Original Research Article

Infrared Spectroscopic Study of Binding Interaction of Metal Complexes with Mefenamic Acid (MFA)

.

ABSTRACT

Aims: The foremost aim of this study was to evaluate 1:1 formed complex when mefenamic acid interact with Cu^{2+}, Zn^{2+}, $EDTA^{4-}$ metal at physiological condition which provide a better understanding of the pharmacological studies. This research provided information on the binding affinity of mefenamic acid with selective metals. It helps to preparative, structural and reactivity studies for multiple drug design in pharmaceutical fields.

Place and Duration of Study: Department of Pharmacy, Stamford University Bangladesh, Dhaka,Bangladesh & CARS ((Centre for Advanced Research in Sciences), University of Dhaka. Duration of this study is between September to December, 2022.

Study Design: The Infrared spectra of Copper (Cu), Zinc (Zn) and Ethylenediaminetetraacetic Acid (EDTA) complex of Mefenamic Acid were investigated in the region between 4000 and 400 cm^{-1}. These spectra were compared standard peaks with specific functional groups. The binding interactions of the selected metal ions were demonstrated by significant variations in the intensities of the amino group of mefenamic acid after metal complexation.

Results: The interactions of the metal ions with the acid product have resulted in the alteration of the functional structure, which was characterized by a negligible reduction in the structure of mefenamic acid. The change in position of the characteristic bands, or the increase/ decrease in the number of bands and appearance of a new metal-atom bond, help to confirm the formation of a complex.

Conclusion: It is recently found out that metal-based complexes decrease antiviral, antibacterial, and anticancer action. In order to construct actively functioning medications, it's vital to study the ability of physiologically active metal ions to interact with metalloproteinase like albumin, which transport and distribute these metal ions. The current research set a standard for repeatable mefenamic acid metal ion research.

Keywords: {Mefenamic acid, Infrared spectroscopy, FT-IR, Binding interactions, Metal complexation, Amino group, Copper, Zinc, EDTA, Functional structure}

1. INTRODUCTION

Mefenamic acid and its metal-binding derivatives, many of which function by chelation, have produced effective medications and selective toxins. They have various medical purposes [1]. Inorganic and medicinal chemistry are studying metal complexes with active drugs as ligands to develop new drugs. NSAIDs are a prominent ligand for metal complex synthesis. First, NSAIDs are exceedingly flexible ligands and exhibit a wide range of binding modes as a function of the metal and the environment. The preparative, structural, and reactivity

research are useful for bio and materials science. Second, NSAIDs have pharmaceutical purposes [2].

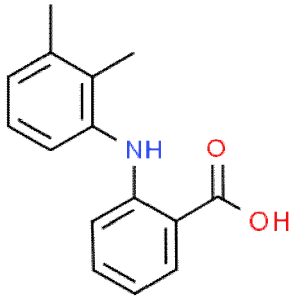


Figure 1: Structure of Mefenamic Acid

Mefenamic acid is a nonsteroidal anti-inflammatory agent. A non-selective inhibitor of COX-1 and COX-2. Mefenamic acid is an N-substituted phenylantharanilic acid (fenamate) analogue linked to meclofenamate. Mefenamic acid has limited anti-inflammatory effect in humans despite being analgesic and antipyretic. Severe gastrointestinal side effects limit its use. It has little advantage over other NSAIDs and is used to treat dysmenorrhea. It is often prescribed for less than one week. 750–1500 mg is the daily human dosage. To reduce GI side effects, it should be taken with food [3].

Mefenamic acid comes in capsules and immediate-release tablets. These drugs are difficult to dissolve in water, adhere to any surface, and difficult to manage during granulation and tableting. To improve tablet ability, increase dissolution rates, and develop a stable and reproducible dosage form, mefenamic acid's physicochemical properties and batch-to-batch variation must be studied [4]. Mefenamic acid solubility is also affected by polymorphism and crystallinity [5].

Mefenamic acid's physiology is diverse. Cell ion channels are affected. This effect is best researched in cation channels [6]. Mefenamic acid inhibits protein and receptor binding sites. This removes thyroxine, uric acid, and warfarin from protein carriers [7]. It modulates the immunological system [8]. Mefenamic acid inhibits platelet aggregation [9]. Smooth muscle affects mefenamic acid's potential clinical applications. It can reduce uterine resting pressure and relax tonic uterine contractions. It reduces norepinephrine-induced arterial constriction. It affects stomach and tracheal smooth muscle and bowel transit time [10][11]. Mefenamic acid is neurotoxic but also neuro protective [12] [13]. GABA-receptors are modulatable and activatable [13]. Mefenamic acid inhibits pyrogens like other NSAIDs.

