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İÇİNDEKİLER

SYNTHESIS OF BENZO-15-CROWN-5 CONTAINING TWO VIC-DIOXIMES AND SOME TRANSITION METAL COMPLEXES[1]

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Ali İhsan PEKACAR[3]

1. INTRODUCTION

Vic-dioximes are organic compounds that contain two oxime (–C=NOH) groups attached to adjacent carbon atoms (vicinal position) in the molecular structure. These compounds are typically derived from dicarbonyl compounds where each carbonyl group is converted into an oxime. Vic-dioximes are commonly used as ligands in chemistry because they can form stable complexes with transition metals. Tschugaeff was the first to identify the vic-dioxime-metal complex known as bis-dimethylglyoxime of nickel (II), which paved the way for a field of coordination chemistry that has been extensively studied throughout the last century [1]. Uhling et al. were the first to prepare vic-oxime quasimacrocyclic complexes [2]. Recently, a copper-oxime complex has been employed to oxidize anthracene [3]. Metal-containing oxime complexes are also in use. For example, recent research has explored the use of vic-dioxime

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1 Derived from Rifat BATTALOĞLU's PhD Thesis.

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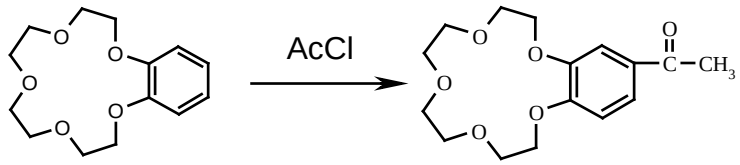
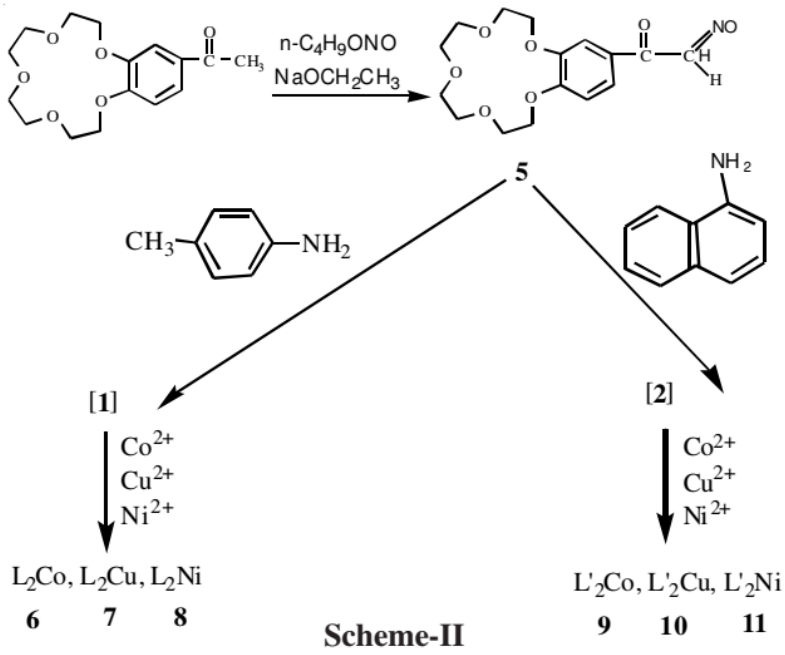
complexes of platinum as potential antitumor agents in chemotherapy [4-7]. Additionally, these complexes are utilized in column packing materials for chromatographic separation of nucleotides and nucleosides, particularly after being bonded to natural resins as functional groups [8]. Meanwhile, the acetylation of benzo-15-crown-5 produces 4'-acetyl-benzo-15-crown-5 (Scheme-1), a crucial intermediate for various technological applications, including complexon for radioactive cation separation, ionophore antibiotics, and phase transfer catalysts [9].



Scheme 1

The acetylation reaction can be carried out using a Friedel-Crafts type process, although this method presents some challenges [10]. Due to these issues, acetylation was instead achieved using polyphosphoric acid as a catalyst. 4'-acetyl-benzo-15-crown-5 was then transformed into an iso-nitroso derivative using n-butylnitrite and sodium ethoxide [11-12]. As a novel approach to synthesizing p-toluidino-benzo-15-crown-5 glyoxime (1) and N-(1-naphthyl)amino-benzo-15-crown-5 glyoxime (2), we synthesized benzo-15-crown-5-chlorooxime (5) (Scheme 3).



Scheme-II

In this study, the complexes [1] and [2] of Cu (II), Co (II), and Ni (II) were investigated, and their structures were confirmed using FT-IR and mass spectroscopy. However, some complexes could not be analyzed by NMR spectroscopy due to solubility issues.

2. EXPERIMENTAL

2.1. Reagents and Techniques

Tetraethyleneglycol was acquired from Fluka and purified following the procedure outlined in the literature [13]. The other chemicals were sourced from Merck. Infrared spectra were obtained using a Jasco FTIR spectrometer with KBr discs and recorded in cm^{-1} units. Elemental analyses were conducted using a Leco CHNS-932 analyzer. Proton NMR spectra were

recorded on a Bruker 250 MHz spectrometer with TMS as the internal standard. Mass spectra were acquired with a VG-2APSPEC spectrometer, with an ion source temperature set at 240°C.

2.2. Synthetic Procedures

2.2.1. Tetraethyleneglycoldicholoride

Tetraethyleneglycoldichloride was synthesized by reacting tetraethylene glycol with $SOCl_2$, following the procedure described in the literatüre [14].

2.2.2. Benzo-15-crown-5

Benzo-15-crown-5 was synthesized by reacting 1,2-dihydroxybenzene with tetraethyleneglycoldichloride, following the procedure outlined in the literature [14].

2.2.3. 4'-acetyl-benzo-15-crown-5

4'-Acetyl-benzo-15-crown-5 was synthesized by reacting benzo-15-crown-5 with polyphosphoric acid, following the published procedure [15].

2.2.4. 4'-(isonitroso)-acetyl-benzo-15-crown-5

4'-(Isonitroso)-acetyl-benzo-15-crown-5 (4) was synthesized by reacting 4'-acetyl-benzo-15-crown-5 with sodium and n-isonitrosobutyl, following the published procedure [16-17].

2.2.5. Benzo-15-crown-5-glyoxime (3)

A solution containing sodium acetate (5 g, 60.98 mmol) and hydroxylamine hydrochloride (6.5 g, 93.53 mmol) in 50 ml

of water was prepared. Over the course of 1 hour, 4'-(isonitroso)acetyl-benzo-15-crown-5 (17 g, 50 mmol) in ethanol was gradually added to this mixture with vigorous stirring. The reaction mixture was then refluxed and stirred for an additional 4 hours. The reaction progress was monitored using TLC. After completion, the mixture was allowed to cool to room temperature. White crystals were collected by filtration and washed with chloroform. The crude product was purified by column chromatography, eluting with $CHCl_3/CCl_4$ (1:2), yielding 3 as white crystals (14.3 g, 81%). The product had a melting point >142°C and the following analytical data: Found: C, 54.17; H, 6.34; N, 7.28. For $C_{16}H_{22}N_2O_7$, the expected values are C, 54.13; H, 6.20; N, 7.89. FTIR (KBr) showed peaks at 3460, 3040, 1690, 1540, 1050, 1020, and 820 cm^{-1}. NMR (250 MHz, DMSO-d_6) δ: 6.9 (2H, m, Ph), 6.3 (1H, s, Ph), 12.0 (1H, s, Ph CNOH, CHNOH), 10.6 (1H, s, Ph CNOH, CHNOH), 8.5 (1H, s, Ph CNOHCHNOH), 3.8-2.8 (16H, m, CH_2-O).

2.2.6. Benzo15-crown-5-choloroglyoxime

This compound was synthesized following a modified method from Ponzio. Benzo-15-crown-5-glyoxime (5) (5 g, 14.12 mmol) was dissolved in 150 ml of freshly distilled $CHCl_3$. Chlorine gas was introduced slowly over 1 hour while stirring at 25°C. The reaction progress was monitored by TLC. After the reaction, excess Cl_2 was removed by adding 200 ml of distilled water. The $CHCl_3$ layer was dried over $MgSO_4$ and then evaporated. The crude product was purified by column chromatography using $CHCl_3/CCl_4$ (1:2) as the eluent, yielding 5 (3.88 g, 71%). The product had a melting point >149°C and the following analytical data: Found: C, 49.02; H, 5.23; N, 7.09. For $C_{16}H_{21}N_2O_7Cl$, the expected values are C, 49.36; H, 5.40; N, 7.20. FTIR (KBr) showed peaks at 3320, 3100, 1660, 1580, 1100, 1040, and 780 cm^{-1}. NMR (250 MHz, DMSO-d_6) δ: 6.9

(2H, m, Ph), 6.3 (1H, s, Ph), 12.0 (1H, s, Ph CNOH, NOHCl), 10.8 (1H, s, Ph CNOH, CNOHCl), 8.5 (1H, s, Ph CNOHCHNOH), 3.8-3.2 (16H, m, CH_2-O).

