Optimization of vitamins and minerals in the composition of recipe was carried out – the content of vitamins and minerals in 40 g of the product is 229 mg, the compliance with the norm – 7.9%.

Flavour testing of the manufactured product was conducted using the method of organoleptic evaluation.

The study of organoleptic indicators of the developed products confirmed the high quality of bars with original taste properties, which can be recommended for industrial production and a wide range of consumers.

As a result of the work, a recipe for a cereal bar with a balanced composition of the main nutrients, a sufficient amount of trace elements and vitamins was developed. The proposed bar, when consumed up to three times a day, is able to provide up to 24% of the daily vitamin and mineral needs of adolescents under 17 years of age, and can be recommended as a functional food or healthy snack.

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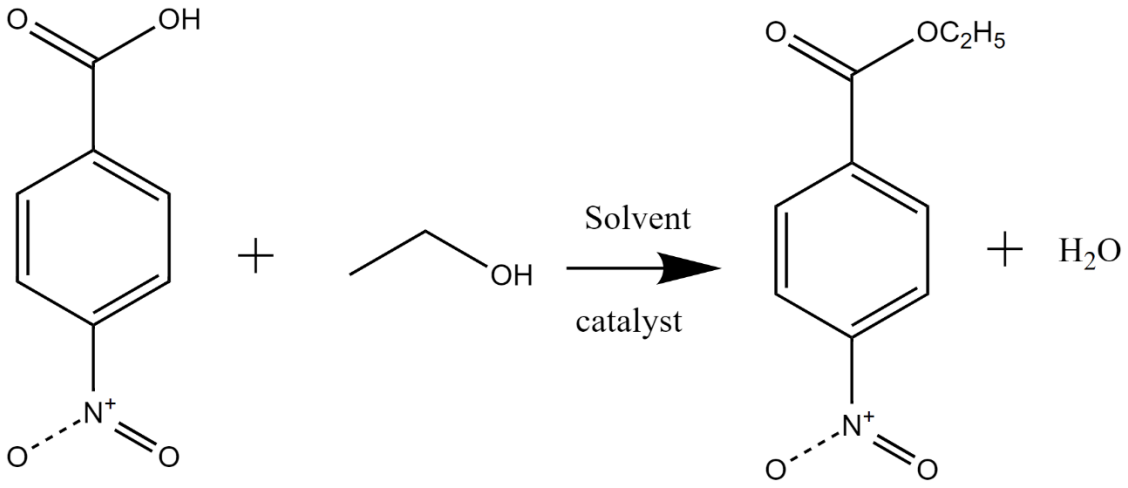
COMPARATIVE CHARACTERISTICS OF ETHYL 4-NITROBENZOATE SYNTHESIS METHODS

Benzoic acid esters are widely used in various industries, such as perfumes, flavors, solvents, and plasticizers; in acrylic films, latex coatings, and polysulfide sealants [3]. Ethyl 4-nitrobenzoate is a semi-product in the chemical and pharmaceutical industry for the production of local anesthetics – novocaine (procaine, 2-ethylaminoethyl ester of 4-aminobenzoic acid) and anesthesine (benzocaine, ethyl ester of 4-aminobenzoic acid), which are also contained in pain relievers.

The classic method for synthesis of ethyl 4-nitrobenzoate involves treating nitrobenzoic acid with ethanol in the presence of sulfuric acid (Scheme 1). Disadvantages of the method include the use of large amounts of sulfuric acid, the need for excessive alcohol regeneration, large amounts of wastewater, and large losses of the target product. In addition, the reaction occurs only due to the dehydrating action of sulfuric acid, which simultaneously causes side reactions, such as sulfonation and oxidation.



Scheme 1 – Reaction for synthesis of ethyl 4-nitrobenzoate

Further possibilities of esterification consist in working with dialkyl sulfates as O-alkylating agents in the presence of basic catalysts, such as dicyclohexylamine, or with diazoalkanes. However, due to the extreme toxicity of the alkylating agents used, both methods can only be applied in combination with a very high degree of safety precautions on an industrial scale [1].

The latest methods of synthesis involve esterification of nitrobenzoic acid with ethanol without a solvent in an argon atmosphere, using nanoporous acid catalysts (H-CL, H-MOR, H-HEU-M, H-PHI); with ultradisperse crystallites (290 – 480 nm), as well as in irradiation of the reaction mixture with ultrasound (37 kHz, 330 W, 2 h) or microwaves (2450 MHz, 300 W, 2 h) [2]. Unlike methods using solvents, these are more environmentally friendly. However, although the technique itself is simpler, the catalysts require a preliminary long synthesis from natural zeolites. In addition, the relatively low yield of the product (55%-67%) can be attributed to the disadvantages.

Thus, we believe that the methods that use environmentally aggressive catalysts (sulfuric acid, ammonium sulfate, sulfuric chloride, polyfluoroalkanesulfonic acid) allow obtaining ethyl 4-nitrobenzoate with a higher yield. However, methods using ultrasound, microwaves, and catalysts of ultra-dispersed natural zeolites are environmentally and financially more profitable and easier to perform.

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IDENTIFICATION AND QUANTIFICATION OF THE TOTAL CONTENT OF VITAMIN D (D_2+D_3) BY IMMUNOENZYMATIC METHODS

Immunological analysis for free vitamin D:

The test refers to an immunological assay and to the analysis of a blood sample or blood components for presence of free vitamin D, including vitamin D metabolites, 25-hydroxyvitamin D or 1,25-dihydroxyvitamin D, where free vitamin D is a circulating, unbound fraction of vitamin D [2].

The method includes the following stages:

(a) adding an immobilized binding protein or antibody to 25-(OH)-vitamin D in the sample;

(b) mixing the sample with a diluent, whereby the diluent contains from 0.1% to 0.25% fluoroalkyl surfactant;