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 [ijirset@gmail.com](mailto:ijirset@gmail.com)

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# Preparation and characterization of compounds obtained by the interaction of D-Ribose with TBC & TAC

Kriti Kumari<sup>1</sup>, Hari Om Pandey<sup>2</sup>

Research Scholar, Dept. of chemistry, Ranchi University, Morabadi Ranchi, Jharkhand, India<sup>1</sup>

Associate Professor, Dept. of chemistry, Ranchi University, Morabadi Ranchi, Jharkhand, India<sup>2</sup>

**ABSTRACT:** The synthesis and characterization of compounds resulting from the interaction of D-Ribose with tert-butyl chromate (TBC) and tert-amyl chromate (TAC) were explored. Initially, controlled reactions were conducted between D-Ribose and TBC/TAC, followed by isolation and purification of the resulting compounds. Characterization was then carried out using various analytical techniques, including FTIR spectroscopy, TGA-DTA Thermal loss, and elemental analysis. Microwave irradiation emerged as a significant tool for accelerating these chemical reactions, offering benefits such as reduced reaction times and improved yields. The catalytic activity of DTBC and DTAC played a pivotal role in promoting efficient and selective synthesis under mild reaction conditions. Moreover, the study emphasized the environmentally friendly aspects of the microwave-assisted synthesis process and its potential applications in carbohydrate chemistry. By employing these analyses, the study provided insights into the molecular structure, functional groups, purity, and elemental composition of the synthesized compounds. Ultimately, this investigation contributes to a deeper understanding of the chemical reactivity and potential applications of the compounds formed through the interaction of D-Ribose with TBC and TAC.

**KEY WORDS:** Di tertiary amyl chromate (DTAC), Di tertiary butyl chromate (DTBC), Carbohydrates (Ribose), CrO<sub>3</sub>, FTIR, TGA-DTA, TAA (tert. amyl alcohol), Distilled water (DW), TBA (tert. butyl alcohol).

## I. INTRODUCTION

Ribose, classified as a simple sugar [1] and carbohydrate, has the molecular formula of C<sub>5</sub>H<sub>10</sub>O<sub>5</sub>. Its linear structure is composed of a series of carbon and oxygen atoms, forming the backbone H-(C=O)-(CHOH)<sub>4</sub>-H. In its naturally-occurring form, known as d-ribose [2], this sugar serves as a fundamental building block of ribonucleotides [3], the molecular units that constitute RNA. Its structural simplicity, comprising a linear pentose [4] sugar with all hydroxyl groups in the D-configuration, makes it highly versatile for chemical modifications and enzymatic transformations. D-Ribose exhibits solubility in water but is insoluble in ethanol. Ribose is a sugar that is naturally produced by the body from food. It is a natural part of DNA and RNA and is required for many processes in the body. Di-tert-butyl chromate [5-11] (DTBC) & Di-tert-amyl chromate (DTAC), among other chromium (VI)-based oxidants, have been extensively utilized for the oxidation of a diverse range of organic compounds. This includes various transformations such as alcohol oxidations, heteroatom oxidations, and functional group conversions. DTBC & DTAC stands out for its efficiency and selectivity in promoting these oxidation reactions, making it a valuable tool in organic synthesis. In the present work the oxidation products of D-Ribose with TBC in various molar ratios have been studied. Two samples were prepared using Distilled water as a solvent. The solid products obtained were isolated & characterized on the basis of elemental analysis, thermogravimetric study FTIR peaks.

## II. LITERATURE SURVEY

In the present work the literature survey has been done on applications of microwave assisted organic reactions. A large no. of oxidants has been used to oxidize the substrates to do the organic synthesis. The literature survey of following topics is described: -

1. Microwave assisted organic reactions (MAOS)
2. Ditertiary butyl chromate
3. Ditertiary amyl chromate
4. Oxidation by chromium-based oxidants

TBC and TAC have been used as a versatile Cr (VI) oxidant and its efficiency towards oxidation of a large variety of organic compounds. It was reported by H. Obberauch & R.V Oppenauer [12] in 1949. The numerous of research journals have been described over a few decades. Some of the recent work with this reagent have been briefly discussed below:

1. The degradative oxidation products of Crotonaldehyde by TBC (Ditertiary Butyl Chromate) and TAC (Ditertiary Amyl Chromate) by Hari Om Pandey, Sangeeta Katre, A.K. Gupta [13].
2. Crotonic acid oxidation with TBC in different research reported by G D Mishra, Hari Om Pandey and Reshma Praveen [14] establishes the change in nature of the oxidation products with increasing concentration of oxidant used.
3. Oxidation of propane 1,2-diol and crotonaldehyde with TBC and Tert.amyl alcohol was studied by H.O. Pandey and Anita K. Gupta [15] in different solvents with varying substrate oxidant molar ratio and in this case also the products were found to be the complex of chromium in its reduced oxidation state.
4. H.O. Pandey and Sangeeta Katre [16] carried out the oxidation of crotonaldehyde with TBC and tert-amyl chromate (TAC) in a microwave reactor and observed different oxidation products varies with changes in the molar ratio of reactants or conditions, this in chemical reactions.

