:
   - Vitamin B1 is produced under various trade names, such as "Thiamine chloride (Vitamin B1)", "Thiamine hydrochloride", "Thiamine chloride-Darnytsya (Vitamin B1-Darnytsya)", "Rokot Thiamine mononitrate 33 1/3 %", " Thiamine chloride-health".
   - Forms of release include a solution for injection and a powder, which allows the drug to be used for various medical purposes.
2. Composition of active substances:
   - Vitamin B1 in the form of a solution for injections contains thiamine hydrochloride in a concentration of 50 mg/ml.
   - In the form of thiamine hydrochloride powder, the concentration is from 98.5% to 101.0% on an anhydrous basis.
3. Manufacturers and countries:
   - The drugs are produced by leading pharmaceutical companies from Ukraine (PJSC "Lekhim - Kharkiv", PJSC "Pharmaceutical Firm "Darnytsia", LLC "Pharmaceutical Company "Zdorovya"), China (Jiangxi Tianxin Pharmaceutical Co., Ltd., Huazhong Pharmaceutical Co., Ltd.), Germany (DSM Nutritional Products GmbH) and the USA (DSM Nutritional Products).
4. Registration certificate numbers and validity period:
   - Most of the registration certificates have an unlimited period of validity, which indicates the long presence of drugs on the market and their stability. For example, UA/12783/01/01 from 01/24/2018 and UA/14650/01/01 from 04/23/2020.

- Some drugs have a fixed expiration date, for example, UA/17916/01/01 from 02/06/2020 to 02/06/2025.

5. Economic and social feasibility:
   - The production of thiamine preparations in the conditions of pharmacies and pharmaceutical enterprises is economically beneficial, especially in the conditions of a military conflict, which allows to ensure availability and reduces the cost of treatment.
   - The social importance of drugs increases in emergency situations, as they help reduce the suffering of victims, reduce pain, inflammation, and elevated temperature, improving the quality of life of patients.

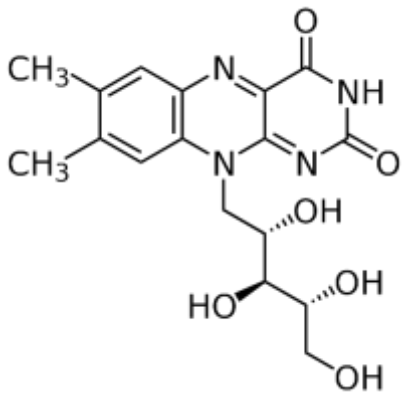

Fig. 2. Riboflavin (Vitamin B2).

Riboflavin (vitamin B2) is a water-soluble vitamin. It plays a key role in maintaining health and functioning of the body. An important component for energy production, maintaining the health of the skin, eyes, and nervous system.

Biological role of riboflavin

Energy metabolism. Riboflavin is a coenzyme in numerous biochemical reactions, including redox processes in the body. Contributes to the conversion of carbohydrates, fats, and proteins into energy. Necessary for the formation of flavin mononucleotide (FMN) and flavin adenine dinucleotide (FAD), which play a key role in metabolic processes.

Maintaining the health of the skin and mucous membranes

Riboflavin helps maintain healthy skin, eyes, and mucous membranes. It is important for the normal development and growth of cells, as well as for the recovery of tissues. Riboflavin deficiency can lead to dermatitis, cracks on the lips and corners of the mouth (angular stomatitis), and vision problems.

Antioxidant protection

Riboflavin has antioxidant properties. Protects cells from damage caused by free radicals. Helps reduce oxidative stress and improve overall health.

Health of the nervous system

Vitamin B2 supports the normal functioning of the nervous system. Contributes to the transmission of nerve impulses. Provides energy for nerve cells.

Support of the cardiovascular system

Riboflavin helps maintain the health of the cardiovascular system. Helps to reduce the level of homocysteine (a risk factor for the development of cardiovascular diseases).

Use of riboflavin in the pharmacotherapy of tuberculosis

Riboflavin may be useful in the pharmacotherapy of tuberculosis due to its multiple biological functions.

Energy metabolism in tuberculosis

When fighting an infection, the body needs additional energy. Riboflavin, as an important component of energy metabolism, contributes to the production of energy necessary for the normal functioning of cells and organs.

Antioxidant protection in Tuberculosis

Riboflavin helps reduce oxidative stress caused by inflammatory processes in tuberculosis. The antioxidant properties of vitamin B2 help protect cells from damage. Contributes to the general strengthening of the body.

Maintaining the health of the skin and mucous membranes in Tuberculosis

Patients with tuberculosis may experience skin and mucous membrane problems. Riboflavin helps to maintain their health. Restores damaged tissues and improves the general condition of the skin.

Support of the nervous system in Tuberculosis

Tuberculosis can affect the nervous system, especially in cases of meningitis. Riboflavin supports the normal functioning of the nervous system. Contributes to the transmission of nerve impulses. Improves cognitive functions.

Support of the cardiovascular system in Tuberculosis

Tuberculosis can lead to heart failure. Riboflavin helps maintain the health of the cardiovascular system. Lowers the level of homocysteine. Improves the general function of the heart.

Conclusion

Riboflavin (vitamin B2) is an important component of supportive therapy in the treatment of tuberculosis. Its role in energy metabolism, antioxidant protection, maintenance of the health of the skin and mucous membranes, nervous and cardiovascular systems make it valuable for patients with tuberculosis. The inclusion of riboflavin in the comprehensive treatment of tuberculosis can help reduce symptoms, improve quality of life, and promote recovery in patients.

The marketing analysis was carried out for Riboflavin drugs that are in circulation on the pharmaceutical market of Ukraine according to Trade name/dosage form, Composition of active substances, Manufacturer/Country, Noю of the registration certificate, Validity from/to is given in Table 2.

