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Synthesis and Identification of Some New tetrazolin-1-yl, Imidazolidine-4-one, and Thiazolidine-4-one Derivatives from pyromellitic diimide and Their Antioxidant Activities Investigation.

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Abstract

This work includes the synthesis of a new five-membrane heterocyclic ring of zolidines derivatives. These derivatives of compounds were synthesized by reaction of pyromellitic diimide was solved in dry DMF with sodium hydrate to produce salt pyromellitic diimide right after that add ethyl chloro acetate to give N, N´-bis (ethyl acetate) Pyromellitic diimide this product is the first compound (1) then with excess hydrazine hydrate in absolute ethanol to obtain hydrazaide derivatives compounds (2). After that compound (2) reacts with *p*-substituted aromatic aldehydes to give Schiff base compounds (3-7). The Schiff base compounds exhibit versatile reactivity, leading to the formation of various heterocyclic derivatives. When reacted with sodium azide, they produce tetrazolidine derivatives (8-12). Similarly, their reaction with 2-amino acetic acid yields imidazolidin-4-one derivatives (13-17), while treatment with 2-mercapto acetic acid results in the formation of thiazolidin-4-one derivatives (18-22). These transformations highlight the adaptability of Schiff base compounds in synthesizing a wide range of structurally diverse and functionally significant heterocyclic compounds. The produced compounds' physicochemical characteristics and melting points were identified. To identify novel compounds, spectral approaches such as ^{1}H-NMR, ^{13}C-NMR, and FT-IR were employed. Assessments from both computational and experimental methods confirm the promising bioactivity of the produced zolidines derivatives as antioxidants.

Key words: Pyromellitic diimide, Schiff base, tetrazolidine, imidazolidine-4-on, thiazolidine-4-on, antioxidant.

تخليق وتحديد بعض مشتقات التترازولين-1-يل، والإيميدازوليدين-4-ون، والثيازوليدين-4-ون الجديدة من ثنائي إيميد البايروميليتيك ودراسة أنشطتها المضادة للأكسدة

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الخلاصه

يتضمن هذا العمل تخليق حلقات خماسية غير متجانسة جديدة من مشتقات الزوليدين. تم تخليق هذه المشتقات من المركبات عن طريق تفاعل البايروميليتيك ثنائي ايميد المذاب في ثنائي ميثيل فورمالديهيد الجاف مع هيدرات الصوديوم لإنتاج البايروميليتيك ثنائي ايميد الملحي مباشرة بعد إضافة أسيتات كلورو الإيثيل لإعطاء N، N´–ثنائي (أسيتات الإيثيل) البايروميليتيك ثنائي ايميد هذا المنتج هو المركب الأول (1)

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ثم مع فائض هيدرازين هيدرات في الإيثانول المطلق للحصول على مركبات مشتقات الهيدرازيد (2). بعد ذلك يتفاعل المركب (2) مع الألدهيدات الاروماتية المستبدلة في موقع بارا لإعطاء مركبات قاعدة شيف (3–7). تظهر مركبات قاعدة شيف تفاعلية متعددة الاستخدامات، مما يؤدي إلى تكوين مشتقات غير متجانسة مختلفة. عند التفاعل مع أزيد الصوديوم، فإنها تنتج مشتقات التترازوليدين (8–12). وبالمثل، فإن تفاعلها مع حمض 2–أمينو أسيتيك ينتج مشتقات إيميدازوليدين–4–ون (13–17)، في حين أن المعالجة بحمض 2–مركابتو أسيتيك ينتج عنها تكوين مشتقات ثيازوليدين–4–ون (18–22). تسلط هذه التحولات الضوء على قدرة مركبات قاعدة شيف على التكيف في تصنيع مجموعة واسعة من المركبات الحلقية غير المتجانسة المتنوعة هيكليًا والمهمة وظيفيًا. تم تحديد الخصائص الفيزيائية والكيميائية للمركبات المنتجة ونقاط الانصهار. لتحديد المركبات الجديدة، تم استخدام الأساليب الطيفية مثل ^{1}H–NMR و^{13}C–NMR وFT–IR. تؤكد التقييمات من كل من الطرق الحسابية والتجريبية النشاط الحيوي الواعد لمشتقات الزوليدين المنتجة كمضادات للأكسدة.

1. Introduction

Cyclic imides serve as essential structural motifs due to their prevalence in numerous biologically active compounds. Medicinal applications for the majority of synthetic heterocyclic compounds include antiepileptics [1], hypnotics [2] , anticancer agents [3], antiseptics [4], antihistamines [5], and antivirals [6]. A significant number of heterocyclic medications are added to pharmacopoeias each year. Strong evidence of the physical and chemical properties of ring structures has been provided by their size, type, and effective substitution groups of the parent scaffold [7]. Heterocyclic compounds are used in many different medical applications, and among them are active antibacterial [8], anti-inflammatory [9], antifungal [10], antitumor, antiviral [11] chemicals and cyclic imides are essential building blocks for the synthesis of pharmaceuticals, natural products, polymers, and drugs[12] .

Tetrazoles, a multi-purpose group of five-membered N-containing heterocyclic compounds containing four nitrogen and a carbon and exist in two 1H- and 2H- tautomeric forms. Tetrazoles possess excellent properties such as low basicity, high acidity, large number of nitrogen, high stability and formation enthalpy; have been used as analytical reagents in the material science [13], as lipophilic spacers in medicinal chemistry antihypertensive drugs [14], efficient antitumor [15] and anticancer agents [16] ,starting materials for the synthesis of propellants, energetic materials, and N-containing compounds and principally ligands for the organization of complexes [11].

There have been reports that the thiazolidin-4-one could be used as a scaffold to build novel compounds for medicinal chemistry. It is possible to modify the thiazolidin-4-one ring at positions 2, 3, and 5. These changes make it easier to find novel compounds that have the needed properties. According to published research, thiazolidin-4-one is a significant scaffold with potential applications in medicine. It has a broad spectrum of biological activity [17] when modified with different substituents, including anti-diabetic [18] , antioxidant [19], anti-tubercular [20] , antibacterial [21] , anticonvulsant [22] , anticancer [23], antiprotozoal [24] , antihyperglycemic [25] and anti-inflammatory actions [26]. Furthermore, thiazolidine-2,4-diones are a well-known class of antidiabetic medications that exhibit affinity for the peroxisome proliferator-activated receptor (PPARγ), including (pioglitazone and rosiglitazone) [15].

Imidazole, an azole compound containing two nitrogen atoms, serves as a fundamental building block in numerous natural products and biological systems. Its unique structure and reactivity make it a key component in various biochemical and pharmaceutical applications. They are essential to many metabolic processes and possess a wide range of toxicological characteristics [27]. Numerous biological systems frequently contain the imidazole core molecule. Several widely recognized elements of the human body include histidine [28],

purines [29], , vitamin B12 [24], and a base component of DNA. Numerous synthetic pharmacological compounds, like Cimetidine, also include it [30] . Clinical medicine uses a wide range of medications that have the imidazole core structure. Antibacterial [31], anticancer [32] ,antitubercular [33], antifungal [34], anti-analgesic [35], anti-HIV [36], and antioxidant [28] properties have all been reported for imidazole. The aim of this study is to form five-membrane heterocyclic compounds and study their biological activity as antioxidants.

2.Experimental

2.1Materials and Instruments

Every chemical that was utilized was bought from Fluka or Aldrich beginning chemicals. With an uncorrected Thomas capillary melting point apparatus, melting points (MP) in open glass capillaries were determined using Gallenkamp. The end of the reaction was monitored by thin- layer chromatography (TLC). On a SHIMAZU FTIR 8400 Fourier transform infrared spectrophotometer, FTIR spectra were captured on KBr discs. The reagent and all of the primary components were pure and easily obtained from a commercial source. A 300 MHz spectrometer was used to record the 1H and 13C NMR spectra. Agilent Technologies model ultra-shield nuclear magnetic resonance (NMR) spectra were recorded in di methyl sulfoxide solvent (DMSO-d6). Tetra methyl silane (TMS) was used as a reference to provide the chemical shifts in δ (ppm) downfield. The antioxidant activity was measured using UV-VIS spectra collected at 760 nm by a BUCK (USA) called the Shimadzu Spectrophotometer.

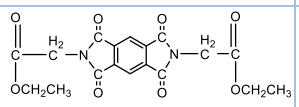
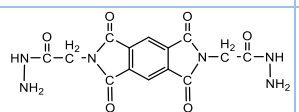
2.2Synthesis of N, N´-bis (ethyl acetate) Pyromellitic diimide[37].