Mefenamic acid is weakly soluble in its acidic state, however its sodium salt could make it significantly more soluble. The absorption rate of mefenamic acid after oral administration is up to 80%. 2–6 mg/L (250-mg dose) and 4–24 mg/L (500-mg dosage) peak blood levels are achieved in 2–4 h after taking unconjugated drug [14]. Half-life is approximately 2–4 hours, and blood levels are below 0.1 mg/L after 24 hours. There are few data on using this medication during renal failure, but short-term dosage change does not seem necessary.

Mefenamic acid helps PMS patients [15]. It lowers menstrual flow compared to placebo in menorrhagia patients [16]. Mefenamic acid is useful for chronic pain of bone, muscle, neuropathy, and soft tissue diseases [17]. It has proved to be as effective as ibuprofen, naproxen, ketoprofen, piroxicam etc [18][19][20]. Mefenamic acid is superior to dextropropoxyphene and paracetamol [21]. According to study, it's as effective or more effective as other NSAIDs for chronic osteoarthritis patients [22][23]. It reduces tension headaches [24]. In a placebo-controlled investigation, mefenamic acid improved migraine symptoms [25]. Its potential as a pediatric antipyretic was recognized early [26].

Short-term usage of mefenamic acid shouldn't harm the kidneys [27]. Mefenamic acid can cause papillary necrosis in animal studies [28], while PGE2 analogues can reduce this impact. Mefenamic acid causes hemolytic anemia. It increases osmotic fragility of red blood cells [29]. Mefenamic acid adverse effects include reversible glaucoma, IgA autoantibody and anti-DNA antibody induction, pseudoporphyria, phototoxicity, delayed menstruation, and cleft palate (mice) [30][31][32][33][34].
According to this, Mefenamic acid binds to COX-1 and COX-2 to inhibit prostaglandin synthase.
These receptors briefly reduce pain symptoms by decreasing inflammation or prostanoid signaling in activity-dependent plasticity.
COX-1: COX-1 is an enzyme that speeds up the production of prostaglandins in the stomach, kidneys and the site of inflammation. Prostaglandins in the stomach produce a natural mucus lining that protects the digestive tract. They interact with inflammation-related cells.
COX-2: COX-2 speeds up the production of inflammatory prostaglandins. Inhibiting cox-2 lowers inflammation.
Cox-2 exclusively active in inflammatory locations, not the stomach [35].
Valproic acid can be displaced from albumin-binding sites by mefenamic acid. This drug may impair renal function if taken with cyclosporine or lithium. A child with CNS toxicity was reported to have co-ingested diclofenac. Toxic effects were also related with iodine consumption with mefenamic acid [36].Consumption of 2,5-Dimethoxy-4-ethylamphetamine with mefenamic acid increases the risk or severity of hypertension. 4-hydroxycoumarin with mefenamic acid exacerbate GI problems [35]. Mefenamic acid paired with Benazepril and enalapril can increase renal failure, hyperkalemia, and hypertension. Caffeine decreases its metabolism. Mefenamic acid with Cefprozil, and Mannitol may induce nephrotoxicity. It may lower the elimination rate of Diazepam, digoxin, flurazepam and folic acid, resulting in a higher serum level. Mefenamic acid with Heparin might increase bleeding and hemorrhage risk. Potassium increases its hyperkalemia activities.
The primary objective of this research was to investigate the 1:1 complex that was generated when mefenamic acid interacted with the metals Cu^{2+}, Zn^{2+}, and $EDTA^{4-}$ in physiological conditions. This was done in in order to gain a better comprehension of the pharmacological experiments. The results of this study offered information on the binding affinity of mefenamic acid with several metals. In the pharmaceutical industry, it assists with preparative, structural, and reactivity investigations for multiple drug design. The purpose of this study to find the complex compound with different functional group.

2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

2.1 Materials & reagents

All chemicals and reagents were of analytical grade and were used as supplied while the solvents were purified according to standard procedure. Mefenamic acid (99.1% purity) were obtained from ACI Pharmaceutical Co. Ltd. Copper sulfate (Cu_2SO_4), Zinc sulfate ($ZnSO_4$) and EDTA (Ethylenediamine tetra acetic acid) was collected from Stamford University Bangladesh, pharmaceutical analysis laboratory. Ethanol & methanol were used for experiment purpose which were of analytical grade.

2.2 FT-IR Spectroscopy Instrumentation & Conditions

FT-IR spectroscopy measurements were done using the IRTracer-100 (Shimadzu, Japan) under physiological conditions. The IRTracer-100 has a stable dynamic alignment mechanism and a high S/N ratio of 60,000:1 for highly sensitive and accurate measurements. Additional detectors, light sources, and beam splitters can be added to expand to the far-IR and near-IR ranges (12,500 to 240 cm^1) and to increase sensitivity with an MCT (Mercury Cadmium-Telluride) detector. The instrument can obtain up to 20

spectra/second for rapid reaction monitoring or in-line gas measurement. FT-IR works based on Michelson Interferometer which having beam splitter, fixed mirror, and moveable mirror.

