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Synthesis and Structural Elucidation of 1, 4 Dihydropyrimido [1, 2-a] Benzimidazole

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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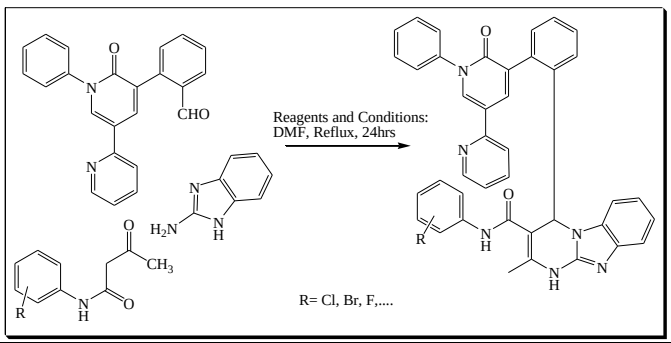
ABSTRACT

Considering various biomedical significance & with a view of pharmacological actions of compound belong to this class, new series of N-(substituted phenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1-4-dihydro pyrimido [1, 2-a] benzimidazole-3-carboxamide ware prepared. The formation of the compound was accomplished by cyclocondensation of 2-(1, 2-dihydro-2-oxo-1-phenyl-5-(pyridin-2-yl)pyridin-3-yl) benzaldehyde and N-(substituted phenyl)-3-oxobutanamide, 2-amino-benzimidazole under acid catalyzed conditions. The structures of pyrimidobenzimidazoles were determined by MASS, IR, 1H NMR spectroscopic techniques & Elemental analysis technique.



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Keywords: Pyrimidobenzimidazoles; carboxamide; biomedical; biginelli; dimethylformamide.

1. INTRODUCTION

Heterocyclic compounds are important class of molecules in organic chemistry. They have been developed since many decades through chemists due to their significant role in medicinal chemistry and make available as a type pattern for the growth of a hodgepodge of therapeutic agents [1-3]. Nitrogen containing heterocycles are widely used amongst all heterocyclic moieties whether it is five or six member ring. Most biologically-active chemical entities contain a heterocycle. It means that heterocycles have vital role to impart in the drug designing section. Heterocycles can be applied to modify various properties of biologically active compounds like polarity, solubility, toxicity etc in the drug development phase. The large variety of heterocyclic compounds is available due to advance synthetic methodologies developed by many scientists. Heterocycles can also be isolated from natural sources and it can be modify as per the requirements. Medicinal chemists play significant role here to identify the lead compound from natural sources and modify their structures to impart some characteristics or decreases the toxic effects during drug discovery process.

Multicomponent reaction a way out because they are good organized cost resourceful and less profligate than straight process. The products of temperature quick to respond reactions from kinetic path can be selectively inaccessible. As multicomponent coupling often complex compound in a single step, they are extensively studied in the era of modern organic chemistry [4]. Poly substituted pyrimido [1, 2-a] benzimidazoles display a wide array of medicinal activities. They bear structural resemblance to purine bases.

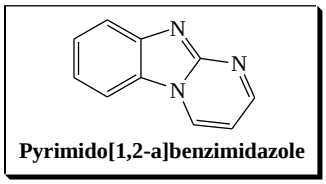


Fig. 1. Structure of pyrimido [1, 2-a] benzimidazole

It serves as a trail to produce molecular environmental that combats the normally expensive and time-consuming drug detection process whereby a small number of novel therapeutics arrive at the market place. The added investigational benefits of generating multifaceted structures from easy raw materials without complex procedures, long-lasting purification procedures get betters the synthetic approach for future youthful researchers wishing to donate products to a more systematically inventive civilization [5,6].

Pyrimidines have extensive and famed times gone by extending from the days of their judgment as significant part of nucleic acids to their present use in the AIDS chemotherapy.

Uracil, thymine and cytosine are the three important constituents of nucleic acids. Alloxan produces diabetes inducing reaction [7].

Pyrimidine class of compound are widely researched & employed as antibacterial agents [8]. Heterocycles bearing a benzimidazole moiety were reported to demonstrate a wide array of Medicinal properties like antimicrobial, anticonvulsant, anticancer, anti-inflammatory, analgesic, antidepressant, bioactivities, Antimicrobial, antimalerial, anticonvulsant, anticancer, anti-inflammatory, analgesic and antitubercular [9-17]. Some other experiments work done in our laboratory [16-20].

