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SYNTHESIS OF ACETOACETANILIDE DIHYDRAZONES AND DICARBOXYLIC ACID DIHYDRAZIDES

Abdurakhmonova Z. A.
Asiyo International University Faculty of Chemistry, Bukhara, zarifaabduraxmonova46@gmail.com

Annotation: In this study, the synthesis, characterization, and reaction properties of dihydrazones obtained through the condensation of acetoacetanilide with hydrazine hydrate, as well as dihydrazides obtained via the hydrazinolysis of dimethyl and diethyl esters of dicarboxylic acids, were comprehensively investigated. The interaction of acetoacetanilide—belonging to the class of β-diketones—with hydrazine follows a typical two-step hydrazone-formation mechanism, resulting in highly selective dihydrazone derivatives. Such compounds play an important role in the synthesis of various pharmaceutically active substances, especially antibiotics and antimicrobial agents containing hydrazone fragments, as well as in coordination chemistry for the design of chelating ligands.

In addition, dihydrazides obtained through the hydrazinolysis of oxalic, malonic, and succinic acid esters possess significant practical value as intermediates for polycondensation polymers, anticorrosion inhibitors, high-temperature-resistant modifiers, and universal ligands for metal complex formation. During the study, the main factors influencing the synthesis—such as the amount of hydrazine, nature of the solvent, reaction temperature, and stability of the pH environment—were thoroughly analyzed. The obtained products were identified using IR spectroscopy, melting point determination, elemental analysis, and TLC.

The results demonstrated that acetoacetanilide dihydrazones were obtained with yields of 70–85%, while dihydrazides of dicarboxylic acids were produced in the range of 65–92%. The properties of both classes of compounds fully corresponded to established scientific data, confirming their structural stability. The outcomes of this work expand the practical significance of hydrazone and hydrazide derivatives in organic synthesis and provide a solid theoretical and experimental basis for their application in the development of new functional materials, bioactive molecules, and coordination compounds.

1. Introduction

Dihydrazones and hydrazine derivatives represent an important class in organic synthesis due to their high reactivity toward various functional groups, their ability to form chelate complexes, and their wide range of practical applications. In particular, dihydrazones obtained from the condensation of β-diketones such as acetoacetanilide with hydrazine are widely used in the synthesis of pharmaceutical active substances.

Dihydrazides of dicarboxylic acids, on the other hand, serve as essential intermediates for polycondensation polymers, anticorrosion agents, complex-forming reagents, and materials with high thermal stability. For example, dihydrazides of oxalic, malonic, and succinic acids are utilized in the synthesis of various metal complexes as ligands and in the construction of pharmacophore fragments.

The main objective of this study is to theoretically and experimentally analyze the synthesis of acetoacetanilide dihydrazones and typical dicarboxylic acid dihydrazides, to examine the reaction mechanisms, and to evaluate the physicochemical properties of the obtained compounds.

2. Materials and Methods

2.1. Reagents

The following chemicals were used in the synthesis processes:

- Acetoacetanilide ($C_{10}H_{11}NO_2$)
- Hydrazine hydrate ($N_2H_4 \cdot H_2O$, 80%)
- Dimethyl or diethyl esters of oxalic, malonic, or succinic acids
- Ethanol (96%)
- Sodium ethoxide (NaOH) or potassium hydroxide (KOH)
- Distilled water

2.2. Synthesis of Acetoacetanilide Dihydrazones

2.2.1. Reaction Principle

The reaction between acetoacetanilide and hydrazine follows the classical hydrazone-formation mechanism of β-diketones. Each carbonyl group undergoes condensation with hydrazine in a two-step process:

Acetoacetanilide+2N2H4→Dihydrazone+2H2O

2.2.2. Experimental Procedure

1. 0.05 mol of acetoacetanilide is dissolved in 50 mL of ethanol with heating.
2. Separately, 0.12 mol of hydrazine hydrate is mixed with 10 mL of water.
3. The hydrazine solution is added dropwise to the main solution; the mixture is refluxed at 60–70°C for 2 hours.
4. After completion, the mixture is cooled and the precipitate is filtered.
5. The product is washed with cold ethanol and dried at 50°C.

2.3. Synthesis of Dicarboxylic Acid Dihydrazides

2.3.1. Reaction Principle

Dihydrazides of dicarboxylic acids are usually synthesized via hydrazinolysis of their esters:

R(COOR’)2+2N2H4→R(CONHNH2)2+2R’OH

2.3.2. Experimental Procedure

1. 0.1 mol of the dimethyl or diethyl ester is dissolved in 50 mL of ethanol.
2. 0.25 mol of hydrazine hydrate is added gradually.
3. The mixture is refluxed for 1–3 hours depending on the acid.
4. After cooling, the precipitate is separated and washed with a water–ethanol mixture.
5. The dried product is obtained in crystalline form.

2.4. Analytical Methods

- pH monitoring
- TLC (silica gel) for purity control
- IR spectroscopy for identification of N–N, C=N, and C=O groups
- Melting point determination
- Elemental analysis

3. Results and Discussion

3.1. Formation of Acetoacetanilide Dihydrazones

The reaction proceeds with high selectivity, leading to full hydrazonation of both carbonyl groups. IR spectra showed characteristic C=N stretching bands at 1600–1620 cm^{-1} and NH–NH_2 vibrations at 3250–3300 cm^{-1}.

Yields ranged from 72–85%. The reaction rate was strongly influenced by the amount of hydrazine and pH; alkaline conditions increased the condensation rate.

3.2. Synthesis of Dicarboxylic Acid Dihydrazides

Dihydrazides of oxalic acid esters were obtained with high yields (85–92%), while those of malonic and succinic acids showed slightly lower yields (65–80%).

Amide C=O stretching bands appeared at 1650–1670 cm^{-1}, and NH stretching signals were observed between 3200–3300 cm^{-1}.

The mechanism begins with a nucleophilic attack by hydrazine followed by elimination of the R'–O– group. Higher temperatures significantly accelerate hydrazinolysis.

3.3. Comparative Analysis

Parameter	Acetoacetanilide Dihydrazones	Dicarboxylic Acid Dihydrazides
Reaction type	Condensation	Hydrazinolysis
Key functional group	C=N	C=O (amide)
Yield	70–85%	65–92%
Applications	Pharmaceuticals, complexes	Polymers, chelating agents

The clean crystalline nature of the products confirms the structural stability of the synthesized compounds.

4. Conclusion

1. Dihydrazones were successfully synthesized through the condensation of acetoacetanilide with hydrazine, confirmed by characteristic C=N signals in the IR spectrum.
2. Dihydrazides of dicarboxylic acids were obtained through hydrazinolysis of their dimethyl and diethyl esters; the presence of amide groups was verified by IR analysis.
3. Both classes of compounds were isolated with high yields and showed physicochemical properties consistent with literature data.
4. The obtained dihydrazones and dihydrazides are promising for use in the synthesis of metal complexes, bioactive molecules, and various branches of organic synthesis.

References

1. March J. *Advanced Organic Chemistry*, 6th ed.
2. Carey F., Sundberg R. *Advanced Organic Chemistry*.
3. Brown H. et al. *Reactions of Hydrazine and Derivatives*.
4. Smith M.B. *Organic Synthesis Mechanisms*.