2.3 Sample preparation

2.3.1 Synthesis of Mefenamic Acid with Copper sulfate

A solution of copper (II) sulfate (0.567 mmol) methanol (2.0mL) was added to a solution of mefenamic acid (1.5 mmol) in methanol (2.0 mL) and a piece of magnet was taken in a round bottom flask. The reaction mixture was rotated by Analog Hot Plate Magnetic Stirrer 120mm metal surface up to 60 minutes at room temperature and a blue powder was precipitated. The mixture was cooled to 5°C in a refrigerator for 4 hours. The precipitate was collected by filtration, washed with cold methanol\water and dry in vacuo to afford [2].

2.3.2 Synthesis of Mefenamic Acid with Zinc sulfate

A solution of zinc sulfate (0.50 mmol) methanol (2.0mL) was added to a solution of mefenamic acid (1.4mmol) in methanol (2.0 mL) and a piece of magnet was taken in a round bottom flask. The reaction mixture was rotated by Analog Hot Plate Magnetic Stirrer 120mm metal surface up to 60 minutes at room temperature and a white powder was precipitated. The mixture was cooled to 5°C in a refrigerator for 4 hours. The precipitate was collected by filtration, washed with cold methanol\water and dry in vacuo to afford [2].

2.3.3 Synthesis of Mefenamic Acid with EDTA

A solution of EDTA (0.48 mmol) methanol (2.0mL) was added to a solution of mefenamic acid (1.4 mmol) in methanol (2.0 mL) and a piece of magnet was taken in a round bottom flask. The reaction mixture was rotated by Analog Hot Plate Magnetic Stirrer 120mm metal surface up to 60 minutes at room temperature and a blue powder was precipitated. The mixture was cooled to 5°C in a refrigerator for 4 hours. The precipitate was collected by filtration, washed with cold methanol\water and dry in vacuo to afford [2].

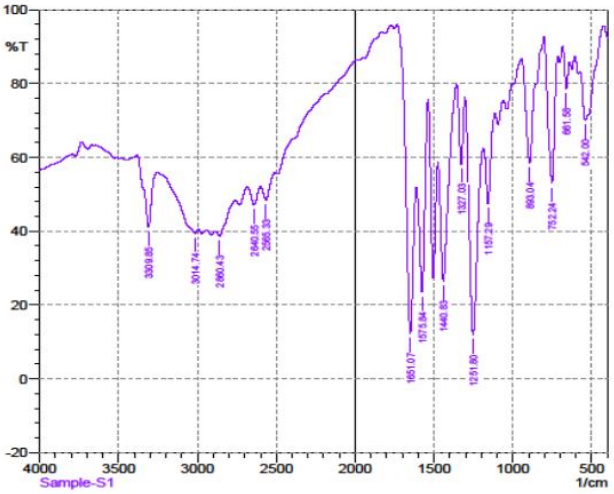
3. RESULTS AND DISCUSSION

FT-IR spectra were recorded to assess the compatibility of the drugs. FT-IR spectra for mefenamic acid, copper metal, zinc metal, EDTA and physical mixture of these drugs at the ratio of (1:1) were revealed by means of FT-IR spectrophotometer using the instrument (FTIR). The scanning range was (400 to 4000) cm^{-1}. Mefenamic acid and metal-complex (1:1 ratio, w/w) mixture can be placed directly into the path of the infrared beam for each measurement. KBr pressed disk was used. 1:1 mixture of drug and potassium bromide were weighted. Samples were mixed in a mortar then pressed for 2-3 minutes to form a semitransparent pellet which lets light to be transmitted to the detector.

As mefenamic acid is a weak acid, it must have a -COOH functional group. This study seeks complicated compounds with different functional groups. A band near 3500 cm^{-1} (NH stretch.) were monitored only for mefenamic acid. The backbone conformation of the structure is directly related to the benzene ring, as 32000–2800 cm^{-1}, where sp C-H (stretching), sp^2 C-H (stretching) were found. Also we have the value of 1157.29 cm^{-1} which indicates the presence of C-O functional group. Finally difference spectra were produced by adding metal ion complexes. These difference spectra monitored intensity changes upon complex formation. These structures of free drug and drug–metal ion complexes were studied, and the intensity of corresponding functional group were calculated to measure complex formation. Peak intensity and area were calculated in the range of the drug's structural components. Mefenamic acid and metal ions interacted 1:1 at various concentrations.