Table 2. Marketing analysis of Riboflavin (Vitamin B2)

Trade name/dosage form	Composition of active substances	Manufacturer/ Country	No. of the registration certificate	Validity from/to
Riboflavin pulveris	riboflavin not less than 97.0% and not more than 103.0% in terms of dry matter	BASF Company Ltd., Korea	UA/15082/01/01	unlimited from 30.07.2020
Riboflavin (Vitamin B2) pulveris	riboflavin not less than 97.0% and not more than 103.0%, calculated on dry matter	Hubei Guangji Pharmaceutical Co., Ltd., China	UA/18294/01/01	04.09.2020 04.09.2025
Riboflavin Sodium phosphate pulveris	riboflavin from 73.0% to 79.0% (dry matter)	Harmen Finochem Ltd. (full cycle of production), India Basf Kampani Ltd. (production of intermediates), Korea	UA/20156/01/01	15.08.2023 15.08.2028

Marketing analysis of the market showed that Riboflavin (vitamin B2) is produced in various forms, in particular in the form of a powder, which provides a wide range of its applications. The main data of the analysis are presented in the following points:

1. Trade names and release forms:
   - ❖ Riboflavin is available under various trade names such as "Riboflavin" and "Riboflavin Sodium phosphate".
   - ❖ Release forms include powder, which allows the drug to be used for various medical purposes.
2. Composition of active substances:
   - ❖ Riboflavin in powder form has a concentration of not less than 97.0% and not more than 103.0% on a dry matter basis.
   - ❖ In the case of Riboflavin sodium phosphate, the concentration of the active substance is from 73.0% to 79.0% on a dry matter basis.
3. Manufacturers and countries:
   - ❖ The drugs are produced by leading pharmaceutical companies from Korea (Basf Company Ltd), China (Hubei Guangji Pharmaceutical Co., Ltd.), India (Harmen Finochem Ltd) in cooperation with Korea (Basf Kampani Ltd).
4. Registration certificate numbers and validity period:
   - ❖ Some registration certificates have an unlimited period of validity, which indicates the long presence of drugs on the market and their stability. For example, UA/15082/01/01 from 07/30/2020.
   - ❖ Other drugs have a fixed period of validity, for example, UA/18294/01/01 from 09/04/2020 to 09/04/2025 and UA/20156/01/01 from 08/15/2023 to 08/15/2028.
5. Economic and social feasibility:
   - ❖ The production of Riboflavin preparations in the conditions of pharmacies and pharmaceutical enterprises is economically beneficial. Allows to ensure accessibility for patients and reduces treatment costs.
   - ❖ The social significance of drugs increases in emergency situations, as they help reduce vitamin B2 deficiency in the population. Improve the general state of health and quality of life of patients.

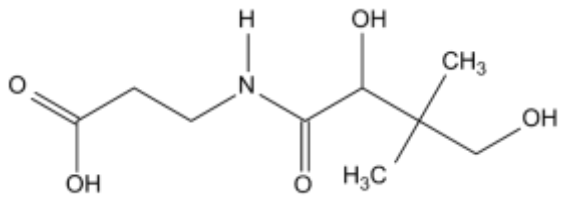

Fig. 3. Pantothenic acid (Vitamin B5).

Pantothenic acid (vitamin B5) is a water-soluble vitamin. It plays an important role in metabolism. Promotes general health. An indispensable component of coenzyme A (CoA), which is involved in numerous biochemical processes.

Biological role of pantothenic acid

Metabolism of fats, proteins, and carbohydrates. Pantothenic acid is a key component of coenzyme A, which is involved in the metabolism of fats, proteins, and carbohydrates. Contributes to the transformation of food into energy and ensuring the normal functioning of cells.

Synthesis of hormones. Vitamin B5 is necessary for the synthesis of adrenal hormones (corticosteroids). Plays an important role in the regulation of stress and immune response.

Skin health and wound healing. Pantothenic acid promotes skin health. Accelerates wound healing processes. Reduces the risk of developing infections. Helps maintain skin elasticity and moisture.

Synthesis of coenzymes. Pantothenic acid is necessary for the synthesis of coenzymes involved in numerous metabolic reactions, including the synthesis of acetylcholine, an important neurotransmitter.

Antioxidant protection. Vitamin B5 helps protect cells from damage caused by free radicals. Helps reduce oxidative stress and improve overall health.

The benefit of pantothenic acid in the pharmacotherapy of tuberculosis

- ✓ Support of the nervous system in Tuberculosis.
- ✓ Pantothenic acid plays an important role in the synthesis of acetylcholine, a neurotransmitter that supports the normal functioning of the nervous system. This may be useful for patients with tuberculosis who may experience neurological complications.

Conclusion

Pantothenic acid (vitamin B5) is an important component of supportive therapy in the treatment of tuberculosis. Its role in metabolism, hormone synthesis, skin health, antioxidant protection, and nervous system support makes it valuable for TB patients. The inclusion of pantothenic acid in the pharmacotherapy of tuberculosis can help reduce symptoms, improve the quality of life and promote the recovery of patients.

The marketing analysis was carried out for Pantothenic acid drugs that are in circulation on the pharmaceutical market of Ukraine according to Trade name/dosage form, Composition of active substances, Manufacturer/Country, No. of the registration certificate, Validity from/to are given in Table 3.

Table 3. Marketing analysis of Pantothenic acid (Vitamin B5)

Trade name/dosage form	Composition of active substances	Manufacturer/ Country	No. of the registration certificate	Validity from/to
Univit tablets	1 tablet contains: vitamin A (retinol acetate) 600 IU; vitamin B1 (thiamine hydrochloride) 0.203 mg; vitamin B2 (riboflavin) 0.3 mg; vitamin B5 (calcium D-pantothenate) 1.2 mg; vitamin B6 (pyridoxine hydrochloride) 0.3 mg; vitamin B12 (cyanocobalamin) 0.0002 mg; vitamin C (ascorbic acid) 10 mg; vitamin D3 (cholecalciferol) 80 IU; vitamin PP (nicotinamide) 3 mg; folic acid 0.04 mg; calcium 12.5 mg; phosphorus 10 mg	" Kyiv Vitamins Factory " JSC, Ukraine	UA/5450/01/01	unlimited from 19.08.2016
Undetab tablets	1 tablet contains: vitamin A 3300 IU; vitamin E 10 mg; vitamin B1 (thiamine hydrochloride) 2 mg; vitamin B2 (riboflavin) 2 mg; vitamin B6 (pyridoxine hydrochloride) 3 mg; vitamin B12 (cyanocobalamin) 0.002 mg; vitamin C (ascorbic acid) 75 mg; vitamin PP (nicotinamide) 20 mg; folic acid 0.07 mg; rutin 10 mg;	" Kyiv Vitamins Factory " JSC, Ukraine	UA/4834/01/01	unlimited from 22.12.2020