2.2.7. Benzo15-crown-5-p-toluidino- glyoxime (1)

Benzo-15-crown-5-chloroglyoxime (5) (1.3 g, 3.33 mmol) was dissolved in 50 ml of ethanol. A solution of p-aminotoluene (0.358 g, 3.35 mmol) in 30 ml of ethanol was added dropwise over 0.5 hours while stirring at 25°C. The reaction mixture was stirred for an additional 3 hours. The progress of the reaction was monitored using TLC. Afterward, 100 ml of distilled water was added, and the mixture was extracted with $CHCl_3$ (3 × 50 ml). The organic layer was dried over $MgSO_4$, filtered, and the solvent was evaporated. The residue was purified by column chromatography using a petrol ether/$CHCl_3$ (1:1) mixture as the eluent, yielding 1 as a dark yellow solid (1.19 g, 78%). The product had a melting point >132°C and the following analytical data: Found: C, 59.78; H, 6.01; N, 8.99. For $C_{23}H_{29}N_3O_7$, the expected values are C, 60.07; H, 6.31; N, 9.14. FTIR (KBr) showed peaks at 3380, 2860, 1640, 1560, 1180, 1170, 970, and 740 cm^{-1}. NMR (250 MHz, DMSO-d_6) δ: 7.00-6.30 (7H, m, Ph), 11.80 (1H, s, PhCNOH, CNOH-), 8.40 (1H, s, Ph-NH), 4.00-3.00 (16H, m, CH_2-O), 4.40 (3H, broad, s, CH_3-Ph).

2.2.8. Synthesis of metal complexes (6-8) from benzo-15-crown-5-p-toluidino-glyoxime (1)

Compound (1) (0.459 g, 1 mmol) was dissolved in 30 ml of methanol, and $Ni(CH_3COO)_2 \cdot 4H_2O$ (0.249 g, 1 mmol) was added to the mixture. The solution was boiled for 2 hours. After cooling to room temperature, a dark green powder was obtained. The resulting solid was washed several times with hot methanol to remove any unreacted metal salt. Further purification was

carried out by column chromatography on alumina, using a methanol/chloroform (1:20) mixture as the eluent. The purified dark green solid (0.79 g, 82%) had a melting point >132°C. Analytical data for the compound is as follows: Found: C, 56.38; H, 5.52; N, 8.45. For $(C_{23}H_{28}O_7)_2Ni$ (6), the expected values are C, 56.58; H, 5.74; N, 8.60. FTIR (KBr) exhibited peaks at 3290, 3090, 1670, 1650, 1600, 1260, 1200, 950, and 750 cm^{-1}. NMR (250 MHz, DMSO-d_6) δ: 7.20-6.50 (14H, m, aromatic), 8.01 (2H, s, NH), 3.80-3.20 (32H, m, CH_2-O), 13.80 (2H, s, OH---O), 4.40 (6H, broad, s, -CH_3).

The same procedure was employed to synthesize L_2Cu (7) and $L_2Co(H_2O)_2$ (8).

Compound (7) was obtained as a claret red solid (0.80 g, 81%), with a melting point >192°C. Analytical data: Found: C, 56.04; H, 5.37; N, 8.48. For $(C_{23}H_{28}N_3O_7)_2Cu$ (6), the expected values are C, 56.35; H, 5.72; N, 8.59. FTIR (KBr) showed peaks at 3320, 3100, 1700, 1630, 1540, 1180, 1150, 960, and 750 cm^{-1}.

Compound (8) was obtained as a brown solid (0.78 g, 77%), with a melting point >181°C. Analytical data: Found: C, 54.48; H, 6.01; N, 8.12. For $(C_{23}H_{28}N_3O_7)_2Co(H_2O)_2$, the expected values are C, 54.49; H, 5.93; N, 8.30. FTIR (KBr) exhibited peaks at 3330, 3100, 1700, 1630, 1580, 1210, 1200, 1000, and 790 cm^{-1}.

2.2.9. N-(1-Naphtyl)amino-benzo-15-crown-5-glyoxime (2)

Benzo-15-crown-5-chloroglyoxime (5) (1 g, 2.58 mmol) was dissolved in 50 ml of ethanol. A solution of 1-amino-naphthalene (0.369 g, 1 mmol) in 30 ml of ethanol was added dropwise over 0.5 hours while stirring at 25°C. The reaction

mixture was stirred for an additional 3 hours. The progress of the reaction was monitored using TLC. After drying under vacuum at 25°C, a pink powder was obtained. The solid was filtered and washed several times with water to remove any unreacted compounds. The crude product was recrystallized from a mixture of ethanol and water (1:2), resulting in a pink solid (1.02 g, 80%). The product had a melting point >112°C and the following analytical data: Found: C, 62.76; H, 5.73; N, 8.24. For $C_{26}H_{29}N_3O_7$, the expected values are C, 62.94; H, 5.85; N, 8.47. FTIR (KBr) showed peaks at 3420, 3140, 1670, 1590, 1240, 1220, and 810 cm^{-1}. NMR (250 MHz, DMSO-d_6) δ: 6.80-6.20 (10H, m, aromatic), 11.90 (s, Ph-CNOH, CNOH-), 10.60 (s, Ph-CHNOH-CNOH-), 8.20 (1H, s, Ph-CNOH-CNOH-NH-naphthyl), 3.90-3.00 (16H, m, -CH_2-O).

2.2.10. Synthesis of metal complexes (9-11) from N-(1-naphty) amino-benzo-15-crown-5-glyoxime (2)

Compound (2) (0.300 g, 0.61 mmol) was dissolved in 30 ml of methanol, and $Ni(CH_3COO)_2 \cdot 4H_2O$ (0.163 g, 1 mmol) was added to the mixture. The solution was boiled for 1 hour. After cooling to room temperature, a dark green powder was obtained. The resulting solid was washed several times with hot methanol to remove any unreacted metal salt. Further purification was carried out by column chromatography on natural alumina, using a methanol/chloroform (1:20) mixture as the eluent. The purified dark green solid (0.51 g, 81%) had a melting point >216°C. Analytical data: Found: C, 59.94; H, 5.43; N, 7.92. For $(C_{26}H_{28}O_7)_2Ni$, the expected values are C, 59.55; H, 5.34; N, 8.02. FTIR (KBr) exhibited peaks at 3380, 3070, 1680, 1640, 1530, 1200, 1180, 940, and 800 cm^{-1}. The same procedure was used to synthesize L'_2Cu (10) and $L'_2Co(H_2O)_2$ (11).

Compound (10) was obtained as a claret red solid (0.50 g, 80%) with a melting point >192°C. Analytical data: Found: C, 52.44; H, 5.07; N, 7.82. For $(C_{26}H_{28}N_3O_7)_2Cu$, the expected values are C, 52.49; H, 5.33; N, 7.99. FTIR (KBr) showed peaks at 3410, 3120, 1680, 1650, 1550, 1190, 1120, 1040, and 790 cm^{-1}.

Compound (11) was obtained as a brown solid (0.53 g, 82%) with a melting point >202°C. Analytical data: Found: C, 51.10; H, 5.34; N, 7.87. For $(C_{26}H_{28}N_3O_7)_2Co(H_2O)_2$, the expected values are C, 50.95; H, 5.54; N, 7.75. FTIR (KBr) exhibited peaks at 3400, 3090, 1690, 1660, 1600, 1190, 1130, 1060, and 820 cm^{-1}.

3. RESULT AND DISCUSSION

In this study, we explored the potential for exchanging acids in glyoxime (3) by first reacting it with chlorine gas (Cl_2) and then with p-amino toluene and 1-amino-naphthalene. The reaction of the resulting product (5) with these amines yielded benzo-15-crown-5-p-toluidino-glyoxime (1) and N-(1-naphthyl)-amino-benzo-15-crown-5-glyoxime (2) under moderate and convenient conditions.

Cu(II) complexes (8) and (11) were prepared from (1) and (2), respectively. Spectral data for the newly synthesized compounds (1), (2), and their complexes are consistent with their proposed structures. For instance, in compound (1), we observed C=N at 1640 cm^{-1}, N-O at 970 cm^{-1}, O-H at 3380 cm^{-1}, C-O-C at 1180 cm^{-1}, and aromatic C-H at 2860 cm^{-1}. The IR spectra of 1 and its metal complexes (M=Co, Cu, Ni) were similar, with the 2860 cm^{-1} peak disappearing in each case. In the ^{1}H-NMR spectrum of 1, the ether protons of the crown ether

group appeared at 2.80-3.80 ppm, consistent with literature values for compounds containing benzo-15-crown-5. The aromatic protons of the benzo-15-crown-5 moiety and phenyl protons were observed at 6.30-7.20 ppm, similar to the corresponding signals in compound 1.

These observations suggest that the compounds are consistent with their proposed structures and do not contain isomeric forms. Oxime-containing ligands typically stabilize Ni(III) and Ni(IV), as well as Cu(III), often with six donor atoms for nickel and four for copper. Our study examined Ni(II) and Cu(II) complexes with ligands having five donor atoms. The complexes exhibited square planar geometry for Ni(II) and Cu(II), while Co(II) complexes displayed octahedral geometry, as indicated by the broad O-H band at 3200-3400 cm^{-1} in their IR spectra. The mass spectrum of compound (8) showed a molecular ion peak at m/z 1011.233, confirming its structure.

This study demonstrates the practical applicability of the synthetic procedure for creating versatile crown ether complexes with various functional groups.

