IJPSR (2023), Volume 14, Issue 12 (Research Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 26 April 2023; received in revised form, 08 July 2023; accepted 28 July 2023; published 01 December 2023

ULTRASOUND SYNTHESIS, SPECTRAL CHARACTERIZATION AND ANTIMICROBIAL ACTIVITIES OF FE (III) COMPLEXES OF B-DIKETONES

Aakash S. Singare [1], Jaiprakash S. Dargad [2] and Nanda S. Korde [* 2]

Swami Ramanand Teerth Marathwada University [1], Nanded - 431606, Maharashtra, India.
Department of Chemistry & Industrial Chemistry [2], Dayanand Science College, Latur - 413512, Maharashtra, India.

Keywords:

β-diketones, Transition metal complexes, Ultrasound irradiation, Baker-Venkataraman transformation, Mass, ^{1}H-NMR, ^{13}C-NMR, IR, UV, Antifungal, Antibacterial

Correspondence to Author:
Dr. Nanda Sheshrao Korde

Associate Professor,
Department of Chemistry & Industrial Chemistry, Dayanand Science College, Latur - 413512, Maharashtra, India.

E-mail: nandineekorde0@gmail.com

ABSTRACT: Consistently the preparation of transition metal complexes of β-diketones has been (and it still is) an area of the highest interest for inorganic and organic chemists, as can be inferred considering the quantity and diversity of research developed in this field. 1,3- Diketones are wide range of valuable molecules including several types of carbocycles and heterocycles hence have high interest. In fact, excessive amount of therapeutical uses are associated with these 1,3- Diketone compounds. The present work is based mainly on the ultrasound irradiation synthesis of various β-diketone ligands and their Fe (III) complexes. At ambient temperature, the clinically active and functionalized various β-diketones has been synthesized from Baker–Venkataraman transformation and its Fe (III) complexes has been prepared and characterized by physical, spectral and analytical data. The different spectroscopic analysis like Mass, ^{1}H-NMR, ^{13}C-NMR, IR, UV and elemental analysis were done. The functionalized beta-diketones showed a certain behaviour and behaved as bidentate ligand and co-ordinate with the transition metal atom through beta-diketo system. The complexes have general formula [ML_2]. The biological activities like antibacterial and antifungal were performed for the synthesized compounds. The biological screening data indicated that the transition metal complexes are more potent antibacterial, antifungal and antioxidant agents than the parent functionalized beta diketones against different species of bacteria and fungi. This constitutes a new group of compounds. The thermal stability of the newly synthesized metal complexes has been studied.

INTRODUCTION: For almost a century the chemistry of 1,3-diketones has attracted the attention of scientists. Diketones are the key intermediates for the synthesis of heterocycles such as isoxazole [1], flavones [2], pyrimidine [3], triazole [4], pyrazole[5] and benzodiazepines [6]. β-diketone for eg. Anabena β-diketone hydrolase have some enzymatic activities [7], rare earth doped complexes of β-diketone were studied as high density optical recording materials for blue optoelectronics [8]. β-diketone lanthanide complexes are studied for their optical properties like fluorescence [9, 10] and electroluminescence [11].

β-diketone are clinically important molecules hence they having some biological activities such as antiviral [12], anti-tumor [13-14], anticancer [15], insecticidal [16], antioxidants [17] and antibacterial [18]. Many naturally occurring 1,3-diketones such as dibenzoylmethane (DBM-1) has been the therapeutic option for cancer treatment, as well as for anti-inflammatory and dementia, has recently

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.14(12).5824-30

This article can be accessed online on www.ijpsr.com

DOI link: https://doi.org/10.13040/IJPSR.0975-8232.14(12).5824-30

reviewed [19]. On the other hand, some novel 3,4-disubstituted pyrazole derivatives have shown antifungal and antibacterial properties [20]. Australifungin, isolated from sporomiella vities of Fe (III) ustralis shown a prominent antifungal activity [21]. Additionally the chemical structures, of β-diketone can be considered as excellent drug, candidate showing multi-target potency. For instance, asymmetrical 1,3-diketones with anti-inflammatory and anti-cancer activities, synthesized by reaction between N-acyl benzotriazoles and ketones based on soft enolization [22]. Thus β-diketones act as very important median to various heterocyclic compounds [23] and also used as chelating agents [24]. It is used as a extractant for copper ions [25]. The research being energizing by the versatility and these compounds as laser chelates [26], chemical and photochemical catalysts [27], shift reagents [28], extraction agents [29]. Studies on the β-diketone and their metal complexes are being of more and more interest to the chemists and biochemists [30]. This paper reports the synthesis of various ligands by Baker-Venkatraman re-arrangement [31] and their Fe (III) complexes, spectral analysis and antimicrobial screening of the compounds.

