

Synthesis of aryl hydrazone derivatives for α -naphthalide and benzothiazolide

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Date of acceptance 1/3 / 2010

Abstract:

Three series of new N-(α -naphthyl-2-(aryl hydrazono)-3-oxo butanamide, N-(6-chloro) benzothiazol-2-yl)-2-(aryl hydrazono)-3-oxo butanamide and N-(6-methyl) benzothiazol-2-yl)-2-(aryl hydrazono)-3-oxo butanamide were synthesized in two steps derived from α -naphthyl amine, 2-aminobenzothiazole. : The first step was involved the reaction of different fused aromatic amines (α -naphthyl amine, 6-chloro-2-aminobenzothiazole and 6-methyl-2-aminobenzothiazole) with methyl acetoacetate at (160-170) °C by using modern method to provide greatly improved yields. In the second step arenediazonium chloride was added to [3-oxo-butanamide derivatives] in basic solution at (0-5) °C to get ten new dyes of aryl hydrazono derivatives. These synthesized compounds were characterized by FT-IR, ¹³C-NMR, ¹H-NMR, UV-Visible spectroscopy, and by measuring their melting points, and solubility.

Key words: benzothiazolide, Synthesis, aryl hydrazone, α -naphthalide .

Introduction

Azo dyes are versatile compounds that have wide application in industry and photodynamic therapy ⁽¹⁾ as photosensitive species in photographic systems. Such azo compounds have found many applications such as dyeing of fabric, the coloring of toners and as dyes or photosensitive species in photographic or electrophotographic systems. ^(2,3)

Hydrazones have been found to possess many biological activities, e.g. antibacterial, ^{4,5} anticonvulsant, ⁶ anti-inflammatory, ⁷ antitubercular and anti-protozoal, ⁸. A large number of heterocyclic Schiff bases have been reported to have bactericidal, fungicidal, antipyretic, antitumor, anticancer and sterease inhibitory activities ⁹

This research includes preparing of some derivatives of aryl hydrazone for α -naphthalide and benzothiazolide having different color which may used in different applications.

Material and Methods:

Melting points were recorded by using Gallen Kamp MFB-600 capillary melting point apparatus and are uncorrected. Infrared spectra were recorded on (FT-IR) infrared spectrophotometer as KBr disc in Baghdad University, College of Science, Chemistry Department. ¹H – NMR Spectra were recorded on Shimadzu and tetramethyl silane as internal standard in Ahl-Albate-University in Jordon. ¹³C –NMR Spectra were recorded on Shimadzu and tetramethyl silane as internal standard in Ahl-Albate- University in Jordon. UV spectra were recorded on UV-Visible spectrometer (SHIMADZU) UV-160A.

Synthesis of 6-chloro -2-aminobenzothiazoles and 6- methyl-2-aminobenzothiazoles ^(10,11) :

These compounds were synthesized depend on procedures in literatures.

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Reaction of methyl acetoacetate with 1-amino naphthalene and 2-amino benzothiazole derivatives :-(12,13)

Methyl acetoacetate (0.023 mle) was heated under reflux at 100C°, and then amino derivatives compounds (0.015 mole) was added portion wise with stirring. The temperature was then raised up to 160-170 °C for 2 hours. The reaction mixture was left to cool, the solid product was filtered off washed with ethanol and recrystallized from (CCl₄ or EtOH). to give compounds (1, 3, and 5)

Synthesis of 2-arylhidazono -3-oxobutanamide derivatives 2(a-d),4(a-c),6(a-c):