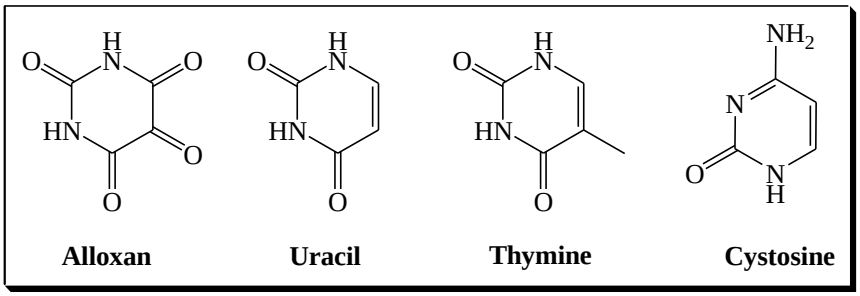


Fig. 2. Structure of pyridine base compounds

2. METHODOLOGY

An open capillary tubes method and uncorrected melting point were reported. Pattern of the compound was on the whole tartan by TLC on silica gel plates (0.51 mm) thickness and stain were situated by I_2 and Ultra Violate. Infrared spectra were documentation in Shimadzu instrument FTIR-8400 using KBr pellet method. Mass spectra were records on Shimadzu GC-MS-QP-2010 mold using express Injection probe method and Turbo spray model using chemical isolation technique. ^{1}H NMR was dogged in $CDCl_3$/dimethyl sulfoxide solution on a Bruker Ac 400 MHz spectrometer.

Common Methods for the preparation of N-(substitutedphenyl)-1,6-dihydro-[2,3'-bipyridin]-2-Methyl-4-(2-(6'-oxo-1'-phenyl-5'-yl)phenyl)- 1,4-dihydro pyrimido[1,2-a] benzimidazole-3-carboxamide (VK- 501 to 510)

A combination of the 2-amino benzimidazole (0.01 M) N-(substitutedaryl)-3-oxo-4-methyl pentanamides (0.02 M) and 2-(1,2-dihydro-2-oxo-1-phenyl-5-(pyridin-2-yl) pyridin-3-yl) benzaldehyde (0.01 M) was heated to reflux in dimethylformamide (20 ml) for 24 hrs. After attaining the room temperature methanol (~25 mL) was supplementary. The reaction mass was kept for 12-14 hours and then filtered to give the 1,4-dihydro pyrimido[1,2-a]benzimidazoles (VK-501 to 510), which were crystallization from alcohol.

N-(Phenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1-4-dihydropyrimido[1,2-a] benzimidazole-3-carboxamide (VK-501).

Yield: 65.3%; MP 170ºC; Mass: m/z 627.

IR (cm^{-1}): 3424 (υN-H secondary amide), 3094 (υC-H of aromatic ring), 2944 (υC-H asym of CH3 group), 2849 (υC-H asym of CH3 group), 1682 (υC=O of amide), 1594 (υN-H of pyrimidine ring), 1525 (υC=C of aromatic ring), 1454 (δ C-H asym of CH3 group), 1345 (υC-H sym of CH3 group), 1265 (υC-N), 742 (υC-H in plane of aromatic ring).

^{1}HNMR (DMSO d6) δ ppm: 1.48 (s 3H, Ha), 5.26 (s 1H, Hb), 6.86-6.88 (m 2H, Hcd), 6.98-7.00 (dd' 2H, Hee), 7.05-7.07 (dd' 2H, Hff'), 7.12-7.15 (m 4H, Hg-j), 7.28-7.29 (dd' 2H, Hkk), 7.47-7.49 (dd' 2H, Hll'), 7.68-7.69 (t 4H, Hm-p), 7.83-7.84 (dd' 2H, Hqq'), 8.45-8.48 (m 3H, Hr-t); 8.70 (s 1H, Hu), 8.88-9.2 (s 1H, Hv).

N-(4-Chlorophenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro -[2-3-bipyridin]-5-yl)-phenyl)-1-4-dihydro pyrimido[1,2-a] benzimidazole-3-carboxamide (VK-502).

Yield: 57%; mp 187ºC; MS: m/z 661.