EXPERIMENTAL METHODS:

Preparation of 2-acetylphenyl, 4-methoxy benzoate:

Compound 1: To the mixture of 2-hydroxy acetophenone (1.36g, 0.01mol) and 4-methoxy benzoic acid (1.52g,0.01mol), a dry pyridine (5-6ml) and phosphorus oxychloride ($POCl_3$) about 1ml were added drop wise at 0°C with the constant stirring. Then reaction mixture was kept in ultrasonicator for 4-5 hrs. After completion of the reaction (monitored by TLC), the reaction mixture was then cooled and poured on cold water containing HCl (1M) and solid product obtained was filtered and washed with cold methanol (10ml) and after that with distilled water. It was then re-crystallized from ethanol. A similar procedure was adopted for the preparation of other compounds namely:

a) 2-acetylphenyl, 4-ethoxy benzoate

b) 2-acetylphenyl, 4-bromo benzoate

c) 5-chloro, 2-acetylphenyl, 4-methoxy benzoate

d) 5-chloro, 2-acetylphenyl, 4-ethoxy benzoate

e) 5-chloro, 2-acetylphenyl, 4-bromo benzoate

Preparation of 1-(2-hydroxyphenyl)-3-(4-methoxyphenyl) propane-1,3-dione [L_1]:

Compound 2: For the preparation of 1-(2-hydroxyphenyl)-3-(4-methoxyphenyl)propane-1,3-dione compound 1, (2.70g,0.01mol) was dissolved in dry pyridine (about 10ml) and to this powdered KOH (1.12g,0.02mol) was added and the reaction mixture was irradiated in ultrasound for 1-2hrs. After completing the reaction (monitored by TLC), the mixture was poured on in ice-cold water and acidified with conc. HCl. The solid obtained was then filtered off and it was re-crystallized from absolute alcohol.

Yield: 85% M.P: 115°C. FTIR(KBr)cm^{-1}: FT-IR (KBr) cm-1: 2912.98 (-OH), 1708.01 (C=O), 1487.74 (Ar C=C).^{1}H-NMR (300 MHz, $CDCl_3$,-d6): δ =7.9 (d, 3H, Ar-H), 6.8 (m, 5H, Ar-H),7.4 (q , 1H,=CH-), 3.9 (s,3H, OCH_3) ,12.2 (s, 1H, OH), 15.9 (s, 1H, Enolic-OH), ^{13}C-NMR (300 MHz, $CDCl_3$), δ 190.0(s, C-1,C=O), 92.8 (s, C-2,-CH=), 185.1(S,C-3), 126.0(d, C-1',C-1''), 162.8 (s,C-2'), 118.4 (s,C-3'), 135.8 (s,C-4'), 119.3 (s,C-5'), 128.7 (s, C-6,'), 128.0 (d, C-2'',C-6''), 114.1(d, C-3'', C-5''), 162.0 (s, C-4''), 55.8 (s,C-7'',0CH_3). UV/Vis (DMSO) nm: 370,410; EC-MS: 270.28 (M+23).

A similar procedure was adopted to prepare following ligands:

