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Synthesis of pyrazoles from hydrazones under microwave irradiation v/s conventional heating

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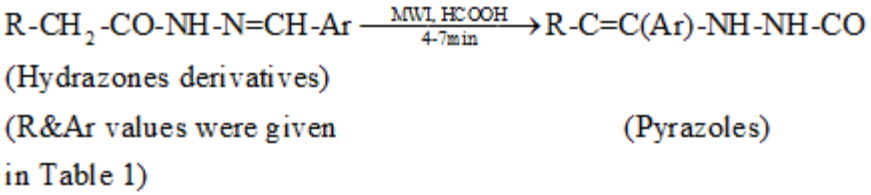
ABSTRACT

Aromatic hydrazones were cyclised in the presence of formic acid to gave pyrazoles under microwave irradiation and conventional heating and the rate of reaction by microwave irradiation was found to be 250 times than the conventional heating method.

Keywords: Hydrazones, pyrazoles, formic acid, water, fungicide.

INTRODUCTION

Pyrazoles are a representative class of heterocyclic compounds having many derivatives with a wide range of interesting properties such as drugs, pesticides, amongst others1-4 because a number of pharmaceuticals and dye stuffs contains these ring systems.5 So, we became interested in the synthesis of bioactive pyrazoles.6-9 We prepared herein the polysubstituted pyrazoles using HCOOH as a cyclising agent under conventional heating as well as under microwave irradiation.



Scheme 1

The pyrazoles were prepared by cyclising hydrazone derivatives in the presence of HCOOH under conventional heating at 100-120° C which requires 30-35 hours (results are reported in Table 1) and the same reactions were carried at the standard level of irradiation 70% (560W) in the unmodified domestic microwave oven which requires only 3-7 minutes (results are reported in Table 1).

In conclusion, we have shown that the cyclocondensation of hydrazones under conventional heating requires 30-35 hours. While the same reactions were completed in 3-7 minutes with improved yield under microwave irradiation.

Typical Experimental Procedure

By conventional heating

The hydrazone (0.01 mole) mixed with

Table 1: Synthesis of Pyrazoles under Microwave Irradiation

Entry	R	Ar	mp (°C)	Under conventional		Under Microwave	
				Yield	Time (hr.)	Yield	Time (min.)
1.	-OC6H5	2-HOC6H4	140-42	65%	30	75%	7
2.	-OC6H5	2-HOC10H6	168-70	62%	25	83%	5
3.	-OC6H5	3-NO2C6H4	177	70%	28	85%	4
4.	-OC6H5	C6H5	148	63%	27	78%	5
5.	-OC6H5	4-ClC6H4	156	55%	35	77%	6
6.	-OC6H5	4-CH3OC6H4	173	59%	27	78%	5
7.	-C8H17	2-OHC6H4	90	62%	30	79%	3
8.	-C8H17	2-HOC10H6	155	65%	25	80%	7
9.	-C8H17	3-NO2C6H4	152	69%	29	86%	4
10.	-C8H17	C6H5	132	57%	30	75%	6
11.	-C8H17	4-ClC6H4	163	61%	32	82%	5
12.	-C8H17	4-CH3OC6H4	142	60%	22	80%	5

formic acid (12ml) and taken in the round bottom flask and heated under reflux for 25-35 hours. The contents were allowed to cool and the solid separated was filtered off and washed with cold H2O and recrystallised (from ethanol).

Under microwave irradiation

The hydrazone (0.01 mole) mixed with formic acid (12ml) and taken in the open erlenmyer flask (100ml). The flask was subjected to 70% irradiation level (560W) in the Kenstar OM-9925 (800W) unmodified domestic microwave oven operating at 2450 MHz for 3-7 minutes. The contents were allowed to cool and the solid separated was filtered off and washed with cold H2O and recrystallised (from ethanol).

Compound 1

1H-NMR (CDCl3, δ, ppm): 7.4-7.6 (m, 9H, Ar-H), 10.1 (br, 2H, 2 × NH), 10.5 (s, 1H, -OH).

Compound 2

^{1}H-NMR ($CDCl_3$, δ, ppm): 7.2-7.7 (m, 11H, Ar-H), 10.2 (br, 2H, 2 × NH) 10.7 (s, 1H, -OH).

Compound 3

^{1}H-NMR ($CDCl_3$, δ, ppm): 7.3-7.8 (m, 9H, Ar-H), 10.1 (br, 2H, 2 × NH).

Compound 4

^{1}H-NMR ($CDCl_3$, δ, ppm): 7.3-7.9 (m, 10H, Ar-H), 9.8 (br, 2H, 2 × NH).

Compound 5

^{1}H-NMR ($CDCl_3$, δ, ppm): 7.4-7.6 (m, 9H, Ar-H), 10.2 (br, 2H, 2 × NH).

Compound 6

^{1}H-NMR ($CDCl_3$, δ, ppm): 3.75 (s, 3H, -OCH_3), 7.4-7.8 (m, 9H, Ar-H), 10.3 (br, 2H, 2 ×NH).

Compound 7

^{1}H-NMR ($CDCl_3$, δ, ppm): 0.92 (t, 3H, 8'-CH_3), 1.32 (m, 10H, 5 × CH_2), 1.70 (m, 2H, 2'-CH_2), 2.45 (t, 2H, 1'-CH_2), 7.3-7.5 (m, 4H, Ar-H), 10.2 (br, 2H, 2 × NH), 10.7 (s, 1H, -OH).

Compound 8

^{1}H-NMR ($CDCl_3$, δ, ppm): 0.89 (t, 3H, 8'-CH_3), 1.28 (m, 10H, 5 × CH_2), 1.67 (m, 2H, 2'-CH2), 2.39 (t, 2H, 1'-CH_2), 7.3-7.8 (m, 6H, Ar-H), 10.1 (br, 2H, 2 × NH), 10.6 (s, 1H, -OH).

Compound 9

^{1}H-NMR ($CDCl_3$, δ, ppm): 0.88 (t, 3H, 8'-CH_3), 1.29 (m, 10H, 5 × CH_2), 1.69 (m, 2H, 2'-CH_2), 2.40 (t, 2H, 1'-CH_2), 6.9-7.4 (m, 4H, Ar-H), 9.89 (br, 2H, 2 × NH).

Compound 10

^{1}H-NMR ($CDCl_3$, δ, ppm): 0.89 (t, 3H, 8'-CH_3), 1.27 (m, 10H, 5 × CH_2), 1.68 (m, 2H, 2'-CH_2), 2.35 (t, 2H, 1'-CH_2), 7.1-7.3 (m, 5H, Ar-H), 9.92 (br, 2H, 2 × NH).

Compound 11

^{1}H-NMR ($CDCl_3$, δ, ppm): 0.88 (t, 3H, 8'-CH_3), 1.30 (m, 10H, 5 × CH_2), 1.69 (m, 2H, 2'-CH_3), 2.41 (t, 2H, 1'-CH_2), 6.9-7.2 (m, 4H, Ar-H), 9.89 (br, 2H, 2 × NH).

Compound 12

^{1}H-NMR ($CDCl_3$, δ, ppm): 0.89 (t, 3H, 8'-CH_3), 1.29 (m, 10H, 5 × CH_2), 1.75 (m, 2H, 2'-CH_3), 2.39 (t, 2H, 1'-CH_2), 3.75 (s, 3H, -OCH_3), 7.1-7.3 (m, 4H, Ar-H), 9.92 (br, 2H, 2 × NH).

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