Pyromellitic diimide (0.5g ,0.002mol.) and NaH (0.2g, 0.004 mol.) were dissolved in 6 mL of dimethylformamide in a 50 mL round-bottom flask that had a magnetic stirring bar attached. Next, (0.4 mL, 0.004 mol.) of ethyl chloroacetate was added. For six reflux was the solution. After the last step of the reaction, the reaction mixture was put into ice water and filtered. washed with distilled water and then re-crystallized from water and ethanol. Table 1 presents selected FT-IR and physical characteristics of compound 1.

2.3Synthesis of N, N´-bis (aceto hydrazide) pyromellitic diimide[38].

A solution of (0.5g ,0.002 mole) N, N´-bis (ethyl acetate) Pyromellitic diimide dissolved in absolute ethanol, then add (0.5 mL,0.006 mole) of hydrazine hydrate was added, stirred and reflexed for 10 hours. Next, the mixture was cooled at room temperature, filtered with washed cold distilled water, and the precipitate dried. The solid yellow precipitate was recrystallized by (petroleum ether). Physical properties of compound (2) and FTIR spectral data are represented in Table 1.

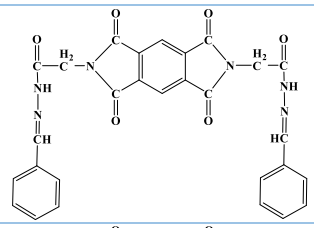
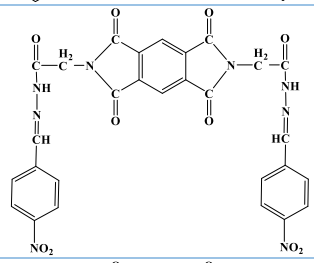
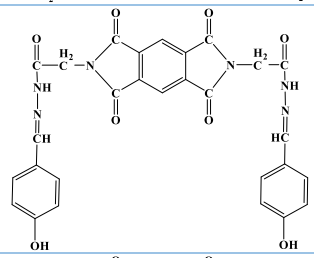
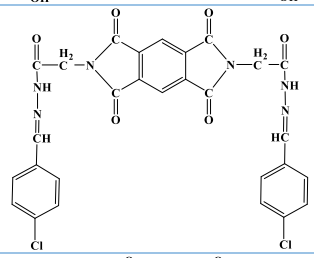
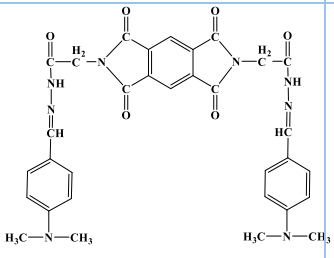
Table 1: physical properties and FT-IR spectral data for prepared compounds (1-2)

Physical properties					Major FTIR absorption cm^{-1}				
No	Structure	M.p °C	Yield %	Color	υ (N-H)	υ(C-H) Arom. Alipha.	υ(C=O) Imide	υ (C=C) Arom.	Other band
1		>300	90	white	———	3068 2960	1772 1735 1720 ester	1600 1542	υ C-N 1033 υ O-C 1303
2		>300	90	yellow	3240	3014 2927	1722 1714 1670a mide	1560 1517	υ N-H_2 asym.3328 sym.3288

2.4Synthesis of N, ´N-bis (substituted benzyledine aceto-hydrazide) pyromelliticdiimidyl (3-7) [39].

A solution of (0.5 g,0.022 mol.) N, N´-bis (aceto hydrazide) pyromellitic diimide (0.044 mol.) Para substituted aromatic aldehydes in (10 mL) absolute ethanol solvent was mixed thoroughly with a catalytic three drops of glacial acetic acid, and refluxed the mixture for (6-7) hours. The product was then dried, after evaporating the excess solvent and recrystallized from (ethanol-water). Table 2 lists FT-IR and physical properties of compounds (3-7).

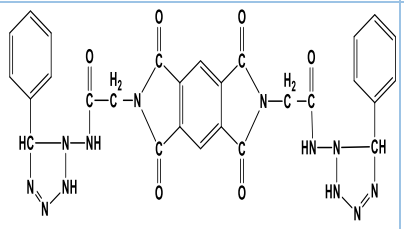
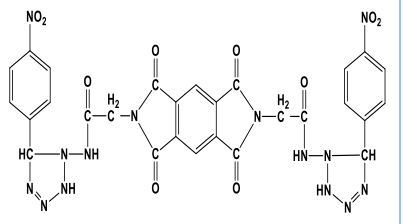
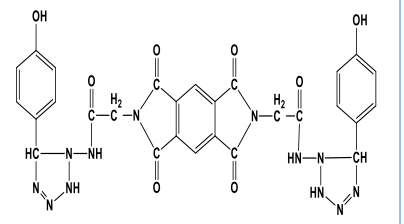
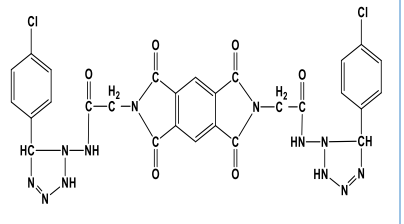
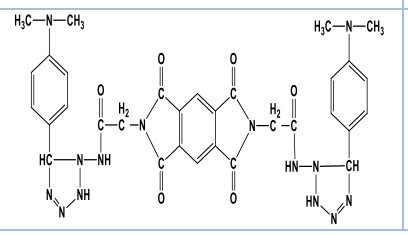
Table 2: physical properties and FT-IR spectral data for prepared compounds (3-7)

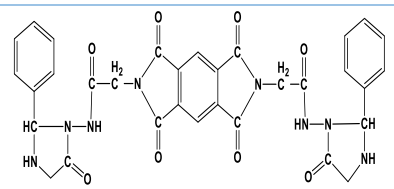
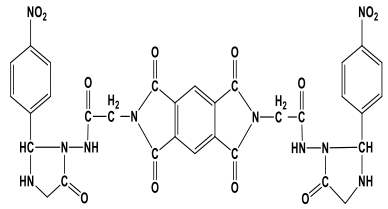
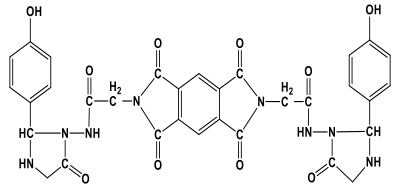
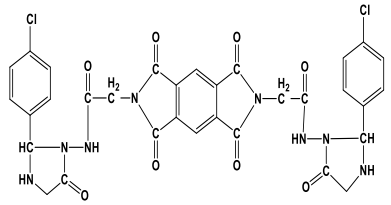
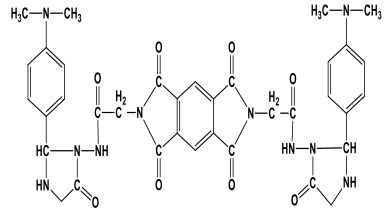
Physical properties					**Major FTIR absorption cm^{-1}**				
No.	Structure	M.p ^{o}C	Yield %	Color	υ(N-H)	υ(C-H) Arom. Alipha.	υ(C=O) Imide Amide	υ(C=N)	Other band
3		204 - 206	80	Gray	3247	3049 3029 2900	1774 1718 1654	1625	υ C-N 1027 δ(p-sub.) 810
4		187 - 189	80	yellow	3270	3082 2975	1731 1658	1610	υ NO_2 Asym1523 sym.1344 δ(p-sub). 810
5		207 - 208	80	Yellowish whit	3280	3029 2891	1774 1722 1656	1627	υ O-H 3342 υ C-N 1026 δ(p-sub). 827
6		224 - 226	80	white	3230	3022 2883	1759 1714 1654	1628	υ C-Cl 1091 δ(p-sub). 808
7		196 - 197	80	yellow	3272	3026 2894	1732 1654	1622	υ C-N 1066 δ(p-sub). 810

2.5Synthesis of N, ´N-bis [5-(4-subsituteded phenyl 2H-tetrazoline-1-yl) acetamide] pyromelliticdiimidyl (8-12), N, ´N-bis [2-(4-subsituteded phenyl) imidazolidin-5-one-1-yl acetamide] pyromelliticdiimidyl (13-17) [35].

Compounds (8-17) were obtained from the reaction of an equimolar mixture of Schiff bases (3-7) (0.001 mol.) in ethanol (10 mL). Sodium azide (0.06 g, 0.002 mol.) dissolved in the same solvent was added and the solution was refluxed for (18-20) hours. The product was filtrated, washed with distilled water, and recrystallized by (ethanol-water). Table 3 lists some of the FT-IR and physical properties of compounds (8-17).