a) 1-(2-hydroxyphenyl)-3-(4-ethoxyphenyl) propane-1,3-dione,

b) 1-(2-hydroxyphenyl)-3-(4-bromoyphenyl) propane-1,3-dione,

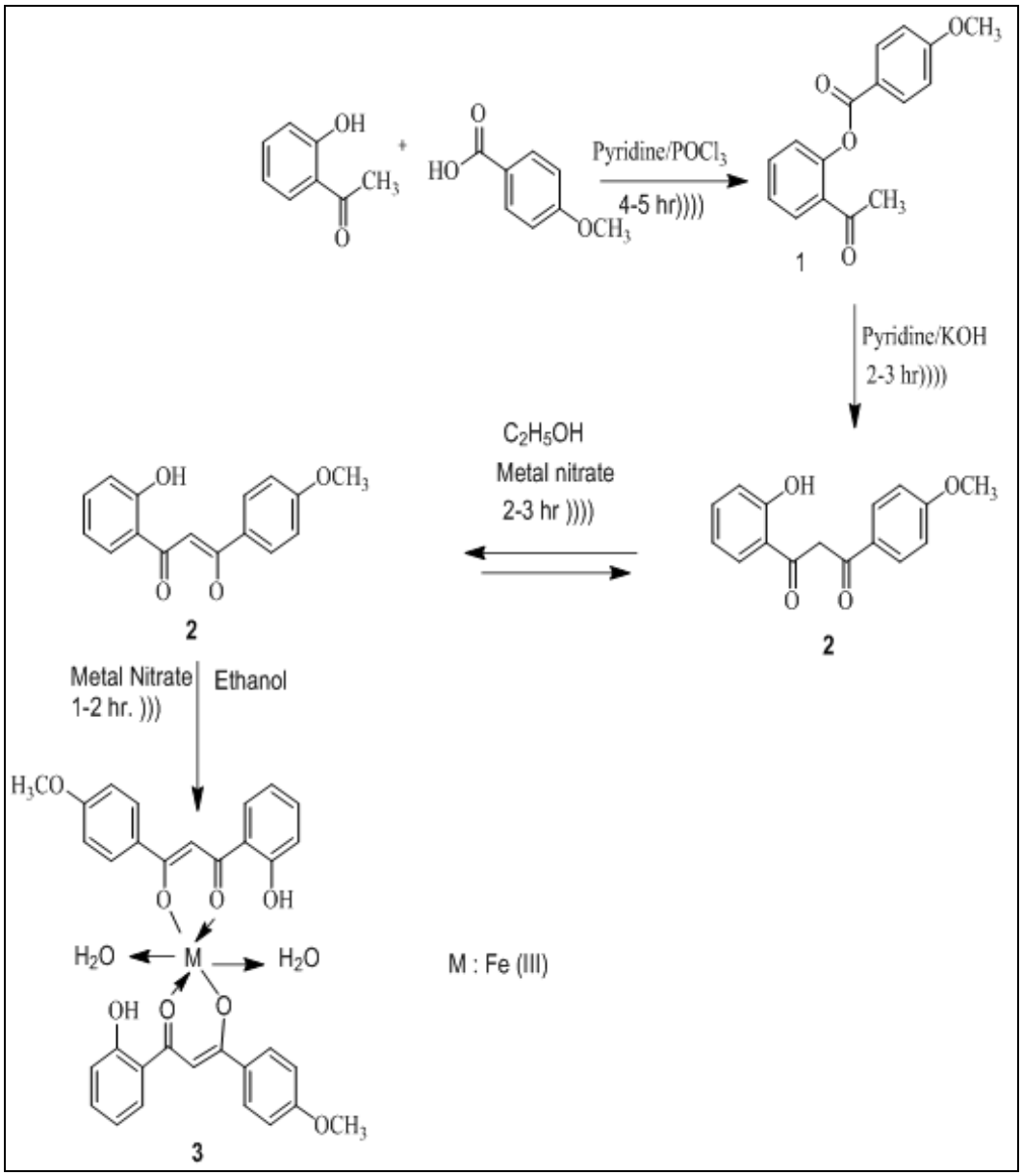
c) 1-(5-chloro,2-hydroxyphenyl)-3-(4-methoxyphenyl).propane-1,3-dione,

d) 1-(5-chloro,2-hydroxyphenyl)-3-(4-ethoxyphenyl) propane-1,3-dione,

e) 1-(5-chloro,2-hydroxyphenyl)-3-(4-bromoyphenyl)propane-1,3-dione.

Preparation of Fe (III) Complex: The mixture of compound 2 (5.40g, 0.02mol), anhydrous Fe (III) nitrate (4.04g, 0.01mol) and 20 ml anhydrous ethanol was added and irradiated for 1-2 hrs under

ultrasound. The obtained solid was washed with hot ethanol and recrystallised from ethyl acetate. The brownish crystals of Fe (III) β- diketonate obtained. Yield: 78%; mp: 348°C. A similar procedure was adopted to prepare Fe (III) complexes of remaining ligands.



