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Swarn Lata Bansal  
 Department of Chemistry,  
 Lucknow University, Lucknow,  
 Uttar Pradesh, India

## A kinetic review of catalytic oxidation of sugar and sugar alcohols

Swarn Lata Bansal

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### Abstract

Catalytic oxidation kinetics of sugar and sugar alcohols with different oxidants has been given a great deal of attention in past years. In continuation of our earlier work, we report here in the Catalytic oxidation kinetics of sugar and sugar alcohols with different oxidants in acidic medium. It has been utilized as effective oxidant for the oxidation of various functional groups in last few decades. The kinetics and mechanism of oxidation of sugars and sugar alcohols have been studied in acidic media employing different transition metal ions, inorganic acids, complex ions and hydrogen peroxide as oxidants. Both oxidations occur under different conditions of pH, temperature and ionic strength giving products that depend on the oxidants used. The results showed that the mechanism may depend on the nature of the substrates; in some cases it involves the formation of intermediate complex, free radical or transition states. The current review summarizes selective research on Kinetics determination of sugar and sugar alcohols in acidic medium.

**Keywords:** Oxidation, sugar alcohols, kinetics, oxidants, mechanism, acidic

### Introduction

The kinetics of oxidation of sugars has been subject of extensive investigation in recent years. This is associated to the economic and biological importance of carbohydrates to living organisms. The oxidations have been carried out in both acidic and alkaline media using such oxidants as transition metal ions, inorganic acids, organometallic complexes and enzymes<sup>[1-5]</sup>. Carbohydrates are a major source of energy for living organisms and the understanding of the oxidation of sugars is therefore of immense importance. The oxidation of sugars especially the mono and disaccharides has been the subject of considerable research<sup>[6-8]</sup>.

The oxidation of sugars has been enhanced with the use of catalyst also known as catalysis; which is the alteration in the rate of a chemical reaction by means of a substance called a catalyst<sup>[9-10]</sup>. A catalyst is a substance, which alters the speed of a chemical reaction without undergoing any chemical change and can be recovered at the end of the reaction. A catalyst provides an alternative route of reaction where the activation energy is lower than the original chemical reaction. There are many different kinds of catalyst and many different mechanisms by which catalyst operates have been proposed (Sharma and Sharma, 2004).

The objective of the current research was to study the kinetics of oxidation of sugar alcohols by various oxidants in an acidic medium under various operational parameters to establish the pathway of reaction on the basis of kinetic data and spectroscopic analysis. An overview on some oxidation studies has been also described.

### Oxidation of sugars on acidic medium

The catalytic oxidation of sugars has been carried out in acidic media using such oxidants as transition metal ions, inorganic acids, organometallic complexes and enzymes.

Yasir Arafat Lone, Masood Ayoub Kaloo, Faizan Danish Khaleel<sup>[56]</sup> have been reviewed that Mechanistic Study of Ruthenium (III) Catalyzed Oxidation of Cyclohexanone by Acidic Bromate. In this work, kinetics and mechanism of Ru (III) catalyzed oxidation of cyclohexanone by acidified solution of potassium bromate has been studied. Present study employ mercuric acetate  $Hg(OAc)_2$  as a scavenger for  $Br^-$  ion to prevent parallel oxidation by bromine. The kinetics and mechanism have also been studied in the temperature range of 30 °C – 45 °C. The reaction exhibits first order kinetics with respect to Ru (III), while zero order kinetics with respect to  $KBrO_3$  and  $HClO_4$ . The influence of  $Hg(OAc)_2$  and ionic strength on the rate of reaction was found to be insignificant. Positive effect in the reaction mixture was also observed upon addition of chloride ion; while as the negative effect was revealed with

Corresponding Author:  
 Swarn Lata Bansal  
 Department of Chemistry,  
 Lucknow University, Lucknow,  
 Uttar Pradesh, India

acetic acid. A suitable mechanism in conformity with the kinetic observations has been proposed and the rate law is derived on the basis of obtained data. The various activation parameters such as energy of activation ( $\Delta E^*$ ), Arrhenius factor (A), entropy of activation ( $\Delta S^*$ ) were calculated from the rate measurements at 30 °C, 35 °C, 40 °C and 45 °C.