Table 3: FT-IR spectral data and physical properties for prepared compounds (8-17).

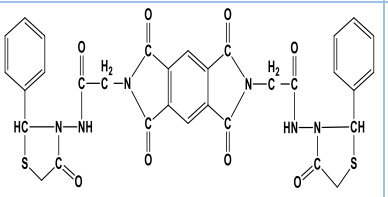
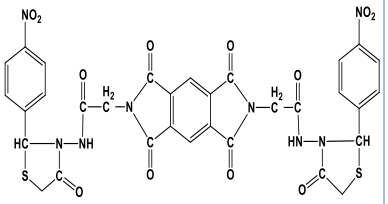
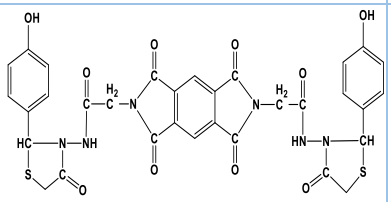
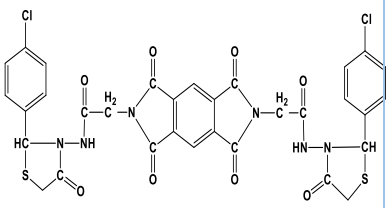
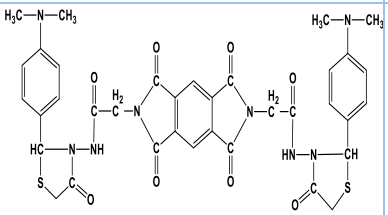
Physical properties					Major FTIR absorption cm^{-1}				
No.	Structure	M.p °C	Yield %	Color	υ(N-H)	υ(C-H) Arom. Alipha.	υ(C=O) Imide Amide	υ(C=C) Arom.	Other band
8		>300	90	Yellow	3296	3077 2921	1776 1731 1643	1573 1548	υ N=N 1452 υ C-N 1020 δ(p-sub). 821
9		234 dec.	90	Light yellow	3290	3058 2921	1772 1739 1680	1600 1548	υ N=N 1452 υ NO_2 Asym.1548 sym.1344 υ C-N 1020 δ(p-sub). 823
10		280 dec.	90	Green	3296	3077 2974	1749 1722 1679	1560 1510	υ O-H 3392 υ N=N 1452 υ C-N 1049 δ(p-sub). 823
11		254 dec	85	Light yellow	3290	3072 2921	1772 1739 1677	1595 1543	υ N=N 1457 υ C-Cl 1068 υ C-N 1085 δ(p-sub). 821
12		192-194	90	Yellow	3290	3077 2912	1749 1730 1680	1600 1550	υ N=N 1455 υ C-N 1012 δ(p-sub). 813

13		200 dec.	85	Matt yellow	32 95	3035 2921	1772 1733 1652	1560 1542	υ C-N 1026
14		246-247	85	Yellow	32 53	3037 2920	1770 1735 1654	1600 1562	υ NO_2 Asym.1521 Sym.1342 υ C-N 1026 δ(p-sub). 810
15		242-244	80	Gray	32 99	3028 2920	1774 1722 1658	1564 1514	υ O-H 3350 υ C-N 1045 δ(p-sub). 826
16		222-223	80	Off white	32 36	3037 2918	1768 1749 1677	1560 1515	υ C-Cl 1091 υ C-N 1035 δ(p-sub). 811
17		200-203	85	Red	32 96	3077 2970	1774 1735 1652	1602 1564	υ C-N 1035 δ(p-sub). 811

2.6Synthesis of N, ´N bis [2-(4-substiuted phenyl)-thiazolidin-4-one-3-yl acetamide] pyromellitic dimidyl (18-22) [40]**.**

A mixture of Schiff bases (0.001 mol.) (3-7) with 2-mercaptoacetic acid (0.2 ml,0.002 mol.) in tetrahydrofuran THF (10 mL) was added gradually. The reaction mixture was then heated to reflux for (20-24) hours. The product was filtered, washed with distilled water and further purification by using recrystallization from ethanol. Table 4 lists some of the FT-IR and physical properties of compounds (18-22).

Table 4: FT-IR spectral data physical properties for prepared compounds (18-22).

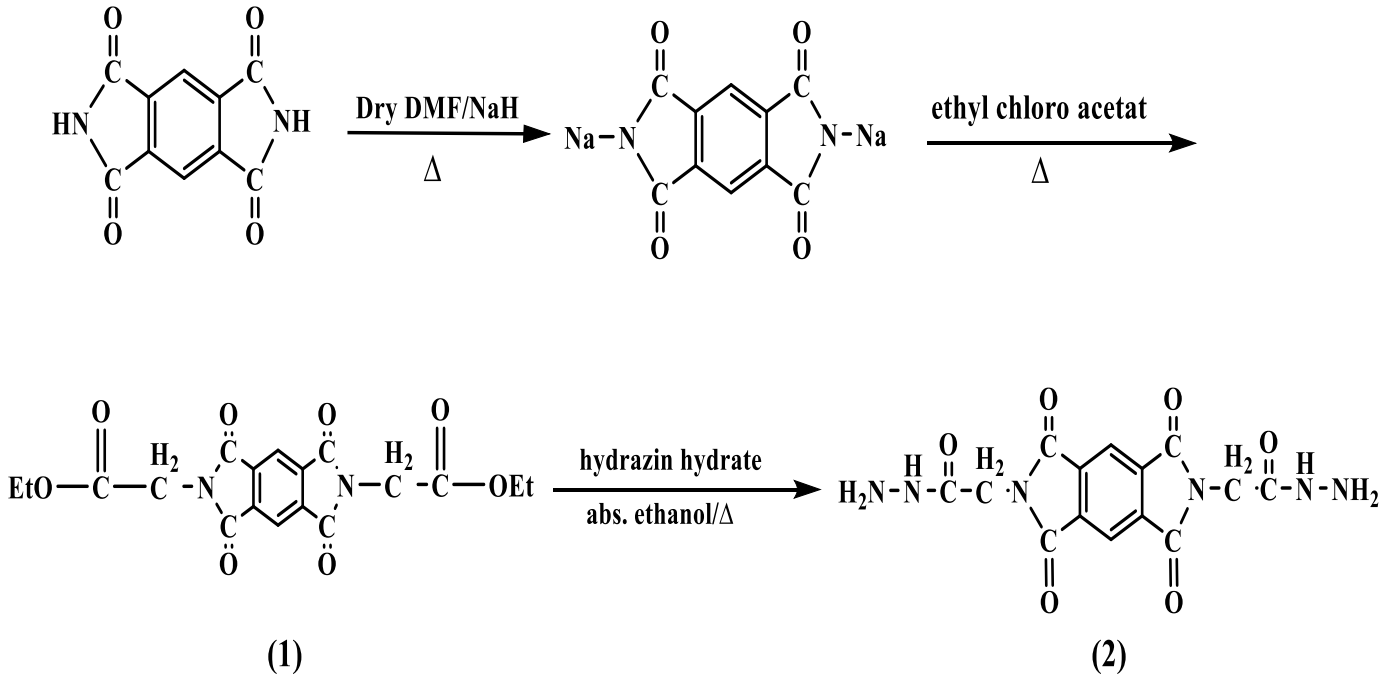
Physical properties					Major FTIR absorption cm^{-1}				
No.	Structure	M.p °C	Yield %	Color	υ(N-H)	υ(C-H) Arom. Alipha.	υ(C=O) Imide Amide	υ(C=C) Arom.	Other band
18		gum	80	Yellow	3299	3080 2920	1785 1714 1686	1596 1556	υ C-N 1026 υ C-S 696
19		gum	80	Orange	3296	3077 2990	1736 1714 1656	1598 1562	υ NO_2 Asym.1521 Sym.1346 υ C-N 1026 δ(p-sub) 808 υ C-S 680
20		gum	80	Yellow	3296	3077 2921	1756 1714 1654	1602 1564	υ O-H 3320 υ C-N 1026 δ(p-sub) 810 υ C-S 675
21		gum	80	Off white	3292	3075 2981	1760 1714 1658	1595 1562	υ C-Cl 1093 υ C-N 1022 δ(p-sub) 808 υ C-S 678
22		gum	80	Light orange	3295	3072 2974	1775 1716 1654	1598 1560	υ C-N 1026 δ(p-sub) 815 υ C-S 675