	vitamin B5 (calcium D-pantothenate) 3 mg			
Undevit dragee	1 dragee contains: vitamin A - 3300 IU, vitamin E - 10 mg, vitamin B1 - 2 mg, vitamin B2 - 2 mg, vitamin B6 - 3 mg, vitamin B12 - 2 μg, vitamin C - 75 mg, vitamin PP - 20 mg, vitamin B – 0.07 mg, vitamin B5 – 3 mg, rutin – 10 mg	" Kyiv Vitamins Factory " JSC, Ukraine	UA/7922/01/01	unlimited from 11.10.2017
Supervit tablets	1 tablet contains: vitamin A (in the form of retinol acetate) 2,666 IU, vitamin D3 (in the form of cholecalciferol) 200 IU (5 μg), vitamin E (in the form of β-tocopherol acetate) 14.9 IU, vitamin B1 (in the form of thiamine mononitrate) 1.4 mg, vitamin B2 (riboflavin) 1.6 mg, vitamin B6 (pyridoxine hydrochloride) 2 mg, vitamin B12 (cyanocobalamin) 1 μg, vitamin PP (nicotinamide) 18 mg, vitamin B5 (pantothenic acid) in in the form of calcium D-pantothenate 6 mg, folic acid 100 μg, vitamin C (ascorbic acid) 60 mg, iron (in the form of ferrous fumarate) 14 mg, zinc (in the form of zinc oxide) 15 mg, copper (in the form of copper oxide) 2 mg, manganese (in the form of manganese sulfate monohydrate) 2.5 mg, chromium (in the form of chromium chloride (III)) 50 μg, selenium (in the form of sodium selenate) 50 μg, iodine (in the form of potassium iodide) 150 μg	"Kyiv Vitamins Factory" JSC, Ukraine	UA/5698/01/01	unlimited from 15.09.2016
Demoton-b neo solution for injections	thiamine hydrochloride (vitamin B1) 5 mg, riboflavin sodium phosphate (vitamin B2) (equivalent to riboflavin) 2 mg, pyridoxine hydrochloride (vitamin B6) 2 mg, nicotinamide (vitamin PP) 20 mg, dexpanthenol (vitamin B5) 3 mg	Demo SA Pharmaceutical Industry, Greece	UA/16956/01/01	04.10.2018 04.10.2024

Marketing analysis of the market showed that vitamin B5 is produced in various forms, in particular in the form of tablets, dragee and solutions for injections. The main data of the analysis are presented in the following points:

1. Release forms and trade names:

- Vitamin B5 is contained in complex vitamin preparations, such as "Univit", "Undetab", "Undevit", "Supervit", as well as in the solution for injections "Demoton-B neo".
- Release forms include tablets, dragees and solutions for injections, which provides a wide range of its use.

2. Composition of active substances:
   - Vitamin B5 is combined with other vitamins, such as vitamins A, B1, B2, B6, B12, C, D3, E, PP (nicotinamide), as well as folic acid and other trace elements.
   - The concentration of vitamin B5 in tablets and dragees varies from 1.2 mg to 6 mg, which provides the necessary daily dose for different age groups and medical needs.
3. Manufacturers and countries:
   - The drugs are produced by the leading pharmaceutical companies of Ukraine, in particular, PrJSC "Kyiv Vitamins Factory".
   - Production is also carried out by the Greek company Demo SA Pharmaceutical Industry.
4. Registration certificate numbers and validity period:
   - Some registration certificates have an unlimited period of validity, which indicates the stability and long-term presence of drugs on the market. For example, UA/5450/01/01 from 19.08.2016 and UA/4834/01/01 from 22.12.2020.
   - Other drugs have a fixed period of validity, for example, UA/16956/01/01 from 04.10.2018 to 04.10.2024.
5. Economic and social feasibility:
   - The production of vitamin B5 preparations as part of complex vitamin supplements is economically beneficial, which allows to ensure availability and reduces treatment costs.
   - The social significance of the drugs increases, as they help to reduce the deficiency of vitamin B5 and other important vitamins and minerals in the population, improving the general state of health and quality of life of patients.

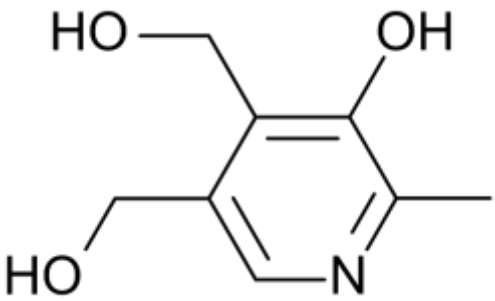

Fig. 4. Pyridoxine (Vitamin B6).

Pyridoxine prevents or reduces toxic effects (especially polyneuritis) during treatment with antituberculosis drugs [23].

Pyridoxine (vitamin B6) is a water-soluble vitamin. It plays a key role in numerous biochemical processes in the body. Indispensable for maintaining the health of the nervous system, protein and carbohydrate metabolism, and immune function.

Biological role of pyridoxine

Amino acid metabolism: is a coenzyme for many enzymes involved in amino acid metabolism. Promotes the synthesis of neurotransmitters (serotonin, norepinephrine), which affect mood and cognitive functions.

Synthesis of neurotransmitters: Essential for the synthesis of gamma-aminobutyric acid (GABA), an important neurotransmitter that helps regulate nerve activity and prevent seizures.

Glucose metabolism: involved in glycogenolysis, the process of breaking down glycogen into glucose, which is important for maintaining stable blood sugar levels.

