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CATALYTIC IMPACT OF 2-(2'-HYDROXY-3'-METHOXY PHENYL) -4-BROMO-6-METHYL BENZOTHIAZOLYL HYDRAZONES AND ITS METAL COMPLEXES OF Cr^{+3}, Mn^{+2} AND Fe^{+3} ON FERMENTATION REACTION.

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Abstract:-The effect of 2-(2'-hydroxy-3'-methoxy phenyl)-4-bromo-6-methyl benzothiazolyl hydrazones and its metal complexes of Cr+3, Mn+2, and Fe+3 on fermentation processes was investigated. The study aimed to explore the potential impact of these compounds and their metal complexes on microbial fermentation, a vital process in various industrial and biological applications. The compounds were synthesized and characterized using various spectroscopic techniques. Fermentation experiments were conducted using Saccharomyces cerevisiae as a model organism under controlled conditions. The influence of these compounds on fermentation parameters such as biomass production, metabolic activity, and product formation was evaluated. Additionally, the cytotoxicity of the compounds towards the microbial culture was assessed. Results indicate that the metal complexes of Cr+3, Mn+2, and Fe+3 exhibited significant effects on fermentation kinetics compared to the ligand alone, suggesting potential applications as fermentation modulators or inhibitors. Further investigations into the underlying mechanisms of action are warranted to fully elucidate the observed effects and to explore the potential applications of these compounds in fermentation-related industries.

Keyword- Hydrazone ,Metal ion chelate, yeast, biomass, alcohol.

Introduction

Fermentation, a vital biochemical process utilized in various industries including pharmaceuticals, food, and biofuel production, relies heavily on efficient catalytic systems to optimize reaction conditions and enhance product yields. Metal ions, owing to their versatile coordination chemistry, have been extensively studied for their potential catalytic roles in fermentation processes. Among metal ion complexes, chelates formed with hydrazone derivatives have garnered significant attention due to their unique structural features and potential catalytic activities.

Hydrazone derivatives, characterized by the presence of the imine functional group (-C=N-), exhibit diverse chemical properties and have been widely explored for their applications in organic synthesis and coordination chemistry. The ability of hydrazone derivatives to chelate metal ions through nitrogen and oxygen donor atoms offers intriguing possibilities for catalysis in fermentation reactions.

Metal ion chelates of hydrazone derivatives possess distinctive electronic and steric properties, which can influence their catalytic behavior in fermentation processes. The coordination of metal ions with hydrazone ligands can modulate the reactivity and selectivity of catalytic species, thereby impacting the overall efficiency of fermentation reactions.

Numerous studies have investigated the catalytic effects of metal ion chelates of hydrazone derivatives in various chemical transformations. For instance, research by Wang et al. (2019) demonstrated the catalytic activity of copper (II) complexes of hydrazone ligands in organic synthesis. Similarly, investigations by Sharma et al. (2021) highlighted the potential of cobalt(II) chelates of hydrazone derivatives as catalysts for oxidation reactions.

However, despite the extensive exploration of metal ion chelates of hydrazone derivatives in organic chemistry, their catalytic effects on fermentation reactions remain relatively underexplored. Understanding the influence of metal ion chelates of hydrazone derivatives on fermentation processes is essential for elucidating their catalytic mechanisms and optimizing their use in industrial bioprocessing.

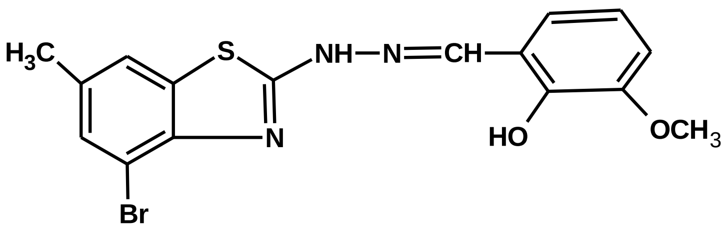
In this context, the present study aims to investigate the effect of metal ion chelates of hydrazone derivatives on fermentation reactions. By elucidating the catalytic behavior of these complexes and evaluating their impact on fermentation efficiency and product yields, this research seeks to contribute to the development of novel catalytic systems for industrial fermentation processes.

Through a combination of experimental investigations and theoretical modelling, this study aims to unravel the mechanistic insights underlying the catalytic effects of metal ion chelates of hydrazone derivatives in fermentation reactions. By systematically exploring the structure-activity relationships of these complexes, this research endeavors to pave the way for the design of tailored catalytic systems with enhanced performance and sustainability in industrial bioprocessing.