IR (cm^{-1}): 3252 (υN-H secondary amide), 3075 (υC-H of aromatic ring), 2952 (υC-H $_{asym}$ of CH_3 group), 2824 (υC-H $_{asym}$ of CH_3 group), 1652 (υC=O of amide), 1602 (υN- H secondary amide), 1556 (υC=C of aromatic ring), 1496 (υC-H $_{asym}$ of CH_3 group), 1365 (υC-H $_{asym}$ of CH_3 group), 1266 (υC-N), 695 (υC-H in plane of aromatic ring), 695 (υC-Cl stretch).

1H NMR (Dimethyl sulfoxide-d6) δ ppm: 1.50 (s 3H, Ha), 5.36 (s 1H, Hb), 6.82-6.87 (m 2H, Hcd), 7.0-7.3 (dd' 2H, Hee), 7.07-7.1 (dd' 2H, Hff'), 7.11-7.18 (m 4H, Hg-j), 7.26-7.30 (dd' 2H, Hkk), 7.41-7.42 (dd' 2H, Hll'), 7.66-7.69 (t 4H, Hm-p), 7.81-7.84 (dd' 2H, Hqq'), 8.46-8.49 (m 3H, Hr-t); 8.72 (s 1H, Hu), 8.81 (s 1H, Hv).

N-(3-Chlorophenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1'-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1-4-dihydro pyrimido[1,2-a] benzimidazole-3-carboxamide(VK-503).

Yield: 63%; mp 188ºC; MS: *m/z* 661.

IR (cm^{-1}): 3360 (υN-.H secondary amide), 3082 (υC-H of aromatic ring), 2957 (υC-H $_{asym}$ of CH_3 group), 2850 (υC-H $_{asym}$ of CH_3 group), 1670 (υC=O of amide), 1608 (υN-H of pyrimidine ring), 1561 (υC=C of aromatic ring), 1450 (υC-H $_{asym}$ of CH_3 group), 1394 (υC-H $_{asym}$ of CH_3 group), 1263 (υC-N), 742 (υC-H in plane of aromatic ring), 690 (υC-Clstretch).

1H NMR (Dimethyl sulfoxide-d6) δ ppm: 1.49 (s 3H, Ha), 5.32 (s 1H, Hb), 6.84-6.87 (m 2H, Hcd), 7.2-7.3 (dd' 2H, Hee), 7.09-7.1 (dd' 2H, Hff'), 7.13-7.19 (m 4H, Hg-j), 7.27-7.31 (dd' 2H, Hkk), 7.44-7.45 (dd' 2H, Hll'), 7.67-7.70 (t 4H, Hm-p), 7.82-7.85 (dd' 2H, Hqq'), 8.45-8.49 (m 3H, Hr-t); 8.75 (s 1H, Hu), 8.80 (s 1H, Hv).

N-(4-Bromophenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1-4-dihydro pyrimido[1,2-a] benzimidazole-3-carboxamide(VK-504).

Yield: 58%; mp 182ºC; MS: *m/z* 706.

IR (cm^{-1}): 3217 (υN-H secondary amide), 3082 (υC-H of aromatic ring), 2950 (υC-H $_{asym}$ of CH_3

group), 2848 (υC-H $_{asym}$ of CH_3 group), 1645 (υC=O of amide), 1593 (υN-H of of pyrimidine ring), 1548 (υC=C of aromatic ring), 1506 (υC-H $_{asym}$ of CH_3 group), 1323 (υC-H $_{asym}$ of CH_3 group), 1244 (υ C-N), 745 (υC-H in plane of aromatic ring), 690 (υC-Br stretch).

1H NMR (Dimethyl sulfoxide-d6) δ ppm: 1.52 (s 3H, Ha), 5.39 (s 1H, Hb), 6.87-6.89 (m 2H, Hcd), 7.3-7.5 (dd' 2H, Hee), 7.1-7.2 (dd' 2H, Hff'), 7.12-7.19 (m 4H, Hg-j), 7.26-7.30 (dd' 2H, Hkk), 7.43-7.45 (dd' 2H, Hll'), 7.65-7.70 (t 4H, Hm-p), 7.84-7.88 (dd' 2H, Hqq'), 8.47-8.51 (m 3H, Hr-t); 8.75 (s 1H, Hu), 8.86 (s 1H, Hv).

N-(3-Bromophenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1-4-dihydro pyrimido[1,2-a] benzimidazole-3-carboxamide (VK-505).

Yield: 55%; MP 178ºC; MS: *m/z* 706.