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DETERMINATION OF CHEMICAL COMPOSITIONS AND ANTIOXIDANT ACTIVITIES OF *PASSIFLORA INCARNATA* EXTRACTS

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1. INTRODUCTION

Passiflora species occupy an important place in both conventional and modern medicine. It is a good source of antioxidants and immune modulators with tremendous therapeutic potential (Dhavan, Dhavan, & Sharma, 2004). Passiflora Incarnata (*P. incarnata*) is a plant belonging to the Passifloraceae family. Among Passiflora species, the one that is medically valuable and used in pharmacy is "P. *incarnata*".

P. İncarnata is used for treatment of anxiolytic, sedative, anticolvunsant, analgesic and also whooping cough, bronchitis and asthma (Ingale & Kasture, 2014). Moreover, many biological activities including anticancer, antioxidant, antiproliperative, sedative, antihypertensive, analgesic (Dhavan, Dhavan, & Sharma, 2004; Alves et al., 2020; Rodríguez et al., 2021; Aguillón et al., 2013; Silva et al., 2014; Villada et al.,

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2023). Extracts of the leaves of various species of Passiflora plant are used in traditional medicine to treat disorders of the nervous system such as migraine and insomnia (Ayres et al., 2015; Zibadi &Watson, 2024). The presence of secondary metabolites, including phenolic and flavonoid compounds, alkaloids, saponins and terpenes, has been demonstrated in various phytochemical studies (Ingale & Kasture, 2014; Alves et al., 2020; Alvarez et al., 2019; Ballesteros et al., 2019; Rodríguez z et al., 2021; Viganó et al., 2020), for *Passiflora* taxa.

The study basically consists of 3 stages. First, using solvents of different polarity, separate extracts of the P. incarnata plant are prepared.

In the second stage, TPC, TFC and TAC of all extracts were analysed spectrophotometrically and the antioxidant properties of the extracts were analysed using DPPH, ABTS, FRAP and CUPRAC methods.

Finally, phenolic composition of the extracts was analysed using HPLC-DAD.

2. MATERIALS AND METHODS

2.1. Chemicals and Solvents

Unless other stade all chemicals and reagents will be used in analytical grade. HPLC-DAD analyses was performed HPLC grade phenolic standards and solutions.

2.2. Sample Preparation

P. incarnata was collected from Muğla-Akyaka, in Türkiye. The collected plant specimens were identified by Pharmacist Omer Cetiner. The plant material (stems, leaves and flowers) used as a whole were dried. Plant then ground in a

blender. 5 grams of the powdered plant was weighed and taken into four separate flasks. 50 mL of ethyl acetate was added to the 1st flask, 50 mL of methanol to the 2nd flask, 50 mL of chloroform to the 3rd flask and 50 mL of water to the 4th flask and extracted at 40°C for 45 min. At the end of time, all the extracts were filtered into separate flasks and evaporated to dryness in an evaporator the solvent of the extract. All extraction procedures were performed in triplicate. Methanol was used for dissolving dried extracts.

Methanol and ethanol the most preferred solvent for extraction of phenolic compounds because polyphenols are mostly well soluble in methanol and ethanol and stable in these solvents (Mokrani & Madani, 2016; Sukeksi & Sarah, 2016). While chloroform is preferred for non-polar compounds, ethyl acetate is mostly suitable for extraction of flavonoid.

2.3. HPLC-DAD Analyses

HPLC-DAD analyses were performed according to the method of Selvi et al. (2024). Detection wavelengths were set at 280 and 315 nm. Gallic acid, protocatechuic acid, catechin, chlorogenic acid (3-caffeoylquinic acid), caffeine, caffeic acid, vanillic acid, rutin, *p*-coumaric acid, ferulic acid, *o*-coumaric acid, quercetin, apigenin, kaempferol, and isorhamnetin were used for phenolic standards.

2.4. Determination of Total Phenolic Content (TPC)

Total phenolic content of *P. incarnata* was determined using the method developed by Singleton, Ortofer, and Lamuela (1999). TPC of the extracts was calculated as mg GAE (Gallic acid equivalent)/g extract.

2.5. Determination of Total Flavonoid Contents (TFC)

The TFC of the extracts was measured in according to the method of Marcucci, Woisky and Salatino (1998). The TFC of the extracts were calculated in mg QE (Quercetin equivalent)/g extract using the regression equations of the calibration graph of quercetin.

2.6. Determination of Total Antioxidant Contents (TAC)

Determination of The total antioxidant content of the extracts was determined using the phosphomolybdate reagent. Ascorbic acid was used as representative compound. The results obtained were calculated as mg AAE (Prieto, Pineda & Aguilar, 1999).

2.7. Free Radical Scavenging Activity Assay (DPPH)

The radical scavenging activity of the extracts against the 2,2-diphenyl-1-picrylhydrazyl was determined spectrophotometric method at 517 nm (Molyneux, 2004). Results were expressed as SC_{50} values.

2.8. Ferric Reducing Antioxidant Power Assay (FRAP)

The antioxidant capacity of the extract was evaluated using the FRAP assay. (Benzie, & Strain, 1999). Results were given as µmol gallic acid equivalent per gram of the extract.

2.9. Cupric Ion Reducing Antioxidant Capacity (CUPRAC)

The CUPRAC antioxidant assay of *P. incarnata* extracts was determined according to the Apak et al. (2004). Results of CUPRAC assay was presented as µmol gallic acid equivalent of one mg extract.

2.10. ABTS/Persulfate Assay

The ABTS method, which can be applied to both biological and food samples (Villano et al., 2004), is a simple and reliable antioxidant method. Results were expressed as SC_{50} values (Garcia Alonso et al., 2004).

3. RESULTS AND DISCUSSION

3.1. HPLC-DAD Analyses

15 phenolic standards were used for analyses of phenolic compounds in the extracts of *P. incarnata*. *p*-coumaric acid was determined as primary phenolic compounds in the extracts (Figure 1 and Table 1). 'Protocatechuic acid, chlorogenic acid, catechin, caffeic acid, rutin and, ferulic acid were also determined in all extracts(Table 1). 'Gallic acid, vanillic acid, , myricetin, quercetin and kaempferol' were not detected in any extracts. Isorhamnetin was not detected in the water extract. Methanol extract was the highest phenolic content among chloroform, ethyl acetate and water extracts.

Table 1. HPLC-DAD Analyses of *P. Incarnata* Extracts

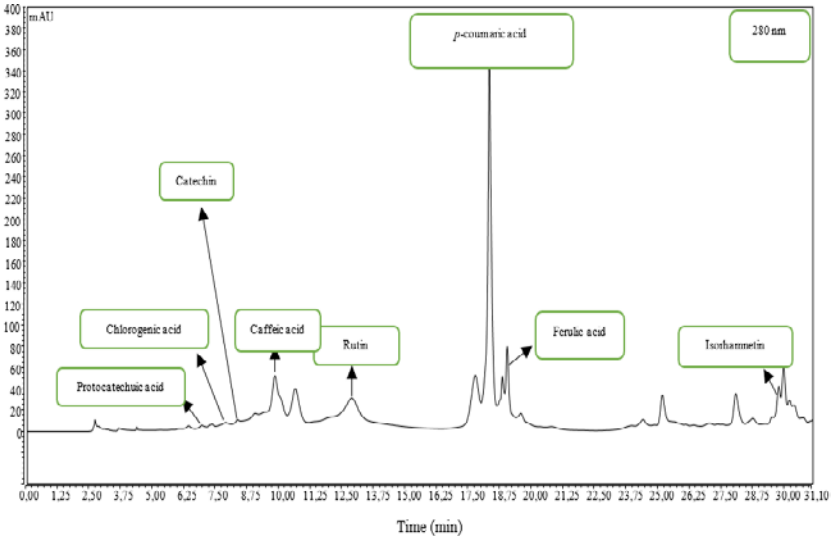
		Extracts			
RT (Min)	**Standards**	**Chloroform***	**Ethyl acetate***	**Methanol***	**Water***
6.92	Protocatechuic acid	3.18	5.28	7.33	2.25
7.70	Chlorogenic acid	0.50	1.25	2.50	0.38
8.34	Catechin	0.25	1.50	3.25	0.53
9.82	Caffeic acid	5.25	12.98	23.31	9.98
12.48	Rutin	1.89	2.58	12.95	5.12
18.28	*p*-coumaric acid	56.55	125.96	186.15	36.86
19.00	Ferulic acid	15.14	36.45	72.14	36.15
29.83	Isorhamnetin	0.12	10.25	15.85	N.D.

*: mg std. g−1 dried extract. N.D.: Not Detected

p-coumaric acid, the major phenolic compounds in chloroform, ethyl acetate, water and methanol extracts of *P. incarnata*, were reported as an important component of phenolic compounds with antioxidant properties and the ability to

eliminate reactive oxygen (Silva et al., 2014; Sova et al., 2020; Rotta et al., 2019). The phenolic composition and antioxidant potential of the fruits of *P. edulis*, *P. alata* and *P. ligularis* were investigated by Rotta et al. (2019). The trans-cinnamic acid, 4-hydroxybenzoic acid, vanillic acid, chlorogenic acid, caffeic acid, ferulic acid, *p*-coumaric acid, rutin and quercetin were determined in the fruits of *P. edulis*. The results were similar to our HPLC-DAD analysis (Table 1). In another study, the phenolic profile of ethyl acetate extracts of fresh fruits of *P. cincinnata* and *P. edulis* was determined. Gallic acid, catechin, epicatechin, epicatechin gallate, epigallic catechin gallate, myricetin, rutin, quercetin, resveratrol, caffeic acid, chlorogenic acid, alpha-coumaric acid, syringic acid were detected in different amounts in the two Passiflora species (Lourith et al., 2013).