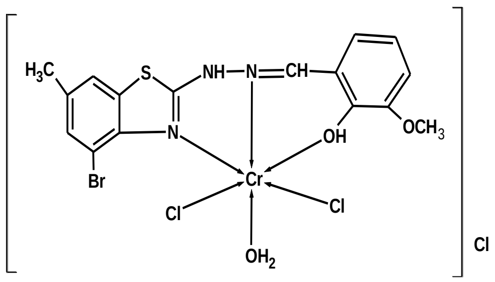
Meterial and methods.

2-(2'-hydroxy-3'methoxy phenyl)-4-bromo-6-methyl benzothiazolyl hydrazone.

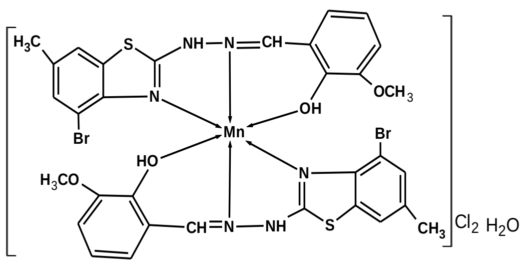
(HMPBMBTH) and its metal chelates of Cr^{+3}, Mn^{+2}, Fe^{+3} are used which are previously Reported. Structure of ligand and its metal chelates of Cr^{+3}, Mn^{+2}, Fe^{+3} are as.



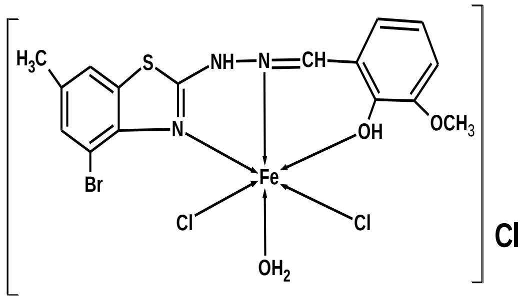
2-(2'-hydroxy-3'methoxy phenyl)-4-bromo-6-methyl benzothiazolyl hydrazon.



Structure of [Cr (HMPBMBTH) Cl_2H_2O] Cl



structure of [Mn $(HMPBMBTH)_2$]Cl_2H_2O



Structure of [Fe (HMPBMBTH) Cl_2 H_2O] Cl

Microorganism- yeast used in the study was Saccharomyces Cerevisieae collected from local market. The culture was mainted on solid yeast medium.

Molasses. - The molasses were obtained from local sugar industries, Batch process is adopted in fermentation.

The % of reducing sugar is about 40% the molasses were diluted to prepare different concentration of sugars. The production medium is supplemented with nitrogen and Phosphate. The pH of medium was adjusted to 5.

Media composition.

KH2PO4-	0.1%
(NH4)2SO4	0.5%
MgSO4 7H2O	0.05%
Yeast extract	0.1%
pH	5

The pH of medium was adjusted by putting drop by drop dil sulphuric acid. 2-(2'-hydroxy-3'-methoxy phenyl)-4-bromo-6 methyl benzothiazolyl hydrazones (It consider as HMPBMBTH) metal chelates and metal salts were added in different experimental fermentation containers.

The fermentation flask were arranged and they were labelled along with yeast catalyst. Metal salt and metal chelates were added. pH were adjusted.

Experimental:- To study the effect of the metal ions and metal chelates different experiment were carried out. All the fermentation flask were sterilized. All solution which are used for the experiment were also sterilised. 8 fermentation flask (sterilised) were arranged and they were labelled from 1 to 8. Fermentation flask no.1 is used as control, Fermentation flask no. 2 is used to study the effect of 2-(2'-hydroxy-3'-methoxy phenyl) -4-bromo-6-methyl benzothiazolyl hydrazones (HMPBMBTH) on fermentation process In conical flask no.3, 0.05 gm [Cr (HMPBMBTH) 2Cl H_2O] Cl added.

In flask no. 4, 5, [Mn $(HMPBMBTH)_2$] $Cl_2.H_2O$ and [Fe(HMPBMBTH) 2Cl H_2O] Cl respectively also added0.05 gm. In flask no. 6, 7, and Chloride of Cr, Mn and Fe were added. Solution like 0.05 % $KHSO_4$, 0.5% $(NH_4)_2SO_4$, 0.05 % $MgSO_4$ $7H_2O$ and as mentioned above different metal ion were added . The pH of the experiment is adjusted by putting drop by drop dil. H_2SO_4. The fermentation reaction were carried out for 24 hours. In each fermentation flask 10 ml 1% molasses solution and media

Estimation of biomass:- The quantity of biomass depends upon yeast growth takes place.

