3.3.2 Number of research papers per teachers in the Journals notified on UGC website during the year

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Synthesis, characterization, and supercapacitor applications of Ni-doped CuMnFeO4 nano Ferrite	Dr. Santosh Uke	Physics	Ceramic International	2023	Print ISSN: 0272-8842, Online ISSN: 1873-3956	https://www.sciencedirect.com/science/article/abs/pii/S0272884223014992
Benzimidazole: A Versatile Scaffold for Drug Discovery and Beyond-A Comprehensive Review of Synthetic	Dr. Santosh Uke	Physics	Results in Chemistry	2023	Online ISSN: 2211-7156	https://www.sciencedirect.com/science/article/pii/S2211715623003788
Effect of Zinc Nitrate on Morphology and Particle Size of Nano-sized Zinc Oxide	Dr. S. D. Charpe	Physics	Tuijin Jishu/Journal of Propulsion Technology	2023	ISSN: 1001-4055	https://www.propulsiontechjournal.com/index.php/journal/article/view/4841

The following Research papers have been published in peer reviewed Journals other than UGC care listed journals

Sr.No	Name of the teacher	Title of paper	National/ International	ISBN/ISSN	Name of the college	Name of the Jouranl
1	Dr. N. T. Mane	Ethics Incorporated in Percy Shelley's Ioconic "Ozymandias"	International	2278-4284	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	Loknayak
2	Dr. J. S. Pusate	Cognitive Development of Children and It's Concept	National	2278-9308	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	B. Adhar
3	Dr. J. S. Pusate	Essential Food & Nutrition For Living Things (Human) is Cause and Effect of Four Element on The Earth	International	2347-7075	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	Internatinal journal of advance and applied research
4	Dr. R. R. Gawande	गाविलगढ टेकड्यामधील अशमयुगीन चित्रे	National	2319-9318	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	Vidyavarta
5	Dr. S.D. Charpe	UV Characterization of Polyblends PMMA and PVC Polymer with Potassium Thiocyanate as Electrolytes	International	2582-7421	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	International Journal of Research Publication and Reviews
6			International	2582-7421	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	International Journal of Research Publication and Reviews
7	Asst Prof. R.V. Bhagwat	UV Characterization of Polyblends PMMA and PVC Polymer with Potassium Thiocyanate as Electrolytes	International	2582-7421	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	International Journal of Research Publication and Reviews
8			International	2322-0015	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	Int. Res. J. of Science & Engineering

9	Dr. S.D. Charpe	A Review: Nano Science As Opportunities in Health & Research Area.	National	2455-314x	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	Pune Reserch Scholar
10		Antibacterial Activity of Different Extracts of Abrus Precatorius	National	2455-4375	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	UPA- National E-Journal
11	Dr. P D Diwan	Leaves Against Oral Microflora To Improve Oral Hygiene	National	2278-8158	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	Roayal Publication
12	Dr . V . R. Desnhmukh	शास्त्रीय संगीत मे बंदिश का महत्व	National	2278-9308	J. D. Patil Sangludkar Mahavidyalaya, Daryapur	Roayal Publication

Ceramics International 49 (2023) 27003–27014

Contents lists available at ScienceDirect

Ceramics International

journal homepage: www.elsevier.com/locate/ceramint

Synthesis, characterization, and supercapacitor applications of Ni-doped $CuMnFeO_4$ nano Ferrite

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ARTICLE INFO

Handling Editor: Dr P. Vincenzini

Keywords:
Sol-gel
$Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ ferrite
Rietveld
And supercapacitor

ABSTRACT

Nickel (Ni) doped magnetically separable $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ ferrite was synthesized using the sol-gel auto-combustion method. The system exhibits a cubic spinel structure with a single phase in all the samples, which was confirmed using Rietveld refinement. Mixed morphology with agglomerated particles with nearly spherical/multi-faceted shapes was observed in FESEM studies. The elemental composition was confirmed from EDAX analysis. TEM images are in well accordance with FESEM images and reveals the crystalline nature of the synthesized samples. Magnetic properties of all the ferrites were studied using VSM. With the increase in the concentration Ni^{2+} the $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ ferrite transform from ferrimagnetic character to a superparamagnetic character. The as-synthesized materials were further tested for their electrochemical and supercapacitor applications. The electrochemical measurements revealed that $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ with ($x = 0.75$) exhibits superior electrochemical performance over the other samples. The high specific capacitance of 975 F g^{-1}, the high energy density of 20.8 Whkg^{-1} at a scan rate of 5 mVs^{-1}, and 94.4% capacity retention over 5000 cycles were observed for $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ with a concentration of $x = 0.75$.

1. Introduction

Exhaustive utilization of fossil fuels has caused very serious environmental problems to the entire world. Researchers throughout the globe are working very hard for the cleaner and more reliable energy resources to deal with environmental issues. The modern world needs a tremendous amount of energy and energy storage devices for domestic, public, and for industrial establishments. Hence energy storage devices have become very hot topic as they possess excellent storage ability as well as charge and discharge very quickly. Excellent devices for energy storage are Batteries and supercapacitors as they can store a very high amount of energy, the output power is excellent as well as they have a long life. Hence the research on supercapacitors is going with a very high speed throughout the globe [1–3]. With the extensive industrialization and modernization, the energy consumption has increased to many folds hence development of new electrode materials is in great demand to enhance the performance of energy storage systems [4,5]. Now a day's supercapacitors are considered the most promising candidates due to its simple geometry and ability to cater the energy need [6,7].

The most promising materials to be used as electrodes in the energy storage devices are the transition metal oxides. They are easily available, environment friendly, and have different constituents, morphologies, and great surface area. They exhibit higher values of specific capacitance (theoretical) [8,9]. Further, these metals play a very vital role by offering a noticeable improvement in the capacitance by tuning and controlling various defects at the surfaces as well as interfaces [10,11]. However, there are certain limitations of transition metal oxides to name a few, low electrical conductivity, sluggish ions diffusion in the bulk phase, and low electrical conductivity, these limitations lower their practical applications [12–14]. These limitations can be overcome by using spinels or ferrites. Spinels are AB_2O_4 type of compounds where, A and B are the bivalent and a trivalent metal cation respectively, if the trivalent cation is iron then they are termed ferrites [15]. The cations occupy tetrahedral (A-bivalent) and octahedral (B-trivalent) interstitial

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https://doi.org/10.1016/j.ceramint.2023.05.240
Received 28 January 2023; Received in revised form 15 May 2023; Accepted 25 May 2023
Available online 26 May 2023
0272-8842/© 2023 Published by Elsevier Ltd.

positions of the FCC lattice formed by O^{2-} ions. Depending upon their crystal structure and cation distribution, the materials exhibit different electrical, magnetic, and electrochemical properties [14]. Spinel ferrites are one of the most intensively studied inorganic nanomaterials due to their versatile applications. Some of the commercial applications of ferrites are in the gas sensing [16], in the photodegradation of dyes as well as in environmental remediation [17–20], in hydrogen production [21], in the supercapacitor applications [22,23] and in the generation of energy storage devices [24]. Ferrites found tremendous application in hyperthermia [25], cytotoxicity [26] and studies on the cancer cell lines [27]. The transition metals are low-cost, environmentally friendly and their oxides are easy to synthesize. Also, the different oxidation states of transition metals are one of the boons for synthesis of different binary as well as ternary metal oxide. Out of the different transition metal oxides, the Ferrites (MFe_2O_4) are abundant in nature, environmentally friendly in nature and have different oxidation states. The ferrites (MFe_2O_4) have been widely studied for supercapacitor applications where (M = Fe, Co, Ni, Mn, Cu, Zn) [22], $NiCo_2O_4$ [28,29], $MgFe_2O_4$ [30], and $CoFe_2O_4$ [31].

Spinel ferrites consisting of a mixture of two divalent metal ions or trivalent metal cations called mixed ferrites are also reported by researchers [32,33], such ferrites are functionalized material and have tremendous applications in almost all fields. Bhujun et al. [34] synthesized $CuCoFe_2O_4$, $NiCoFe_2O_4$, and $NiCuFe_2O_4$ using sol-gel method and studied the electrochemical performance of the nanocomposite. A maximum specific capacitance of 221 Fg^{-1} was obtained with $CuCoFe_2O_4$ at a scan rate of 5 mVs^{-1}. In addition to excellent cycling stability, an energy density of 7.9 $Whkg^{-1}$ was obtained at a current density of 1 Ag^{-1}. Huang et al. [35] demonstrated that the electrical conductivity of $NiCo_2O_4$ is two or three orders of magnitude higher than the corresponding single metal oxide NiO or Co_3O_4. Chen et al. had demonstrated doping of a Ni element in Co_3O_4 and showed that there is a great enhancement in the electrical properties [36]. Thus, doping of Ni element in the ferrites increases the properties of ferrites to many folds. Due to these advantages, Ni element was selected as a dopant to synthesize $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite system with composition (x = 0.0, 0.25, 0.50, 0.75 and 1.0), using sol-gel auto-combustion method with glycine as the fuel. The as-synthesized nano ferrites were characterized using different physicochemical techniques such as XRD, FTIR, FESEM, TEM, XPS and VSM. Literature survey reveals that this is the first report in which $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrites were used in the supercapacitor application.

2. Experimental

2.1. Materials

In present study, Ni $(NO_3)_2{\cdot}6H_2O$, Cu $(NO_3)_2{\cdot}6H_2O$, Mn $(NO_3)_2{\cdot}6H_2O$, and Fe $(NO_3)_3{\cdot}9H_2O$ were used as a source of nickel, copper, manganese, and iron respectively and were used to synthesize $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrites. All the above salts and the reagents were purchased from Loba chemicals and were utilized to carry out synthesis of ferrite with no further purification.

2.2. Synthesis of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (X = 0.0, 0.25, 0.50, 0.75, and 1.0) nano ferrites

Sol-gel auto-combustion method was used to synthesize $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite. As per the chemical formula $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (where, x = 0.0, 0.25, 0.50, 0.75, and 1.0), individual starting metal salt and the corresponding material were weighed separately. Above material was added in 20 mL of distilled water and stirred to ensure complete dissolution. This was followed by addition of 50 mL of glycine as the fuel with simultaneous dropwise addition of ammonia

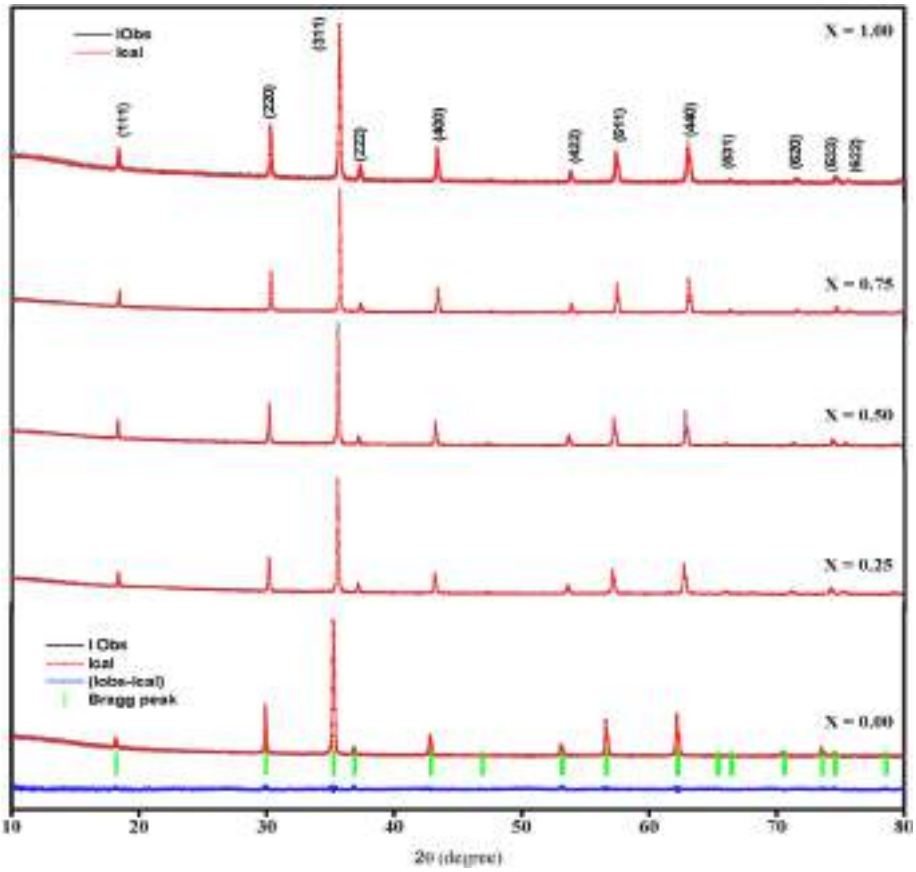

Fig. 1a. Rietveld Refined Pattern of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite samples (x = 0.0, 0.25, 0.50, 0.75, and 1.0).

Table 1
Summary of the Rietveld refinement factors like expected factor (Rexp), weighted profile factor (Rwp), goodness-of-fit (χ^2), Crystallite size (d), lattice parameter (a), lattice parameter theoretical (ath), X-ray density (dx), r.m.s. strain and Tolerance factor (T).

Comp	Rexp	Rwp	χ2	d (nm) ±2 nm	a (Å)	ath (Å)	Dx (gm/cm3)	r.m.s. Strain (10^{-4})	Tolerance Factor T
x = 0.00	10.1	7.28	1.39	36.76	8.4200	8.4101	5.3029	0.85	1.0459
x = 0.25	7.73	5.80	1.51	50.45	8.3823	8.3929	5.3249	2.85	1.0423
x = 0.50	8.09	6.23	1.46	55.32	8.3672	8.3870	5.3489	0.76	1.0383
x = 0.75	8.83	6.79	1.36	54.79	8.3501	8.3856	5.3542	2.28	1.0410
x = 1.00	9.76	7.32	1.58	49.52	8.3450	8.3807	5.3363	1.98	1.0421

to the solution to attain a desirable pH (in the range between 8 and 9). Further, the sol so formed was converted to viscous gel by heating it at 90 °C using hot plate. The homogeneous gel was further transformed into the product by heating. The gel thus formed was ignited to cease the reaction by at once consuming all the glycine. This auto combustion process results into the formation of a brown colour residue, which was further crushed into fine powder using mortar pestle and was sintered at 800 °C in the muffle furnace for 5 h. The sintered fine powder was further characterized using various physicochemical characterization methods. Depending upon the variable Ni concentration $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite were labelled as X = 0.00, X = 0.25, X = 0.50, X = 0.75 and X = 1.00 for x = 0.00, 0.25, 0.50, 0.75, and 1.0 respectively.

2.3. Characterization

The room temperature XRD pattern of Cu1-xNixMn1.0Fe1.0O4 (X = 0.0, 0.25, 0.50, 0.75, and 1.0) nano ferrites were taken on a Philips (X pert) X-ray diffractometer using Cu kα radiation (λ = 1.5418 Å) in the 2θ range from 10 to 80°. FTIR spectra in the wavenumber range from 400 to 4000 cm− 1 were carried out using 3000 Hyperion Microscope with vertex 80 FTIR spectrometer. Morphology and the microstructure of the nano ferrites were carried out using FESEM instrument Carl Zeiss model Supra 55. TEM images were carried out on JEOL JEM 1200 EX ll instrument with an acceleration voltage of 80 kV. Magnetic measurements were carried out at room temperature using a vibrating sample magnetometer (VSM) on a Quantum Design USA make SQUID system (Model MPMS XL). XPS was carried out on a VG-ADES400 spectrometer (Al K*a* radiation).

2.4. Electrode fabrication

The substrate used for the fabrication of electrodes was stainless steel (SS) of grade 304, which functions as a current collector. The surface of the SS substrate was first cleaned in the detergent and, was dipped in 4 N HNO_3 for 30 min and finally washed using acetone followed by double distilled water and dried in the oven. Electroactive $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75, and 1.0) nano ferrite material was loaded on SS substrate as per the procedure and protocol laid down for the supercapacitor measurement [37,38]. A Homogeneous mixture of active material (85 wt %), acetylene black (5 wt %) as a conductive additive and the binder PVDF (5 wt %) were converted to a fine homogeneous mixture using mortar and pestle. This fine mixture was dispersed in dimethyl formamide (DMF) to convert it into slurry. The SS substrate was then coated with the slurry using doctor blade and dried in the oven at 60 °C and further used for the electrochemical studies. The active mass loaded on the SS plates was estimated to be in the range of 1.2–1.8 mg.

2.5. Electrochemical characterizations

Cyclic voltammetry (CV), Galvanostatic charge-discharge (GCD), and impedance spectroscopic measurements were performed using the Palmsence EmStat4s. LR electrochemical workstation forming an electrochemical cell comprising $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75, and 1.0) nano ferrites as working electrode, platinum as counter

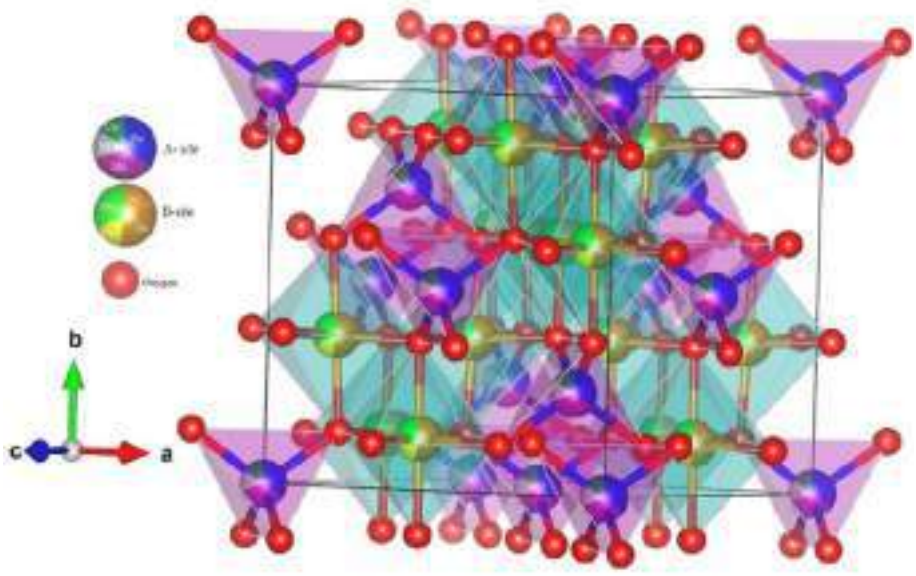

Fig. 1b. Three-dimensional Crystal structure of cubic spinel belongs to space group Fd3m of Interstitials positions partially occupied by Tetrahedral – A and Octahedral- B atom.

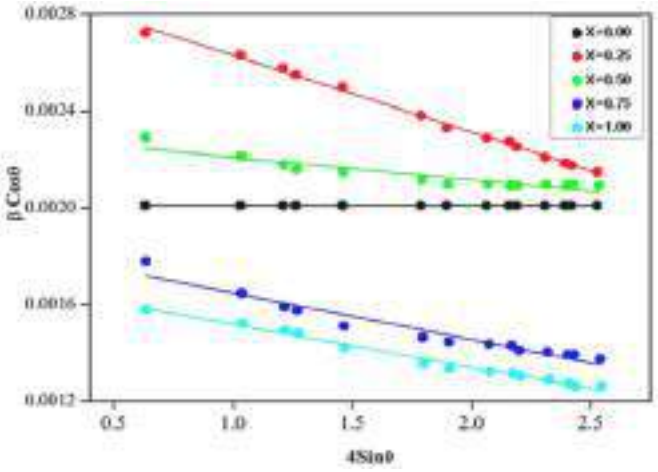

Fig. 2. Williamson hall plot of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite samples (x = 0.0, 0.25, 0.50, 0.75, and 1.0).

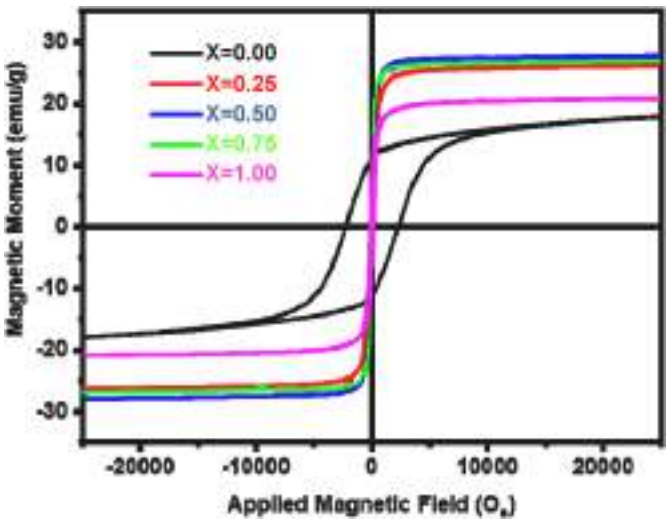

Fig. 4. Magnetic hysteresis loops for as-synthesized $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite samples (x = 0.0, 0.25, 0.50, 0.75, and 1.0).

electrode and Ag/AgCl as a reference electrode in 1 M Na_2SO_4 liquid electrolyte. An electrochemical impedance spectroscopic investigation of the as-synthesized material was carried out within the frequency range 1 Hz–100 kHz at open circuit potential and at 5 mV AC perturbation.

3. Result and discussion

Rietveld refined XRD pattern of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrites are depicted in Fig. 1a. Reflection at (111), (220), (311), (222), (400), (422), (511), (440), (531), (620), (533) and (622) planes correspond to the face centre cubic spinel structure. It corresponds to the structure which is a single-phase exhibiting space group Fd3m. Refinement results are tabulated in Table 1. The low values of goodness-of-fit ($\chi 2$) ranging from 1.36 to 1.58 indicates that the refinement is excellent. The low values of goodness-of-fit ($\chi 2$) range from (1.36–1.58) indicating that the refinement is excellent. A three-dimensional crystal structure of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrites obtained from the Rietveld refinement is depicted in Fig. 1b. Debye Scherrer equation as discussed elsewhere was used to calculate the crystallite size using the most intense 311 peak [39]. The results indicate that for lower doping concentrations (x = 0.0, 0.25, 0.50), the crystallite size increases from 36.76, 50.45, 55.32 and further decreases to 54.79 and 49.52 (for x = 0.75, and 1.0) respectively in the system. There is a gradual decrease in the lattice parameters (a) with the doping of Ni^{2+}ion (Table 1) this is in accordance with the Vegards law [33]. X-ray density of all the samples was calculated using the lattice parameters and depicted in Table 1. From the analysis, it is observed that, there is a slight increase in the X-ray density with the increase in concentration of nickel. Increase in the crystallinity with the decrease in the lattice parameters may be the factor responsible to increase in the X-ray density [33]. The r. m. s. strain of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite were measured (Fig. 2). It is clear from Fig. 2 that the variation of sin θ with βcos θ is linear for all the samples. The straight lines obtained were extrapolated to the y axis to measure the strain. The value of the strain is listed in Table 1, very low values of the lattice strain confirm stability of structure [40].

Tolerance factor (T) was determined using following equation.

$$T = \frac{1}{\sqrt{3}}\left(\frac{r_A + R_o}{r_B + R_o}\right) + \frac{1}{\sqrt{2}}\left(\frac{R_o}{r_A + R_o}\right) \quad (1a)$$

Where rA, rB are the radii of tetrahedral and octahedral sites respectively and R_0 is the radius of the oxygen ion. The literature survey reveals that if the value of tolerance factor is close to unity, then the structure is defect free spinel's structure. The catalyst $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ is defect free as the value of tolerance factor is close to unity (Table 1) [40].

The FTIR spectra of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite material were recorded from 4000 to 400 cm^{-1} range and depicted in Fig. 3a. Various positions of the bond are identified using FTIR spectra. As there is difference in the distance for oxygen ion, tetrahedral ion, and octahedral ions [40], the band positions will differ. The band at 592.58 cm^{-1} (M tet-O) are assigned for tetrahedral metal ions and oxygen ion bond whereas the band at 436.85 cm^{-1} (M oct-O) are assigned for octahedral metal ions and oxygen ion bond. In Fig. 3b with the increase in the concentration of Ni^{2+} ions the higher frequency band (M oct-O) and the lower frequency band (M tet-O) slightly shifted toward the higher and

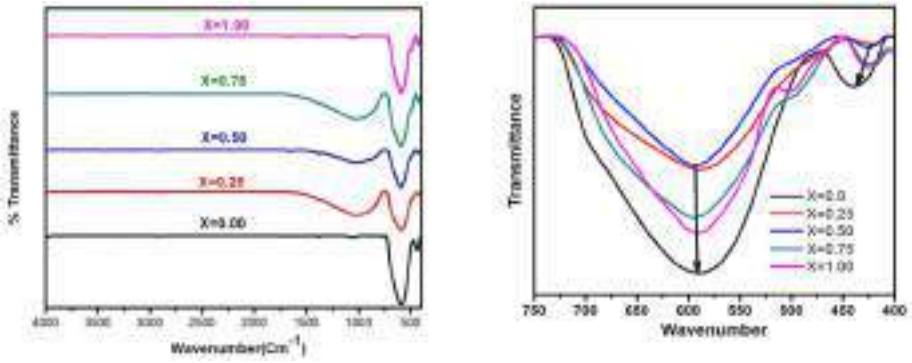

Fig. 3. FTIR sectra of as-synthesized $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite samples (x = 0.0, 0.25, 0.50, 0.75, and 1.0).

Table 2
Magnetic parameters (Saturation Magnetization Ms, Remanence Mr, Coercivity Hc, Magnetic Moment nB, Anisotropy constant K) at room temperature of $Cu_{1-x}Ni_xFeMnO_4$ system as function of Ni content (x).

Samples	Ms (emu/g)	Mr (emu/g)	Hc (Oe)	Mr/Ms	nB (μB)	K (erg/g)
x = 0.00	17.96	10.79	2287.80	0.60	0.77	42800.94
x = 0.25	26.28	0.93	27.73	0.04	1.12	759.15
x = 0.50	27.89	0.36	5.06	0.01	1.18	147.08
x = 0.75	26.98	0.76	8.47	0.03	1.14	237.90
x = 1.00	20.89	8.52	173.24	0.41	0.87	3769.94

lower wavelength respectively. These changes are observed due to the replacement of tetrahedral Cu^{2+} ion by lighter Ni^{2+} ion at the same time Ni^{2+} ions push few Fe^{3+} ions from tetrahedral site to octahedral site which replace the lighter Mn^{2+} ions [33].

The cations at the tetrahedral site (A) and octahedral site (B) are responsible for the magnetic properties of ferrites. In normal spinel ferrites the tendency of trivalent metal cation is to occupy octahedral position whereas the bivalent metal cation occupies tetrahedral position. In ferrites the net magnetization is due to the 'B' site, as 'B' site have greater magnetic moment than that of the 'A' site. The room temperature Magnetic hysteresis loops of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrites were recorded and are depicted in Fig. 4. Important parameter such as saturation magnetization (Ms), coercivity (Hc), remanent magnetization (Mr), squareness ratio (Mr/Ms), magnetic moment (nB) and anisotropy constant (K) are summarized in Table 2. An increase in the saturation magnetization was observed with the increasing concentrations of nickel. Saturation magnetization depends upon the type and the number of ions present at the tetrahedral and octahedral sites of the ferrites as the distribution of ions affects magnetization. With the increase in concentration of Ni^{2+} ions in $Cu_{1.0}$ $Mn_{1.0}$ $Fe_{1.0}O_4$ nano ferrites Ni^{2+} ions replace few Fe^{3+} ions from octahedral site to the tetrahedral site. Mn^{+3} ions spread at tetrahedral as well as octahedral site. The Ms value of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrites depends on the distribution of the magnetic Ni^{2+} (d8), Cu^{2+} (d9) and Fe^{3+} (d5) ions between the A sites (tetrahedral) and B sites (octahedral). In the present work, it was found that the Ms value (Table 2) of the nanoparticles slowly increased with the increase of the content of Ni^{2+} until x = 0.50, which is due to the magnetic Ni^{2+} ions occupying the octahedral B sites preferentially, and then slight decreased for x = 0.75 and large decrease for x = 1.00 as indicated in Table 2. Similar behaviour in Ms were reported by Jangam et al. [33]. In $Cu_{1-x}Ni_xFeMnO_4$ nano ferrite there is decrease in the remnant magnetization and coercivity up to x = 0.50 and further increase for x = 0.75 and 1.0 In $Cu_{1-x}Ni_xFeMnO_4$ nano ferrite with X = 0.0 ($Cu_{1.0}Fe_{1.0}Mn_{1.0}O_4$) the coercivity value is extremely high as compare with other concentration (X = 0.25, 0.50, 0.75 and 1.0) this is due to the distribution of Mn^{+3}, Fe^{+3} and Cu^{2+} ions over the octahedral sites [33]. Extremely high value of coercivity is further supported by the crystallite size, squareness ratio and anisotropy constant studies [15]. There is an increase in the crystallite size with the increase in the concentration of $Cu_{1-x}Ni_xFeMnO_4$ nano ferrite and found to be lowest for $Cu_{1.0}Fe_{1.0}Mn_{1.0}O_4$ (X = 0.0, Table 1). In $Cu_{1.0}Fe_{1.0}Mn_{1.0}O_4$ nano ferrite system the hysteresis loop is very broad as the material is hard magnetic material [15] and the squareness ratio Mr/Ms is highest in $Cu_{1.0}Fe_{1.0}Mn_{1.0}O_4$ for X = 0.0 system (Fig. 4 and Table 2 respectively). Further the anisotropy constant is very high for $Cu_{1.0}Fe_{1.0}Mn_{1.0}O_4$ (X = 0.0) system and decreases for the other concentration of $Cu_{1-x}Ni_x$-$FeMnO_4$ (X = 0.25,0.50,0.75) nano ferrite. Very high value of the magnetic anisotropy and low value of crystallite size are responsible for

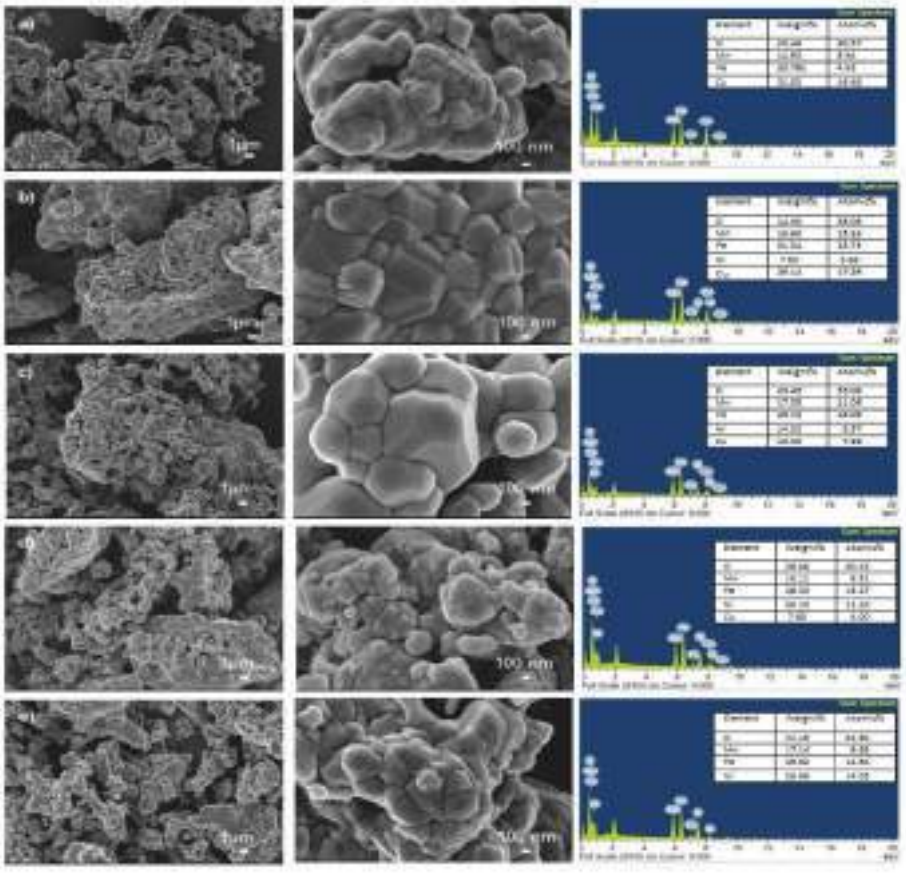

Fig. 5. Low and high resolution FESEM images of as-synthesized $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite samples (x = 0.0, 0.25, 0.50, 0.75, and 1.0) with corresponding EDS elemental mapping.

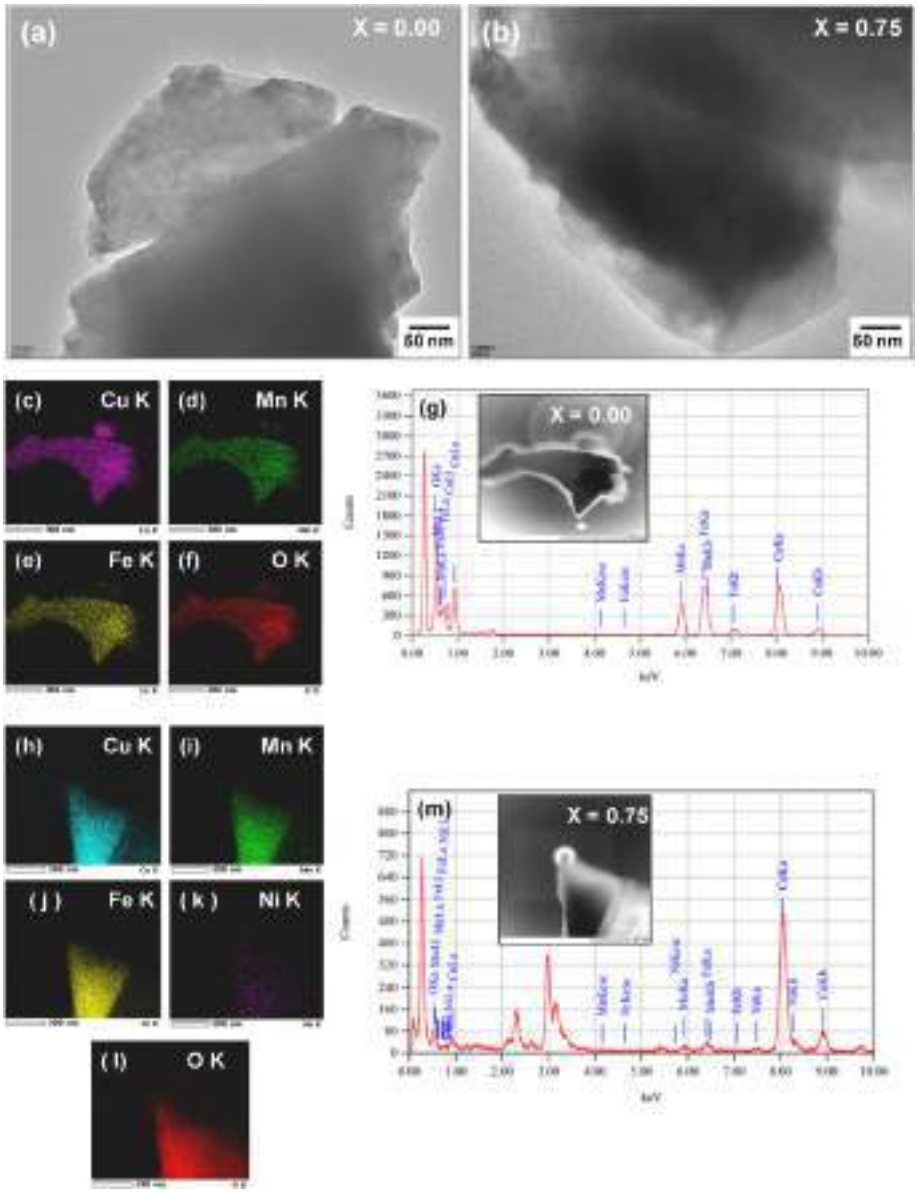

Fig. 6. (a, b) TEM images of as-synthesized representative $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ ferrite samples X = 0.00 and X = 0.75 respectively, (c–m) EDS elemental mapping of sample X = 0.00 and X = 0.75 respectively.

increasing coercivity of the material. Lowest particle size (Table 1), highest squareness ratio (Table 2), very high anisotropy (Table 2) is responsible for the highest coercivity in $Cu_{1.0}Fe_{1.0}Mn_{1.0}O_4$ (X = 0.0) system. Further Mn^{+3}, Fe^{+3} and Cu^{2+} ions spread over octahedral sites are responsible for the highest coercivity in $Cu_{1.0}Fe_{1.0}Mn_{1.0}O_4$ (X = 0.0) system. The squareness ratio is less than 0.10 for x = 0.25, 0.50 and 0.75 which suggest that the material is paramagnetic. Whereas for x = 0.0 and 1.0 the squareness ratio is more than 1.0 which suggest these two catalysts are ferromagnetic material [17].

The surface morphology of as-synthesized $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ ferrite samples were investigated with the help of FESEM. Corresponding low and high resolution FESEM images of as-synthesized $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ ferrite samples with changing Ni^{2+} contents x = 0.00, x = 0.25, x = 0.50, x = 0.75 and x = 1.00 (x = 0.00, x = 0.25, X = 0.50, x = 0.75 and x = 1.00) are depicted in Fig. 5. Low-resolution images of all as-synthesized samples reveal that it exhibits mixed morphology with agglomerated particles. However, a careful observation revealed from the high-resolution images indicates that most of the particles are nearly spherical/multi-faceted in shape. A pristine sample, x = 0.0 without Ni^{2+} content exhibits agglomerated morphology with irregularly shaped particles varying in size from 30 to 60 nm. The doping of Ni^{2+} in the $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ ferrite, results in formation of agglomerated products with well faceted crystals (sample x = 0.25 and x = 0.50). This can be attributed to the displacement of Cu^{2+} ions by lighter Ni^{2+} ions and consequently the replacement of Fe^{3+} ions from tetrahedral to octahedral sites. Further increase in Ni^{2+} contents again lead to formation of agglomerated crystal with spherical/irregularly shaped particles (sample x = 0.75 and x = 1.00). These findings are in total agreement with the XRD results. Elemental composition of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite was confirmed using energy dispersive X-ray studies (EDS). The corresponding EDS patterns are depicted in Fig. 5. For undoped (x = 0.00) sample, peaks corresponding to the elements Cu, Mn, Fe and O are observed. For the ferrites with concentration x = 0.25, x = 0.50 and x = 0.75 the peaks of Cu, Mn, Fe, Ni, O were observed. For sample x = 1.00, there are peaks pertaining to Ni, Mn, and Fe only. Absence of any impurity peak suggest that the synthesized ferrites are pure. The microstructure of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite was further confirmed using TEM and EDS elemental mapping. The TEM images of

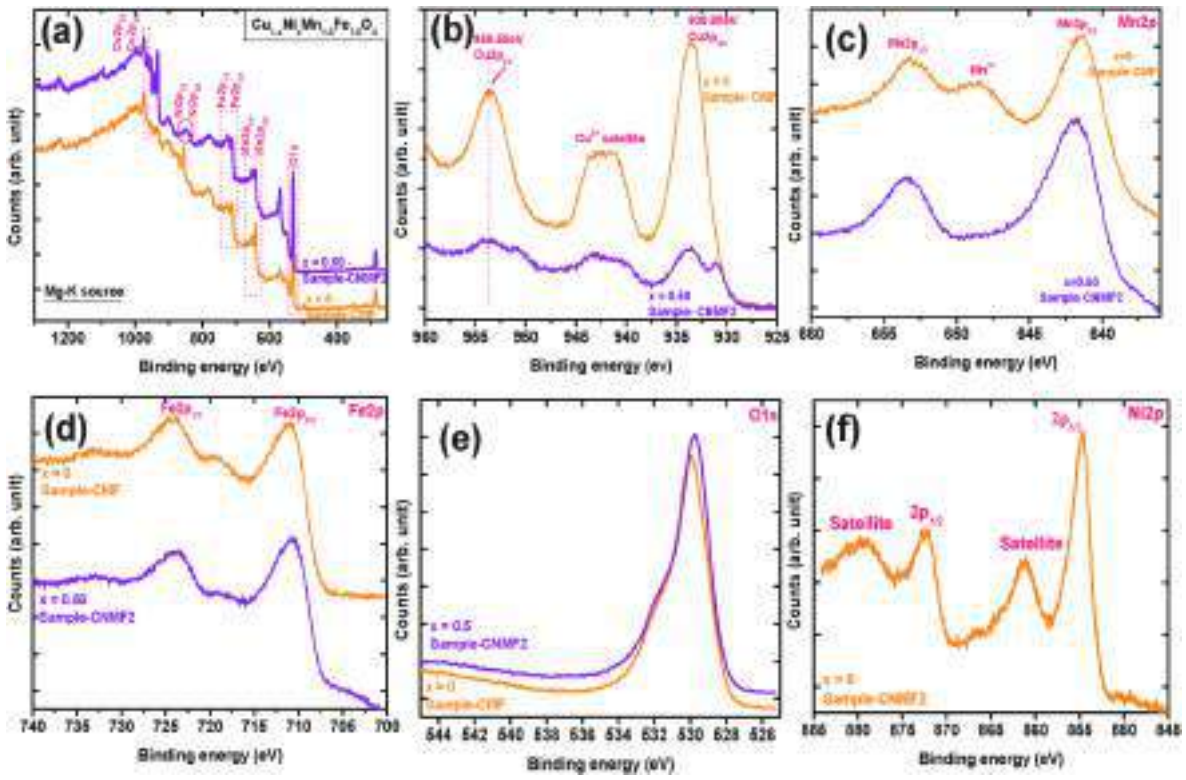

Fig. 7. XPS spectra of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ ferrite:(a) survey scans for x = 0 and 0.5 (sample X = 0.00 and X = 0.50 resp.), (b)–(e) long-time measured patterns of Cu2p, Mn2p, Fe2p.

representative samples x = 0.00 and x = 0.75 are depicted in Fig. 6(a and b). The results are in well accordance with FESEM images and reveals the crystalline nature of the synthesized samples. The EDS elemental mapping of these samples is depicted in Fig. 6 (c - m) which further suggests that the nano ferrite with concentration x = 0.00 and x = 0.75 are pure and consists of Cu, Mn, Fe and Cu, Mn, Fe, Ni respectively with uniform distribution of these elements within their crystallite structure.

XPS spectroscopy was used to investigate the oxidation states as well as for the cation distribution. Survey XPS scans of the $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite with concentration of x = 0.00 and x = 0.50 respectively are depicted in Fig. 7a. In the survey scans main photo-ionization signals of metals Cu2p, Fe2p, Mn2p, oxygen O1s and Auger signals of O KLL, Fe LMM, and Ni LMM are clearly displayed.

Oxidation states, relative intensities and cationic distributions can be investigated by studying the narrow scan for long-time measured patterns of Cu2p, Mn2p, Fe2p, O1s and Ni2p bands which are depicted in Fig. 7(b–e) and (f) respectively. With concentration, x = 0.00 the peaks binding-energy positions are at 930.98 and 942.21 eV corresponds to $Cu2p_{3/2}$ and its shake-up satellite, while the weaker peak at 950.58 eV is for $Cu2p_{1/2}$ signal. Core signals of other metal ions are as follows, Mn $2p_{3/2}$ (641.7 eV) and its satellite (641.52 eV), $Mn2p_{1/2}$ (653.55 eV); Fe $2p_{3/2}$ (711.4 eV) and its satellite (719.3 eV), Fe $2p_{1/2}$ (725 eV). Further, evident XPS results confirms that the gradual increase in the Ni^{2+} content in $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ ferrite samples occupies on account of Cu^{2+} rather than Mn nor Fe content as can be clearly seen in of the signals intensity pattern, Fig. 7 (c) and (d). It can be clearly seen, for Mn2p and Fe2p, almost all peaks exhibit slight position shift by Ni doping with virtually same peaks intensities, Fig. 7c and (d), while gradual decrease in intensity of Cu 2P peak is observed, Fig. 7 (b). The peaks assignment indicated the most stable oxidation state of Cu^{2+}, Ni^{2+} and Fe^{2+} and dominant Mn^{2+}. Similar observation in the ferrites were reported by Patil et al. [17]. The formation of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (X = 0.0, 0.25, 0.50, 0.75, and 1.0) nano ferrite is supported by these findings.

Cyclic voltammetry (CV) technique is used to study the energy density, specific capacitance, and cycle life of the electrode material [38]. CV curves of nanocrystalline $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (X = 0.0, 0.25, 0.50, 0.75, and 1.0) ferrite at different scan rate of 5–100 mVs^{-1} and voltage 0–0.8 V vs. Ag/AgCl in 1 M Na_2SO_4 electrolyte is depicted in Fig. 8(a–e). It is clear from the CV curves that with the increase in the scan rate the current under the curve gradually increases, which implies that the voltametric current is directly proportional to the scan rate. The $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite shows broad peaks. Moreover, the rectangular shape of CV curves due to the redox reaction shows the pseudocapacitive behaviour of the electrodes. Furthermore, the broad peaks as well as the rectangular shape of CV curve of as-synthesized samples originated from the redox reaction. The CV curve shows the high rate-capability is due to the high rate of intercalation and deintercalation of electrolyte ions into electrodes. This excellent high-rate performance of electrodes in electrolyte is obtained due to the mesopores structure of prepared electrode materials. The specific capacitance of the as prepared nano structured material is estimated by measuring area under the CV curve [38]. As demonstrated in Fig. 8 (a - e), the electrode $Cu_{0.25}Ni_{0.75}Mn_{1.0}Fe_{1.0}O_4$ shows better electrochemical performance than the other samples i. e. $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, and 1.0). Remarkably, the area under the CV curve for sample $Cu_{0.25}Ni_{0.75}Mn_{1.0}Fe_{1.0}O_4$ at a 5 mVs^{-1} scan rate is high as compared to other electrode samples (Fig. 8 (f)). From the CV curves, the specific capacitance (Cs) (Fg^{-1}), and energy density E ($Whkg^{-1}$) were calculated using equations (1) and (2). The $Cu_{0.25}Ni_{0.75}Mn_{1.0}Fe_{1.0}O_4$ electrode shows the high specific capacitance 975.0 Fg^{-1}, energy density 20.8$Whkg^{-1}$ at 5 mVs^{-1} and capacity retention of 94.4% over 5000 CV cycles at 100 mVs^{-1}. This excellent electrochemical activity, high specific capacitance, high cyclic stability of electrode $Cu_{0.25}Ni_{0.75}Mn_{1.0}Fe_{1.0}O_4$ is obtained due to high electrical conductivity, the perfect doping of Ni^{2+} and Mn^{2+} ions in $CuFe_2O_4$ crystals and efficient utilization pores in the 1 M Na_2SO_4 electrolyte. Moreover, the calculated specific capacitance, energy density at different scan rates, and cyclic stability over 5000 CV cycles at 100 mVs^{-1} of the $Ni_xMn_{1.0}Fe_{1.0}O_4$ (x =

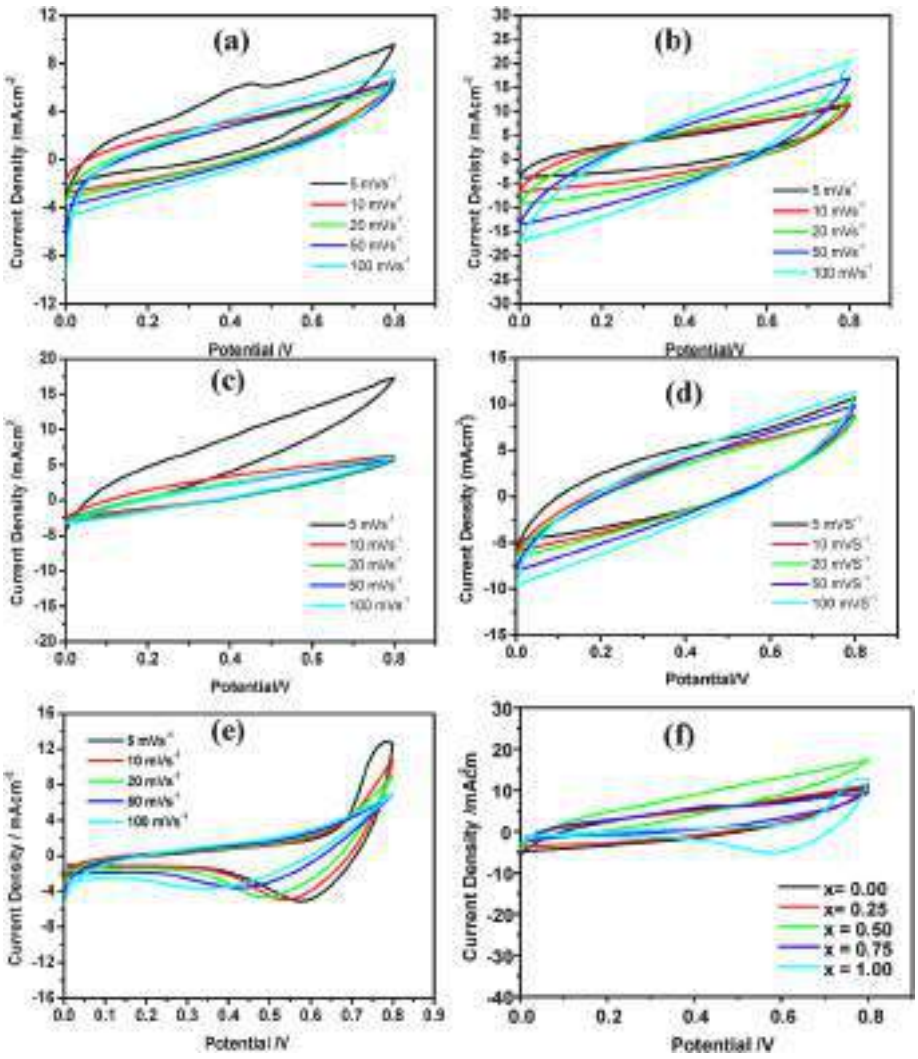

Fig. 8. Cyclic voltametric (CV) curves of nanocrystalline $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ sample (a) x = 0.0, (b) x = 0.25, (c) x = 0.50, (d) x = 0.75, and (e) x = 1.0 electrode samples and (f) comparison of all samples CV at 5 m Vs^{-1} scan rates in 1 mol L^{-1} Na_2SO_4 electrolyte.