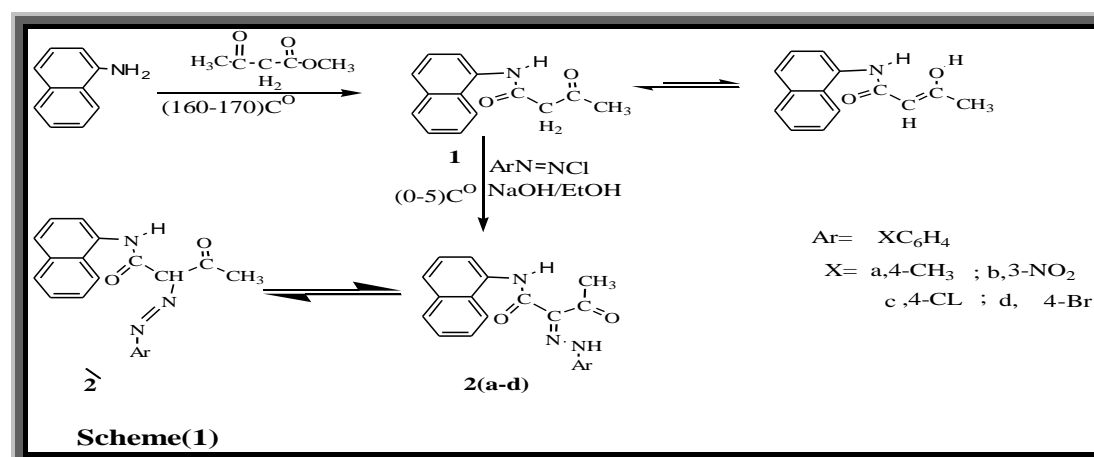
To a stirred solution of compounds (1, 3, or 5) (10mmole) in absolute ethanol (50ml) ,(10mmole) sodium hydroxide was added and the mixture was cooled in an ice bath(0-5 °C).To the resulting solution, while being stirred added drop wise over period of 20 min, a solution of the appropriate arenediazium chloride was prepared from the reaction of respective aniline (10mmole) in hydrochloric acid (6M, 6ml) with sodium nitrite (1M, 10ml). The whole mixture was left over night in a refrigerator. The solid was collected and washed with water and finally recrystallized from the mixture of dioxan: EtOH (1:1) to give the respective hydrazones.

All physical properties of these compounds were listed in table (1) and table (2)

Results & Discussion:

Since azo dyes are important compounds having wide applications the ten new azo compounds were synthesized by two steps of reactions. the first step included the reaction of methyl acetoacetate with α -naphthylamine at 160-170°C according modern method in order to provide greatly improved yields of acetoaceto- α - naphthalide(1) which has active methylene group -CH₂-.FTIR Spectra of compound (1) showed clear absorption bands at 3240 cm⁻¹,1630 cm⁻¹ ,and1600 cm⁻¹ due to NH band ,acetyl and amide carbonyl groups ,respectively. The low stretching vibrations of acetyl carbonyl is due to the hydrogen bonding with the NH amide. All the synthesis compounds in this search in second step can exist in two possible tautomeric forms in which the acetyl carbonyl and amide carbonyl was involved in the H-bonded system.

In the second step these active methylene compounds reacted with four diazotized aniline derivatives in ethanol in the presence of sodium hydroxide at (0-5) °C and afforded the respective hydrazone derivatives 2(a-d).These reaction are summarized in scheme (1).

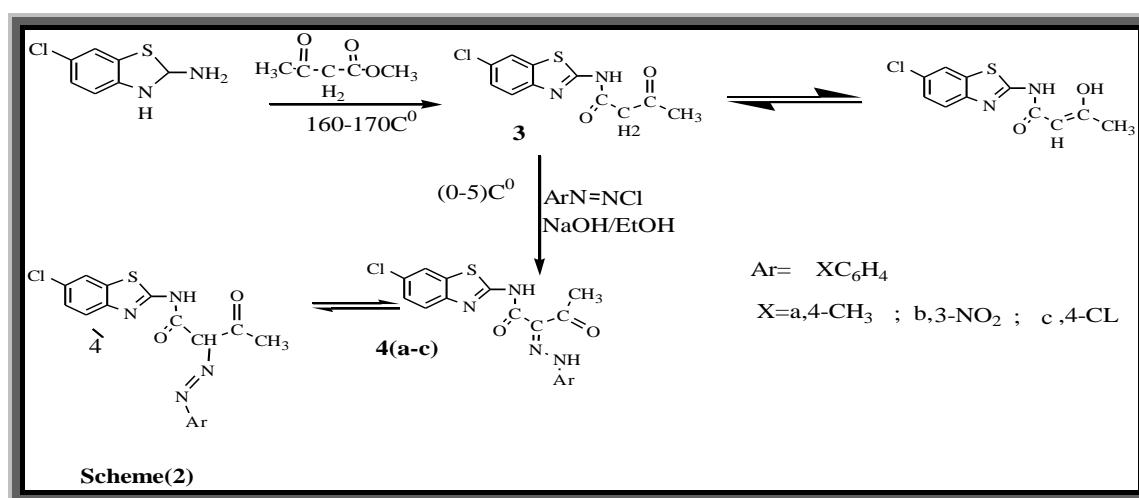


FTIR Spectra of the synthesis compounds 2(a-d) showed the characteristic absorption bands at $(1635-1700) \text{ cm}^{-1}$, $(1620-1666) \text{ cm}^{-1}$ due to acetyl and amide carbonyl groups respectively. Other absorption bands appeared at $(1500-1540) \text{ cm}^{-1}$ and $(3210-3379) \text{ cm}^{-1}$ which were assigned for $\nu\text{C}=\text{N}$ and $\nu(\text{N-H})$ amide another details are listed in table (4)

