

PUBLICATIONS

SYNTHESIS OF N-(5-NITRO-1H-BENZIMIDAZOL-2-YL)PROPIONAMIDE AND DETERMINATION OF OPTIMAL CONDITIONS FOR ITS PREPARATION

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Benzimidazole derivatives are an important class of nitrogen-containing heterocyclic compounds that exhibit diverse biological activities and are of considerable interest in agriculture and medicine. The aim of this study was to synthesize N-(5-nitro-1H-benzimidazol-2-yl)propion amide and determine the optimal conditions for its preparation. The target compound was obtained by nitration of N-(1H-benzimidazol-2-yl)propion amide using a mixture of nitric and concentrated sulfuric acids. The synthesis was carried out in a three-necked flask equipped with a mechanical stirrer and a reflux condenser. The obtained product was isolated by precipitation on ice, filtration, washing with water, drying, and recrystallization from ethanol in the presence of activated charcoal.

To increase the yield of the target compound, the main technological parameters affecting the reaction were investigated using the Box–Wilson design of experiments. The effects of reaction temperature, reaction time, and molar ratio of the starting materials on the product yield were evaluated. The studied ranges were 0–20 °C for temperature, 3–5 h for reaction time, and 1:4:7–1:6:9 for the molar ratio. Based on the experimental data, a regression equation was obtained: $Y = 77.46 - 2.48x_1 - 0.66x_2 + 2.91x_3$, where Y represents the product yield. Statistical analysis confirmed the adequacy of the developed mathematical model. The calculated Fisher criterion was $F_{calc} = 2.75$, which was lower than the tabulated value of $F_{table} = 3.8$.

The optimal conditions for the synthesis of N-(5-nitro-1H-benzimidazol-2-yl)propion amide were established as a temperature of 0 °C, reaction time of 5 h, and a molar ratio of starting materials of 1:6:9. Under these conditions, the product yield reached 85.3%. The structure of the synthesized compound was confirmed by IR, ¹H NMR, and ¹³C NMR spectroscopy. The compound has the molecular formula C₁₀H₁₀N₄O₃, a molecular weight of 234.21 g/mol, and a melting point of 292–294 °C.

The obtained results demonstrate that the Box–Wilson method provides an effective approach for determining the optimal technological parameters of the synthesis process. Optimization of temperature, reaction time, and reagent ratio allowed the development of reproducible conditions for obtaining N-(5-nitro-1H-benzimidazol-2-yl)propion amide with a relatively high yield. The synthesized compound also demonstrated moderate fungicidal activity against *Fusarium oxysporum* and *Aspergillus niger*, while pronounced inhibitory activity was observed against the early growth of wheat and cucumber seedlings. This work was supported by the Academy of Sciences of the Republic of Uzbekistan.