### III. MATERIALS AND METHODS

1. **Chemical used:** The chemicals used in synthesis of complex from Acros, Rankem and Merck. Throughout this study, only freshly prepared solutions were utilized. The chemicals utilized included D-Ribose, DW (Distilled water), TBA (Tertiary butyl alcohol), acetone, Chromium (VI) oxide, silver nitrate, potassium persulphate, ammonium iron (II) sulphate (Mohr's salt), potassium dichromate, barium diphenylamine-4-sulphonate.

2. **Synthesis:**

In the experimental setup, D-Ribose was dissolved in distilled water in the first beaker, (substrate), while chromium trioxide was dissolved in tertiary butyl alcohol in the second beaker, forming tertiary butyl chromate (oxidant). The two solutions were mixed together using different molar ratios. The resulting products were subsequently washed with water and acetone, finalizing the purification process. Following the mixing process, a solid compound with a dark bluish ash colour was obtained. This synthesized compound was labelled as RDW21b, with a specific molar ratio of 2:1.

In the experimental setup, D-Ribose was dissolved in distilled water in the first beaker, (substrate), while chromium trioxide was dissolved in tertiary amyl alcohol in the second beaker, forming tertiary amyl chromate (oxidant). The two solutions were mixed together using different molar ratios. The resulting products were subsequently washed with water and acetone, finalizing the purification process. Following the mixing process, a solid compound with a greenish blue colour was obtained. This synthesized compound was labelled as RDW21a, with a specific molar ratio of 2:1.

3. **Experimental analysis:** - At BIT Mesra, the elemental composition of carbon (C), hydrogen (H), and oxygen (O) was analyzed, while the chromium (Cr) percentage was determined through titration.

### IV. RESULT AND DISCUSSION

#### 1. Elemental analysis

- a) **Compound R.6 (RDW21b):** - The light bluish Ash colour solid product R.6 contains chromium 22.18%, carbon 18.08%, hydrogen 2.61% and oxygen 57.13%. The expected formula for this set is  $\text{Cr}_2\text{C}_7\text{H}_{12}\text{O}_{17}$ .
- b) **Compound R.5 (RDW21a):** - The light greenish blue solid product R.5 contains chromium 26.12%, carbon 15.40%, hydrogen 3.68% and oxygen 54.80%. The expected formula for this set is  $\text{Cr}_2\text{C}_5\text{H}_{14}\text{O}_{14}$

#### 2. FTIR analysis

The assignments of various IR band and spectrum of sample (RDW21b) and (RDW21a) are shown as given below: -

R.6 (RDW21b)

Peak	Nature of peaks	Group assignment
3335.84	Broad	O-H stretching of -COOH
2878.00	Small	C-H stretching of alkyl
1560.55	Sharp	C=O stretching for carbonyl
1368.43	Sharp	C-H bending for methyl group
1041.10	Small	C-O stretching for 1° alcohol
803.92	Small	Cr=O stretching of chromium oxide
504.10	Medium	Cr-O stretching of chromium oxide

R.5 (RDW21a)

Peak	Nature of peaks	Group assignment
3304.4	Broad	O-H stretching of -COOH
2887.60	Small	C-H stretching of alkyl
1561.73	Sharp	C=O stretching for carbonyl
1368.13	Sharp	C-H bending for methyl group
1050.80	Weak	C-O stretching for 1° alcohol
800.71	Weak	Cr=O stretching of chromium oxide
494.57	Medium	Cr-O stretching of chromium oxide

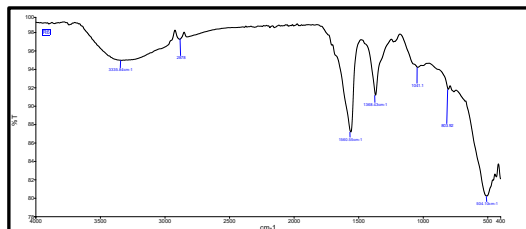


Fig 1 (RDW21b)

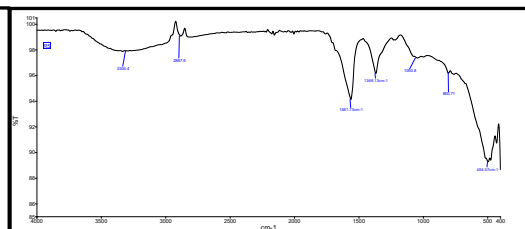


Fig 2 (RDW21a)

3. Thermal analysis

The thermogravimetric change and thermal change showing loss formula weight and percentage loss for RDW21b as table (1) & for RDW21a as table (2).

