



# Of Synthesis and Physicochemical Properties of Dicarboxylic Acid Dihydrazones Acetoacetanilide

Abdurakhmonova Zarifa Abduraxmonovna\*

Asian International University Faculty of Chemistry Bukhara

## \*Correspondence :

[zarifaabduraxmonova46@gmail.com](mailto:zarifaabduraxmonova46@gmail.com)

Received: 28-02-2026

Accepted: 05-03-2026

Published: 18-03-2026

Copyright © 2024 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

This article presents the results of the synthesis and investigation of physicochemical properties of dicarboxylic acid dihydrazones based on acetoacetanilide. During the research, dihydrazides of several dicarboxylic acids were synthesized and subsequently reacted with acetoacetanilide through condensation reactions. The obtained compounds were isolated as crystalline products and their melting points, solubility properties and spectral characteristics were determined. Infrared spectroscopy confirmed the formation of hydrazone functional groups. The obtained results indicate that the synthesized dihydrazone derivatives possess relatively high thermal stability and may be considered promising compounds for coordination chemistry and biologically active substance development.

## Keywords

acetoacetanilide, hydrazone, dihydrazone, dicarboxylic acids, organic synthesis, condensation reaction, IR spectroscopy.

## 1. Introduction

One of the important directions of organic chemistry is the synthesis of new compounds rich in functional groups and the study of their properties. In recent years, hydrazone and dihydrazone derivatives have become one of the most widely studied classes of compounds. Such compounds are widely used in the synthesis of various biologically active substances, in the pharmaceutical industry, analytical chemistry, and as ligands in coordination chemistry.

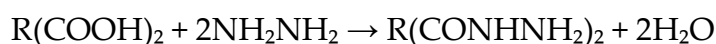
Hydrazone compounds contain the  $-C=N-NH-$  functional group and can participate in numerous organic reactions. These compounds are usually formed through condensation reactions between carbonyl compounds and hydrazides. The chemical structure and reactivity of hydrazone derivatives significantly expand their practical application. Acetoacetanilide belongs to the class of

aromatic amides and is an important organic compound. Due to the presence of carbonyl and amide groups in its structure, it can easily participate in various condensation reactions. Therefore, it is considered a convenient starting material for the synthesis of many new organic compounds. Dicarboxylic acids contain two carboxyl groups in their structure, which makes them convenient substrates for obtaining various functional derivatives. Hydrazone derivatives of these acids can react with carbonyl compounds to form dihydrazone compounds. Scientific literature reports numerous biological activities of hydrazone derivatives, including antibacterial, antifungal, antioxidant, and complex-forming properties. Therefore, the synthesis of new hydrazone and dihydrazone derivatives and the study of their properties represent an important and relevant task in organic chemistry. The main objective of this research work is the synthesis of dihydrazone derivatives of dicarboxylic acids based on acetoacetanilide, as well as the investigation of their physicochemical properties and structural features using spectral methods.

## 2. Materials and Methods

**Reagents and Materials** The following chemical substances were used in the research: acetoacetanilide hydrazine hydrate oxalic acid malonic acid succinic acid ethanol acetic acid dimethylformamide (DMF) All reagents were of analytical grade and were used without additional purification during the experiments.

**Synthesis of Dicarboxylic Acid Dihydrazides** Dihydrazone derivatives of dicarboxylic acids were synthesized by reacting the corresponding dicarboxylic acids with hydrazine hydrate. The reaction was carried out in a flask equipped with a reflux condenser. During the reaction, 0.05 mol of dicarboxylic acid was mixed with 0.1 mol of hydrazine hydrate and heated at a temperature of 70–80°C for 2–3 hours. As a result of the reaction, water was released and the corresponding dihydrazone was formed. The obtained product was cooled, filtered, washed with ethanol, and dried. The reaction equation can be expressed as follows:



**Synthesis of Acetoacetanilide Dihydrazones** The obtained dihydrazides were subjected to condensation reactions with acetoacetanilide. For this purpose, 0.01 mol of acetoacetanilide and 0.01 mol of the corresponding dihydrazone were mixed in 25 ml of ethanol solution. The mixture was refluxed for 2–3 hours, during which the condensation reaction took place. During the reaction, water was released and a hydrazone bond was formed. After completion of the reaction, the solution was cooled and the resulting precipitate was filtered off. The obtained product was purified by recrystallization from ethanol.

**Physicochemical Analysis Methods** The synthesized compounds were investigated using the following methods: determination of melting point by the capillary method investigation of solubility in different solvents IR spectroscopic analysis elemental analysis for determining composition The IR spectra were recorded in the range of 400–4000  $\text{cm}^{-1}$ .

## 3. Results

During the research, several new dihydrazone derivatives of dicarboxylic acids based on acetoacetanilide were synthesized. The obtained compounds were isolated as crystalline substances and their basic physical properties were studied. Some physicochemical characteristics of the synthesized compounds are presented in the following table.

No	Compound name	Melting point (°C)	Solubility
1	Oxalate dihydrazone	210–212	ethanol, DMF
2	Malonate dihydrazone	198–200	ethanol, DMSO
3	Succinate dihydrazone	205–207	alcohols

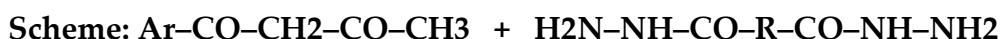
The following characteristic absorption bands were observed in the IR spectra:

3200–3300  $\text{cm}^{-1}$  – stretching vibrations of NH groups  
1650–1680  $\text{cm}^{-1}$  – vibrations of the carbonyl group  
1580–1600  $\text{cm}^{-1}$  – vibrations of the C=N hydrazone bond

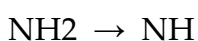
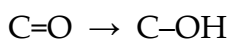
These results confirm the formation of the hydrazone structure in the synthesized compounds.