Figure 1. HPLC-DAD Chromatogram of Methanol Extract of *P. Incarnata*



3.2. Total phenolic (TFC) Total flavonoid content (TFC) and Total Antioxidant Content (TAC)

TPC and TFC of chloroform, water, ethyl acetate and methanol extracts of *P. incarnata* were analysed spectrophotometrically. TPC, TFC, and TAC results of *P. incarnata* were given in Table 2.

Table 2. TPC, TFC and TAC of *P. Incarnata*

Extracts	TPC mgGA/gext	TFC mgQ/gext	TAC mgAAE/gext
Water	35.89	42.68	2.15
Chloroform	9.49	58.87	0.22
Ethyl acetate	196.52	663.57	3.82
Methanol	571.00	829.48	6.15

The methanolic extract of P. incarnata was found to have the highest levels of TPC, TFC and TAC. Methanol extract was followed by ethyl acetate, chloroform and water extracts respectively. The lowest TPC, TFC and TAC was calculated in the water extract.

Elghobashy et al. (2020) prepared the water extract of *P. incarnata* and determined the TPC and TFC of the extract. As a results of the study TPC of the aqueous extract was 133.7 mgGA/g and the TFC was 19.03 KE/g. Michael et al. (2022) prepared ethanol extract using the leaves of *P. incarnata* and analysed the TPC and TFC. The TPC was found to be 2.49 mg/dext and the TFC was found to be 2.1 mg/dext against the gallic acid standard. Although the plants were collected from different countries, regions and extracted with different solvents, similar results were obtained in our study.

Another study Lourith & Kanlayavattanakul, (2013) investigated TPC of ethyl acetate and water fractions of *P. incarnata* fruit seeds. The total phenolic contents were 58.3 g GAE/100 g for ethyl acetate fraction and 2.7 g GAE/100 g for water fraction, respectively. Santos et al. (2021) analysed TPC

of *P. cincinnata* and *P. incarnata.* As a result of study the highest TPC was determined *P. incarnata* (476.1 mg GAE/kg). Another study investigated the TPC and TFC of ethanol extracts of *P. vitifolia* and *P. incarnata s*eeds. The results of the study the ethanol extract of *P. incarnata* seeds was rich in total phenolics and total flavonoids (Rodríguez et al., 2021).

3.3. Antioxidant Analysis of P. incarnata

The antioxidant properties of different polarities of extracts of *P. incarnata* were determined using DPPH, FRAP, ABTS and CUPRAC methods (Table 3). Methanol extract was showed best antioxidant properties. Ethyl acetate extract showed as high antioxidant properties as methanol extract, while aqueous and chloroform extracts showed low antioxidant properties.

Table 3. Antioxidant Activities of the Extracts from *P. Incarnata*

Extracts	CUPRAC*	FRAP*	DPPH**	ABTS**
Water	0.84	0.46	0.14	1.28
Chloroform	0.25	0.12	0.16	2.70
Ethyl acetate	3.09	2.61	0.04	0.54
Methanol	5.47	3.90	0.03	0.38

*: µmolGA/gext, **: SC_{50}, mg/mL

Elghobashy et al. (2020) determined the antioxidant properties of water and methanol extract of *P. incarnata* using DPPH method. As a results of the study, the SC_{50} value for aqueous extract was found to be 0.032 at a concentration of 5 mg/ml and 0.022 for methanol extract at the same concentration. Michael et al. (2022) determined the antioxidant activity of the ethanol extract of the leaves of *P. incarnata* using DDPH and ABTS methods. The SC_{50} value was found to be 0.043 mg/mL for DPPH, and 0.046 mg/mL for ABTS analyses.

The antioxidant activity of ethyl acetate extracts of *P. incarnata* and *P. cincinnata* fruits was confirmed by Santos et al.,

(2021) using DPPH, ABTS and FRAP methods. Based on the results of the study, it was observed that the extract of P. *incarnata* fruits was higher than the extract of P. *cincinnata* fruits. Another study (Sova & Sosa, 2020) investigated the antioxidant activity of aqueous, ethanol and methanol/acetone extracts of *P. incarnata* fruits using ABTS, DPPH and FRAP methods. Aqueous and ethanol extracts showed higher antioxidant activity than methanol/acetone extract.

4. CONCLUSIONS

In the present study, methanol, ethyl acetate, chloroform, and water extracts of *P. incarnata* were analysed for their phenolic composition and antioxidant activities. The methanolic extract of *P. incarnata* was found to be the richest in TPC and TFC. These results were also supported by HPLC-DAD analysis. The results of phytochemical analyses, among the chloroform, water and ethyl acetate extracts, the methanol extract had the highest phenolic content. Similarly, the highest antioxidant activity was found for the methanol extract. in the DPPH, FRAP, ABTS and CUPRAC antioxidant tests. The extracts contained significant amounts of *p*-coumaric acid, which is known to have potential biological activity, according to the results of HPLC-DAD analysis (Sova & Sosa, 2020). (Sova & Sosa, 2020).

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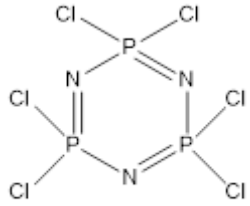
MONO-SPİRO-2,2'-DİOKSİBİFENİL SİKLOTRİFOSFAZEN TÜREVİ BİLEŞİKLER

Saliha BEGEÇ[1]

1. GİRİŞ

1.1.Fosfazenlerin Genel Özellikleri

Fosfor azot arasında çift bağ bulunduran bileşikler fosfazenler olarak adlandırılırlar. Fosfazen bileşikleri, son yıllarda hem bilimsel çalışmalarda hem de teknolojinin ihtiyaç duyduğu ileri teknoloji malzemelerinin yapımında önemli yer tutmaktadır. Fosfazenler halkalı ya da düz zincirli yapıda olabilirler. Halkalı fosfazenler $(NPCl_2)_n$ heterohalkalı anorganik bileşiklerin önemli bir sınıfını oluşturmaktadır. Bu bileşikler aktif P-halojen bağları içerirler. Bu nedenle çeşitli nükleofiller ile yer değiştirme reaksiyonları vererek çok çeşitli siklofosfazen türevleri oluşturdukları için oldukça ilginçtirler. Halkalı fosfazen türevlerinin en önemlilerinden bir tanesi hekzaklorosiklotrifosfazatrien [trimer, $N_3P_3Cl_6$ (**1**)]'dir. Bu bileşik en yoğun çalışılan fosfor azot bileşiklerinden biridir.



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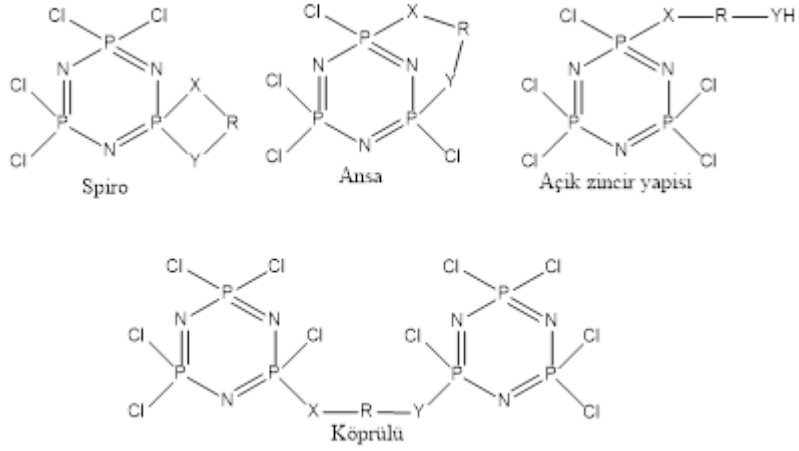
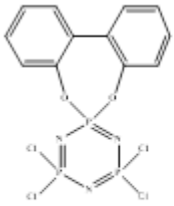
Trimer fosfazen kimyasında fosfazen türevlerinin hazırlanmasında önemli bir başlangıç bileşiğidir [1-3].

Siklofosfazenlerin fiziksel ve kimyasal özellikleri sübstitüe yan gruplara bağlı olarak değişebilir [4-9]. Siklotrifosfazen türevi bileşikler bilim ve teknolojide çok önemli uygulama alanı bulmaktadır [10-17].