Table 3
The calculated specific capacitance, energy density and cyclic stability of the $Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, and 1.0) samples.

Samples code	Specific capacitance (Fg^{-1})	Energy density ($Whkg^{-1}$)	Cyclic stability after 5000 cycles at 100 mVs^{-1}
x = 0.00	428.3	9.1	91.8%
x = 0.25	479.2	10.2	92.6%
x = 0.50	398.2	8.4	96.5%
x = 0.75	975.0	20.8	94.4%
x = 1.00	325.0	6.9	90.6%

0.0, 0.25, 0.50, and 1.0) samples is demonstrated in Table 3.

$$C_s = \frac{1}{mv(V_c - V_a)} \int_{V_a}^{V_c} I(V)dv \tag{1b}$$

$$E = \frac{0.5 \times C_s\left(V_{max}^2 - V_{min}^2\right)}{3.6} \tag{2}$$

Here, m is the mass deposited in (gcm^{-2}), $I(v)$ is the response current in (mA) of the sample electrode for unit area, V is the scan rate, $(V_c - V_a)$ is the operational potential window in (V), V_a anodic voltage and V_c cathodic voltage, t_d is the discharge time in (s), I_d is the discharge current (mA).

The Galvanostatic charge discharge (GCD) study of the Cu_{1-x} Ni_x Mn $_{1.0}$ $Fe_{1.0}O_4$ nano ferrite samples (x = 0.0, 0.25, 0.50, 0.75, and 1.0) was carried out at different current densities ranges from 20 $mAcm^{-2}$ to 60 $mAcm^{-2}$ within the potential window 0–0.8 V in 1 M Na_2SO_4 liquid electrolyte. Fig. 9 (a)-(e) shows the GCD curves Cu_{1-x} Ni_x Mn $_{1.0}$ $Fe_{1.0}O_4$ nano ferrite samples (x = 0.0, 0.25, 0.50, 0.75, and 1.0) of the samples at different current densities ranges from 20 $mAcm^{-2}$ to 60 $mAcm^{-2}$. Moreover, the comparative GCD curves for all Cu_{1-x} Ni_x Mn $_{1.0}$ $Fe_{1.0}O_4$ nano ferrite samples (x = 0.0, 0.25, 0.50, 0.75, and 1.0) is shown in Fig. 9 (f). Using the GCD curves, specific capacitance (Cs) (Fg^{-1}), energy density E ($Whkg^{-1}$) and power density (Wkg^{-1}) were calculated using equations (2)–(4) where, I_d is the discharge current, t_d discharge time, m is mass loaded on stainless steel electrodes and $\Delta V$is the applied potential window. The calculated specific capacitance (Fg^{-1}), energy density ($Whkg^{-1}$) and power density (Wkg^{-1}) of the Cu1-x Ni_x Mn $_{1.0}$ $Fe_{1.0}O_4$ nano ferrite samples (x = 0.0, 0.25, 0.50, 0.75, and 1.0) is demonstrated in Table 4. The Cu_{1-x} Ni_x Mn $_{1.0}$ $Fe_{1.0}O_4$ nano ferrite samples with X = 0.75 show highest specific capacitance compared to other Cu_{1-x} $Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite samples with x = 0.0, 0.25, 0.50, and 1.0. The Cu_{1-x} $Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrite samples with X = 0.75, show a high specific capacitance of 875 Fg^{-1}, high energy density of 19.7 $Whkg^{-1}$and a high-power density of 1.6 $kWkg^{-1}$at current density of 20 $mAcm^{-2}$. The high specific capacitance, high energy density and high-power density obtained in Cu_{1-x} $Ni_xMn_{1.0}Fe_{1.0}O_4$ nano

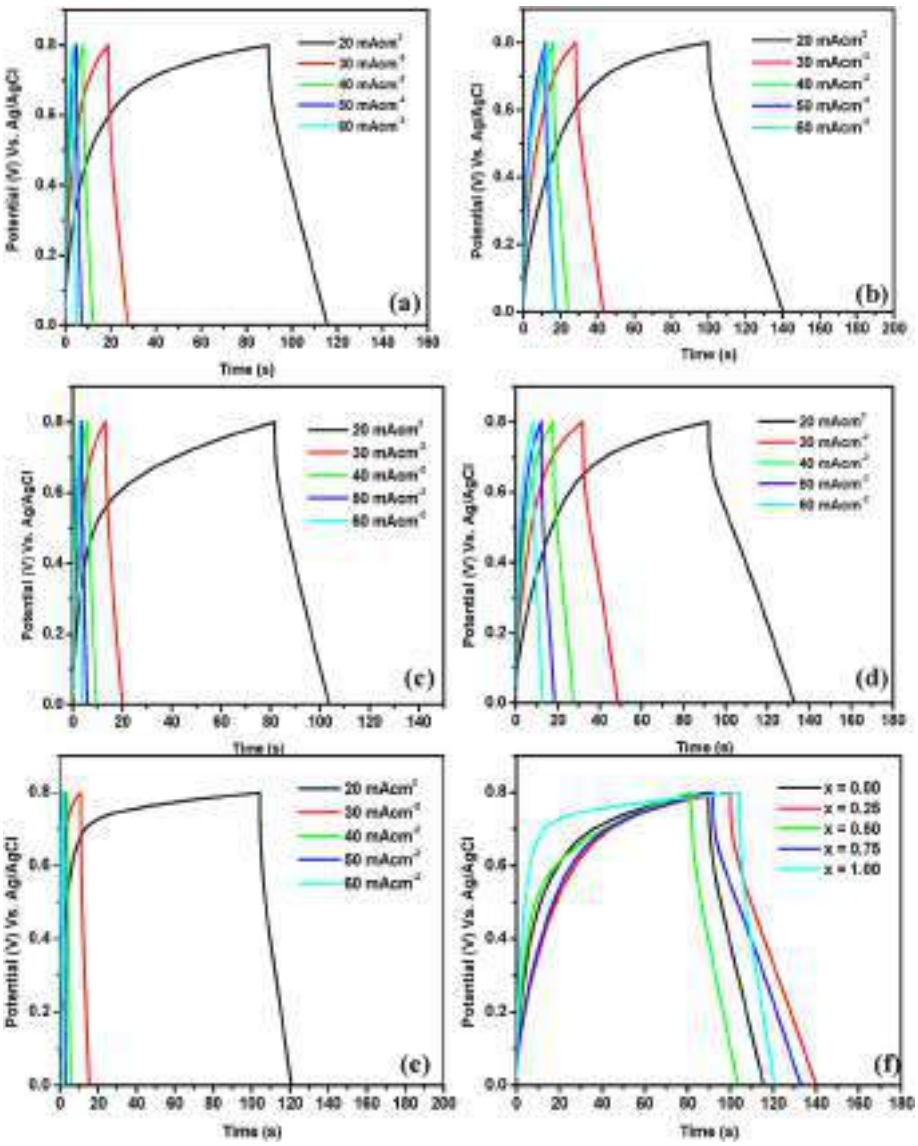

Fig. 9. GCD curves of nanocrystalline $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ sample (a) x = 0.0, (b) x = 0.25, (c) x = 0.50, (d) x = 0.75, (e) x = 1.0 electrode samples, and (f) the comparative GCD curve for all Cu_{1-x} Ni_x Mn $_{1.0}$ $Fe_{1.0}O_4$ nano ferrite.

Table 4
The calculated specific capacitance, energy density and power density of the $Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75 and 1.0) samples from GCD curves.

Samples code	Specific capacitance (Fg^{-1})	Energy density ($Whkg^{-1}$)	Power Density (Wkg^{-1})
x = 0.00	541.6667	12.0	1666.7
x = 0.25	569.4444	12.7	1111.1
x = 0.50	437.5	9.7	1666.7
x = 0.75	875	19.4	1666.7
x = 1.00	354.1667	7.8	1666.7

ferrite samples with X = 0.75. This is due to the proper doping of Ni in $CuMnFeO_4$. The proper doping of an external impurity enhances the electrical conductivity of material, and as a consequence, the electrochemical activities of the electrode at the electrode-electrolyte interface increases [39,40]**.** Moreover, Fig. 10 (a) and (b) demonstrate the specific capacitance obtained from CV curves at different scan rates and GCD curves at different current rates, respectively, for $Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75 and 1.0) samples. Interestingly, the specific capacitance obtained from the CV and GCD curves was found to be nearly equal. Fig. 10 (c) shows the plot of variation of specific capacitance verses current density curve for $Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75 and 1.0) samples. Fig. 10 (c) demonstrates that the specific capacitance obtained at higher current densities is remarkably lower than the specific capacitance obtained at lower current densities. This decrease in specific capacitance at higher current density is due to the inability of electrolyte ions to pour into electrode material at higher current values [41,42]. The obtained specific capacitance for the $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O$ for X = 0.75 is higher than the reported Mn, Fe and Ni based metal oxide electrode materials reported in recent research reports. Moreover, to illustrate the significance of this study, we have compared present study with the earlier studies reported on Mn, Fe and Ni based metal oxide electrode materials for supercapacitor applications. Moreover, to illustrate the significance of this study, we have compared the present study with the earlier studies reported in literature considering Mn, Fe, and Ni-based metal oxide electrode materials for supercapacitor applications [43–48] (Table 5).

$$C_s = \frac{I_d t_d}{(V_2 - V_1)m} \tag{3}$$

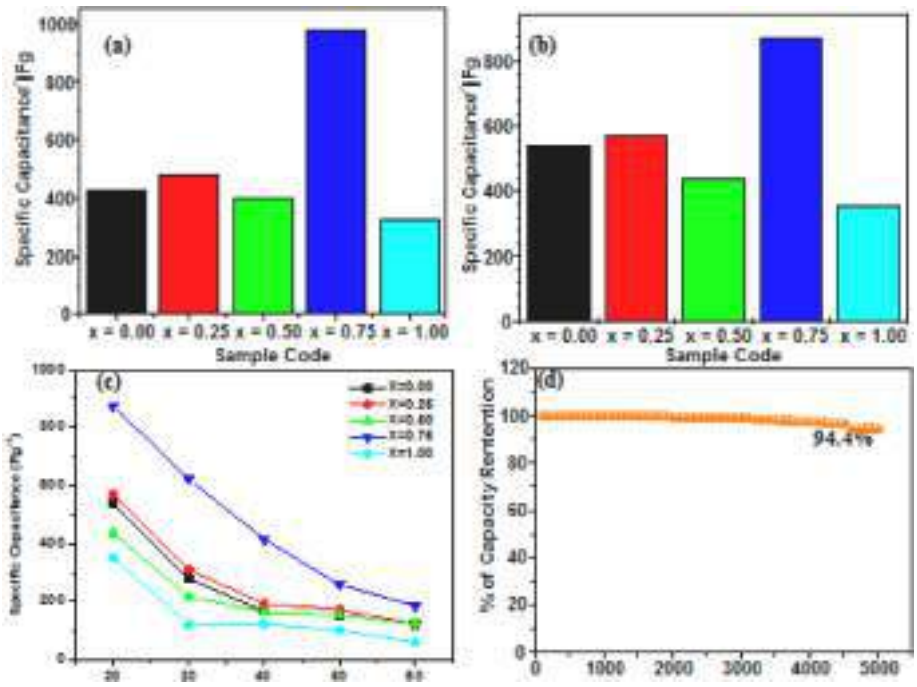

Fig. 10. Specific capacitance calculated from (a) CV curves, (b) GCD curve (c) plot of specific capacitance and current density for $Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75 and 1.0) samples., (d) plot of capacity retention vs. cycle number for $Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.75).

Table 5
Comparison of earlier studies reported for Mn, Fe and Ni based metal oxide electrode materials and present study.

Sr. No.	Material	Method of synthesis	Electrolyte	Potential window	Specific capacitance	Energy density	Power Density	% Retention of capacitance	Reference
1	$Mg_{0.1}Mn_{0.9}Fe_2O_4$	Solvothermal reflux	1 M KOH	0.0–0.6 V	226.4 Fg^{-1} at current density 0.5 Ag^{-1}	–	–	94. 6 up to 3000 cycles	[43]
2	Zn doped $MgFe_2O_4$	Sol-gel	1 M Na_2SO_4	0.0–0.4 V	484.6 Fg^{-1} at scan rate 1 $mAcm^{-2}$	10.8 $Whkg^{-1}$	0.5 $kWKg^{-1}$	–	[44]
3	$MnFe_2O_4$/graphene hybrid	Solvothermal	1.0 M H_2SO_4	0.0–0.8 V	300 F g^{-1} at a current density of 0.3 A g^{-1}	5.0 $Whkg^{-1}$	0.4 kWk^{-1}	105 after 5000 cycles	[45]
4	$MnFe_2O_4$/ graphene/PANI	Combustion	1 M NaCl	−0.55 and 0.25 V.	241 F g^{-1} at current density 0.5 mA cm^{-2},	17 $Whkg^{-1}$	–	100 after 5000 cycles	[46]
5	$NiFe_2O_4$	Chemical oxidation	2 M KOH	0–0.45 V	266 F g^{-1} at 3 mVs^{-1}	22.5 $Whkg^{-1}$	0.85 $kWkg^{-1}$	126 up to 5000 cycles	[47]
6	$MnFe_2O_4$	Combustion	0.1 M HCl and 0.1 M $NaNO_3$	−1.0–1.2 V and −1.6 to 1.6 V for 0.1 M HCl and 0.1 M $NaNO_3$ electrolyte, respectively	297.7 Fg^{-1} current density 1 Ag^{-1} (in 1 M HCl)	–	–	92 for 0.1 M HCl for and 90 for 0.1 M $NaNO_3$ after 2500 cycles	[48]
7	$MnFe_2O_4$/GO	Co-precipitation	6 M KOH	−0.9-0.2 V	298 F g^{-1} at current density of 1 A/g	–	–	92 up to 500 cycles.	[49]
8	$MnFe_2O_4$	Chemical oxidation	2 M KOH	0.0–0.45 V	415 Fg^{-1} current density 1 Ag^{-1}	–	–	104 up to 3000 cycles	[50]
9	carbon modified Fe_3O_4	chemical oxidation	6 M KOH	−0.8-0.3 V	274 F g^{-1} at current density 0.5 Ag^{-1}	–	–	83 up to 5000 cycles	[51]
10	$Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O$ for X = 0.75	Auto-combustion	1 M Na2SO4	0.0–0.8 V	875 Fg^{-1}, at current density of 20 $mAcm^{-2}$.	20.8 Wh kg^{-1}	1.7 4 $kWkg^{-1}$	94.4 after 5000 cycles	Present work

$$P = \frac{E \times 3600}{t_d} \quad (4)$$

Electrolyte resistance (R_s) as well as the charge–transfer resistance (R_{ct}) of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75, and 1.0) nano ferrite was calculated using electrochemical impedance spectroscopy (EIS). The EIS study of the samples was carried out at an open circuit potential of 5 mV a. c. within the frequency range from 1 Hz to 100 kHz. The Nyquist plot of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75, and 1.0) nano ferrite sample electrodes are depicted in Fig. 11. The electrolyte resistance (R_s) is also called equivalent series resistance. The electrolyte resistance (R_s) is obtained from the high–frequency intercept of the semicircle on the real axis of the Nyquist plot. Moreover, the diameter of the semicircle of high–frequency intercept on the real axis of the Nyquist plot gives the charge-transfer resistance (R_{ct}) [38]. The

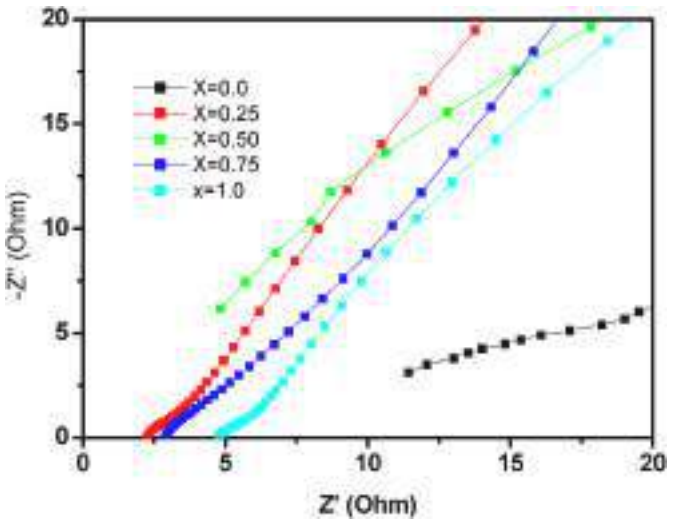

Fig. 11. The complex impedance plot (Nyquist plot) of nanocrystalline $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75, and 1.0) samples.

Table 6
Electrolyte and charge transfer resistance of the $Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75 and 1.0) samples.

$Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ electrodes for different x	Electrolyte resistance (R_s) (Ω)	Charge–transfer resistance (R_{ct}) (Ω)
x = 0.00	9.8	8.2
x = 0.25	2.4	2.66
x = 0.50	2.5	1.98
x = 0.75	1.5	1.8
x = 1.00	4.9	3.9

electrolyte resistance (R_s)/equivalent series resistance consists of electronic and ionic contribution. Whereas interfacial resistance corresponds to inter–particles resistance and resistance between particles and current collector. Low values of electrolyte resistance (R_s), and charge transfer resistance (R_{ct}) is responsible for easy access for intercalation and de–intercalation of ions on the electrode surface, and facile charge-transfer at electrode-electrolyte interface. From Nyquist plot the electrolyte resistance (R_s) as well as charge–transfer resistance (R_{ct}) of $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ (x = 0.0, 0.25, 0.50, 0.75, and 1.0) nano ferrite is calculated as demonstrated in Table 6. From Table 6, the sample $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ with x = 0.75 resulted in the low values of electrolyte resistance (R_s) 1.5 Ω and charge–transfer resistance (R_{ct}) 1.8 Ω. Interestingly, the results obtained from EIS are in good agreement with the results obtained from CV and GCD studies. Hence, the electrode materials synthesized in this study exhibit excellent electrochemical performance and could serve as potential candidates for electrode fabrication, with the potential for use in high-energy density supercapacitor applications.

4. Conclusion

In summary, Ni-doped $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ nano ferrites having five different compositions (x = 0.0, 0.25, 0.50, 0.75 and 1.0) were synthesized by sol-gel auto-combustion method and were characterized with the help of various physicochemical techniques such as XRD, FTIR, SEM, TEM, XPS and VSM. The outstanding electrochemical performance demonstrated by the as-prepared nanostructure $Cu_{1-x}Ni_xMn_{1.0}Fe_{1.0}O_4$ with X = 0.75 can be attributed to the uniform morphology, appropriate doping at active sites, and high electrical conductivity. These factors have led to the high specific capacitance (975 Fg^{-1}), high energy density (20.8 $Whkg^{-1}$) at a scan rate of 5 mVs^{-1}, and remarkable capacity retention (94.4%) over 5000 cycles. The exceptional electrochemical performance of the as-synthesized samples highlights their high practicability as potential electrode materials in the fabrication of high energy density supercapacitors. With their stability and durability, these materials could significantly contribute to the development of advanced energy storage technologies and hold promise for a sustainable energy future.

Credit author statement

Contribution of Authors in the manuscript: Credit author statements are as follows. Mr. Pramod Agale: Format analysis, Methodology, Investigation, Supercapacitor studies, Mr. Vaibhav Salve: Plotting of the graphs, Synthesis of Material, Mr. Kundan Patil: Synthesis of ferrites, Plotting of graphs, Dr. Satish Mardikar: Synthesis of ferrites, Plotting of graphs, Dr. Santosh Uke: Electrode preparation, Software, Project Administration, Dr. Sunil Patange: Plotting, software run of Rietveld, Dr. Paresh More: Conceptualization of idea, writing review and editing, writing original manuscript and supervision.

Declaration of competing interest

There are no conflicts to declare.

Acknowledgements

PMA, VMS and PSM are thankful to the Management and Principal Prof. Preeta Nilesh of K. E. T'S, V. G. Vaze College Autonomous for encouragement and support.

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Results in Chemistry 6 (2023) 101139

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Benzimidazole: A versatile scaffold for drug discovery and beyond – A comprehensive review of synthetic approaches and recent advancements in medicinal chemistry

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ARTICLE INFO

Keywords:
Benzimidazole
Scaffold
Pharmacological
Pharmaceutical
1,2-diphenylamine (orthophenylenediamine) (OPDA)
Anticancer
Antioxidant
HIV

ABSTRACT

Heterocyclic compounds are foundational in drug discovery, constituting the core structure of approximately 80% of pharmaceuticals. Benzimidazole, in particular, emerges as a critical aromatic heterocyclic system present in natural compounds, playing an indispensable role in medicinal chemistry. Beyond its pharmaceutical importance, benzimidazole demonstrates its versatility across diverse domains, including materials science and a wide spectrum of pharmacological applications, encompassing antiviral, antifungal, antioxidant, and anticancer properties. The prominence of benzimidazole in both biological activities and industrial applications underscores its pivotal role as a versatile heterocyclic scaffold. Its outstanding attributes, such as enhanced bioavailability, stability, and biological activity, have drawn significant attention from both researchers and industries. This comprehensive review delves into various synthetic approaches to benzimidazole synthesis, with a focus on practical and eco-friendly pathways utilizing various catalysts, including biocatalysts, nanocatalysts, and photocatalysts. Additionally, this review sheds light on the recent advancements of benzimidazole across multiple sectors, spanning pharmaceuticals, materials science, agriculture, and coordination chemistry. Finally, this work summarized the major challenges and presents potential directions for future research endeavors in benzimidazole applications within pharmaceuticals, agriculture, and industrial sectors.

1. Introduction

With the development of organic chemistry in the 18th century, the history of heterocyclic compounds began. The heterocyclic chemistry is the largest subfield of organic chemistry. The heterocyclic moieties possess structural diversity at high degree and are present in most of the biologically active compounds. More than 65 % of the data in organic chemistry, according to Gupta *et al.* is based on the chemistry of heterocyclic compounds [1]. There were many heterocyclic compound reported in literature like histamine, proline, tryptophan, vitamins and coenzymes such as riboflavin, vitamin B12, vitamin E, folic acid etc. In the present time, Pathan *et al.* studied that the heterocyclic compounds play a pivotal role in medicinal study and research [2]. More than 90 % of clinically available drugs contain heterocyclic nuclei. This explains the central position occupied by heterocyclic compounds in pharmaceutical and medicinal chemistry [3] studied by Wang *et al.* It is all known that heterocyclic compounds containing nitrogen and sulphur show broad pharmaceutical activities. The nitrogen-based heterocycles are of great significance to life in nature. They have the ability to bind to several medicinal targets because of their electron rich structural versatility, and hence studied under the far-reaching spectrum in biology and chemistry. A large number of synthetic nitrogen-based heterocyclic compounds became the centre of attention with their wide activities in the aspect of pharmaceutical, agricultural and industrial applications. Among the nitrogen-based heterocycles, benzimidazole stands out as the building block in most of the clinical drugs which are in regular use. Fig. 1 represents the structure of benzimidazole.

Benzimidazole is extensively studied as heterocyclic scaffold. Due to

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https://doi.org/10.1016/j.rechem.2023.101139
Received 12 August 2023; Accepted 27 September 2023
Available online 30 September 2023
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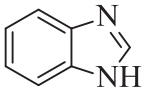


Fig. 1. Structure of benzimidazole.

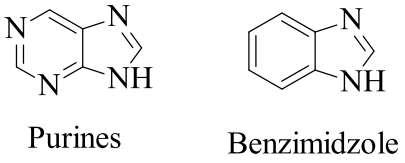


Fig. 2. Structures of purines and benzimidazole.

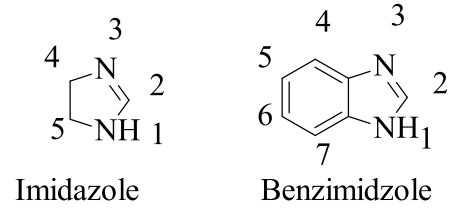


Fig. 3. Numbering of imidazole and benzimidazole nucleus.

the structural resemblance, benzimidazole and purines based nucleic acid are isostere of each other. It has been projected as an important moiety in pharmaceutical study to show a wide range of pharmaceutical activities and hence to synthesize its derivatives became the part of interest for organic and medicinal chemists [4–6]. Its pharmaceutical profile came to light in 1944 when Woolley assumed that benzimidazole can act like purines to draw some biological responses [7]. Along with this, benzimidazole exhibits a wide scope in agricultural, synthetic organic chemistry, polymer chemistry, coordination chemistry, material science etc. Thus, heterocycles are very important not only pharmaceutically but also industrially. Fig. 2 shows the numbering in imidazole and benzimidazole.

2. The chemistry of benzimidazole

The benzimidazole nucleus is formed when the benzene nucleus and imidazole ring are fused. Benzimidazole is a heterocyclic scaffold which is formed when the benzene and imidazole rings are fused at 4th and 5th position. Fig. 3 displays the numbering in imidazole and benzimidazole nuclei.

The reduction of 2-nitro-4-methylacetanilide shown in Scheme 1 was first reported by Hobrecker (Wright) in 1872 for the synthesis of benzimidazole [8,9] followed by the Ladenburg in 1875 reported from 3,4-diamino toluene in acetic acid (Scheme 2). During this process, dehydration occurred and the term 'anhydrobase' was derived. Benzimidazole was commonly was commonly called benzimidazoles and benzoglyoxaline, derivatives of o-phenylenediamine (OPDA). Fig. 4 explains the tautomerism in benzimidazole, the H-atom linked in the N-1 atom of the scaffold gets tautomerized, resulting to the isomerization. In the Fig. 4, benzimidazole (1) and 2-methylbenzimidazole (2) were referred to as methenyl-o-phenylenediamine and ethenyl-o-phenylenediamine respectively. Besides this, benzimidazole were previously called as derivatives of groups that contained imidazole component of scaffold. As o-phenylene formamidine, benzimidazole was previously known. The compounds 2(3H)-benzimidazolone (4a) and 2 (3H)-benzimidazolethione (4b) were historically been referred as o-phenylurea and o-phenylenethiourea respectively [8].

In order to investigate the potential uses of benzimidazole in pharmaceuticals, Goodman and Nancy Hart published the first research paper on benzimidazole in 1943. Woolley represented its antibacterial activities in 1944. Brink *et al.* in 1949 recognized 5,6-dimethylbenzimidazole as a vitamin B12 degradation product. It was found that the other derivatives showed the same properties like vitamin B12 studied by Emerson *et al.* [10,11] From this time, various synthetic approaches were developed to synthesis of the benzimidazole derivatives [12], like Norman G.B. and Karl Folker synthesized the degradation product 5,6-dimethyl benzimidazole [7]. Because of –NH group present in the molecule benzimidazole is amphoteric in nature. Due to its ability to form salt, it exhibits both acidic as well as basic behavior. Wang *et al.* explained that benzimidazole can form the hydrogen bonding with the biological enzymes as well as receptors and can function as a ligand for metal ions [13]. After studying these properties of benzimidazole, it came to light as an important heterocyclic scaffold showing bioactivities and has multiple roles as antiviral, anticancer, anti-inflammatory,

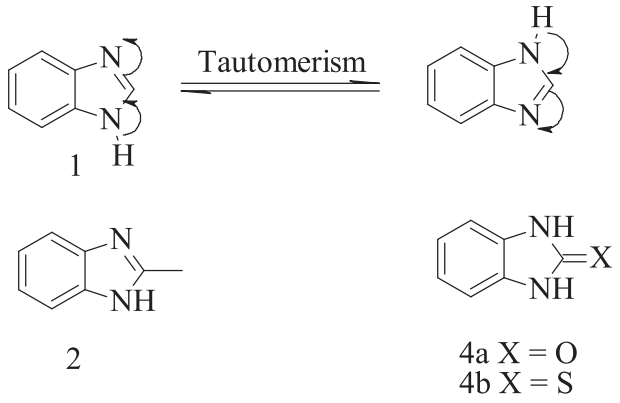
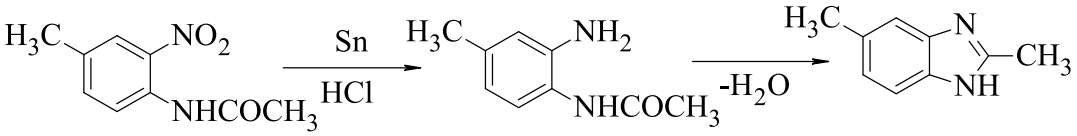
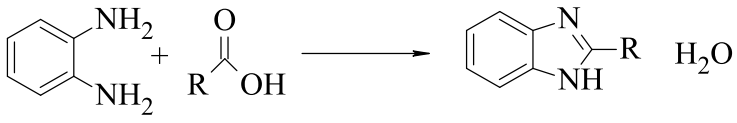


Fig. 4. Tautomerism in benzimidazole.



Scheme 1. Synthesis of benzimidazole from 2,5-dimethylbenzimidazole.



Scheme 2. Synthesis of benzimidazole from OPDA and carboxylic acid.

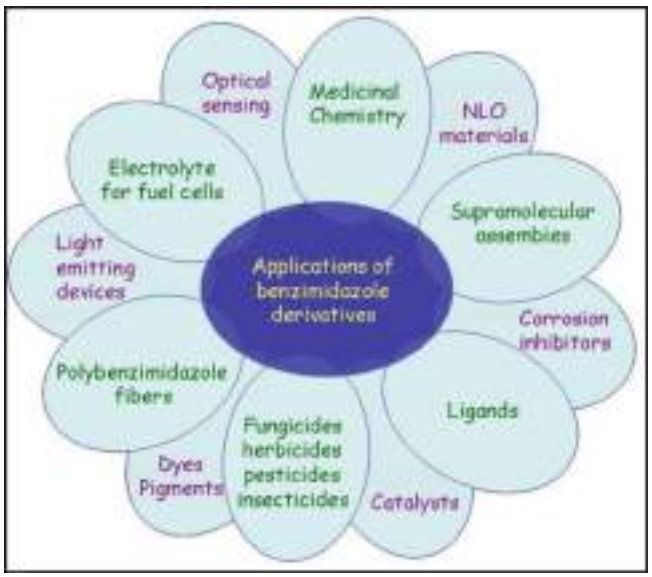


Fig. 5. Applications of benzimidazole [14] (Image reproduced with permission).

antibacterial, antiparasitic, analgesic, antihistaminic, antifungal, anticoagulant, antiulcer, etc. Fig. 5 gives the virtual representation of the various applications of benzimidazole.

The first clinically available benzimidazole based drug is thiabendazole which is an antiparasitic and fungicide.(Yadav *et al.*) [15] In the last few years, a variety of benzimidazole based derivatives have been discovered. Some of them are mentioned in Fig. 6 along with their biological activities. As a result, both the synthetic organic chemists and biologists are concentrating their research study on the synthesis of benzimidazole.(Narasimhan *et al.*) [16,17].

3. Synthetic approaches to benzimidazole

The first synthesis of benzimidazole was carried out by Hoebrecker by reducing 4-methyl-2-nitroacetanilide and then second synthesis was carried out by Ladenburg through refluxing 3,4-diaminotoluene with acetic acid. These are depicted in Scheme 1 and 2 respectively. With the advancement in the knowledge and as per the need of the time the various synthetic approaches (Fig. 7) were developed to synthesize the versatile pharmacophore i.e. benzimidazole scaffold [20,21]. In this study, the various synthetic approaches to scaffolds of benzimidazole family are studied along with the biological and industrial uses are also discussed.

3.1. From ortho phenylenediamines (OPDA)

3.1.1. Through condensation with carboxylic acid

Nearly all of the synthesis of benzimidazole is initiated from the benzene derivatives with nitrogen containing functional groups ortho to one another as presented in Fig. 8. Most of the benzimidazole synthesis is carried out by condensing *ortho*-phenylenediamine (OPDA) in addition to its derivatives.

The sealed tube containing the reaction mixture of *ortho*-phenylenediamine (OPDA) and carboxylic acid were heated to get the desired compound 2-substituted benzimidazole. The sealed tube was heated by steam. Phillip's method is the most commonly used for the synthesis of a variety of benzimidazoles. In this method, by condensing OPDA along with carboxylic acids or its derivatives, by heating them together in an acidic environment by adding conc. HCl. This is the most extensively used method explained by Özbey *et al.* to synthesize benzimidazole [22]. Scheme 3 displays the HCl catalyzed condensation of OPDA and carboxylic acid.

The use of *ortho*-phenylenediamine for the synthesis of various 2-substituted benzimidazole derivatives has been done by using different aromatic acids in presence of ammonium chloride as a catalyst (Scheme 4) explains the green approach to benzimidazole synthesis [23].

The benzimidazole scaffold can be synthesized using catalyst ZnO nanoparticles (NAP-ZnO) to give 90–98 % yield. A number of substituted o-aryldiamines heated with formic acid at 70 °C for 6–240 min. The use of pricier reagents carried out without using any solvent. The advantages of this method are easy preparation of catalyst NAP-ZnO which is nontoxic, reusable and affordable heterogeneous nanocatalyst as well as benign reaction conditions. This makes it efficient and environment friendly method (Scheme 5) and studied by Alinezhad *et al.* [24,25].

2-aryl benzimidazole derivative was synthesized by Eshghi *et al.*, by condensing OPDA and aromatic acid in the presence of polyphosphoric acid (PPA) or polyphosphate ester (PPE) employed as dehydrating agent. For this phosphorus pentoxide can be used as a dehydrating agent. 2-phenylbenzimidazoles exhibits anthelminthic activity in a number of veterinary and human anthelmintics. It is shown that the aliphatic acids reacts smoothly with OPDA (on heating with dil.HCl) to yield 2-aryl benzimidazole (Scheme 6). But aromatic acids react with OPDA only in the presence of dehydrating agents [26].

Alam *et al.* represented that by condensing an equimolar solution containing OPDA and p-aminobenzoic acid in presence of polyphosphoric acid (PPA) and xylene for about 6 h, yields 2-substituted benzimidazole derivative (Scheme 7) [27].

The synthesis of benzimidazole-2-thiol derivative involves refluxing OPDA and mercaptoacetic acid together. It is then subsequently followed with the cyclization process with different aromatic aldehydes or chloroacetic acid to yield polynuclear fused benzimidazole derivative [28]. The synthesis of the fused rings.Huynh *et al.* (Scheme 8) carried out the green approach of benzimidazole derivatives by condensing OPDA with mono-carboxylic acid using the microwave irradiation (Scheme 9) [29]. In recent times, alumina, silica gel, and zeolite HY have been used as catalysts in the microwave-irradiated, solvent-free synthesis of benzimidazole. Scheme 10 gives the outline of this method, OPDA is reacted with either aliphatic, aromatic or heterocyclic carboxylic acid along with alumina, zeolite or silica gel, by mixing them in a mortar. And then this mixture is treated with microwave irradiation for 5–9 min at 160–560 V. The reaction progress is checked by thin layer chromatography by employing n-Hexane: Ethyl acetate in the ratio (90:10) as eluent. Chloroform is used to extract this mixture which eventually gets evaporated. The purification process involves column chromatography and recrystallization gives 2-substituted benzimidazole.

Saberi *et al.* designed the same reaction under microwave irradiation using OPDA and benzonitrile derivatives (RCN) instead of carboxylic acid under solvent free conditions to give 2-substituted benzimidazoles [30].

3.1.2. Through condensation with aldehydes

The synthesis of benzimidazole derivatives from OPDA can be carried out using either aliphatic or aromatic aldehydes, along with the presence of methanol, molecular oxygen at room temperature have been reported in the study. Instead of using various hazardous and costly oxidants, Park *et al.* developed the reaction to be more efficient, practical and eco-friendly by using visible light irradiation [31] using molecular oxygen as oxidant. This environmentally friendly approach does not need any metal catalyst or anything toxic. By involving the use of alcohol solvents like methanol or ethanol instead of harmful organic solvents under very mild conditions (Scheme 11). There is a possibility that diimine will be formed as a byproduct when there is no visible light. The process is accelerated by the visible light. The visible light promotes the reaction effectively investigated by Sontakke *et al.* [32] In one of the study done by Sarkate *et al.*iodine catalyzed synthesis 2-aryl-1-arylmethyl-1H-benzimidazole,by heating OPDA & aldehydes at 80–90 °C

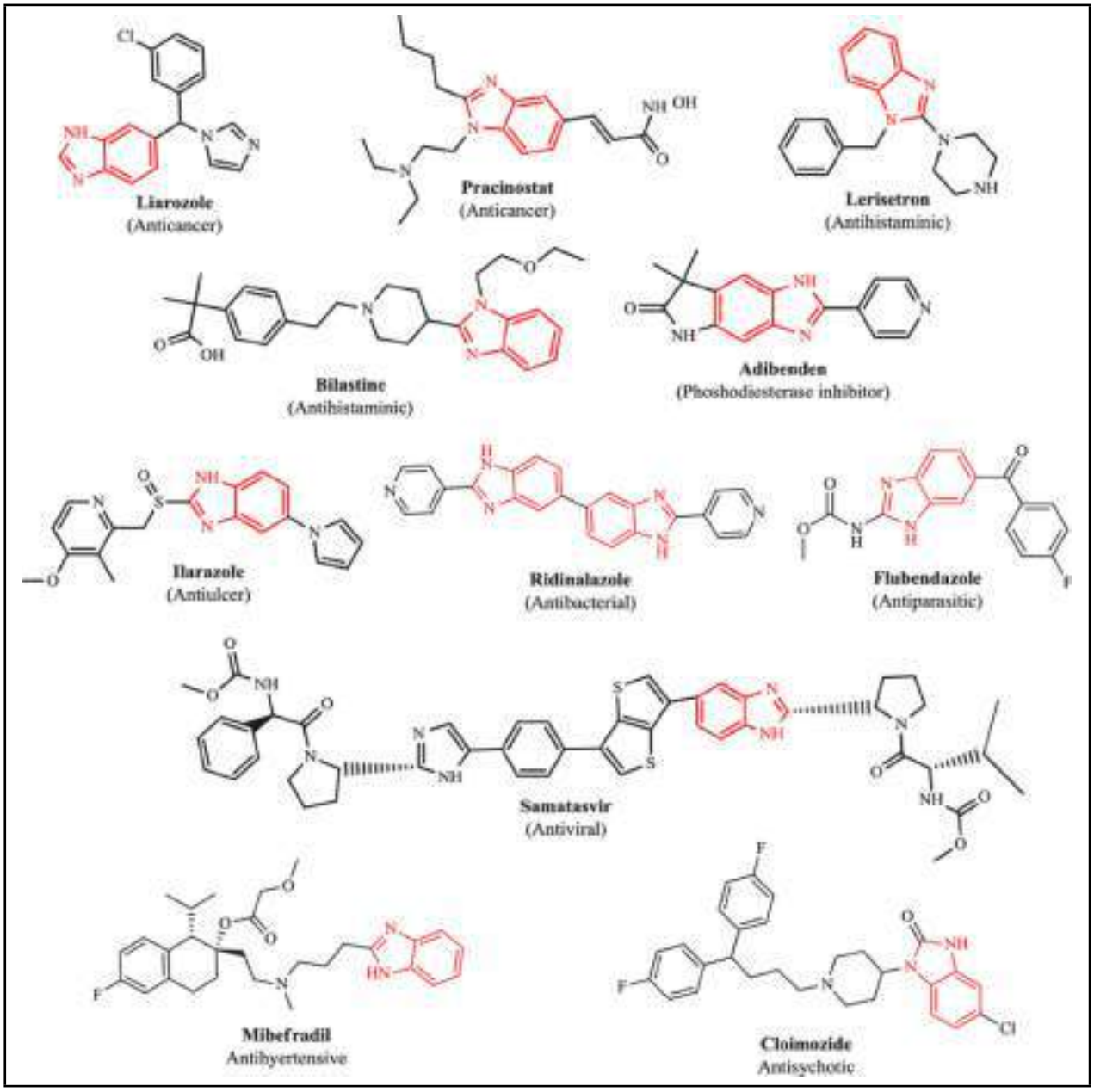


Fig. 6. Examples of Significant benzimidazole nucleus drugs [18] (Image reproduced with permission).

for 1.5 h (Scheme 12) [33]. This method is simple, efficient, eco-friendly and practical for one- pot synthesis. Iodine is inexpensive, non-hazardous and commercially available reagent and hence of great importance.

Alapati *et al.* reported the preparation of substituted benzimidazole by one-pot condensation from OPDA and aryl aldehyde by employing urea hydrogen peroxide (UHP) and iodine in dimethylsulfoxide (I_2 in DMSO) heated at 80–90 °C for 1.5 h, interpreted in Scheme 13. This is a very efficient method which provides a good yield [34].

As reported by Kumar *et al.*, using sodium metabisulphite (SBM) adsorbed on silica gel to synthesize benzimidazole which proved to be the eco-friendly reagent. The reaction is fast, efficient and eliminates the use of expensive and hazardous chemicals giving pharmaceutically important benzimidazole scaffold in high quantities. The OPDA solution in ethanol is added to benzaldehyde, and then SMB-SiO_2 (SMB adsorbed on silica gel) is added and stirred for 4 to 8 h (Scheme 14). Thin layer chromatography (TLC) and column chromatography helps to confirm the product i.e. substituted benzimidazole [35].

The one step synthesis of benzimidazole derivatives involves the refluxing of OPDA & aldehydes at 100 °C in the presence of air as an oxidant reported by Lin *et al.* and Birajdar *et al.* [36,37] as illuminated in Scheme 15.

Waghmare *et al.* brought to light the alternative way to the reaction explored in Scheme 15, is by the condensation of OPDA with different aromatic aldehydes while using ferric hydrogensulphate (FSH) as an oxidative catalyst (Scheme 16). The reaction rate is accelerated by the electron withdrawing groups on benzaldehyde, where as electron donating groups slow down the process. In making this reaction a green approach, water can be used as solvent but it decreases the yield [26,38].

The comparative (%) yields of substituted benzimidazoles presented in Scheme 16 employing different solvents like water and ethanol substituting R_2 on the aldehyde given in Table 1. It helps to opt for a particular solvent comparing the yield of product.

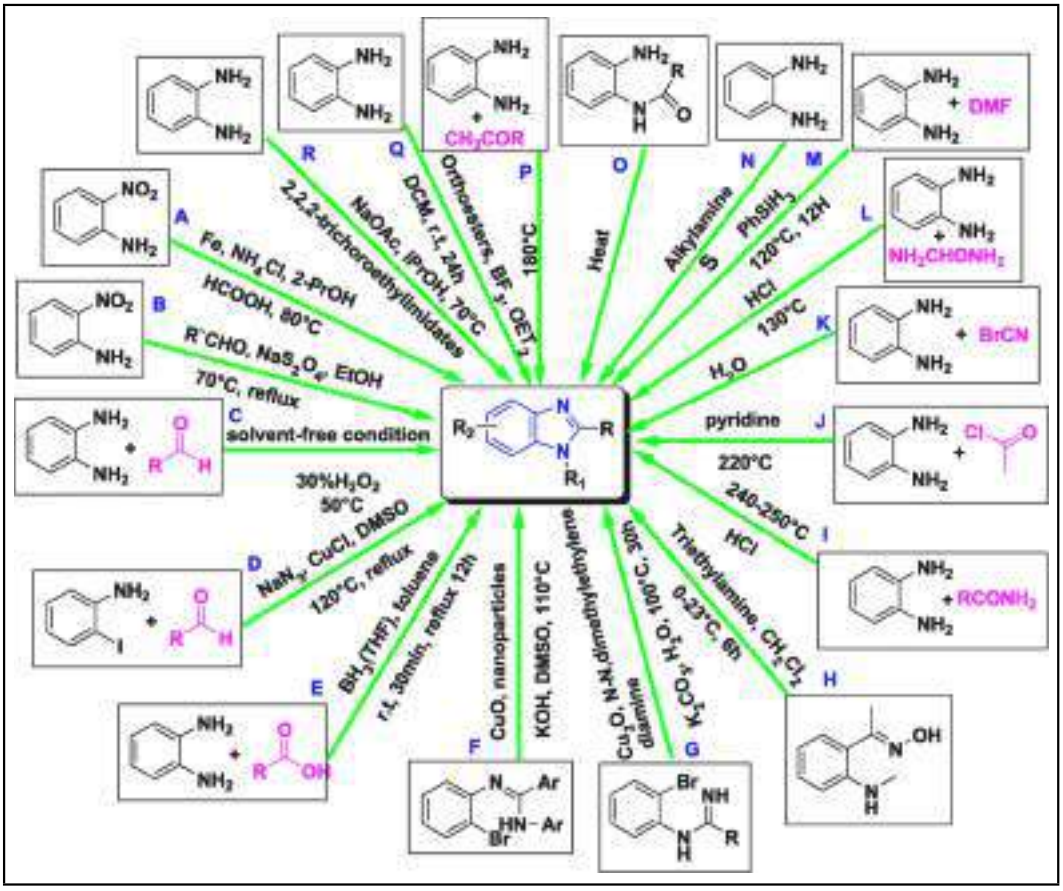


Fig. 7. Various Synthetic pathways to benzimidazole [19] (Image reproduced with permission).

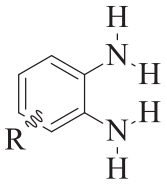
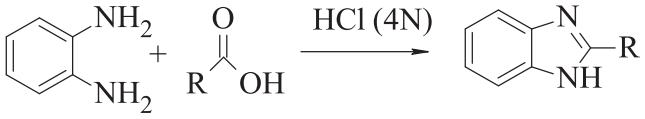
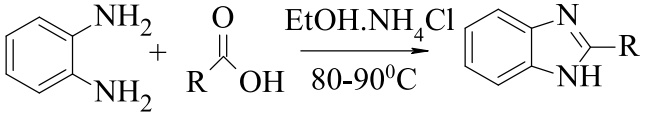


Fig. 8. Structure of ortho di nitrogen compound.



Scheme 3. Philip's condensation.



Scheme 4. One-pot synthesis of benzimidazole.

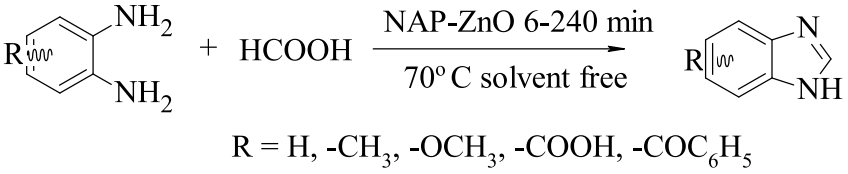
Mobinikhaledi *et al.* designed and prepared a series of 2-aryl benzimidazole by reacting OPDA with different aromatic aldehydes along with sodium-hexafluroaluminate [Na_3AlF_6] as a catalyst at 50 °C. If the aliphatic aldehydes are used instead of aromatic aldehydes in the reaction, product is obtained in trace amount. This efficient environmentally benign method has numerous benefits like significant yield, mild reaction condition, easy workup and catalyst is easily available. The reaction is explicated as 2-aryl benzimidazoles have antibacterial activity (Scheme 17) [32,39].

The reaction involving OPDA with various substituted aromatic aldehydes using Na_3AlF_6 in ethanol at 50 °C gives different yields (%) reported by Eren *et al.* discussed in the Table 2 [40]. The reaction time taken for Scheme 17 and the yield produced are studied relatively in Table 2. From the Table 2, the effect of substituting (-Ar = Aromatic nucleus/ ring) in the Scheme 17 on the reaction time taken and the yield produced.

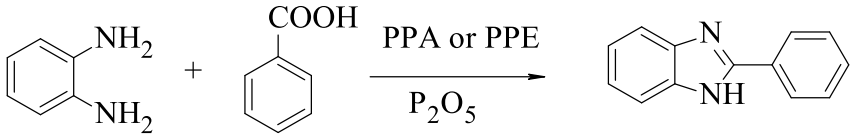
Kutschy *et al.* created a new, facile and efficient method for benzimidazole synthesis by the oxidative cyclization of OPDA with variety of aldehydes using dioxanedibromide (Scheme 18) to give 2-subsituted-1H-benzo[d]imidazoles. Dioxanedibromide is a catalyst used in these reactions which is mild, stable, affordable and efficient catalyst [41]. In cold 1,4-dioxane, bromine is added while stirring to produce orange solid, which is then filtered followed by washing with 1,4-dioxane to get dioxanedibromide in pure form as demonstrated by Chaudhuri *et al.* [42].