**Reaction Mechanism Between Acetoacetanilide and Dicarboxylic Acid Dihydrazides** The acetoacetanilide molecule contains an active carbonyl group (C=O), which readily participates in condensation reactions with nucleophilic reagents. Dihydrazides of dicarboxylic acids possess nucleophilic  $\text{-NH}_2$  centers. Therefore, they react with carbonyl compounds to form hydrazone derivatives.

**Step 1. Nucleophilic Attack** In the first step of the mechanism, the  $\text{-NH}_2$  group of the dihydrazide molecule attacks the electrophilic carbon atom of the carbonyl group.

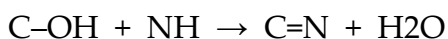


The intermediate product formed in the previous step becomes stabilized through proton transfer.



This stage is an important part of the reaction mechanism and prepares the system for the formation of the hydrazone bond.

**Step 3. Water Elimination (Dehydration)** In the next stage, a water molecule ( $\text{H}_2\text{O}$ ) is eliminated from the intermediate, resulting in the formation of a C=N double bond.



**Step 4. Formation of Dihydrazone** Since the dihydrazide of a dicarboxylic acid contains two reactive functional groups, the condensation reaction can occur twice. Consequently, a dihydrazone compound is formed. The general structure of the resulting compound can be represented as follows:



#### 4. Discussion

The obtained results showed that acetoacetanilide easily undergoes condensation reactions with dihydrazides of dicarboxylic acids. When the reaction was carried out in ethanol medium, the product yield was relatively high. The results of IR spectroscopic analysis clearly indicated the formation of hydrazone functional groups. The appearance of absorption bands characteristic of the C=N bond confirmed the successful completion of the condensation reaction. The relatively high melting points of the obtained compounds indicate that they possess crystalline structures and

possibly contain intermolecular hydrogen bonds. The solubility properties also demonstrate that these compounds dissolve well in polar solvents. Comparison of the obtained results with literature data showed that the synthesized dihydrazone derivatives have structures similar to previously reported compounds. At the same time, these compounds exhibit relatively high thermal stability and may possess the ability to form coordination complexes.

## 5. Conclusion

In this study, several dihydrazone derivatives of dicarboxylic acids based on acetoacetanilide were successfully synthesized. The synthesis process was carried out under relatively simple conditions and the products were obtained with good yields. The physicochemical properties of the obtained compounds were investigated and their structures were confirmed by IR spectroscopic analysis. The results indicate that the synthesized dihydrazone derivatives are stable chemical compounds. Further studies on the biological activity of these compounds as well as their ability to form metal complexes may have significant scientific and practical importance.

## References

1. Sreekanth A., Fun H.K. **Synthesis, Characterization and Metal Complexes of Hydrazone Ligands Derived from Acetoacetanilide.** *Polyhedron*, 2004, Vol. 23, pp. 2393–2400.
2. Huang F.X., Chen Z.M., Wang Q. **Spectroscopic and Thermal Studies of Hydrazone Ligands Containing Acetoacetanilide.** *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, 2007, Vol. 68, pp. 918–926.
3. Rollas S., Küçükgülzel S.G. **Biological Activities of Hydrazone Derivatives.** *Molecules*, 2007, Vol. 12, pp. 1910–1939.
4. Singh R., Chaudhary P. **Hydrazones as Versatile Ligands in Coordination Chemistry.** *Journal of Coordination Chemistry*, 2010, Vol. 63, pp. 2361–2388.
5. Casas J.S., García-Tasende M.S., Sordo J. **Main Group Metal Complexes of Semicarbazones and Hydrazones.** *Coordination Chemistry Reviews*, 2000, Vol. 209, pp. 197–261.
6. Belskaya N.P., Dehaen W., Bakulev V.A. **Synthesis and Properties of Hydrazones.** *Arkivoc*, 2010, Issue 1, pp. 275–332.
7. Kumar S., Dhar D.N., Saxena P.N. **Applications of Hydrazones in Medicinal Chemistry.** *Journal of Scientific & Industrial Research*, 2009, Vol. 68, pp. 181–187.
8. Çakmak R., Başaran E. **Synthesis of Hydrazide–Hydrazone Derivatives and Their Structural Characterization.** *ACS Omega*, 2024, Vol. 9, pp. 20030–20041.
9. Hussain G., Akram S., Lateef M. **Hydrazone Ligands and Their Metal Complexes: Synthesis and Characterization.** *Journal of Population Therapeutics and Clinical Pharmacology*, 2024.
10. Acar Cevik U., Ünver H. **New Hydrazone Derivatives: Synthesis, Characterization and Biological Studies.** *Zeitschrift für Naturforschung C*, 2025.
11. Khan K.M., Rasheed M., Ullah Z. **Synthesis and Biological Evaluation of Hydrazone Derivatives.** *Bioorganic & Medicinal Chemistry*, 2003, Vol. 11, pp. 1381–1387.
12. Karthikeyan M.S., Prasad D.J., Poojary B. **Synthesis and Antimicrobial Activity of Hydrazone Derivatives.** *European Journal of Medicinal Chemistry*, 2006, Vol. 41, pp. 109–115.

13. El-Sayed N., Al-Shihri A. **Spectroscopic Studies on Hydrazone Compounds and Their Complexes.** *Journal of Molecular Structure*, 2011, Vol. 1006, pp. 191–199.
14. Vogel A.I. **Vogel's Textbook of Practical Organic Chemistry.** 5th ed. London: Longman Scientific & Technical, 1989.
15. March J. **Advanced Organic Chemistry: Reactions, Mechanisms and Structure.** 6th ed. New York: Wiley, 2007.