IR (cm^{-1}) : 3446 (υN-H secondary amide), 3096 (υC-H of aromatic ring), 2948 (υC-H $_{asym}$ of CH_3 group), 2805 (υC-H $_{asym}$ of CH_3 group), 1705 (υC=O of amide), 1633 (υN-H of pyrimidine ring), 1528 & 1440 (υC=C of aromatic ring), 1386 (δC-H $_{asym}$ of CH_3 group), 1300 (υC-H $_{asym}$ of CH_3 group), 1256 (υC-N), 775 (υC-H in plane of aromatic ring), 695 (υC-Br stretch)

1H NMR (Dimethyl sulfoxide-d6) δ ppm: 1.51 (s 3H, Ha), 5.38 (s 1H, Hb), 6.87-6.88 (m 2H, Hcd), 7.1-7.3 (dd' 2H, Hee), 7.09-7.1 (dd' 2H, Hff'), 7.13-7.19 (m 4H, Hg-j), 7.29-7.31 (dd' 2H, Hkk), 7.46-7.47 (dd' 2H, Hll'), 7.67-7.69 (t 4H, Hm-p), 7.83-7.87 (dd' 2H, Hqq'), 8.46-8.49 (m 3H, Hr-t); 8.75 (s 1H, Hu), 8.84 (s 1H, Hv).

N-(4-Fluorophenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1-4-dihydro pyrimido[1,2-a] benzimidazole-3-carboxamide (VK-506).

Yield: 62.82%; MP 189ºC; MS: *m/z* 645.

IR (cm^{-1}): 3392 (υN-H secondary amide), 3059 (υC-H of aromatic ring), 2926 (υC-H $_{asym}$ of CH_3 group), 2847 (υC-H $_{asym}$ of CH_3 group), 1647 (υC=O of amide), 1591 (υN-H of pyrimidine ring), 1548 & 1508 (υC=C of aromatic ring), 1406 (δ C-H $_{asym}$ of CH_3 group), 1340 (υC-H $_{asym}$ of CH_3group), 1271 (υC-N), 1026 (υC-Fstretch), 730 (υC-H in plane of aromatic ring).

N-(3-Fluorophenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1,4-dihydro pyrimido[1,2-a] benzimidazole-3-carboxamide (VK-507).

Yield: 66%; MP 187ºC; MS: *m/z* 645.

IR (cm^{-1}): 3300 (υN-H secondary amide), 3001 (υC-H of aromaticring), 2933 (υC-H $_{asym}$ of CH_3 group), 2850 (υC-H $_{asym}$ of CH_3 group), 1687 (υC=O of amide), 1526 (υN-H of pyrimidine ring), 1533 & 1465 (υC=C of aromaticring), 1344 (δ C-H $_{asym}$ of CH_3 group), 1292 (υC-H $_{asym}$ of CH_3 group), 1197 (υC-N), 1010 (υC-Fstretch), 748 (υC-H in plane of aromatic ring).

N-(4-Methylphenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1-4-dihydro pyrimido[1,2-a] benzimidazole-3-carboxamide (VK-508).

Yield: 63%; mp 183ºC; MS: m/z 641.

IR (cm^{-1}): 3116 (υN-H secondary amide), 3000 (υC-H of aromatic ring), 2942 (υ C-H asym of CH3 group), 2856 (υC-H asym of CH3 group), 1627 (υC=O of amide), 1528 (υN-H of pyrimidine ring), 1454 & 1442 (υC=C of aromatic ring), 1365 (υC-H asym of CH3 group), 1299 (υC-H asym of CH3 group), 1238 (υC-N), 774 (υC-H in plane of aromatic ring)

N-(4-Methoxyphenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1-4-dihydro pyrimido[1,2-a] benzimidazole-3-carboxamide (VK-509).

Yield: 61%; mp 184ºC; MS: *m/z* 657.

IR (cm^{-1}): 3114 (υN-.H secondary amide), 3009 (υC-H of aromatic ring), 2956 (υC-H $_{asym}$ of CH_3 group), 2894 (υC-H $_{asym}$ of CH_3 group), 1657 (υC=O of amide), 1576 (υN-.H of pyrimidine ring), 1518, 1502 & 1460 (υC=C of aromatic ring), 1345 (υC-H $_{asym}$ of CH_3 group), 1324 (υC-H $_{asym}$ of CH_3 group), 1257 (υC-N), 731 (υC-H in plane of aromatic ring).