Hemoglobin synthesis: promotes the synthesis of hemoglobin, a protein that carries oxygen in the blood, and also supports the health of red blood cells.

Immune function: important for maintaining the immune system, promotes antibody synthesis and lymphocyte activity.

Benefits of Pyridoxine in the Treatment of Tuberculosis: May be useful in an integrated approach to the treatment of Tuberculosis due to its multiple biological functions.

Prevention of side effects of anti-tuberculosis drugs

Some antituberculosis drugs (isoniazid) can cause vitamin B6 deficiency, which leads to the development of peripheral neuropathy. Pyridoxine helps prevent this side effect by protecting the nervous system.

Support of the immune system: helps to strengthen the immune system, helps to increase the production of antibodies and the activity of lymphocytes, improves the body's defenses.

Nervous system support: plays a key role in the synthesis of neurotransmitters that support normal nervous system function.

Conclusion

Pyridoxine (vitamin B6) is an important component of supportive therapy in the treatment of tuberculosis. The inclusion of pyridoxine in the complex pharmacotherapy of tuberculosis can contribute to reducing symptoms, improving the quality of life and faster recovery of patients.

The marketing analysis was conducted for Pyridoxine drugs that are in circulation on the pharmaceutical market of Ukraine according to Trade name/dosage form, Composition of active substances, Manufacturer/Country, No. of the registration certificate, Validity from/to (Table 4).

Table 4. Marketing analysis of Pyridoxine (Vitamin B6)

Trade name/dosage form	Composition of active substances	Manufacturer/ Country	No. of the registration certificate	Validity from/to
Pyridoxine hydrochloride (Vitamin B6) solution for injection	1 ml of solution contains pyridoxine hydrochloride 50 mg	Private joint-stock company "Lekhim - Kharkiv", Ukraine	UA/13399/01/01	unlimited from 26.11.2018
Pyridoxine hydrochloride solution for injection	1 ml of solution contains pyridoxine hydrochloride 50 mg	JSC "Lubnypharm", Ukraine	UA/13549/01/01	unlimited from 24.01.2019
Pyridoxine hydrochloride (Vitamin B6) pulveris	pyridoxine hydrochloride not less than 99.0% and not more than 101.0%, calculated on dry matter	Jiangxi Tianxin Pharmaceutical Co., Ltd., China	UA/13894/01/01	unlimited from 24.01.2019
Pyridoxine hydrochloride (Vitamin B6) pulveris	pyridoxine hydrochloride (vitamin B6) not less than 99.0% and not more than 101.0% in terms of dry matter	Zhangxi Tianxin Pharmaceutical Co., Ltd., China	UA/14182/01/01	unlimited from 02.10.2019

Pyridoxine hydrochloride pulveris	pyridoxine hydrochloride not less than 99.0% and not more than 101.0%, calculated on dry matter	Jiangxi Tianxin Pharmaceutical Co., Ltd., China	UA/14669/01/01	unlimited from 13.04.2020
Pyridoxine hydrochloride powder	pyridoxine hydrochloride not less than 99.0% and not more than 101.0%, calculated on dry matter	DSM Nutritional Products GmbH, Germany	UA/18220/01/01	30.07.2020 30.07.2025
Pyridoxine hydrochloride powder	pyridoxine hydrochloride from 99.0% to 101% on a dry basis	DI ES EM Vitamin (Shanghai) LTD., China	UA/18704/01/01	21.04.2021 21.04.2026
Pyridoxin-Darnytsya (Vitamin B6-Darnytsya) solution for injection	1 ml of solution contains 50 mg of pyridoxine hydrochloride	PrJSC "Pharmaceutical firm "Darnytsia", Ukraine	UA/5420/01/01	unlimited from 10.11.2016
Pyridoxine hydrochloride - health solution for injection	1 ml of solution contains pyridoxine hydrochloride 50 mg	Limited liability company "Pharmaceutical company "Zdorovya", Ukraine	UA/8736/01/01	unlimited from 07.02.2018
Pyridoxine hydrochloride - health solution for injection	1 ml of solution contains 50 mg of pyridoxine hydrochloride	Limited liability company "Pharmaceutical company "Zdorovya", Ukraine	UA/8736/01/01	unlimited from 07.02.2018

Marketing analysis of the market showed that vitamin B6 (pyridoxine hydrochloride) is produced in various forms, in particular in the form of solutions for injections and powders. The main data of the analysis are presented in the following points:

1. Release forms and trade names:
   - Vitamin B6 is included in drugs with trade names such as "Pyridoxine hydrochloride" and "Pyridoxine-Darnytsya".
   - Release forms include solutions for injections and powders, providing a wide range of applications for various medical needs.
2. Composition of active substances:
   - Solutions for injections contain 50 mg of pyridoxine hydrochloride per 1 ml of solution.
   - The powders contain pyridoxine hydrochloride in concentrations from 99.0% to 101.0% on a dry basis, which meets high quality standards.
3. Manufacturers and countries:
   - The drugs are produced by leading pharmaceutical companies of Ukraine, in particular Lekhim-Kharkiv PJSC, Lubnypharm JSC, Darnytsia Pharmaceutical Company PJSC, Zdorovya Pharmaceutical Company LLC.

- Production is also carried out by international companies from China, in particular Jiangxi Tianxin Pharmaceutical Co., Ltd., and the German company DSM Nutritional Products GmbH.

4. Registration certificate numbers and validity period:
   - Most registration certificates have an unlimited validity period, which indicates the stability and long-term presence of drugs on the market, for example UA/13399/01/01 from 11/26/2018, UA/13549/01/01 from 01/24/2019, UA/14669/01 /01 from 04/13/2020.
   - Other drugs have a fixed period of validity, for example UA/18220/01/01 from 07/30/2020 to 07/30/2025 and UA/18704/01/01 from 04/21/2021 to 04/21/2026.
5. Economic and social feasibility:
   - Production of vitamin B6 preparations is cost-effective, allows for availability and reduces treatment costs.
   - The social significance of the drugs increases, as they help reduce vitamin B6 deficiency in the population, improving the general health and quality of life of patients.