$N_3P_3Cl_6$' nın birden fazla fonksiyonel gruba sahip alifatik veya aromatik dioller, diaminler veya aminoalkoller gibi nükleofiller ile sübstitüsyon tepkimeleri, çok sayıda yapısal izomerin ve stereoizomerin oluşumuna neden olmaktadır. Oluşan ürünlerin yapısı reaksiyona giren fonksiyonel grupların zincir uzunluklarına, reaksiyon sıcaklığına ve çözücü polaritelerine bağlı olarak değişir. Siklofosfazenlerin birden fazla fonksiyonel gruba sahip olan nükleofiller ile gerçekleştirilen sübstitüsyon tepkimelerinde, iki fonksiyonel grubun fosfazen halkasındaki aynı fosfor atomuna bağlanması ile *spiro-*, farklı fosfor atomlarına bağlanması ile *ansa-*, bir fonksiyonel grubun fosfor atomuna bağlanıp diğer fonksiyonel grubun serbest kalması ile *açık zincir yapısı*, iki fonksiyonel grubun herbirinin farklı fosfazen halkalarındaki fosfor atomlarına bağlanması ile *köprülü-* sübstitüe izomerler veya bunların bir karışımı oluşmaktadır.



Fosfazenlerin difonksiyonel ligantlarla reaksiyonları çok yoğun bir şekilde çalışılmaktadır [18-21]. En yoğun çalışılan difonksiyonlu ligantlardan bir tanesi 2,2'-dihidroksibifenil'dir. Bu bileşik ilk olarak 1996 yılında Carriedo ve çalışma arkadaşları tarafından fosfazen: bifenil 1:1, 1:2, 1:3 oranlarında K_2CO_3 ün varlığında aseton içinde etkileştirilmiş bu reaksiyonlardan mono-, di- ve trispiro fosfazen türevi bileşikler sentezlenmiştir [22].


mono-spiro
(I)


Di-spiro
(II)


Tri-spiro
(III)

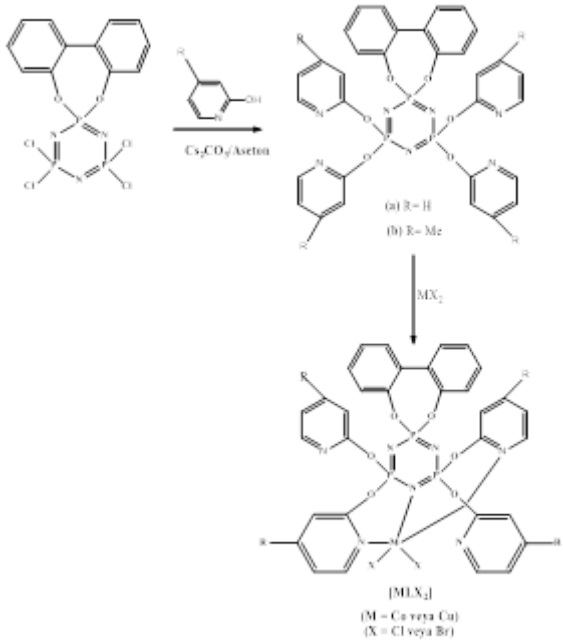
Elde edilen mono-spiro ve di-spiro fosfazen türevi bileşikler daha sonraki yıllarda birçok araştırmacı tarafından başlangıç maddesi olarak kullanılmış, bu spiro bileşiklerin pek çok türevi hazırlanmış ve uygulama alanı belirlenmiştir.

2,2'-dioksibifenil grubu içeren spirohalkalı fosfazen bileşikleri özellikle floresans kemosensör özellik gösteren bileşiklerin hazırlanmasında oldukça önemlidir [23-27].

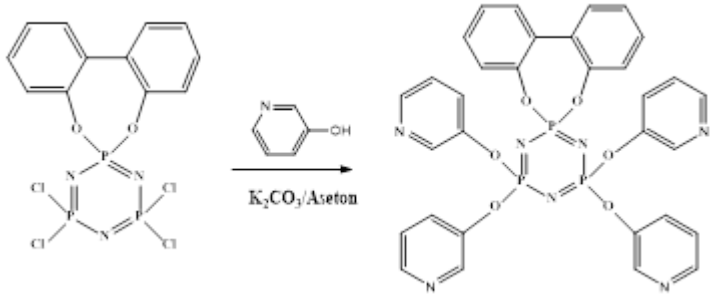
1.2.Monospiro-2,2'-dioksibifenil Türevi Bileşiklerle İlgili Çalışmalar

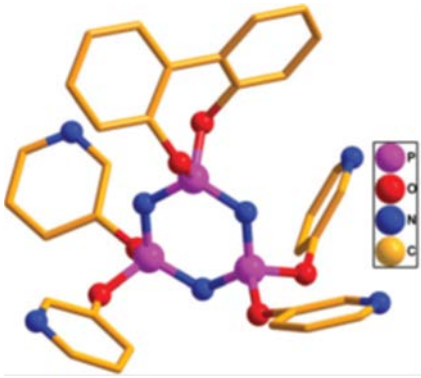
2007 yılında Ainscough ve çalışma arkadaşları **(I)** bileşiğinin 2-hidroksipiridin ve 2-hidroksi-4-metilpiridin ile Cs_2CO_3'ün varlığında aseton içinde (2,2'-dioksibifenil) tetrakis (2-piridilokso) siklotrifosfazen veya (2,2'-dioksibifenil) tetrakis (4-metil-2-piridilokso) siklotrifosfazen türevlerini sentezlemiş, yapılarını elemental analiz, NMR (^1H, ^{31}P), ESMS tekniklerini kullanarak aydınlatmışlardır. Ardından bu türevlerin diklorometan (DCM) içinde CoX_2 ve CuX_2 (X= Cl veya Br) tuzları ile metal komplekslerini hazırlamışlardır. Hazırlanan

komplekslerin spektroskopik (ESR ve elektronik) ve magnetik özelliklerini rapor etmişlerdir [28].

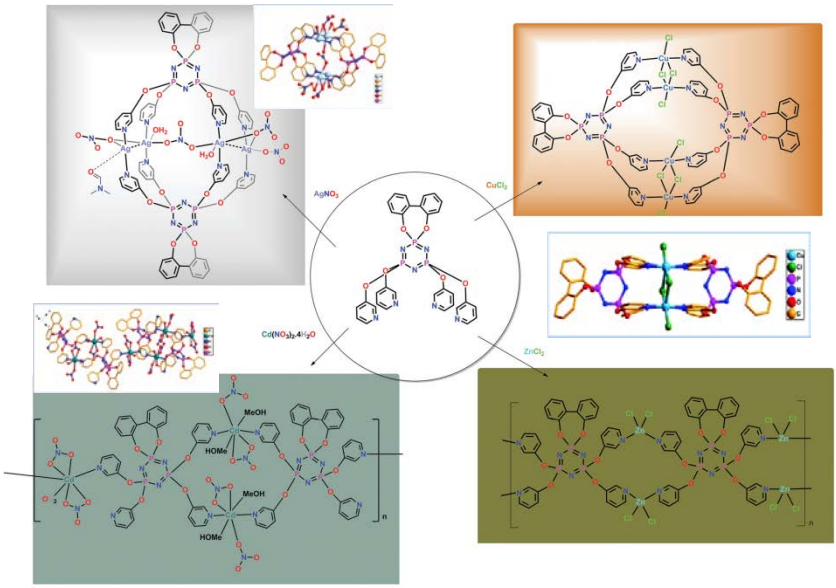


2013 yılında Chandrasekhar ve çalışma arkadaşı aynı bileşiği 3-hidroksipiridin ile K_2CO_3 ün varlığında aseton içinde etkileştirmiş ve sonuçta piridin ile tamamen sübstitüe olmuş fosfazen türevini hazırlamış ve yapısını elemental analiz ^{1}H, ^{31}P, ESI-MS, FT-IR yöntemleri ile karakterize etmişlerdir.

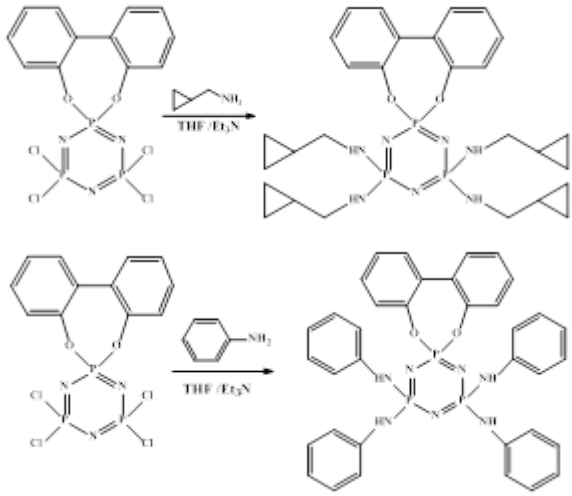




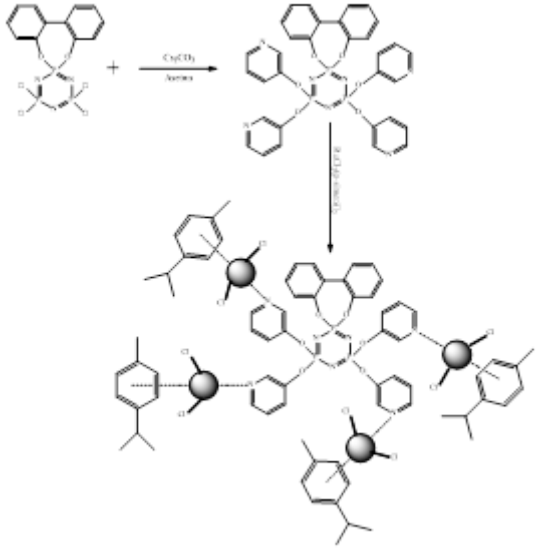
Aynı çalışma kapsamında elde edilen bileşiğin $CuCl_2$, $ZnCl_2$, $AgNO_3$ ve $Cd(NO_3)_2.4H_2O$ ile metal komplekslerini hazırlamışlardır [29]