N-(4-Nitrophenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1-4-dihydro pyrimido[1,2-a] benzimidazole-3-carboxamide (VK-510).

Yield: 71%; mp 181ºC; MS: m/z 672.

IR (cm^{-1}): 3390 (υN-H secondary amide), 3028 (υC-H of aromatic ring), 2936 (υC-H asym of

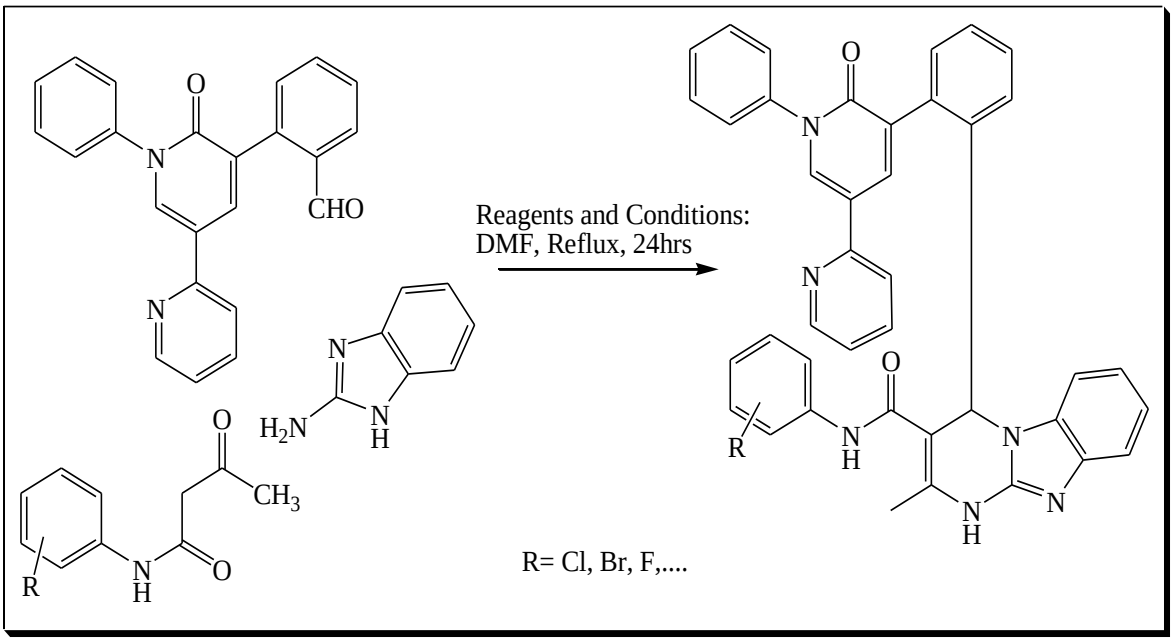
CH3 group), 2853 (υC-H asym of CH3 group), 1687 (υC=O of amide), 1611 (υN-H of pyrimidine ring), 1532, & 1446 (υC=C of aromatic ring), 1364 (υC=C of Aromatic ring), 1333 (υC-H sym of CH3 group), 1275 (υC-N), 1275 (υC-N), 750 (υC-H in plane of Aromatic ring)

3. RESULTS AND DISCUSSION

The bioactivity potential of 1, 4-dihydropyrimido [1, 2-a] benzimidazoles is widely reported. Further, diversely substituted derivatives of this class of compound have depicted impressive medicinal profile.

Man-made ways to 1, 4-dihydropyrimido [1, 2-*a*] benzimidazoles is pedestal on the **Biginelli** like cyclo combination of new -CHO and N-(substituted phenyl)-3-oxobutanamide with 2-amino benzimidazole.

Noting a range of claim biomedical and with a view further to deem the Medicinal profile of this set of compound, narrative series of N-(substituted phenyl)-2-methyl-4-(2-(6-oxo-1-phenyl-1-6-dihydro-[2-3-bipyridin]-5-yl)phenyl)-1-4-dihydropyrimido[1,2-a] benzimidazole-3-carboxamide (VK-501 to VK-510) were manufactured. The manufacture of (VK-501 to VK-510) were achieved by reaction of N-(substituted phenyl)-3-oxobutanamide, 2-aminobenzimidazole and 2-(1,2-dihydro-2-oxo-1-phenyl-5-(pyridin-2-yl)pyridin-3-yl)benzaldehydein the presence of HCl.