SCHEM 1: SYNTHESIS OF 1-(2-HYDROXYPHENYL)-3-(4-METHOXYPHENYL) PROPANE-1, 3-DIONE AND Fe(III) COMPLEX

RESULT AND DISCUSSION:

Antimicrobial Activity: Antimicrobial screening [32-33] is done by using the method called Kirby Baur's disc diffusion technique using dimethyl sulfoxide as a solvent. The streptomycin was used as a standard and the method were tested against bacteria such as *Staphylococcus aureus* and *Bacillus subtilis* (Gram +ve); *Escherichia coli* (Gram-ve) and against fungi like *Fusarium oxysporum* and *Aspergillus niger*. A uniform suspension of a test organism of 24 hours old cultures was prepared in test tube holding a sterile saline solution. A 20 ml sterile Muller-Histon agar was then added in each of the petri plates. The plates were rotated to ensure the uniform mixing of micro-organism in agar medium which was then allowed to solidify. Then by keeping sterile Whatman filter paper disc were dipped in the solution of each compound and placed on labeled plates. Then these petri plates were kept in refrigerator for half an hour for diffusion then bacterial cultured plate incubated at 37°C for 24

hours and fungal cultured plate were incubated at 30°C for 24 hours. The antibacterial activity was examined by measuring the diameter of inhibition zone formed. The zones were measured in terms of mm. The results of antimicrobial activity of synthesized compounds have shown that the transition metal complex reveals the greater antimicrobial activity than that of the ligand. The observed data of antimicrobial activity of synthesized compounds and the standard is given in **Table 1.**

TABLE 1: DATA OF ANTIMICROBIAL ACTIVITY OF LIGANDS (L_1-L_6) WITH THEIR FE (III) COMPLEXES

Compounds	Zone of Inhibition in mm				
	Antibacterial activity			Antifungal activity	
	Bacillus subtilis	*Staphylococcus aureus*	*E. coli*	*Fusarium oxysporum*	*Aspergillus niger*
L_1	6	6	7	7	7
ML_1	8	7	8	7	9
L_2	7	7	6	8	7
ML_2	7	8	8	7	7
L_3	7	7	7	7	7
ML_3	7	6	8	8	6
L_4	7	8	6	7	6
ML_4	7	8	8	6	
L_5	7	6	7	7	7
ML_5	8	7	8	6	7
L_6	7	7	7	7	7
ML_6	8	7	6	7	8
stryptomycin	6	6	7	6	6

TABLE 2: ANALYTICAL DATA OF Fe (III) COMPLEXES

Complex	Molecular formula	Mol. Wt	% Found (calculated)					
			C	H	Br	Cl	O	Fe
ML_1	$C_{32}H_{36}FeO_{12}$	632	60.97 (60.11)	4.80 (4.97)	----	----	25.38 (25.11)	8.86 (8.17)
ML_2	$C_{33}H_{38}FeO_{12}$	660	62.02 (61.08)	5.20 (5.17)	----	----	24.30 (24.01)	8.48 (7.35)
ML_3	$C_{32}H_{36}FeBrO_{12}$	730	49.48 (49.41)	3.32 (3.15)	21.95 (21.30)	----	17.58 (17.04)	7.67 (7.01)
ML_4	$C_{32}H_{36}FeClO_{12}$	701	54.96 (54.41)	4.04 (4.12)	-----	10.14 (10.02)	22.88 (22.30)	7.99 (7.12)
ML_5	$C_{33}H_{38}FeClO_{12}$	729	56.14 (55.23)	4.43 (4.47)	----	9.75 (9.13)	22.00 (21.45)	7.68 (7.07)
ML_6	$C_{32}H_{36}FeClBrO_{12}$	799	45.21 (45.15)	2.78 (2.01)	20.05 (19.71)	8.90 (8.19)	16.06 (15.77)	7.01 (6.91)