$^1\text{H-NMR}$ spectrum of compound (2a) showed two clear singlet signals at $(\delta 2.4 \text{ and } \delta 2.5) \text{ ppm}$ belong to three

proton of two CH_3 group. While ^{13}C spectrum of the same compound showed two signal due to two aliphatic carbons in $(\delta 21 \text{ and } \delta 22) \text{ ppm}$. FTIR and $^1\text{H-NMR}$ spectra are listed in table (4) and table (5)

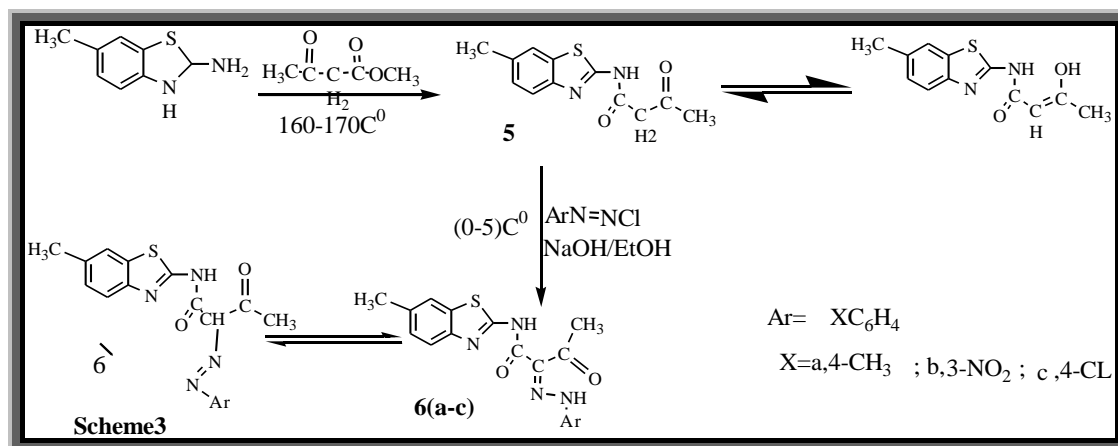
Other kind of dyes were synthesized by reaction of methyl acetoacetate with 6-chloro-2-amino benzothiazole to afford N-(6-chlorobenzothiazole-2-yl)-3-oxobutanamide (3), which was reacted with three aryl diazonium salts to get three new dyes 4(a-c). This reaction depicted in (scheme2).



While FTIR spectrum of compound (3) showed absorption band at 3301 cm^{-1} due to NH band, 3132 cm^{-1} due to CH aromatic, 2931 cm^{-1} due to C-H aliphatic, and absorption band at $(1712 \text{ and } 1658) \text{ cm}^{-1}$ due to acetyl and amide carbonyl groups respectively. While FTIR of 4(a-b) compounds showed absorption band at $(3382-3201) \text{ cm}^{-1}$ due to $\nu(\text{N-H})$, and other bands at $(1728-1750) \text{ cm}^{-1}$ and $(1650-1658) \text{ cm}^{-1}$ due to acetyl and amide carbonyl groups respectively, while absorption band of $\nu(\text{C}=\text{N})$ for thiazole ring and for keto-hydrazone were appeared at $(1512-1573) \text{ cm}^{-1}$, other details for FTIR absorption band of these compounds are shown in table (4). $^1\text{H-NMR}$ Spectrum of compound 4a showed two clear singlet signals $(\delta 2.4 \text{ and } \delta 2.5) \text{ ppm}$ belong to three

proton of CH_3 of two CH_3 groups, while there are many singlet signals at $(\delta 12.9-\delta 14) \text{ ppm}$ due to the proton of four N-H tautomeric structures. $^{13}\text{C-NMR}$ Spectrum of this compound showed the present of two aliphatic carbons in the range of $\delta 20 \text{ and } \delta 24$.