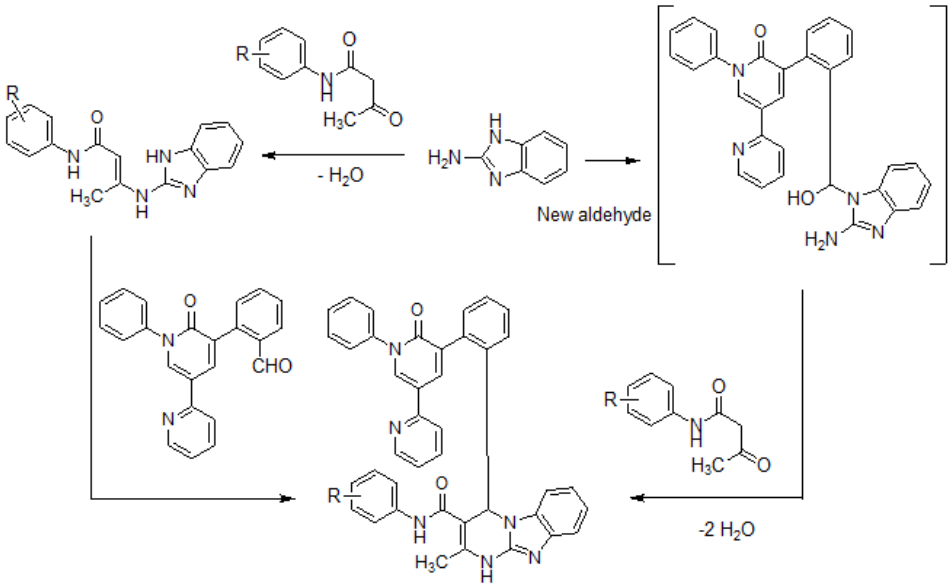


Scheme 1. Reaction scheme of pyrimidine derivatives

Table 1. Physical data

Code	R	Molecular formula	Molecular Weight	Melting Point °C	R_f	Yield
VK-501	H	$C_{40}H_{30}N_6O_2$	627	170	0.43	64
VK-502	4-Cl	$C_{40}H_{29}ClN_6O_2$	661	187	0.44	57
VK-503	3-Cl	$C_{40}H_{29}ClN_6O_2$	661	188	0.50	63
VK-504	4-Br	$C_{40}H_{29}BrN_6O_2$	706	182	0.49	58
VK-505	3-Br	$C_{40}H_{29}BrN_6O_2$	706	178	0.43	55
VK-506	4-F	$C_{40}H_{29}FN_6O_2$	645	189	0.44	62
VK-507	3-F	$C_{40}H_{29}FN_6O_2$	645	187	0.46	66
VK-508	4-Me	$C_{41}H_{32}N_6O_2$	641	183	0.40	63
VK-509	4-OMe	$C_{41}H_{32}N_6O_3$	657	184	0.50	61
VK-510	4-NO_2	C40H29N7O4	672	181	0.47	71

3.1 Plausible Reaction Mechanism



Scheme 2. Plausible reaction mechanism

4. CONCLUSION

In conclusion, Our study commenced with different types of N-(substituted phenyl)-3-oxobutanamide, 2-aminobenzimidazole, two new special kind of aldehyde as 4-(4-(trifluoromethyl)-2-nitrophenoxy)-2-hydroxybenzaldehyde and 2-(1,2-dihydro-2-oxo-1-phenyl-5-(pyridin-2-yl)pyridin-3-yl)benzaldehyde in presence of DMF (N,N'-Dimethyl formamide) as solvent. The reaction proceeds with fast rate and yields good to high percentage of product. Structure ware elucidated by IR, mass and NMR.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. White A, C, Black RM. US Patent 3, 1997, 989, 709; Chemical Abstract. 1977;86:72694c.
2. Vartale P, SP, Ubale PN, Sontakke SG, Halikar NK, Pund MM. Antioxidant and antimicrobial evaluation of pyrimido [1, 2-a] benzimidazoles. World Journal of Pharmaceutical Sciences, 2014;2,:665–670.
3. Forche Asobo P, Wahe H, Mbafor JT, Nkengfack AE, Fomum ZT, Sopbue EF, Döpp D. Heterocycles of biological importance. part 5. the formation of novel biollogically active pyrimido [1,2-a] benzimidazoles from allenic nitriles and aminobenzimidazoles. Journal of the Chemical Society, Perkin Transactions. 2001;1:457–461. Available:https://doi.org/10.1039/B005511P
4. Haas CP, Tallarek U. Kinetics studies on a multicomponent knoevenagel−michael domino reaction by an automated flow reactor. Chemistry Open. 2019;8:606-614. Available:https://doi.org/10.1002/open.201900124
5. Chandra Kant Belwal, Kaushik A Joshi. Synthesis and antimicrobial screening of 2-[(5,6-dimethoxy-2,3-Dihydro-1h-inden-1-ylidene)hydrazinylidine]-1,3-thiazolidin-4-one and its 5-arylidine derivatives. Heterocyclic Letters. 2014;4(1):65-71.
6. Chauhan V, Joshi KA, Ram HK. Synthesis of Novel schiff base of 3-(2, 4-Disulfamoylanilne) morpholine derivatives.