3.1 Individual Data of Selective Compounds

Interpretation of Mefenamic acid and other metallic compounds were measured under physiological condition as in Figure (2 to 10). It was clearly viewed that the raw sample of mefenamic acid was given a strong and broad peaks at 3309 cm^{-1}, 3014cm^{-1}, 2860cm^{-1}, 2640 cm^{-1} wavelength which indicating respectively N-H, C=C, C-C groups (Figure 2). The raw sample of copper sulfate was given strong and broad peaks at 3444 cm^{-1} wavelength which indicating N-H group (Figure 3). Zinc sulfate give strong and broad peak at 3564 cm^{-1} and indicates O-H groups (Figure 4). Finally, were measured the interpretation of mefenamic acid with copper sulfate, zinc sulfate and EDTA respectively at 3430 cm^{-1}, 3444cm^{-1}, 3516 cm^{-1} and indicate N-H and O-H bond which formed by sp^3 hybridization (Figure 5-7).



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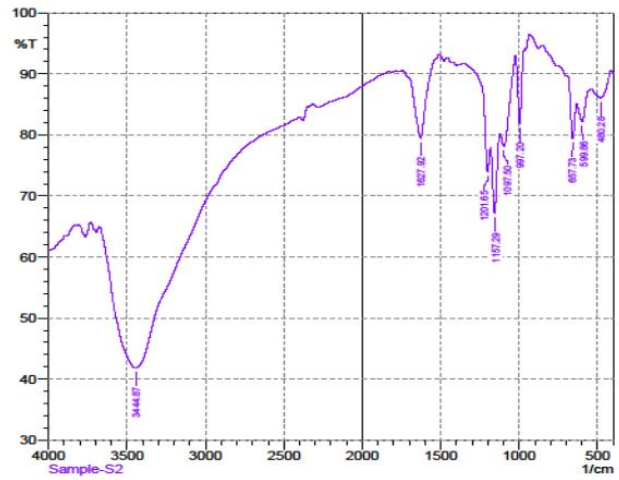
CARS, DU

	Peak	Intensit	Corr. In	Base (H	Base (L	Area	Corr. Ar
1	542	70.146	5.366	574.79	524.64	6.358	0.699
2	661.58	78.633	9.35	684.73	640.37	3.427	0.976
3	752.24	53.021	36.613	802.39	715.59	13.2	9.235
4	893.04	58.481	24.134	945.12	858.32	12.799	5.874
5	1157.29	47.478	18.93	1188.15	1114.86	16.87	4.116
6	1251.8	11.894	58.278	1303.88	1188.15	50.705	32.052
7	1327.03	58.25	19.729	1357.89	1303.88	8.908	3.142
8	1440.83	26.497	38.452	1475.54	1357.89	35.738	16.397
9	1575.84	23.472	39.914	1612.49	1537.27	28.117	12.792
10	1651.07	12.32	53.675	1732.08	1612.49	41.572	23.586
11	2565.33	48.47	5.1	2600.04	2509.39	25.986	1.707
12	2640.55	47.107	4.972	2684.91	2600.04	25.793	1.744
13	2860.43	38.696	3.052	2887.44	2760.14	46.822	1.576
14	3014.74	39.426	2.251	3253.91	2993.52	84.6	1.983
15	3309.85	41.042	17.009	3383.14	3253.91	37.539	7.278

Figure 2: IR Sample (S1) Mefenamic Acid



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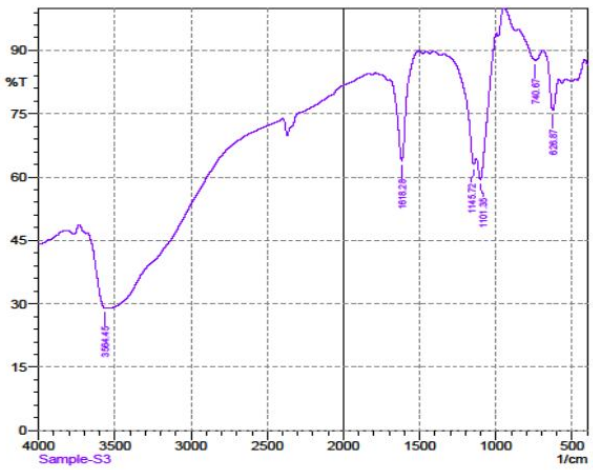
CARS, DU