The excellent yield for the Scheme 18 is obtained with 100 mol % of dioxanedibromide, the yield decreases with decreasing moles of dioxanedibromide. This method is versatile and applicable to substituted aldehyde substrates. This is the first reported method to synthesize benzimidazole using dioxanedibromide. The various effects of solvent were studied and found that acetonitrile is suitable for getting good yield in less time for Scheme 18 in which yield varies with the solvent as well as with the moles of dioxanedibromide, summarized by Birajdar et al. in the Table 3: [43].

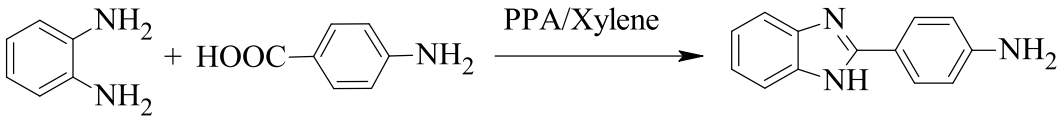
Pardeshi *et al.* used a surfactant sodium dodecyl sulfate (SDS) as a



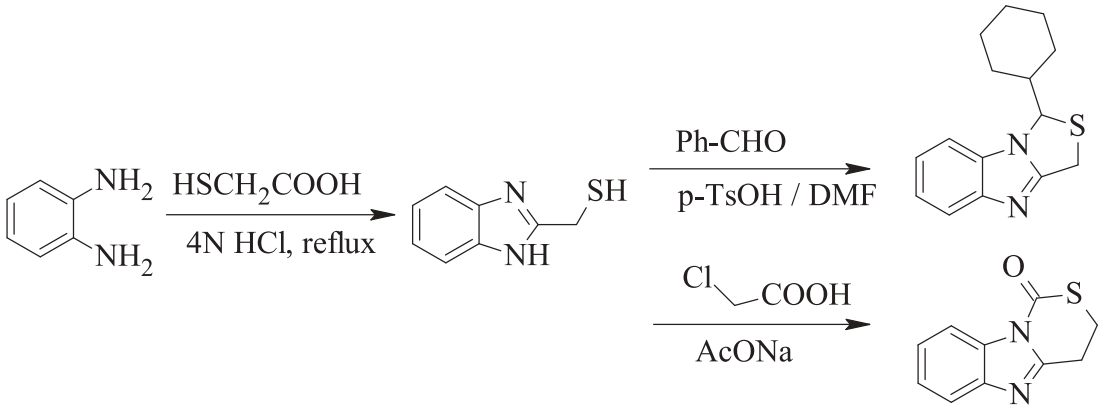
Scheme 5. Synthesis of benzimidazole using NAP-ZnO catalyst [24].



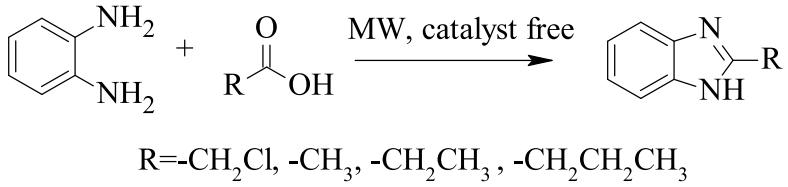
Scheme 6. Synthesis of benzimidazole using PPA or PPE.



Scheme 7. Synthesis of benzimidazole using PPA/Xylene.



Scheme 8. Synthesis of benzimidazole using mercapto acetic acid.

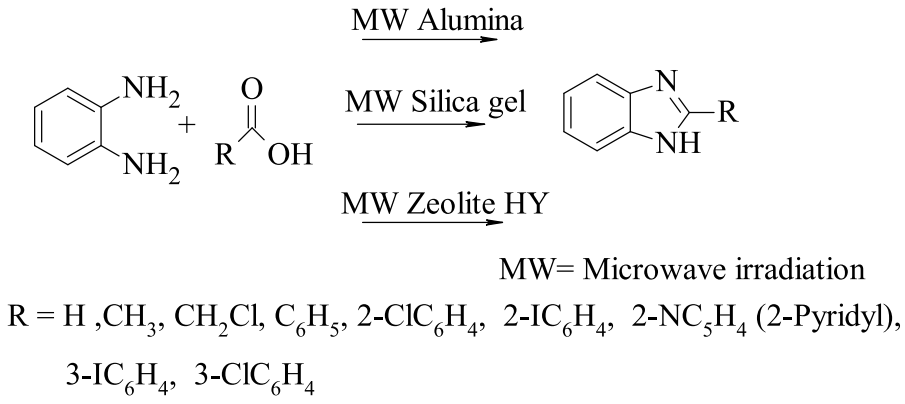


Scheme 9. Synthesis of benzimidazole using microwave irradiation.

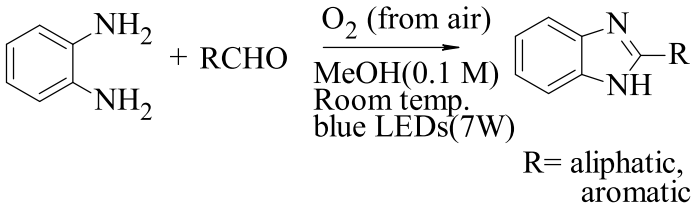
catalyst by the reaction of *ortho*-phenylenediamine and aryl aldehydes in aqueous medium, giving the good yield without any oxidizing agent. Scheme 19 reveals the reaction that sodium dodecyl sulphate added to the mixture of OPDA, various substituted aromatic aldehydes and water in a round bottom flask. This mixture is irradiated in an ultrasonic bath for appropriate time before its extraction with ethyl acetate. The synthesized compound was dried under vacuum and separated by using silica to get pure compound. By substituting various aromatic rings (Ar) in the aldehyde in Scheme 19, affects over the time taken by reaction with varying yield of the product noted in Table 4. The comparative yield of various products obtained by using substituted aromatic aldehydes and OPDA using SDS reported by Pardeshi *et al.*, mentioned in Table 4: [44].

Chundawat *et al.* studied, on heating aldehydes under reflux with N-Tosyl-o-phenylenediamine for 1 h forms the unstable intermediate which is converted into a number of benzimidazole derivatives followed by hypervalent iodine C-H amidation. It involves the oxidative cyclization promoted by iodine (I_2) in addition to potassium carbonate (K_2CO_3) and dichloromethane (CH_2Cl_2). The process conferred in Scheme 20, is a straightforward and applicable to wide variety of substituted anilines and provides an efficient approach to benzimidazole derivatives [45].

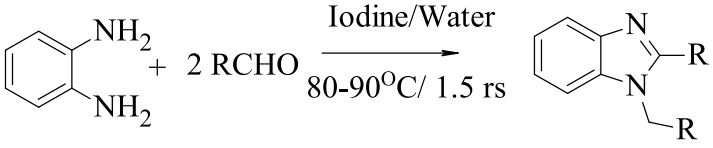
Chakrabarty *et al.* explored a new way to synthesize benzimidazole



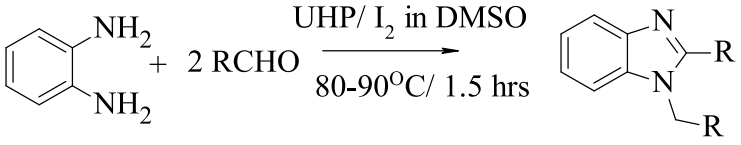
Scheme 10. Synthesis of benzimidazole using microwave irradiation.



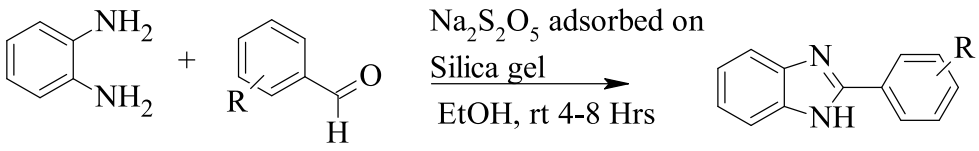
Scheme 11. Synthesis of benzimidazole using molecular oxygen.



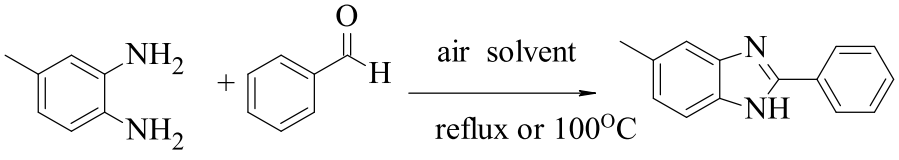
Scheme 12. Iodine catalyzed synthesis of benzimidazole [33].



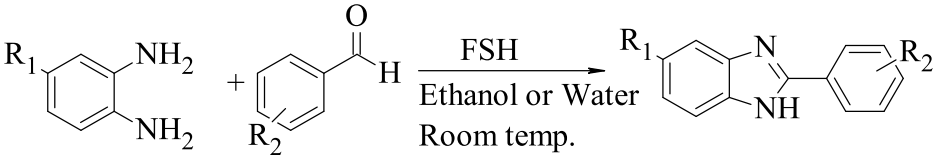
Scheme 13. Benzimidazole synthesis in one-pot using UHP and DMSO.



Scheme 14. Synthesis of benzimidazole with Sodium metabisulfite adsorbed on silica gel in ethanol [35].



Scheme 15. Synthesis of benzimidazole using air as oxidant.



Scheme 16. Synthesis of benzimidazole using ferric hydrogensulphate (FSH) as oxidative catalyst.

Table 1
The percentage (%) yields of substituted benzimidazoles.

Sr.No.	R_1	R_2	Yield (%) in Water	Yield (%) in Ethanol
1	H	H	93	95
2	H	4-CH_3-	90	90
3	H	4-$(CH_3)_2CH$–	75	80
4	H	4-CH_3O-	90	91
5	H	4-$(CH_3)_2$-N-	90	95

using transition metal triflate like $Sc(OTf)_3$ in the presence of oxidant like H_2O_2, resulting in an excellent yield of 2-arylbenzimidazole. The aromatic aldehydes react with OPDA independent of the substituent over it i.e., the nature of substituent over aryl ring like electron donating or withdrawing group does not make such a difference. But this reaction shown in Scheme 21 involves the formation of side product 1,2-disubstituted benzimidazole along with 2-arylbenzimidazole. This can be overcome by diluting the aldehyde into ethyl alcohol and dropping it into the reaction mixture, yield of 2-arylbenzimidazole is improved, studied by Fan *et al.* With decreasing amount of H_2O_2, yield also decreases [46,47].

Punniyamurthy *et al.* designed a route to substituted benzimidazole by the three-component reaction in one-pot by forming imine, which acts as chelate for metal atoms. If aromatic amine and aldehyde along with trimethylsilyl (TMS) -azide are reacted in the presence of copper as a catalyst and *tert*-butyl hydroperoxide (TBHP). An alternative path for this synthesis is to use copper (II) acetate as a catalyst with substituted aniline and various amines, sodium azide in TBHP refluxing at 80 °C. The reaction involvestrans-amination, ortho selective amination and then cyclization [48,49]. This method is applicable to the broad functional groups. The reaction is elaborated in Scheme 22.

When aldehyde is treated with OPDA in the presence of atmospheric oxygen, substituted benzimidazole is formed. The various oxidizing agents employed may be H_2O_2-HCl, $LaCl_3$ [50], $FeBr_3$ [51], $Ce(NO_3)_3$ [52], sulfamic acid [53], manganese dioxide [54] etc. For the benzimidazole synthesis from aldehyde, OPDA is used and the reaction depends on the substituent and not on the substrate and steric factors. The reaction was studied for substrate scope and found that the substrates with electron withdrawing groups like chloro, bromo proceeds the reaction at faster rate as compared to that of electron donating groups like methyl. Also, the meta and *para*-substituted aldehydes give higher yield as compared to the *ortho*-substituted. This simple, efficient, inexpensive and green method to synthesize benzimidazole via oxidation, many synthetic pathways require anhydrous conditions reported by Gogoi *et al.* [55] This cyclization reaction is depicted in Scheme 23.

In Scheme 23, by using $LaCl_3$ as an oxidizing agent, the product yield varied when different solvent were used. The variation is depicted in Table 5. The highest yield was observed with acetonitrile (CH_3CN) by varying aldehydes. Venkateswarlu *et al.* proved that $LaCl_3$ (10 mol%) stands out as a novel as well as cost effective catalyst for benzimidazole synthesis [50]. Table 5 represents the yields for Scheme 23 using different solvents and $LaCl_3$ as an oxidizing agent.

Table 2
The percentage (%) yields of substituted benzimidazoles using Na_3AlF_6.

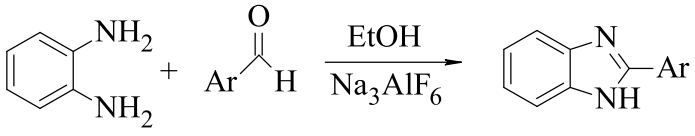
Product	Ar	Time (in h)	Yield (%)
1	C_6H_5	11	80
2	4-$CH_3C_6H_4$	9	81
3	2-$NO_2C_6H_4$	17	68
4	3-$NO_2C_6H_4$	13	72
5	4-$NO_2C_6H_4$	2	80
6	4-BrC_6H_4	4	92
7	2-HO, 5-BrC_6H_3	1	96
8	3-$OCH_3C_6H_4$	13	95

Sankar *et al.* demonstrated that OPDA when treated with aliphatic or aromatic aldehydes in the presence of NH_2-MIL-125 (Ti) MOFs (Molecular Organic Frameworks) as a catalyst (synthesized by solvothermal method) in the presence of methanol and refluxed at 60 °C gives a very good yield of 2-aryl benzimidazole. MOFs are the heterogeneous catalysts which are porous, crystalline in nature having large surface area, flexibility, stability and organic/inorganic hybrid materials. It also reduces the use of harmful chemicals. Kim *et al.* studied, NH_2-MIL-125(Ti) MOF is such catalyst, in which Ti^{4+} sites in the Ti-oxocluster enhances the electrophilicity of the aldehyde increasing the rate of the reaction. It gives high yield in a very short time. The catalyst NH_2-MIL-125(Ti) MOF can be removed and reused after the reaction is completed [56,57]. The reaction is presented in Scheme 24.

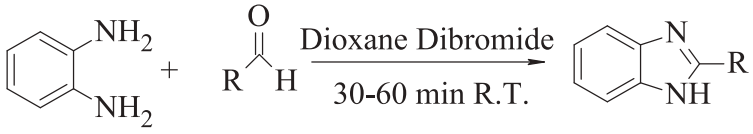
Gioia *et al.* designed a green synthesis, in which OPDA in choline chloride (ChCl): urea deep eutectic solvent (DES) when added to 1 mol of benzaldehyde in equal proportions which is then stirred and heated to 80 °C for 10 min gives 2-substituted benzimidazole (95 %) as a major product and 1,2-disubstituted benzimidazole derivative as a minor product. If the same reaction is employed using 2 mol of benzaldehyde, it yields 1,2-disubstituted benzimidazole (97 %) selectively. The advantage of DES is that it requires easy workup and no need to use any chromatographic or purification methods. The product can be separated with simple dilution of the reaction mixture by water and then extracted using ethyl acetate. By involving the use of reactive DES solvent, changing proportion of aldehyde, the product can be obtained selectively in excellent yield as delineated in Scheme 25 [58].

(Choline chloride (C5H14NO.Cl) is a quaternary ammonium salt with choline cation and chloride anion.).

Kumara *et al.* designed the benzimidazole derivative synthesis through cross coupling reactions by using OPDA with alkyl or aryl aldehydes and even containing heteroatoms in the presence of palladium [59] and copper-based catalyst, which results in a good yield, illustrated in Scheme 26.



Scheme 17. Synthesis of benzimidazole using Na_3AlF_6.

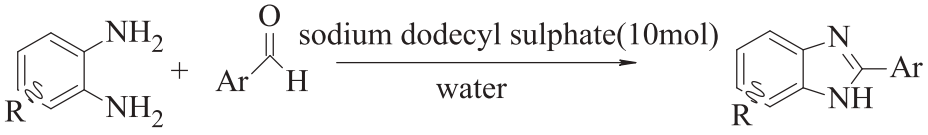


Scheme 18. Synthesis of benzimidazole using Dioxanedibromide.

Table 3
The % Yield of benzimidazoles using dioxanedibromide.

Product	Solvents	Dioxnedibromidemole %	Time (minutes)	Yield (%)
1	1,4-dioxane	100	120	70
2	THF	100	80	75
3	Chloroform	100	90	63
4	Ethanol	100	80	78
5	Water	100	160	45
6	Acetonitrile	0	160	20
7	Acetonitrile	50	90	45
8	Acetonitrile	100	35	87

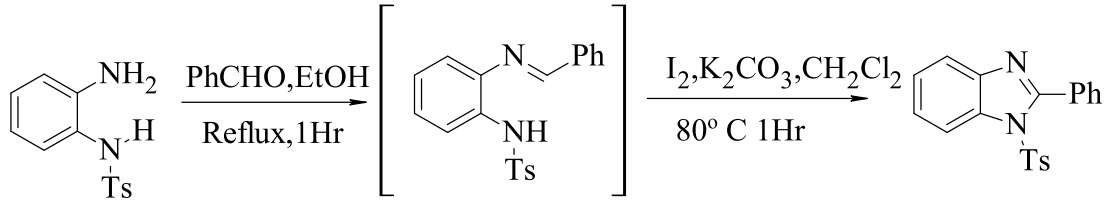
Jithendra K. *et al.* proposed the sustainable synthesis by using efficient catalysts like cobalt ferrite nanoparticles ($Co@Fe_2O_4$) and silica coated cobalt ferrite nanoparticles (SiO_2/ $Co@Fe_2O_4$) for cross-coupling reactions of OPDA with various aldehydes results in benzimidazole derivatives (27a) and (27b) in good yield as depicted in Scheme 27 [60]. The different catalysts were used to investigate the formation of 1,2-disubstituted benzimidazole, such as an aqueous extract of pods of *Acacia Concinna* and presented in Scheme 28. This is a low-cost greener approach which helps to reduce the harmful effects of halogenated organic solvents. This surfactant medium is superior to condense OPDA with two equivalents of aldehyde providing 1,2-disubstituted benzimidazole in high yield [61].



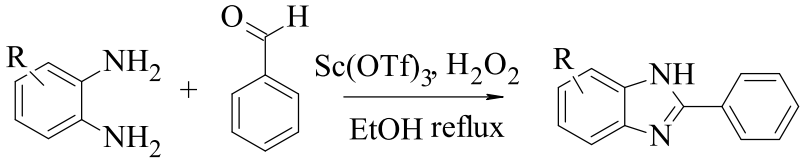
Scheme 19. Synthesis of benzimidazole using SDS.

Table 4
The percentage (%)yields of substituted benzimidazoles using SDS [44].

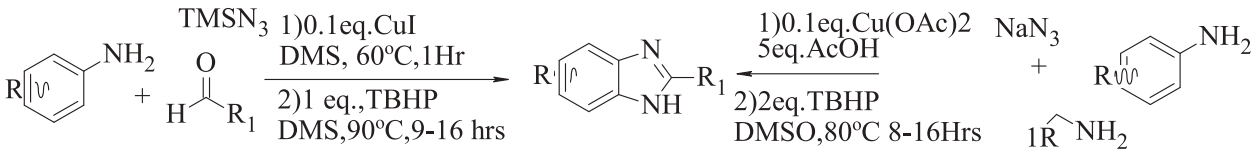
Product	R	Ar	Time (minutes)	Yield (%)
1	H	Ph	15	90
2	H	4-$MeOC_6H_5$	20	89
3	H	4-Cl C_6H_5	35	85
4	H	3-$NO_2C_6H_5$	40	90
5	H	3-Pyrydyl	15	92
6	H	3-F C_6H_5	25	91
7	H	3-Cl C_6H_5	40	92



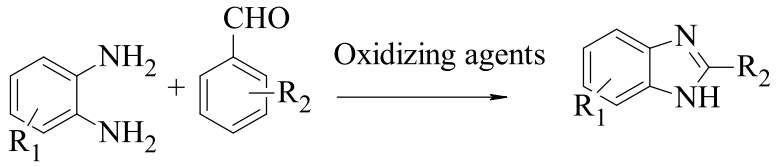
Scheme 20. Iodine promoted oxidative cyclization.



Scheme 21. Cyclization of OPDA and aromatic aldehyde using Sc(OTf)3.



Scheme 22. Three elements in one-pot approach.

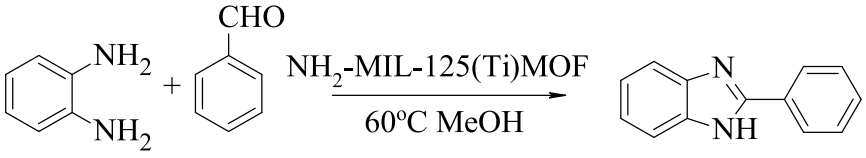


Scheme 23. Cyclization using aldehyde with oxidizing agents.

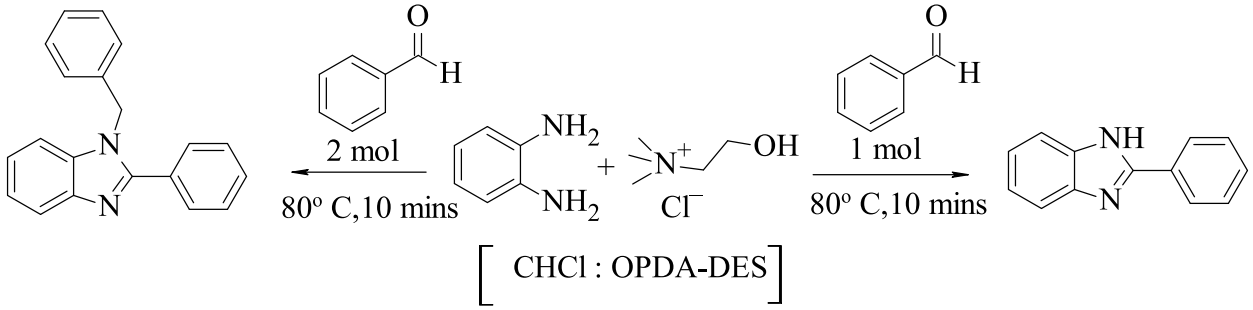
Table 5
Comparative analysis of the solvent system with $LaCl_3$ as an oxidizing agent [50].

Sr.No.	Solvent	Time (hrs)	Yield (%)
1	CH_3CN	2.0	95
2	CH_3OH	4.0	80
3	Dioxane	5.0	75
4	THF	6.0	70
5	Toluene	7.0	65
6	DMF	5.0	6
7	DCM	8.0	50

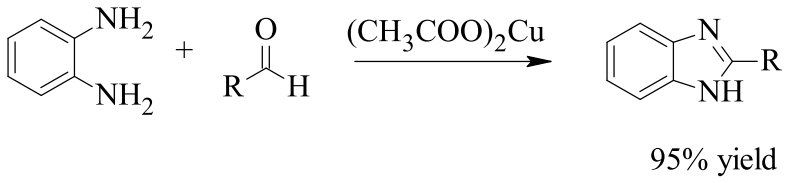
Nasr-Esfahani *et al.* synthesized the benzimidazole derivatives by the condensations of OPDA with different aldehydes by using different transition metal nanoparticle catalysts like Si-CuO nanoparticle catalyst (CuOnp-SiO2 10 %) to give a very good yield (76–93 %), reaction presented in Scheme 29. Also by using nanocatalyst Cu(II) 0.34 mol % (Cu (II)- TD@nSiO2, nanosilica triazine dendrimers) gives 88–97 % yield [62]. Kommula *et al.* synthesized 2-aryl benzimidazoles by using Fe (III)-Schiff base/SBA-15 as an effective catalyst in the presence of water results to give (79–92 %) yield. It requires a short reaction time, aqueous medium and recyclable catalyst [63].



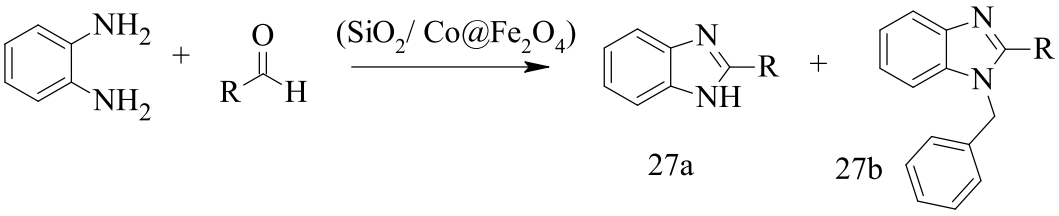
Scheme 24. Synthesis of benzimidazole using MOFs.



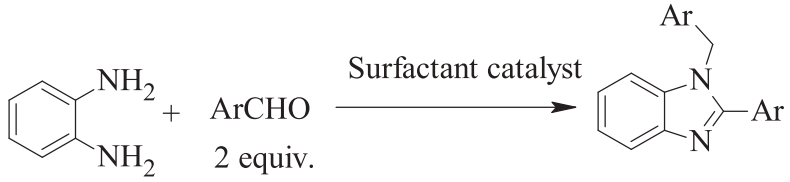
Scheme 25. Synthesis of benzimidazoles using active deep eutectic solvent cyclization.



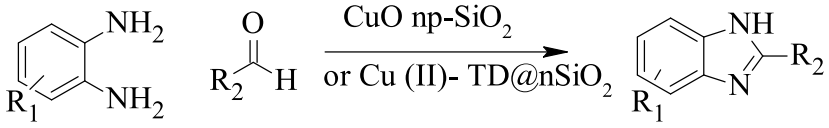
Scheme 26. Synthesis of benzimidazole using copper-based catalyst.



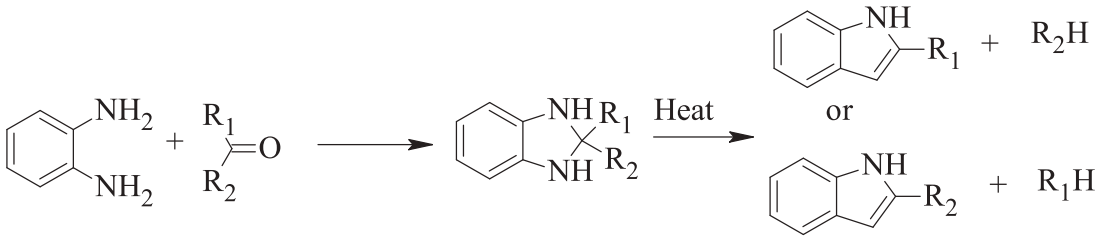
Scheme 27. Synthesis of benzimidazole using SiO2/Co@Fe2O4 nanoparticles.



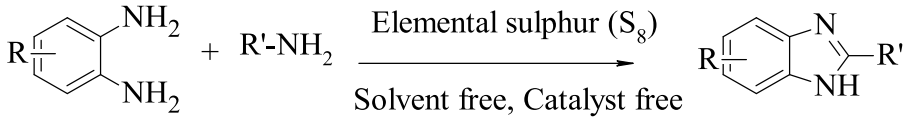
Scheme 28. Synthesis of benzimidazole using surfactant catalyst.



Scheme 29. Synthesis of different benzimidazole derivatives using Cu-based nanocatalyst.



Scheme 30. Synthesis of benzimidazole by condensation of OPDA and ketone.



Scheme 31. Synthesis of benzimidazole using elemental sulphur.

3.1.3. : Through condensation with ketone

The benzimidazole derivative can be synthesized by the condensation of OPDA with various ketones. The condensation of OPDA with ketone gives 2-disubstituted benzimidazoline. The unsymmetrically substituted benzimidazoline is quite unstable and and gets decomposed to give a mixture of two different benzimidazole derivatives dependent on alkyl group which is being eliminated [64] as is explained in Scheme 30. Nguyen *et al.* reported when aliphatic amine (1equivalent) is heated with OPDA at 130 to 150 °C in the presence of elemental sulfur (S_8) (3 equivalents) under solvent free as well as catalyst free reaction condition results to give excellent yield of 2-substituted benzimidazole. The reactions involving sulfur show different reactivities and selectivities without catalyst at moderate temperature without metallic contaminants. Under the optimized condition, various substituted aliphatic amines and substituted OPDA react to give corresponding benzimidazoles in good yield [65] as depicted in Scheme 31.

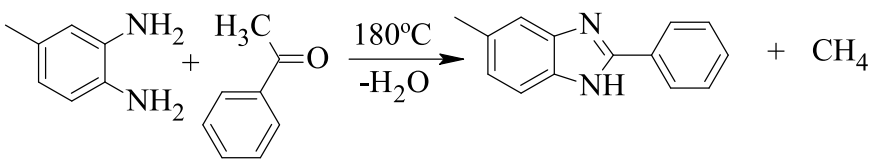
2-phenyl-5(or6)-methylbenzimidazole is synthesized when 3,4- diaminotoluene is heated with acetophenone at 180 °C and the methyl group is discarded to give the stable product. This scheme has a number of limitations, takes a long time, forms by products and is difficult for workup. Hence other reactions with better conditions are studied [64]. The reaction is presented in Scheme 32.

The benzimidazole derivative in a good yield can be synthesized by the reaction of OPDA with α-β unsaturated ketones both thermally or by using microwave irradiation [28]. The reaction is presented in Scheme 33.

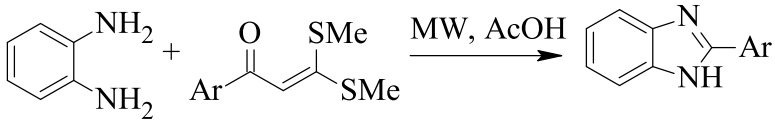
3.1.4. From OPDA, alcohol and acid chloride

Kumaraswamy *et al.* designed the photocatalytic synthesis of 2-aryl benzimidazole, from OPDA and alcohol by using cobalt-loaded TiO_2 (Co-TiO_2)under solar light irradiation exhibits great performance by giving excellent yield [66]. This can be observed in Scheme 34.

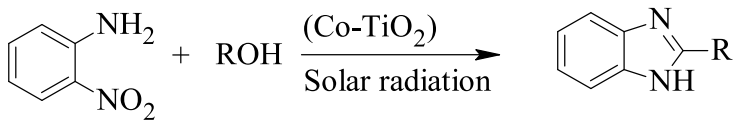
Heravi *et al.* synthesized 2-substituted benzimidazole, when OPDA reacts with acid chloride in the presence of dioxane, stirred for 30 min, zeolite is added as catalyst [67]. The mixture is heated to 100–102 °C for 3 h. After cooling the mixture is filtered to collect the solid formed, which is dissolved in chloroform. This catalyst can be removed by simple filtration technique and the solution is washed with NaOH. The resultant



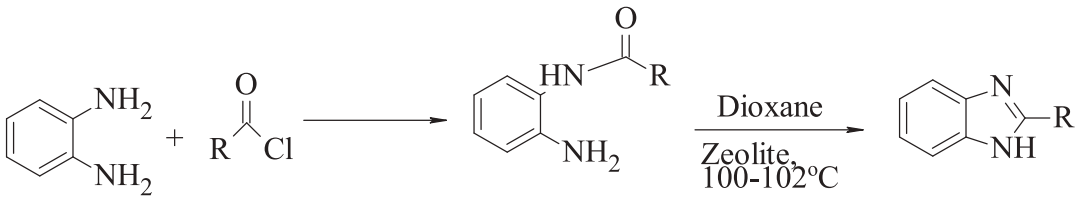
Scheme 32. Synthesis of benzimidazole from OPDA derivative and acetophenone.



Scheme 33. Synthesis of benzimidazole from OPDA and α-β unsaturated ketones.



Scheme 34. Synthesis of benzimidazole from OPDA and alcohol.



Scheme 35. Synthesis of Benzimidazoles from Acid Chloride.

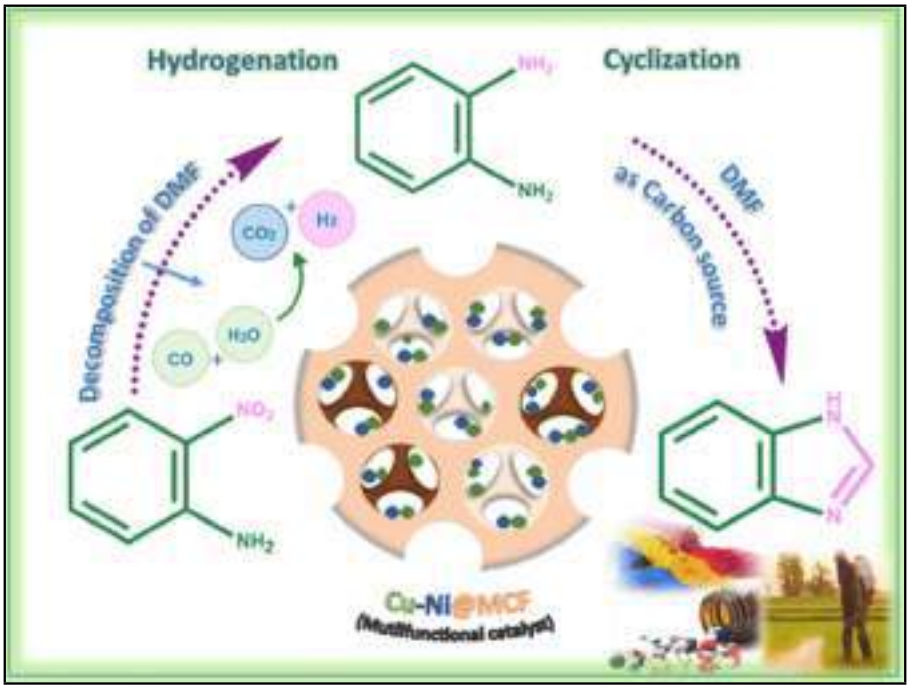


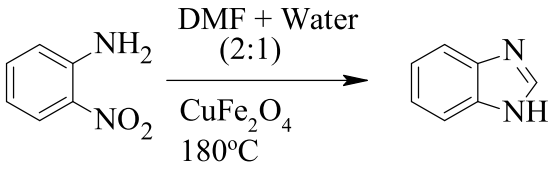
Fig. 9. Synthesis of Benzimidazole by using Cu-Ni@MCF [68] (Image reproduced with permission).

solid can be recrystallized from ethanol to give the product after the evaporation of solvent. The zeolite is a commercially available, reusable and inexpensive catalyst. This reaction presented in Scheme 35 has an easy work-up, one-pot reaction method proceeding in less time without isolating N-acyl phenylenediamine (mono substituted derivative).

3.2. From o-nitroaniline

Mohire *et al.* reported the synthesis of benzimidazole in one-pot over a mesocellular foam (MCF) along with bimetallic catalyst Cu-Ni@MCF is a clean and green process. This catalyst enables the active sites of metal for hydrogenation of o-nitroaniline to OPDA resulting in cyclization to form the benzimidazole as pictured in Fig. 9. The final product is obtained after 6 h at 180 °C and 800 rpm. The *in-situ* source of the hydrogen for hydrogenation and carbon dioxide for cyclization is generated by the solvent containing dimethylformamide (DMF) and water (2:1) [68].

Rasal *et al.* demonstrated the synthesis of benzimidazole from o-nitroaniline by using $CuFe_2O_4$ as a catalyst, in one-pot involves reduction followed by cyclization. This method gives 100 % product in 12 h with 97.5 % selectivity. The mechanism is the same as that of the Cu-Ni@MCF catalyst. The hydrogen gas was produced by the thermal



Scheme 36. Synthesis of benzimidazole using $CuFe_2O_4$.

decomposition of DMF in the presence of $CuFe_2O_4$. It reduces o-nitroaniline to *ortho*-phenylenediamine and is cyclized by DMF as C-source in the presence of $CuFe_2O_4$ catalyst [69]. This economical method with great yield is explained in Scheme 36.

The synthesis of benzimidazole by one pot reductive cyclocondensation of o-nitroaniline and aldehyde using small amount of zinc (Zn) dust and sodium bisulphite ($NaHSO_3$)in water medium at 100 °C, reported by Dasgupta *et al.* gives very good yield with easy workup, high atom economy and less time [70]. The reaction is presented in Scheme 37.

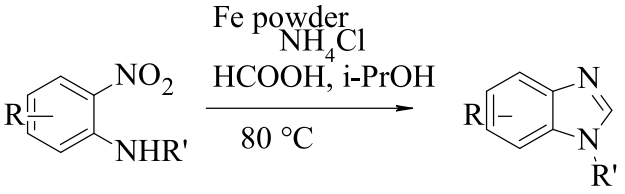
Shen *et al.* designed one pot condensation of 2-nitroaniline with various aldehyde (benzaldehyde) catalysed by nanocomposite of AgPd nanoparticle anchored on WO_2(AgPd/WO_2) in the presence of formic acid at 80 °C in dioxane for about 8 hr results to give more than 90 % yield of substituted benzimidazole. In the reaction explained in Scheme 38, WO_2 protects the Ag/Pd catalyst from poisoning. This reaction can be extended up to the synthesis of other benzene-fused heterocycles. This catalyst can be reused upto 5 rounds giving the yield up to 90 %. The AgPd/WO_2 provides the method to synthesize benzene-fused heterocyclic scaffold for pharmaceutical and functional polymer application [71].

Ermolenko *et al.* synthesized 2-substituted benzimidazole derivatives from o-nitro aryl amines, by reacting it with substituted benzyl alcohols or various benzyl amines, involving use of redox mediators like $FeCl_3$ at 140 °C by cyclization in single step. Due to its excellent yield this path has high commercial value. When 2-nitroaniline and benzylamine undergoes redox condensation by solvent free cobalt or iron catalyst, it gives 2-substituted benzimidazole. This method is applicable for the wide range of alkylamines as reducing components or 2-nitrobenzamide as oxidizing components if iron or cobalt are used as catalysts. The reaction noted in Scheme 39 is simple, straightforward, and economical carried out with readily available, non-toxic, inexpensive catalysts [72].

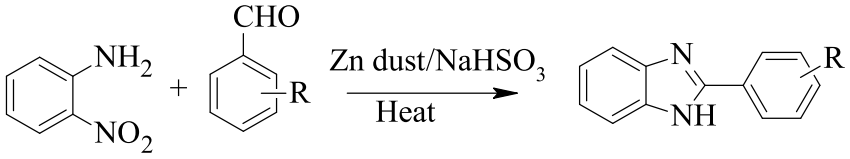
N-substituted benzimidazole derivative synthesis reported by Hanan et al. in one-pot can be carried out using aromatic 2-nitroanilie in the presence of 10 equivalents of iron powder, 10 equivalents of ammonium chloride (NH_4Cl) and equimolar (1:1) solution of formic acid and 2-propanol undergoes reductive cyclization. It is heated at 80 °C for 1–2 h. The solvent used 2-propanol can be substituted with 1-butanol and separated with simple filtration and aqueous extraction giving a very good yield. This reaction elaborated in Scheme 40 requires much optimized conditions using easily handled and inexpensive, non-toxic reagents having the flexibility of solvents and hence it is applicable for a broader range of organic synthesis [73]. The benzimidazole derivative can be synthesized from o-nitroaniline and phenylacetic acid by using Fe/S catalytic redox condensation. The reaction presented in Scheme 41 results to give product in high yield without any by-product reported by Huynh *et al.* [29].

3.3. Miscellaneous

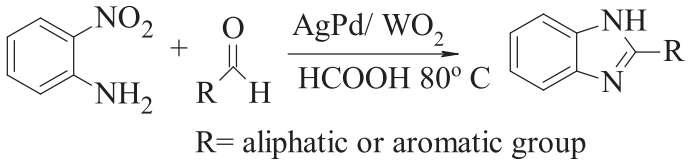
The synthesis of benzimidazoles can be carried out by the annulation of aniline derivatives with dioxazolones using Ir(III) as a catalyst under redox-neutral conditions shown in Scheme 42. This reaction involves C-H activation-amidation followed by the cyclization. This reaction



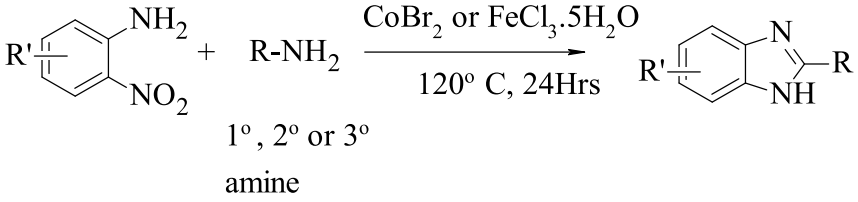
Scheme 40. One-pot conversion: o-nitroanilines into 2H-benzimidazoles.



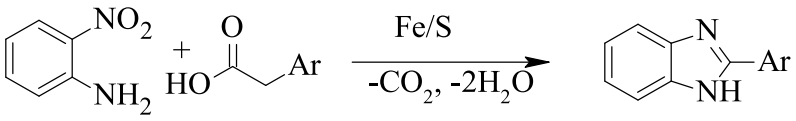
Scheme 37. Synthesis of benzimidazole using Zn dust and $NaHSO_3$.



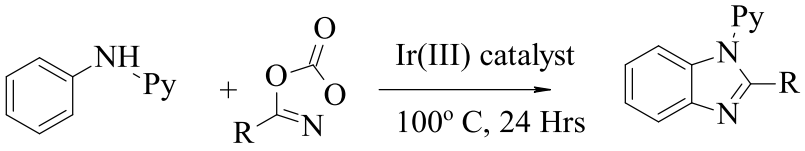
Scheme 38. One pot Condensation using AgPd/WO2.



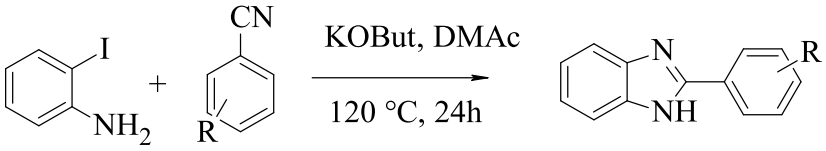
Scheme 39. Synthesis of benzimidazole using $CoBr_2$ or $FeCl_3$catalyst.



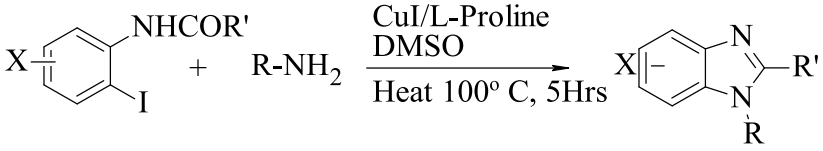
Scheme 41. Synthesis of benzimidazole using Fe/S catalyst.



Scheme 42. Iridium catalysed synthesis of Benzimidazole.



Scheme 43. Cyclization reaction using DMAc.



Scheme 44. CuI / L-Proline catalysed Synthesis of Benzimidazoles.

reported by Xia *et al.* can be carried out with readily available substrates, and a very small amount of catalyst is required. The by-products formed are only H_2O and CO_2 [74].

When 2-iodoaniline is treated with benzonitriles in the presence of potassium tertiary butoxide (KtBuO) as a base and N,N-dimethylacetamide (DMAc), the reaction mixture heated at 120 °C for 24 h resulting 2-substituted benzimidazole as shown in Scheme 43. This method is transition metal free and one step intermolecular cyclization. 2-iodoaniline reacts independently of the substituents over the ring, whether it is electron donating or withdrawing group. Butbenzonitrile with a methyl group at ortho position gives lower yield of the product as compared to that of meta or para position. Thus reactivity of benzonitrile gets affected by steric effect studied by Xiang *et al.* [75].

1,2-disubstitutedbenzimidazoles can be obtained by the copper catalyzed amination of 2-iodoacetanilide and primary amines in the presence of L-proline and dimethyl sulfoxide (DMSO) as a solvent as presented in Scheme 44. Variation at 1st and 2nd positions of benzimidazoles can be carried out if various primary amines are used by varying the amido groups of 2-haloanilides. Thus polysubstituted benzimidazoles can be obtained on a large scale as per the study by Zou *et al.* [76].

Trivedi *et al.* and Saha *et al.* reported when 2-aminobenzyl alcohol is treated with benzonitrile under microwave 100 W for 0.8 h., it forms an inseparable mixture of product. But if this reaction is performed by employing Lewis acids like $ZnCl_2$, ZnI_2, 2-substituted benzimidazole derivative is formed as shown in Scheme 45. The impact of ZnI_2 is more effective. This involves C-N bond formation leading to medicinally important benzimidazole derivative requiring mild reaction conditions [77,78].

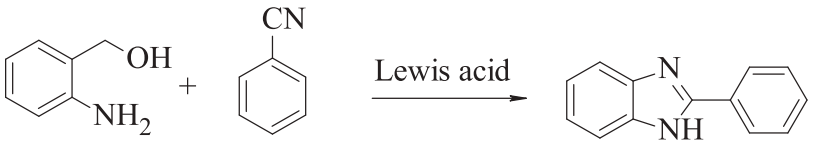
Table 6
The % Yields of Substituted Benzimidazoles using Lewis Acid.

Product	Lewis acid	Time (Hrs)	Yield (%)
1	ZnI_2	0.8	72
2	$ZnCl_2$	0.8	59
3	CuI	0.8	25
4	$Cu(OAc)_2$	0.8	trace

The comparative effect of Lewis acids noted in Scheme 45 can be studied from Table 6.

Applications of benzimidazole

In nature the heterocyclic compounds are distributed on a large scale, which are biogenic to living things. The nitrogen based



Scheme 45. Synthesis of benzimidazole in presence of Lewis acid.

Fig. 10. The applications of benzimidazole in various fields [68] (Image reproduced with permission).

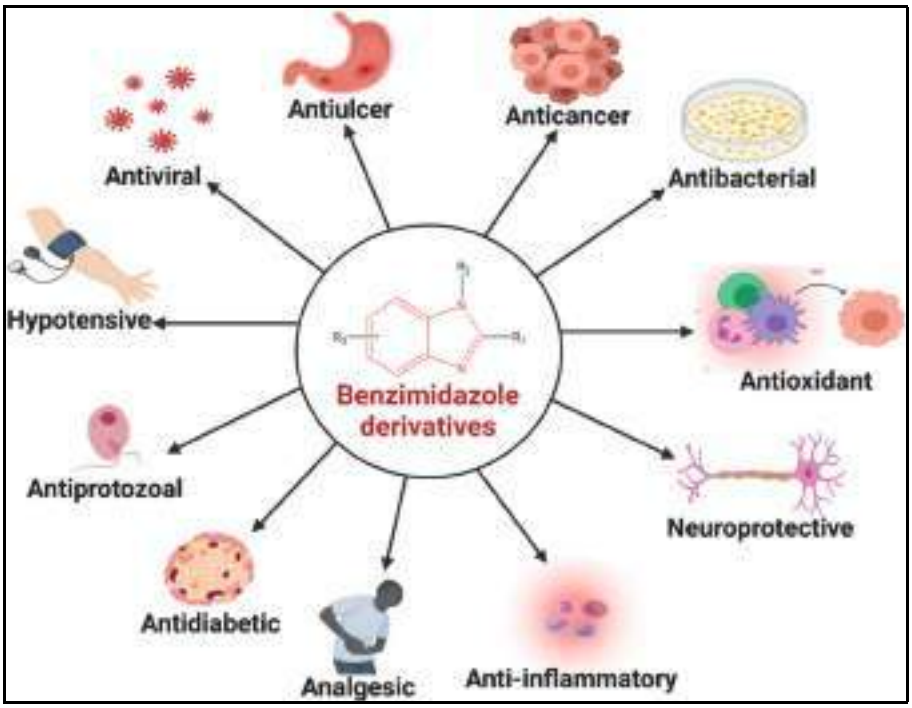


Fig. 11. Various Biological Activities of Benzimidazole derivatives [83] (Image reproduced with permission).

benzimidazole: a heterocyclic organic moiety has distinguished applications in the biological as well as industrial aspects. Due to its speedy applicability in the various fields, it is a privileged scaffold. This study is a practice to cast the light on the number of particulars focusing the synthesis and applications of benzimidazole derivatives in different sectors. The aim of this study is to summarize the multifaceted applications of benzimidazoles as portrayed in Fig. 10.