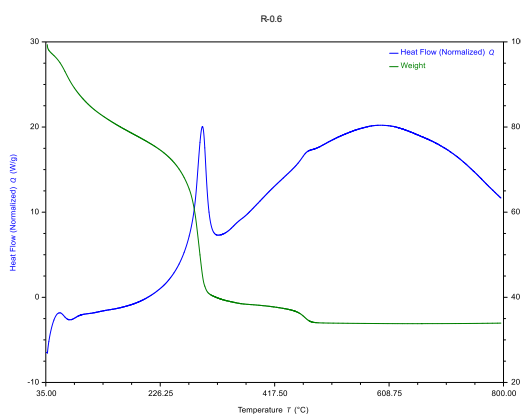


Fig. 3 (RDW21b)

Table 1 (Thermogravimetric loss pattern of RDW21b)

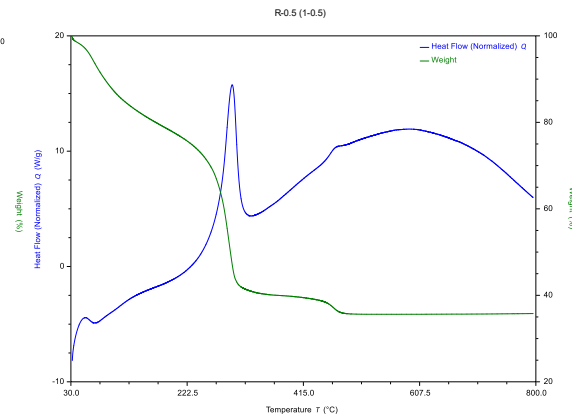


Fig. 4 (RDW21a)



Temperature	Formulation Sequence showing changes	Percentage Loss	
		Experimental	Theoretical
35°-230°C	$2\text{CrO}(\text{C}_3\text{H}_4\text{O}_5) (\text{C}_2\text{H}_2\text{O}_4)_2 (\text{H}_2\text{O})_2$ ↓ Loss of $\text{C}_3\text{H}_4\text{O}_5, \text{H}_2\text{O}$	30.00	29.23
230°-330°C	$2\text{CrO}(\text{C}_2\text{H}_2\text{O}_4)_2 (\text{H}_2\text{O})$ ↓ Loss of $2\text{C}_2\text{H}_2\text{O}_4,$	37.02	38.12
330°-410°C	$2\text{CrO} (\text{H}_2\text{O})$ ↓ Loss of $\text{H}_2\text{O}$	4.00	3.81
	$2\text{CrO}$ Chromium and its oxides	28.98	28.84

Table 2 (Thermogravimetric loss pattern of RDW21a)

Temperature	Formulation Sequence showing changes	Percentage Loss	
		Experimental	Theoretical
30°-240°C	$2\text{CrO}(\text{C}_3\text{H}_4\text{O}_5) (\text{HCOOH})_2 (\text{H}_2\text{O})_3$ ↓ Loss of $\text{HCOOH}, \text{H}_2\text{O}$	18.02	15.91
240°-320°C	$2\text{CrO}(\text{C}_3\text{H}_4\text{O}_5) (\text{HCOOH}) (\text{H}_2\text{O})_2$ ↓ Loss of $\text{C}_3\text{H}_4\text{O}_5,$ $\text{HCOOH}$	43.11	41.29
320°-450°C	$2\text{CrO} (\text{H}_2\text{O})_2$ ↓ Loss of $2\text{H}_2\text{O}$	7.38	8.94
	$2\text{CrO}$ Chromium and its oxides	31.49	33.86



## V. CONCLUSION

In conclusion, the synthesis of RDW21b and RDW21a has demonstrated a notable absorb of energy, evident from the pronounced endothermic peak observed in the Differential Thermal Analysis (DTA) curve. The small difference between ignition and explosion points indicates that these compounds contain significant energy and can undergo rapid combustion. So, it can be used as potential energetic and explosive for number of purposes.

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