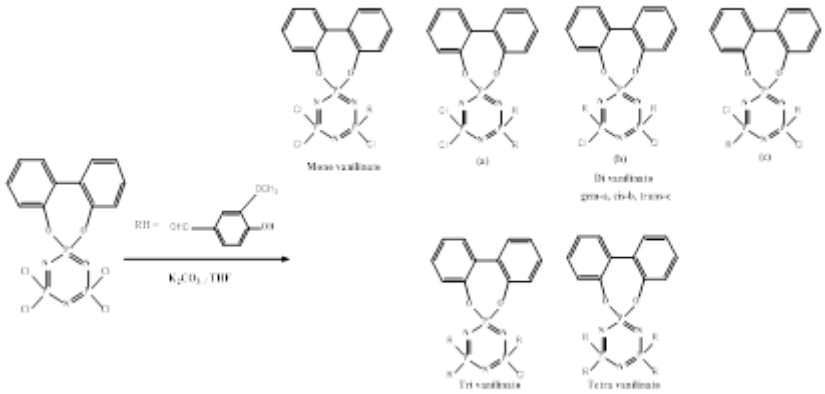
2020 yılında Tanrıverdi Eçik ve arkadaşları **(I)** bileşiği ile anilin ve siklopropanmetilamin'in tetrahidrofuran (THF) içinde trietilamin (Et_3N)'in varlığında reaksiyonlarından tamamen sübstitüe olmuş spiro fosfazen türevi bileşikleri sentezleyerek yapılarını elemental analiz, MALDI-TOF MS, FT-IR ve NMR (^1H, ^{31}P) teknikleri ile aydınlatmışlardır [30].



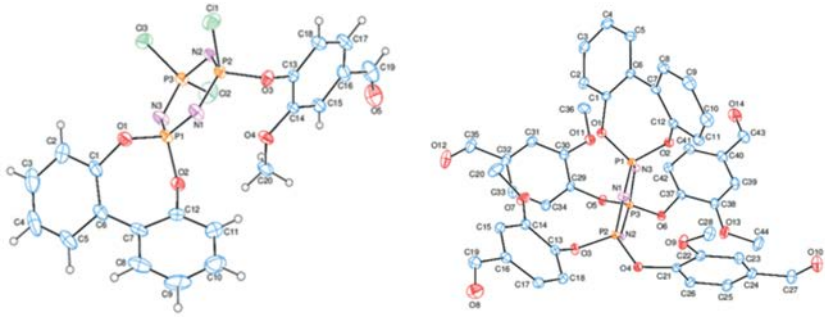
2015 Yılında Erdener Çıralı ve çalışma arkadaşı monospirofosfazen bileşiğini 3-hidroksi piridin ile etkileştirerek (2,2'-dioksibifenil) tetrakis (3-piridiloksosiklotrifosfazen) bileşiğini sentezleyerek yapısını elemental analiz, FT-IR, ^{1}H, ^{31}P NMR teknikleri ile aydınlatmışlardır. Daha sonra da elde ettikleri bu bileşiğin Ru (II) kompleksini hazırlamış ve ketonların hidrojen transferinde katalitik uygulamalarını incelemişlerdir [31].



2021 Yılında Tümer ve çalışma arkadaşı bileşik (I) ile vanilini etkileştirerek monospirofosfazen bileşiğinin vanilin türevlerinin sentezini yapmış element analizi, IR ve NMR (^{1}H, ^{13}C, ^{31}P) spektroskopisi teknikleri ile yapılarını aydınlatmış ve bu bileşiklerin termal özelliklerini termal gravimetrik analiz (TGA) tekniğini kullanarak açıklamışlardır.

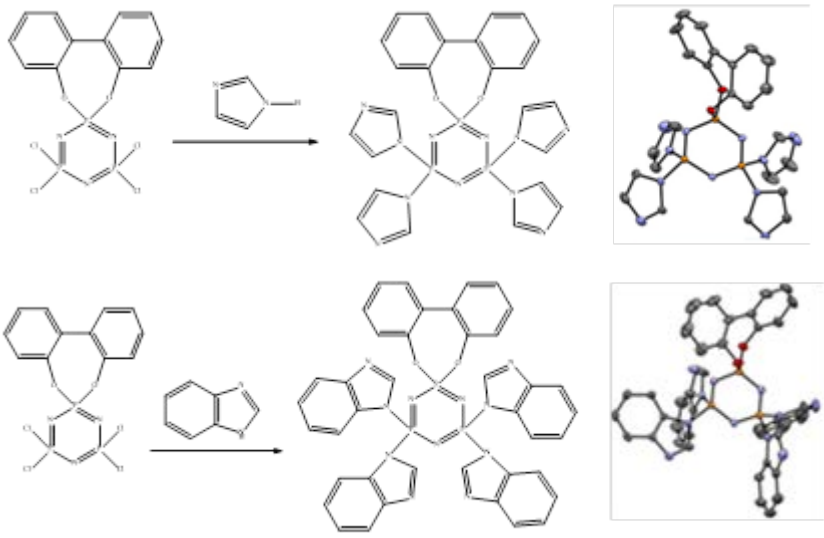


Ayrıca mono ve tetra vanilinato-sübstitue monospirosiklotrifosfazen türevlerinin yapılarını X-ışınları tek kristal analizi ile de aydınlatmışlardır [32].

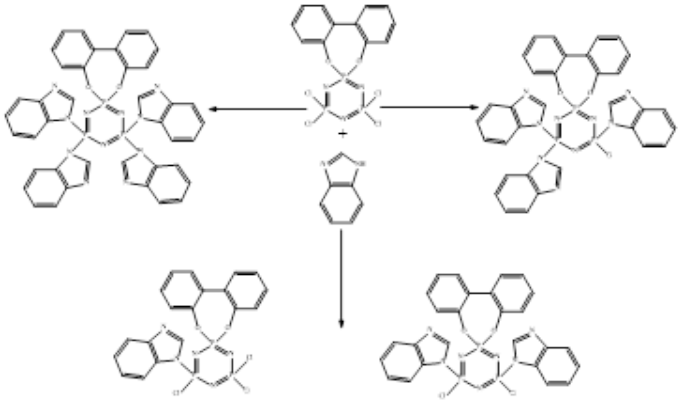


2019 yılında İbişoğlu ve çalışma grubu monospiro bileşiğin **(I)** imidazol ve benzimidazol ile tamamen sübstitüe olmuş türevlerini THF içinde Et_3N varlığında sentezlemiş; elde ettikleri bileşiklerin yapılarını elemental analiz, MALDI-TOF-MS, ^{1}H, ^{31}P NMR spektroskopisi ve X-ışınları tek kristal analizi

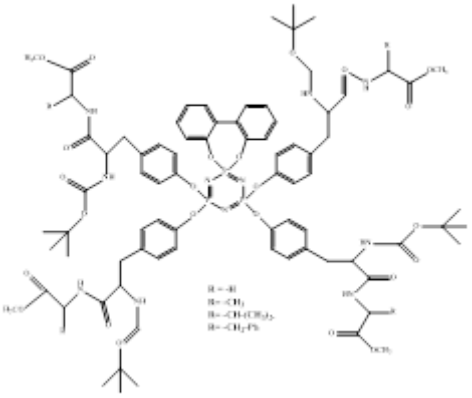
ile aydınlatmışlardır. Ayrıca elde edilen bileşiklerin fotofiziksel özelliklerini incelemişledir [33].



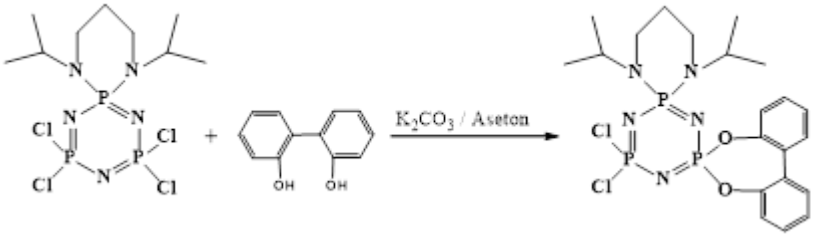
İbişoğlu ve çalışma arkadaşları 2020 yılında monospiro(dioksibifenil)siklofosfazenin **(I)** mono-, non-geminal bis- ve tris- benzimidazolil sübstitüe spiro(bifenil)siklotrifosfazen türevlerinin sentezini yaparak elemental analiz, FT-IR, ^{1}H, ^{31}P NMR teknikleri ile tamamen karakterize etmişler; bu bileşiklerin ve tetra benzimidazolil türevin Gram (+) ve Gram (-) bakterilere karşı antimikrobiyal özelliklerini incelemişlerdir [34].