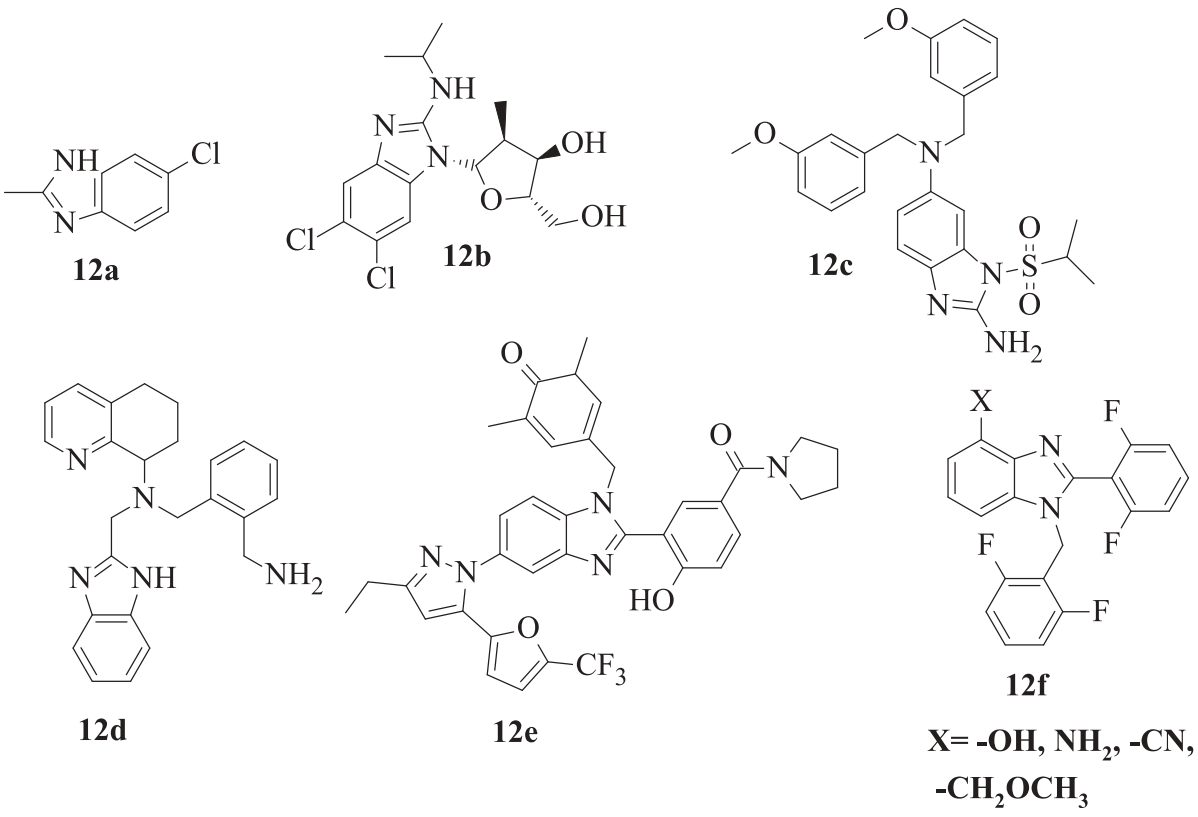


Fig. 12. Benzimidazole derivatives as antiviral drugs.

4.1. Pharmaceutical applications

In recent times, the applications of benzimidazole derivatives have been found very benevolent to the human kind. The organic chemists and medicinal researchers studied the pharmacological diversity [79] of benzimidazole derivatives standing out as a good drug applicant against various diseases, making it a primary focus for synthetic organic chemistry. The benzimidazole derivatives were wildly used for the treatment of the various biological infections like antiviral, antifungal, anti-HIV, anticancer, antimicrobial, anti-inflammatory, analgesic, anti-allergic, antioxidant, antidiabetic, anti-malarial [80] etc. as picturized in Fig. 11. This made it outstanding due to its versatility [81] and became the centre of attraction for the medicinal [82] and organic chemists.

4.1.1. Antiviral activity

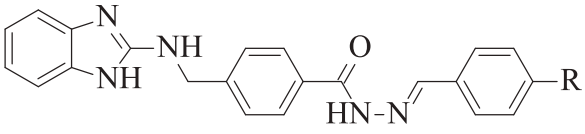
The application of imidazoles and their substituted compounds used for viruses like human immunodeficiency virus (HIV) [84], human herpes simplex virus, enterovirus, respiratory syncytial virus (RSV), bovine viral diarrhea (BVDV), human cytomegalovirus (HCMV), and hepatitis B and C virus, Influenza virus etc. [85] Clercq and Naesens reported the non-nucleoside analogues 2-bromo-5,6-dichlorobenzimidazole (12a) and 1-(b-L-*ribo*-furanosyl)-2-isopropyl amino-5,6-dichlorobenzimidazole (12b) showing a good anti-viral activity [86,87]. Hepatitis B virus is responsible for chronic and acute hepatitis. Li *et al.* reported N-(2-amino-1-(propane-2-sulfonyl)-1H-benzo[d]-imidazol-6-yl)-2,6-difluoro-benzamide (12c) found to be the most potent antiviral agent against hepatitis B virus [74]. The o-substituted amine (12d)found to show potent anti-HIV activity than para and meta substituted derivative [88,89]. Tremblay *et al.* reported compound (12e) and (12f) also shows anti-HIV activity [90]. The structures of antiviral agents are presented in Fig. 12 (12a-f).

4.1.2. Antimicrobial activity

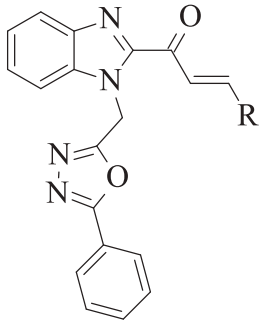
The various diseases like pneumonia, malaria, dysentery, cough, cold, typhoid, tuberculosis [91] etc are caused by the various pathogenic microorganisms. The benzimidazole nucleus possesses antimicrobial activity. The active benzimidazole derivatives are tested for their *in vitro* antimicrobial activity against Gram + ve bacteria (*Billuspumillus, Staphylococcus aureus*) [92,93] as well as Gram –ve bacteria *(Escherichia coli, Pseudomonas aeruginosa.*) [94] For ex: azetidine-2-one, 2-thiohalogenonitrophenyl benzimidazole etc. Yusuf *et al.* designed the benzimidazoles derivative (13a) [95] showing good antimicrobial activity and benzimidazole derived chalcones derivatives (13b) showing antibacterial activity against gram-positive and gram-negative bacteria. Zhang *et al.* synthesized the 5(6)-bromo-1- [(phenyl)sulfonyl]-2-[(4-nitrophenoxy)methyl]-1H-benzimidazoles (13c) showed good antimicrobial activity against Micrococcus luteus, Bacillus subtilis, S. aureus [89,96,97]. The different antimicrobial agents reported by Ansari *et al.* (13d) [94] active against *Escherichia coli, Klebsiella pneumoniae and Mycobacterium fortuitum, Mycobacterium smegmatis strains*, (13e) by Arora *et al.* [98] and (13f) [99] against Strains of *S. aureus* and *S. epidermidi* showing a very potent activity when tested. The structures of some benzimidazole based antimicrobial agents are illustrated in Fig. 13 with the various Fig. 13a-f.

4.1.3. Antidiabetic activity

The chronic endocrinological condition in which body stops to make sufficient insulin results in high blood level of glucose is known as diabetes mellitus. The benzimidazole derivatives used as antidiabetic agents like Pimobendum shown good results. Hosmani *et al.* synthesized novel 2- thiosubstituted benzimidazole derivatives 14a and 14b showing good antidiabetic activity [100]. The derivatives 14c-d and 14e-f reported by Velazquez *et al.* showed good results when studied for antidiabetic activity [101]. Minoura *et al.* reported 14 g benzimidazole derivative as insulin sensitizer and screening proved its good

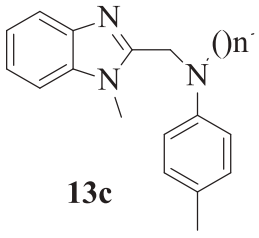


13a



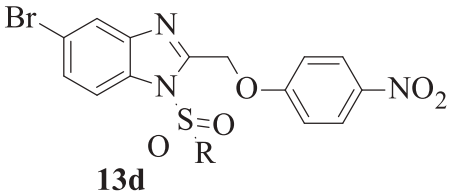
13b

(R= 3-FC_6H_4, 4-BrC_6H_4, 2-furyl, 3,4-$(MeO)_2C_6H_3$, 3,4,5-$(MeO)_3C_6H_2$)



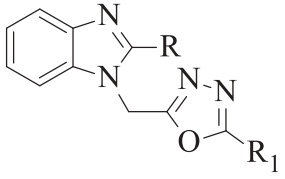
13c

(n = 2, 5, 7, 9, 11, 17)

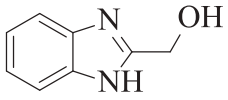


13d

(R= 2,5-difluorophenyl; 2-nitrophenyl; 2-chlorophenyl)



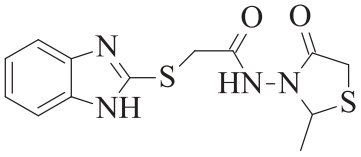
13e



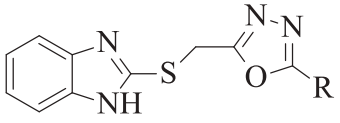
13f

(R=H, -CH_3;
R1= -CH_3, -C_2H_5 4-ClC_6H_4, 4-OHC_6H_4, 4-$OCH_3C_6H_4$)

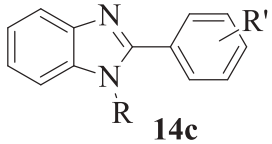
Fig. 13. Benzimidazole derivatives used as antimicrobial agents.



14a

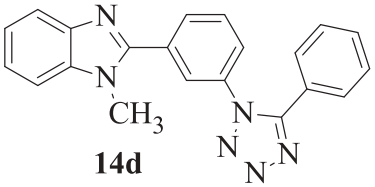


14b

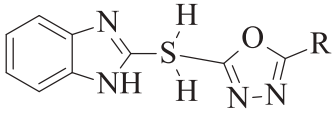


14c

R= -CH_3, R'= benzamide

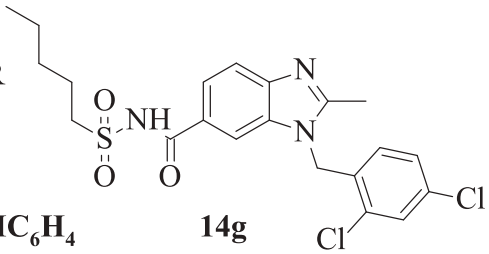


14d



14e-f

R= f) 3-OHC_6H_4 g) 4-OHC_6H_4



14g

Fig. 14. Benzimidazole derivatives as antidiabetic drugs.

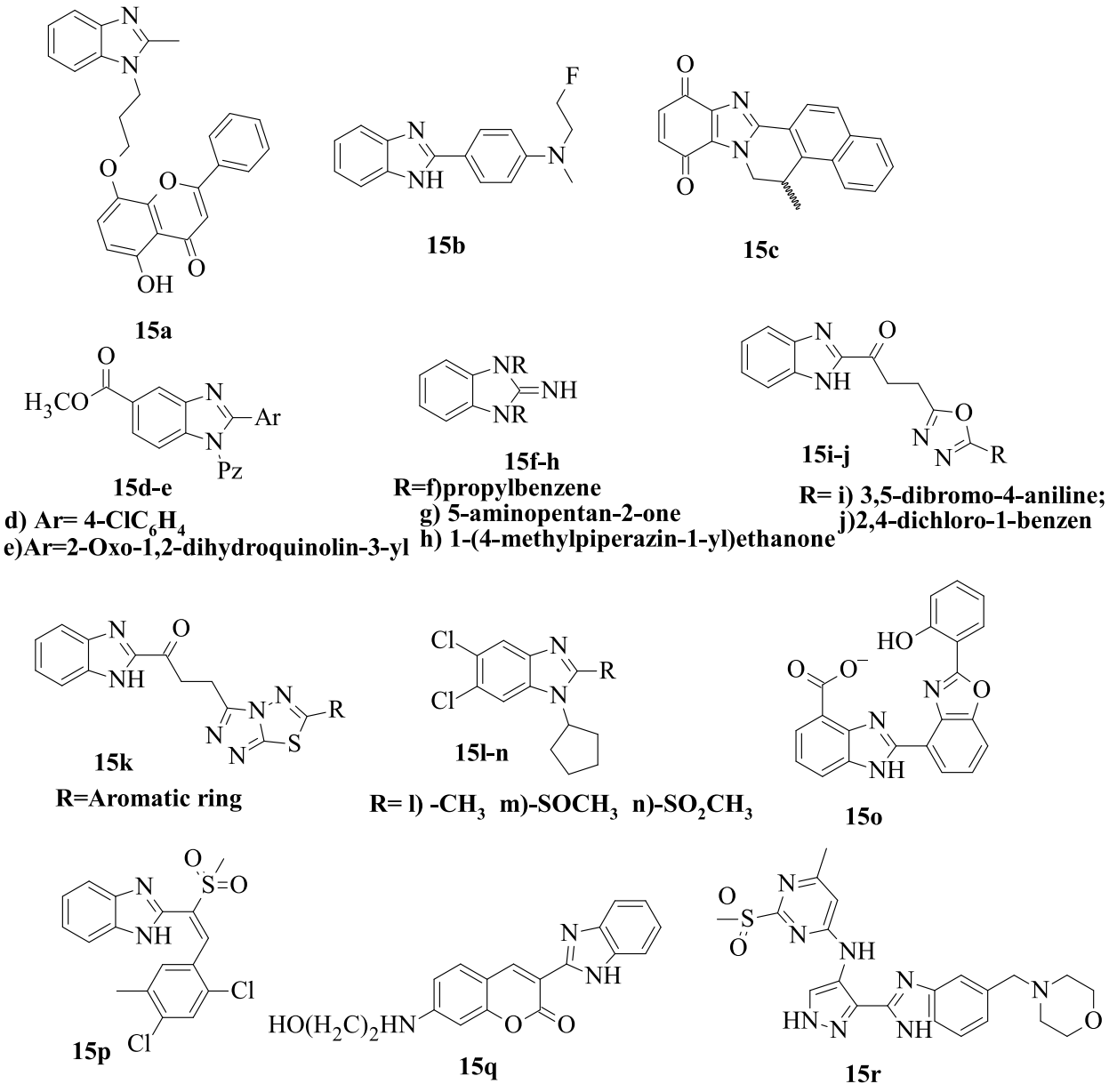


Fig. 15. Anti-cancer derivative.

antidiabetic results [102]. These derivatives 14a-g are elaborated in Fig. 14.

4.1.4. Anticancer activity

As cancer is the most leading health hazard shaking the lives of people worldwide, thus increasing need for novel anticancer agents, benzimidazole based drugs came in focus due to high toxicity to tumor cells, for lung cancer, ovarian cancer, breast cancer, colorectal cancer, brain cancer, leukemia, melanoma cancer etc [29,103,104]. The previously used anticancer drugs found to be toxic to the tumor cells along with normal cells, resulting into increased toxicity and side effects. Zhe Wanga *et al.* reported a series of chrysin benzimidazole derivatives against tumor growth. The compounds were shown in Fig. 15(15a-b) and found to be the most potent activity against tumour [105]. The conjugated naphthyl fused benzimidazolequinone 15c were reoprted the highest inhibition towards cancer cell line and least in normal cells [106]. Abonia *et al.* reported the compounds 15d-e which inhibited 60 distinct cancer cell lines in human [107]. The benzimidzole based derivatives 15f-h reported by Mavrora *et al.* studied for cytotoxicity against two cancer cell lines viz. human colorectal and breast cancer cell lines, it resulted to find out 60f-h are very potent versus human colorectal cell lines [108]. The benzimidazole derivatives reported by Husain *et al.* 15i-j-k showed good to remarkable anticancer activity against lung cancer cell lines [109]. Alkahtani *et al.* synthesized and studied 15 l-n benzimidazole derivatives having ability to induce cancer cell apoptosis [110]. The benzimidazole derivative 15o reported by Kumar *et al.* [111], The styryl sulfone compound 15p reported by Vedula *et al.* has shown 51 % tumor growth inhibition. The benzimidazole-based compound 15q [112] synthesized by Singh *et al.*, pyrazole-benzimidazole derivative 15r reported by Zheng *et al.* are designed, synthesized, screened against cancer cell lines. It was shown as potent to inhibit cancer growth [113]. The structures of anti-cancer derivatives are presented in Fig. 15.

Benzimidazole analogues exhibits a broad spectrum of bioactivities and hence it can easily mimic the nucleotides interrupting biological processes in the cancer leading to stop multiple cellular processes at a time, these molecules offer excellent prospects for developing of new medicines for cancer [114]. All the data studying the roles of benzimidazole derivatives to target cancer accepts positively the application

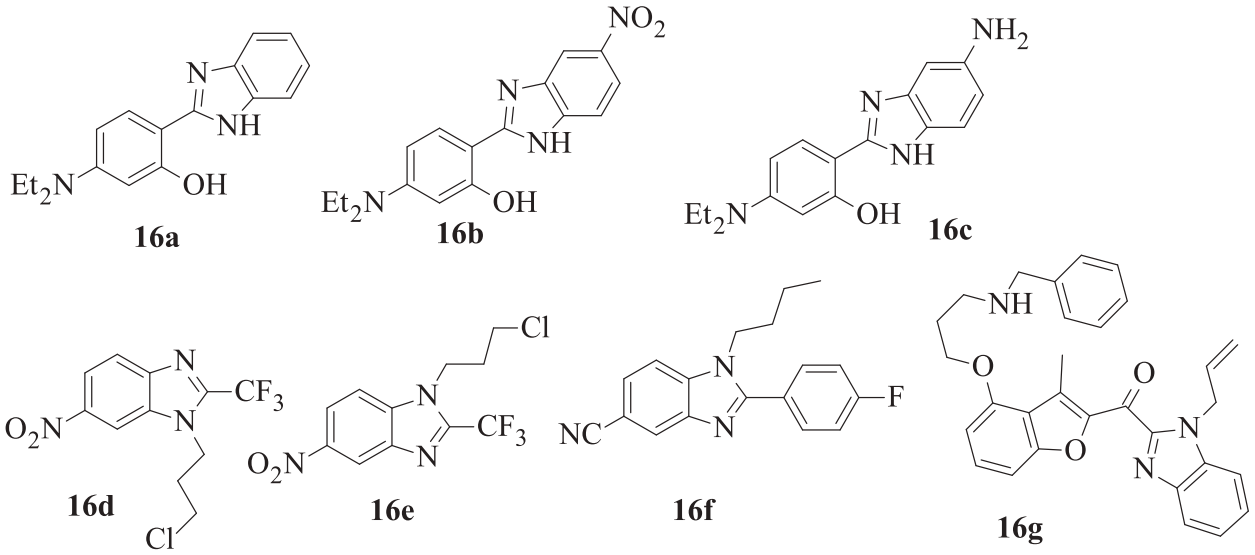


Fig. 16. Benzimidazole derivatives as antifungal agents.

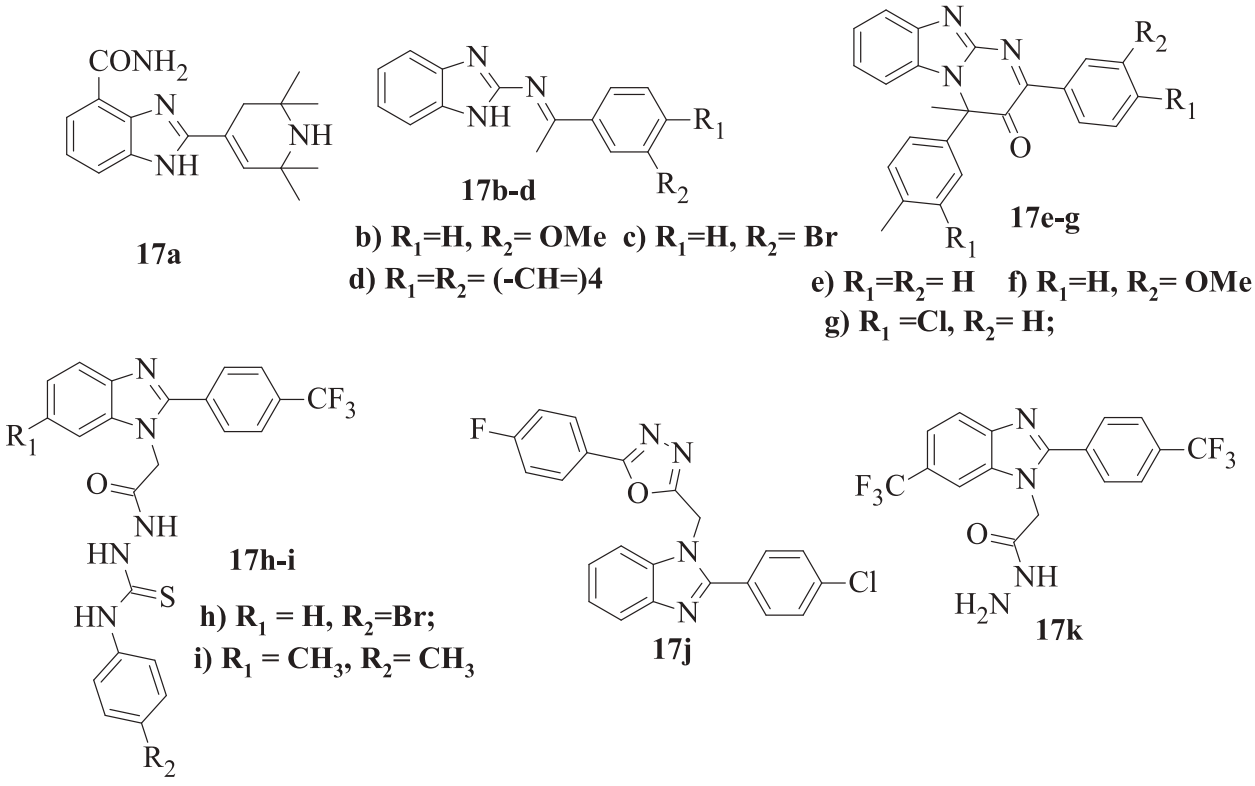


Fig. 17. Benzimidazole derivatives as antioxidants.

of benzimidazole scaffold to level up from conventional to accurate medicine [115,116] clinical trials continue, ushering in a new era of precision medicine.

4.1.5. Antifungal activity

The fungal pathogens like Candida albicans, Aspergillus fumigates, Cryptococcus neoformans cause human death. The benzimidazole based antifungal agents are used to treat superficial as well as systemic fungal infection. A series of 2-(1Hbenzimidazol-2-yl)-5-(diethylamino)phenol have been evaluated for antifungal activity [117,118] and the benzimidazole derivatives are given in Fig. 16 (16a-c). The positional isomers of 1- alkyl-2-trifluoromethyl-5 or 6-substituted benzimidazoles 16d-e derivatives reported by Sathaiah *et al.* found to have promising antifungal activity towards gram positive and gram negative bacterias [119]. The benzimidazole-based derivatives 16f-g designed and synthesized, Kawasaki *et al.* found them potent and growth inhibitor against *Candida albicans in vitro* [120]. The various benzimidazole-based antifungal agents 16a-g are mentioned in Fig. 16.

4.1.6. Anti-oxidant activity

Antioxidants are the therapeutic agents which are used for treating a number of diseases. The aerobic microorganisms generate free radicals

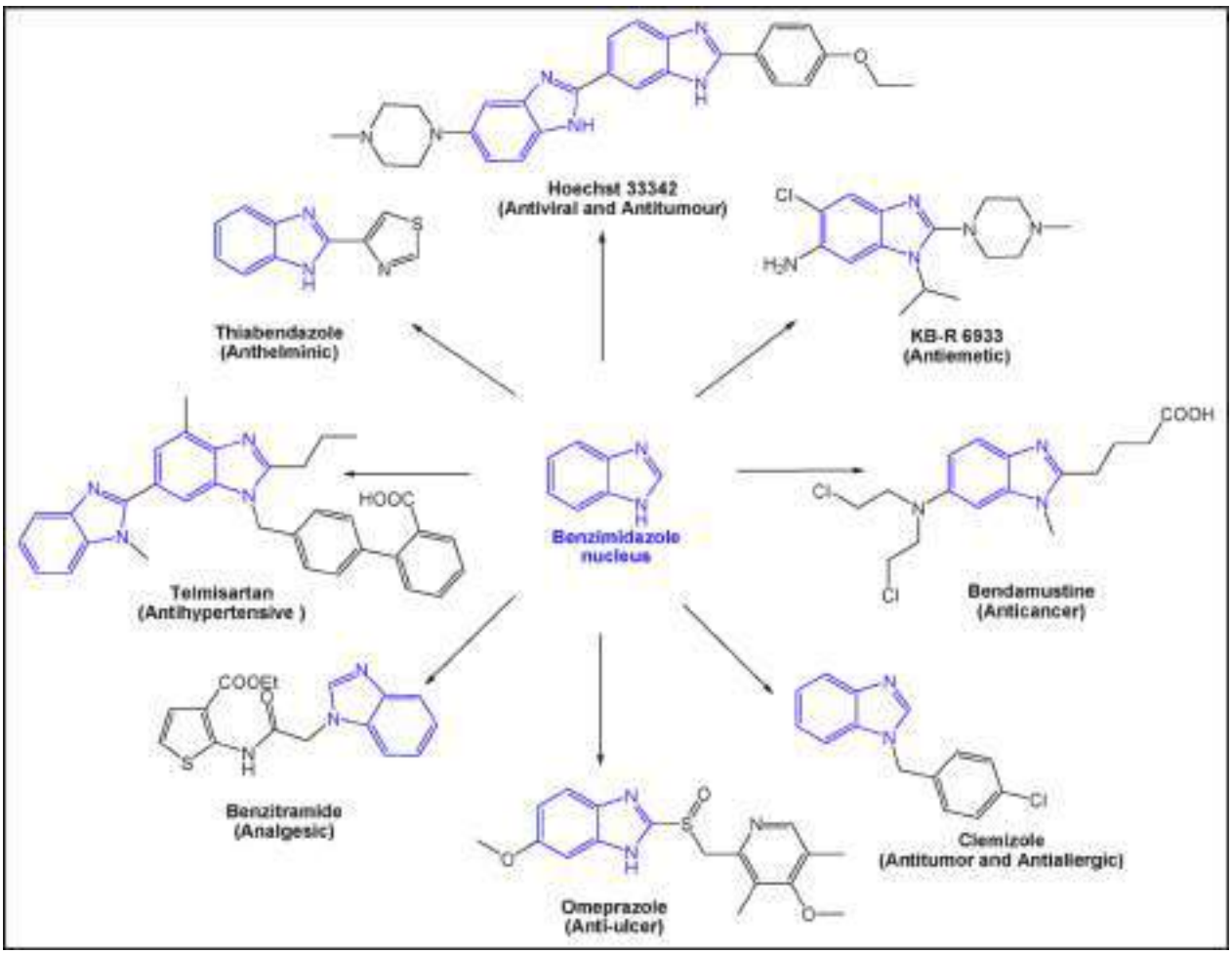


Fig. 18. Various pharmaceutical drugs derived from benzimidazole [58] (Image reproduced with permission).

due to the oxidative life process. The free radicals are called reactive oxygen species (ROS) which are toxic which causes a large number of lethal effects like death, dysfunctioning of cells or malignant transformation due to lack of reduction of oxygen. It results in protein, DNA or lipid damage may even cause genetic mutation, may cause cancer, cardiovascular diseases, diabetes etc. The antioxidants are in practice to bring down the deleterious effects of free radicals and also lessening oxidative stress. A series 4-carboxyamidobenzimidazoles synthesized presented in Fig. 17, are found to be very effective. The compound 17a containing six-membered, sterically hindered amine shows a great antioxidant activity [121]. The compounds 17b-d and 17e-g are found to be most potent when screened for antioxidant activity [122]. 17 h-k showed very good scavenging behavior as antioxidant activity when tested [123,124].

The various pharmaceutically employed benzimidazole drugs are depicted in Fig. 18, Fig. 19 and Fig. 20.

Collectively, Figs. 18, 19, and 20 present an array of pharmaceutically designed drugs based on benzimidazole, each tailored for specific clinical applications across various domains. These figures serve as a comprehensive resource for the examination of numerous benzimidazole analogues, showcasing the remarkable diversity inherent in the benzimidazole scaffold, thus facilitating an in-depth exploration of this versatile class of compounds in drug development and therapeutic innovation.

4.2. Material science

Benzimidazole derivatives are known for their biological activities and therapeutic uses. Also, this heteroatomic nucleus has a large number of applications in material science. For organic and inorganic polymers preparation, liquid crystals, to develop organic light emitting diodes (OLED) and the materials having optical and electronic properties, benzimidazole derivatives are used. As the benzimidazole have electron accepting ability, π-bridging, metal-ion chelating properties makes it a multifunctional nucleus and hence is used to design and develop smart molecular sensors, optical chemical sensors, nano materials etc [127]. Benzimidazole based polymers have exceptional properties like excellent mechanical properties, high thermal stability, good electrical conductivity which makes it able to be used for electrochemical devices, high performance fibers and gas separation membranes. Polybenzimidazole(PBI) has excellent durability at 200 °C and poly[2,2′-(m-phenylene)-5,5′-bibenzimidazole] shows high proton conductivity, superb oxidative and thermal stability with great mechanical strength [128–130]. Benzimidazole represents the crucial multifunctional building block in the field of optical chemical sensor due to its crucial role which maintains the system function and also counts for the lead role in analytical signal formation. The benzimidazole-based materials used for optical sensing are exhibited as sol–gel, gels matrices, polymer and silica nanoparticles, thin layer chromatography (TLC) or paper-based strips, nanoaggregates. Till date optical sensors viz. paper-based were used for the neutral molecules, cations or anions. But, now derivatives of benzimidazole can be used as the optical chemical sensors for the same. By preparing sensing material using pyrene-substituted benzimidazole-isoquinolinones can discover trinitrotoluene (TNT) in the aqueous medium, and can be observed with the naked eye. Benzimidazole is also used as an optical sensor for amine/acid vapours with

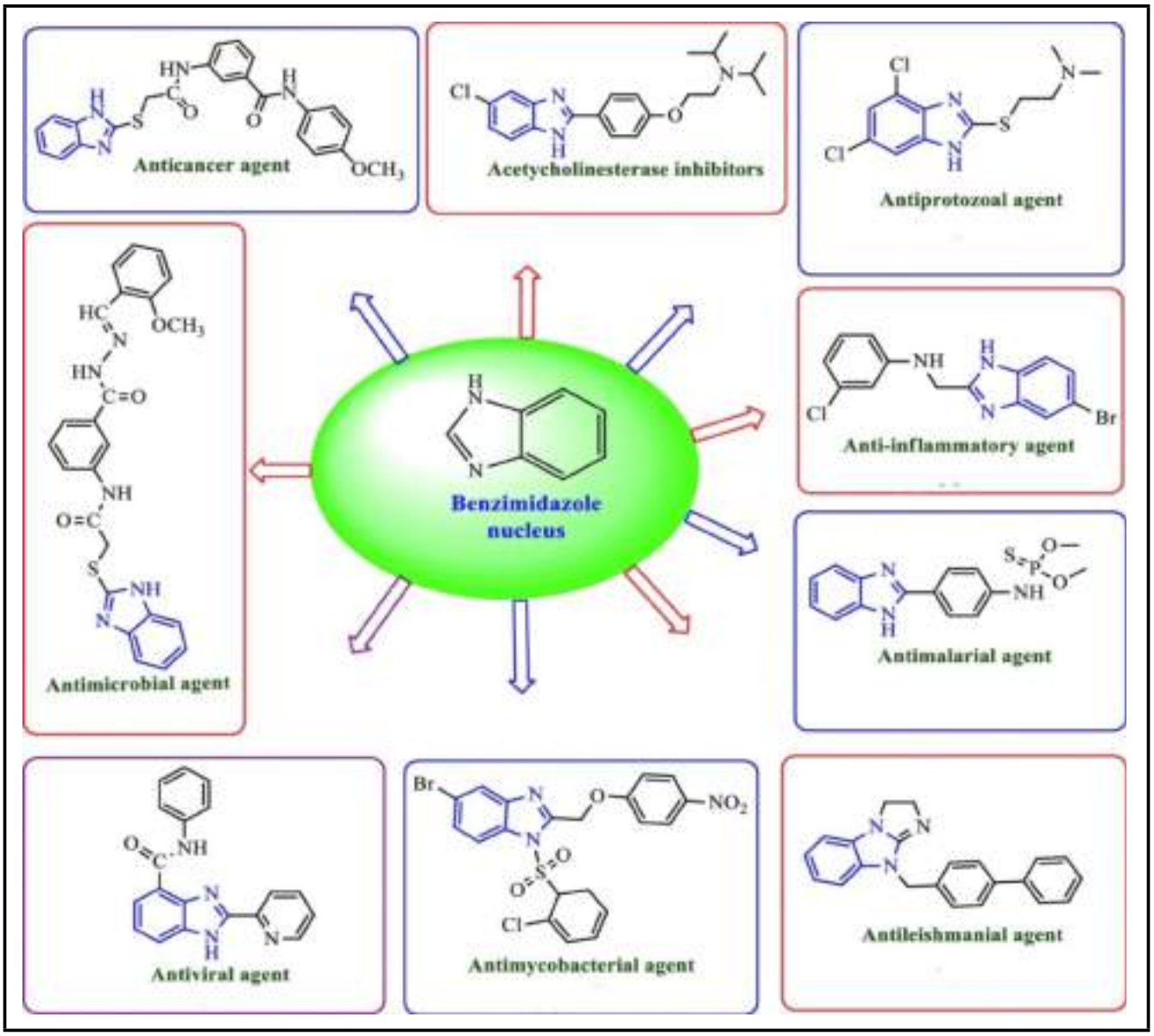


Fig. 19. Various designed benzimidazole based derivatives [125] (Image reproduced with permission).

three carbazole-based benzimidazole derivatives present in the solid state, performed with TLC plates. These plates when immersed with benzimidazole-based dye and gave exposure to trifluoroacetic acid (TFA) vapours for one minute, and then treated with triethyl amine vapours, it was found that colour was restored and is illustrated in Fig. 21 [131,132].

Along with the applications of benzimidazole-based derivatives as optical sensing, paper-based materials, they are also treated as the smart and stimuli responsive material having high potential application in security, fluorescent imaging. Aggregation induced emitters is the analytical tool used in optoelectronics, chemosensors and bioimaging [133]. The benzimidazole based fluorophores can emit intense fluorescence in the aggregated form and hence used as novel sensing materials [134]. In one study, self assembled nanoaggregates of the benzimidazole based acrylonitrile are presented as sensing system for pH which is based on the mechanism of aggregation, deaggregation and aggregation-induced emitters. 2-benzimidazolyl-substituted acrylonitrile dyes emit fluorescence emission in the green, red or cyan spectral region. Such novel benzimidazole-based aggregation induced emitters can detect pyrophosphate (PPi). The aggregation-induced emission of benzimidazole-based derivatives as well as detection of pyrophosphate (PPi) is depicted in Fig. 22. The benzimidazole scaffold has a key role in aggregation of structure and recognition of pyrophosphate [135].

The benzimidazole tethered perfluoropolymers (PF) or perfluoromolecules are employed as ionomers in electrodes for utilization at high temperature. These synthesized perfluoropolymers have a flexible chain of both backbones along with side chains. It is suitable for electrode binder materials at high temperature and low humidity. They are used as proton conducting membrane and or as electrode ionomers [136].

4.3. *Agriculture*

Benzimidazole and its derivatives have a number of applications in the field of agriculture [137]. Benzimidazole based compounds have a very good potential to control insects by disrupting their nervous system and inhibiting their feeding or mating and thus acts as a good insecticide. The benzimidazole based compounds are used to control the growth of the weeds in the fields. The benzimidazole compounds are also used to control nematodes, the microscopic worms damaging the

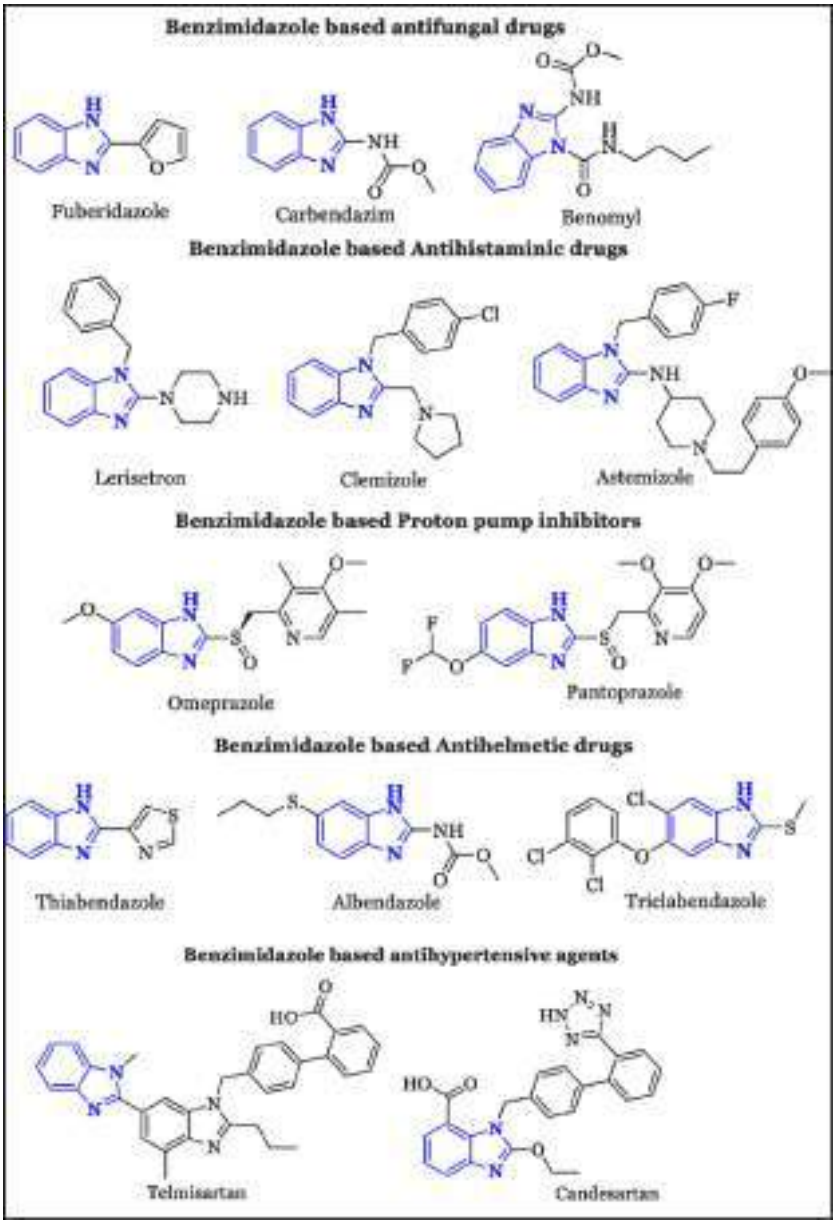


Fig. 20. Various examples of benzimidazole based drugs in clinical use [126] (Image reproduced with permission).

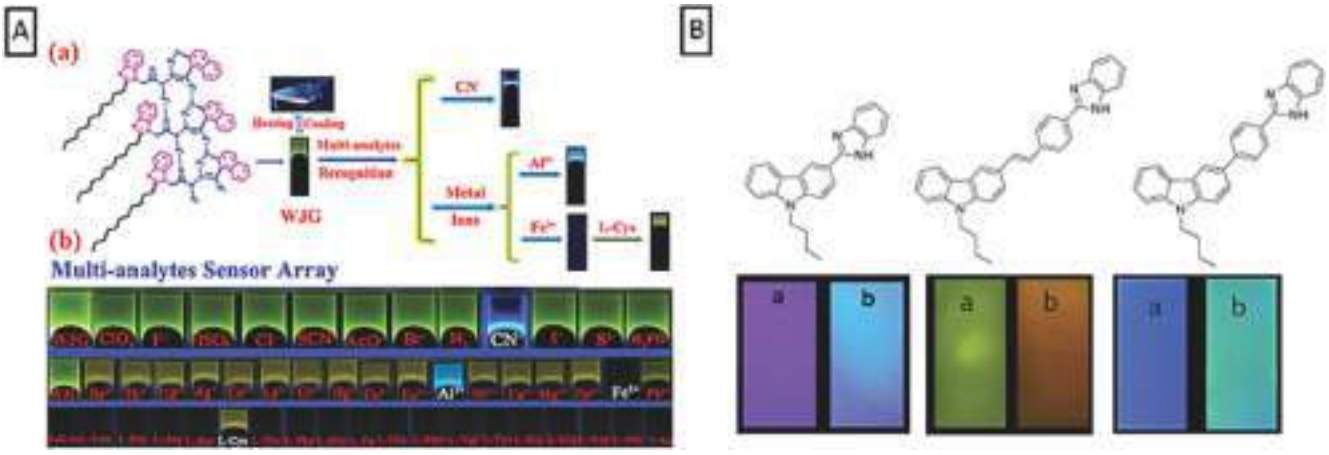


Fig. 21. TLC plates immersed in carbazole benzimidazole-based dyes observed under the UV light before (a) and after (b) exposure to trifluoroacetic acid vapours [132] (Image reproduced with permission).

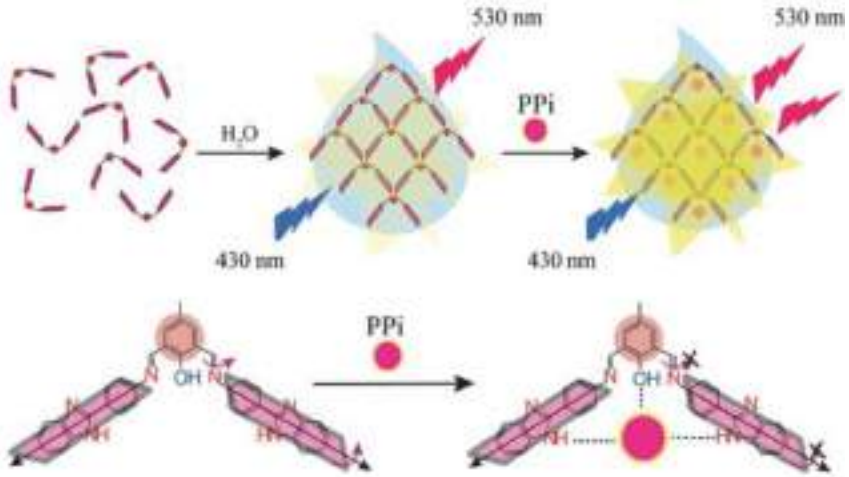


Fig. 22. Aggregation-induced emission of benzimidazole-based derivatives and detection of pyrophosphate (PPi) [55] (Image reproduced with permission).

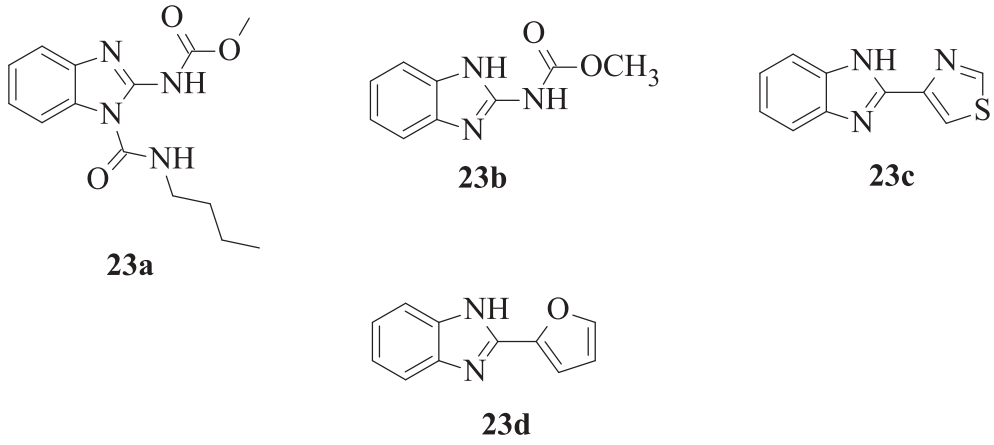


Fig. 23. Benzimidazole derivatives as antifungal agents.

crops such as Mebendazole, Flubendazole etc. The benzimidazole compounds are very well known for their use as fungicides under broad spectrum due to a very high potency with minimum use and its ability to maintain and protect the new growth of the crop. The fruits, vegetables, cereals are prevented from the fungal cells. The fungicides prevent their growth by disturbing cellular metabolism and cell division. For ex: Thiabendazole, thiopanate-methyl, benomyl (23a), carbendazim (23b), thiabendazole (23c), fuberidazole(23d) etc shown in Fig. 23. These derivatives show antifungal activity over a very wide range of diseases, involving most ascomycetes, some deuteromycetes and basidiomycetes. The main economic pathogens which are controlled involve Cercospora spp., *Botrytis cinera*, *Fusarium* spp., *Colletochrichum* spp. powdery mildews in a number of crops, including eyespot in cereals as well as Erysiphe spp., Oidium spp. The benzimidazole fungicides acts as β-tubulin potent inhibitor in many species of fungi [138,139].

4.4. Coordination chemistry

In Coordination Chemistry, benzimidazole is extensively used as ligand as it forms the stable complexes with transition metal ions and is employed as catalysts in organic transformations. The benzimidazole-based ionic liquids (BILs) are providing a fresh outlook by evolving ecofriendly basic catalyst consisting of transition as well as non-transition metals as they have flexible, noncorrosive, nonvolatile nature and gets immiscible with most of the organic solvents. The BILs are used in several named-chemical reactions such as benzoin reaction,

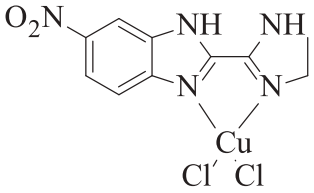


Fig. 24. Copper (II) complex coordinated with bidentate chelating 2-substituted benzimidazole ligand showing anticancer activity.

aldol condensation, etherification, Heck cross coupling, Suzuki, Suzuki-Miyaura reaction and also as electrocatalyst in solar cell, anion sensor, proton conduction etc [140] The ruthenium complex containing benzimidazole and triphenylphosphine have application in the non-linear optical power limiting studies and catalytic oxidation (alcohol to aldehyde conversion) under solvent free conditions [141]. A series of coordinated compounds containing zinc metal, which is considered as the health element and benzimidazole-the bioactive ligand. Its screening for anticancer activity proved that by converting ligands into respective metal complex, enhances its cytotoxicity- anticancer activity [142–144]. Cu(II) complexes coordinated with benzimidazole-derived bidentate chelating ligands when studied, (4,5-dihydro-1H-imidazol-2-yl)-5-nitro-1H-benzimidazole $CuCl_2$ complex shown in Fig. 24 reported as the most cytotoxic to inhibit the growth of cancer cells [145].

The carbon-di-oxide (CO_2) gas is a greenhouse environmental pollutant. It can be reused due to its potential to be used as a building block for the chemical industry as it has very attractive utilities. CO_2 capture techniques which are currently used are quite expensive and energetically not affordable. Thus, advanced porous coordination polymers (PCPs) found to have great potential as CO_2 absorbers. The benzimidazole based coordination polymers are interpenetrating, flexible, rigid and effortlessly influences cavity pore size and other supramolecular interactions among the pores. The CO_2 sorption is also favored by the electronic environment of the benzimidazole scaffold by the functionalized pores with coordinated unsaturated metal ions. It shows high uptake of CO_2 due to its aromatic groups with π-π interactions by transferring the net charge from aromatic scaffold to CO_2 molecule [146].

5. Conclusion and future perspective

Benzimidazole is a very important nitrogen-containing heterocyclic scaffold having an auspicious place in biological activities and hence a very wide range of pharmaceutical applications. It is a significant and versatile scaffold in organic and medicinal chemistry. It can be synthesized by various synthetic approaches by using different starting materials and different reagents/ catalysts by using a number of solvents or even under solvent free conditions. All the synthesized derivatives of benzimidazole are biologically active showing diverse applications in pharmaceuticals in addition to the industrial applications. This review is an effort to study and compile the several synthetic approaches to benzimidazoles and its derivatives, applicable for large scale synthesis along with their various applications in a simple manner. In the future, there is lot of scope for this multifunctional scaffold due to a large number of molecular targets, the futuristic research to investigate benzimidazole scaffold will provide the cheering results in the medicinal field to combat life-threatening diseases. This study will help to design the better benzimidazole scaffold with enriching and biogenic activities leading to high specificity, developing the synthetic approaches. This proves that benzimidazole is a lead compound in drug discovery. This study will help to link the modernized concepts to develop more potential by offering the chemical space to build the versatile benzimidazole scaffold in future drug discoveries and commercial utilities.

CRediT authorship contribution statement

Neha D. Mahurkar: Conceptualization, Validation, Writing – original draft. **Nandkishor D. Gawhale:** Validation, Writing – review & editing. **Mahendra N. Lokhande:** Validation, Writing – original draft. **Santosh J. Uke:** Project administration, Validation, Writing – original draft. **Manisha M. Kodape:** Conceptualization, Validation, Supervision, Project administration, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Article *in* Tuijin Jishu/Journal of Propulsion Technology · November 2023

DOI: 10.52783/tjjpt.v44.i5.4841

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Vol. 44 No. 5 (2023)

Effect of Zinc Nitrate on Morphology and Particle Size of Nano-sized Zinc Oxide

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Abstract:

Zinc oxide nanostructures were synthesized by chemical route method. The XRD spectrum indicates that the sample is wurtezite (hexagonal) structured ZnO with lattice constants of a = 3.249A0, c = 5.206 A0. The crystallinity and structure of these ZnO nanostructures were studied by X-ray diffraction. The morphologies of these synthesized nanostructures were analyzed by transmission electron microscope. Effects of concentration of zinc nitrate during synthesis on the morphology and particle size of resultant product were investigated.

Keywords*: Chemical route method, Zinc oxide*

Introduction

Semiconductor nanostructures are a very important topic in the ongoing research activity across the world. As the semiconductor particles exhibit size dependent properties like scaling of the energy gas and corresponding change in the optical properties, they are considered as the front runners in the technologically important materials.

Zinc oxide is attracting tremendous attention due to its interesting properties like wide direct band gap of 3.37 eV at room temperatures and high exciton binding energy of 60 meV. Zinc oxide is promising materials for electronics or optoelectronics applications such as solar cells, gas sensors, liquid crystal displays, heat mirrors, surface acoustics wave devices etc [1-10].