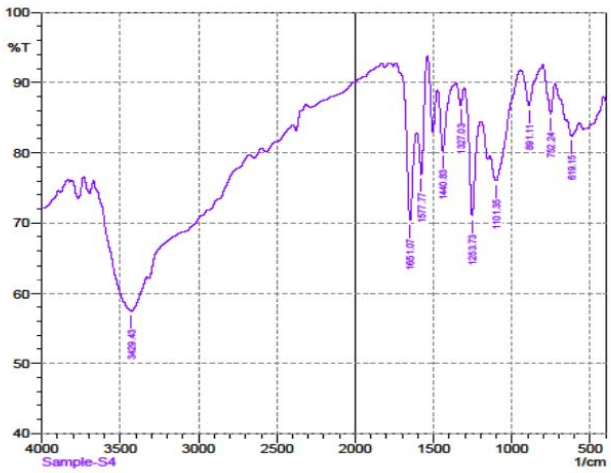
	Peak	Intensit	Corr. In	Base (H	Base (L	Area	Corr. Ar
1	480.28	86.027	2.96	540.07	414.7	7.392	1.073
2	599.86	82.136	3.823	632.65	540.07	6.618	0.699
3	657.73	79.416	7.59	692.44	632.65	4.532	1.018
4	997.2	81.846	11.649	1024.2	968.27	3.094	1.465
5	1097.5	78.113	5.341	1122.57	1024.2	7.706	1.429
6	1157.29	67.142	11.777	1182.36	1122.57	8.004	1.913
7	1201.65	73.968	5.542	1355.96	1182.36	10.659	-1.977
8	1627.92	79.516	12.079	1743.65	1533.41	13.069	4.95
9	3444.87	41.827	26.362	3672.47	2401.38	248.184	78.446

Figure 3: IR Sample (S2) Copper Sulfate



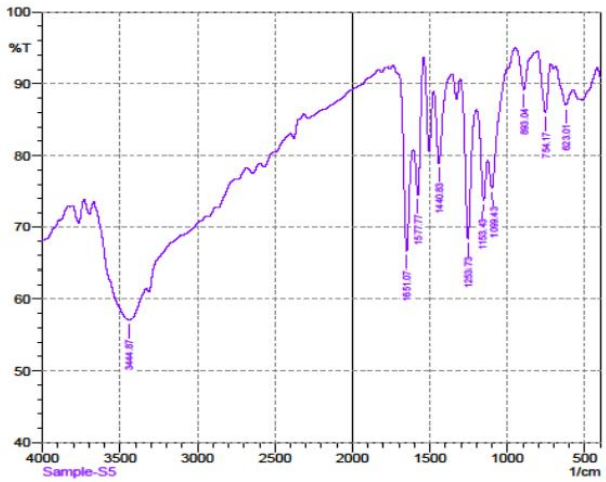
	Peak	Intensit	Corr. In	Base (H	Base (L	Area	Corr. Ar
1	626.87	75.781	10.04	692.44	586.36	8.686	2.031
2	740.67	87.679	3.783	854.47	692.44	6.974	1.441
3	1101.35	59.446	11.101	1128.36	997.2	17.7	3.441
4	1145.72	62.94	3.551	1338.6	1128.36	20.477	-4.84
5	1618.28	63.843	22.063	1697.36	1502.55	19.824	7.549
6	3564.45	28.993	1.41	3680.18	3554.81	54.97	1.357

Figure 4: IR Sample (S3) Zinc Sulfate



	Peak	Intensit	Corr. In	Base (H	Base (L	Area	Corr. Ar
1	619.15	82.355	2.157	650.01	569	6.416	0.476
2	752.24	85.576	5.222	802.39	725.23	4.061	0.968
3	891.11	86.709	5.363	943.19	802.39	6.441	1.449
4	1101.35	76.013	5.994	1139.93	943.19	16.033	2.647
5	1253.73	70.985	15.875	1303.88	1201.65	9.709	3.413
6	1327.03	86.781	2.79	1357.89	1303.88	2.907	0.336
7	1440.83	80.217	9.02	1475.54	1357.89	7.556	1.858
8	1577.77	76.931	10.609	1606.7	1539.2	5.283	1.586
9	1651.07	70.362	15.906	1735.93	1606.7	10.514	3.138
10	3429.43	57.455	8.808	3647.39	3329.14	64.669	11.829

Figure 5: IR Sample (S4) Mixture of Mefenamic Acid & Copper Sulfate



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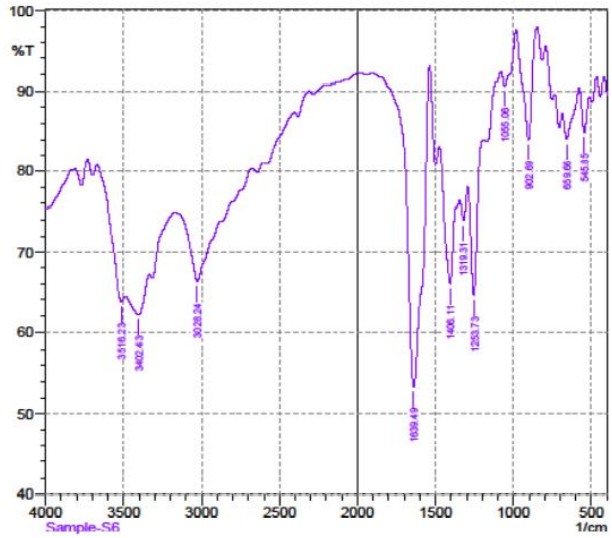
CARS, DU