In order to synthesis other new dyes derived from benzothiazole using 6-methyl-2-amino benzothiazole instead of 6-chloro-2-amino benzothiazole with methyl acetoacetate at 160°C for 2hrs. to produce compound (5). FTIR spectrum for this compound showed absorption bands at 1712 cm^{-1} and 1658 cm^{-1} due to acetyl and amide carbonyl group respectively. The compound (5) reacted with three aryl diazonium salts to get another three new dyes 6(a-c), (scheme3).



The FTIR spectra of these compounds showed absorption band at (1657-1658) cm^{-1} and (1712-1743) cm^{-1} due to acetyl and amide carbonyl group respectively; in the same reason; the low stretching vibration of acetyl carbonyl group is due to the hydrogen bonding with the NH amide. $^1\text{H-NMR}$ spectrum of the compound (6a) showed two singlet at (δ 2.5 and δ 2.4) ppm belong to three proton of CH_3 of two CH_3 group. $^{13}\text{C-NMR}$ spectra of the same compound showed two signal at (δ 21 and δ 28) ppm belong to two

CH_3 groups, and signal at 161 ppm due to carbonyl carbon.

The physical properties of all prepared compounds were listed in table (1) and (2).

In U.V spectra of three schemes off all prepared compounds in the second step (2(a-d), 4(a-c) and 6(a-c)) showed absorption at longer wave length than the prepared compounds 1,3,5 in first step because of the extension conjugation system as shown in table (6). The solubility of prepared compounds are tested in many solvent as shown in table (3)

Table (1): Physical properties of the prepared compounds

Comp. No.	Nomenclature of compounds structure	m.p	Yield%	Colour of Cryst.
2a	N-(α naphthyl)-2-(4-methyl phenyl hydrazono)-3-oxobutanamide	170	96	Green
2b	N-(α naphthyl)-2-(3-nitro phenyl hydrazono)-3-oxobutanamide	150-152	71	Brown
2c	N-(α naphthyl)-2-(4-chloro phenyl hydrazono)-3-oxobutanamide	173	74	Yellow
2d	N-(α naphthyl)-2-(4-bromo phenyl hydrazono)-3-oxobutanamide	205	73	Orange

Table (2): Physical properties of the prepared compounds

Comp. No.	Nomenclature of compounds structure	m.p	Yield%	Colour of Cryst.
3	N-(6-chloro benzothiazol-2-yl)-3-oxobutanamide	200	90	Yellow
4a	N-(6-chloro benzothiazol-2-yl)-2-(4-methyl phenyl hydrazono)-3-oxobutanamide	>250	71	red
4b	N-(6-chloro benzothiazol-2-yl)-2-(3-nitrophenyl hydrazono)-3-oxobutanamide	208-210	74	Yellow
4c	N-(6-chloro benzothiazol-2-yl)-2-(4-chloro phenyl hydrazono)-3-oxobutanamide	204-241	73	brown
5	N-(6-methyl benzothiazol-2-yl)-3-oxobutanamide	205	80	Yellow
6a	N-(6-methyl benzothiazol-2-yl)-2-(4-methyl phenyl hydrazono)-3-oxobutanamide	226-228	75	Yellow
6b	N-(6-methyl benzothiazol-2-yl)-2-(3-nitro phenyl hydrazono)-3-oxobutanamide	196	72	Orange
6c	N-(6-methyl benzothiazol-2-yl)-2-(4-chloro phenyl hydrazono)-3-oxobutanamide	220	76	Yellow

Table (3): Solubility of the prepared compounds

Comp no	Ethanol.	Methanol	H ₂ O	CHCl ₃	Dioxan	CCl ₄	DMF	DMSO
1	+	+	-	+	+	-	+	+
2a	+	+	-	+	+	+	+	+
2b	+	+	-	+	+	+	+	+
2c	+	+	-	+	+	+	+	+
2d	+	+	-	+	+	+	+	+
3	+	+	-	+	+	+	+	+
4a	+	+	-	+	+	+	+	+
4b	+	+	-	+	+	+	+	+
4c	+	+	-	+	+	+	+	+
5	+	+	-	+	+	+	+	+
6a	+	+	-	+	+	+	+	+
6b	+	+	-	+	+	+	+	+
6c	+	+	-	+	+	+	+	+

Table (4): FTIR absorption (cm⁻¹) of the prepared compound(1), 2(a-d), (3), 4(a-c) (5),6(a-c)