A variety of techniques like spray pyrolysis, molecular beam epitaxy, chemical vapor deposition, hydrothermal method, pulsed laser deposition, sol-gel method, laser ablation [11-17] etc. have been widely used to synthesis ZnO nanostructures.

In the present study, ZnO nanostructures were synthesized by using chemical route method. The crystallinity and structure of these ZnO nanostructures were studied by X-ray diffraction. The morphologies of these synthesized nanostructures were analyzed by transmission electron microscope.

Experimental

All chemicals were of analytical grade and were used as purchased without further purification.

In typical process, 2.974 g Zn $(NO_3)_2 \cdot 6H_2O$ (Zinc nitrate hexahydrate) was dissolved in 100ml distilled water and 2.0 g of NaOH was dissolved in 100 ml distilled water. The zinc nitrate solution was added drop wise to the NaOH solution to form white solution. Then, white solution was subsequently kept at 75^0C For 12 hr. The

resulting white precipitates were collected, washed with distilled water and ethanol several times and then dried at 80^0C in vacuum oven for 2hr. Resultant product was treated as 0.1 M ZnO since during process 0.1M zinc nitrate solution was used.

Similar procedure were adopted to synthesized 0.05M ZnO, 0.15M ZnO and 0.2M ZnO by keeping concentration of zinc nitrate 0.05M, 0.15M and 0.2M respectively.

Results and discussion

1. X-ray diffraction

X-ray diffraction data for structural characterization of various products synthesized by chemical route method were collected on the Philips PW 1710 X-ray Diffractometer using Cu-Kα source. X-ray diffraction pattern of various synthesized products are helpful in studying the crystalline structure and determination of crystallite size.

Figure 1(a) to 1(d) shows XRD pattern of 0.05M ZnO, 0.1M ZnO, 0.15M ZnO and 0.2M ZnO respectively. The recorded XRD pattern of 0.05M ZnO confirmed that synthesized ZnO are highly crystalline in nature.

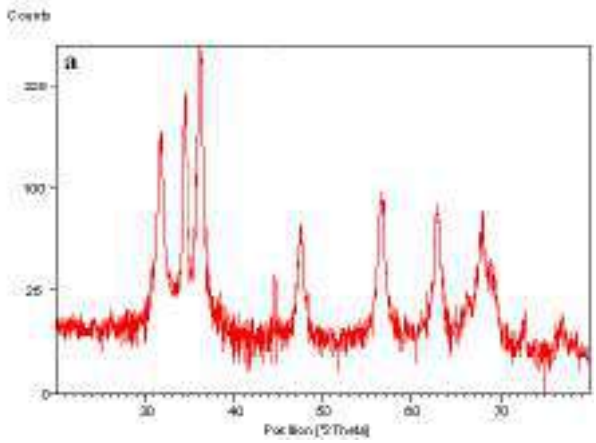

Figure 1(a) powder XRD pattern of 0.05M ZnO

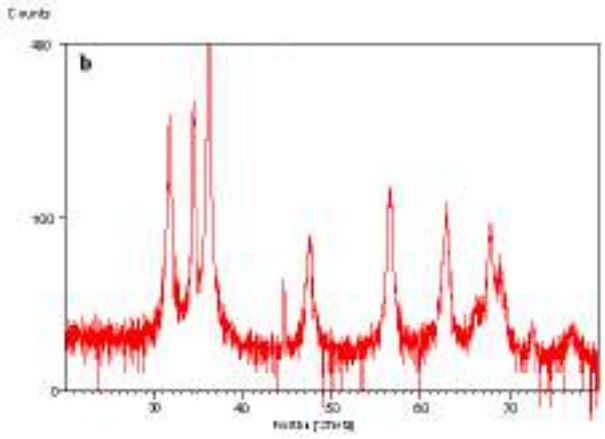

Figure 1(b) powder XRD pattern of 0.1M ZnO

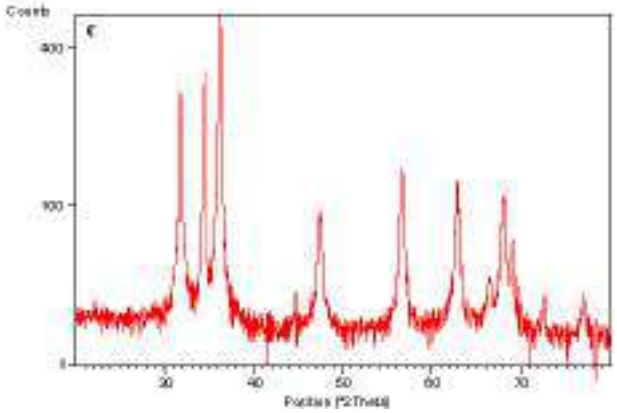

Figure 1(c) powder XRD pattern of 0.15M ZnO

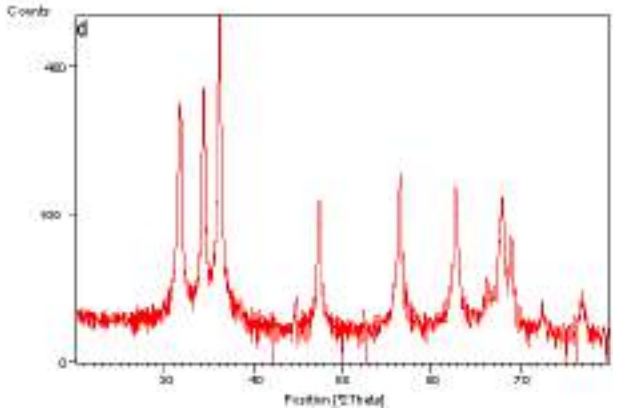

Figure 1(d) powder XRD pattern of 0.2M ZnO

The corresponding X-ray diffraction peak for (100), (002), (101) and (102) planes confirm the formation of hexagonal wurtzite structure of ZnO, which are in good agreement with the literature values (JCPDS card No. 36-1451). In this XRD pattern, extra pick appear at $2\theta = 44^0$. This peak was identified as surface hydroxyl groups, which can be related to the formation of water on the ZnO nanostructure surface [18]. Also XRD pattern of the 0.1M ZnO, 0.15M ZnO and 0.2M ZnO shows parallel results.

The table 1 shows the comparison of obtained XRD data with standard data (JCPDS card No. 36-1451).

Sample	Observed		Standard (JCPDS card No. 36-1451)		(h k l) Plane
	2θ	'd' Values (A^0)	2θ	'd' Values (A^0)	
0.05M ZnO	31.7008	2.82030	31.770	2.8143	(1 0 0)
	34.4878	2.59850	34.422	2.6033	(0 0 2)
	36.3819	2.46754	36.253	2.4759	(1 0 1)
0.1M ZnO	31.6854	2.8263	31.770	2.8143	(1 0 0)
	34.3774	2.60659	34.422	2.6033	(0 0 2)

	36.2095	2.47880	36.253	2.4759	(1 0 1)
0.15M ZnO	31.7805	2.8134	31.770	2.8143	(1 0 0)
	34.4793	2.59912	34.422	2.6033	(0 0 2)
	36.3109	2.47210	36.253	2.4759	(1 0 1)
0.2M ZnO	31.7036	2.82006	31.770	2.8143	(1 0 0)
	34.3174	2.61101	34.422	2.6033	(0 0 2)
	36.1648	2.48176	36.253	2.4759	(1 0 1)

To extract more information on the crystallinity, the XRD data is exercised to determine the crystallite size. The full width at half maxima (FEHM) of the intense (101) peak was evaluated for all the ZnO nanostructures, by using Scherrer's formula [19, 20].

$D = k\lambda/\beta\sin\theta$

Where λ is the wavelength of incident beam (1.5406 A^0), β is the FWHM of the peak in radians, θ is the diffraction angle and k is Scherrer constant.

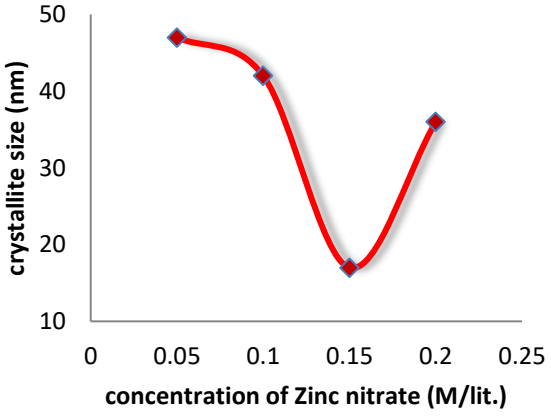

Figure 2 variation of crystallite size with concentration of zinc nitrate

Figure 2 shows the variation of crystallite size of synthesized ZnO with the concentration of Zinc nitrate during synthesis.

The influence of the concentration of zinc nitrate on the particle size of product was the main subject of interest here. Figure 2 shows the variation of crystallite size of synthesized ZnO with its reactant concentration. It is seen that crystallite size decreases with concentration of zinc nitrate, conquer minimum value (17 nm) at 0.15M Concentration and for further higher concentration of zinc nitrate it increases. The increase in crystallite size with increasing concentration of zinc nitrate may be due to accumulation of ZnO nanoparticles to form crystallite of higher size.

Transmission electron microscope

The morphology and particle size of ZnO samples synthesized by chemical route method were examined by using Techai G2 20 Ultra-Twin transmission electron microscope (Pune University, Pune). For the TEM observation, the as-prepared samples were added into an alcohol solution and subjected to violent ultrasonic stirring for hours; subsequently, a drop of this solution was dipped on a copper grid used for the TEM observation.

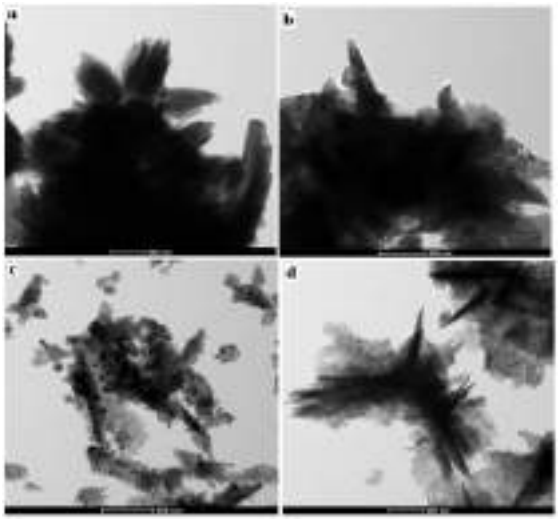

Figure 3 TEM images of a) 0.05M ZnO, b) 0.1M ZnO, c) 0.15M ZnO, d) 0.2M ZnO

Figure 3 represent TEM images of the products obtained by chemical route method with different concentration of Zinc nitrate. Figure 3(a) shows the formation of nanoparticles featuring the occurrence of surrounding pyramids by using 0.05N zinc nitrate during synthesis. The formation of pyramid can be ascribed to the anisotropic growth of ZnO crystal. As the concentration of reactant increased to 0.1M, the nanoparticles of ZnO further coarsened (figure 3b). Further, increases in concentration of zinc nitrate to 0.15M, most of the pyramids get separated from the branched nanocrystals; formation of nanorods and nanoparticles takes places with average particle size of 15 to 25 nm. Figure 3(d) represent that further increasing the zinc nitrate concentration to 0.2M, formation of branched nanocrystals were observed.

Zinc oxide nanostructure growth mechanism

In chemical route method when zinc nitrate reacts with sodium hydroxide formation of $Zn(OH)_2$ along with $Zn(OH)_4^{2-}$ takes place. The concentration of $Zn(OH)_4^{2-}$ are kept constant in the reaction process because $Zn(OH)_2$ is dissolved by the OH^- produced by the decomposition of $Zn(OH)_4^{2-}$ according to following reactions,

$$Zn(OH)_2 + 2OH^- \rightarrow Zn(OH)_4^{2-}$$

$$Zn(OH)_4^{2-} \rightarrow ZnO + H_2O + 2OH^-$$

The stable concentration of $Zn(OH)_4^{2-}$ may be important for controlling the growth rate of different crystal faces of ZnO.

Form the results of XRD it is clear that ZnO synthesized by chemical route method keeping 0.15M concentration of zinc nitrate yield the products with small crystallite size. Such products with small crystallite size and innovative morphology can be used as sensor elements.

Conclusion

From the results obtained, following statements can be made for the synthesized ZnO nanostructures by hydrothermal and chemical route method.

1. Zinc Oxide nanostructures synthesized by chemical route method show highly crystalline in nature with hexagonal wurtzite structure.
2. When the concentration of zinc nitrate was kept 0.15M during reaction in chemical route method, resultant ZnO nanostructure produce with a lowest crystallite size 17nm among other products.

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View publication stats

LiJ

Loknayak

Interdisciplinary
Peer Reviewed Journal
For Innovative
Research and Evaluation

ISSN (L) 2278 - 4284

Issue :
August
2023
Vol. : X

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- I N D E X -

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Ethics Incorporated In Percy Bysshe Shelley's Iconic "ozymandias"

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- *Abstract* -

Percy Bysshe Shelley, as an excellent poet, epitomizes the ethics of life in his verses by means of metaphors. P. B. Shelley was pretty an insurgent in his literary works. He, under no circumstances, established with slighter evidences. His valiant temperament compelled him to convey his inimitable recounting of 'Ozymandias' into an admiration of permanence and perpetuity of art. His exclusive modus operandi to depict the moral principles of life and destiny has rendered the poem an insight into a prime literary work. This research piece of writing will explore the script skills of P. B. Shelley into a mode of prettiness and perpetuity and infinity of arts.

Key Words : Ethics, metaphors, moral principles, perpetuity, romanticism, temperament, themes, imagery

INTRODUCTION:

The vital conceptual apprehensions of P. B. Shelley's verses are principally the same subject matters that delineated romanticism, particularly amongst the younger English versifiers of P. B. Shelley's epoch that is splendour, zeal, natural world, political independence, ingenuity and the sacredness of the mind's eye. What formulates P. B. Shelley's handling of these subject matters exceptional is his idealistic association with his themes.

He robustly assumed in the prospects of appreciating a principle of human bliss as based on consistency and his jiffies of dimness and desolation not quite all the time shoot from his disillusionment at considering that ultimately sacrificed to individual love.

He, by no means, botched to manuscript his passionate emotions, beliefs and feelings on consistency and idioms in the course of verses such as Ode to the West wind and To a Skylark, in which he summons imagery and metaphors from natural world to exemplify his association to his art. He accentuates the actuality that verse fetches ethical excellence. P. B. Shelley forever glues to his manner as one is obliged to envisage extremely and scrupulously. In addition, one ought to place himself in the position of another and of several others.

The twinge and gratifications of his genus must turn into his personal one. It is the art of verse; no other English versifier of the early nineteenth century so accentuated the association between prettiness and righteousness or still supposed so fervently in the supremacy of art's corporeal enjoyments to perk up civilization.

P. B. Shelley strongly assumed that verse formulates folks and civilization superior. His verse is crammed with the sort of ethical sanguinity, which he anticipated would influence his readers corporeally, sensuously, piously and ethically all in unison. One amongst his highly celebrated poem is the iconic "Ozymandias", which episodically evokes the pharaoh Ramesses splendid years and the qualms. By crucially and critically exploring this verse, the present research paper reprises P. B. Shelley's art of verse, and how it

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accurately realized the splendour and magnificence and perks up the discernment of the readers.

Ozymandias is a sonnet, a poem of fourteen-line metered in iambic pentameter. This sonnet from 1817 is largely renowned and the immensely anthologised verse which is to some extent bizarre, bearing in mind that it is in various ways a nonconforming verse for P. B. Shelley.

Even though, it lays a hand little upon the most essential concepts and themes from his formation enormously, Ozymandias is dedicated to a solitary metaphor that is the devastated, destroyed and ruined sculpture in the desert wasteland, with its supercilious obsessive and expressive face and monomaniacal inscription:

Look on my works, ye Mighty, and despair!

The previously great king's arrogant swank has been sarcastically condemned. Ozymandias's colossal works have collapsed and vanished, his culture and civilization are disappeared and all have been converted into grime by the uncongenial, unsystematic, vicious supremacy of history. This devastated sculpture is at the moment purely a monument to one man's arrogance and an influential proclamation about the irrelevance of mankind to the course of time.

Ozymandias is primary and chief allegory for the transient temperament of political supremacy and in the sense the verse is P. B. Shelley's most stupendous political sonnet. Operating the precise frenzy of a verse like "England in 1819" is for the overwhelming uncongenial allegorical metaphor of the effigy.

Ozymandias connotes not only political supremacy but the sculpture can be a symbol for the superiority and arrogance of all civilization also, in any of its materialization. It is momentous that all the vestiges of Ozymandias are a classical work of art and a cluster of expressions, P. B. Shelley merely reveals that art and extensive lingo survive the erstwhile inheritances of supremacy.

Predominantly, it is P. B. Shelley's dazzling lyrical portrait of the narrative and not the focus of the chronicle itself which composes the verse subsequently exceptional and unforgettable. Structuring the sonnet as a legend enlightened to the orator by a voyager from an antique and historic terrain facilitates P. B. Shelley to adjoin an additional stage of murkiness to Ozymandias's spot with reference to the bookworms.

Instead of watching the sculpture with our own ogles, we take notice of it from somebody who took notice of it from somebody who has witnessed it. Consequently, the antique emperor is submitted yet a lesser amount of ordering the estrangement of the sequence of events doles out to destabilize his supremacy over us merely as entirely as has the course of moment in time.

P. B. Shelley's portrayal of the effigy is instrumental to rebuild, slowly but surely the outline of the King of Kings; primarily, we plainly perceive the strewn and traumatized face or shattered visage, then the countenance itself with its

Frown And wrinkled lip and sneer of cold command.

Subsequently, we are initiated to the stature of the sculptor and are capable to envision the existing man carving the emperor alive whose phizog bore the appearance of the obsessions currently indomitable and fearless. Then, we are initiated to the king's citizens in the poem's line,

The hand that mocked them and the heart that fed

The monarchy is currently ingeniously absolute and ultimately, we are pioneered to the glorious, vanity of the king

Look on my works, ye Mighty, and despair!

With that, the versifier razes our imagery portrait of the sovereign, and introduces centuries of wreck sandwiched between it and us that those who extraordinarily transmits zilch alongside vestiges of life.

Round and decay
Of that colossal wreck, boundless and bare
The lone and level sands stretch far away.

With these lines, P. B. Shelley demonstrates the veracity of life, man, environment and the natural world. Supremacy, pride and arrogance are the

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largely vital aspects in human life. Ozymandias was excessively proud and arrogant about his kingdom's prosperity and his purity in guiding it. Eventually, he devours all at the time of his life's end and no worldly supremacy will exceed the destiny. Actually, human beings are mortal and the labours he made to endure time are by crafting these insensible sculptures with a query spot of permanence.

P. B. Shelley exemplifies the impact and influence of romanticism on literature throughout the metaphors of the poem and preference of verbal skills. In this verse, he identifies subject matters of superiority, pride, supremacy, dominance, transience, nature, traditions, art and culture. He utilizes verse to embark the significance, ethics and prettiness in life.

The metaphors endowed in the verse ensembles the ethics of life, permanence of arts and perpetuity. The strewn sculpture in spite of its adverse condition mirrors the dominant monarch of Egyptian era. Although the historic stature devoured by the time, it still enlightens the readers of present and future.

As a consequence, Art and Culture persuades the future with ethics to stay alive in the world is the decisive aspiration supplied by P. B. Shelley all the way through this verse.

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Impact Factor-8.632 (SJIF)

ISSN-2278-9308

B.Aadhar

Single Blind Peer-Reviewed & Refereed Indexed

Multidisciplinary International Research Journal

August -2023

ISSUE No - (CDXXV) 425

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Aadhar Publications

Impact Factor – (SJIF) -8.632
ISSN – 2278-9308

B.Aadhar

Single Blind Peer-Reviewed & Refereed Indexed

Multidisciplinary International Research Journal

August -2023

ISSUE No - (CDXXV) 425

Sciences, Social Sciences, Commerce, Education, Language & Law

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INDEX

B.Aadhar International Peer-Reviewed Indexed Research Journal
Impact Factor -(SJIF) -8.632, Issue NO, (CDXXV) 425
ISSN : 2278-9308
August, 2023

Cognitive Developments of Children and it's concepts

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Abstract :-

Human behavior development (growth) process is start from the birth of child. These are processes by which knowledge of an object is obtained, including perception memory and imagination. Cognitive development can be best understood when a child progresses in verbal skills. Regarding cognitive development is depending upon abilities or intelligence available culture in childhood life. As a concepts cleared, cognitive development in progress.

Introduction :-

Development of cognitive abilities have great significance especially during the early year of life. Cognition develops rapidly in the early year of life. The speed of verbal skills with which he learn new words. Children's speaking and his ability, the length of sentences, etc. he uses all these demonstrate his cognitive development. The psychological concept of intelligence defines a network of strongly related abilities concerning the retention, transformation and utilization of verbal and numerical symbols.

Man's nature is to do imitation. Man learned by doing imitation. Child verbal skills developed by doing imitation of old. Formed education is not esstential to the development of important aspects of intelligence. Children are particularly good at reading the subtle, effective or expressive connotations that can be carried by what goes on in the environment. Most of the cognitive abilities and its development measured in human developments sre based on the principals suggested by Jean Piaget.

1) Cognitive's Concept and it's meaning :-

A concept is a basic unit of all types of learning. Human beings throughout from infancy to old age learn new concepts and use old concepts in new situations of their daily lives. A concept is an idea or understanding of what a thing is concept formation helps the child interpret its experience and the way it interprets, determines its behavior. Though language helps in the formation of concept, many times it is difficult to define or to verbalize the concept, though it is formed while organizing the learnt experience.

Cognitive system is an interrelated complex of separate cognitions about objects and persons. In cognitive system, one has to recognize the importance of understanding because only through understanding cognitive abilities could be developed and the appropriate concepts could be formed. Understanding is the ability to achieve the grasp of the nature's significance of explanation of something and to have clear and complete idea of it. In other words, it means the ability to comprehend.

The importance of concept in life was emphasized by Kagan (1966), who wrote fundamental agents of intellectual work are represented by concepts of the different categories of concept developed in early childhood, some of the common and most important are concept of life and deaths, concept of space, concept of weight, number of concepts, times concepts, concept of self, social concepts, asthetic concepts and concept of comic. An identifying attribute of cognitive theory is a prominent rule assigned to internal states of organism.

In cognitive development, concept must be clear of children. Parents, teacher must be help to clear concept. During the sensory motor stage of cognitive motor development children begin to develop an understanding of themselves as separate and distinct from the environment, causality, time & space. As age developed, from two years to six years of age, is the time children are capable of using language and symbolic thinking, however, children's concept is clear, in the pre operational stage of cognitive development. The third stage of cognitive development extends from six years age to 11 or 12 years of age. This stage is called as the stage of concrete operations. During this stage, the vogue concepts of preschool years became concrete and specific. This enable children to begin to think deductively, to form concept of space, and time and to categorize objects. They are able to take the role of the others and this leads to greater understanding of reality. The final stage of cognitive development beings around the age of 11 or 12 years an extends onward. Children are capable of considering all possible ways of solving problems and are able to reason on the basis of hypothesis and positions. Jean

pigments clearly suggest that understanding develops of children, along with maturation, that's the cognitive development of children.

2) Some common concepts of children in cognitive development :-

In childhood, children learn cause and effect relationship gradually. The ability to see cause and effect relationship is more closely related to children's personal and learning expenses than to their cognitive abilities or mental abilities. For example, children learn a number or religious and superpositions beliefs to explain natural phenomenon or accidental happenings. As a result, they have many faulty concepts of causality but if their learning expenses had been more realistic then they could have learned better cause and effect relationships. In the patter of development of concepts of causality, concepts of physical causality are usually developed early than concepts of psychological causality.

3) Scientific Types of Concepts in Cognitive developments :-

In cognitive development, concepts are reflection of children's personal and unique development, Concepts clears as age developed in stage by age. As a experiences developed, concepts also clear, time to time.

Following are concepts develops as per age (i) Concepts of Space (ii) Cardial directions (iii) Distance of Depth (iv) Concept of weight (v) number of concepts (vi) Colour of concept (vii) Concept of Shape (Sky) (viii) Concept of form and Colours (ix) Concept of conservation (x) Concepts of mental cognition (xi) Concepts of animals (xii) Concept of building (xiii) Concept of school (xiv) Concept of ground playing (xv) Concept of Book (xvi) Concept of teacher (xvii) Concept of group (xviii) Concept of problem (xix) Concept of weight (xx) Concept of size & shape etc. (xxi) Social concept etc.

Conclusions :-

Human behavior is not so simple as it appears. All human behavior are based on cognitive processes as development. Psychology is a part in cognitive sciences. A concept is a mental representation. Cognitive scientists have identified two principal types of concepts, artificial & natural. Concept formation is also cognitive process, we acquire concepts gradually by learning cause and effects. There are number of concept types that helps the cognitive development. Development of concepts and also that the development of cognitive abilities of children is depending upon, its life situation, mother, father, teacher & social environment, etc. culture also.

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International Journal of Advance and Applied Research (IJAAR)
Peer Reviewed Bi-Monthly

ISSN – 2347-7075
Impact Factor –7.328
Vol.4 Issue-32 Sept-Oct 2023

International journal of advance and applied research (IJAAR)

A Multidisciplinary International Level Referred and Peer Reviewed Journal

Volume-4 *Issue-32*

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International Journal of Advance and Applied Research
www.ijaar.co.in
ISSN – 2347-7075 Impact Factor – 7.328
Peer Reviewed Bi-Monthly
Vol.4 No.32 Sept-Oct 2023

Essential Food & Nutrition for Living things (Human) is a cause and effect of Four Elements on the Earth

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Abstract:-

In universe, Earth is one of the most important planet; Because of the earth, there is a Biodiversity means the variety and variability of life on the earth. Biodiversity is a measure of variation at the genetic, species and ecosystem level. Only on the earth, there are four elements (Super Powers (Mahabute), Soil, Light, Water and Air because of on the earth that environment, living being – man, animals, germs, microbe and number of vegetation, grass etc. planting the foods. Food is essential for human existence, and nourishes the body, nature is to live, for live.

Introduction:-

In the Sun orbit, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune, Moon etc. are planets. The sun is a hot ball of glowing gases. It gives us light & energy on the earth, It keeps out planet worm enough for living things to grow without the Sun's light and energy, life as we know it could not exist on our home planet, Earth. Earth is one of the most important Planet in all universe. Because, living things are on the earth, only. In the earth there are also ecosystem Living being and it concepts of energy law which says energy can neither be created nor destroyed. It can only be transferred from one sort to another. For ex. : (Light energy to food energy), Sunlight, soil, water and air, are the four super power (Mahabhute) and its energy is fixed in food production by green plants, through the ecosystem by food chains or food webs that is essential for human existence and nourishes the body. Nutrition is defiend as food at work in the body, of being man and animals (being life). Human being (life) is on the earth because of four elements, earth (prithvi) water (Apa), Light (Tej) and air (Vyau). Consciousness (science) is result of the combination of the four elements (Four Mahabute) and it is true that consciousness arise with birth dies with death – not soul. It's natural creation the life consciousness and its foods.

Theory Nama – Rupa against the existence of the soul, Living being on the Earth:-

Nama – Rupa is a collective name for a sentient Being. It is theory against the existence of the soul. According to Buddha's analysis a sentient Being is a compound thing consisting of certain Physical elements and certain mental elements. They are called Khandas. The Rupa Khanda primarily consist of the physical elements such as earth, water, fire and air, oxygen. They constitute the body of Rupa. Besides the Rupa Khanda, there is a such a thing as Nama Khanda which goes to make up sentient Being. This Nama Khanda is called vinana, or consciousness. This Nama Khanda includes the three mental elements Vedana (Sensation springing from contact of the six senses with the world), Sanna (perception), Sankahara (States of Mind), Chetana (Consciousness) is sometimes spoken of along with three other mental states as being one of them. Consciousness is result of the combination of the four elements. Prithi (Earth), Apa (Water), Tej (Sunlight) and Vayu (air).

It is the time that consciousness arises with birth and dies with death of the being life. What the Buddha said was that wherever there was Rupa of Kaya there was consciousness accompanying it. Whatever the Buddha's answer was but today's science is cleared that consciousness is the result of the combination of the four elements (four mahabute) means the co-existence or aggregation of the physical elements produces consciousness, to give an analogy from science, there is an electric field and wherever there is an electric field it is always accompanied by magnetic field. No one knows how the magnetic field is created or how it arises, But it always exists along with the electric field. The magnetic field in relation to the electric field is called an induced field. The Buddha's argument against the soul was one consciousness arises man becomes sentient being consciousness is therefore the chief thing in Man's / animal's life. To live life of man's consciousness, nutrition is differed as food at work in the body. In other words food being processed and used for various functions in the body up to death.

Food and Food's Functions essential for Human / Animal existence and nourishes the body:-

Nutrition is the analysis of the effect of food and its constituents on the living organism, nourishing the body. As per WHO said, Health is a state of complete physical, mental and social well being and hot merely the absence of disease or infirmity. Food is essential for human existence and nourishes the body. Food can be defined as any thing solid or liquid, that useful to keep the body well. Nutrition is defined as food at work in the body and used for various functions in the body. A balanced diet is one that contains different types of foods in such quantities and proportions that the need for calories, minerals, vitamins and other nutrients is adequately met. There are 13 essential vitamins (A, B, C, D, E and K with 8 Vitamins in the B Complex) and many minerals the body requires for optimal health. Vitamins are organic substance found in plants and animals. Minerals are inorganic elements from earth (soil and water). Both are essential for normal growth and optimal health. Nutrient rich soil or water contains large amounts of nitrogen, carbon, Phosphorus, sulphur and potassium. These nutrients can come from natural sources, [soil, water, light, & air (oxygen)] like plant (trees) and animal remains. As plants and animals die, they decompose. Decomposition releases nutrients in the environment. Nutrients are chemical substances found in every living thing on earth.

Conclusion :-

In universe Earth is one of the most important planet, in the sun orbit. Energy from light (Sun), Oxygen from air food nutrition from water and soil (earth) is available on the earth, there is Biodiversity means the variety and variability of life on the earth. Consciousness in the being life not because of soul. But today's science is cleared that consciousness is the result of the combination of the four elements [char mahabute]. Life on the earth is cause and effect of food and nutrition that's essential for living thing [Human / animal being]. These nutrients (vitamins, minerals, calories and other nutrients] as a food at work in the body to continue consciousness in the live life. Four mahabute [earth, light, air and water] are the sourced of Foods which is essential for consciousness continued means life being continuous on the earth.

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MAH/MUL/ 03051/2012 ISSN :2319 9318

आंतरविद्याशाखीय बहुभाषिक शोध पत्रिका

विद्यावार्ता™

Jan. To Mar. 2023
Issue 45, Vol-08

Date of Publication
1 Feb. 2023

Editor
Dr. Bapu g. Gholap
(M.A.Mar.& Pol.Sci.,B.Ed.Ph.D.NET.)

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"Printed by: **Harshwardhan Publication Pvt.Ltd.** Published by **Ghodke Archana Rajendra** & Printed & published at Harshwardhan Publication Pvt.Ltd.,At.Post. Limbaganesh Dist,Beed -431122 (Maharashtra) and Editor **Dr. Gholap Bapu Ganpat**.

Reg.No.U74120 MH2013 PTC 251205
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समारोप

रस्ता अपघात होऊ नये याचे नियोजन व व्यवस्थापन केले तर कोणतेही वाहतुकीची आपत्ती येणार नाही, आपत्तीचा होणारा परिणाम हा भयंकर असतो, त्यामुळे स्वत:ची, कुटुंबाची, समाजाची देशाची खूप हानी होते.सुरक्षित जीवनासाठी सुरक्षित रस्ता वाहतूक काळाची गरज आहे, त्यासाठी आपत्ती व्यवस्थापनाचे तंत्र अंगीकारावे. आपत्ती व्यवस्थापन म्हणजे शास्त्रीय, काटेकोर पणे, निरीक्षणाने व माहितीचं पृथक्करणाने आपत्तींना तोंड देण्याची क्षमता मिळवणे व त्यात वेळोवेळी वाढ करणे, आपण स्वत: आपल्या प्रवासासाठी रस्ता वाहतुकीच्या व्यवस्थापन आराखडा तयार करून कार्यप्रणाली राबवली किंवा व्यवस्थापन केले तर रस्ता सुरक्षाच्या दृष्टीने प्रवास सुरक्षित होईल.

संदर्भसूची

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२) पाटील, सतीश यू. विज्ञान व तंत्रज्ञान कार्यपुस्तिका, प्रगती बुक्स प्रा.लि. पुणे

३) पाटील, सतीश यू. शैक्षणिक आंतरवासिता — एक दृष्टीक्षेप, निराली प्रकाशन, पुणे.

४) पाटील, सतीश यू. आपत्ती व्यवस्थापन संशोधन पेपर, धुळे.

५) पाटील, सतीश यू., बाबाराव, द. डोईजड, शैक्षणिक व्यवस्थापन व प्रशासन आणि आपत्ती व्यवस्थापन (२०२२), निराली प्रकाशन, पुणे.

६) आपत्ती व्यवस्थापन मार्गदर्शिका.

७) दैनिक सकाळ, दैनिक पुण्यनगरी, दैनिक लोकसत्ता मधील वृत्त.

14

गविलगड टेकड्यामधील अश्मयुगीन चित्रे

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प्रस्तावना —

मानवी अस्तित्वाच्या खुणांच्या माध्यमातून मानवाची प्रगतीचा आलेख चितारता येतो. अश्मयुगिन मानवाची तत्कालीन हत्यारे व इतर साधनाच्या माध्यमातून त्याच्या जीवन शैलीचा मागोवा घेण्यास मदत मिळते. या साधनामध्ये अश्मयुगीन मानवाने चितरलेले चित्रे त्याचा सामाजिक व जीवनाविषयी माहिती करिता उपयोगी ठरली आहे. भिम्बवेटका येथे मानवाने चितरलेली चित्रे त्याचे उत्तम उदाहरण ठरले आहे. यातून त्याच्या समाज जीवनाशी संबंधित क्षण, शिकार, सार्वजनिक उत्सव, घटना, भटकंती ई. रंगविलेले आढळतात. या प्रागैतिहासिक भित्तिचित्रावरून त्याचे जीवन उलगडण्यास मदत झाली आहे. अलीकडे सातपुडा पर्वत रांगातील गाविलगड टेकड्या मध्ये अशीच शिलचित्रे आढळून आलेली आहे. यावरून आदिमानवाचे सातपुड्याच्या रांगमध्ये असलेले अस्तित्व सिद्ध झाले आहे. ही शैल गृहेप्राकृतिक दृष्ट्या आदिमानवास आश्रय उपलब्ध करून देत असल्यामुळे मानवाने त्यास निवास स्थळ म्हणून उपयोगात आणले असावे. (चित्र क्र.१, ८)

चित्रांचा शोध —

अमरावती जिल्ह्यातील मोर्शी तालुक्यातील चिचोली (गवळी) या गावापासून मध्य प्रदेशची हद्द सुरु होते. याच हद्दीत काही अंतरावरच आदिवासी धारूळ हे गाव आहे येथूनच जवळ असलेल्या गविलगड सातपुडा प्राचीन गुहा व अश्मयुगीन चित्र असल्याचा शोध रहौसी पर्यटकांनी गुहाचित्रांचा शोध लावला.

कुक्कासदेव, अंबादेवी, गायमुख परिसर, कोसुंभ,

या ठिकाणी या गुफा असून वैशिष्ट्यपूर्ण गुहाचित्र येथे पाहावयास मिळतात. सातपुडा पर्वत रांगेत १८ नव्या गुहांचा शोध लागला असून यात १२ हजार वर्षापूर्वीच्या पाषाण युगातील हत्यारांचे अवशेष व गुहेत कोरलेली चित्रकला आढळून आली असून या परिसरात आणखी गुहा असल्याचा दावा प्राचीन इतिहास व पुरातत्व विभागाच्या तज्ज्ञांनी केला आहे

भारतीय पुरातत्वीय खात्याचे उत्खनन —

सन २०१२–२०१३ मध्ये या ठिकाणी उत्खनन व शोधकार्य सुरू झाले. भारतीय पुरातत्त्व सर्वेक्षणाने (ए.एस.आय) मध्यप्रदेशातील बेतुल जिल्ह्यातील सातपुडा पर्वतराजीमधील गवळीगढ डोंगरावर शैलगृह सर्वेक्षणाचे कार्य पूर्ण केले आहे. या सर्वेक्षणात त्यांनी गवळीगढ डोंगरावरील ४० कि.मी. अंतराच्या परिसरात शोध शोध घेण्यात आला आहे. आतापर्यंत एकूण २४७ शैलगृह आश्रयस्थान उजेडात आले आहे.' ही विविध चित्रे, आणि पेटोग्लीफ्स संबंधित दोन मुख्य खोदकाम (साइट्स) उत्खननाचे कार्य हाती घेण्यात आले आहेत यामध्ये अंबादेवी कुक्सासा देव ग्रुप (केएसडी) आणि गोडपेंड ग्रुप महत्त्वपूर्ण आहेत. अंबादेवी गुफा गट, मुंगसा देव गट, तेलकन देव गट, कुक्कासा देव गट, कोसुम गट, गायमुख गट' याप्रमाणे गटांची विभागणी करून सखोल अभ्यास भारतीय पुरातत्विय विभागाने सुरु केला आहे'

येथे शास्त्रीय पद्धतीने उत्खनन करण्यात आले असून छायाचित्रण आणि रेखाचित्र या दोन्हींचा उपयोग करून निष्कर्षांचे दस्तऐवजीकरण केले गेले आहे. केएसडी ग्रुपमध्ये सापडलेल्या उपकरणांमध्ये प्रामुख्याने मायोलिलीथ (एक लहान दगड चकमक उपकरण जे सामान्यतअर्धा सेंटीमीटर रुंद आहे). काही ठिकाणी श्कोरश देखील आढळले होते. कोर हा एक उपकरण आहे जो कास्टिंग आणि मोल्डिंग प्रक्रियेमध्ये अंतर्गत खड्ड्यांत आणि पुन्हा प्रवेश करणार्या कोन तयार करण्यासाठी वापरला जातो. काही ठिकाणी मातीचे छप्पर सुधा सापडले आहे.

विस्तार —

या पुरातत्वीय शिल्पगृहाशी संबंधित क्षेत्राचा विस्तार किती प्रमाणात झाला असावा हे निश्चित सांगता येत नाही. पुरतत्वीय खात्यातील विद्वानांच्या मते शिल्पगृहाचा विस्तार नेमका किती झाला हे आम्ही निश्चितपणे सांगू शकत नसलो तरी आम्ही जवळजवळ संपूर्ण बेल्ट शोधून काढला आहे आणि आमच्याजवळ कोणताही शैलगृह गहाळ नसल्याची फारच कमी संधी आहे असेASI ने स्पष्ट केले आहे. सर्वेक्षणात आणि उत्खननांत रहिवाशांची जीवनशैलीचा अभ्यास करण्याचा प्रयत्न केला, जसे की पेंटिंग्स, कोरिंगिंग्स आणि साहित्य तयार करताना शिल्लक v l y g h l lexb आढळून आलेली आहे.

कालखंड —

या शैलगृह आश्रयस्थानांमध्ये मोठ्या प्रमाणं वैशिष्ट्ये पूर्ण दगडावर पेंटिंग केलेली आढळतात. हे पेंटिंग पाशानकालीन युगाशी (मासोलिथिक काळ) आणि ताम्रपाषाण कालीन कॅल्कोलिथिक (ताम्रधातु) काळासंबंधित संबंधित असावेत आसा अंदाज बांधण्यात आला आहे. (उत्तर पाषाणकाळ ५०००० ते १०००० वर्षापूर्वी) २०११ मध्ये प्रभात साहू यांनी ही शैलगृह शोधून काढली होती. ते सध्या नागपूर विद्यापीठात प्राचीन भारतीय इतिहास, संस्कृती आणि पुरातत्त्व विभागाचे सहकारी प्राध्यापक म्हणून काम करीत आहे. त्यानंतर त्यांची पत्नी नंदिनी भट्टाचार्य साहू, यांनी महत्त्वाची कामगिरी बजावत ए एस आय च्या उत्खनन शाखेचे अधीक्षक पुरातत्त्वतत्व अधिकारी म्हणून यशस्वी कार्य पूर्ण केले आहे.

चित्रांचे स्वरूप/वर्णन —

माणसाचा हात पोहचेल इतक्या उंचीवर ही चित्रे काढली आहेत प्रत्येक चित्राचा आकार १० ते १५ सेमी आहे. प्राण्यांच्या चित्रा व्यतिरिक्त या ठिकाणी लहान मुलाचे व आईचे चित्र सुद्धा सापडले आहे. हे चित्र त्या काळातील कुटुंब संस्थेशी संबंधित असावे.

या अश्मयुगीनमानवाने चितारलेल्या चित्रामधे वाघ, हत्ती, जिराफ, गेंडा, रानगवे, सांबर, अस्वले, वानर, रानकुत्रे ह्यांची चित्रे आहेतगिधाड या पक्षाचे एकमेव चित्र गेरूसारख्या लाल रंगात साकारले आहे. आणखी एका चित्रामध्ये एका गुहेत फांदीवर झोके घेणाऱ्या आदिमानवाचे चित्रेही चितारलेली दिसतात. या मानवाचे पाय मात्र माकडाच्या पंज्यासारखे दाखवले आहेत जवळपास ७० ते ८० फुट रुंद आणि ४० फुट उंचीच्या धनुष्यबाणा सारख्या अर्धगोलाकार शीलेवरील

चित्र हे वैशिष्टय आहे हे चित्र तळापासून ४ फुट उंचीवर डावीकडून उजवीकडे विशिष्ट अंतरावर निर्माण केलेले आहे. बरीचशी चित्रे आज कालौघात अस्पष्ट झाली आहे त्यामुळे त्याचा अंदाज बांधणे कठीण कार्य झाले आहे. काही चित्रे ही लाल रंगाने तर काही चित्रे ही अणकुचीदार दगडाने कोरलेली आहे. या चित्रामध्ये आयुध घेऊन असलेला मानव लाल रंगामधे चितारलेला आहे. तत्कालीन दैनदीन जीवनासाठी शिकार करणे आवश्यक असल्यामुळे त्याला आयुध घेऊन दाखवले आहे. बहुदा ही अवजारे दगडापासून निर्मित असावीत (चित्र क्र.८). मोठ्या खंदकाच्या बाजूला असलेल्या शिळेवर मधाचे पोळे सुंदररीत्या चितारलेले आहे आज सुद्धा चांगल्या स्थितीत आहे. (चित्र क्र.४).

गोडपेंड —५ ब्लॉकमध्ये एक आश्रयस्थानाच्या परिसरात एक खंदक खणलेला आढळेला आहे. यामध्ये एकूण पाच थर आढळून आले असून शेवटच्या थरामध्ये पाषाणयुगाशी संबंधित मोठे ब्लेड होते. या स्थळांचा सांस्कृतिक अनुक्रम chalcolithic, Mesolithic आणि नवचमत चसमवसपजीपव शी सबंधित आहे.

आढळून आलेली तत्थे —

ही सर्वात मोठी प्रागैतिहासिक कालीन वस्ती आहे मानवी उत्क्रांती दरम्यान ही वसाहत विकसित झाली असावी येथे आढळलेल्या पुरातन वस्तू इतर कोणत्याही ठिकाणापेक्षा खुप पुरातन आहेत. हे एकमेव शैलगृह आहे की जेथे मोठ्या प्रमाणात विविध कलाकृत्या आढळून आल्या आहेत.

चित्रदीर्घा —


Image:1 Rock Shelters Image:2 Tortoise


Image:3 AnimalImage:4 Honeycomb


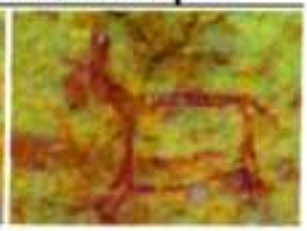

Image:5 AnimalImage:6Animal

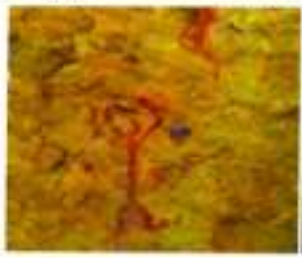


Image7: Man with Weapon Image:8 Rock Shelters

संदर्भ

1 Times of India,ASI discovers 247 rock shelters at Gawilgarh hills, May 30] 2015

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3 Times of India 24 April 2014

3 Times of India,Snehlata Shrivastava, ASI discovers 247 rock shelters at Gawilgarh hills, May 30, 2015

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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

UV Characterization of Polyblends PMMA and PVC Polymer with Potassium Thiocyanate as Electrolytes

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DOI: https://doi.org/10.55248/gengpi.4.1023.102829

ABSTRACT

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Keyword: PMMA, PVA, KSCN, UV- Spectroscopy

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Large number of host polymer i.e. PMMA (Polymethylmethacrylte), Polyethylene oxide (PEO), Polyvinylalcohol (PVA) etc. with different alkali and alkaline salt have been investigated in the past four decade. Out of these PMMA is synthetic polymer of methyl methacrylate. PMMA is most studied polymeric system. Poly (methyl methacrylate) (PMMA)-based electrolyte has a special significance because of its well-known chemistry and cheaper method of processing them as laminates. However, its low conductivity at room temperature due to the formation of crystalline precludes it from practical applications. [2]

Polyvinyl alcohol (PVA) can be classified as amorphous or semi crystalline according to the internal structure [3]. Semi crystalline PVA can be synthesized via the creation of the both a carbon amorphous and crystalline areas [4]. Poly (vinyl alcohol) (PVA) is a semi crystalline polymer, studied extensively because of its many interesting physical properties, which arise from the presence of OH groups and the hydrogen bond formation [5].

2. Materials and Experimental

2.1 Materials

All chemicals were of analytical grade. Poly (vinyl alcohol) and Poly (methylmethacrylte) were supplied by SIGMA –ALDRICH, Co., 3050 spruce street, St. Louis. MO 63103 USA 314-771-5765. Potassium Thiocyanate by (Sd fine- chem. Limited, Mumbai) and Tetrahydrofuran (THF-E-Merck India Ltd., Mumbai) is being used as a solvent for thin film crafting process. The thin films were prepared by using isothermal evaporation technique.

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Thin films of PMMA–KSCN- PVA in different mole ratios were prepared by weight % method. The 70% weight of PMMA powder is added into PVA at room temperature .The appropriate weights of KSCN and mixed solution of PMMA- PVA , were dissolved in 20 ml THF (tetrahydrofuran) followed by the addition of plasticizer. Then blend solution perfectly spread horizontally levelled on the glass plate. Then solution was allowed to evaporate for

24 hour. After 24 hours, we observe the deposition of thin film on glass plate. Then dried sample to remove the trace from the glass plate. Then studied UV characterization of sample.

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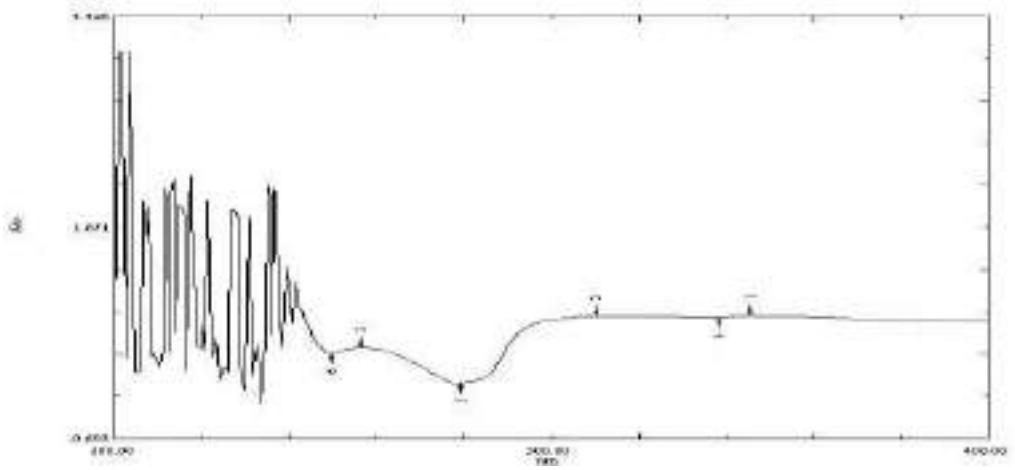
3.1 Ultra Violet (UV) Characterization

The optical absorption (UV) spectrometric scan in 200 nm – 400 nm of pure PVA blend are shown in fig 1.1, 1.2, 1.3, 1.4. The observed spectra are characterized by a main absorption edge around 260 nm for all curves slightly shifted toward short wavelength with increasing concentration of PVA. Also PVA material can be used as material for light spectra in the visible region in contest to tradition crystalline materials. Moreover, it is possible to improve further the modified optical PVA photopolymer by the applications of an external electric field [6].



