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Bioconversion of 2-Ethylpyridine by Beauveria bassiana

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Investigated the bioconversion of 2-ethylpyridine by the fungus Beauveria bassiana ATCC 7159. In the result of researches was obtained the hydroxylated derivative of the initial substrate. The yield of the product was observed as 60%.
Keywords: *bioconversion, fungi, Beauveria bassiana, 2-ethylpyridine*

Introduction

Microbial hydroxylation is very important for obtaining new compounds used in organic synthesis [1–12]. Known not so many strains of microorganisms are able to carry out the hydroxylation of pyridines [13,14].

Some fungi are capable of hydroxylating of alkyl substituents of pyridines without affecting the heterocyclic ring. This allows you to get the appropriate hydroxyalkyl pyridines of interest to pharmacology with preparative yield [15].

The aim of this work was to study of the microbial hydroxylation of the methylene group of the alkyl substituent of 2-ethylpyridine. The product of such hydroxylation has optical activity and can be used in the synthesis of various valued medicines.

Materials and Methods

We used the strain of fungus *Beauveria bassiana* ATCC 7159 from the American Type Culture Collection.

The process of hydroxylation was carried out in a buffer solution of pH 6.0, for 48 hours by suspension of non-reproducing cells which previously grown up to stationary phase in the medium of the following composition (g/L): glucose — 20.0; corn steep liquor — 10.0; peptone — 5.0; KH_2PO_4 — 5.0; and deionized water, 1000 ml; the pH was adjusted to 5.0. 2-ethylpyridine (**I**) was added to the buffer mixture in an amount of 100 mg/L. The products of transformation were extracted from the culture medium by extraction with chloroform and separated on a column in the solvent system — hexane-ethyl acetate-methanol (5:5:1). For column chromatography was used silica gel — Kieselgel 0.200±0.036 (Merck AG, Germany). Thin-layer chromatography was performed on plates Silica gel 60 F_{254} (Merck KgaA, Darmstadt, Germany).

Electron ionization (EI) mass spectrometry was performed at an electron energy of 80 eV on the instrument Varian MAT-112 and on the instrument MX 1321A with the electron energy of 70 eV.

^{1}H nuclear magnetic resonance (NMR) spectral analyses were performed at 60 MHz Tesla BS-467 (Czech Republic)

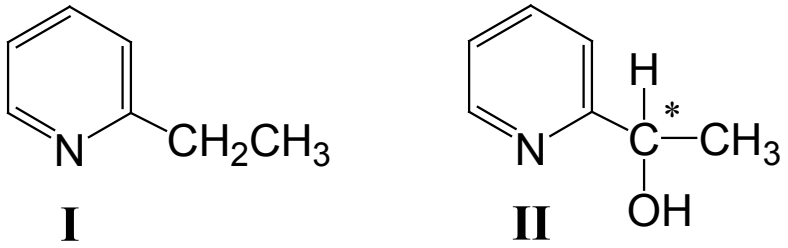

Fig. 1. **Structures of 2-ethylpyridine (I) and of 2- (1-hydroxyethyl) pyridine (II)**

NMR spectrometer operating at 28°C. Compounds were dissolved in CCl_4.

Optical rotations were measured on a polarimeter Chemapol IV (Rudolph, USA)

Results and discussion

It has been found that *B. bassiana* ATCC 7159 transformed 2-ethylpyridine (**I**) into (-) — 2-(1-hydroxyethyl) pyridine (**II**), in a yield of 60% (Fig. 1). In extracts was detected product **II** (R_f= 0,44) moreover there was detected presence of starting material **I**.

The EI mass spectrum of compound **II** (*m/z*, *I* %): 123 $[M^+]$ (5), 122 $[M-H]^+$ (3), 108 $[M-CH_3]^+$ (100), 106 $[M-OH]^+$ (47), 105 $[M-H_2O]^+$ (14), 80 $[M-CH_3-CO]^+$ (47), 79 $[M-CH_3-CHO]^+$ (70), 78 $[M-CH_3-CHOH]^+$ (47), 53 $[M-CH_3-CO-HCN]^+$ (35).

To confirm the structure of the compound **II** was investigated its ^1H NMR spectrum (CCl_4) δ 1,36 d (3H, CH_3, 7,0), 4,53 s (1H, OH), 4,73 q (1H, CH, 7,0), 6,8–7,8 m (3H, β, β', γ-CH), 8,33 d (1H, α-CH, 5,0).

As a substrate for the hydroxylation was selected 2-ethylpyridine, that is of practical interest.

So if the alkyl substituent of that compound has a methylene group, there can be expected the hydroxylation and the formation of an optically active alcohol.

The desired product (-) — 2-(1-hydroxyethyl) pyridine was obtained for 48 hours and was isolated on a colomn with a yield of 60%, $[\alpha]_D^{20}$ −56,7º (*c* 2.2, CH_3OH).

Previously, it was described similar oxidation of ethylbenzene with yields from 3 to 60%. Thus, in some cases, also was observed formation of optically active secondary alcohols (enantioselectivity with 5 to 97%) [16].

Our proposed method for producing an optically active alcohol **II** has a great value, since some of its levorotatory enantiomers have the medicinal properties [17]. The fragment of pyridine is part of many drugs [18], including antimalarial [19].

Known chemical methods for the preparation of isomeric (-) — (1-hydroxyethyl) pyridines are complicated, multistage, require the use of expensive and aggressive reagents, making those technologies low.

Our proposed process has great advantages over known chemical methods for producing (-) — (1-hydroxyethyl) pyridines.

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Биологические особенности и пищевая ценность унаби на Кубани

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Западное Предкавказье — уникальный природный регион, где могут произрастать ценные плодовые культуры, выращивание которых в некоторых других более северных районах невозможно. Среди ценных плодовых культур китайский финик интересен для исследования. Он неприхотлив к условиям выращивания, отличается высокими пищевыми, диетическими и лекарственными свойствами и что особенно важно — деревья китайского финика выдерживают значительные понижения температуры в зимний период [2; 13; 14; 17; 20; 25; 28; 29; 37; 39; 42].

В мировом плодоводстве это древнейшее растение, известное на родине в Китае более 4000 лет. В России выращивают вид китайского финика — *Ziziphusjujuba Mill*.

Природные условия Прикубанской плодовой зоны вполне благоприятствуют получению высокого хозяйственного эффекта культуры китайского финика (унаби). Но промышленное развитие культуры задерживается из-за отсутствия данных по вопросам биологии растения [27; 30; 31; 36; 38; 40; 43].

На основании многолетних исследований в Прикубанье выделены перспективные формы китайского финика, изучены сорта пригодные для промышленного выращивания и получения плодов высокого качества с хорошими технологическими свойствами. Культура унаби — скороплодная, засухоустойчивая, нетребовательна к почвенным условиям, имеет не только пищевое, но также лекарственное и декоративное значение [1; 3; 6; 11; 16; 19; 22; 24; 26].

Плоды унаби содержат до 30% сухих веществ, в основном это сахара (21–25%), кислоты (0,47–1,87%). Они богаты содержанием витамина С (от 350 до 735 мг %), пектиновых веществ (2,1–5,8 мг %), а также содержат вещества с Р витаминной активностью (25–100 мг %). Поэтому ценность плодов не только пищевая, но и лекарственная. Плоды потребляются как в сыром, в сухом