	Peak	Intensit	Corr. In	Base (H	Base (L	Area	Corr. Ar
1	623.01	87.01	3.505	688.59	576.72	5.639	0.94
2	754.17	85.956	7.48	806.25	721.38	3.891	1.47
3	893.04	89.185	5.524	948.96	825.53	4.127	1.194
4	1099.43	75.459	6.363	1126.43	948.96	11.335	0.505
5	1153.43	73.762	8.175	1201.65	1126.43	7.444	1.294
6	1253.73	68.425	20.156	1303.88	1201.65	9.789	4.372
7	1440.83	78.892	10.765	1475.54	1357.89	7.52	2.221
8	1577.77	74.469	12.092	1608.63	1539.2	6.101	1.914
9	1651.07	66.636	18.088	1735.93	1608.63	11.249	3.215
10	3444.87	56.975	8.483	3668.61	3334.92	70.17	12.618

Figure 6: IR Sample (S5) Mixture of Mefenamic Acid & Zinc Sulfate



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CARS, DU

	Peak	Intensit	Corr. In	Base (H	Base (L	Area	Corr. Ar
1	545.85	84.906	4.931	578.64	513.07	3.817	0.764
2	659.66	84.025	3.994	686.56	578.64	6.698	1.129
3	902.69	84.003	13.832	983.7	850.61	5.43	4.14
4	1055.06	90.61	1.527	1082.07	1026.13	2.174	0.183
5	1253.73	64.578	15.765	1292.31	1193.94	12.666	3.623
6	1319.31	73.934	3.225	1344.38	1292.31	6.321	0.464
7	1406.11	66.005	12.393	1475.54	1365.6	15.104	4.023
8	1639.49	53.361	39.494	1907.6	1537.27	37.718	25.455
9	3028.24	66.24	8.193	3167.12	2877.79	42.884	5.737
10	3402.43	62.215	3.734	3487.3	3334.92	29.794	2.071
11	3516.23	63.755	3.244	3668.61	3487.3	26.206	0.465

Figure 7: IR Sample (S6) Mixture of EDTA & Mefenamic Acid

3.2 Combination Data Analysis of Selective Compounds

Overall interpretation between Mefenamic acid and selective metals were shown at (Figure 08-10) and (Table 1-3). Microsoft Excel (MS Excel, 2010) was used to analyze all data.

Table 1. IR interpretation:

Interpretation	WAVELENGTH Mefenamic acid (cm^{-1})	Copper metal (cm^{-1})	Mixture (cm^{-1})
N-H	3309	N/A	N/A
O-H	3014.74	3444.87	3429.43
C-H	2860.43	N/A	N/A
C=O	1157.29	N/A	1327.09
C-N	N/A	N/A	1651.07
C=C	1575.84	N/A	1577.77
S=O	N/A	1097.5	1101.35

**IR interpretation of mefenamic acid, copper metal and mixture, wavelength unit- cm^{-1}*

Discussion:

Here measured any interaction between the drugs are identical change to IR pattern. Here mefenamic acid revealed its spectra of 3309 cm^{-1}, 3014 cm^{-1}, 2860 cm^{-1}, 1157 cm^{-1} and 1575 cm^{-1} indicating N-H, O-H, C-H & C=C groups. Copper metal was given spectra at 3444 cm^{-1} & 1097 cm^{-1}. Besides mixture of mefenamic acid and copper metal revealed one spectra for 3429 cm^{-1} wavelength which have given no possible interaction because of same wavelength. On the other hand, stretching peaks at 1327 cm^{-1}, 1651 cm^{-1} & 1577 cm^{-1} wavelength and the combination get effective changes that alter the whole result of FT-IR pattern. So there is a possible interaction with C=O, C-N & C=C groups which formed respectively by sp^3 , sp, sp^2 hybridization [37].