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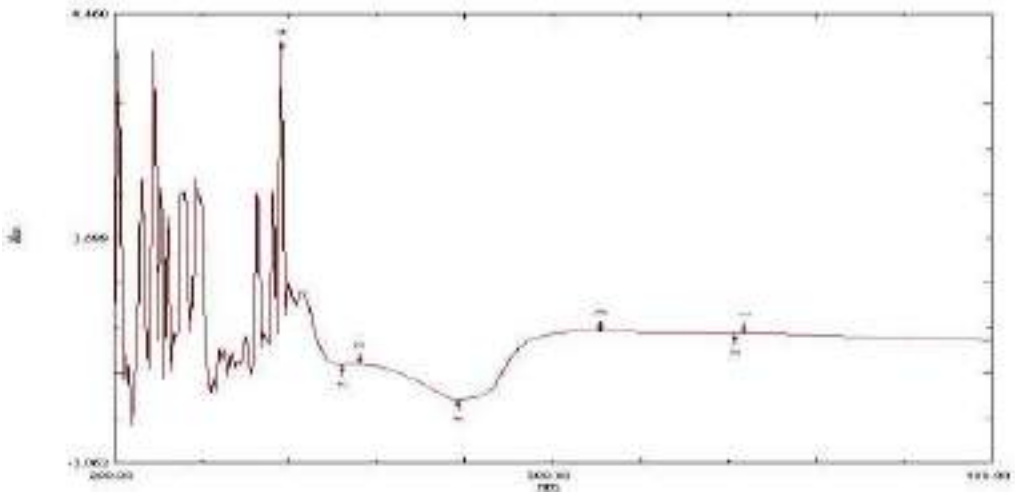

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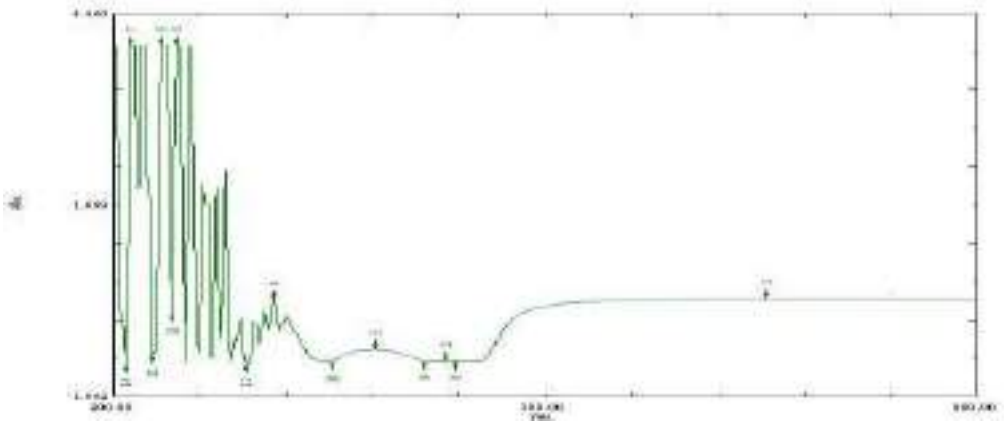

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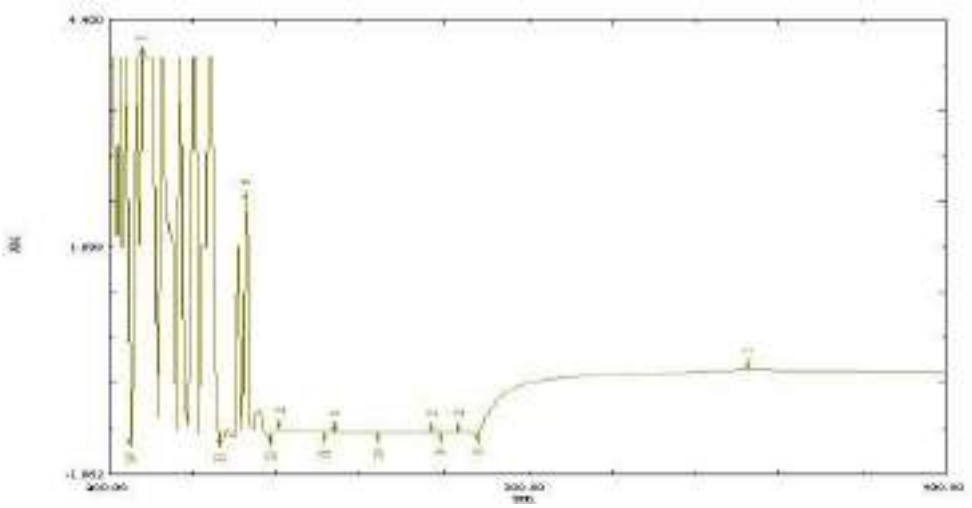

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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

UV Characterization of Polyblends PMMA and PVC Polymer with Potassium Thiocyanate as Electrolytes

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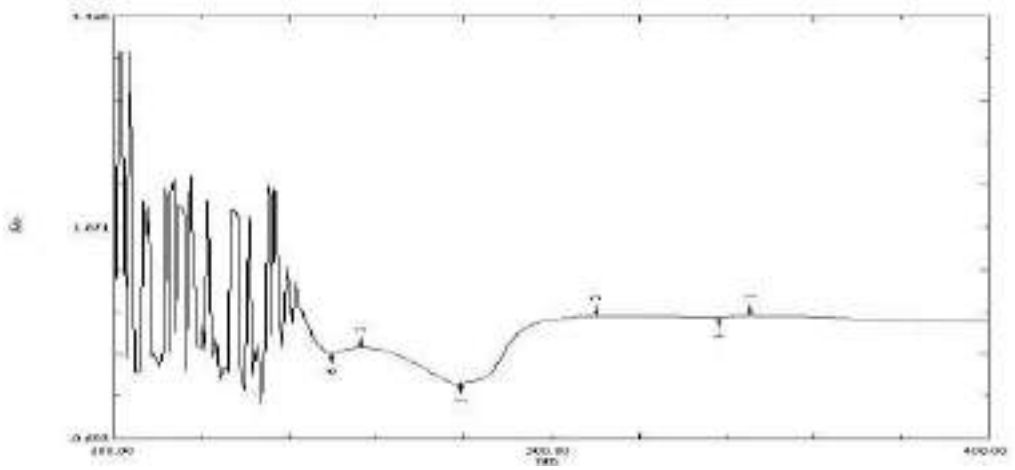

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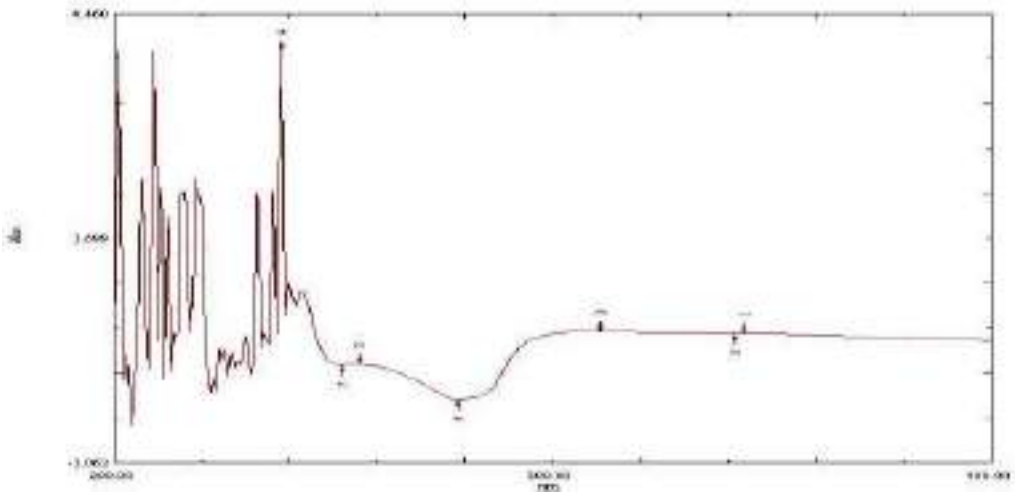

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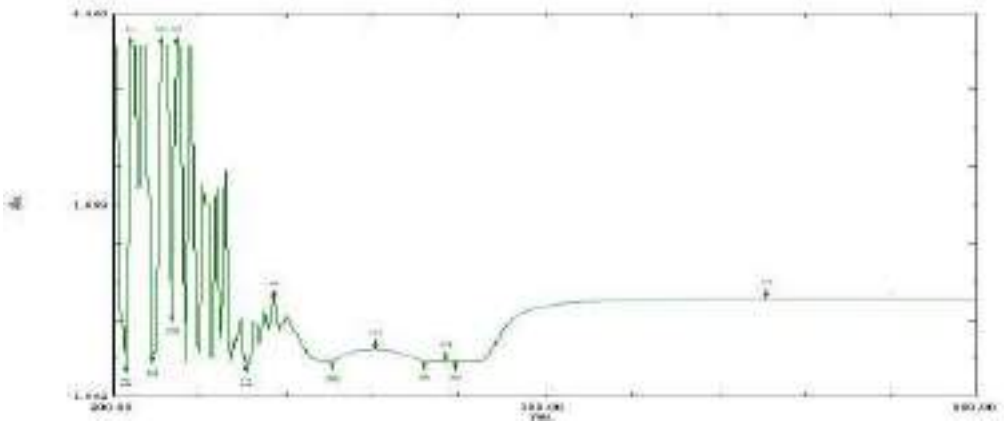

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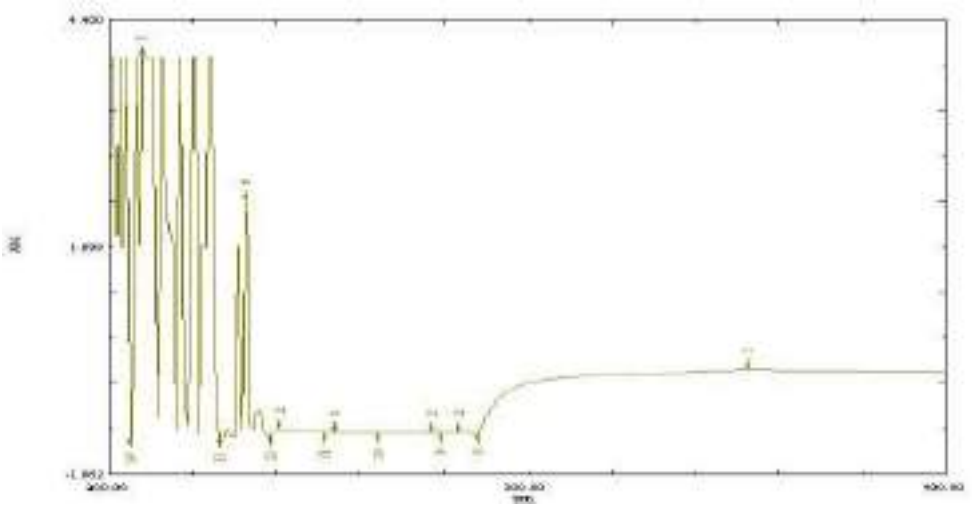

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Journal homepage: www.ijrpr.com ISSN 2582-7421

A Review: Nano Science as Opportunities in Health & Research Area.

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DOI: https://doi.org/10.55248/gengpi.4.1023.102838

A B S T R A C T

Devolvement's of Science in 20th century make human life pleased with prospective Health. Innovation of "Nano" Science change structure of many materials from micro size to nano size that inspires scientist's community to manipulate many materials into nano size (bio medicine) which gives remedies for improvable diseases and chronic diseases. In commercial approach because of nano science cost of many medicines become low which improve the common man wealth ultimately subsequent in nation prosperity. This satisfies the catch phrase 'Health is Wealth'.

Keywords: Science; Nanotechnology; Nanomaterials; Healthcare.

1. Introduction

Technological innovations such as Science aim to enrich human life. However, nanotechnology presents a unique technical challenge in that a disparity of nine orders of magnitude separates the length scales of a human (a meter) and a nanometer. Ultimately, this goal needs to be achieved through the development of a definitive pathway that fuses existing technology with future technology to link the nanoscale with human life. Taking advantage of those interesting properties of nanoscale particles will require the successful manipulation of their position and properties. For example, a self-assembling biological system could be employed in a bottom-up fabrication scheme. The fusion of biology with nanotechnology will not only result in technological innovation but will also encourage future research into natural biological nano systems.

Once an academic curiosity, nanotechnology has sweeping implications for many electronic, optical, magnetic, catalytic, and medical-therapeutic applications. Nanomaterials are being used to produce composite materials with improved electro conductivity and catalytic activity, hardness, scratch resistance, and self-cleaning capabilities. They are being exploited to improve the performance of gas sensors and other devices, the way drugs reach targets in the human body, and the aesthetic appeal and efficiency of consumer products.

In this review the necessary strategies for realizing the ultimate goal of nanotechnology to benefit the human condition. Fundamental studies in the nano sciences have provided the building blocks on which nanotechnology will drive the creation of novel devices with applications in energetic, electronics, materials, medicine, and beyond. These systems will address the differences between being integration or fusion-based by possessing embedded intelligence through a series of nanoscale sensors and actuators. Nanotechnology achievement of this magnitude would serve dual roles. First, nanotechnology would be cemented as the visionary industry for the next millennium. Second, the true benefits for humankind enabled by the maturation of this technology will have been realized. The example of coordinated smart dust activity provides a promising demonstration of basic emergent behavior.

The extreme surface-to-volume ratio of nanoparticles is a key attribute that accounts for their range of superior performance characteristics. As the functional advantages of ultra-small particles continue to be deciphered, and processes are perfected to make and manipulate then, there seems to be no limit to what nano-materials can do.

2. Role of Nano Science Technology in Health Care Area

Nanotechnology in Life care

Nanotechnology offers new solutions for the transformation of bio systems and provides a broad technological platform for applications in industry; such applications include bio-processing, molecular medicine (detection and treatment of illnesses, body part replacement, regenerative medicine, nanoscale surgery, synthesis and targeted delivery of drugs), environmental improvement (mitigation of pollution and ecotoxicology), improving food and agricultural systems (enhancing agricultural output, new food products, food conservation), and improving human performance (enhancing sensorial capacity, connecting brain and mind, integrating neural systems with nano electronics and nano-structured materials). Nanotechnology will also serve as

a technological platform for new developments in biotechnology; for example, biochips, “green” manufacturing (bio compatibility and bio complexity aspects), sensors for astronauts and soldiers, bio fluidics for handling DNA and other molecules, in vitro fertilization for livestock, nano filtration, bio-processing by design, and traceability of genetically modified foods [1].

Figure 1: Health Care

2.1. Nanoparticles for Drug Delivery

Nanoparticle-based delivery vehicles improve drug efficacy by modulating drug, kinetics and bio distribution. Small-molecule drugs are rapidly eliminated from the circulation by the kidneys. Injectable nanoparticle delivery vehicles, typically ranging from 5nm to 200nm in size, substantially increase circulation (particles >5nm avoid kidney clearance) while minimizing removal by cells that police the blood for foreign particles (macrophages have less propensity for particles <200nm in size). Oral delivery is currently the most preferred method of drug administration because of its cost effectiveness and ease of use.

The market for oral drug-delivery systems has been growing at a rate of 8.6 percent per year since 2000. A major area of research in oral delivery is in delivery materials for protein drugs. Because particle permeability across the intestinal wall is inversely proportional to size, nanoparticles used for oral delivery offer obvious advantages. The interest in nanoparticle-based drug delivery for other administration routes is also growing. The following sections focus on polymer, lipid, and inorganic or metallic nanoparticles that are <500nm in size. For example, a cyclodextrin-based polymer developed at Insert Therapeutics increases the solubility of camptothecin, an insoluble chemotherapy drug, by three orders of magnitude.[2]

2.2. Inorganic and Metallic Nanoparticles

Delivery of drugs using new inorganic and metallic nano-sized vector is still in the proof-of-concept of stage. One unique approach originates from C-60, a soccer ball shaped fullerene [2].Another interesting approach is to use magnetic nanoparticles to carry chemotherapeutic drugs to cancer sites directed by an external magnetic field.

Figure 2: Inorganic and Metallic Nanoparticles as Drug Deliver

Very recently, other metal nanoparticles have been investigated as therapeutics and drug-delivery systems. An example from Dr. Naomi Halas's research group (Rice University) is the nano shell, a new type of nanoparticle composed of a dielectric silica core coated with an ultrathin gold layer [3]. Once the nano shells penetrate tumor tissues, they can be activated for thermal therapy by taking advantage of their ability to convert absorbed energy from the near-infrared region to heat.

2.3. Nano-porous Membranes

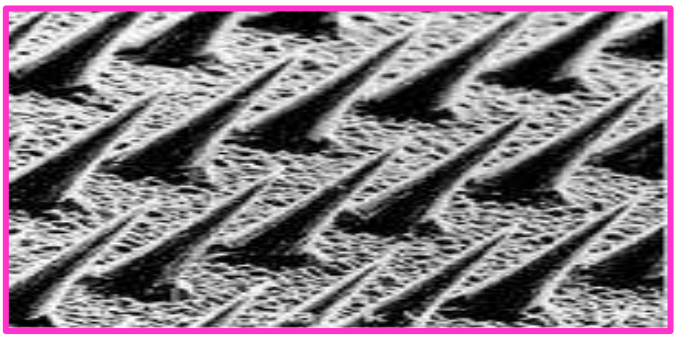

Figure 3: Solid silicon micro needles with heights ~150nm can be applied painlessly to enhance trans dermal drug delivery.

Nano-porous membranes are micro fabricated with well-defined pores (diameters in the tens of nanometers). The membranes can be used to deliver small-molecule, peptide, or protein drugs figure 3. One application under investigation involves encapsulation of pancreatic islet cells for insulin delivery. The reproducible and uniform pore size precisely controls the material exchange across nano-porous membranes: Nutrients for the cells and secreted insulin can pass through the pores, but proteins and cells from the immune system that may attack the implanted islet cells are restricted from entering the bio-capsules due to their size.

A pilot human trial revealed that the micro needle arrays are indeed applied painlessly [4]. Trans dermal micro needle delivery was quickly adopted by the pharmaceutical and drug-delivery industries; several companies are currently developing this technology for trans dermal drug administration. As this technology matures, it has the potential to quickly surpass the market currently occupied by traditional patch formulations.

2.4. Automated diagnosis

Medicine has already become accustomed to depending on heavy computations in the various topographies that are now routine in large hospitals. Diagnosis is essentially a problem of pattern recognition: an object (in this case, the disease) must be inferred from a collection of features. Although there have already been attempts to ease the work of the physician by encapsulating his or her knowledge in an expert system that makes use of the physician's regular observations, significant progress is anticipated when measurements from numerous implanted biosensors are input to the inference engine. This is an example of indirect nanotechnology: the practical feasibility depends on the availability of extremely powerful processors, based on chips having the very high degree of integration enabled by nanoscale components on the chips [5].

2.4. Biomedical devices

Figure 4: Biomedical devices

The flagship nano-medical system (rather than device) is the "nano-bot", an autonomous robot envisaged to be about the size of a bacterium (i.e., about one micrometer in diameter), and containing many nano devices (an energy source, a means of propulsion, an information processor, environmental sensors, and so forth). When engineering such devices it is important to note the environment in which they must operate: viscous (highly dissipative), dominated by friction and fluctuations (Brownian motion), and in which inertia plays a negligible role. This is in contrast to the familiar macroscopic mechanisms that follow Newton's laws: for the nano-bot, force is not given by the product of mass and acceleration, but by the product of the coefficient of friction and its velocity, together with superimposed random fluctuations. Any self-propelling nano-bot are therefore likely to resemble a motile bacterium rather than a device equipped with nanoscale oars or paddles [5].

2.5. Biochips

Drug release from IDD devices is not constant, and "burst" effects are still observed. In addition, drug release cannot be controlled after implantation of IDD devices. Biochips have been developed to precisely control the amount of drug released. Biochips are usually fabricated using silicon and contain a number of mini-wells with precisely controlled sizes, each capable of holding a few hundred nano liters. These mini-wells are loaded with drugs and are covered with caps of thin metal foils (usually gold) that are connected to the wires on the face of the chips [6].

When electrical signal is applied, the current dissolves the metal covers and releases the drug. Biochips can be implanted beneath the skin or into more specific areas such as the spinal cord or brain. The electronics package outside the chips receives a radiofrequency instruction through a built-in antenna to order a microprocessor to control the melting of metal foils. Microchips, Inc. is one of the key companies developing this technology. Preclinical studies in animals using biochips developed by Microchips, Inc., have shown good biocompatibility without significant side effects. Once successfully developed, the biochip-based drug-delivery technology will allow for precisely controlled drug administration to patients.

Figure 6: Biochips

3. Advantage of Nanotechnology in Pharmacy and Future Trends in Drug Delivery

Many other promising drugs never make it to clinical trials because of inherent pharmacological drawbacks. Low-molecular-weight drugs, such as most chemotherapy drugs, are usually insoluble and highly toxic. Protein and nucleic acid drugs usually have poor stability in physiological conditions. It is therefore essential for these drugs to be protected en route to their target disease sites in the body. Drug-delivery systems may rescue potential drug candidates by increasing solubility and stability.

Drug-delivery technologies are developed to improve the safety and efficacy of drugs, to ensure better patient compliance, and to improve the shelf life and stability of therapeutic products. Controlled drug release involves the combination of a biocompatible material or device with a drug to be delivered in a way that the drug can be delivered to and released at diseased sites in a designed manner.

The major routes of drug administration are oral, inhalation, injection, and transdermal delivery. The most well-known route is oral drug delivery, which accounted for about 50 percent of the market as of 2003. The other routes of administration inhalation, transdermal, injection and implantation, and nasal delivery account for the remaining market share at 19 percent, 12 percent, 10 percent, and 7 percent, respectively. In the past 30 years, the field of drug deliveryhas been undergoing rapid development and has attracted attention from both academia and pharmaceutical industries. According to a recent report, the U.S. market alone for drug delivery is estimated at $43.7 billion in 2003 and is expected to grow more than 11 percent annually in the next five years [7].

Nanotechnology has played a large role in advancing the drug-delivery field by enhancing existing areas of small-molecule and protein delivery and by opening doors for delivery of new families of nucleic acid-based drugs. The ability to control the properties of nanoscale materials will continue to impact the pharmaceutical field by providing new technologies for improved drug delivery. We are optimistic that these developments will lead to delivery vehicles with high target specificity and with the ability to precisely control drug release.

4. Commercial Areas for Nano Science Technology

High surface-to-volume catalysts, which promote chemical reactions more efficiently, and selectively**;** ceramics, lighter-weight alloys, metal oxides and other metallic compound in coatings, paints, plastics, fillers, and food-packaging applications. Polymer–composite materials, including tires, with improved mechanical properties transparent composite materials, such as sunscreens containing nano size titanium dioxide and zinc oxide particles use in fuel cells, battery electrodes, communications applications, photo- graphic film developing, and gas sensors**.** nano-bar codes tips for scanning probe microscopes.

5. Ethical, Legal, and Societal Implications

In addition to the lingering environmental, health, and safety questions associated with nanotechnology, a wide-ranging array of ethical, legal, and societal questions also arise when on considers the wide-ranging nature of the many nanotechnology applications currently under development.

6. Conclusion

Science has vital role in human day-to day life. In 1980’s innovations of “Nano Science” in form of new arising technology, make enormous change in human life. This science technology made human health away from diseases and give remedies for improvable diseases and chronic diseases. Ultimately Science makes human life exultant.

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Int. Res. J. of Science & Engineering, Volume 11 (4) 2023
ISSN: 2322-0015

SJIF Impact Factor 6.70
https://doi.org/10.5281/zenodo.8350168

RESEARCH ARTICLE OPEN ACCESS

Antibacterial activity of different extracts of *Abrus precatorius* leaves against oral microflora to improve oral hygiene

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Manuscript Details

Received :22.07.2023
Accepted: 22.08.2023
Published: 24.08.2023

Available online on https://www.irjse.in
ISSN: 2322-0015

Cite this article as:

Diwan PD. Antibacterial activity of different extracts of *Abrus precatorius* leaves against oral microflora to improve oral hygiene, *Int. Res. Journal of Science & Engineering*, 2023, Volume 11(4): 187-190.
https://doi.org/10.5281/zenodo.8350168

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Abstract

Medicinal plants are part and parcel of human society to compact diseases from dawn of civilization. Herbs are considered to be food rather than medicine because they are complete, all natural and pure, as nature intended. Oral diseases are major health problem with dental caries. Oral health influence the general quality of life and poor oral health is linked to chronic conditions and systemic diseases. Effective antimicrobial agents against these oral pathogens could play an important part in the prevention of dental caries. Natural products have been used for thousands of years in folk medicine for several purposes including oral health care. Present investigation is focused on antibacterial activity of aqueous, petroleum ether, chloroform and acetone extract of leaves of *Abrus precatorius* (Family- Fabaceae) against seven bacterial species (*Lactobacillus rhamnosus, Staphylococcus aureus , Bacillus subtilis, Actinomyces viscoscus, Staphylococcus epidermidis, Escherichia coli , Streptococcus mutans*) which are known to cause oral diseases in human being. Antibacterial activity of the extracts was determined by paper disc diffusion method using 200mg/ml concentration of extract and there % zone of diffusion was calculated. Result showed that all the four extracts are equally effective at 5% level of significance. Test organism from the present study were found to be effected by all the four type of extract of *Abrus precatorius* leaves but pronounced inhibition for four extract was observed for bacterial species, *Lactobacillus rhamnosus*,. Aqueous extract was found to be more effective against the entire test microorganism.

Keywords: Oral micro-organisms, Antibacterial activity, *Abrus precatorius,* Oral diseases, Medicinal plants.

1. Introduction

Right from its beginning, the documentation of traditional knowledge, especially medicinal uses of plants, has provided many important drugs of modern day [1]. Investigation of traditional medicine is very important for the welfare of rural and tribal communities for treatment of conventional illness. This is due to the health care facilities in rural areas are inadequate and expensive too. Moreover, traditional medicine based on plants provides utmost rural or tribal healthcare, because 80% of the

raw materials used in the preparation of drugs is obtained from medicinal plants. A vast knowledge and venerable history of use of plants against different health problems has been known since antiquity. Alike different health illness, dental and oral diseases has becoming an alarming problems of the century. Poor hygiene, poor nutrition and smoking contribute to dental and oral problems. Due to colonization and accumulation of microorganism, oral diseases are included into a category of global infectious diseases. As most of the oral diseases are due to bacterial infections and it has been well documented that medicinal plants confer considerable antibacterial activity against various microorganisms including bacteria responsible for dental caries [2].

A few recent studies have documented antimicrobial activity against selected oral pathogen from natural resources. An antibacterial activity of *Myristica fragrans* against Oral Pathogens [3]. Similarly antibacterial activity of *Glycyrrhiza glabra* against oral pathogens was carried out and found effective results against oral pathogens [4]. An *in vitro study* evaluated antibacterial activity of different extract of *J. regia* against oral micro flora [5]. In vitro antibacterial activity of traditional medicinal plants from tribal regions against oral pathogen has also shown positive results [6].

Survey study of traditional ethnomedicinal plants used for oral health care by tribals of Melghat region. Dist. Amravati (M.S.) India has been carried out and found that *Abrus prcatorius* species is most predominantly used for oral care by tribal population [7]. In the present investigation antibacterial activity of *Abrus precatorius* (Family- Fabaceae) aqueous, pet ether, chloroform and acetone extract of leaves of was carried out against seven bacterial species which are known to cause oral diseases in human being. *Abrus prcatorius* commonly known as jequirity bean or rosary pea is an herbaceous flowering plant in the bean family Fabaceae. It is a slender, perennial climber with long, pinnate-leafleted leaves that twines around trees, shrubs, and hedges. The plant is best known for its seeds, which are used as beads and in percussion instruments. It is commonly called as *Gunj* in Marathi. Tribals of Melghat region use this plant species for medicinal purpose as well as food stuff.

2. Material and Method

2.1 Plant collection and identification

Fresh leaves of *Abrus precatorius* was collected from Amravati and Melghat region. Authentication and identification was performed at department of botany Govt. Vidarbha Institute of Science and Humanities, Amravati. Collected material was shade dried and stored into airtight container.

2.2 Preparation of extracts

Shade dried powdered extract of leaves was subjected to successive Sox let extraction using solvent of varying polarity such as water, petroleum ether, chloroform and acetone. After extraction solvent was removed under reduced pressure. Extracted material was stored in airtight container till use.

2.3 Test organism / Microbial flora

Seven lyophilized bacterial strains were procured from Institute of Microbial Technology (IMTECH), Microbial Type Culture Collection (MTCC) Chandigarh.

Table 1-List of Bacterial Strains

S.N.	Bacterial Strain	Gram +/- ve	MTCC Code	Growth Medium (Agar and Broth)	Incubation time in hours	Incubation Temp.
1	*Lactobacillus rhamnosus*	+ ve	*1408	MRS agar and broth	24-48	37°
2	*Streptococcus mutans*	+ ve	890	Brain Heart Infusion(BHI) agar and broth	48	37°
3	*Staphylococcus aureus*	+ ve	3408	Soyabene Casein Digest agar and broth	24	37°
4	*Actinomyces viscoscus*	+ ve	7345	Pikoskaya's agar	24	30°
5	*Staphylococcus epidermidis*	+ ve	3639	Nutrient agar and broth	24	30°
6	*Escherichia coli*	- ve	732	Nutrient agar and broth	24	37°
7	*Bacillus subtilis*	+ ve	3160	Nutrient agar and broth	24	30°

2.4 Antibacterial activity by disc diffusion assay

Antibacterial activity of 4 extracts i.e. aqueous, petroleum ether, chloroform and acetone were determine by paper disc diffusion method of Bauer**[8,9]** Sterilized Whatman filter paper no. 1 discs of 5 mm diameter were soaked in respective 200 mg/ml extract solution.0.2 ml inoculums of test organism was spread on surface of respective bacterial agar plates. Previously soaked discs were placed on surface of inoculated plates. Ciprofloxacin is used as positive control and water, DMSO was used as negative control. Bacterial plates were initially transferred to refrigerator for 40-45 min to allow diffusion and then transferred to incubator set at 37^0 c. and incubated for given incubation period. All the tests were performed in triplicates and under the sterile condition. Zone of inhibition in mm were measured from edge of disc after incubation.

2.5 Analysis of data

2.5.1 % Zone of inhibition

% Zone of inhibition of 4 extracts of plant *Abrus precatorius* leaves against seven bacterial strains were calculated by formula-

$$\%\,Zone\ of\ inhibition\ in\ mm = \frac{Zone\ of\ inhibition\ of\ experimental\ plant\ extract\ in\ mm}{Zone\ of\ inhibition\ of\ positive\ control\ (standard\ drug)\ in\ mm} X100$$

3. Result and Discussion

The results for zone of inhibition against test organisms (oral bacteria) were observed for all the four extracts of leaves of *Abrus precatorius* aqueous, pet. ether, chloroform and acetone extract). Percent zone of inhibition was calculated by comparing zone of inhibition of plant extract with the zone of inhibition of standard drug used. (Ciprofloxacin). Table 2 depicts the result of Zone of inhibition of 4 extract of *Abrus precatorius* leaves against test microorganisms. From the results, it is observed that aqueous extract showed maximum inhibitory action against the test microorganism i.e. 36.3% for *Lactobacillus rhamnosus*, 20% for against *Staphylococcus epidermidis,* 13.18 % for against *Streptococcus mutans,* 13.15% for *Escherichia coli* and 25.5% for *Staphylococcus aureus.* Although all test organism from the present study were found to be affected by the four types of extract of *Abrus precatorius* leaves but pronounced inhibition of all the extract was observed for bacterial species *Lactobacillus rhamnosus.* Minimum inhibitory action of all extracts was found against *Staphylococcus aureus* and no antibacterial effect was found against *Bacillus subtilis* and *Actinomyces viscoscus.*

Table 2- Zone of inhibition of 4 extract of *Abrusprcatorius*leaves against test microorganisms

Plant and control	*L.r*	*S.m*	*S.e*	*E.c*	*S.a*
Aqueous extract zone of inhibition in mm					
Abrus precatorius	7	2.5	4	5	5
Standard drug (Ciprofloxacin)	19.3	18	20	15.2	19.6
% zone of inhibition	36.3%	13.8%	20%	13.15%	25.5%
Petroleum extract zone of inhibition in mm					
Abrus precatorius	5	1.1	2.1	1	0.5
Standard drug (Ciprofloxacin)	25	13	12	20	12
% zone of inhibition	20%	8.46%	17.5%	5%	4.1%
Chloroform extract zone of inhibition in mm					
Abrus precatorius	2.1	1	2	1	0.5
Standard drug (Ciprofloxacin)	25	18	25	25	36
% zone of inhibition	8%	5.5%	8%	4%	1.3%
Acetone extract zone of inhibition in mm					
Abrus precatorius	3	1	2	0.7	0.3
Standard drug (Ciprofloxacin)	11	7	23	28	26
% zone of inhibition	27.2%	14.2%	8.6%	2.5%	1.1%

L.r- Lactobacillus rhamnosus, S.m-Streptococcus mutans, S.e- Staphylococcus epidermidis ,E.c- Escherichia coli, S.a- Staphylococcus aureus.

Despite the widespread use of toothbrushes and toothpastes, natural methods of tooth cleaning using chewing sticks selected and prepared from the twigs, stems or roots from a variety of plant species have been practiced for thousands of years in Asia, Africa, the Middle East and the Americas [10]. Natural products have been used for thousands of years in folk medicine for several purposes. As most of the oral diseases are due to bacterial infections and it has been well documented that medicinal plants confer considerable antibacterial activity against various microorganisms including bacteria responsible for dental caries [2]. An Assessment of phytochemical composition and antibacterial activity of different extracts of *Merremiaem argenata* leaves and *Barleria prionitis* against oral microflora to improve dental hygiene has been evaluated and they got a resistant activity [11,12].

In the present investigation four extract of *Abrus precatorius* has been screened for its antibacterial potential against seven strains of oral bacteria i.e *Lacto bacillus rhamnosus Streptococcus mutans*, *Staphylococcus aureus*, *Actinomyces viscoscus*, *Bacillus subtilis, Escherichia coli* and *Staphylococcus epidermidis* by disc diffusion method. Although test organism from the present study were found to be effected by all the four type of extract of *Abrus precatorius* leaves but pronounced inhibition for four extract was observed for bacterial species, *Lactobacillus rhamnosus*,. Aqueous extract was found to be more effective against the entire test microorganism.

4. Conclusion

This study has confirmed antimicrobial potential of the plant *Abrus precatorius*, thus supporting its folklore application as preventive remedy against oral microbial diseases. The present investigation is an attempt to give herbal products against the drugs used today.

Conflicts of interest: The author stated that no conflicts of interest.

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PUNE RESEARCH SCHOLAR ISSN 2455-314X
AN INTERNATIONAL MULTIDISCIPLINARY JOURNAL VOL-10, ISSUE

शास्त्रीय संगीत में बंदिश का महत्व

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सारांश :-

बंदिश कहने के बाद ख्याल ही बंदिश, बंदिश का मतलब है शब्द प्रधान बंदिश जिसे वाद्य यंत्रों के माध्यम से व्यक्त किया जाता है। बंदिश शास्त्रीय संगीत में लयबद्ध काव्य का एक रूप है, और बंदिश लयबद्ध गायन का एक रूप है। राग की मुद्रा भी अनेक सीमाओं से उभरती हुई दिखाई देती है। रमणलाल मेहता के अनुसार बंदिश राग का एक विशेष रूप है और राग का सौन्दर्य नये रूपों से निर्मित होता है। तो बंदिश रागके कई रूप दिखाने में काम आती है. मधनराव हळदनकर कहते है, "बंदिशों में सब कुछ शुरू से अंत तक महत्वपूर्ण और योजनाबद्ध है। बंदिशों के तार, उनके सुरों का खिंचाव, उनके खंड, बंदिशों के अंत की सुंदरता एक बंदिशी की पहचान है।

उद्देश :-

प्राचीन एवं मध्यकालीन गायन शैलियों के अन्तर्गत गीतियां, जातियां, प्रबन्ध तथा ध्रुपद आदि शैलिया भारतीय संगीत में अपना-अपना एक निजी इतिहास रखती है और शोध के अन्तर्गत भी यह सभी स्वयं में एक विस्तृत विषय हो सकती है। परन्तु उपरोक्त बिन्दु के अन्तर्गत इन सभी संगीत शैलियों अथवा प्रकारों का उपयोग बंदिश के संक्षिप्त इतिहास के अन्तर्गत यहां पर मात्र उदाहरण (बंदिश) के रूप में ही दिया जा रहा है। जिससे यह और भी

भलीभाँति स्पष्ट हो जाएगा कि प्राचीनकाल से वर्तमान समय तक बंदिश के स्वरूप में किस तरह से परिवर्तन आया है और संगीत में यह कितनी उपयोगी रही है।

प्रस्तावना :- बंदिश का अर्थ एवं परिभाषा – बंदिश का शाब्दिक अर्थ है-बंदिश (संज्ञा स्त्री) (1) बाँधने की क्रिया या भाव (2) पहले से किया हुआ प्रबन्ध (3) गीत, कविता आदि की शब्द योजना

बंदिश शब्द मूलत उर्दू भाषा का शब्द है, जिसका प्रयोग हिन्दुस्तानी संगीत विधाओं में निबद्ध रचनाओं के लिए होता है। भातखंडे जी ने अपनी क्रमिक पुस्तक मालिका में रागों की बंदिशों के लिए धीज शब्द का प्रयोग किया है।

धीज शब्द का अर्थ हिन्दी में इस प्रकार होता है- धीज (संज्ञा पु) (1) पदार्थ वस्तु द्रव्य (2) अलंकार, गहना (3) गीत

संक्षिप्त रूप में बंदिश का शाब्दिक अर्थ हुआ बाधना या कसना अर्थात विशिष्ट राग एवं विशिष्ट ताल में निबद्ध गीत या स्वर रचना ही बंदिश है। गायन-वादन की किसी भी विधा में बंदिश और गायन अथवा वादन शैली से दो चीजे मूलभूत आधार होती है। स्वर शब्द तालबद्ध पद रचना या गत रचना को बंदिश की संज्ञा दी जाती है और इस बंदिश के आधार पर प्रस्तुत की जाने वाली गायन-वादन क्रिया का विशेष ढंग या तरीका ही गायन-वादन शैली कहा जाता है।प्राचीनकाल से वर्तमान काल तक संगीत में बड़े क्रांतिकारी परिवर्तन हुए है। हिन्दुस्तानी संगीत में जहां नए-नए संगीत प्रकार प्रचार में आए हैं वहीं हिन्दुस्तानी शास्त्रीय संगीत के प्रधान तत्व राग के सम्बन्ध में भी अनेक क्रांतिकारी परिवर्तन हो रहे हैं। इसके परिणामस्वरूप ही राग संगीत की गीत रचनाओं पर भी सामाजिक प्रवृत्तियों, व्यवहार, आवश्यकताओं, विभिन्न भाषा एवं रीति-रिवाजों का समय के साथ-साथ गहरा प्रभाव पड़ता आया है।

भरत से पूर्व काल में वैदिक काल के ऋक, याणिक तथा गाथा जैसे गीतों के उपरांत मद्रक, अपरान्तक, उल्लोप्यक प्रकरी, ओवणक रोविन्दक, उत्तर और वर्धमानक सात गीतों के प्रचलन का उल्लेख प्राचीन ग्रन्थों में प्राप्त होता है। यह गीत स्वर तथा तालबद्ध थे। इन गीतों के विभागों अथवा खण्डों के लिए वस्तु की संज्ञा दी जाती थी।

भरत के बाद मतंग ने बृहददेशी में विभिन्न गीतियों में गाए गये ग्राम रागों का वर्णन किया है। यह गीतियां पद और लय से युक्त वर्ण, अलंकार आदि से सुसज्जित थीं। इन गीतियों के विभिन्न प्रकार बताएं है।

प्राचीनकाल से वर्तमान काल तक भारतीय संगीत बदला है संगीत से सम्बन्धित शैलियां बदली है तथा शैलियों से सम्बन्धित संगीत रचनाओं में बहुत बदलाव आया है। संगीत रचनाओं (बंदिशों में बदलाव का एक मुख्य कारण भाषा भी रहा है। प्राचीन व मध्य समय में प्राधान्य तो संस्कृत भाषा का था किन्तु देशी भाषाओं में भी रचनाएं हुई। आधुनिक रचनाओं में तो जनसाधारण से सम्बन्धित भाषाओं जैसे-भोजपुरी, बृज, पंजाबी, हिन्दी आदि सभी भाषाओं में संगीत रचनाएं अथवा बंदिश प्राप्त होती हैं।

आधुनिक रागदारी संगीत में स्थायी अन्तरा आलाप लयकारी तथा तान एक राग बंदिश के मुख्य तत्व होते हैं। इनमें से आलाप लयकारी व तान में गायक अथवा वादक को अपने-अपने इस शैलियों के अनुसार राग के नियमों में रहकर विविधता, सृजनात्मकता तथा बढ़त करने की पूर्ण स्वतंत्रता प्राप्त होती है।

ख्याल गायन में बंदिश के घटकों या भागों के अन्तर्गत दो भाग होते है-स्थायी और अन्तरा। स्थायी में राग के मन्द्र व मध्य सप्तक के स्वरों में बढत करते हुए विस्तार होता है। दूसरे भाग अन्तरे में राग के मध्य और तार सप्तकके स्वरोंका विस्तार किया जाता है। परन्तु बढत प्रारम्भ करने से पहले अधिकतर पूरी बंदिश गाई जाती (1) बंदिश का मुखड़ा ताल का सम दिखाते हुए तालका सन्दर्भ स्थान प्रकट करता है। इसके अलावा बंदिश का मुखडा राग-विस्तार का पूरक होना चाहिए।

इस प्रकार 20वीं शताब्दी में भारत की स्वतंत्रता के पश्चात् शिक्षा एवं प्रचार-प्रसार के साधनों में क्रांतिकारी परिवर्तनों एवं सरकारी प्रोत्साहन के कारण संगीतज्ञों के आपसी सम्पर्क बढे और उनकी संगीत सृजन क्षमता में भी काफी समृद्धि हुई, एक नई स्फूर्ति जागी। जिसके फलस्वरूप पारम्परिक संगीत रचनाओ मे सुधार हुआ और नही संगीत रचनाओ को रचने की प्रेरणा व प्रोत्साहन मिला

PUNE RESEARCH SCHOLAR ISSN 2455-314X
AN INTERNATIONAL MULTIDISCIPLINARY JOURNAL VOL 10, ISSUE

परम्परागत बंदिशों में परिवर्तन :-

सदारंग, अदारंग, मनरंग, हररंग आदि वाग्यकारो की बंदीशे आज परंपरागत बंदिशों के रूप में प्रचलित है। लगभग 100-200 साल पुरानी इन बंदिशो पर समय-समय पर विभिन्न घरानो का प्रभाव पड़ता रहा है। जिस कारण अलग-अलग घरानों मे गायकों ने उन्हें अपनी घरानेदार गायकी के अनुरूप गाया। इस वजह से प्रत्येक घराने मे बंदिश प्रस्तुतिकरण भिन्न हो गया और प्रत्येक आलाप लयकारी, तानकारी तथा गायकी के वजन में भी भिन्नता आ गई। इसके परिणामस्वरूप विविध घरानों मे बंदिश के स्वरूप मे काफी परिवर्तन हो गया।

बंदिश का रूप :-

संगीत मे मुख्यतः विशेष प्रकार की रचनाओं के क्रम मे जो विलक्षणता रहती है वह प्रायः सांगीतिक कलाकृति का मूल है। जैसे भक्ति संगीत की रचना से उत्पन्न भक्ति रस उस रचना की विलक्षणता है अथवा विचित्रता है और इसी तरह विवाहोत्सव पर अथवा पुत्र जन्म पर बजाई जाने वाली धुनों से उत्पन्न शृंगार रस उन रचनाओं की विचित्रता है जिनमे संगीत के विभिन्न रूपों के दर्शन होते हैं। इसी तरह शास्त्रीय संगीत मे मसीतखानी व रज़ाखानी गतोद्वारा और विलम्बित ख्याल अथवा बड़ा ख्याल और द्रुत अथवा छोटा ख्याल द्वारा राग का रूप प्रदर्शित किया जाता है। प्रस्तुत उदाहरण शास्त्रीय संगीत मे निहित बंदिश के वादन व गायन स्वरूपों को परलक्षित करते हैं

तबले के प्रमुख घरानों में प्रयुक्त होने वाली बंदीशोका विवरण :-

आज यह समस्या हमारे तबला वादको तथा विद्यार्थियों के सम्मुख हमेशा समस्या खडी रहती है कि कौन सी बंदिश किस घराने से सम्बद्ध रखती है। तथा किस घराने मे किन-किन बंदीशोका वादन किया जाता है इस समस्या का एक कारण तो यह है कि आज तबला वादन कोई एक किसी एक घराने का वादन किसी एक समय करते नही देखे जाते हैं। वे प्रायः अपने वादन मे लोकप्रियता प्राप्त करने हेतु विभिन्न घरानों की बंदीशो का प्रयोग एक साथ करते देखे जाते हैं जिसमे यह समस्या और भी अधिक जटिल हो जाती है। इस प्रकार देखे तो आज घरानेदार तबलावादक घराने की शुद्धता का कड़ाई से पालन नही करते हैं। ऐसे मे तबला विद्यार्थियों तथा साधारण जनमानस को तबला विषय की थोड़ी जानकारी रखते हैं।

OL 10, ISSUE 2 www.puneresearch.com/scholar APR to MAY 202
IMPACT FACTOR 4.15 (CIIF) INDEXED, PEER-REVIEWED / REFEREED INTERNATIONAL...