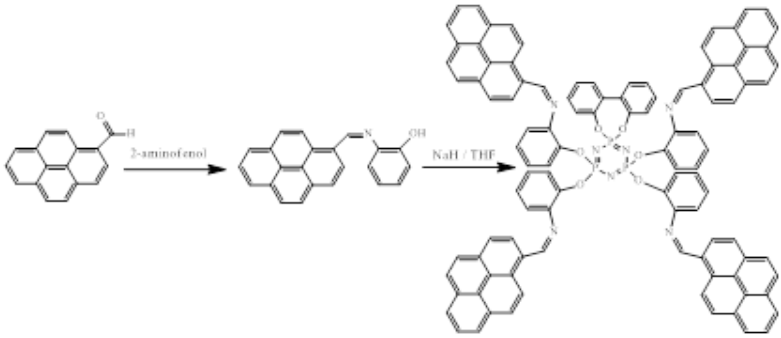
2023 Yılında Koran ve çalışma grubu spirodioksibifenilfosfazen bileşiği **(I)**'nin K_2CO_3 ün varlığında aseton içinde peptid türevlerini hazırlayarak FT-IR, MS, 1D (^{31}P, ^{1}H, ^{13}C-APT NMR) ve 2D (HETCOR) NMR spektroskopisi tekniklerini kullanarak yapılarını aydınlatmış ve bu türevlerin stotoksik aktivitelerini incelemişlerdir [35].



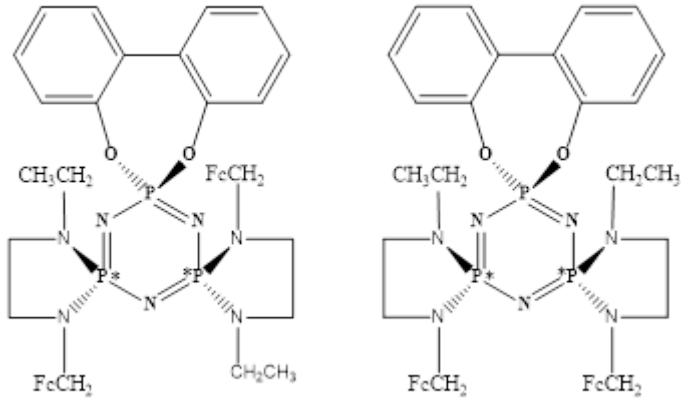
2022 yılında Begeç spiro-*N*,*N'*-diizopropilpropan-1,3 -diamino-2,2-4,4 tetrachlorocyclotriphosphazatriene bileşiği ile 2,2'-dihidroksibifenil'in reaksiyonunu K_2CO_3 ın varlığında aseton içinde inceleyerek elde ettiği türevin yapısını elemental analiz, ^{1}H, ^{13}C ve ^{31}P NMR tekniklerini kullanarak aydınlatmıştır[36].

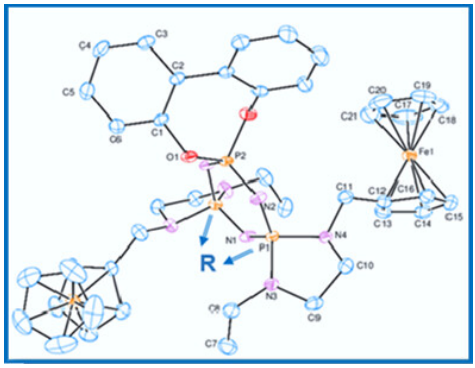


Tümay ve arkadaşları 2018 yılında 2-(piren-1-il-metilenamino)fenol ile **(I)** bileşiğinin reaksiyonunu incelemiş ve elde ettikleri ürünün Hg^{2+} iyonlarına karşı sensör davranışlarını UV/Vis ve floresans spektroskopileri ile incelemişlerdir [37].

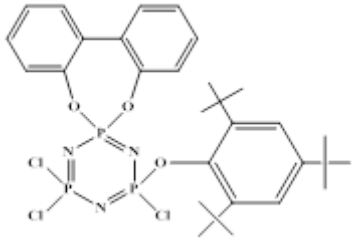


Tümer 2022 yılında mono spiro türevin N-etil-N'-ferrosenilmetil-etilendiamin ile reaksiyonunu K_2CO_3'ın varlığında THF içinde incelemiş ve elde ettiği bileşiklerin yapılarını karakterize etmiş ve stereojenik özelliğini araştırmıştır [38].

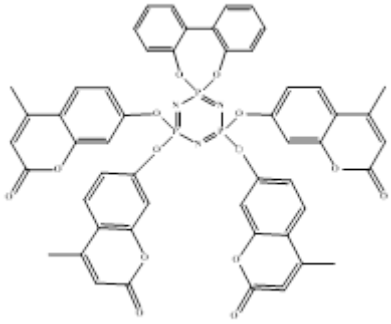




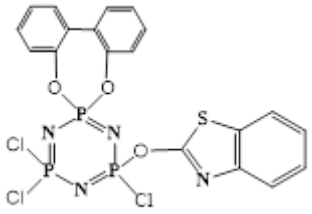
Begeç 2007 yılında aynı bileşiğin 2,4,6-tri-*tert*-bütilfenoksi türevini hazırlayarak elde edilen bileşiğin yapısını aydınlatmıştır [39].



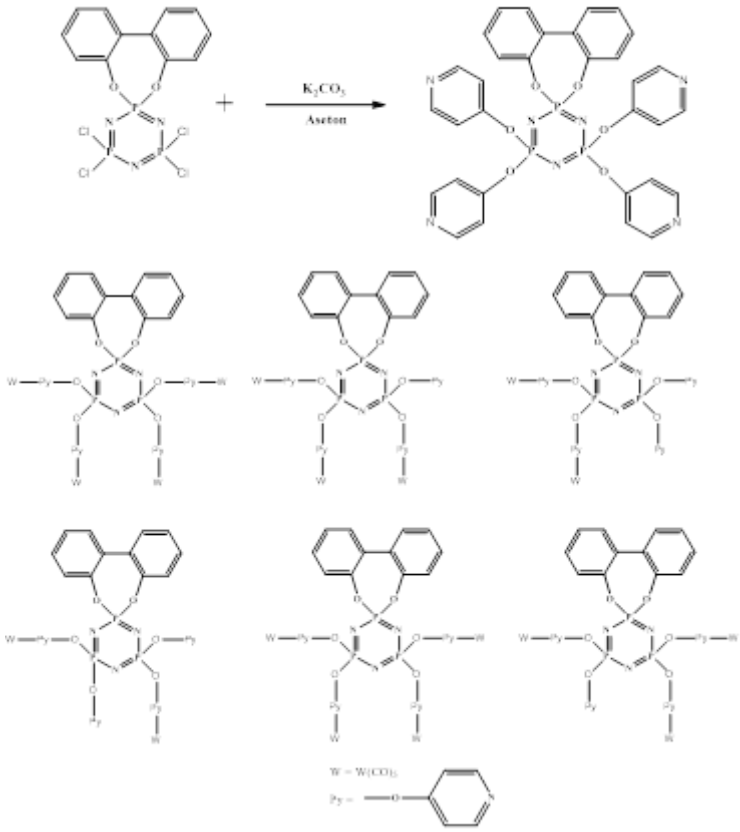
Chen ve çalışma grubu 2019 yılında spirobifenoksi sübstitüe fosfazen **(I)** bileşiğinin 4-metil-7-hidroksikumarin ile tamamen sübstitüe olmuş türevini sentezleyerek yapısını ^{1}H, ^{13}C, ^{31}P NMR ve MS tekniklerini kullanarak aydınlatmış antikanser aktivitesini incelemişlerdir [40].



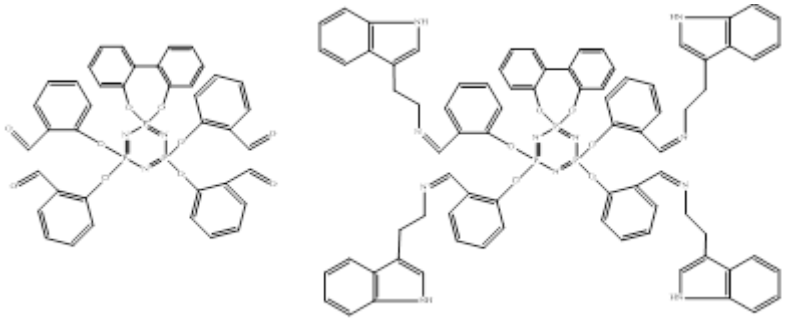
Begeç 2024 yılında **(I)** bileşiğinin 2-hidroksibenzotiyazol sübstitüe türevini hazırlayarak yapısını elemental analiz ^{1}H, ^{13}C ve ^{31}P NMR tekniklerini kullanarak aydınlatmıştır [41].



Carriedo ve çalışma arkadaşları 1999 yılında mono spirofosfazen türevi bileşiğin tamamen sübstitüe olmuş 4-piridiloksi türevini K_2CO_3'ın varlığında aseton içinde sentezlemiş yapısını ^{1}H, ^{15}N, ^{31}P NMR tekniklerini kullanarak aydınlatmış ve ardından bu bileşiğin $W(CO)_5$ ile metal komplekslerini hazırlamışlardır. Elde edilen metal komplekslerinin yapılarının aydınlatılmasında ^{1}H, ^{15}N, ^{31}P NMR tekniklerine ilaveten ^{183}W NMR tekniği de kullanılmıştır [42].



Yenilmez Çiftçi ve çalışma arkadaşlarının yapmış olduğu çalışmada monospiro bileşiği **(I)**' nin shiff bazı türevleri sentezlenmiş yapıları tayin edilmiş ve fizikokimyasal ve farmasokinetik özellikleri araştırılmıştır [43].