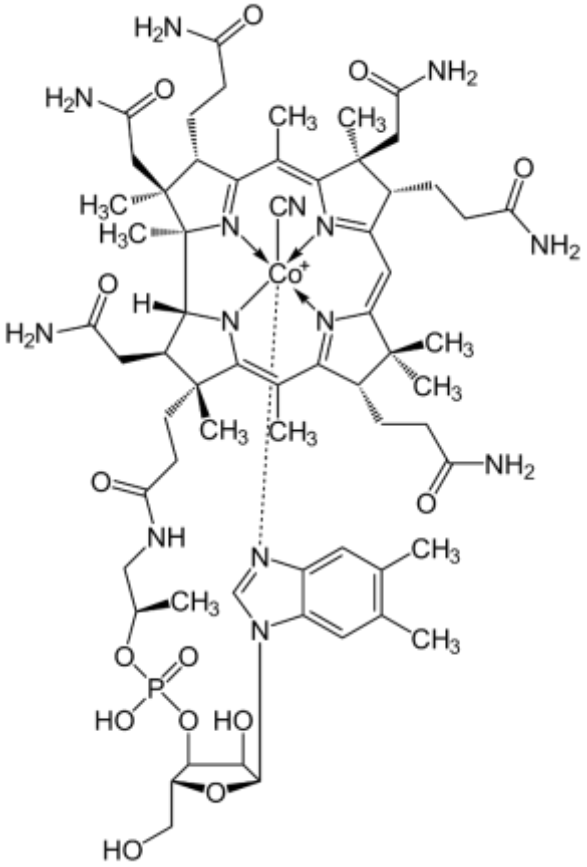

Fig. 5. Cyanocobolamine (Vitamin B12).

Cyanocobalamin (vitamin B12) is a water-soluble vitamin. Contains cobalt. It plays an important role in many physiological processes in the body. Necessary for maintaining the health of the nervous system, production of erythrocytes, DNA synthesis.

Biological role of cyanocobalamin

Metabolism of amino acids and fats: participates in the metabolism of amino acids and fats, helps to convert them into energy necessary for cellular functions.

DNA synthesis: is an important cofactor in the processes of DNA synthesis, ensures the correct division and functioning of cells.

Health of the nervous system: supports the synthesis of myelin, a substance that envelops nerve fibers, ensures the rapid transmission of nerve impulses.

Production of red blood cells: necessary for the production of red blood cells in the bone marrow. Deficiency can lead to megaloblastic anemia.

Strengthening the immune system: contributes to the normal functioning of the immune system, ensures the activity of white blood cells that protect the body from infections.

Benefit of cyanocobalamin in the treatment of Tuberculosis: may be a useful adjunct to the pharmacotherapy of Tuberculosis.

Support of the nervous system

Patients with tuberculosis may experience neurological complications associated with long-term treatment and vitamin deficiency. Vitamin B12 helps maintain the health of the nervous system, prevents neuropathy and other neurological disorders.

Prevention of anemia

Vitamin B12 deficiency can lead to anemia, which reduces the blood's ability to carry oxygen. Including cyanocobalamin in the diet of patients with tuberculosis helps to maintain a normal level of red blood cells and prevent anemia.

Support of the immune system

Vitamin B12 strengthens the immune system, increases the activity of white blood cells.

Improvement of metabolism

Cyanocobalamin contributes to the effective metabolism of amino acids and fats, provides the necessary energy for cells and organs during the pharmacotherapy of tuberculosis.

Conclusion

Cyanocobalamin (vitamin B12) is an important component of supportive pharmacotherapy for tuberculosis. Its role in supporting the nervous system, preventing anemia, strengthening the immune system, and improving metabolism makes it indispensable for patients with Tuberculosis.

A marketing analysis was conducted for Cyanocobalamin drugs, which are in circulation on the pharmaceutical market of Ukraine according to Trade name/dosage form, Composition of active substances, Manufacturer/Country, No. of the registration certificate, Validity from/to (Table 5).

Table 5. Marketing analysis of Cyanocobalamin (Vitamin B12)

Trade name/dosage form	Composition of active substances	Manufacturer/ Country	No registration certificate	Validity from/to
Neovitam tablets	1 tablet contains: vitamin B1 (thiamine hydrochloride) 100 mg; vitamin B6 (pyridoxine hydrochloride) 200 mg; vitamin B12 (cyanocobalamin) 0.2 mg	" Kyiv Vitamins Factory" JSC, Ukraine	UA/11551/01/01	unlimited from 16.01.2021
Neurorubin-forte laktab tablets	1 film-coated tablet contains thiamine nitrate (vitamin B1) 200 mg, pyridoxine hydrochloride (vitamin B6) 50 mg, cyanocobalamin (vitamin B12) 1 mg	Acino Pharma AG (Manufacturing bulk product, quality control, batch release approval, primary and secondary packaging), Switzerland Unterzuhungsinstitut Heppeler GmbH (additional laboratory participating in quality control), Germany	UA/1950/02/01	unlimited from 12.06.2017