2.7 Total antioxidant capacity [41] [42]**.**

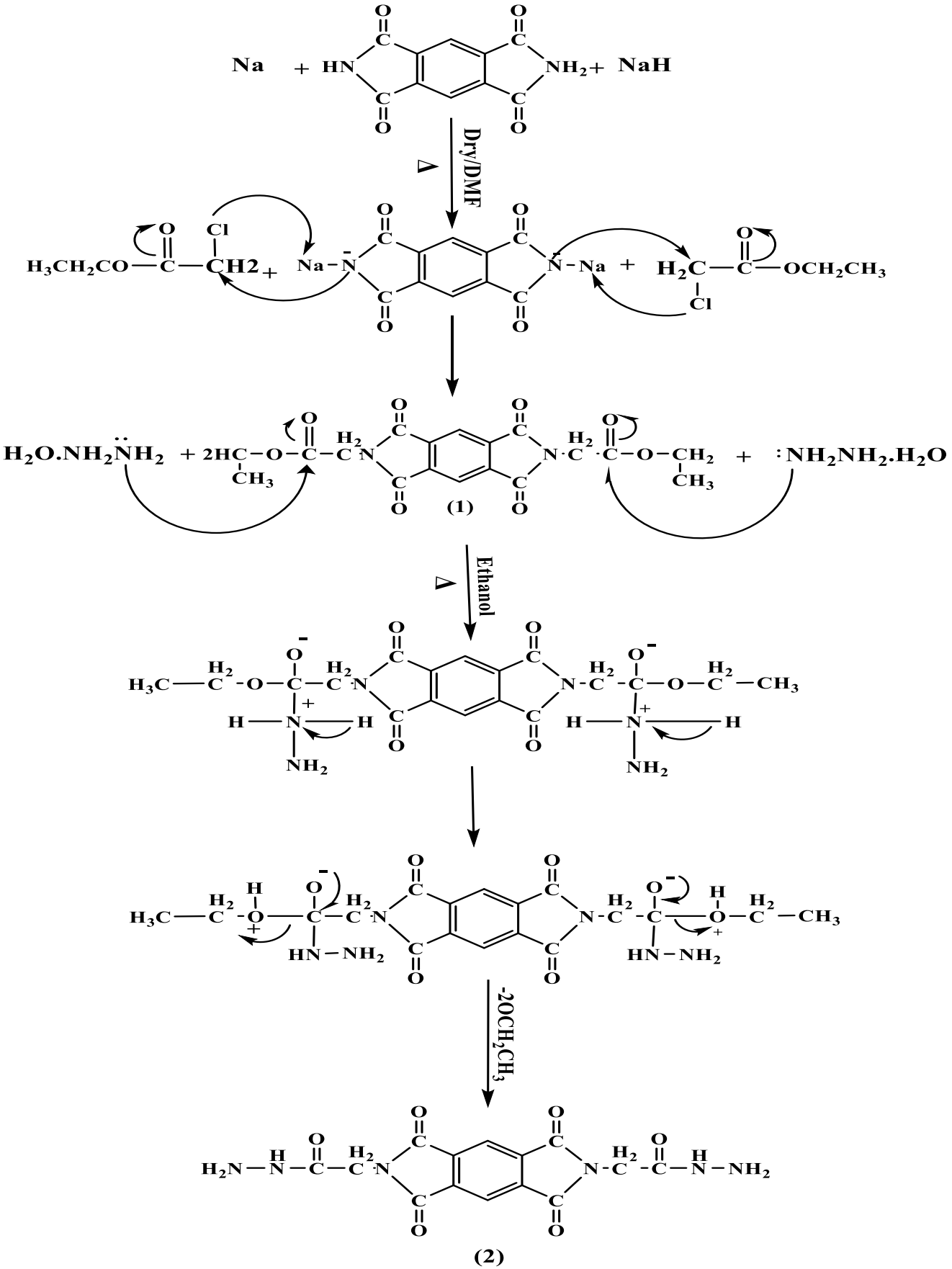
The total antioxidant capacity of the fractions was determined using the phosphomolybdate assay, with ascorbic acid serving as the standard. A 0.1 ml aliquot of the sample solution was combined with 1 ml of the reagent solution, which contained 4 mM ammonium molybdate, 28 mM sodium phosphate, and 0.6 ml of sulfuric acid. After being sealed, the tubes were placed for 90 minutes in a water bath that was set at 95°C. Once the samples had cooled to room temperature, the mixture's absorbance was measured at 765 nm against a blank. A standard blank, containing 1 milliliter of the reagent solution and the appropriate amount of solvent, was incubated under the same circumstances. Ascorbic acid served as the reference value.

3.Results and Discussion

The reaction of pyromellitic diimide with sodium hydride and ethyl chloroacetate yielded compound (1) as shown in scheme 1. The structure was confirmed by the physical properties presented in Table 1. Infrared spectral data disappearance υ(N-H) of amide at 3448 cm^{-1} and showed appearance at 3068 and 2960 cm^{-1} for (C-H aromatic and aliphatic) respectively (1772,1735 and 1720) cm^{-1} for υ (C=O imide and ester). The presence of the ester group resulted in a positive Hydroxamic Acid test [43]. The combination of chemical (1) and hydrazine hydrate yields N, N′-bis (aceto hydrazide) pyromellitic diimide (2). FTIR spectrum data showed absorption at (3328-3288) cm^{-1} for υ (NH_2) asymmetric and symmetric, (3240), (3014,2927), (1722,1714,1670), (1560,1517), (3461,3025) cm^{-1} for υ (N-H), υ (C-H aromatic and alpha), υ (C=O imide and amide), υ (C=C Aromatic) While the ^{1}H-NMR spectra data of compound (1) ppm in DMSO-d_6 solvent show in table 5. 1.25(t,3H, CH_3);3.42(q,2H,O-CH_2);4.20(S,2H, N-CH_2);8.07-8.37(m,2H,Ar-H).^{1}H-NMR spectrum data of compound (2) 3.77(b,2H,CH_3);3.97(s,2H,N-CH_2);8.34-8.94(s,2H,Ar-H);10.72. All details of ^{1}H-NMR and ^{13}C-NMR spectra for compounds (1) and (2) are presented in Table 5.



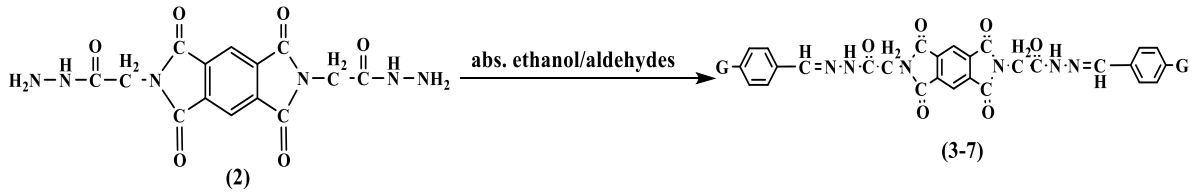
Scheme 1: synthesis of compounds (1-2)



Scheme 2: The mechanism of prepared compounds (1-2) [44]

The Schiff base (3-7) was synthesized by a condensation reaction of compound (2) with different *p*- substituted aromatic aldehydes with a little drop of glacial acetic acid in absolute ethanol to form Schiff base (3-7) in equation 1. Absence of υ(NH_2) (3328-3288) cm^{-1} of compound (2) FT-IR of compounds (3-7). The absorption bands showed at (3280-3230) cm^{-1} for υ (NH) and confirmed the formation of compound (3-7) from the appearance of the bands at (1774-1714), (1658-1654) cm^{-1} for υ (C=O) imide and amide and the absorption of υ (C=N) 1628-1610 cm^{-1} Schiff base. All details of infrared spectral data to compounds (3-7) are in Table 2. ^{1}H-NMR spectrum data of compound (4) 3.61(s,2H,N-CH_2);6.23(s,1H,N=CH);8.11-8.64(m,10H,Ar-H);
10.72(s,1H,NH) while ^{1}HNMRspectrum data of compound (5) 3.64(s,2H,N-CH_2);6.86(s,1H,N=CH);7.69-8.57(m,10H,Ar-H);9.7(s,1H,OH);10.52(s,1H,NH) and the ^{1}H-NMR spectrum data absorption of compound (7) 3.11(s,6H,N-$(CH_3)_2$); 3.84(s,2H-N-CH_2); 6.91(s,1H,N=CH); 7.68-8.92(m,10H,Ar-H); 11.01 (s,1H,NH). All details of ^{1}H-NMR and ^{13}C-NMR spectra for Schiff base compounds (3-7) are presented in Table 5.