International Journal For Pharmaceutical Research Scholars. 2015;4(4):178-182.
7. Goldner MG, Spergel G. On the transmission of alloxan diabetes and other diabetogenic influences. Adv, Metabolic Disorder. 1972;6:57-72. Available:https://doi.org/10.1016/B978-0-12-027306-5.50007-3
8. Mohamed MS, Awad SM, Sayed AI. Molecules. 2010;15:1882-1890. Available:https://doi.org/10.3390/molecules15031882
9. Kumari NS, Lingappa B, Girisha KS, Rai S, Kalluraya BN. Ind J Chem. 2008;47B:1858-1864.
10. Gitto R, Caruso R, Orlando V, Quartarone S, Barreca ML, Ferreri G, Russo E, Sarro G, Chimirri A. IL FARMACO. 2004;59:7-12. Available:https://doi.org/10.1016/j.farmac.2003.10.003
11. Shrivastava N, Naim MJ, Alam MJ, Nawaz F, Ahmed S, Alam O. Arch. Pharm. Chem. Life Sci. 2017;350:e1700040. Available:https://doi.org/10.1002/ardp.201700040
12. Gaba M, Gaba P, Uppal D, Dhingra N, Bahia MS, Silakari O, Mohan C. Benzimidazole derivatives: Search for GI-friendly anti-inflammatory analgesic agents. Acta Pharm Sin B. 2015;5:337-342. Available:https://doi.org/10.1016/j.apsb.2015.05.003
13. Gaba M, Singh S, Mohan C. Benzimidazole: An emerging scaffold for analgesic and anti-inflammatory agents. Eur. J. Med. Chem. 2014;76:494-505. Available:https://doi.org/10.1016/j.ejmech.2014.01.030
14. Araujo DML, Maste MM, Alegaon S, Saxena A. Synthesis, antitubercular evaluation and docking studies of novel benzimidazole analogues. IJPSR. 2018;9:3696-3704. DOI:10.13040/IJPSR.0975-8232.9(9).3696-04
15. Dokla EME, Abutaleb NS, Milik SN, Li D, Elbaz K, Shalaby MA, Al-Karaki R, Nasr M, Klein CD, Abouzid KAM, Seleem MN. E. J. Med. Chem. 2020;186:111850. Available:https://doi.org/10.1016/j.ejmech.2019.111850
16. Siddiqui N, Alam Md. S, Sahu M, Yar MS, Alam O, Siddiqui Md. JA. Antidepressant, analgesic activity and SAR studies of substituted benzimidazoles. Asian J. Pharm. Res. 2016;6:170-174. DOI: 10.5958/2231-5691.2016.00024.1
17. Kuchekar B, Pore Y. Dig. J. Nanomater Bios. 2008;3:293-298.
18. Joshi KA, Makwana NR. Synthesis and biological screening of N-((2-(4-Fluorophenyl)-6-methylh- Imidazo[1,2-A] Pyridin-3-Yl)Methyl)-4-arylamines. International Journal for Innovative Research in Multidisciplinary Field. 2019;7:16-21.
19. Joshi VN*, Joshi KA, Modhavadiya VA. Synthesis and characterization of fluoropyrimidine derivatives. European Journal of Biomedical and Pharmaceutical sciences. 2017;4(12):374-377.
20. Kaushik A. Joshi*, Haresh K Ram. Synthesis a number of unimpeachable pyrimidine derivatives. International Journal of Applied Chemistry. 2017; 13(1):135-140.

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