TABLE 3: PHYSICAL CHARACTERISTICS OF LIGANDS WITH THEIR Fe (III) COMPLEXES

Sr. no.	Compounds	% Yield	Colour	Melting point
1	ML_1	78	Blackish brown	348°C
2	ML_2	82	Blackish brown	324°C
3	ML_3	79	Blackish brown	330°C
4	ML_4	84	Blackish brown	319°C
5	ML_5	81	Blackish brown	338°C
6	ML_6	80	Blackish brown	345°C

Molar Conductance and Magnetic Susceptibility: The new synthesized ligands and their Fe(III) complexes are in the solid state and are very stable at room temperature. The synthesized ligands are soluble in common organic solvents, and their Fe(III) complexes are soluble in DMF and DMSO. Due to the continuous variation results, it is concluded that the stoichiometry of the complexes are conformable with the ratio 1:2 for metal to ligand. The molar conductivity of all complexes were measured in dimethyl formamide and values were observed between 61.3-67.2 $ohm^{-1}cm^2$ mol^{-1} indicating their non-electrolytic nature [34].

TABLE 4: MOLAR CONDUCTANCE AND MAGNETIC SUSCEPTIBILITY OF Fe(III) COMPPLEXES

Sr. no.	Complex	Molar conductance	Xdia × 10^{-6}	μ_{eff} (B.M.)
1	ML_1	61.3	-513.15	5.55
2	ML_2	62.4	-564.21	6.01
3	ML_3	67.2	-319.66	5.62
4	ML_4	63.1	-489.25	5.92
5	ML_5	65.6	-535.11	6.37
6	ML_6	64.8	-521.17	6.06

Spectral Characterizations:

TABLE 5: INFRARED SPECTRAL DATA, UV AND MASS OF SYNTHRESIZED COMPOUNDS

Sr. no.	Compound	IR (cm^{-1})					UV	Mass spectra	
		ν(C=O)	ν(C=C)	ν(OH)	C-Br bond	M-O	λ_{max} for >C=O (nm)		Donor atom
1	L_1	1708	1599	2912			410,370	270.28	O-O
	ML_1	1682	1602	3187,3290		620	---	---	---
2	L_2	1702	1565	2921	----	----	410,360	284.3	O-O
	ML_2	1692	1599	3243,3526	----	562	----	----	----
3	L_3	1718	1558	3069	1223	----	412,360	319.15	O-O
	ML_3	1685	1580	3271,3180	----	575	----	----	----
4	L_4	1741	1591	2919	----	----	412,374	304.73	O-O
	ML_4	1670	1597	3216,3417	----	562	----	----	----
5	L_5	1720	1605	2977	----	-----	410,370	318.75	O-O
	ML_5	1650	1605	3244,3412	----	600	----	----	----
6	L_6	1743	1587	2916	1239	----	410,360	353.6	O-O
	ML_6	1690	1634	3216,3072	----	606	----	----	----

^{1}H-NMR: ^{1}H-NMR spectra of β-diketones showed two proton signals at a range δ15.4-17.7 ppm and δ 11.9-12.2 ppm which corresponds to enolic proton and phenolic proton adjacent to carbonyl group. It confirms the formation of β-diketone. The compound in enolic form is more stable than that of ketonic one [35].

^{13}C-NMR: In the ^{13}C-NMR spectra all synthesized β-diketone ligands gives characteristic peak at ketonic carbon C_1, C_2 and enolic carbon C_3 are in the ranges δ 189.5-193.8, δ 91.2-93.1 and δ 176.8-185.1 ppm confirms the formation of β-diketone [36].

TABLE 6: INDUCED X-RAY DIFFRACTION OF COMPLEX Fe-L_1

Peak no.	2θ(obs)	2θ(cald)	d(obs)	d(cald)	Miller indices of planes			Intensity (%)
					h	k	I	
1	25.796	25.963	3.4509	3.4291	1	0	1	40.0
2	27.298	27.015	3.2643	3.2979	-1	0	2	35.1
3	28.988	28.996	3.0777	3.0769	-1	1	2	23.1
4	30.697	30.708	2.9101	2.9091	-1	2	1	41.1
5	32.094	32.453	2.7866	2.7566	0	1	3	28.2
6	38.012	37.655	2.3652	2.3869	0	3	2	30.0
7	57.077	56.882	1.6123	1.6174	0	2	5	31.2
8	61.199	61.229	1.5132	1.2125	1	3	4	30.1
9	64.311	64.292	1.4473	1.4477	1	5	2	24.1
10	66.287	66.419	1.4088	1.4064	0	6	1	22.0