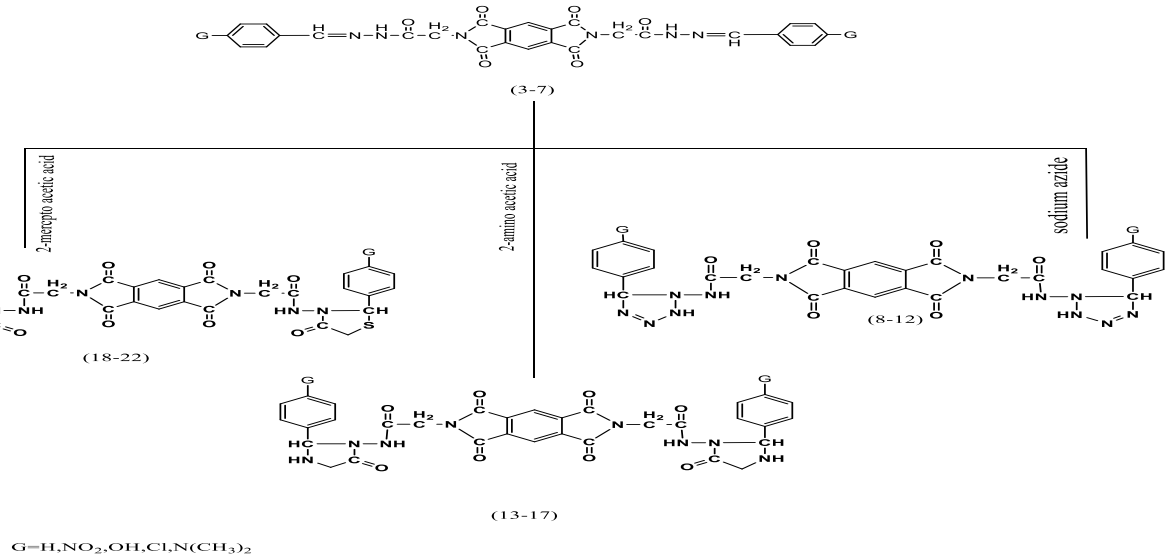
.



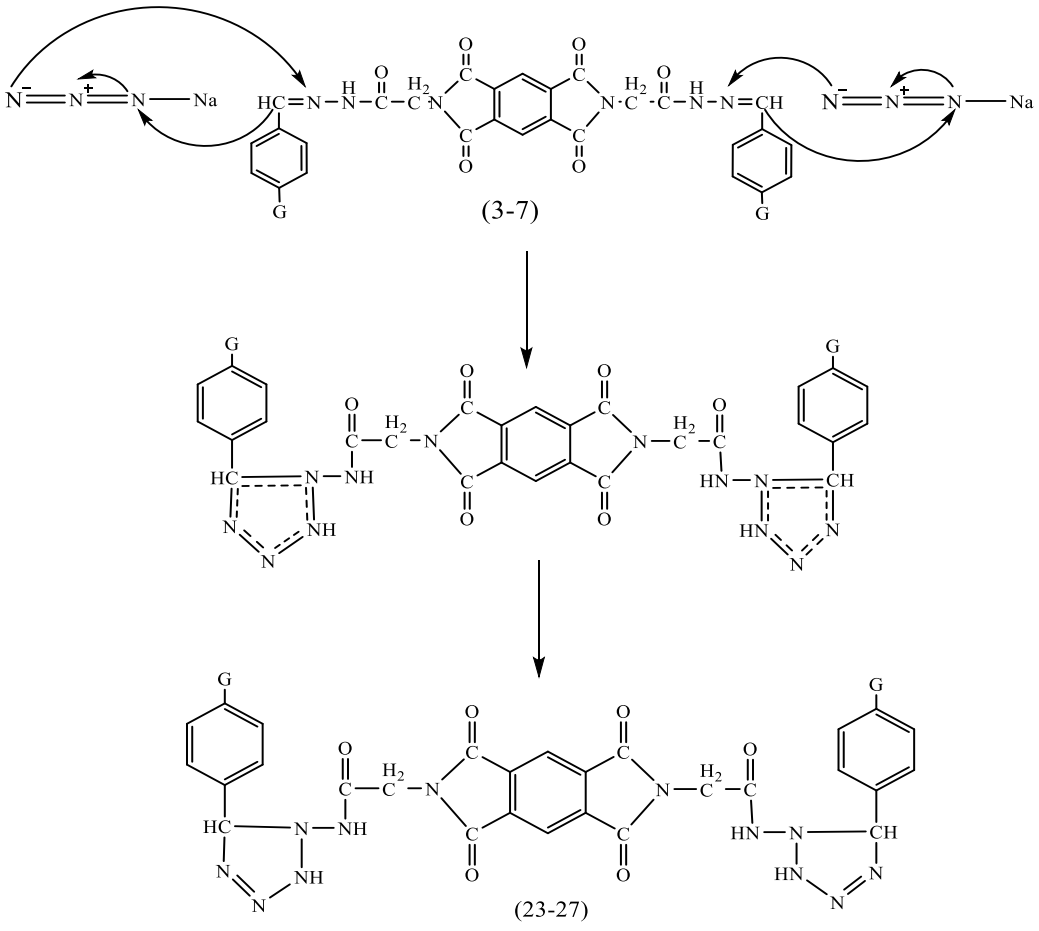
G=NO_2,OH,Cl,N$(CH_3)_2$

Equation (1)

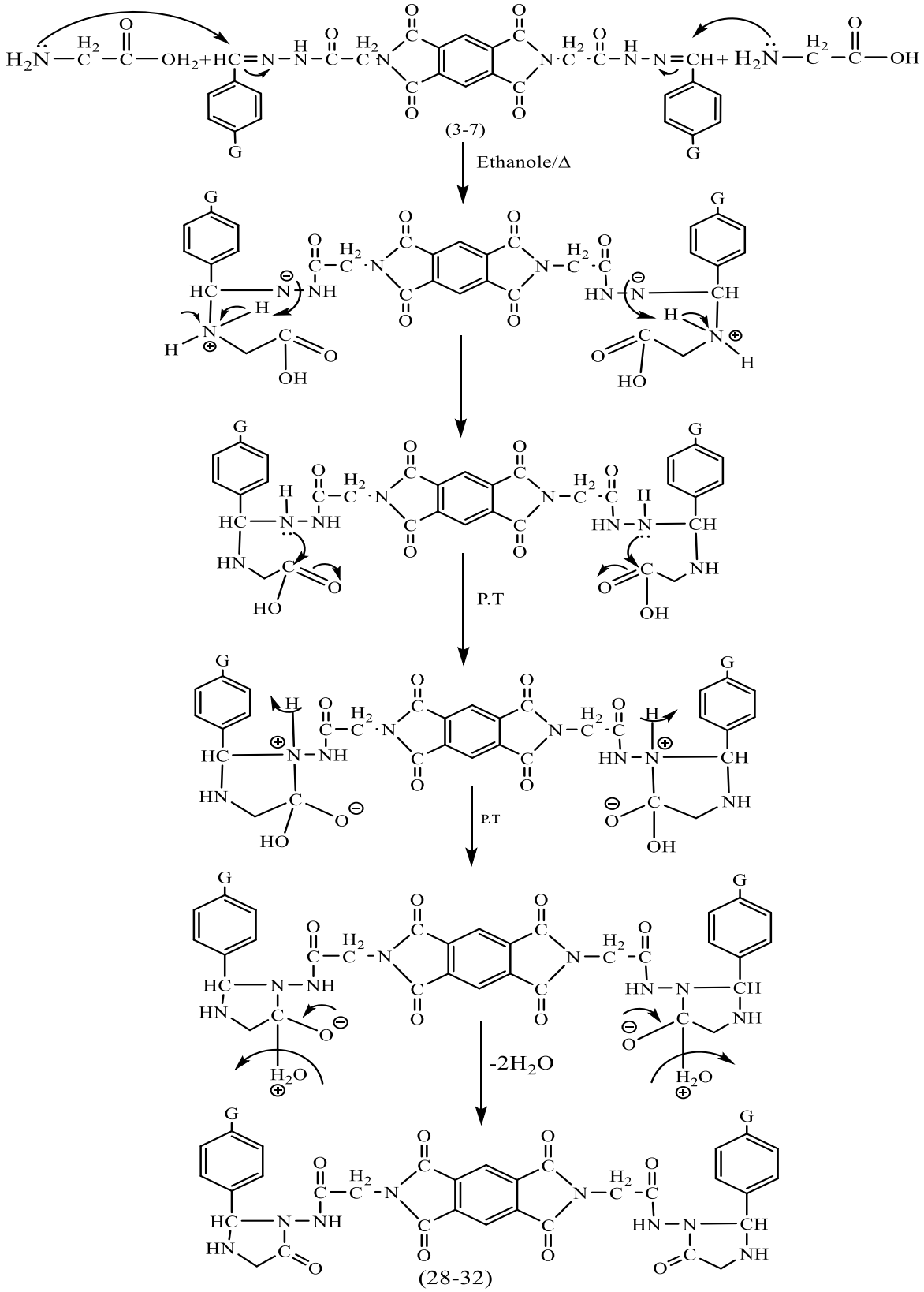
Schiff base (3-7) was reacted with (sodium azide and 2-amino acetic acid) in absolute ethanol as a solvent to produce the compounds (8-12) tetrazoline and (13-17) imidazolidine-4-one respectively while when Schiff base reacted with 2-mercapto acetic acid, the solvent was (THF) to give compounds (18-22) thaiazolidine-4-one. All compounds are shown in scheme 2. The FT-IR data showed the absence of the double bond in the cyclization reaction when Schiff base (3-7) reacted with sodium azide giving synthesis of N, ´N-bis [5-(4-subsituteded phenyl 2H-tetrazoline-1-yl) acetamide] pyromelliticdiimidyl (8-12) showed absorption in FT-IR (3296-3290) cm^{-1} for υ(NH), (1772-1722), (1680-1643) cm^{-1} for υ(C=O) imide and amid. All data for FT-IR show in table 3.^{1}H-NMR of compound (9) showed 3.94(d,1H, CH-tetrazoline ring);4.02(d,1H,NH-tetrazoline-ring);4.61(s,2H,N-CH_2);7.57-8.24(m,10H,Ar-H).10.64(s,1H,C=O-NH).While compound (10) 3.85(d,1H,CH-tetrazoline ring); 4.24(d,1H,NH-tetrazoline ring);4.26(s,2H,N-CH2);6.78-8.53(m,10H,Ar-H);10.50(s,1H,C=O-NH).11.324(s,1H,-OH). And compound (11) 3.95(d,1H,CH-tetrazoline-ring);4.28(d,1H,NH-tetrazoline-ring);4.29(s,2H,N-CH_2);7.66-8.24 (m,10H,Ar-H);10.52(s,1H,C=O-NH). All details about ^{1}H-NMR and ^{13}C-NMR are presented in Table 5.