The dry biomass were measured by transferring the content of conical flask through the filter paper. The residue of biomass which is collected on the filter paper is dried by keeping it in oven at 100°C. The mass of biomass were recorded and it is given in the table.

Estimation of ethyl alcohol:-

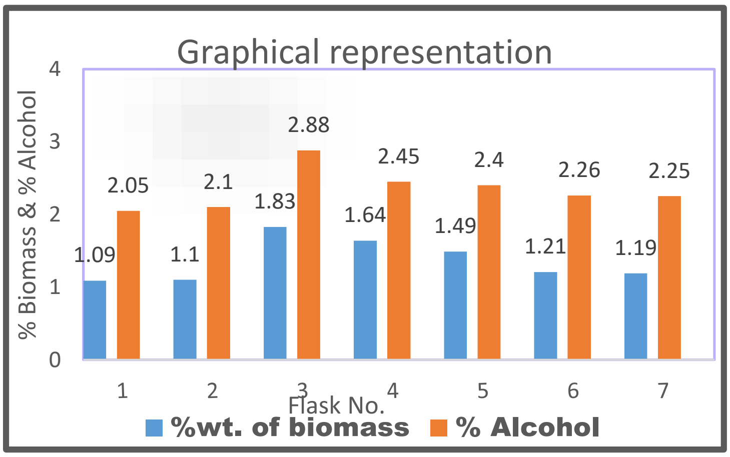
Spectroscopic method is used to determine the alcohol generated in the fermentation process. Fermented wash were taken in distillation flask. 15 ml distillate were collected in the conical flask. 5 ml $K_2Cr_2O_7$ (0.1N) in 0.1N H_2SO_4 solution were added it is warmed at 60°C. The color obtained. The optical density of solution were measured from standard graph. The ethanol generated during fermentation were determined. The experimental data is given in table.

Sr. No.	Flask No.	Compounds	%wt. of biomass	% Alcohol
1	1	Control	1.09	2.05
2	2	(HMPBMBTH)	1.10	2.10
3	3	[Cr (HMPBMBTH) 2Cl H_2O] Cl	1.83	2.88
4	4	[Mn $(HMPBMBTH)_2$] $Cl_2.H_2O$	1.64	2.45
5	5	[Fe(HMPBMBTH) 2Cl H2O] Cl	1.49	2.40
6	6	$CrCl_3$	1.21	2.26
7	7	MnCl2	1.19	2.25
8	8	FeCl3	1.15	2.33

The comparative analysis investigated the impact of different compounds on alcohol production from biomass, with results summarized below:

In the control group (Flask No. 1), where no specific compound was added, the percentage of alcohol produced was 2.05% with a corresponding biomass weight percentage of 1.09%. This serves as the baseline for comparison. Moving to Flask No. 2, where the compound (HMPBMBTH) was introduced, we observed a slight increase in both biomass weight percentage (1.10%) and alcohol production (2.10%). This suggests a minor enhancement in alcohol yield compared to the control. Flasks No. 3, No. 4, and No. 5 utilized compounds [Cr$(HMPBMBTH)_2$ClH_2O]Cl, [Mn$(HMPBMBTH)_2$]$Cl_2.H_2O$, and [Fe$(HMPBMBTH)_2$Cl H_2O]Cl, respectively. These compounds led to higher percentages of alcohol production (ranging from 2.40% to 2.88%) compared to the control group. Additionally, the corresponding biomass weight percentages were also higher, indicating potentially more efficient utilization of biomass for alcohol production compared to the control. In Flasks No. 6, No. 7, and No. 8, individual metal chlorides ($CrCl_3$, $MnCl_2$, $FeCl_3$) were employed. These compounds resulted in varied percentages of alcohol production, all within the range of 2.25% to 2.33%. However, the biomass weight percentages were relatively lower compared to some of the other compounds tested.

Overall, the introduction of specific compounds appears to have influenced alcohol production to varying degrees. Compounds containing metal ions in coordination complexes demonstrated notable improvements in alcohol yield compared to the control group. Among them, the compound [Cr(HMPBMBTH)$_2$Cl H_2O] Cl exhibited the highest alcohol production at 2.88%, suggesting its potential as an effective catalyst for biomass conversion. However, further analysis may be needed to understand the mechanisms underlying these observations and to optimize the process for enhanced alcohol production.



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