Comp. No.	ν N-H	ν C-H	ν C-H	ν C=O acetyl	ν C=O amide	ν C=C	ν C=N	ν N=N	ν C-S	Other bands
1	3240	3008	2923	1630	1600	1578	1589	1430	-	-
2a	3379	3008	2731	-	1666	1589	1540	1445	-	3008enol form
2b	3247	3163	2993	1681	1620	1596	1527	1465	-	ν C-NO ₂ 1350 1527
2c	3325	3085	2923	1635	1625	1573	1500	1490	-	ν C-Cl 756
2d	3210	3047	2923	1700	1650	1559	1500	1411	-	ν C-Br 763
3	3301	3132	2931	1712	1658	1583	1573	1419	617	-
4a	3382	3120	2916	1750	1658	1610	1512	1500	662	-
4b	3300	3132	2923	1740	1658	1596	1519	1440	609	ν C-NO ₂ 1519 1350
4c	3201	3078	2923	1728	1650	1596	1519	1510	645	ν C-Cl 825
5	3332	3170	2962	1712	1657	1600	1575	1420	640	-
6a	3386	3124	2916	1720	1658	1610	1512	1582	660	-
6b	3317	3101	2916	1743	1658	1610	1527	1520	671	ν C-NO ₂ 1527 1350
6c	3386	3047	2854	1720	1658	1610	1512	1432	642	ν C-Cl 740

Table (5): ¹H-NMR absorption (cm⁻¹) of the prepared compounds 2a, 4a, 4b, 6c.

Compd. No.	δ H aliphatic ppm	δ H aromatic ppm	δ NH
2a	2.4(s,3H,CH ₃) 2.5(s,3H,CH ₃)	7-8.5(m,7 Ar-H)	13.5(s,1H,NH) 12.8(s,1H,NH)
4a	2.4(s,3H,CH ₃) 2.4(s,3H,CH ₃)	7-8.1(m,7 Ar-H)	12.6(s,1H,NH) 12.8(s,1H,NH) 13.5(s,1H,NH)
4b	2.4(s,3H,CH ₃) 2.4(s,3H,CH ₃)	7.3-8.3(m,7 Ar-H)	12.9(s,1H,NH) 12.8(s,1H,NH) 13.5(s,1H,NH)
6c	2.5(s,3H,CH ₃) 2.4(s,3H,CH ₃)	7.2-7.2(m,7Ar-H)	12.6(s,1H,NH) 13.5(s,1H,NH)