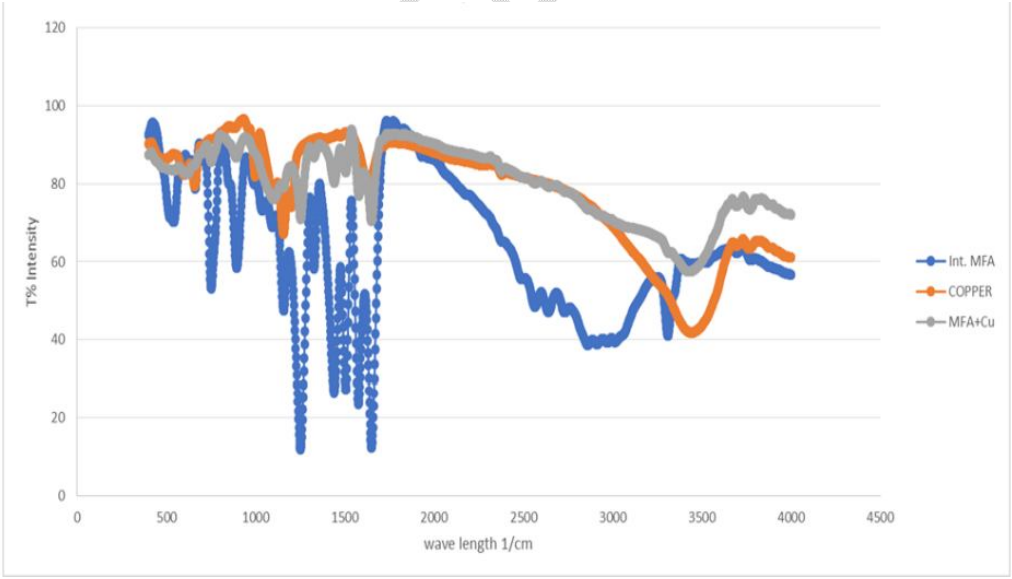

Figure 8: Combination of Mefenamic acid, Copper Sulfate & Mixture

Table 2. IR interpretation:

Interpretation	WAVELENGTH Mefenamic acid (cm^{-1})	Zinc metal (cm^{-1})	Mixture (cm^{-1})

N-H	3309	N/A	3444.87
O-H	3014.74	3564.45	N/A
C-H	2860.43	N/A	N/A
C=O	1157.29	N/A	1651
C-N	N/A	N/A	N/A
C=C	1575.84	N/A	1577.77
S=O	N/A	1101.35	1099.43

**IR interpretation of mefenamic acid, zinc metal & mixture, wavelength unit-cm^{-1}*

Discussion:

Here measured any interaction between the drugs are identical change to IR pattern. Here mefenamic acid revealed its spectra of 3309 cm^{-1}, 3014 cm^{-1} , 2860 cm^{-1} , 1157 cm^{-1} & 1575 cm^{-1} indicating N-H, O-H, C-H & C=C groups. Zinc metal was given spectra at 3444 cm^{-1} & 1101 cm^{-1}. Besides mixture of mefenamic acid and copper metal revealed no spectra for wavelength which have given no possible interaction because of same wavelength. On the other hand, stretching peaks at 3444 cm^{-1}, 1651 cm^{-1} & 1577 cm^{-1} wavelength and the combination get effective changes that alter the whole result of FT-IR pattern. So there is a possible interaction with N-H, C-N & C=C groups which formed respectively by sp^3 , sp, sp^2 hybridization [37].

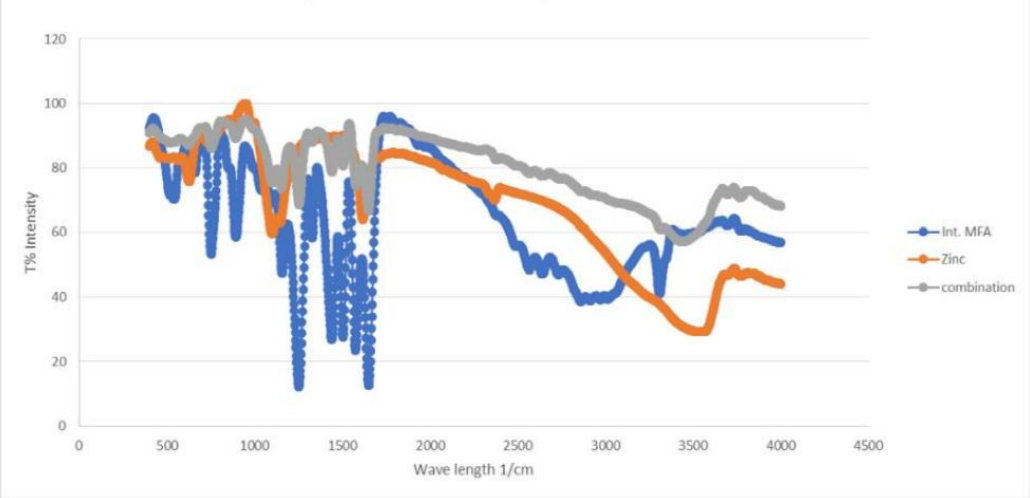

Figure 9: Combination of Mefenamic acid, Zinc & Mixture

Table 3. IR interpretation:

Interpretation	WAVELENGTH Mefenamic acid (cm^{-1})	EDTA (cm^{-1})	Mixture (cm^{-1})
N-H	3309	N/A	3402.43
O-H	3014.74	3776, 3431	3028.43
C-H	2860.43	2926	N/A

C=O	1157.29	1593	1406
C-N	N/A	1169	1319.31
C=C	1575.84	1029	1253.73
S=O	N/A	1080	1055.06

**IR interpretation of mefenamic acid, EDTA & mixture, wavelength unit- cm^{-1}*

Discussion:

Here measured any interaction between the drugs are identical change to IR pattern. Here mefenamic acid revealed its spectra of 3309 cm^{-1}, 3014 cm^{-1}, 2860 cm^{-1}, 1157 cm^{-1} and 1575 cm^{-1} indicating N-H, O-H, C-H & C=C groups. EDTA was given spectra at (3776, 3431) cm^{-1}, 2926 cm^{-1}, 1593 cm^{-1}, 1169 cm^{-1} , 1029 cm^{-1} & 1080 cm^{-1} . Besides mixture of mefenamic acid and EDTA revealed one spectra for 3028 cm^{-1}, 1406 cm^{-1} & 1253 cm^{-1} wavelength which have given no possible interaction because of same wavelength. On the other hand, stretching peaks at 3402 cm^{-1} wavelength and the combination get effective changes that alter the whole result of FT-IR pattern. So there is a possible interaction with N-H groups which formed respectively by sp^3 hybridization [37].

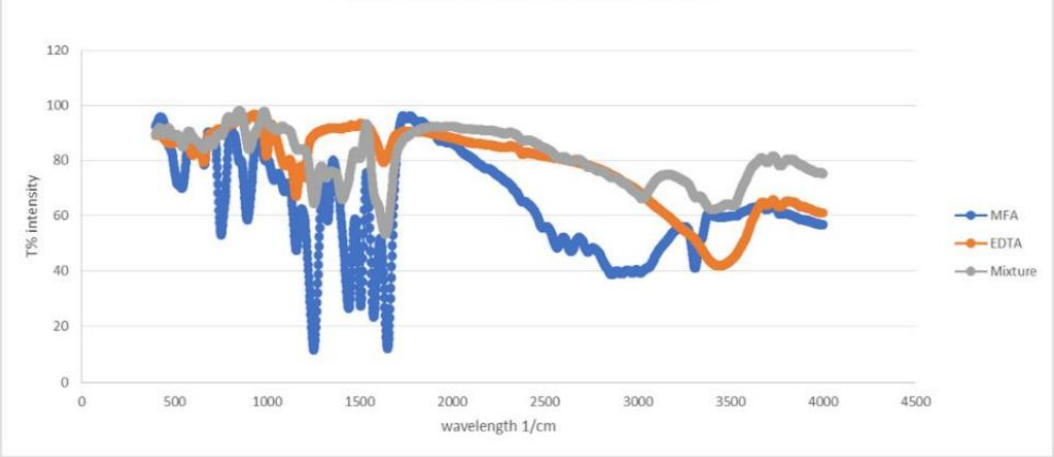

Figure 10: Combination of Mefenamic acid, EDTA & Mixture

4. CONCLUSION

To reduce drug interactions much research is being done to find novel medications. It is recently found out that metal-based complexes decrease antiviral, antibacterial, and anticancer action. In order to construct actively functioning medications, it's vital to study the ability of physiologically active metal ions to interact with metalloproteinase like albumin, which transport and distribute these metal ions. The current research used FT-IR spectroscopy technique to analyze interactions of Cu^{2+}, Zn^{2+}, $EDTA^{4-}$ with mefenamic acid. Variations in the amino group of mefenamic acid after metal complexation demonstrated the metal ions' binding interactions. Metal ion interactions with acid product altered the functional structure, resulting in a negligible reduction in mefenamic acid structure. All significant interactions were supported by functional group of metal ion and drug product binding intensity. The present findings set a standard for repeatable mefenamic acid metal ion research.

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ABBREVIATIONS

MFA- MEFENAMIC ACID
COX 1- CYCLOOXYGENASE 1
COX 2- CYCLOOXYGENASE 2
PGE 2- PROSTAGLANDIN E2
EDTA- ETHYLENEDIAMINETETRAACETIC ACID
NSAID- NON-STEROIDAL ANTI-INFLAMMATORY DRUG
GI- GASTRO INTESTINAL
GABA- GAMMA-AMINOBUTYRIC ACID
MCT- MERCURY CADMIUM-TELLURIDE
FT-IR- FOURIER TRANSFORM INFRARED