Scheme 4: synthesis of compounds (8-22).

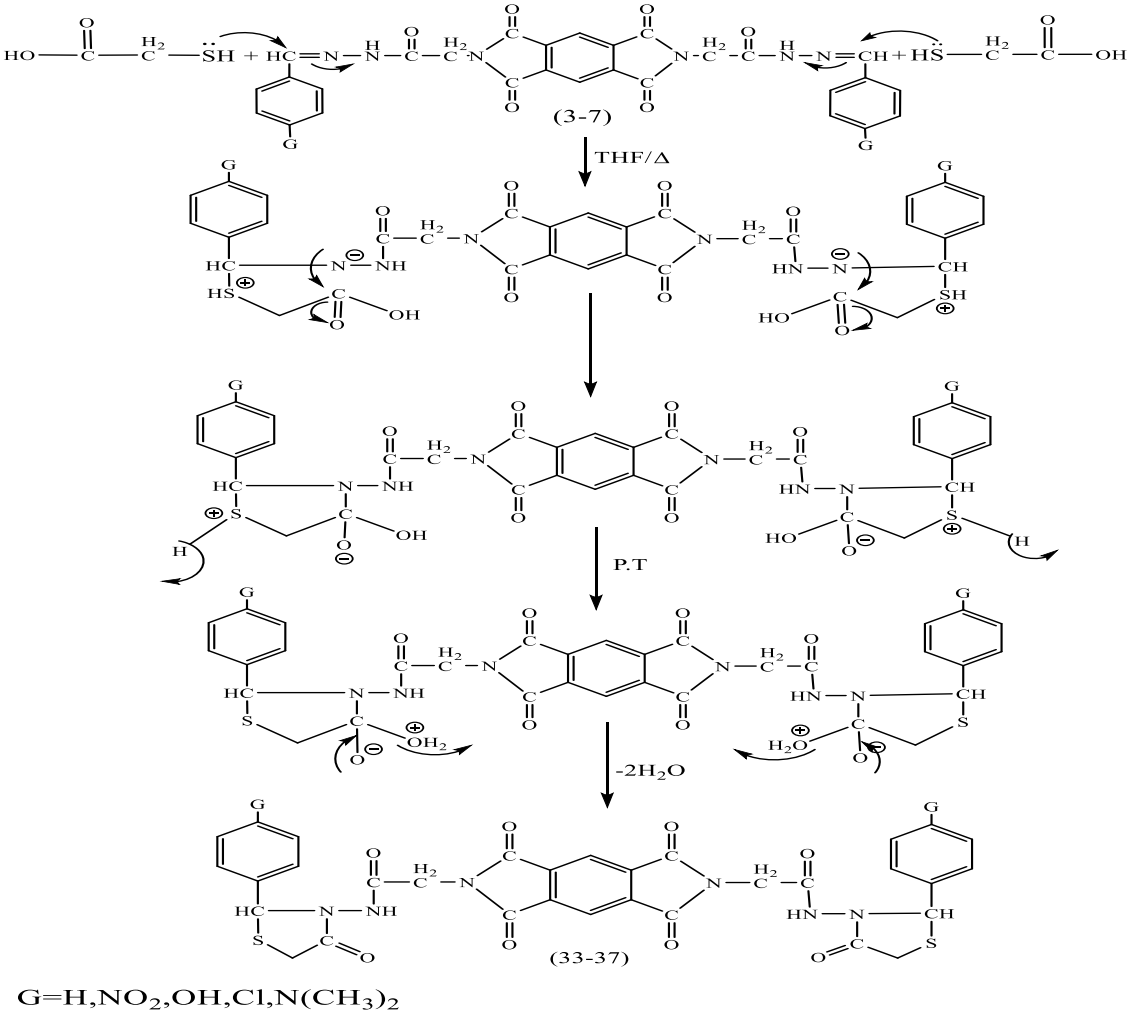


Scheme 5: The mechanism of prepared compounds (8-12) [45]



G=H, NO_2, OH, Cl, $N(CH_3)_2$

Scheme 6: The mechanism of prepared compounds (13-17) [38]

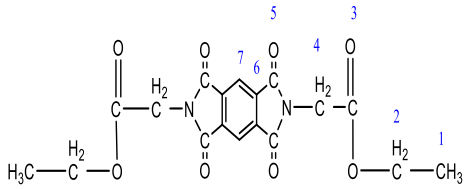
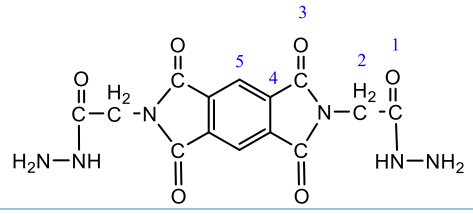
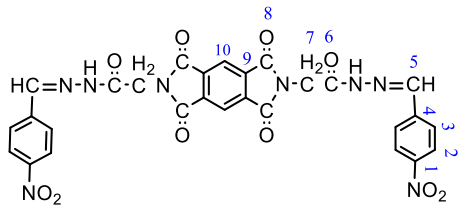
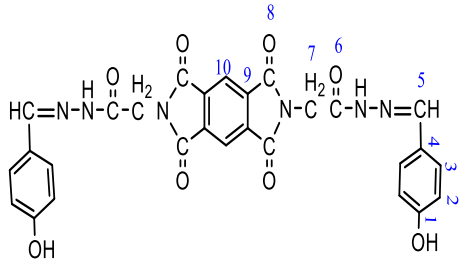
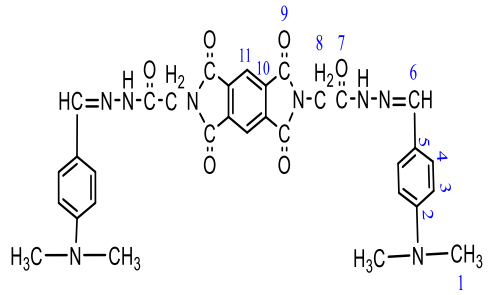
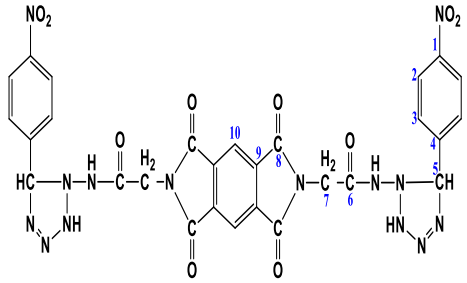