Table (6): UV spectral data of some prepared compounds in ethanol

Comp. No.	λ nm.
3	368
4a	380
4b	388
4c	390
5	270
6a	401
6b	380
6c	368

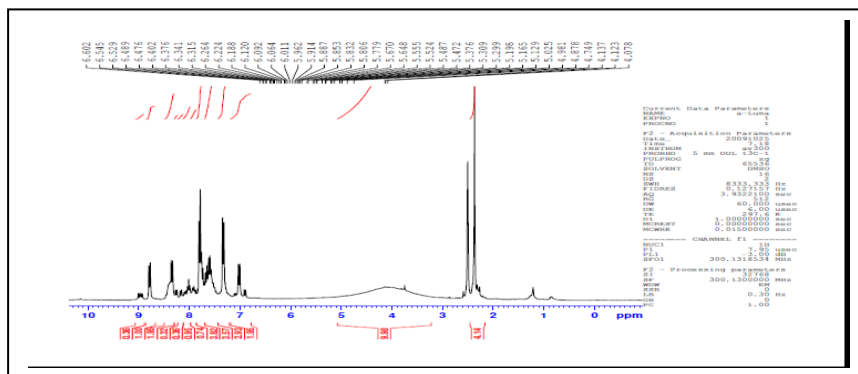


Fig1: ¹H-NMR spectrum of compound 2a

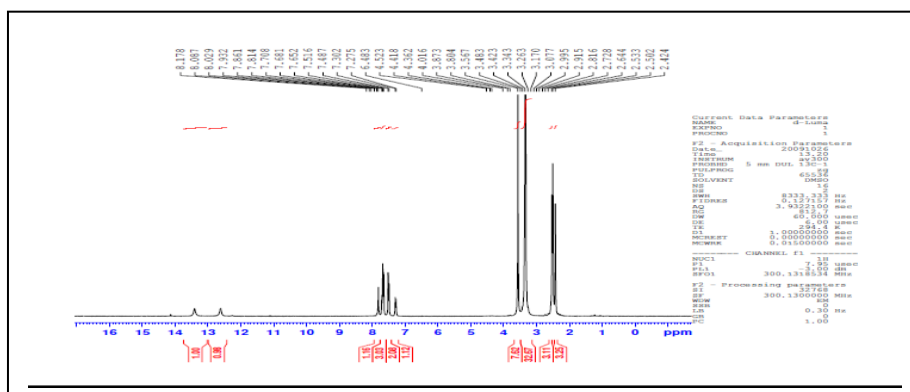


Fig2: ¹H-NMR spectrum of compound 6c

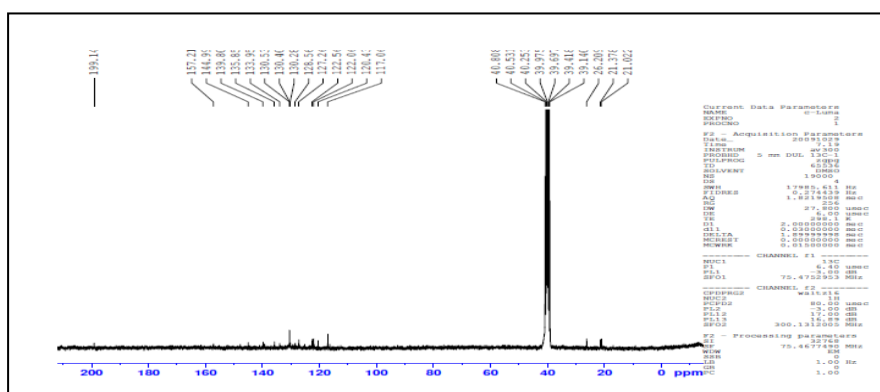


Fig3: ¹³C-NMR spectrum of compound 4a

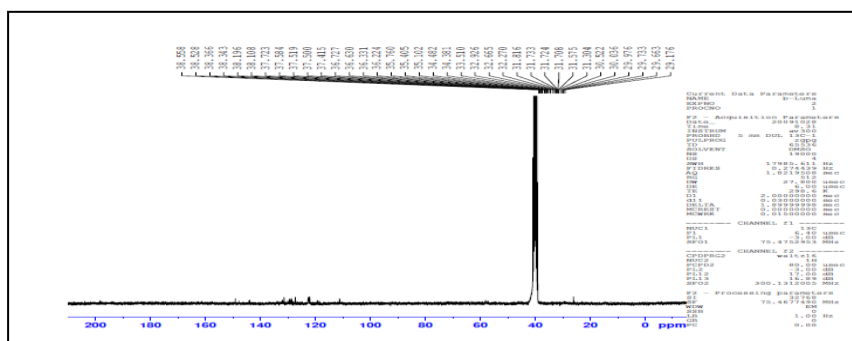


Fig4: ¹³C-NMR spectrum of compound 4b

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تحضير مشتقات اريل هايدروزن للمركب الفا- نفتالايد وبنزو ثايوزلايد

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الخلاصة:

تضمن البحث تحضير ثلاثة سلاسل من المركبات الجديدة من α -N - نفتايل -2-(اريل هيدرازونو)-3-او كسو بيوتاناميد، و N-(6-كلورو بنزو ثايوزول -2-يل)-2-اريل هيدرازونو)-3-(او كسو بيوتاناميد) ، N-(6-ميثل بنزو ثايوزول -2-يل)-2-اريل هيدرازونو)-3-(او كسو بيوتاناميد) والمشتقة من النفثايل امين و2-امينو بنزو ثايوزول وقد أجريت التفاعلات بخطوتين: الخطوة الأولى كانت تفاعل النفثايل امين مع مثيل اسيتو اسيتيت للسلسلة الأولى وتفاعل مشتقات الامينو بنزو ثايوزول(6-كلوروامينو بنزو ثايوزول ،6-ميثل امينو بنزو ثايوزول) مع مثيل اسيتو اسيتيت للسلسلة الثانية والثالثة على التوالي عند (170-160)م⁰ باستعمال طريقة حديثة في التحضير تزيد من النسبة المئوية للمنتوج. اما الخطوة الثانية فهي تفاعل هذه المركبات الناتجة مع املاح الاريل دايازونيوم كلورايد في وسط قاعدي وعند درجة (0-5) م⁰ للحصول على عشر صبغات جديدة من مشتقات الاريل هيدرازونو-3-او كسو بيوتاناميد جميع هذه المركبات الجديدة تم تشخيصها بواسطة اطياف الاشعة تحت الحمراء FTIR وطيف الرنين النووي المغناطيسي ¹H-NMR, ¹³C-NMR وال UV-Visible وقياس درجات الانصهار وكذلك الذوبانية.