के लिए यह ज्ञात करना काफी कठिन हो जाता है कि कौन सी बंदिशे किस घराने के वादन मे प्रयुक्त की जाती है।

निष्कर्ष :-

यह बात भी सत्य है कि बंदिश रचना हरेक की बश की बात नहीं होती। इसके लिए स्वाभाविक प्रतिभा व सृजनात्मकता की निरंतरता के साथ-साथ रचनाकर्ता को संगीत शास्त्र के साथ-साथ काव्य व साहित्य का भी अच्छा ज्ञान होना जरूरी है। पर बंदिश निर्माण के कोई नियम पहले से निश्चित नहीं होने चाहिए। क्योंकि कभी-कभी कोई स्वर-संगत अथवा स्वर-समूह पहले मन में गूँजता है, बाद में उस पर शब्द बिठाये जाते हैं। कभी पहले ही शब्द रचना होती है और बाद में उसे स्वरों में बैठाया जाता है। कभी-कभी पुरानी किसी बंदिश के आधार पर ही नई बंदिश बना दी जाती है।बंदिश के बारे मे उपरोक्त सभी टिपणिया यह सिद्ध करती है कि बंदिश ये शास्त्रीय संगीत मे महत्वपूर्ण घटक है।

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2) सांगीतिक बंदिश रचना,सिद्धांत एवं स्वरूप लेखक :-डॉ. सीमा शर्मा कनिष्क पब्लिशर्स, नई दिल्ली

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6) संगीत चिंतन , लेखक :-डॉ.भोजराज चौधरी ,नभ प्रकाशन

ISSN 2319 - 359X

AN INTERNATIONAL MULTIDISCIPLINARY
HALF YEARLY RESEARCH JOURNAL

IDEAL

Volume - XII Issue - II March - August - 2024

HINDI PART - I

Peer Reviewed Referred and
UGC Listed Journal No. 47026

Single Blind Review/Double Blind Review

ज्ञान-विज्ञान विमुक्तये

IMPACT FACTOR / INDEXING
2023 - 7.537
www.sjifactor.com

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❖ PUBLISHED BY ❖

Ajanta Prakashan

CONTENTS OF HINDI PART - I

VOLUME - XII, ISSUE - II - MARCH - AUGUST - 2024
IDEAL - ISSN - 2319 - 359X - IMPACT FACTOR - 7.537 (www.sjifactor.com) CC - 5

३२. जीवन में संगीत का महत्त्व

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पं. डी. पाटील सांगुळदकर महाविद्यालय, दर्यापूर ।

सारांश

संगीत एक ऐसी आकर्षक कला है जो अनादिकाल से ही आकर्षण का केन्द्र-बिन्दु बन चुकी थी, जब आदि मानव को भाषा का भी उचित प्रयोग करना नहीं आया था । "प्रागैतिहासिक काल में संगीत का अस्तित्व उपलब्ध होता है। हड़प्पा के उत्खननों में नृत्यरत पुरुष की खंडित मूर्ति उपलब्ध हुई है। ऐसी मूर्तियों का निर्माण संगीत प्रिय सभ्यता के अंतर्गत ही हो सकता है।"

संगीत की उत्पत्ति तथा विकास कुछ वर्षों में या किसी एक व्यक्ति के द्वारा नहीं हुआ। संगीत का जो विकसित रूप वर्तमान में हमारे सम्मुख आया है, वह अनेक आयामों से गुजरा है ।

संगीत की उत्पत्ति सृष्टि के साथ हुई । सत्, चित्, आनंद स्वरूप ब्रह्मा ने अपने त्रिगुणात्मिका प्रकृति के द्वारा इस संसार की रचना की । संगीत की उत्पत्ति के विषय में जो अभिमत प्राप्त होते हैं, वे प्रायः धार्मिक हैं अथवा किंवदन्तियों पर आधारित भारतीय परम्परानुसार संगीत का संबंध वेदों से मान्य है । वेद का बीज मंत्र है 'ओउम्' । ओउम् के तीन अक्षर अ, उ और म तीन ईश्वरीय शक्ति के द्योतक है।

- अ-ब्रह्मा की शक्ति का द्योतक है ।
- उ-विष्णु की शक्ति का द्योतक है ।
- म-महेश की शक्ति का द्योतक है ।

ब्रह्म आनंदस्वरूप है । इस आनंद तत्व से ही संगीत शब्द की उत्पत्ति हुई । अपने सर्वप्रथम अपने को तीन रूपों में प्रकट किया ब्रह्मा, विष्णु और महेश। इन तीनों ने क्रमशः सरस्वती, लक्ष्मी व काली इन शक्तियों से इस सत्, चित्, आनंदमय विश्व की उत्पत्ति की इन त्रिशक्तियों का पुंज ही त्रिमूर्ती परमेश्वर है ।इन तीन अक्षरों के संयोग से 'ओउम्' शब्द निर्मित हुआ है। शब्द और स्वर की उत्पत्ति ओउ के गर्भ से हुई है। 'ओउम्' शब्द ही संगीत का जनक है। समस्त कलाएँ ओउ में ही निहित हैं। तीन शक्तियों के आधार पर ही 'ओउम्' शब्द में स्वर, लय व ताल का समावेश है जो कि हमारे संपूर्ण संगीत का आधार है। ब्रह्मा के चार मुख थे। चारों मुखों से उन्होंने चार वेदों की उत्पत्ति की-ऋग्वेद, यजुर्वेद, अथर्ववेद व सामवेद ।

ऐतिहासिक आधार पर संगीत का उद्गम स्थल सामवेद माना जाता है । सामवेद के समस्त मंत्र गेय हैं। सामवेदीय गेय पद उदात्त, अनुदात्त और स्वरित-इन तीन स्वरों में गाए जाते हैं। इन तीनों स्वरों में से सा, रे, ग, म, प, ध, नि सातों स्वर का समावेश है ।

उदात्ते निषादगान्धारावनुदात्ते ऋषभधैवतौ । स्वरिते प्रभवाह्येते षड्जमध्यमपंचमाः ॥

सामवेद के भाष्यकारों ने उन सात स्वरों का नामकरण किया और उनकी उत्पत्ति तथा विकास के विषय में अनुसंधान किया। वैदिक काल से संगीत का विकास होते गया और भिन्न-भिन्न देश तथा काल के परिवर्तन के फलस्वरूप लोगों की रुचि में परिवर्तन हुआ और इसी प्रकार संगीत का क्षेत्र धीरे-धीरे विकसित होता गया।

उद्देश

संगीत एक कला है जो सार्वदेशिक है। यह आंतरिक मनोभावों की अभिव्यक्ति है और इसीलिए प्रत्येक प्राणी मात्र को सुख देने वाली है। वस्तुतः संगीत मानव समाज के लिए वरदान है। जिससे शांति मिलती है। संगीत मानव के मस्तिष्क की खुराक है और जब मनुष्य को भूख होती है तो वह प्रसन्न होता है। उसी प्रकार जिस प्रकार भोजन से उदर भरे होने पर मनुष्य प्रसन्न होता है। इस संगीत से मानव जीवन में खुशहाली का संचार होता है। संगीत जब ऐसी सुसंस्कृत कला है तो इसको विद्यालयों में अन्य विषयों जैसा सम्मान मिलना चाहिए। परंतु ऐसा नहीं है, फिर भी जिन विद्यालयों में संगीत है वहां के शिक्षक अपनी ओर से इस विषय को सर्वप्रिय बनाने की चेष्टा अवश्य करते हैं और अपने भरसक प्रयत्न से इसे लोकप्रिय और सर्वसाधारण तक पहुंचाने की चेष्टा भी करते हैं। अपने संगीत को प्रशंसनीय बनाने में कोई कसर नहीं छोड़ते। इसके अतिरिक्त अनजाने में ही वह संगीत द्वारा बच्चों में परस्पर प्रेम भावना पैदा कर देते हैं। आपस में मिलकर कार्य करने की प्रवृत्ति जगा देते हैं। पाठशाला में सबसे प्रथम प्रार्थना से सभी कार्य आरम्भ होते हैं।

प्रस्तावना

मनुष्य के जन्म से मृत्यु तक सभी अवसरों पर संगीत का सहयोग सर्वमान्य है। प्राचीन काल से ही संगीत को समाजजीवन में महत्वपूर्ण स्थान प्राप्त हुआ है। मनुष्य की बाल्यावस्था से ही आपर किए गए संगीत के संस्कार उसे एक सक्षम तथा संवेदनशील नागरिक बनाने अपूर्व योगदान देते हैं। भारत के किसी भी प्रदेश की एक भी ऐसी संस्कृति नहीं है, जिसमें संगीत ना हो। संगीत मनुष्य के मनोमस्तिष्क पर गहरा असर करता है। भावनाओं की अभिव्यक्ति में संगीत अत्यंत सहायकारी होता है। जिन भावनाओं को शब्दों द्वारा प्रकट करना संभव नहीं है, उन्हें संगीत के माध्यम से पहुंचाना और समझना आसान होता है। व्यक्तित्व विकास में भी संगीत अहम भूमिका निभाता है। किसी भी व्यक्ति का आत्मिक, मानसिक, भावनिक विकास करने की क्षमता संगीत में है। यह बात केवल अपने देश तक ही नहीं अपितु संपूर्ण विश्व में वैज्ञानिक आधार पर स्वीकार की गयी है। यही कारण है की सभी ने बालविकास के लिए संगीत को एक आदर्श माध्यम माना है।[५]

किसी भी बालक का व्यक्तित्व संवर्धन उसके शालेय जीवन में हुए संस्कारों के आधार पर होता है, जहाँ संगीत की महत्वपूर्ण भूमिका दिखाई देती है। संगीत का अभ्यास करते करते उस प्रक्रिया में अन्य सामाजिक शिष्टाचार भी बालक आत्मसात करता है। संगीत एवं मन का संबंध अटूट है। संगीत द्वारा बालक भावप्रेरित होकर अपनी भावनाओं को अभिव्यक्त करना सीखता है। स्वामी प्रज्ञानानंद के अनुसार स्व का अर्थ है स्वत्व और र से तात्पर्य है, आनंद सेना। मनोवैज्ञानिक दृष्टिकोण से संगीत के प्रशिक्षण द्वारा विद्यार्थी की जिज्ञासा, एकाग्रता, एकात्मता, स्मृति कल्पना, अभ्यास सृजनशीलता आदि विकासात्मक घटकों में वृद्धि होती है। बुद्धिमत्ता वर्धन,

चारित्र में सुधार आदि परिणाम भी प्राप्त होते है। संगीत बालक के ध्वनि संवेदनाओं में सुधार लाता है। बाल्यावस्था में ही इस प्रकार कला प्रशिक्षण द्वारा बालक में आंतरिक संतुलन एवं सुसंगत व्यक्तित्व की निर्मिति होती है।

संगीत के स्वरों में ऐसी शक्ति है कि नवजात शिशु भी इसके परिणाम से दूर नहीं रह पाते। इन शिशुओं को सुलाते समय जब माँ लोरी गाते हुए उनकी पीठ थपथपाती है, उसी समय से इन शिशुओं को लय, ताल, स्वर के संस्कार शुरू होते है। आगे चलकर जब बच्चा बोलने लगता है, तब श्लोक, बाल कविताएँ, आरती आदि के रूप में इन संस्कारों को अधिक दृढ़ किया जाता है। बालक के शैक्षिक काल में भी संगीत की संगति बराबर रहती है। देश के अधिकतर स्कूलों में संगीत विषय प्राथमिक तथा माध्यमिक स्तर की पाठशालाओं में सिखाया जाता है। सन 2020 में घोषित नयी शिक्षा नीति के अंतर्गत तो संगीत तथा अन्य कलाओं का अभ्यास इन स्तरों पर अनिवार्य किया गया है। भारतीय कलाओं का बाल विकास में महत्व इसी से सिद्ध होता है।मनुष्य एक सामाजिक प्राणी है। प्रकृति से उसे बुद्धिमत्ता का वरदान मिला है। बुद्धिमत्ता के साथ-साथ भावना, विचार प्रेम वात्सल्य अभिव्यक्ति जैसी शक्तियाँ भी उसे प्राप्त है। अन्न, वस्त्र तथा रहने के लिए घर जैसी मूलभूत आवश्यकता की प्राप्ति एवं पूर्ति हेतु मनुष्य मनुष्य का आपसी संबंध स्थापित होता है और समाज का निर्माण होता है।

विभिन्न प्रकार के संगीत का हमारे मन पर विभिन्न परिणाम होता है और इन परिणामों के अंतर्गत मानसिक तथा शारीरिक गतिविधियों में भी परिवर्तन होता है। व्यक्ति के जीवन में जितना महत्व शारीरिक स्वास्थ्य का है, उतना ही महत्व मानसिक स्वास्थ्य का भी है। व्यक्ति के समग्र जीवन में विभिन्न क्षेत्रों में उसके समायोजन पर मानसिक स्वास्थ्य का प्रभाव पड़ता है। किसी भी प्रकार के मानसिक विकारों से ग्रित व्यक्ति अपने दैनिक जीवन की विभिन्न परिस्थितियों के समायोजन में कठिनाइयों का अनुभव महसूस करते हैं। आज के मुस्किलों एवं कठिनाइयों से भरे जीवन में शारीरिक और मानसिक रूप से स्वस्थ व्यक्ति ही सफलता को हासिल करता है। इसलिए मानव[01]

जीवन में शारीरिक स्वास्थ्य के साथ-साथ मानसिक स्वास्थ्य पर ध्यान देना भी आवश्यक है। मानसिक रूप से अस्वस्थ व्यक्ति न केवल स्वत को परंतु उससे जुड़े प्रत्येक व्यक्ति एवं समाज के लिये परेशानी उत्पन्न करता है।

मनोवैज्ञानिक रूप से मानसिक स्वास्थ्य यह एक अत्यंत गहन विषय है। इसमें मूलभूत घटकों में व्यवहारात्मक, संज्ञात्मक और मनोगत्यात्मक घटकों का समावेश होता है। इनमें से प्रत्येक घटक दूसरों के साथ संबद्ध और उन्हें प्रभावित करते है। मानसिक स्वास्थ्य के अन्तर्गत वर्तन, व्याधि तनाव, निराशा जैसी विभिन्न समस्याओं का समावेश होता है।

संगीत न केवल मनोरंजन तथा आनंदप्राप्ति देता है अपितु मानसिक स्वास्थ्य के लिए एक महत्वपूर्ण साधन है। ध्वनियों मानसिक स्थितियों की सूचक होती है। विभिन्न ध्वनियाँ हमारे मनोभावों को भी प्रभावित करती है। जिसके कारण संगीत सुनते समय हमारे मस्तिष्क में विभिन्न भावों का निर्माण होता है। इसी का आधार लेकर मनोविज्ञान में मानसिक स्वास्थ्य तथा रोगों के इलाज के लिये संगीत का उपयोग किया जाता है। जिसे संगीत चिकित्सा या Music Therapy कहा जाता है। तनावपूर्ण स्थिति का मुख्य कारण अत्यंत गतिशील जीवन प्रणाली है। और इसका सामना करने में और मन को तनाव मुक्त करने में कई माध्यम जैसे-योग, ध्यान, हास्य

चिकित्सा आदि का उपयोग हम सरलता से कर सकते हैं। संगीत का माध्यम के रूप में प्रयोग कई रूप से किया जा सकता है। जैसे-संगीत का अभ्यास, नृत्य के रूप में संगीत का उपयोग, प्रवास को तनाव मुक्त बनाने में संगीत का उपयोग महत्वपूर्ण है। शारीरिक कसरत या कवाब के समय शारीरिक तनाव की स्थिति में संगीत का उपयोग तनाव मुक्ति में सहायरूप होता है। ध्यान तथा योग क्रिया के समय धीमी आवाज में संगीत का प्रयोग काफी फायदेमंद होता है। क्योंकि संगीत ध्यान के समय अन्य आकर्षित करनेवाले तत्वों से दूर रखता है। कार्यक्षेत्र पर धीमा संगीत रखने पर वातावरण में तनाव का प्रभाव कम लगता है। काम में स्फूर्ति आती है। इसका उपयोग हम स्कूल में तथा परीक्षा केन्द्रों में भी कर सकते हैं। इस प्रकार हमारी सर्वसामान्य दिनचर्या में विभिन्न तनावपूर्ण स्थिति में संगीत का प्रयोग विभिन्न रूप से किया जा सकता है. जिसकी परिणाम स्वरूप मानसिक स्वास्थ्य पूर्वी सकारात्मक प्रभाव पड़ता है।साधारण रूप से संगीत के माध्यम से हम मन की कई नकारात्मक तथा अनावश्यक परिस्थितियों को सुधार सकते है। संगीत कई रूप से मनुष्य शरीर तथा मन को उभारने में उपयोगी होता है।

प्रयोगों से यह सिद्ध हुआ है, की संगीत के उपयोग से विविध बीमारीयों का इलाज भी संभव है। तनावपूर्ण स्थिति में रुचि अनुरुप संगीत का आधार लेने से उस परिस्थिति में तनाव या दबाव कम हो जाता है। शारीरिक पीड़ा या दर्द को कम करने के लिए संगीत की सहायता ली जाती है। जैसे-कई अस्पतालों में शल्यक्रिया के समय पीछे धीमी आवाज में संगीत बजाया जाता है। भावाभिव्यक्ति में संगीत का उपयोग सर्वाधिक है। स्मरण शक्ति बढ़ाने में संगीत का उपयोग होता है। विभिन्न प्रयोगों से यह सिद्ध हुआ है कि, संगीत के द्वारा छोटे बच्चे जिनको शैक्षिक अभ्यास याद रखने में कठिनाई होती थी, उनको काफी फायदा हुआ है। व्यवहार तथा बातचीत में आने वाली कठिनाईयो को संगीत के द्वारा दूर किया जा सकता है। संगीत के माध्यम से शैक्षणिक उद्देश्यों को भी साकार किया जा सकता है। जैसे, अन्य विषयों के साथ इसे जोड़ कर विभिन्न संकल्पनाओं में संगीत का उपयोग कर उसे बच्चों को सिखाना। इस प्रकार सर्वसाधारण रूप से मानसिक-शारीरिक क्रिया तथा व्याधियों में संगीत के प्रयोग से सकारात्मक परिणाम मिलते है।

निष्कर्ष

मानसिक व्याधि जैसे तनाव, निराशा, मानसिक रोगी टि पागलपन इत्यादि में संगीत एक महत्वपूर्ण माध्यम का काम करता है। शास्त्रीय संगीत के विभिन्न रागों के प्रयोगों से शारीरिक बीमारी जैस हृदय विकार, रक्तचाप, कैंसर, शारीरिक पीड़ा में प्रभाव पड़ता है। विशेष प्रकार के वाद्यों की ध्वनि का प्रभाव भी मानसिक बीमारियों को काबू में लाने के लिए किया जाता है।

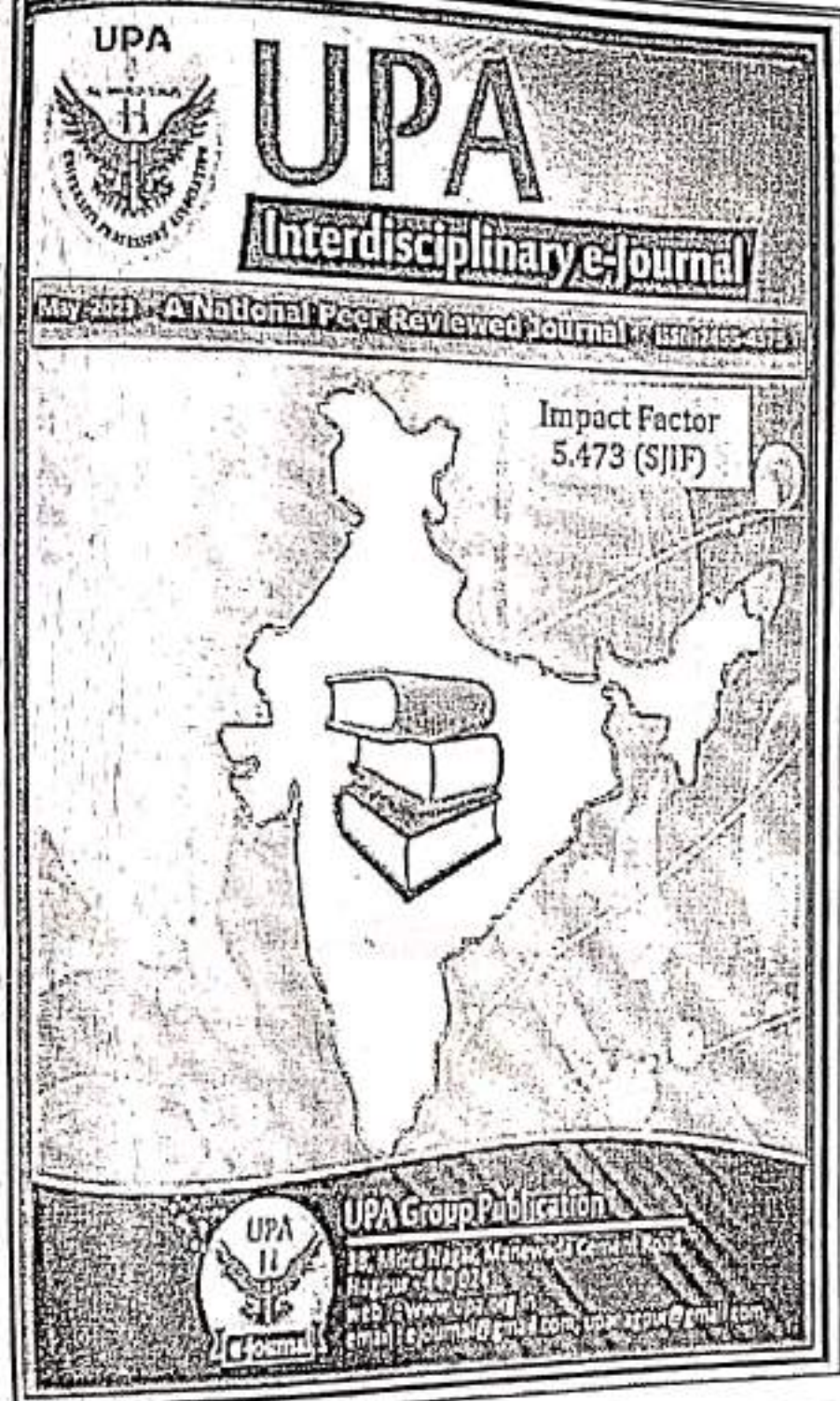
तनावपूर्ण स्थिति का मुख्य कारण अत्यंत गतिशील जीवन प्रणाली है। और इसका सामना करने में और मन को तनाव मुक्त करने में कई माध्यम जैसे-योग, ध्यान, हास्य चिकित्सा आदि का उपयोग हम सरलता से कर सकते हैं। संगीत का माध्यम के रूप में प्रयोग काफी रूप से किया जा सकता है।मनुष्य की अभिव्यक्ति के लिए संगीत एक शक्तिशाली माध्यम है। आनंदप्राप्ति के साथ-साथ संगीत का विविध स्तर पर मानवीय मन का गहरा प्रभाव पड़ता है। मानसिक स्वास्थ्य यह वर्तमान समय में व्याधिग्रस्त की सबसे बड़ी समस्या है। मानसिक स्वास्थ्य के अंतर्गत व के कारण रक्तचाप, चिड़चिड़ापन अनिद्रा जैसी अनेक बीमारियों का प्रभाव बढ़ना यह

सामान्य हो गया है। ऐसी परिस्थिति में संगीत का आयोग तनाव मुक्ति हेतु करना यह अत्यंत उपयुक्त बात है। क्योंकि संगीत सर्वव्यापी है और अत्यंत सरलता से उपलब्ध भी हो जाता है।

यह जीवन मे संगीत का महत्त्व है।

संदर्भ सूची

1. भारतीय संगीत की परंपरा वंशानुक्रम एवं वातावरण -लेखक डॉक्टर हरी बिलास गोस्वामी, कनिष्क पब्लिशर्स डिस्ट्रीब्युटर्स नई दिल्ली।
2. राष्ट्रीय एकता मे संगीत की भूमिका लेखक -डॉ.सत्या भार्गव, संजय प्रकाशन नई दिल्ली।
3. संगीत विविधा संगीत विषयक निबंधो का संग्रह लेखक डॉ. अनया खते डॉ.विजय पटेल, कनिष्क पब्लिशिंग हाऊस नई दिल्ली।



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PUBLISHED BY :
UPA Group Publication In Association with University Professors' Association. 38, Mitra Nagar, Manewada Cement Road, Nagpur-24.

CORPORATE OFFICE:
38, Mitra Nagar, Manewada Cement Road, Nagpur-24.

PUBLICATION :
The UPA Interdisciplinary e-Journal is published Bi-annually.

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UPA National Peer-Reviewed Interdisciplinary e-Journal

Published By

UPA Group Publication

In Association With

University Professors' Association

Volume-9 : Issue-1 (May-2023)

IMPACT FACTOR 5.473(SJIF)

UPA NATIONAL E-JOURNAL
Interdisciplinary Peer-Reviewed Journal

ISSN 2455-4375

प्राचीन व आधुनिक विश्वविद्यालयीन शिक्षण पद्धती

डॉ. वृषाली देशमुख
जे.डी.पाटील सांगळूदकर महाविद्यालय, दर्यापूर.

सारांश:-

आधुनिक काल मी संगीत शिक्षा का एक अभिन्न विषय बन चुका है| शिक्षा मानव की सर्वांगीन विकास के लिए एक अविच्छिन्न भावात्मक सत्ता है, जिसके प्रभाव में मनुष्य के मन की कल्पना आहे अथवा उदार तम भाव नाही न तो प्रस्फुटित होती है और नही मनुष्य की कलात्मक आकांक्षा हो की तृप्ती हो सकती है|संगीत अन्य ललित कलाओं की अपेक्षा मानव समाज की कलात्मक उपलब्ध येऊ व सांस्कृतिक परम्पराओं का मूर्तिमान प्रतीक है|यह मानव की आरंम्भीक काल सेही जनजीवन की आत्मिक उल्लास और सुखानुभूतियों की ललित अभिव्यक्ती का मधुर उत्तम माध्यम रहा है|इतना ही नही दुःख के समय भी संगीत मनुष्य का साथ नही छोडता अंतः संगीत जैसे सर्वात उत्कृष्ट कला जो मानव जीवन के इतना समिप है और जीवन में महत्वपूर्ण स्थान रखते है |उसकी शिक्षा प्राप्त करना अतिआवश्यक हो जाती है|

इस महत्व को स्वीकार करते हुए ही शिक्षण विषयों में इसे शिक्षण विश्व मे एक विषय की रूप मे स्वीकार किया है|19वी शताब्दी के अंतिम चरण में श्रद्धेय विष्णूद्वय के अथक प्रयत्न द्वारा संगीत का संस्थागत शिक्षण प्रारम्भ हुआ इन दोनो संगीत धारो को संगीत को शिक्षा के क्षेत्र में पदार्पण करवाया अनेक संगीत संमेलन संगीत सभाओं का आयोजन करवाया जिसे संगीत साधारण जनसमुदाय तक पोहोच सके|विभिन्न स्तर उपर संगीत की विषय वस्तू मे अंतर होता है प्रायमरी स्तर पर संगीत स्वतंत्र विषय कि रूप मे नही है तथापी यहा संगीत शिक्षण विधी को स्थान दिया गया है|बीस वी शताब्दी के पूर्वार्ध में अनेक विद्वान कलाकार हुई रचनात्मक कार्य व शिक्षण पद्धतीचे संगीत शिक्षण के विकास मे सहायता मिली

सन1947 के पश्चात हमारे समाज मे सांस्कृतिक विकास के प्रति जागरूकता उत्पन्न हूई और जैसे जैसे साधारण जन समुदाय मे यह भावना प्रबळ होती गई जैसे -जैसे भारत सरकारने भी अपना यह उत्तरदायित्व समजा की विद्यालयीन स्तर पर भारतीय कला व संस्कृती का विकास करना आवश्यक है| सन 1949 मी अर्थात स्वतंत्रता प्राप्ति की दु वर्ष उपरांत भारतीय सरकारने सामान्य शिक्षण मे ललित कला ओके महत्त्व को पूर्णतः स्वीकार किया और सामान्य पाठ्यक्रम ललित कला व संबंधित करने के लिए गंभीरता पूर्वक विचार करने लगी|

उद्देश:-

20 वी शताब्दी मी भारतीय सरकारने ललित कलाओं के विकास हेतू सराहनीय प्रयास किए आकाशवाणी दूरदर्शन संगीत नाटक अकादमी की स्थापना एवं अपने देश के विभिन्न राज्यों में व विदेशी के सांस्कृतिक आदानप्रदान संबंधी कार्यक्रम का आयोजन कर तथा लोकसंगीत व लोक कलावो को विभिन्न प्रकारसे प्रोत्साहन देकर हमारी सरकारने संगीत शिक्षा का विस्तार कर दिया है|अनेक विश्व विद्यालय मे संगीत पर शोध कार्य भी हो रहे है|वर्तमान संगीत शिक्षण की कुछ उपलब्धिया संगीत सर्वजण सुलभ हो गया है |पहिली गुरु शिष्य परंपरा मे संगीत

शिक्षा देने के लिए गुरु गण सरलता से तयार नही होते थे आधुनिक विश्वविद्यालय शिक्षण पद्धतीने बहुत सुधार आये है| प्राचीन व आधुनिक विश्वविद्यालय शिक्षण पद्धतीमे कौन सी शिक्षण पद्धती ज्यादा महत्वपूर्ण है यही उद्देश इस विषय का है|

प्रस्तावना:-

आज संगीत विद्यालयों महाविद्यालयों या विश्व विद्यालयों में दि संगीत शिक्षण की व्यवस्था है | प्राचीन कालमे संगीत की शिक्षा गुरू या उस्ताद द्वारा दी जाती थी परंतु आज कल गुरु शिष्य परंपरा तो समाप्त होती जा रही है |कला पद्धती काही प्रचार दिखाई दे रहा है |संगीत शिक्षा की सभी संस्थांनो शासकीय अथवा व अशासकीय महाविद्यालय सभी मे संगीत के सामूहिक शिक्षण की व्यवस्था है |संगीत शिक्षण की नूतन परीपाटी का आरंभ यशस्वी उन्नसवीशती मे हुआ हैं |

आधुनिक समय मे संगीत शिक्षा का व्यापक प्रचार हुआ है |तथा संगीत शिक्षालयो जैसे प्रयाग संगीत समिती अखिल भारतीय गांधर्व महाविद्यालय मंडळ इंदिरा ,कला संगीत विश्वविद्यालय मंडळ इंदिरा कला संगीत विश्वविद्यालय आधी के द्वारा संगीत की विशेष अध्ययन और शिक्षण के लिए न्यूज पाठ्यक्रम का निर्माण किया गया है|

आज देश मे अनेक छोटी बडी संगीत संस्था ये है |परंतु इन संस्थाओं के संस्थापक अपने अधिपत्य को दरिद्र की कोडी जैसे संभाल कर जीस प्रकार रख रहे है| पंडित भातखंडे जैसे अनेक विद्वान भी ऐसा करते तो जो तत्कालीन उपलब्ध कराया गया हजारो परंपरागत बंदिशी को प्राप्त करके मुद्रित रूप मे जन जन के लिए उपलब्ध कराया गया, नवीन विद्यालय इन संगीत शिक्षक व परीक्षापद्धती की स्थापना करते हुए उसकी पाठ्यक्रम के अनुसार व्यवस्थित संगीत शिक्षण की परीपाटी चलाई गई साथी कार्य संभव न होते वर्तमान परिस्थिती में हम सोचने के लिये बाद्य हो रहे है की पंडित भातखंडे जिने जिन उद्देशोओ को लेकर शिक्षा लाईन संगीत शिक्षण पद्धती की स्थापना की थी पूर्ण हो रही है |

आज साहित्य संगीत व कला की बिना कोई भी राष्ट्र उन्नती नही कर सकता| आज हमारी सरकार की शिक्षा विभाग ने संगीत क्षेत्र में एक नया मोड ला दिया है| पांचवे दशक तक शास्त्रीय संगीत की शिक्षा इतनी लोकप्रिय नही थी जितनी आज है छोटे बडे सभी शहर ओके स्कूल महाविद्यालय ने संगीत शिक्षा किसी न किसी रुप में चल रही है|

आज कल शास्त्रीय संगीत के जितने समारोह आयोजित होते रहते है |या जितनी विद्यालय विश्वविद्यालय और संगीत संस्थाओ में संगीत शिक्षा की जा रही है |आज संगीत शिक्षा लेणी आसान हो गई है |एक निश्चित शुल्क निश्चित स्थान पर निश्चित समा संगीत शिक्षा पुराने संगीत शिक्षको से शिक्षा लीना आसान काम नही था |बडाही कठीण परिश्रम त्याग तथा बलिदान करना पडता था |आज समस्त संगीत हमारी उंगलियो के इशारे पर है यांनी रेडिओ ,टेलिव्हिजन, चलचित्र ,कॅसेट ,व्हिडिओ ,रेकॉर्ड प्लेयर आदि|

केंद्रीय सरकारने संगीत नाटक अकादमी की तथा दिल्ली मे भारतीय कला केंद्र की स्थापना कर उसमे विभिन्न शैलयो के शीर्ष घराणेदार मान्य संगीतज्ञ को ,छात्र को शिक्षित करने के हेतू वेतन भोगी बनाकर रखा गया, जब की पहले यह घराणेदार मान्य संगीतज्ञ को छात्रो को सुलभ नही होते थे|

(संस्थागत शिक्षण के फायदे और तोटे)

आज वर्तमान संगीत शिक्षा पद्धती मे सामान्यतः एक ही विद्यालय महाविद्यालय मे शिष्य को शिक्षा काल में विभिन्न घरानो से संम्बन्धित विभिन्न संगीत शिक्षको से शिक्षा लाभ मिल सकती है |यही लाभ पहले नही होता था पहले एकही घरने के संगीत शिक्षक यह लाभ ले सकते थे और शिक्षा पूर्ण होने तक दुसरे शिक्षक का गाना या संगीत सुनाना भी अनिवार्य था| संगीत स्कूल कॉलेज मे बहुत शिक्षण विषय मे से एक है और जिसे परीक्षा में उत्तीर्ण होने के उद्देश्य से सीखा सिखाया जाता है परीक्षा की दृष्टि से कुछ सांगीतीक व्याकरण का शिक्षण होता है और एक निश्चित रुप से रटी रटाई जाती है शुद्ध संगीत के ऐसे पुराने विश्वविद्यालय थी है संगीत की साधना वर्षो से की जाती रही है कला के विकास के साथ साथ कलाकारो मे भी सादगी उदारता नम्रता सहनशीलता है गुण पाये जाते है परंतु आज पढे लिखे कलाकारो और संगीत शिक्षको मे परस्पर बडी राजनीति और मन मुटाव है|

विद्यार्थी चोवीस घंटे गुरु की निगराणी मे रहे यह संस्थागत शिक्षण मे संभव नही है यहा महाविद्यालयोमे विद्यार्थी को एकही समय मे अनेक गुरूओसे शिक्षा लेणी पडती है| और यह भी स्पष्ट है कि सभी गुरु एक शैली के कलाकार नही होते तालीम का तरीका भी सभी का अलग अलग होता है| संस्थागत शिक्षण की एक बडी कमजोरी है की एक कक्षा मे एक साथ 15-20 विद्यार्थी की तालीम गुरु और शिष्य मे ऐसा संबंध नही होता था की इतने थोडे समय में गुरु यांनी शिक्षक और विद्यार्थी पर अलग अलग ध्यान दे सके|

संस्थागत पद्धती संगीत विद्यार्थी को उतना महत्व नही देती |सीमित पाठ्यक्रम समाप्त करना और परीक्षा मे अच्छे अंक प्राप्त करवाना ही उसका एक मात्र मुख्य उद्देश है|यह पद्धती इस तरह मे रहती है की परीक्षार्थी को कम से कम परिश्रम से अधिक से अधिक अंक कैसे दिलवाये जाते है |परंतु परंम्परागत गुरू-शिष्य शिक्षा प्रणाली मे गुरू का ध्येय शिक्षक को अधिक से अधिक काबिल बनाना होता है|

पहले विद्यार्थी की आवाज के धर्मानुसार उसे ध्रुवपद ,ख्याल ,टप्पा या ठूमरी इन मे से किसी एक विषय पर विशेष ध्यान दे कर उस्मे निपुणता प्राप्त करने की और ध्यान दे बारीक या पतली आवाज वाले व्यक्ति के लिए ध्रुवपद करने का प्रयत्न व्यर्थ था मोठा व भारी आवाज वाले व्यक्ती को ठूमरी गाना व्यर्थ सिद्ध होता था| जहा आज महाविद्यालयमे संगीत के सिलॅबसमेही सभी प्रकार अध्ययन के लिए है पहले गुरु के लिए शिष्य और शिष्य के लिए गुरु जितना महत्त्वपूर्ण था उतना नही है उस वक्त लखनऊ मे विद्यालय की छात्रो की संख्या ईतनी बढ गई की सिखाने के लिए शिक्षक कम पडणे लगे गुरूने एक तर्कीब निकाली की चौथी पाचवी कक्षा के विद्यार्थी दो-एक प्राथमिक अक्षय मे लेने लायक हो तो उन्हे दो-एक क्लास के शिक्षक की कमी की समस्या का हल करे पर आज स्थिती ऐसी नही है आज क्लास मे पडणे के लिए विद्यार्थी ही नही रहते फोन कर करके बुला बुला कर क्लास मे बैठणा पडता है |आज महाविद्यालयीन विद्यार्थी परसेंटेज बढाने के लिए और डिग्री हासिल करने के लिए संगीत विषय लेते है|

आधुनिक काल मे शिक्षण मे पाठ्यक्रम की अधिकता और समय अभाव के कारण रियाज पर बहुत कम जोर दिया जाता है वार्षिक परीक्षा पाठ्यक्रम निर्धारित रागो और तालो को पूरा करने की ही कोशिश रहती है उस समय पाठ्यक्रम जैसे कोई चीज नथी गुरु शिष्य को समय दे तेथे आधुनिक संगीत शिक्षण मे 45 -50 निश्चित कालावधी के अनुसार शिक्षक को पढाना होता है और शिक्षक कां दिया पाठ याद करना शिष्य के अपनी जिम्मेदारी होती है| दस बीस वर्ष में होनेवाली संगीत विषयी की जागृती को देख कर कोई भी संगीतप्रेमी आनंदित हुए बिना नही रहता आज कल बडे बडे शहरो मे घर घर मे गायन-वादन सूनाई देता है सरकारी संगीत संस्था ऐसी चल रही है चलाने का कार्य ही ये संस्थाए करते है इस्मे विचार-विनिमय करना एक महत्त्वपूर्ण बात है|

संस्थागत शिक्षण प्रारंभ होने से पूर्व समाज मे संगीतकला को अच्छी दृष्टी से नही देखा जाता था परिस्थितीयोवश संगीत कला कोठेवाली के पास पोहोच गये ऐसी संस्कारोसे जकडा समाज इस कला को हिन दृष्टि से देखने लगा था और अपनी संतानो को संगीत सिखाने के प्रति उदासीन हो गया था इसका एक और कारण भी था की संगीत के उस्ताद अधिक तर मुसलमान और अनपड होते थे मुसलमान उस्तादों का संम्पर्क अधिक रहता था और शिक्षा और संस्कार की कमी रहती थी समाज के लोगो संगीत शिक्षा लेने अथवा अपने संन्तानो को उनका शिष्य बनाने में संकोच करते थे उनके अतिरिक्त कुछ गुणी उस्ताद भी थे किन्तु उन्मे स्वाभिमान व अहंकार इतना अधिक था कि उन तक सामान्य व्यक्ति की

पोहोच थी ही नही चतुर्थी ही नही ये उस्ताद केवल अपने रिश्तेदार अपने संतान अथवा अपने अति प्रिय शिष्यको ही अत्यंत गोपनीय रूप से शिक्षा देते थे परिणाम स्वरूप समाज मे संगीत की स्थिति बहुत शोचनीय व गंभीर हो गई संगीत की स्थिति समाज मे पिंजरे मे बंद कर फडफडते पंछी के समान कैद हो कर रह गये इस उस कैद संगीत को आजाद करने का कार्य सामान्य जनसमुदाय तक पोहोचणे का अधक परिश्रम दोन विष्णु ने किया इन दोनो को संगीत धारक कहा जाता है जिस मे कोई अतिशयोक्ति नही है।

संस्थागत शिक्षण की प्रारंभ होने का कारण संगीत को सामान्य जन समुदाय तक सोचा नाही था श्रद्धेय विष्णू द्वाय ने संगीत कला मी रुची रखने वाली सामान्य जनो के लिए संगीत संस्था ये खुलकर उनके कलाकार बनने के द्वार होली संगीत के सैद्धान्तिक शास्त्र की जानकारी एव इससे तालमेल रखकर क्रियात्मक पक्ष का ज्ञान देना पंडित भातखंडे जी का प्रमुख लक्ष था पुराने उस्ताद अपने शिष्य को शास्त्रो का ज्ञान बहुत कम देते थे इसके दो कारण थे एक तो वे क्रियात्मक पक्ष पर अधिक बल देते थे दुसरे स्वयंभी शास्त्र पक्ष से अनभिन्न होते थे

निष्कर्षः-

प्राचीन संगीत शिक्षण प्रणाली का उद्देश्य कला की जागृती था जबकी आधुनिक संगीत शिक्षा पद्धती का उद्देश्य संगीत का व्यापक प्रचार है। उस समय के विद्यार्थियों मे कला की साधना मे लगने तपस्या सतत अभ्यास गुरु के प्रति श्रद्धा की अपेक्षा होती परंतु आज की विद्यार्थीयोमें इन गुणकी कमी पाई जाती है। ऐसे अनेक संस्था ओके परिणामस्वरूप आज विश्वविद्यालयोसे या संस्थागत शिक्षण से ऐसा विद्यार्थी बहार आ रहा है। जिसका दृष्टिकोण व्यापक हे लेकिन कलात्मक क्षमता किसी घराणेदार शार्गिद का मुकाबला नही कर पाती संगीत का अच्छा समालोचक बन सकता है शास्त्रीय संगीत का अच्छा कलाकार नही

संदर्भसूचीः-

- हिंदुस्तानी संगीत पद्धती क्रमिक पुस्तक मालिका भाग 6 मुल ग्रंथकार -पंडित विष्णू नारायण भातखंडे संम्पादक- डॉक्टर लक्ष्मीनारायण गर्ग
- उत्तरी भारत मे संगीत शिक्षा लेखक- तृप्त कपूर संम्पादक -मंजित सिंह
- आचार्य श्रीकृष्ण रातंजनकर सुजान जीवनी तथा स्मृतीसंचय संम्पादक -डॉक्टर श्रीरंग संगोराम
- संगीत सितंबर 1989 अंक 9 वर्ष 55 संस्थापक -प्रभुलाल गर्ग प्रधान संपादक -डॉक्टर लक्ष्मीनारायण गर्ग
- संगीत का सांस्कृतिक व सामाजिक पक्ष लेखक -डॉक्टर प्रभा भारद्वाज प्रकाशन -साहित्यागार

आज वर्तमान संगीत शिक्षा पद्धती मे सामान्यतः एक ही विद्यालय महाविद्यालय मे शिष्य को शिक्षा काल में विभिन्न घरानो से संम्बन्धित विभिन्न संगीत शिक्षको से शिक्षा लाभ मिल सकती है |यही लाभ पहले नही होता था पहले एकही घरने के संगीत शिक्षक यह लाभ ले सकते थे और शिक्षा पूर्ण होने तक दुसरे शिक्षक का गाना या संगीत सुनाना भी अनिवार्य था| संगीत स्कूल कॉलेज मे बहुत शिक्षण विषय मे से एक है और जिसे परीक्षा में उत्तीर्ण होने के उद्देश्य से सीखा सिखाया जाता है परीक्षा की दृष्टि से कुछ सांगीतीक व्याकरण का शिक्षण होता है और एक निश्चित रुप से रटी रटाई जाती है शुद्ध संगीत के ऐसे पुराने विश्वविद्यालय थी है संगीत की साधना वर्षो से की जाती रही है कला के विकास के साथ साथ कलाकारो मे भी सादगी उदारता नम्रता सहनशीलता है गुण पाये जाते है परंतु आज पढे लिखे कलाकारो और संगीत शिक्षको मे परस्पर बडी राजनीति और मन मुटाव है|

विद्यार्थी चोवीस घंटे गुरु की निगराणी मे रहे यह संस्थागत शिक्षण मे संभव नही है यहा महाविद्यालयोमे विद्यार्थी को एकही समय मे अनेक गुरूओसे शिक्षा लेणी पडती है| और यह भी स्पष्ट है कि सभी गुरु एक शैली के कलाकार नही होते तालीम का तरीका भी सभी का अलग अलग होता है| संस्थागत शिक्षण की एक बडी कमजोरी है की एक कक्षा मे एक साथ 15-20 विद्यार्थी की तालीम गुरु और शिष्य मे ऐसा संबंध नही होता था की इतने थोडे समय में गुरु यांनी शिक्षक और विद्यार्थी पर अलग अलग ध्यान दे सके|

संस्थागत पद्धती संगीत विद्यार्थी को उतना महत्व नही देती |सीमित पाठ्यक्रम समाप्त करना और परीक्षा मे अच्छे अंक प्राप्त करवाना ही उसका एक मात्र मुख्य उद्देश है|यह पद्धती इस तरह मे रहती है की परीक्षार्थी को कम से कम परिश्रम से अधिक से अधिक अंक कैसे दिलवाये जाते है |परंतु परंम्परागत गुरू-शिष्य शिक्षा प्रणाली मे गुरू का ध्येय शिक्षक को अधिक से अधिक काबिल बनाना होता है|

पहले विद्यार्थी की आवाज के धर्मानुसार उसे ध्रुवपद ,ख्याल ,टप्पा या ठूमरी इन मे से किसी एक विषय पर विशेष ध्यान दे कर उस्मे निपुणता प्राप्त करने की और ध्यान दे बारीक या पतली आवाज वाले व्यक्ति के लिए ध्रुवपद करने का प्रयत्न व्यर्थ था मोठा व भारी आवाज वाले व्यक्ती को ठूमरी गाना व्यर्थ सिद्ध होता था| जहा आज महाविद्यालयमे संगीत के सिलॅबसमेही सभी प्रकार अध्ययन के लिए है पहले गुरु के लिए शिष्य और शिष्य के लिए गुरु जितना महत्त्वपूर्ण था उतना नही है उस वक्त लखनऊ मे विद्यालय की छात्रो की संख्या ईतनी बढ गई की सिखाने के लिए शिक्षक कम पडणे लगे गुरूने एक तर्कीब निकाली की चौथी पाचवी कक्षा के विद्यार्थी दो-एक प्राथमिक अक्षय मे लेने लायक हो तो उन्हे दो-एक क्लास के शिक्षक की कमी की समस्या का हल करे पर आज स्थिती ऐसी नही है आज क्लास मे पडणे के लिए विद्यार्थी ही नही रहते फोन कर करके बुला बुला कर क्लास मे बैठणा पडता है |आज महाविद्यालयीन विद्यार्थी परसेंटेज बढाने के लिए और डिग्री हासिल करने के लिए संगीत विषय लेते है|

आधुनिक काल मे शिक्षण मे पाठ्यक्रम की अधिकता और समय अभाव के कारण रियाज पर बहुत कम जोर दिया जाता है वार्षिक परीक्षा पाठ्यक्रम निर्धारित रागो और तालो को पूरा करने की ही कोशिश रहती है उस समय पाठ्यक्रम जैसे कोई चीज नथी गुरु शिष्य को समय दे तेथे आधुनिक संगीत शिक्षण मे 45 -50 निश्चित कालावधी के अनुसार शिक्षक को पढाना होता है और शिक्षक कां दिया पाठ याद करना शिष्य के अपनी जिम्मेदारी होती है| दस बीस वर्ष में होनेवाली संगीत विषयी की जागृती को देख कर कोई भी संगीतप्रेमी आनंदित हुए बिना नही रहता आज कल बडे बडे शहरो मे घर घर मे गायन-वादन सूनाई देता है सरकारी संगीत संस्था ऐसी चल रही है चलाने का कार्य ही ये संस्थाए करते है इस्मे विचार-विनिमय करना एक महत्त्वपूर्ण बात है|

संस्थागत शिक्षण प्रारंभ होने से पूर्व समाज मे संगीतकला को अच्छी दृष्टी से नही देखा जाता था परिस्थितीयोवश संगीत कला कोठेवाली के पास पोहोच गये ऐसी संस्कारोसे जकडा समाज इस कला को हिन दृष्टि से देखने लगा था और अपनी संतानो को संगीत सिखाने के प्रति उदासीन हो गया था इसका एक और कारण भी था की संगीत के उस्ताद अधिक तर मुसलमान और अनपड होते थे मुसलमान उस्तादों का संम्पर्क अधिक रहता था और शिक्षा और संस्कार की कमी रहती थी समाज के लोगो संगीत शिक्षा लेने अथवा अपने संन्तानो को उनका शिष्य बनाने में संकोच करते थे उनके अतिरिक्त कुछ गुणी उस्ताद भी थे किन्तु उन्मे स्वाभिमान व अहंकार इतना अधिक था कि उन तक सामान्य व्यक्ति की

पोहोच थी ही नही चतुर्थी ही नही ये उस्ताद केवल अपने रिश्तेदार अपने संतान अथवा अपने अति प्रिय शिष्यको ही अत्यंत गोपनीय रूप से शिक्षा देते थे परिणाम स्वरूप समाज मे संगीत की स्थिति बहुत शोचनीय व गंभीर हो गई संगीत की स्थिति समाज मे पिंजरे मे बंद कर फडफडते पंछी के समान कैद हो कर रह गये इस उस कैद संगीत को आजाद करने का कार्य सामान्य जनसमुदाय तक पोहोचणे का अथक परिश्रम दोन विष्णु ने किया इन दोनो को संगीत धारक कहा जाता है जिस मे कोई अतिशयोक्ति नही है।

संस्थागत शिक्षण की प्रारंभ होने का कारण संगीत को सामान्य जन समुदाय तक सोचा नाही था श्रद्धेय विष्णू द्वाय ने संगीत कला मी रुची रखने वाली सामान्य जनो के लिए संगीत संस्था ये खुलकर उनके कलाकार बनने के द्वार होली संगीत के सैद्धान्तिक शास्त्र की जानकारी एव इससे तालमेल रखकर क्रियात्मक पक्ष का ज्ञान देना पंडित भातखंडे जी का प्रमुख लक्ष था पुराने उस्ताद अपने शिष्य को शास्त्रो का ज्ञान बहुत कम देते थे इसके दो कारण थे एक तो वे क्रियात्मक पक्ष पर अधिक बल देते थे दुसरे स्वयंभी शास्त्र पक्ष से अनभिन्न होते थे

निष्कर्ष:-

प्राचीन संगीत शिक्षण प्रणाली का उद्देश्य कला की जागृती था जबकी आधुनिक संगीत शिक्षा पद्धती का उद्देश्य संगीत का व्यापक प्रचार है। उस समय के विद्यार्थियों मे कला की साधना मे लगने तपस्या सतत अभ्यास गुरु के प्रति श्रद्धा की अपेक्षा होती परंतु आज की विद्यार्थीयोमें इन गुणकी कमी पाई जाती है। ऐसे अनेक संस्था ओके परिणामस्वरूप आज विश्वविद्यालयोसे या संस्थागत शिक्षण से ऐसा विद्यार्थी बहार आ रहा है। जिसका दृष्टिकोण व्यापक हे लेकिन कलात्मक क्षमता किसी घराणेदार शागिंद का मुकाबला नही कर पाती संगीत का अच्छा समालोचक बन सकता है शास्त्रीय संगीत का अच्छा कलाकार नही

संदर्भसूची:-

- हिंदुस्तानी संगीत पद्धती क्रमिक पुस्तक मालिका भाग 6 मुल ग्रंथकार -पंडित विष्णू नारायण भातखंडे संम्पादक- डॉक्टर लक्ष्मीनारायण गर्ग
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RESEARCH HUB

International Peer-Reviewed Multidisciplinary E-Journal

ISSN : 2582-9173

Impact Factor : 5.307 (SJIF)

Refereed & Indexed Journal

Volume-4 : Issue-2 (April -2023)

Published by

Skylark International Publication

38, Mitranagar, Manewada, Nagpur-27

www.researchhub.org.in/research-hub

Impact Factor 5.307 (SJIF)

RESEARCH HUB

International Peer-Reviewed Multidisciplinary E-Journal

ISSN 2582-9173

संगीत में ताल का महत्व

सहा. प्रा. डॉ. वृषाली देशमुख

(संगीत विभाग)

[illegible] महाविद्यालय [illegible]