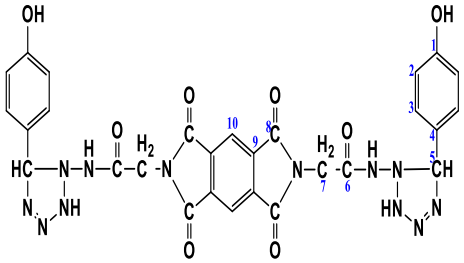
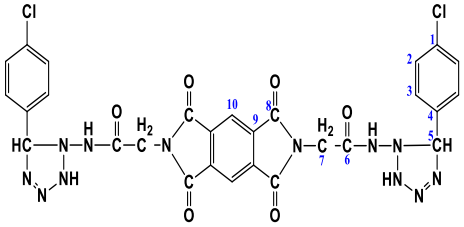
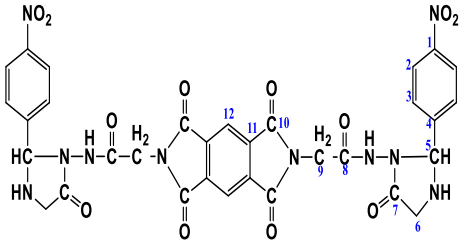
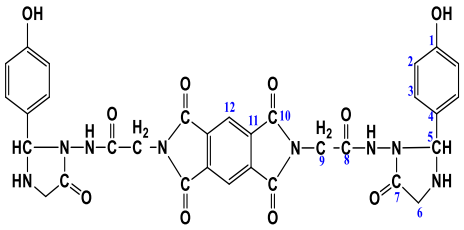
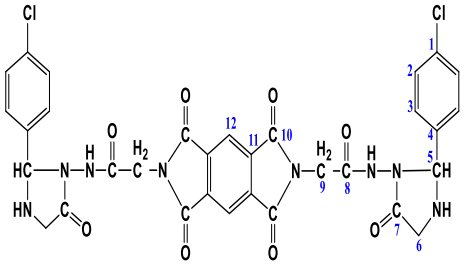
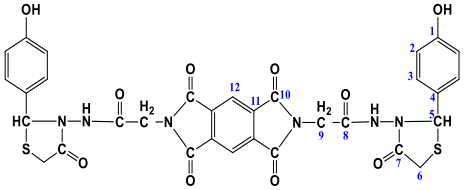
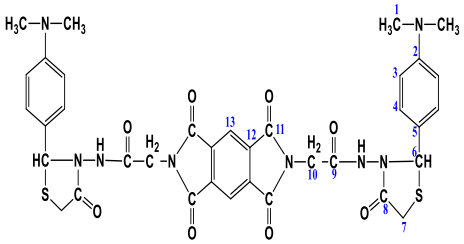
Scheme 7: The mechanism of prepared compounds (18-22) [46]

When Schiff base (3-7) react with 2-amino acetic acid gave synthesis of N, ´N-bis [2-(4-subsituteded phenyl) imidazolidin-5-one-1-yl) acetamide] pyromelliticdiimidyl (13-17) showed absorption in FT-IR (3299-3236) cm^{-1} for υ(NH), (1774-1722), (1677-1652) cm^{-1} for υ(C=O) imide and amide. All data for FT-IR show in table 3.^{1}H-NMR of compound (14) showed 3.51(s,1H,CH-imidazolidine ring); 3.72(s,2H,CH_2); 5.65(d,1H,NH-imidazolidine ring); 5.77(s,2H,-CH_2-imidazoline-ring); 7.67-8.24(m,10H,Ar-H);11.00 (s,1H,C=O-NH).While compound (15) 3.38(s,1H,CH- imidazolidine ring); 3.72(s,2H,CH2); 4.32(d,1H,NH- imidazolidine ring); 5.21(s,2H,-CH_2-imidazoline ring); 7.72-8.10(m,10H,Ar-H);10.03(s,1H,C=O-NH);11.29(s,1H,-OH) and compound (16) 3.39(s,1H,CH-imidazolidine-ring);4.29(d,1H,CH_2);5.25(s,2H,-CH_2-imidazoline ring); 7.36-8.24(m,10H,Ar-H); 7.97 (d,1H,NH- imidazolidine ring);11.29(s,1H,C=O-NH).All details of ^{1}H-NMR and ^{13}C-NMR spectral data are presented in Table 5.

Schiff base (3-7) react with 2-mercpto acetic acid gave synthesis of N, ´N bis [2-(4-substiuted phenyl)-thiazolidin-4-one-3-yl acetamide] pyromellitic dimidyl (18-22) showed absorption in FT-IR (3299-3292) cm-1 for υ(NH),(1785-1714),(1686-1654)cm^{-1} for υ(C=O)imide and amide. All data for FT-IR are presented in Table 3. ^{1}H-NMR of compound (20) showed 3.80(s,1H, CH- thiazolidine ring);4.60(s,2H,N-CH2);5.92(s,1H,S-CH_2-thiazolidine ring);6.73-8.12(m,10H,Ar-H);10.90(s,1H,C=O-NH);11.27(s,1H,-OH). And compound (22) showed 3.05(s,6H,2-N-CH_3);3.73(s,1H,CH-thiazolidine-ring);4.65(s,2H,N-CH_2);5.86(s,2H,S-CH_2-thiazolidine);6.72-8.24 (m,10H,Ar-H); 11.28(s,1H,C=O-NH). All details of ^{1}H-NMR and ^{13}C-NMR spectral data are presented in Table 5.

Table 5: ^{1}H-NMR and ^{13}C-NMR spectral data ($^{\delta}$ppm).

No	Structure	^{1}H-NMR spectral data ($^{\delta}$ppm)	13C-NMR spectral data ($^{\delta}$ppm)
1		1.25(t,3H, CH_3); 3.42(q,2H, O-CH_2); 4.20(S,2H, N-CH_2); 8.07-8.37(m,2H,Ar-H).	14.42(C1); 40.77(C2); 62.06(C4); 125.80(C7); 136.82(C6,C8) ;165.82(C5) ;168.01(C3).
2		3.77(b,2H, NH_2); 3.97(S,2H, N-CH_2); 8.34-8.94(s,2H, Ar-H); 10.72(t,1H,NH).	62.00(C2); 125.55(C5); 135.56(C4,C6); 163.86(C3); 170.01(C1).
4		3.61(s,2H, N-CH_2); 6.23(S,1H, N=CH); 8.11-8.64(m,10H, Ar-H); 10.72(S,1H,NH).	56.45(C7); 123.93(C5); 124.30(C2,C3); 125.42(C10); 135.71(C9); 139.87(C4); 144.01(C5);153.11(C1); 163.54(C8); 171.11(C6).
5		3.64(s,2H, N-CH_2); 6.86(s,1H, N=CH); 7.69-8.57(m,10H, Ar-H); 9.7(s,1H, OH); 10.52(s,1H,NH).	60.21(C7); 116.22(C2); 125.55(C10)128..92(C4); 130.56(C3) 135.53(C9); 144.01(C5); 160.77(C1); 168.24(C8);171.11(C6).
7		3.11(s,6H, N-$(CH_3)_2$); 3.84(s,2H, N-CH_2); 6.91(s,1H, N=CH); 7.68-8.92(m,10H,Ar-H); 11.01(s,1H,NH).	44.46(C1); 60.21(C8); 125.55(C11); 131.58(C3,C4,C5); 133.17(C10); 153.60(C2,C6); 163.43(C9); 170.0(C7).
9		3.94(d,1H,CH-tetrazoline ring); 4.02(d,1H,NH-tetrazoline ring); 4.61(s,2H,N-CH_2); 7.57-8.24(m,10H,Ar-H). 10.64(s,1H,C=O-NH).	50.10(C7);96.89(5); 124.64-139-90 (C2,CC3,C9,C10); 146.00(C4);153.64(C1); 168.23(C8);170.36(C6).