		NNAS Labor Dr. Heusler GmbH (Quality control), Germany		
Neurorubin solution	1 ampoule with solution (3 ml) contains: thiamine hydrochloride (vitamin B1) 100 mg, pyridoxine hydrochloride (vitamin B6) 100 mg, cyanocobalamin (vitamin B12) 1 mg	Merkle GmbH (full cycle production; quality control), Germany	UA/10051/01/01	unlimited from 30.08.2019
Neurobion solution	1 ampoule (3 ml) contains: thiamine hydrochloride (vitamin B1) 100 mg, pyridoxine hydrochloride (vitamin B6) 100 mg, cyanocobalamin (vitamin B12) 1 mg	Senexi HSC (full production cycle), France	UA/5409/02/01	unlimited from 03.11.2021
Neuromultivit tablets	1 tablet contains thiamine hydrochloride (vitamin B1) 100 mg, pyridoxine hydrochloride (vitamin B6) 200 mg, cyanocobalamin (vitamin B12) 0.2 mg	H.L. Pharma GmbH, Austria	UA/5926/01/01	unlimited from 28.04.2017
Neurobex-Teva tablets	1 tablet contains: thiamine nitrate (vitamin B1) 15 mg; pyridoxine hydrochloride (vitamin B6) 10 mg; cyanocobalamin (vitamin B12) 0.02 mg	Balkanfarma-Dupnytsia JSC, Bulgaria Balkanfarma-Razgrad JSC, Bulgaria	UA/7313/01/02	unlimited from 07.11.2018
Neurobion advance tablets	1 film-coated tablet contains thiamine nitrate (vitamin B1) 100 mg, pyridoxine hydrochloride (vitamin B6) 50 mg, cyanocobalamin (vitamin B12) 1 mg	P&G Health Austria GmbH & Co. OG, Austria	UA/20293/01/01	13.12.2023 13.12.2028
Neurodiklov IT capsules	1 capsule contains: diclofenac sodium 50.0 mg; thiamine hydrochloride (vitamin B1) 50.0 mg; pyridoxine hydrochloride (vitamin B6) 50.0 mg; cyanocobalamin (vitamin B12) 0.25 mg	H.L. Pharma GmbH (manufacturer responsible for product release), Austria	UA/5909/01/01	unlimited from 06.04.2017

Trimetabol solution	solution: DL-carnitine hydrochloride 7.5 g; L-lysine hydrochloride 5.0 g; powder: cyproheptadine acephylinate (metopin) 35.0 mg; pyridoxine hydrochloride (vitamin B6) 600 mg; thiamine hydrochloride (vitamin B1) 600 mg; cyanocobalamin (vitamin B12) 20 mg	H. Uriak and Company, S.A. (production of bulk products, primary packaging), Spain Italpharmaco, S.A. (production of bulk products, primary packaging (solution only), secondary packaging, serial release permit), Spain	UA/3529/01/01	unlimited from 02.07.2021
Undevit dragee	1 dragee contains: retinol acetate (vitamin A) – 1.135 mg (3300 IU); DL-alpha-tocopherol acetate (vitamin E) – 10 mg; thiamine hydrochloride (vitamin B1) – 2 mg; riboflavin (vitamin B2) – 2 mg; pyridoxine hydrochloride (vitamin B6) – 3 mg; cyanocobalamin (vitamin B12) – 0.002 mg; ascorbic acid (vitamin C) - 75 mg; nicotinamide (vitamin PP) – 20 mg; folic acid - 0.07 mg; rutoside trihydrate, in terms of rutoside - 10 mg; calcium pantothenate - 3 mg	Technolog PJSC, Ukraine	UA/2986/01/01	unlimited from 02.04.2020
Neurobion tablets	1 film-coated tablet contains: thiamine disulfide (vitamin B1) 100 mg, pyridoxine hydrochloride (vitamin B6) 200 mg, cyanocobalamin (vitamin B12) 200 μg	P&G Health Austria GmbH & Co. OG, Austria	UA/5409/01/01	unlimited from 01.10.2021
Univit tablets	1 tablet contains: vitamin A (retinol acetate) 600 IU; vitamin B1 (thiamine hydrochloride) 0.203 mg; vitamin B2 (riboflavin) 0.3 mg; vitamin B5 (calcium D-pantothenate) 1.2 mg; vitamin B6 (pyridoxine hydrochloride) 0.3 mg; vitamin B12	" Kyiv Vitamins Factory" JSC, Ukraine	UA/5450/01/01	unlimited from 19.08.2016

	(cyanocobalamin) 0.0002 mg; vitamin C (ascorbic acid) 10 mg; vitamin D3 (cholecalciferol) 80 IU; vitamin PP (nicotinamide) 3 mg; folic acid 0.04 mg; calcium 12.5 mg; phosphorus 10 mg			
Cardonat capsules	1 capsule contains cobamamide (dibencoside, coenzyme B12) – 1 mg, cocarboxylase (chloride) (coenzyme B1) – 50 mg, pyridoxal-5-phosphate (coenzyme B6) – 50 mg; carnitine chloride – 100 mg, lysine hydrochloride – 50 mg	Joint Ukrainian-Spanish enterprise "Sperko Ukraine", Ukraine	UA/6386/01/01	unlimited from 27.04.2017
Supervit tablets	1 tablet contains: vitamin A (in the form of retinol acetate) 2,666 IU, vitamin D3 (in the form of cholecalciferol) 200 IU (5 μg), vitamin E (in the form of β-tocopherol acetate) 14.9 IU, vitamin B1 (in the form thiamine mononitrate) 1.4 mg, vitamin B2 (riboflavin) 1.6 mg, vitamin B6 (pyridoxine hydrochloride) 2 mg, vitamin B12 (cyanocobalamin) 1 μg, vitamin PP (nicotinamide) 18 mg, vitamin B5 (pantothenic acid) in in the form of calcium D-pantothenate 6 mg, folic acid 100 μg, vitamin C (ascorbic acid) 60 mg, iron (in the form of ferrous fumarate) 14 mg, zinc (in the form of zinc oxide) 15 mg, copper (in the form of copper oxide) 2 mg, manganese (in the form of manganese sulfate monohydrate) 2.5 mg, chromium (in the form of	" Kyiv Vitamins Factory" JSC, Ukraine	UA/5698/01/01	unlimited from 15.09.2016