TABLE 7: INDUCED X-RAY DIFFRACTION OF COMPLEX Fe-L_3

Peak no.	2θ(obs)	2θ(cald)	d(obs)	d(cald)	Miller indices of planes			Intensity (%)
					h	k	I	
1	21.700	21.960	4.0921	4.0443	-1	0	0	60.0
2	23.492	23.144	3.7839	3.8399	0	2	1	55.1
3	28.192	28.012	3.1628	3.1827	1	1	1	45.1
4	30.302	30.400	2.9472	2.9379	-1	2	0	42.2
5	34.115	34.313	2.6260	2.6113	-1	0	3	40.5

6	35.597	35.930	2.5200	2.4974	-1	1	3	35.3
7	37.708	37.655	2.3835	2.3869	0	3	2	30.1
8	55.878	55.773	1.6440	1.6469	1	2	4	32.1
9	79.082	79.075	1.2099	1.200	-2	4	5	30.6
10	85.107	85.087	1.1390	1.1392	-3	2	5	28.1

Thermogram of Fe(III) Complexes: In nitrogen atmosphere using α-Al_2O_3 as reference, the simultaneous TG/DT analysis of a complex of Fe (III) was studied. At the temperature range 185-200°C the thermogram curve of Fe (III) complex shows weight loss 7.40% (calcd. 7.78%) and at 190°C it shows keen endotherm which distinctly designate removal of two coordinated water molecules [37]. The anhydrous complex revealed a single step decomposition with 70% mass loss and a broad endothermic peak in the DTA at the temperature range from 210°C to 820°C. The Fe_2O_3 is obtained as the end product.

CONCLUSION: In the present work ligands and its Fe(III) complexes were synthesized. On the basis of their spectral analysis the structures were elucidate. Due to presence of enolic proton and phenolic proton adjacent to carbonyl group, the prepared diketones having characteristics peaks of ^{1}H NMR and ^{13}C NMR spectra. It has been suggested that the antibacterial and antifungal activity of ligands (L_1)–(L_6) increased upon chelation/coordination with the transition of metal atoms. By coordinating metal ion with ligands, the chelation process reduces the polarity of metal ion which increase the lipophilic nature of the metals and enhanced its penetration through the lipoid layer of cell membrane of the microorganism. Also, it has been suggested that beta-diketones having combined two or more pharmacophore sites played an important role in antibacterial and antifungal activity. This functionalized system may be responsible for the enhancement of hydrophobic character and liposolubility of the molecules.The synthesized compounds were screened in vitro for antifungal, antibacterial and found to be promising candidates as new antibacterial, antifungal agents.

ACKNOWLEDGEMENTS: One of the authors is thankful to Head, Department of chemistry, Dayanand Science College, Latur for providing the laboratory facility and Head, Department of microbiology, Dayanand Science College, Latur for providing the laboratory facility for evaluation of biological studies.

CONFLICTS OF INTEREST: Nil

REFERENCES:

1. Rajiv Khobare, Ramkrushna P Pawar, Khandu D Warad, Amit Tayade and Chandrakant B Mane: An Efficient Synthesis Of Substituted Isoxazole Derivatives Using Ultra Sound Sonication Method, European Journal of Molecular & Clinical Medicine 2020; 7: 7.
2. Manisha Bansal, Kulvir Kaur, Jyoti Tomar and Lakhvir Kaur: Synthesis of Flavones, Biomedical 2017; 1(6): 1752-1755.
3. Mahmoud S. Tolbaa, Adel M. Kamal El-Deanb, Mostafa Ahmeda, Reda Hassaniena, Mostafa Sayeda, Remon M. Zakib, Shaaban K. Mohamedc and Sameh A: Zawame and Shaban A. A. Abdel-Raheemf: Synthesis, reactions, and applications of pyrimidine derivatives, Current Chemistry Letters 2022; 11: 121–138.
4. Mohammed M. Matin, Priyanka Matin, Md. Rezaur Rahman, Taibi Ben Hadda, Faisal A. Almalki, Shafi Mahmud, Mohammed M. Ghoneim, Maha Alruwaily and Sultan Alshehri: Triazole and their derivatives: Chemistry, synthesis and therapeutic applications, Frontiers in Molecular Biosciences 2022; 9: 864286.
5. Vishvdeep Sisodia, Arpan Pandya, rutvik Patel, Mansi Patel, Hiteshri Patel and Shanta Raj Lakshmi: A Short review on synthesis of pyrazole derivatives and their properties. Inter J of Creative Res Thoughts 2022; 10: 4.
6. Shrikrishna D. Tupare and Pawar RP: Highly Efficient Synthesis and Antibacterial of 1, 5- Benzodiazepines under Microwave Irradiation, International Journal of Applied Chemistry 2017; 13(2): 369-376.
7. Benette J, Whittingham J, Brzozowski A, Leonard P and Grogan G: Structural Characterization of a β-diketone Hydrolyse from the Cyanobacterium Anabaena sp. PCC 7120 in Native and Product-Bound Forms, a Coenzyme A-Independent Member of the Crotonase Suprafamily, Biochemistry 2007; 46: 137-144.
8. Ma D, Wu Y and Zuo X: Rare earth doped β-diketone complexes as promising high-density optical recording materials for blue optoelectronics, Materials Letters 2005; 59: 3678.
9. Luo YM, Chen Z, Tang RR, Xiao LX and Peng HJ: Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 2008; 69: 513.
10. Xiao LX, Luo YM, Chen Z, Li J and Tang RR: Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 2008; 71: 321.
11. Metlin MT, AMbrozevich SA, Metlina DA, Vitukhnovsky AG and Taydakov IV: Lumenescence of pyrazolic 1,3-diketone Pr+3 complex with 1,10-phenanthroline, Journal of Luminescence 2017; 188: 365-370.
12. Khudina OG, Elkina NA, Ya V. Burgart, Ezhikova MA, Kodess MI, Ya. L. Esaulkova, Zarubaev VV, Shtro AA, Triandafilova GA, Krasnykh OP, Malysheva KO, Gerasimova NA, Evstigneeva NP and Saloutin VI: Russian Chemical Bulletin 2023; 27: 2670-2684.
13. Shokova EA, Kim JK and Kovalev VV: 1,3-Diketones. Synthesis and Properties, Russian Journal of Organic Chemistry 2015; 51(6): 755–830