10		3.85(d,1H,CH-tetrazoline ring); 4.24(d,1H,NH-tetrazoline ring); 4.26(s,2H,N-CH_2); 6.78-8.53(m,10H,Ar-H); 10.50(s,1H,C=O-NH). 11.324(s,1H,-OH).	50.10(C7);96.89(C5); 115.77(C2);124.80-139.90(C3,C4,C9,C10); 157.34(C1);168.23(C8); 170.36(C6).
11		3.95(d,1H,CH-tetrazoline ring); 4.28(d,1H,NH-tetrazoline ring); 4.29(s,2H,N-CH_2); 7.66-8.24(m,10H,Ar-H); 10.52(s,1H,C=O-NH).	50.11(C7);96.65(C5); 127.63-1 (C1,C2,C3,C4,C9,C10); 144.55(C4);168.33(C8); 170.38(C6).
14		3.51(s,1H,CH-imidazolidine ring);3.72(s,2H,CH_2); 5.65(d,1H,NH-imidazolidine ring);5.77(s,2H,-CH_2 imidazoline);7.678.24(m,10H,Ar-H); 11.00(s,1H,C=O-NH).	50.21(C9);54.76(C6); 77.97(C5);125.76-146.85 (C1,C2,C3,C4,C9,C10); 168.24(C7,C10);170.33(C8).
15		3.38(s,1H,CH- imidazolidine); 3.72(s,2H,CH_2); 4.32(d,1H,NH- imidazolidine ring); 5.21(s,2H,-CH_2-imidazoline ring); 7.72-8.10(m,10H,Ar-H); 10.03(s,1H,C=O-NH); 11.29(s,1H,-OH).	50.21(C9);54.76(C6); 77.97(C5);115.23-156.21(C1,C2,C3,C4,C11 ,C12); 168.24(C7,C10); 170.33(C8).
16		3.39(s,1H,CH- imidazolidine ring); 4.29(d,1H,CH2); 5.25(s,2H,-CH2-imidazoline ring); 7.36-8.24(m,10H,Ar-H); 7.97 (d,1H,NH- imidazolidine ring);11.29(s,1H,C=O-NH).	50.21(C9);54.39(C2); 77.97(C5);118.89-136.51(C2,C3,C4,C11,C12);154.55(C1);169.23(C7, C10);172.89(C8).
20		3.80(s,1H,CH- thiazolidine ring); 4.60(s,2H,N-CH_2); 5.92(s,1H,S-CH_2-thiazolidine ring);6.73-8.12(m,10H,Ar-H); 10.90(s,1H,C=O-NH); 11.27(s,1H,-OH).	50.12(C9);54.24(C6); 77.95(C5);115.75-157.96 (C1,C2,C3,C4,C11,C12); 167.56(C7,C10); 171.05(C8).
22		3.05(s,6H,2-N-CH_3); 3.73(s,1H,CH- thiazolidine ring); 4.65(s,2H,N-CH_2); 5.86(s,2H,S-CH_2-thiazolidine); 6.72-8.24(m,10H,Ar-H); 11.28(s,1H,C=O-NH).	41.37(C1)50.01(C2); 61.57(C7);77.71(C6); 112.18(C3);123.89-149.23(C2,C4,C5,C12,C13); 169.23(C11);169.72(C8); 171.22(C9).

3.1Quantitative measure of antioxidant capacity.

The overall antioxidant potential of all chemicals generated by certain compounds was determined using the phosphor molybdenum technique. This method is based on the synthetic chemicals' capacity to change colorless 70 Molybdenum (VI) into colorful Molybdenum (V) by forming a green phosphate - Mo(V) complex at an acidic pH. Compared to ascorbic acid, the compound was shown to have substantially better antioxidant activity. Except for compounds (12, 13, and 16) that have strong antioxidant activity as indicated in table 6, the newly synthesized pyromellitic diimide derivatives (9–22) show a modest antioxidant ability against decreasing Mo (VI) to Mo(V).

Table 6: Assessment of antioxidant capacity using the phosphor-molybdenum technique.

Sample No.	150 µg/mL		100 µg/mL		50 µg/mL	
	Absorbance	Conc.	Absorbance	Conc.	Absorbance	Conc.
8	0.132 ± 0.004	12.432	0.076 ± 0.004	2.874	0.021 ± 0.003	2.973
9	0.164 ± 0.004	24.770	0.097 ± 0.004	14.696	0.032 ± 0.003	4.848
10	0.147 ± 0.003	22.308	0.087 ± 0.004	13.105	0.028 ± 0.003	4.204
11	0.131 ± 0.004	19.771	0.060 ± 0.004	9.090	0.021 ± 0.003	3.144
12	0.200 ± 0.004	30.300	0.121 ± 0.003	18.369	0.051 ± 0.001	7.727
13	0.182 ± 0.003	27.535	0.110 ± 0.004	16.703	0.047 ± 0.002	7.083
14	0.147 ± 0.004	22.233	0.069 ± 0.002	10.416	0.032 ± 0.003	4.848
15	0.127 ± 0.005	19.203	0.048 ± 0.002	7.234	0.000 ± 0.000	0.000
16	0.198 ± 0.006	30.035	0.088 ± 0.003	13.370	0.053 ± 0.003	7.499
17	0.160 ± 0.004	24.240	0.078 ± 0.003	11.855	0.039 ± 0.003	5.757
18	0.103 ± 0.003	15.529	0.050 ± 0.001	7.575	0.000 ± 0.000	0.000
19	0.084 ± 0.004	12.650	0.018 ± 0.004	2.765	0.000 ± 0.000	0.000
20	0.094 ± 0.004	14.279	0.028 ± 0.004	4.280	0.000 ± 0.000	0.000
21	0.122 ± 0.003	18.445	0.059 ± 0.005	8.901	0.014 ± 0.003	2.083
22	0.139 ± 0.003	21.021	0.068 ± 0.001	10.340	0.026 ± 0.003	3.977
Blank	0.004 ± 0.002					
Control	0.133 ± 0.002	20.11	0.124 ± 0.002	18.75	0.144 ± 0.002	17.31

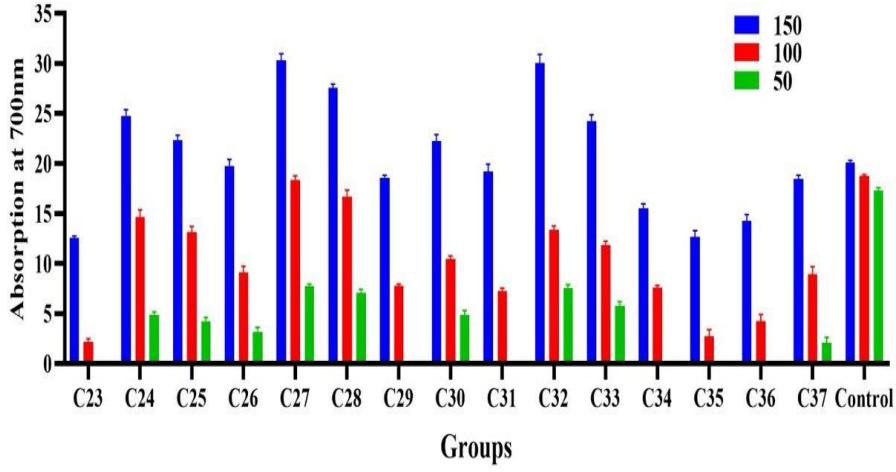


Figure 1: Antioxidant for compound (8-22).

Conclusion

In summary, this study involved the reaction of pyromellitic diimide with sodium hydroxide to produce compound 1, N, N'-bis (ethyl acetate) pyromellitic diimide. Subsequent reaction of compound 1 with hydrazine hydrate yielded compound 2, N, N'-bis(acetohydrzaide) pyromellitic diimide. Finally, various para-substituted aromatic aldehydes were reacted with compound 2 to synthesize Schiff bases 3-7. Synthesis of N, ´N-bis [5-(4-subsituteded phenyl 2H-tetrazoline-1-yl) acetamide] pyromelliticdiimidyl (8-12) obtained from react Schiff bases (3-7) with sodium hydrate, while N, ´N-bis [2-(4-subsituteded phenyl) imidazolidin-5-one-1-yl) acetamide] pyromelliticdiimidyl (13-17) form from react Schiff base (3-7) with 2-amino acetic acid. And Synthesis of N, ´N bis [2-(4-substiuted phenyl)-thiazolidin-4-one-3-yl acetamide] pyromellitic dimidyl (18-22) obtained by reacting Schiff bases (3-7) with 2-mercapto acetic acid. Afterwards, the newly synthesized compounds tetrazoline-1-yl derivatives, imidazolidin-4-one derivatives, thiazolidin-4-one derivatives showed variable measured biological activity of anti-oxidant activity. In addition, the results showed the compounds (12,13 and 16) had good antioxidant activity.

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