	chromium chloride (III)) 50 μg, selenium (in the form of sodium selenate) 50 μg, iodine (in the form of potassium iodide) 150 μg			
Neuraxin v solution for injection	2 ml of solution (1 ampoule) contain pyridoxine hydrochloride (vitamin B6) - 100 mg, thiamine hydrochloride (vitamin B1) - 100 mg, cyanocobalamin (vitamin B12) - 1 mg, lidocaine hydrochloride - 20 mg	JSC "Calcseks" (manufacturer, which is responsible for the release of the series), Latvia KhBM Pharma s.r.o. (all stages of the production process, except for batch release), Slovakia JSC "Grindex" (manufacturer responsible for batch control/testing), Latvia	UA/16907/01/01	30.08.2018 30.08.2024
Quadevit tablets	1 tablet contains: vitamin A 2500 IU; vitamin E 3 mg, vitamin B1 2.5 mg, vitamin B2 2.5 mg, vitamin B6 2 mg, folic acid 0.1 mg, rutin 10 mg, nicotinamide 20 mg, vitamin C 75 mg, vitamin B12 10 μg, L - Glutamic acid 50 mg, DL-Methionine 50 mg, calcium D-pantothenate 5 mg, phytin 30 mg, potassium 10.5 mg, copper 0.4 mg	" Kyiv Vitamins Factory" JSC, Ukraine	UA/8633/01/01	unlimited from 29.11.2017
Decamevit tablets	1 tablet contains: vitamin A 6,600 IU, vitamin E (?-tocopherol acetate) or dry vitamin E 50% 10 mg, vitamin B1 (thiamine hydrochloride) 20 mg, vitamin B2 (riboflavin) 10 mg, vitamin B6 (pyridoxine hydrochloride) 20 mg, vitamin C (ascorbic acid) 200 mg, folic acid (vitamin B) 2 mg, nicotinamide (vitamin PP) 50 mg, rutin (vitamin P) 20 mg, methionine 200 mg, vitamin B12 (cyanocobalamin) 0.1 mg	" Kyiv Vitamins Factory" JSC, Ukraine	UA/4850/01/01	unlimited from 16.01.2021

Livolin forte capsules	1 capsule contains lecithin 35% (polyunsaturated phosphatidylcholine) 300 mg, dl-α-tocopheryl acetate (vitamin E) 10 mg, thiamine mononitrate (vitamin B1) 10 mg, riboflavin (vitamin B2) 6 mg, pyridoxine hydrochloride (vitamin B6) 10 mg, cyanocobalamin (vitamin B12) 10 μg, nicotinamide 30 mg	Mega Lifesciences Public Company Limited, Thailand	UA/5581/01/01	unlimited from 28.04.2017
Undevit dragee	1 dragee contains retinol acetate (vitamin A) in 100% substance - 0.001135 g (3300 IU), □-tocopherol acetate (vitamin E) in 100% substance - 0.01 g, thiamine hydrochloride (vitamin B1) in terms of 100% of the substance - 0.002 g, riboflavin (vitamin B2) in terms of 100% of the substance - 0.002 g, pyridoxine hydrochloride (vitamin B6) in terms of 100% of the substance - 0.003 g, cyanocobalamin (vitamin B12) in terms of 100% substance - 2 μg, ascorbic acid (vitamin C) in 100% substance - 0.075 g, nicotinamide in 100% substance - 0.02 g, folic acid in 100% substance - 0.00007 g, rutin in the calculation of 100% substance - 0.01 g, calcium pantothenate in the calculation of 100% substance - 0.003 g	"Vitaminy" JSC, Ukraine	UA/5605/01/01	unlimited from 22.11.2016
Undevit dragee	1 dragee contains: vitamin A - 3300 IU, vitamin E - 10 mg, vitamin B1 - 2 mg, vitamin B2 - 2 mg, vitamin B6 - 3 mg, vitamin B12 - 2 μg, vitamin C - 75 mg,	" Kyiv Vitamins Factory" JSC, Ukraine	UA/7922/01/01	unlimited from 11.10.2017

	vitamin PP - 20 mg, vitamin B – 0.07 mg, vitamin B5 – 3 mg, rutin – 10 mg			
Undevit dragee	1 dragee contains: vitamin A 1.135 mg vitamin E 10 mg; vitamin B1 2 mg; vitamin B2 2 mg; vitamin B6 3 mg; vitamin B12 0.002 mg; vitamin C 75 mg; vitamin PP 20 mg; folic acid 0.07 mg; rutoside - 10 mg; calcium pantothenate - 3 mg	Technolog PJSC, Ukraine	UA/2985/01/01	unlimited from 02.04.2020
Undetab tabulettas	1 tabuletta contains: vitamin A 3300 IU; vitamin E 10 mg; vitamin B1 2 mg; vitamin B2 2 mg; vitamin B6 3 mg; vitamin B12 0.002 mg; vitamin C 75 mg; vitamin PP 20 mg; folic acid 0.07 mg; rutin 10 mg; vitamin B5 3 mg	" Kyiv Vitamins Factory" JSC, Ukraine	UA/4834/01/01	unlimited from 22.12.2020
Elevit pronatal tablets	1 tabuletta contains: vitamin A - 3600 IU, vitamin B1 -1.6 mg, vitamin B2 -1.8 mg, vitamin B6 - 2.6 mg, vitamin B12 - 4 μg, vitamin C (as calcium ascorbate dihydrate) - 100 mg, vitamin D3 - 500 IU, vitamin E - 15 mg, calcium pantothenate - 10 mg, biotin - 0.2 mg, nicotinamide - 19 mg, folic acid - 0.8 mg, calcium (in the form of calcium ascorbate dihydrate, calcium pantothenate, calcium hydrogen phosphate anhydrous) - 125 mg, magnesium (in the form of light magnesium oxide, magnesium hydrogen phosphate trihydrate, magnesium stearate) - 100 mg, phosphorus (in the form of calcium hydrogen phosphate anhydrous,	Drazhenopharm Apotheker Püschl GmbH, Germany	UA/9996/01/01	unlimited from 05.07.2019

	magnesium hydrogen phosphate trihydrate) - 125 mg, iron (in the form of iron fumarate) - 60 mg, zinc (in the form of zinc sulfate monohydrate) - 7.5 mg, manganese (in the form of manganese sulfate monohydrate) - 1 mg, copper (in the form of anhydrous copper sulfate) - 1 mg			

Marketing analysis of the market showed that cyanocobalamin (vitamin B12) is produced in different forms: tablets, solutions for injections. The main data of the analysis are presented in the following points:

1. Release forms and trade names:
   - Vitamin B12 is contained in drugs with trade names such as "Neovit", "Neurorubin-forte laktab", "Neurorubin", "Neurobion", "Neuromultivit", "Neurobex-Teva", "Neurobion advance", "Neurodiklovit", "Trimetabol", "Undevit", "Neurobion", "Univit", "Cardonat", "Supervit", "Neuraxin V", "Quadevit", "Decamevit", "Livolin forte", "Undevit", "Undetab", "Elevit pronatal".
   - Release forms include tablets, dragees, capsules and solutions for injection.
2. Composition of active substances:
   - Tablets and solutions contain vitamin B12 (cyanocobalamin) in different doses, for example 0.2 mg, 0.02 mg, 1 mg, 10 μg, 4 μg.
   - Additional vitamins in the composition of the drugs include vitamins B1 (thiamine), B6 (pyridoxine), E, A, D3, C, PP, and other trace elements.
3. Manufacturers and countries:
   - The drugs are produced by various pharmaceutical companies from Ukraine, Germany, Austria, Switzerland, Spain, Latvia, Bulgaria, France, Slovakia, and Thailand.
   - Among the manufacturers: "Kyiv Vitamins Factory" JSC (Ukraine), Acino Pharma AG (Switzerland), Merkle GmbH (Germany), Senexi HSC (France), H.L. Pharma GmbH (Austria), Balkanfarma-Dupnytsia JSC (Bulgaria), P&G Health Austria GmbH & Co. OG (Austria), "Technolog" PJSC (Ukraine), "Vitaminy" JSC (Ukraine), "Sperko Ukraine" (Ukraine), "Calcseks" JSC (Latvia), "Grindex" JSC (Latvia), Mega Lifesciences Public Company Limited (Thailand), Drazhenopharm Apotheker Püschl GmbH (Germany) and others.
4. Registration certificate numbers and validity period:
   - Most registration certificates have an unlimited validity period, for example UA/11551/01/01 from 16.01.2021, UA/1950/02/01 from 12.06.2017, UA/10051/01/01 from 30.08.2019, UA/5409/ 02/01 from 03.11.2021, UA/5926/01/01 from 28.04.2017.
   - Other drugs have a fixed period of validity, for example UA/20293/01/01 from 13.12.2023 to 13.12.2028, UA/16907/01/01 from 30.08.2018 to 30.08.2024.
5. Economic and social feasibility:
   - Production of vitamin B12 preparations is cost-effective, ensures availability and reduces treatment costs.
   - The social significance of the drugs increases, as they help to reduce vitamin B12 deficiency in the population, improve the general state of health and quality of life of patients.

Marketing analysis of vitamins of group B showed that these drugs are in high demand and are widely distributed on the pharmaceutical market in various forms of release. Here are the key findings:

1. Variety of products:
   - ✓ Vitamins of group B are presented in the form of tablets, capsules, dragee and solutions for injections. This allows us to meet the needs of different categories of patients, from children to the elderly.
   - ✓ Many preparations include several B vitamins, as well as other vitamins and trace elements, which provides a comprehensive approach to the prevention and treatment of vitamin deficiency.
2. Manufacturers and geography of production:
   - ✓ Preparations of group B vitamins are produced by both domestic and foreign companies, which provides a wide range and competitive prices.
   - ✓ The main manufacturers include companies from Ukraine, Germany, Austria, Switzerland, Spain, Latvia, Bulgaria, France, Slovakia, and Thailand.
3. Economic feasibility:
   - ✓ The production and sale of B vitamin preparations are economically beneficial, as these preparations are in steady demand due to their important role in maintaining health.
   - ✓ High competition among manufacturers helps to maintain affordable prices for products, which makes them available to the general population.
4. Social significance:
   - ✓ Vitamin B preparations are of great importance to public health because they help prevent and treat vitamin deficiencies, improving the general health and quality of life of patients.
   - ✓ Complex vitamin preparations containing B vitamins contribute to the prevention of many diseases associated with a deficiency of these vitamins, such as anemia, neuropathies, metabolic disorders, etc.
5. Market trends and prospects:
   - ✓ Further growth of the B vitamins market is expected due to increased attention to a healthy lifestyle and disease prevention.
   - ✓ Innovations in the production and packaging of drugs, as well as the expansion of the assortment with new combinations of vitamins and trace elements will contribute to the further development of the market.

Therefore, the B vitamins market is dynamic and promising, with many opportunities for development for both producers and consumers.

Conclusions. The role of group B vitamins-antioxidants in the prevention and pharmacotherapy of tuberculosis was studied. Evidence and open questions regarding their use are summarized. The potential benefits and possibilities of using B vitamins in the pharmacotherapy of tuberculosis, especially among those at high risk of infection with Mycobacterium tuberculosis and active tuberculosis, are discussed. A retrospective and marketing analysis was conducted. Well-known scientific databases, such as PubMed, Scopus, Google Scholar, EMBASE, as well as Cochrane Library and WHO resources, were used. A retrospective search of articles covered the period from 1950 to 2024. The results of our analysis indicate the potential benefit of antioxidant vitamins in the prevention and treatment of tuberculosis. B vitamins are known for their antioxidant properties and ability to support the immune system, making them potentially important in fighting tuberculosis infection. Analysis of the market of group B vitamins-antioxidants in Ukraine made it possible to determine the availability and popularity of these drugs among the population and medical institutions. Therefore, the author's work provides valuable conclusions for medical and pharmaceutical practice. It can serve as a basis for further research in this area in order to improve the prevention and treatment of tuberculosis. Marketing analysis of the B vitamins market showed the high popularity and wide range of these drugs. Vitamins of group B are presented in different

forms of release, such as tablets, capsules, dragee and solutions for injections, which allows meeting the needs of different categories of patients. The drugs are produced by both domestic and foreign companies from Ukraine, Germany, Austria, Switzerland, Spain, Latvia, Bulgaria, France, Slovakia, and Thailand. High competition promotes affordable prices, which makes products economically profitable and accessible to the population. B vitamins have a significant impact on health, helping to prevent and treat deficiencies, improving overall health and quality of life. The market is expected to grow further due to increased attention to healthy lifestyles and innovations in production.

Conflict of interest. The author has approved the article for publication and declare that the research was conducted in the absence of any conflict or potential conflict of interest.

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