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Cu^{2+} /Dy^{3+}, Cu^{2+} /Tb^{3+}) complexes: Synthesis, structure, and Magnetism''. Inorg. Chem. 51: 2031-2038 (2012).

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MEDICINAL AROMATIC PLANT SHEPHERD'S PURSE (*Capsella bursa-pastoris*)

Ebru COTELI[1]

Gizem Nur AKSOY[2]

1. GİRİŞ

1.1.Medicinal Aromatic Plants

All animals, plants, and people in the world are in balance. In mythology, it is written that plants are the most valuable gift given to humans and that all plants exist to serve the needs of humans (Gezgin, 2007). Since ancient times, people have used plants to meet their nutritional needs and cure their diseases (Koçyiğit, 2005). From past to present, people have used plants for various purposes, such as nutrition, shelter, healing, and the treatment of diseases. It has been observed that there are 250 plants in plant treatment methods dating back to 5000 BC (Göktaş & Gıdık, 2019). Plants that enable the use of different parts of the plant or substances obtained from these parts in diseases are called medicinal plants. Today, medicinal plants are used not only in healing diseases but also in many fields such as pharmacy, nutrition, spices, dyes, and agriculture (Hakverdi & Yiğit, 2017). The word "Phytotherapy," which means treatment with medicinal plants, was first used by Henri Leclerc (Faydaoğlu & Sürücüoğlu, 2011). Many plants are traded for different purposes in the world and in our country. It is thought that at least 1000 of the species

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in our country are used for various purposes and about 400 are traded (Arslan, 2014).

Today, plants are used in many sectors such as agriculture, food, cosmetics, medicine and paint. Usage varies depending on the development level of the countries. According to FAO (Food and Agriculture Organization), 30% of the medicines used in the world are produced from plants (Acıbuca & Bostan Budak, 2018). For example, the discovery of aspirin, which is used primarily in the treatment of cardiovascular and cerebrovascular diseases, dates back 3500 years. Aspirin was discovered when willow tree bark was used as an antipyretic and analgesic and has become one of the most widely used drugs today (Desborough & Keeling, 2017). It is also known that many important plants play a role in the treatment of fatal diseases such as cancer, AIDS, and hepatitis (Salehi et al., 2018). Traditional medicines made from such plants have fewer side effects than chemical medicines (Dar et al., 2017). As the side effects of artificial drugs on the individual increase day by day, the tendency towards plants is increasing. For this reason, researching the contents of plants and advancing studies in the areas where they are beneficial may be beneficial for many diseases that are common today (Yücel & Tülükoğlu, 2000). Recently, an increase has been observed in the occurrence of many vital diseases such as cancer, Alzheimer's, diabetes, and anti-inflammatory diseases. Therefore, it is important to find new natural herbal pharmaceuticals that prevent these diseases.

Plants that grow spontaneously in their natural environment may have parts such as stems, leaves, and roots, and weeds also exist in these environments. Most of these plants, which are used in many areas around the world, are collected in their natural environment rather than obtained as culture. Today, people still obtain plants from the surrounding mountains and forests in rural areas. The aboveground parts or root parts of many

medicinal plants are used. These plants are consumed dried, pickled, cooked, or directly. Medicinal aromatic plants are also frequently used in food to add flavor and scent (Faydaoğlu & Sürücüoğlu, 2013).

Medicinal aromatic plants can be used frozen, dried, or fresh. Its therapeutic aspect is used in medicine production (Christaki et al., 2012). Studies have shown that some plants have antiviral, antimetastatic, antimutagenic, antiaging, and anti-cancer activities (Unsal et al., 2014).

Some of the uses of medicinal aromatic plants today are as follows (Varlı et al., 2020):

1) It is used as a raw material in essential oil production (Temel et al., 2018).
2) It is used as a spice in the food industry and kitchens (Kızıl et al., 2010).
3) It has medical uses such as teas, alcoholic products, plant extracts, creams, and enemas (Göktaş & Gıdık, 2019).
4) Plant components such as carbohydrates, proteins, fatty acids, vitamins, minerals, and fiber are used as food supplements.
5) Due to the limitation in the use of antibiotics, new factors that can be used in the development of poultry have been investigated instead, and as a result, it has been revealed that the essential oils in plants have effects that increase feed efficiency and survival times in the nutrition of broiler chickens (Adıyaman & Veysel, 2010).
6) Medicinal aromatic plants are also used in the production of many cosmetic products, air fresheners, paints, and disinfectants.

7) It is used as herbal tea in the treatment of some diseases (Faydalıoğlu & Çözümoğlu, 2011). For example: In hemorrhoid disease: Yarrow, rosehip, thuja,

   High Cholesterol: rosemary, thyme, rosehip, grape seed, green tea, ginger

   High Sugar: bitter melon, mahlep, myrtle, cinnamon Liver Disease: Artichoke, chicory, gourd's claw, turmeric

   Menopause: Sage, anise, yarrow, clove

   Stomach Bleeding: Yarrow, rosehip, sumac

8) Among the antimicrobial activities of medicinal aromatic plants are the effects that eliminate the growth, proliferation, or metabolism of microorganisms, thanks to the essential oils, phenolic compounds, flavonoids, alkaloids, and other bioactive substances contained in the plants (Faydaoğlu & Sürücüoğlu, 2013).

9) In the food sector, essential oils or extracts of plants are added to foods to prevent the growth of foodborne pathogens, ensure food safety, and extend the life of foods (Faydaoğlu & Sürücüoğlu, 2013).

10) In the cosmetics industry, essential oils or extracts of plants can be used in skin, hair, or oral care products to prevent skin infections, acne, eczema, dandruff, tooth decay, or bad breath and improve skin health and appearance (Uçar et al., 2015).

11) Literature studies show that *Capsella bursa-pastoris* has antioxidant, anti-inflammatory, antitumoral, Alzheimer's treatment, and coagulation effects (Kuroda & Akao, 1981; Glasl & Vermathen, 1993).

1.2.Properties of *Capsella bursa-pastoris* Plant

The *Capsella bursa-pastoris* plant, which belongs to the Brassicaceae (Cruciferae) family, is popularly called shepherd's purse (Baytop, 1999). The Brassicaceae (Cruciferae) family includes 365 species worldwide and 61 species in Türkiye (Karaismailoğlu, 2016). There are different species of Capsella around the world. However, there are *capsella bursa-pastoris* and *capsella rubella* species in our country (Tanrikulu, 2013). The seeds of the plant were first found in Turkey in 5950 BC in Çatalhöyük (Defelice, 2001).

The plant, which can grow up to 55 cm, is small, herbaceous, and annual. The appearance of the plants may differ from each other, but they generally have triangular-shaped, serrated, and long leaves. It grows naturally at altitudes up to 2000 meters above sea level in Turkey and at altitudes of 3000 meters in the Alps (Aksoy & Hale, 1998).

Table 1. Biological Classification of *Capsella-Bursa Pastoris*

Domain	Eukaryote
Kingdom	Plant
Lower kingdom	Green plants
Upper Branch	Soil plants
Branch	Vascular plants
Branch	Angiosperm
Class	Dicotyledonous
Team	Cruciferous family
Family	Mustard family
Species	*Capsella Medic.*
Species	*Capsella-bursa pastoris*

Source: (Çığ et al., 2020).

Generally, the leaf parts of *Capsella bursa pastoris* that remain above the ground are used rather than the root parts. It is generally used in dried or fresh form in many diseases, such as menstrual irregularities, injuries, and urinary tract infections. It is made into a liquid medicine when fresh and consumed by brewing

when dry (Defelice, 2001). It is popularly used as a deworming plant, blood purifier, regulating bowel movements, rapid healing of wounds, and good for skin diseases and eye inflammation (Kaya et al., 2004).

In Europe and China, it is generally used as brewed tea to cure many diseases, such as eye diseases and intestinal infections (Defelice, 2001).

1.3.Studies Conducted on *Capsella bursa-pastoris* Plant

Many studies have been conducted on the *Capsella bursa pastoris* plant. In a study conducted on rats, it was observed that it had an effect similar to oxytocin in the rat uterus (Kuroda & Takagı, 1968). At the same time, another study revealed that the shepherd's purse plant lowers blood pressure and helps small intestine movements. (Kuroda & Kaku, 1969).

A study showed that consuming 46 grams of Capsella bursa pastoris plant meets individuals' daily vitamin C needs. However, since the plant will lose vitamins when cooked, it is recommended to consume it fresh as a salad (Guerrero et al., 2007).

In another study, it was determined that there are natural lipids in the leaves and roots of this plant. Additionally, it has been determined that the above-ground parts of this plant contain β-carotene and β-sitosterol (Glushenkova et al., 2002).

In a study on the reproductive system, two dried and ground forms of the plant were added to the diets of male and female mice at 20% and 40% levels. It has been observed that 40% consumption of the plant prevents ovulation and causes infertility in men and women (Al-Snafi, 2016).

In a study conducted in Spain, fatty acid levels of some plants were measured. It has been revealed that α-linolenic acid

found in the seeds of the *Capsella bursa pastoris* plant, which is among these plants, constitutes 50.67% of the total fatty acids (Guerrero et al., 2007).

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