सारांश

मानव और संगीत के विकास की कहानी प्रागैतिहासिक काल से साथ साथ चलती रही है। मानव एवं संगीत का विकास आवश्यकता के सिद्धान्त पर ही आगे बढ़ा है। जहाँ मानव ने प्रकृति के सानिध्य में रहकर हवा व जल की प्राप्ति के साधन और माध्यम ढूंढे, वहीं हवा और जल ने उसकी आवश्यकताएं एवं वस्तुओं के बीच कोई साधन ने जब कीड़ों से खाये हुये बाँस की डण्डी के छेद में हवा द्वारा उत्पन्न ध्वनि को मानव ने सुना, तब उसने भी उस छिद्र में मुँह लगाकर ध्वनि पैदा किया। इससे उसके भीतर प्रसन्नता एवं कौतूहल उत्पन्न हुआ। आज भी अपने ओठ के कौतूहल और प्रसन्नता को व्यक्त करने के लिये सुसंस्कृत मानव अपने जैसे किसी दूसरे मानव के सामने उसी बात को बताता है अथवा करके दिखाता है। वहीं भाव उस आदिम मानव में भी रहे होंगे। अपनी खुशी और अभिव्यक्ति की भावना को प्रदर्शित करने के लिये उसे अपने जैसे किसी मानव की आवश्यकता हुई होगी और इस प्रकार संगीत ने पशुतुल्य मानव में सामाजिकता के गुणों को जाग्रत किया होगा और इसी प्रकार हजारों वर्षों से मानव व संगीत विकास पथ पर साथ साथ चल रहे हैं। नीचे हम उसी विकास गाथा को और अधिक स्पष्ट कर रहे हैं।

संगीत गायन, वादन तथा नृत्य का अस्तित्व ताल के बिना असम्भव सा है। ताल की अवधारणा कैसे उत्पन्न हुई इसका अध्ययन हम ताल की ऐतिहासिकता के अन्तर्गत कर चुके हैं। अब हम ताल शब्द की उत्पत्ति के विषय में विचार करेंगे। संगीत के प्रायः सभी ग्रंथों में ताल तत्व का विवेचन आवश्यक तथा अभिन्न अंग के रूप में प्रस्तुत हुआ है।

संगीतरत्नाकर ग्रन्थ में ताल शब्द की उत्पत्ति के विषय में इस प्रकार कहा है

"ताल शब्दस्य निष्पत्तिः प्रतिष्ठार्थेन धातुना। गीत वाद्य च नृत्य च यतो ताले प्रतिष्ठितम्"

ताल शब्द का (संस्कृत भाषा के वैय्याकरण के अन्तर्गत) धातु रूप तल है। इस तल का शाब्दिक अर्थ स्थिति कहा जा सकता है, और सामान्य भाषा में स्थिति (आधार) शब्द का अर्थ बुनियाद होता है। गीत वाद्य तथा नृत्य तीनों की प्रतिष्ठा ताल पर हुई है, संभवतः इसीलिए प्रतिष्ठावाचक धातु रूप तल से ताल शब्द निर्मित प्रतीत होता है।

उद्देश

भारतीय संगीत में स्वर, शब्द के साथ तीसरा महत्वपूर्ण घटक है ताल। ताल संकल्पना भारतीय संगीत परंपरा में प्राचीन काल से अस्तित्व में है और अत्यंत विकसित घटक है। ताल में मूलतः लय का आविर्भाव होता है। यद्यपि 'ताल' संकल्पना 'लय' का मूर्त स्वरूप है, तथापि उसका निर्माण लय व्यक्त करने हेतु ही हुआ है। 'ताल' संकल्पना से पूर्व लय संकल्पना को समझना आवश्यक है।ताल के विषय में विभिन्न विद्वानों के विचार एवं परिभाषा संस्कृत में अधिकांशतया संज्ञा सार्थक रूप से व्युत्पत्ति के आधार पर ही की जाती है, ऐसी परम्परा रही है। संगीतशास्त्र की भी अधिकांश संज्ञाएं इसी प्रकार निश्चित की गई हैं।

प्रस्तावना :

ताल शब्द की व्युत्पत्ति

संगीत गायन, वादन तथा नृत्य का अस्तित्व ताल के बिना असम्भव सा है। ताल की अवधारणा शनैशनै कैसे उत्पन्न हुई इस cxका अध्ययन हम ताल की ऐतिहासिकता के अन्तर्गत कर चुके हैं। अब हम ताल शब्द की उत्पत्ति के विषय में विचार करेगें। संगीत के प्रायः सभी ग्रंथों में ताल तत्व का विवेचन आवश्यक तथा अभिन्न अंग के रूप में प्रस्तुत हुआ

संगीत की लक्ष्य, लक्षण और सूत्र रूप में व्याख्या हमें सर्वप्रथम भरतमुनि द्वारा रचित नाट्यशास्त्र में ही मिलता है। यद्यपि नाट्यशास्त्र नाट्य विषय का ग्रन्थ है परन्तु संगीत के सूक्ष्मतम विषयों पर भी सूत्र रूप में भरतमुनि ने स्पष्ट विवेचना की है। संगीत का ऐसा कोई तत्व नहीं जिसे उन्होंने सूत्र रूप में ही सही परन्तु इंगित न किया हो। कुछ विद्वानों की मान्यता एवं जैसा कि नाट्यशास्त्र के अनुशीलन से भी ज्ञात होता है कि भरत नाट्यशास्त्र से पहले भी कुछ अन्य आचार्यों के संगीत विषयक ग्रंथ अवश्य थे।संगीत की लक्ष्य, लक ताल शब्द का (संस्कृत भाषा के वैय्याकरण के अन्तर्गत) धातु रूप ताल है। इस ताल का शाब्दिक अर्थ मित्ति कहा जा सकता है, और सामान्य भाषा में मिलित (आधार) शब्द का अर्थ बुनियाद होता है। गीत वाद्य तथा नृत्य तीनों की प्रतिष्ठा ताल पर हुई है, संभवत: इसीलिए प्रतिष्ठावाचक धातु रूप तल से ताल शब्द.निर्मित प्रतीत होता है।संगीत की लक्ष्य, लक्षण और सूत्र रूप में व्याख्या हमें सर्वप्रथम भरतमुनि द्वारा रचित नाट्यशास्त्र में ही मिलता है। यद्यपि नाट्यशास्त्र नाट्य विषय का ग्रन्थ है परन्तु संगीत के सूक्ष्मतम विषयों पर भी सूत्र रूप में भरतमुनि ने स्पष्ट विवेचना की है। संगीत का ऐसा कोई तत्व नहीं जिसे उन्होंने सूत्र रूप में ही सही परन्तु इंगित न किया हो। कुछ विद्वानों की मान्यता एवं जैसा कि नाट्यशास्त्र के अनुशीलन से भी ज्ञात होता है कि भरत नाट्यशास्त्र से पहले भी कुछ अन्य आचार्यों के संगीत विषयक ग्रंथ अवश्य थे।संगीत की लक्ष्य, लक्षण और सूत्र रूप में व्याख्या हमें सर्वप्रथम भरतमुनि द्वारा रचित नाट्यशास्त्र में ही मिलता है। यद्यपि नाट्यशास्त्र नाट्य विषय का ग्रन्थ है परन्तु संगीत के सूक्ष्मतम विषयों पर भी सूत्र रूप में भरतमुनि ने स्पष्ट विवेचना की है। संगीत का ऐसा कोई तत्व नहीं जिसे उन्होंने सूत्र रूप में ही सही परन्तु इंगित न किया हो। कुछ विद्वानों की मान्यता एवं जैसा हेकि नाट्यशास्त्र के अनुशीलन से भी ज्ञात होता है कि भरत नाट्यशास्त्र से पहले भी कुछ अन्य आचार्यों के संगीत विषयक ग्रंथ अवश्य थे।संगीत की संरचना का एक महत्त्वपूर्ण आधार तत् स्वर और 'पद (शब्द) के रूप में प्रयुक्त होने वाली ध्वनि है, वही ताल 'के' रूप में प्रयुक्त होने 'कालप्रमाण संगीत संरचना का दूसरा महत्त्वपूर्ण आधार तत्व है किसी भी संगीत के लिए यद्यपि यह दोनों ही आवश्यक है तथापि इनमें से 'ध्वनि' का संगीत निर्माण में प्रधान योगदान उसकी स्वतः सक्षमता के कारण होता है, जबकि 'काल' केवल उसके सहायक रूप में विद्यमान रहता है।संगीत में कालमान की इसी प्रक्रिया से ताल की संरचना हुई है। शारंग देव ने अपने ग्रंथ संगीत रत्नाकर में गीत, वाय, नृत्य को परिमित करने वाले तथा सशब्द व निशब्द क्रियाओं द्वारा लघुगुरूप्लुतादि में परिछिन्न होकर परिमाप किए जाने वाले 'काल' को 'ताल' बनाया है" भारतीय चिंतन के अनुसार, 'ताल' की परिकल्पना आवृत्ति के रूप में की गई है। अतः प्रत्यक्ष प्रयोग में प्रत्येक ताल की पुनरावृत्ति उनके आवर्तनों में बार-बार होती रहती है।

प्राचीत काल से ही भारतीय संगीत में परम्परागत रूप से ताल संरचना के कुछ मूलभूत आधार माने जाते रहे हैं। जिनमें क्रम संख्या तथा नामों में विभिन्नता हमें विभिन्न ग्रंथों में मिलती हैं जैसे-भरत कृत नाट्यशास्त्र' में जहाँ इनके क्रम, संख्या व नाम इस प्रकार है। 1. काल, 2. कला, 3. पात, 4. लय, 5. मार्ग, 6. योनि, 7, यति, 8. पाणि, वहीं शारंगदेव कृत संगीत रत्नाकर में यह 1. काल, 2. क्रिया, 3. मार्ग, 4. कला, 5. लय 6. यति, 7. ग्रह व 8. प्रस्तार

तथा 'संगीत समयसार ग्रंथ में - 1. कालमान, 2. क्रिया, 3. मात्रा, 4. लय, 5. यति, 6. मार्ग, 7. ग्रह व 8 प्रस्तार इत्यादि। किन्तु ताल संरचना के दस मूलभूत आधारों का 'ताल के दशप्राण' के रूप में सर्वप्रथम उल्लेख नारद कृत' 'संगीत मकरंद' ग्रंथ में इस प्रकार मिलता है-

काल मार्ग क्रियाङ्गानि ग्रह जाति कला लयाः। यति प्रस्तारक चैव ताल प्रमाणा दश स्मृताः ॥5॥

अर्थात् काल, मार्ग, क्रिया, अंग, ग्रह, जाति, कला, लय और प्रस्तार में ताल के दस प्राण हैं। ऐसा प्रतीत होती है कि प्राचीन परम्परा से चले आये ताल संरचना के मूलभूत आधारों की परिकल्पना ही आगे सुव्यवस्थित होकर 'ताल के दस प्राण' के रूप में प्रस्फुटित हुई है। भारतीय संगीत की आधुनिक ताल पद्धति बहुत अंशों में परिवर्तित हो जाने के कारण यद्धपि प्रत्यक्ष व्यवहार में अब इनमें से कई का महत्त्व लगभग शून्य सा हो गया है फिर भी भारतीय ताल संरचना की पृष्ठभूमि को समझने में इनका अध्ययन काफी सहायक व उपयोगी है।

प्राचीन काल से ही स्वर और रागों के विकास के साथ-साथ तालशास्त्र का विकास होता आया है। प्राचीन ताल पद्धति अत्यंत जटिल और गहन थी। समय के साथ-साथ जैसे उत्तर भारतीय तथा दक्षिण भारतीय संगीत पद्धतियों का विभिन्न पथ पर विकास होने लगा, वैसे दोनों संगीत की ताल पद्धतियों में भी काफी परिवर्तन आया। जहाँ एक ओर उत्तर भारतीय संगीत में ताल शास्त्र में परिवर्तन हुआ, वहीं दक्षिण भारतीय संगीत प्राचीन पद्धति से जुड़ा रहने के कारण उसके तालशास्त्र में भी अधिक परिवर्तन नहीं हुआ।

प्राचीन काल में जातियों के आधार पर तालों का प्रचलन था। जिसे जाति-ताल कहा जाता था। सामवेद काल में इन्हीं जाति-तालों में ऋचाओं का गान होता था। इन तालों में लय के विभिन्न प्रकार थे। जैसे-8 क्षण अर्थात् 1 लय, 8 लय अर्थात् 1 काष्ट इस प्रकार 10 प्रकार की लय का प्रचलन था जिनके नाम क्रमशः लय, काष्ट, निमिष, कला, अणुद्रुत, द्रुत, लघु, गुरु, प्लुत, का हेकपद इस प्रकार थे। प्राचीन शास्त्रज्ञों द्वारा ताल के 10 प्राण बताए है- काल, मार्ग, क्रिया, अंग, ग्रह, जाति,

संगीत विविध 84 कला, यति और प्रस्तार। प्राचीन तालों का स्वरुप मात्राओं के आधार पर प्रदर्शित होता था। मार्गी तालों में लघु, गुरु, प्लुत और देशी तालों में द्रुत मात्राओं का प्रयोग होता था। तथा हाथ से ताली के माध्यम से ताल दिखाने की क्रिया होती थी। आज उत्तर भारतीय संगीत में इस प्रथा का पालन नहीं होता किन्तु दक्षिण भारतीय संगीत में इसका आज भी पालन किया जाता है।

कुल जाति तालों की संख्या प्राचीन संगीत में 7 थी। जिनके नाम इस प्रकार थे। एकताल, रुपक, झप, त्रिपुट, मठताल, अठताल, ध्रुवताल। ताल में लघु, गुरु तथा प्लुत के चिन्ह के अनुसार मात्राएँ थी। इनमें लघु की मात्रा में बदलाव कर (2, 3, 4, 5 और 9) प्रत्येक ताल के 28 और ताल बनते है। संगीत रत्नाकर में 60 और 70 मात्राओं के भी तालों का उल्लेख मिलता है। इस प्रकार प्राचीन ताल शास्त्र का स्वरुप अत्यंत जटिल था। निष्कर्ष:-आधुनिक काल मे तालका जो स्वरूप है उसमे प्रमुख लय तथा लय को प्राधान्य दिया जाता है लायकी तीन प्रकार है विलंबितलय ,द्रुतलय, इसके अतिरिक्त लय के विभिन्न प्रकार जैसे, दुगुन, तिगुन, चौगुन, आड़, कुआड़, बिआड इत्यादी का प्रयोग संगीत में होता है। लय के अलावा ताल के प्रमुख लक्षण है, जिसमें मात्रा, छद, आवर्तन, ठका, सम, खाली, विभाग (खंड), ताली (भरी) इन सभी का समावेश होता है। इन सभी लक्षणों के आधार पर ताल का निर्माण होता है। इस के साथ एकल तबला के लिये उपयोगी विभिन्न संकल्पनाएं, जिसमे कायदा, गत, पेशकार, टुकड़ा, मुखड़ा, रेला, मोहरा, उठान परन, पलटा, लग्गी इत्यादी का समावेश होता है इन सारे घटक का अभ्यास तालशास्त्र के लीये आवश्यक है।

निष्कर्ष :

ताल पर विभिन्न विद्वानों के विचारों एवं परिभाषाओं के तर्कपूर्ण अध्ययन के पश्चात् हम इस निष्कर्ष पर पहुँचते हैं कि गायन, वादन तथा नर्तन में विभिन्न गति, लय, छन्द, मात्रा विधान द्वारा काल मापन करने वाला काल प्रमाण ही 'ताल' है। क्यूँकि ताल का प्रयोग गायन, वादन तथा नृत्य को आधार प्रदान करने के लिए किया जाता है, अतः उसका स्वरूप भी गायन, वादन, नर्तन की प्रयोगधर्मिता के आधार पर बदलता रहता है। भारतीय संगीत का विकास दो धाराओं में हुआ है मार्गी तथा देशी। तथा इसी के अनुसार दो प्रकार की तालों का भी विकास हुआ है। मार्गी संगीत के लिए मार्गी तालें तथा देशी संगीत के लिए देशी तालें निर्मित की गई। नाद ब्रह्म में गतिमान काल के प्रवाह को संयमित और अनुशासित करके दिशा प्रदान करने तथा उसे संगीत सृष्टि हेतु उपयोगी बनाने के महत्वपूर्ण दायित्व का निर्वहन 'ताल' करता है। ताल की इकाई मात्रा है, और विभिन्न मात्राओं के लयबद्ध स्वरूप जो लय / ताल वाद्यों के वर्गों द्वारा प्रदर्शित किये जाते हैं, 'ताल' कहलाते हैं।

संदर्भ सूची:-

- उत्तर भारतीय तालों में छंद रस और सौन्दर्यतत्व -डॉ. शुभा श्रीवास्तव
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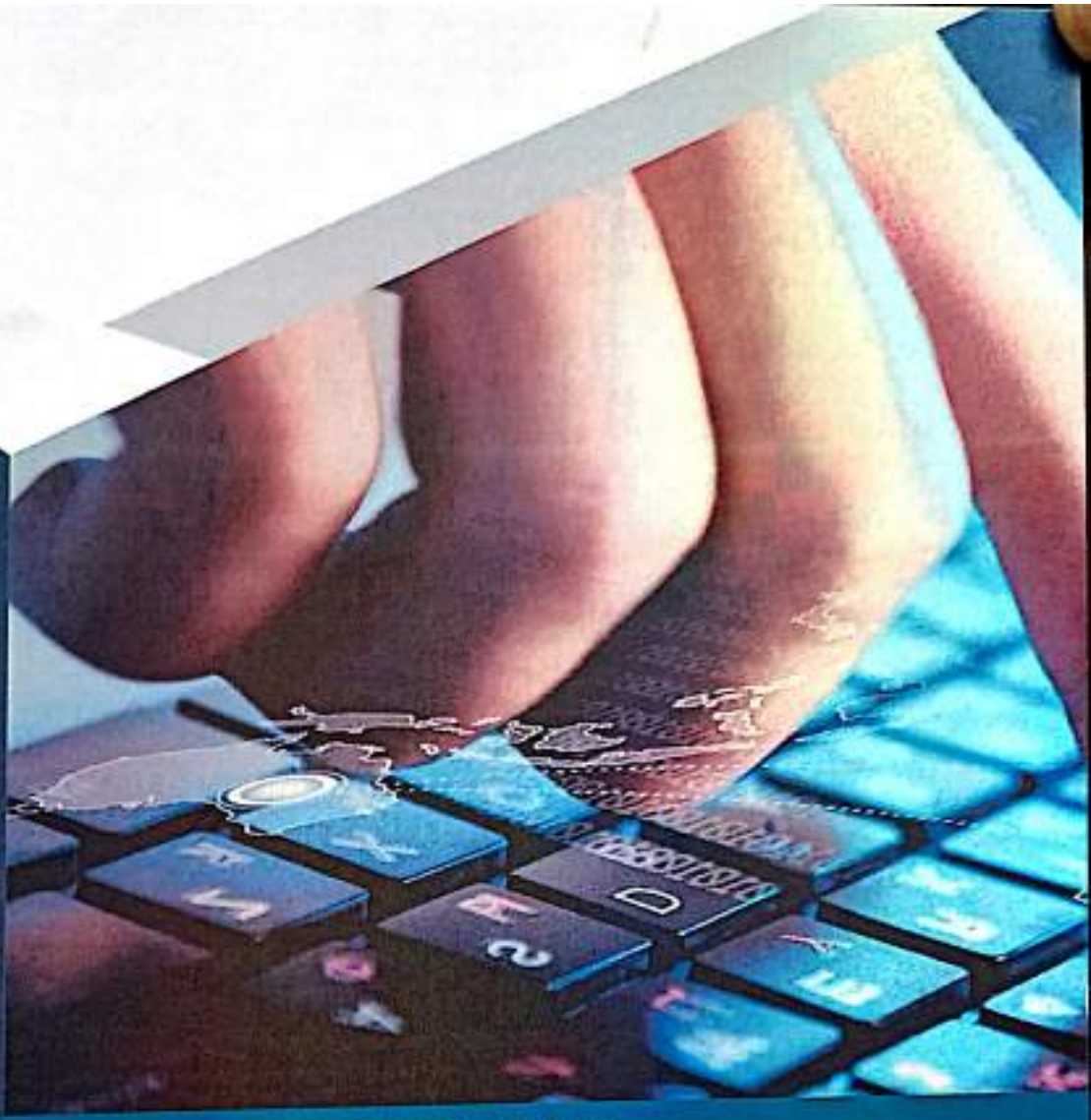

ज्ञान-विज्ञान विमुक्तये

Peer Reviewed Refereed
and UGC Listed Journal
Journal No. 47037

ISO 9001 : 2015 QMS
ISBN / ISSN

ISSN 2278 - 8158

AN INTERNATIONAL MULTIDISCIPLINARY
HALF YEARLY RESEARCH JOURNAL

ROYAL

Single Blind Review

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Volume - XII, Issue - II,
December - May - 2023-24
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Impact Factor - 2023 - 6.701
(www.sjifactor.com)

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IMPACT FACTOR / INDEXING
2023 - 6.701
www.sjifactor.com

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M.Sc (Math's), M.B.A. (Mkt), M.B.A (H.R),
M.Drama (Acting), M.Drama (Prod & Dirt), M.Ed.

❖ PUBLISHED BY ❖

Ajanta Prakashan
Aurangabad. (M.S.)

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९. भारतीय संगीत में ठुमरी का स्थान वर्तमान स्थिती

डॉ. राजेश का. उमाळे
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उत्तर भारतीय संगीत की लोकप्रिय गीतविधाओं में ठुमरी का विशिष्ट स्थान है। स्वर और ताल के सहयोग सं गीत के बोलों की भावाभिव्यक्ति ठुमरी गान की उन्यत विशेषता है। संगीत रसिक जनसमाज को इतना आकर्षित व अभिभूत किया कि आज भी सभी संगीततज्ञ ठुमरी गाने में गौरव अनुभव करते है। इतना ही नही सभी तत् एवं सुशीर वाद्यों के वादक ठुमरी धुन बजाकर अपने कार्यक्रक को समाप्त करते है।

ठुमरी शब्द की उत्पत्ती

'ठुमरी' शब्द का व्यवहार उत्तर भारत की प्रायः सभी भाषाओं में प्रचलित है। जैसे हिंदी, पंजाबी और गुजराती में ठुमरी; सिंधी मे ठुमिरी; मराठी में ठुमरी तथा ठंबुरी; नैपाली में ठुमरी तथा ठुम्रि और बंगला में ठुंग्रि इत्यादी। किंतु मूलतः यह शब्द हिंदी भाष का माना जाता है क्योंकि ठुमरी का उद्गम तिकास और प्रसार हिंदी क्षेत्र में हुआ है और सभी पुरानी ठुमरीयाँ हिंदी की उपभाषाओं में मिलती है।

व्यापक दृष्टिकोण के आधार पर हिंदी की सत्रह बोलियाँ मानी जाती है: अवधी, बघेली, छत्तीसगढ़, खडी, ब्रज, कन्नौजी, बुंदेली, बाँगरू, भोजपुरी, मैथिली, कुमायूँनी, गढ़वाली, मारवाड़ी, मेवाती, ढूढाडी और मालवी। किंतु विशुद्ध भाषा वैज्ञानिक दृष्टीकोण के आधार पर इनमें से केवल प्रथम आठ बोलियाँ को हिंदी भाषा के अंतर्गत मानकर इन्हें पूर्वी और पश्चिमी दो वर्गो में बाँट दिया गया है।

शोरसेनी अपभ्रंश से विकसति ब्रजभाषा मूलतः ब्रजक्षेत्र की बोली है। ब्रज की प्रेम और श्रृंगारमयी कृष्णलीला और उससे संबंधित कथक नृत्य से ठुमरी का अत्यंत घनिष्ठ संबंध रहा है। ठुमरी के पुरानी रचनाओं के ब्रजभाष होने का उल्लेख मिलता है। अत 'ठुमरी'मूलतः ब्रजभाषा का शब्द माना जाता है। ब्रजभाष के अतिरिक्त हिंदी के अन्य बोलियों में यह शब्द प्रायः नही मिलता। ठुमरी शब्द की उत्पत्ती और उसके मूल अर्थ के संबंधी विव्दानों के विभिनन मत है।

'ठुमरी' शब्द के 'ठुम' और 'री' दो अंश है। आचार्य बृहस्पती के मत अनुसार 'ठुम' ठुमकने का द्योतक है और 'री' अंतरंग सखी से अपने अंतर की बात कहने का। 'ठुमरी' का विषय नायिका के अंतर की असंख्य भाव लहरियों का चित्रण है। पैरो में पहने घुंगरू जब छमछम करते समय इस पद्धती से नृत्य की लय से चलणा ऐसे अर्थ में ठुमकना या हिंदी क्रियापद से 'ठुमरी' शब्द की उत्पती मानी जाती है। श्री 'ध्रुवतारा जोशी' का कथन है कि लगभग सन् 1928 और सन 1930 ई. के बीच कलकत्ता में दरभंगा के प्रसिद्ध हार्मोनियम वादक श्री 'मुहम्मद इस्माइल' उनकी मुलाकात हुई थी। श्री 'मुहम्मद इस्माइल' संगीतजीवी वर्ग के थे और

रिश्ते में वे बड़े करामत खाँ के महान् हारमोनियक वादक तथा ठुमरीकार भैया गनपवत राव से हारमोनियम वादन तथा ठुमरी गान सीखा था। अतः ठुमरी के बारे में श्री मुहम्मद इस्माइल का मत विशेष महत्वपूर्ण और विचारणीय है। श्री मुहम्मद इस्माइल ने ठुमरी की उत्पती और षब्द उत्पती के संबंध में जोषी जी को बताया था कि ठुमरी का आविष्कार ग्वालियर के राजा 'मानसिंह तँवर' के द्वारा हुआ। कहते है की एक बार 'भैरवी' गाते समय राजा मानसिंह तँवर ने गलतीसे षुद्ध रिषभ लगा दिया। विवादी स्वर के प्रयोग से राग अषुद्ध हो गया परंतू अन्य स्वरो के प्रयोग से अत्यंत रोचक और कर्णमधूर प्रतित हो गयां। और इससे राग की रंजकता बढ़ गई। अत एवं ऐसे रागों को उनके मूल स्वरूप से भिन्न रखने तथा राजा मानसिंह तँवर से उनका संबंध दर्षने के लिए लोगों ने उन रागों के साथ तँवेरी विशेषन लगा दिया। जैसे 'तँवेरी भैरवी', 'तँवेरी खमाज' इत्यादी और यही तँवेरी षब्द बाद में बिगड़कर ठुमरी हो गया।

ठुमरी षब्द की उत्पति अथवा ठुमरी शैली के उद्भव के सबध मे इतना कह देना न्याय संगत होगा कि कतपिय शास्त्रीयों ने इसको 'टप्पे' पश्चात की उत्पति कहा है। और इसके आविष्कार का संबंध भी 'गुलामनबी शोरी' के खानदान से ही स्थापित किया है।

ठुमरी का इतिहास

कला की किसी भी विधा की उपलब्धि तथा जनसमाज में उसके प्रचार, प्रसार, लोकप्रियता व प्रतिष्ठापना इत्यादि की व्यापक प्रगति को उसकी से ही समझा जा सकता है। अतः इस दृष्टी से ठुमरी का इतिहास संक्षिप्त रूप से अध्ययन करणा जरूरी है। पं. लक्ष्मण जोषी कहते है की, ई.स. 1772 मे 'हिरा' नामक एक नृत्यगना थी। वह पेषवा के यहा नौकरी करती थी, इसका नृत्य तारिफ करने जैसा था वह ठुमरी सुंदरतासे गाया करती थी।

स्व. प. विष्णु नारायण भातखंडे जी ठुमरी के संदर्भ में बैनर्जी का मत कथन करते हुवे बताते है 'जीन रागों में टप्पे रहते है उन्ही रागों में ठुमरी अधिक रहती है। ठुमरी पंजाबी, अध्धा, कव्वाली इत्यादी तालो में रहती है। कॅप्टन विलार्ड ने अपने ग्रथ मे 'ठुमरी' नाम का राग ही बताया है। संगीतसार ग्रंथ में कहा है की, ठुमरी की उत्पती 'शौरीमिया' से हुई है। हरिवंष प्राचीन साहित्य में (इ.स.400) काव्य, नाटयत्मक हावभाव, और नृत्य इन का समावेष है इस छालिक्य नामक सादरीकरण की परंपरामे ठुमरी का आदिनमुना मिलता है। बादमें 'कल्हन' ने अपना ग्रंथ 'राजतरंगिणी' में 'डोंबिका' गायन का किया गया निर्देश और कुछ समय बाद 'झुमरी' का कीया गया उल्लेख ठुमरी से साम्य बताते हुए उस तरफ ध्यान जाता है। मध्ययुग में 'मानसोल्लास' ग्रंथ मे 'त्रिपदी' नामक का वर्णन मिलता है। संगीत दामोदर (इ.स.1500) इस ग्रंथ मे 'झुमरी' नामक संगीत प्रकार का उल्लेख प्राप्त होता है। जिसे लयबद्ध झुमरी गीत नर्तकी गाती है। डॉ. सुषील कुमार चौबे अपने ग्रंथ मेकहते है की, ठुमरी लखनऊ मे पैदा हुई। लखनऊ ही इसका जन्म स्थान है। लखनऊ के नवाब 'सादिक अली खाँ' ही इसके अविष्कारक थे और इन्होंने ही इस नयी शैली का सबसे पहले प्रचार किया।

ठुमरी की वर्तमान स्थिती

ठुमरी गायकी को लखनऊ के 'वाजिद अली षाह' के दरबार में बेपनाह आदर मिला। स्वयं नवाब 'अख्तर पिया' ठुमरी नाम से गीत रचा करते थे। ठुमरी गायकी के मुख्य दो अंग है। एक पूर्व अंग और दुसरा पंजाब अंग। पूर्व शैली का कला क्षेत्र

लखनऊ तथा बनारस है। इनमें बोल बाट की ठुमरी बोल बनाव की ठुमरी का प्रचार भी है। बोल बाट ठुमरी के गायकों तथा वाग्गेयकारों में कदर पिया, चांद पिया, बिन्दा पिया, दीन सनद पिया, ललन पिया, मथुरा के काले खाँ, 'सरस पिया' दिल्ली के 'कुवर श्याम' सुधा बैल ग्वालियर के नजर पिया आदि के प्रमुख नाम है।

अनेक घरानेदार एवं उच्चश्रेणी के प्रतिष्ठित ख्याल गायक भी बडे चौक से ठुमरी गाते है। जैसे रहमत खां, भास्कर राव, राजा भैया पंडू छ वाले, शंकरराव पंडित, फैयाज खां, करीम खां, भीमसेन जोषी, गूलाम मुस्तफा खां, इत्यादी। और गायिकाओं में रोषन आरा बेगम, सिद्धेश्वरी देवी, रसूल बाई, बेगम अख्तर, शोभा गुटू, सविता देवी इत्यादी।

फिल्म क्षेत्र में जगजीत सिंह, स्व. कुंदनलाल सहगल, मोहम्मद रफि, इत्यादी ठुमरी गायन में प्रसिद्ध थे। उस्ताद राशिद खा, की ठुमरी प्रसिद्ध है। गायक गायिकाओं के अतिरिक्त सितार, सरोद, षहनाई, बांसरी, इत्यादी वादकों के वादकों ने भी ठुमरी को बडे आदर से उपनाया।

उपसंहार

भारतीय संगीत में ठुमरी का हमारे आधुनिक संगीत में विशेष स्थान है। हमारे ध्रुपद, ख्याल, फिल्म के गायक-गायिका, वाद्य वादक इत्यादी इस लोकप्रिय षैली को अपनाना पड़ा और इस विषय में उदासिन और तटस्थ नहीं रह सके। ठुमरी की उत्पति, विकास और वर्तमान षैलीयों के अध्ययन से ज्ञात होता है कि ठुमरी देषीसंगीत की एक ऐसी उत्तर भारतीय गीतविधा है, जिसे मूलतः नर्तकीयाँ भावाभिनय नृत्य के साथ गाती थी। आज के युग में ठुमरी की स्थिती को देखते हुए यह निसंदेह कहा जा सकता है कि ठुमरी एक कलात्मक गेयविधा है और भारतीय संगीत में उसका स्थान अन्यतम है।

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International conference

Impact Factor-8.632 (SJIF) ISSN-2278-9308

B.Aadhar

Single Blind Peer-Reviewed & Refereed Indexed

Multidisciplinary International Research Journal

April -2023

ISSUE No - (CDVI) 406

Volume-B

Research Methodology in Social Science and Commerce

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INDEX-B

B.Aadhar International Peer-Reviewed Indexed Research Journal | ISSN : 2278-9308
Impact Factor -(SJIF) -8.632, Issue NO, (CDVI) 406- B | April, 2023

Use Of Research Techniques In Social Science

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Abstract :

Research is a tool of building block and a sustaining pillar of every discipline scientific or otherwise that one knows of. Before comprehending the true meaning of the term, we would like to make it clear that this is primarily focuses on the process of business research. The premise of this decision-oriented enquiry is vast and may range from the simplistic view, which involves compilation and validation of information, to an exhaustive theory and model construction.

Business to Business (B2B) is a transaction which occurs between two companies, that is to say, the consumer is not involved in the transaction of a company. The term may also refer to the total information of the company that provides goods or services to another company.

Techniques Of Research

Desk Research:-

Desk research is used to collect secondary data which is collected from previous research. Most research is published in electronic copy or hard copy of the research. Libraries, online databases and internet are important sources of the desk research.

Internet Research:-

Internet research tool is growing rapidly in the industrial market and e-intelligence is important in Business To Business research. It is used to find all the material and new findings of a research.

Qualitative Research:-

In this research there are three techniques used; they are focus groups, depth interviews and e-focus groups.

1. Focus groups:- It is a method using in qualitative research. It is a type of group discussion. In this participants are involved in debate or in discussions of a market for a product. The participants make comment or suggestions of a market they have scrutinised to the subject and the other participants have to confirm or reject the comment. In this the focus groups understand the motivations and prejudices of the participants. Focus groups have four key characteristics.

i) All participants are actively involved.
ii) The people have experience in the field of research.
iii) The researchers provide depth qualitative data
iv) Discussions will help the researchers understand what is going on the market.

i. Focus groups are small groups with five to ten people involved. The participants have diverse experience in the field and interaction allows all members to speak. In larger groups there is little time and opportunity to for discussion. Therefore small groups are better suited and obtain a small pool of ideas.

ii. The commonality of experience is crucial in order to find the people who give correct information to the research. In this the people are selected on the basis of their degree of homogeneity, recruitment, and their ability to attend all the groups.

iii. Depth information provides qualitative data which does not have numerical value. The data is presented in words, diagrams and symbols etc. The data will be presented by the researcher to the group. The moderator of the group or researcher will guide the group to get the discussions for getting more ideas, attitudes and experiences. It is having more important preferences than group interviews. In this the key factor of this methodology is interaction between the group members.

iv. The topic discussion is important in the focus group. Questions are given to the group participants to start the discussion in a comfortable manner to give ideas and experiences on the topic to research.

2. Depth Interviews:-

Depth interviews are conducted for differing data collection in research and take the form of traditional appointment in personal interviews about the research. Nowadays, telephone or web interviews are common. It is a time extended depth interview. In this the participants contact by phone or net for several days on the research. From this the researcher will consider the information in questions and stimuli of the interview. Again the researcher expresses them to follow up the interview.

3. E-focus groups:-

Online focus groups are the new innovation in taking the qualitative research methods. Technological advances help to conduct the market research when it can be difficult to interview groups. In the Business To Business group the e-focus is becoming popular in the market because they are offering many things. In e-focus group it is easy to conduct research because there is no need to transcribe or manually record the discussions because it is captured electronically. Online groups are more cost effective than traditional methods in viewing the rental, transportation and transcribing expenses. In this we can find some benefits through e-focus groups they are

i. Participants and researchers are participating in group from their offices or houses without travelling to the specific venue.

ii. Researchers can watch the views of the groups online and send the messages and directions to influence the topic through the moderator without disturbing the group session.

iii. In this the participants can participate throughout the world from their respective places. There is no need to come to the venue.

Quantitative Research:-

Quantitative Research is used to measure the market, calculating the measurement of the market size and qualifying the measurement of the data. In this the data is in market share, market segmentations, penetration, distribution levels and growth rate of the market.

In this research there are three techniques are used. They are CATI Interviews, sampling and e-surveys.

1. CATI Interview:

CATI stands for Computer Assisted Telephonic Interview. In this research telephone is playing an important role in the Business To Business market and it is easy to solve the large scale quantitative projects. From this we have many benefits. They are

I) From this interview we can reduce the interview error through navigating the data and increasing the accuracy of the data.

II) From this we will get immediate feedback of the data.

III) Getting more productivity with the lower cost.

IV) Complete the project rapidly, in a short period of time.

V) We are managing the quotas and multiple languages with great accuracy.

2. Sampling:

Sampling is a technique of selecting a suitable sample or gathering the information from the population by taking different parameters and considerations into account. In sampling the researchers use the rules of random sampling to applying for the consumer surveys in Business To Business research. In this sampling some researchers argue that '- as a rule of thumb-' in Business To Business surveys that all the samples are relative to the lower sample size because the researchers or consumers see the target market as comparable to the structured environments and on similar criteria they make decisions on it. In this fewer survey responses to see that the same pattern that to relevant to the rest of the target market. This process is controversial, and may be strongly influenced by the structure of the organisation. In this case it is easy to understand the study concentration of market. In Business To Business research there is homogeneity between constructing the consumer market and consumer type sampling method are used. One advantage in this sampling is collecting the data in random sampling or error in the result to calculate mathematically. Random sampling is expensive because it requires the list of the companies involved in the research for selection. From this the researcher chooses to take multi stage sampling. In multi stage sampling the companies is listed into separate groups which have different characteristics in common. These company groups are known as stratum companies. The strata group companies are also having same and it is based of selecting the "quota" sample. From this the researchers select the companies in the process of quota or proportions from the stratum group companies to carry out.

3. E-surveys:

In the past, web surveys were a very expensive methodology and slower for self completion than the postal surveys. With advances in technology it is preferable to collect data through web survey to evaluate the satisfaction of customer and staff. This provides product and service feedback immediately and it is evaluated in many Business To Business markets.

All researchers prefer to web surveys because it saves the time, cost and getting the accuracy of the data through levels in automatic routing.
At present e-surveys are done by the email invitations. From this we have to check the basic requirements of the survey.
i. The researcher should have the accurate and quality of email address list.
ii. The researcher has to see the audiences are using their computers and internet in their day to day working environment.
iii. The format of the survey should be a questionnaire type and it should be completed in ten minutes of time only.

From this survey the customers are answered to this survey then online survey is right technique for collecting the data.

This investigation has given an overview of the different tools and techniques used in research in the discipline of Business To Business marketing. It has looked at different methodological approaches and commented on their advantages and disadvantages.

Conclusion:-

The most important and difficult task of a researcher is to be objective and neutral as possible. The temptation to skew the results in the hypothesized direction has to be avoided at all costs. Magazine articles and newspaper surveys which want to prove a point might want to skew the opinion polls in favour of the Capitalists or the Republicans, or on the need for reservation versus no reservation in educational institutes but a researcher has to collect and display the findings of the research as objectively as possible.

Whatever the research may be, it is essential to collect the sources and equipments according to the subject. Likewise, the appropriate handling of there sources is also vital. Therefore that research depends on the research's work. At the same time to draw a conclusion through the use of subtle & clever interviewing skill as per appropriate time or conditions is also vital. There should not be any exaggeration through the questions so that the conclusion should be derived by asking relevant questions to the interviewer.

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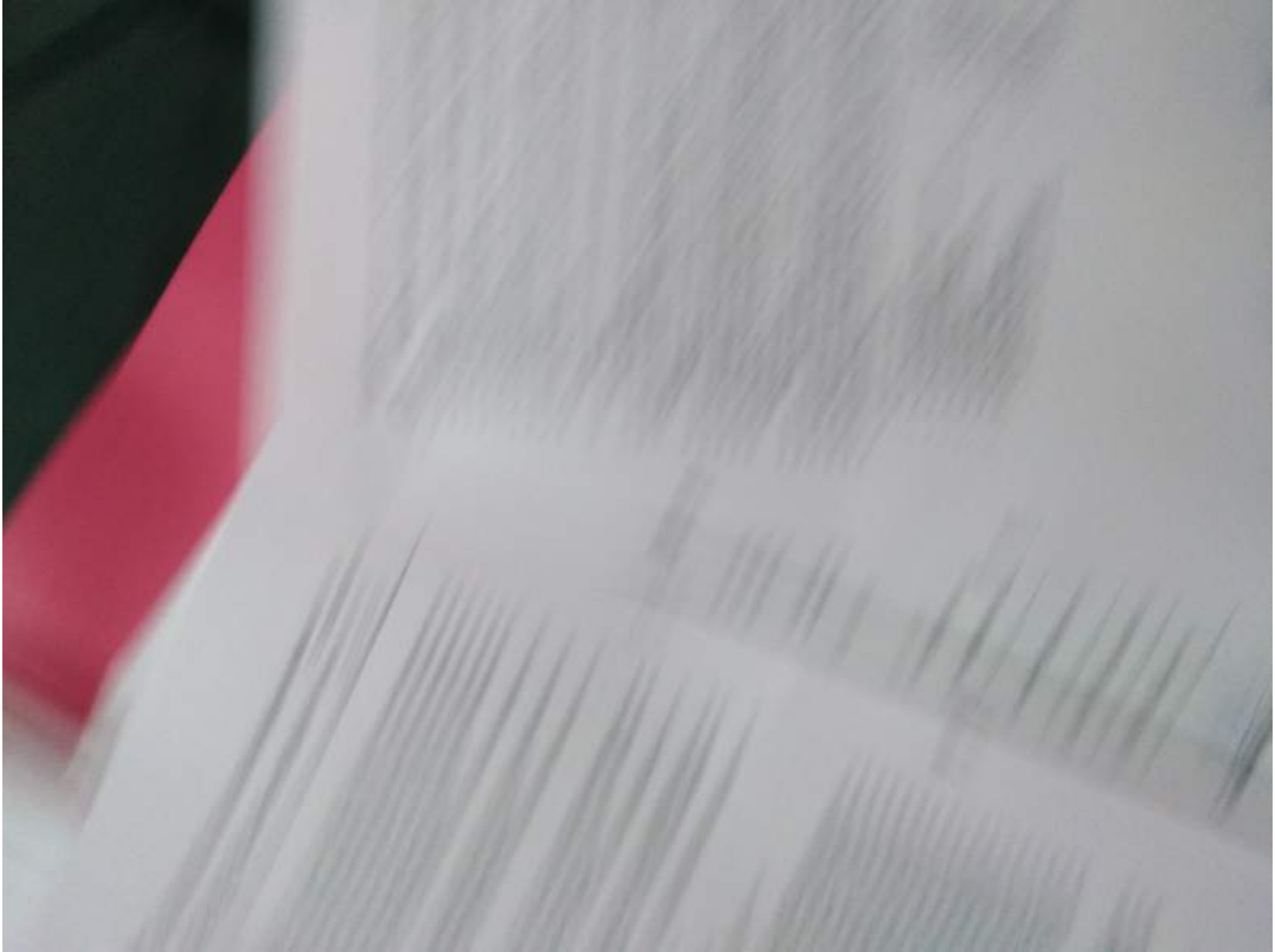

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Recent Trends in EDUCATION

: A Multidisciplinary Exploration

Editors

Dr. Ambadas B. Pande

Dr. Rupa Z. Gupta

Academic year

2023-24

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ISBN : 978-81-963340-8-6

Publishing Date : 11 November 2023

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Published By

Mr. Sandesh D. Pahulkar
Eagle Leap Printers And Publisher Pvt. Ltd.
Chinchwad, Pune - 411033
Mo. 8600071634

Printed By

Mr. Shivprasad D. Pahulkar
Eagle Leap Printers And Publisher Pvt. Ltd.
Chinchwad, Pune - 411033
Mo. 9604623206

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31 Tools of Effective Education-In Present Scenario

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Abstract :

Online learning is one of the new innovative study methods that have been introduced in the pedagogy field. In the last few years, there has been a great shift in the training methods. students can now learn remotely using the internet and computers.

Online learning comes in many forms and has been developing with the introduction of new technologies. Most of the universities, high schools and other institutions in the world have all instituted this form of learning and the student population in the online class is increasing fast. There has been a lot of research on the impacts of online education as compared to the ordinary classroom education.

Thesis Statement / Hypothesis

The thesis statement for this study is: "online learning has positive impact on the learners, teachers and the institution offering these courses"

Background study

Online learning or E learning is a term used to describe various learning environments that are conducted and supported by the use of computers and the internet. There are a number of definitions and terminologies that are used to describe online learning.

These include: E learning, distance learning, computer learning among others (Anon, 2001). Distant learning is one of the terminologies used in E learning and encompasses all learning methods that are used to train students that are geographically away from the training school. Online learning on the other hand is used to describe all the learning methods that are supported by the internet (Moore et al., 2011).

Another terminology that is used is E learning which has been described by most authors as a learning method that is supported by the use of computers, web enabled communication and the use of new technological tools that enhance communication (Spector, 2008). Other terminologies that are used to describe this form of online learning are virtual learning, collaborative learning, web based learning and computer supported collaborative learning (Conrad, 2006).

Impacts of online education

Various studies and articles documents the merits, demerits and challenges of online studies. These studies show that online study is far beneficial to the students, teachers and the institution in general and that the current challenges can be overcome through technological advancement and increasing efficiency of the learning process.

Another benefit is time and cost saving. Online students are able to study at home and this saves them the travel and accommodation costs. This is in contrast with the classroom environment where learners have to pay for transport and accommodation costs as well as any other costs associated with the learning process.

Online study has been found to reduce the workload on the tutors. Most of the online notes and books are availed to the students and this reduces the teacher's workload. Due to the availability of teaching materials online, tutors are not required to search for materials. Teachers usually prepare lessons and this

reduces the task of training students over and over again.

Accessibility to learning materials is another benefit of online learning. Students participating in online study have unlimited access to learning materials and this makes them have the ability to study effectively and efficiently. On the other hand, students in the classroom environment have to take notes as the lecture progress and these notes may not be accurate as compared to the materials uploaded on the websites.

Unlimited resources are another advantage of online study. Traditionally, learning institutions were limited on the number of students that could study in the classroom environment. The limitations of facilities such as lecture theaters and teachers limited the student enrollment in schools (Burgess & Russell, 2003).

However, with the advent of online studies, physical limitations imposed by classrooms, tutors and other resources have been eliminated. Vast number of students can now study in the same institution and be able to access the learning materials online. The use of online media for training enables vast number of students to access materials online and this promotes the learning process.

Promoting online study has been found by most of the resechers to open the students to vast resources that are found on the internet. Most of the students in the classroom environment rely on the tutors notes and explanations for them to understand a given concept.

However, student using the web to study at most of the time are likely to be exposed to the vast online educational resources that are available. This results to the students gaining a better understanding of the concept as opposed to those in the classroom environment (Berge & Giles, 2008).

Online study environment allows tutors to update their notes and other materials much faster as compared to the

classroom environment. This ensures that the students receive up to date information on a given study area.

One of the main benefits of E-learning to institutions is the ability to provide training to large number of students located at any corner of the world. These students are charged training fees and this increases the money available to the institution. This extra income can be used to develop new educational facilities and these will promote the education further (Gilli et al., 2002).

Despite the many advantages that online study has on transforming the learning process, there are some challenges imposed by the method. One of the challenges is the technological limitations of the current computers which affect the quality of the learning materials and the learning process in general.

Low download speed and slow internet connectivity affects the availability of learning materials. This problem is however been reduced through the application of new software and hardware elements that have high access speeds. This makes it easier to download leaning materials and applications. As the computing power increases, better and faster computers are being unveiled and these will enable better access to online study facilities.

Another disadvantage of online learning as compared to the classroom environment is lack of feedback from the students. In the classroom environment, students listen to the lecture and ask the tutors questions and clarifications of any issues they didn't understand. In the online environment, the response by the teacher may not be immediate and students who don't understand a given concept may find it hard to liaise with the teachers.

The problem is however been circumvented by the use of simple explanation methods, slideshows and encouraging discussion forums between the teachers and students. In the discussion forums, students who don't understand a concept can

leave a comment or question which will be answered by the tutor later.

Like any other form of learning, online studies have a number of benefits, and challenges. It is therefore not logical to discredit online learning due to the negative impacts of this training method. Furthermore, the benefits of e-learning far outweigh the challenges.

Conclusion

In culmination, a comparative study between classroom study and online study was carried out. The study was done by examining the findings recorded in books and journals on the applicability online learning to students. The study revealed that, online learning has many benefits as compared to the conventional learning in the classroom environment.

Though online learning has several challenges such as lack of feedback from students and lack of the proper technology to effectively conduct online learning, these limitations can be overcome by upgrading the E-Leaning systems and the use of online discussion forums and new web based software's.

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Learning Beyond the CLASSROOM : Higher Education for a Changing World

Edited by : Dr. Rita T. Deshmukh

Published by : DnyanPath Publication

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The editorial board does not necessarily agree with all the research articles included in this edited book.

Learning Beyond the CLASSROOM : Higher Education for a Changing World

Editor : Dr. Rita T. Deshmukh

Published by **DnyanPath Publication, Amravati (INDIA)**
The edition published in January, 2024

ISBN : 978-81-19435-33-3

DnyanPath® Publication
ISO 9001 : 2015

Reg. Office	:	FFS-A, Block C, First Floor, Venus Plaza, Shegaon Naka, V.M.V. Road, Amravati, Maharashtra 444 603
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Printed at - Shri Gurudeo Printers, Amravati.
Mahatma Fule Sankul, Shegaon Naka,
V.M.V. Road, Amravati - 444603 (Maharashtra)

₹ : 200/-

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