14. Sheikh J, Ingle V and Juneja H: Synthesis of novel antibacterial agents 1-(2'.4'-dihydroxy-5'-cholorophenyl)-3- arylpropane-1,3-diones, E-J. Chem 2009; 6: 705-712.
15. Jakob Kljun and Iztok Turel: -Diketones as Scaffolds for Anticancer Drug Design – From Organic Building Blocks to Natural Products and Metallodrug Components. Eur J Inorg Chem 2017; 1655–1666.
16. Pengmian Huang, Minghui Wu, Liang Lv, Liqi Zhou, Xiangwei Liu and Jiyong Liu: Tetraherdon Letters 2022; 96: 153743.
17. Carla I. Nieto, María Pilar Cornago, María Pilar Cabildo , Dionisia Sanz, Rosa M. Claramunt, María Carmen Torralba, María Rosario Torres, Diana Martínez Casanova, Yaiza Rebeca Sánchez-Alegre, Esther Escudero and José Luis Lavandera: Evaluation of the Antioxidant and Neuroprotectant Activities of New Asymmetrical 1,3-Diketones. Molecules 2018; 23: 1837.
18. Sushil Pagariya: Synthesis and Antimicrobial Studies of Newly Synthesized 1-Substituted-3- Substituted Propane-1, 3-Diones, Journal of Chemical and Pharmaceutical Research 2021; 13(11): 01-07
19. Pravin S. Bodkhe, Sushil K. Pagariya and Prafulla P. Chaudhari: *In-vitro* Anti-Inflammatory and Antioxident activity of novel 1-substituted-3-Substituted propane -1,3-Dionеs (β-Diketones) derived from vanillin. Rasayan J Chemistry 2023; 16(1): 434-439.
20. Ganesh Akula, Kaushal K Chandrul and Bhikshapathi Dvrn: Synthesis, characterization and antimicrobial activity of some novel 3,4-disubstituted pyarazole derivatives, Asian J of Pharma and Clin Res 2020; 13: 1.
21. Williams DR, Cullen Klein J, Kopel LC, Nguyen N and Tantillo DJ: Studies towards australifungin. A synthesis dilemma of regioselective keto-enol tautomerization. Org Lett 2016; 18: 424-427.
22. Porchezhiyan V, Kalaivani D and Shobana SE: Synthesis, docking and *in-vitro* evaluation of L-proline derived 1,3-diketones possessing anti-cancer and anti-inflammatory activities. J Mol Struct 2020; 1206: 127754.
23. Poui Erik Hansen: Structural Studies of β-Diketones and Their Implications on Biological Effects. Pharmaceuticals 2021; 14(11): 1189;
24. Kurajica S: A Brief Review on the Use of Chelation Agents –Diketones in Sol-gel Synthesis with Emphasis on -Ketoesters and Chem Biochem 2019; 33(3): 295–301.
25. Katarzyna Witt and Elzbieta Radzyminska-Lenarcik: Studies of the aromatic β-diketones as extractant of copper ions, MEC, E3S Web of Conferences 2017; 18: 01016.
26. Samelson H: Laser phenomena in europium chelates. J Chem Phys (III) 1965; 42: 1081.
27. Veierov D, Bercovici T, Fisher E, Mazur Y and Yogev A: Photoisomerization of beta-diketones and beta-keto esters, J Am Chem Soc 1973; 95(24): 81738175.
28. Hinckley CC: Paramagnetic shifts in solutions of cholesterol and the dipyridine adduct of trisdipivalomethanatoeuropium (III). A shift reagent. J Am Chem Soc 1969; 91: 5160-5162.
29. Poskanzerand AM and Foremn BM: The chemistry of trhe Actinide and Transactinide elements. J Inorg Nuc Chem 1961; 16: 323.
30. Patharkar VR, Jadhav SM, Munde AS, Shankarwar SG and Chondhekar TK: Synthesis and spectral studies of β-diketone metal complexes, Inorganic chemistry An Indian Journal 2009; 4(4): 184-190.
31. Gonzalo de Gonzalo and Andrés R. Alcántara: Recent Developments in the Synthesis of β-Diketones, Pharmaceuticals 2021; 14: 1043.
32. Anjali S. Rajbhoj, Nanda S Korde, Suresh T. Gaikwad and Seema S. Korde: Efficient Ultrasound synthesis of β-diketone and its metal complexes, Der Pharma Chemica 2012; 4(5): 1868-1872.
33. Chohan Z, Arif M, Akhtar A and Supuran C: Metal-based antibacterial and antifungal agents: synthesis, characterization, and *in-vitro* biological evaluation of Co(II), Cu(II), Ni(II), and Zn(II) Complexes with Amino Acid-Derived Compounds J. Bioinorganic Chemistry and Applications 2006; 13: 83131.
34. Verma P, Sheikh J and Juneja H: Synthesis of β-diketone and its Metal Complexes. World Applied Sciences Journal 2011; 14(8): 1154-1157.
35. Nanda S. Korde, Yuvraj P. Sarnikar and Annarao M. Chougule: Ultrasound irradiation assisted synthesis and antimicrobial screening of Novel transition metal complexes of β-diketone, World Journal of Pharmacy and Pharmaceutical Sciences 2016; 5(11): 1104-1110.
36. Nanda S. Korde, Anjali S. Rajbhoj, Suresh T. Gaikwad and Bhimrao C. Khade: Ultrasound irradiation assisted synthesis and antimicrobial screening of Novel cyclic β-diketones and its transition metal complexes, World J of Pharmaceutical Research 2015; 4(10): 1571-1578.
37. Veeraraj A, Sami P and Raman N: Copper (II) complex of 3-cinnamalideneacetylacetone: Synthesis and characterisation, Prod. Indian Acad. Sci, (Chem Sci), 2000; 112(5): 515–521.

How to cite this article:
Singare AS, Dargad JS and Korde NS: Ultrasound synthesis, spectral characterization and antimicrobial activities of Fe (iii) complexes of β-diketones. Int J Pharm Sci & Res 2023; 14(12): 5824-30. doi: 10.13040/IJPSR.0975-8232.14(12).5824-30.