Bharat Singh, Shipra Tripathi, Sadeep Kumar Mishra <sup>[12]</sup> have been determined that mechanistic studies of aquachloroiridium (III) catalysis in the oxidation of 1, 2-propanediol by N-bromosuccinimide in acidic medium: A Kinetic modelling. Kinetics of oxidation of 1,2-propanediol by N-bromosuccinimide (NBS) have been investigated in the presence of aquachloroiridium (III) complex as catalyst and mercuric acetate as bromide ions scavenger in perchloric acid in the temperature range 25 to 45 °C. The reaction showed zero order kinetics with respect to [NBS]. First-order kinetics with respect to both 1, 2-propanediol and Ir (III) in their low concentration range tends to shift to zero order in their higher concentration range. Decreasing effect of both  $[H^+]$  and  $[Cl^-]$  was observed while successive addition of each of mercuric acetate and succinimide showed negligible effect on the rate of reaction. Variation of ionic strength of the medium was found to have zero effect on the rate of the reaction. Formic acid and acetic acid were identified as oxidation products. Activation parameters for the slow and rate-determining step of the proposed mechanism, which involves the formation of the most activated complex,  $[Cl_5Ir-O-CH(CH_3)(CH_2OH)]_3^-$  prior to the slowest step, have been obtained from the rate measurements at 25, 30, 35, 40, and 45°C. The rate law in agreement with the observed kinetic results has been deduced.

M.K. Ghosh, S.K. Rajput <sup>[13]</sup>, have been reported that Kinetics and Mechanism of Rhodium (III) Catalyzed Oxidation of Dextrose by Cerium (IV) in Aqueous Acidic Medium. A kinetics investigation of catalysed oxidation of D-(+) dextrose by cerium (IV) has been studied in acidic medium in the temperature range 308-333 K. The reaction has been found to be first order with respect to dextrose in the presence of Rh (III) catalysed. The rate follows first-order kinetics in Rh (III) catalysed oxidation reaction. The effect of  $[HSO_4^-]$  has also been observed and 1: 2 stoichiometry is observed in the oxidation. From the effect of temperature on the rate of reaction, the Arrhenius equation and various activation parameters have been computed. A suitable mechanism has been proposed and a rate law explaining the experimental observations is derived. Chemical Sciences Journal, Vol. 2012: CSJ-77.

P. C. Shukla, P. S. Tiwari and Deepa Khare <sup>[14]</sup> have been conveyed that N-Bromosaccharin oxidation of some aldoses: a kinetic study. Kinetics of oxidation of some aldoses viz. D-ribose, D-xylose, L-arabinose and D-glucose by N-bromosaccharin in aqueous acetic medium in the presence of mercuric acetate as a scavenger for Br<sup>-</sup>, exhibits first-order dependence in [NBSA] and  $[HClO_4]$ . The order with respect to aldose varies from 1 to 0. The reaction rate is retarded by the addition of saccharin. Effect of variation of composition of acetic acid-water binary mixture was also studied. Various activation parameters have been computed. These results points to a polar mechanism involving the formation of hypobromite ester in pre-equilibrium step which disproportionate into products via rate limiting attack of water molecule. Key-Words: Kinetics and mechanism\aldoses/ N-bromosaccharin

E.O. Odebunmi and A.S. Ogunlaja <sup>[15]</sup> have been showed that Homogeneous Catalytic Oxidation of Some Sugars: A Review. The study of carbohydrates is one of the most exciting fields of organic chemistry. Carbohydrates serve as the chief fuel of biological system, supplying living cells with usable energy. Carbohydrates are the body's primary source of energy. Energy is stored in the complex molecular structure of the carbohydrates when we metabolized the complex compounds, the atoms arrange themselves back into simple compounds and in the

process, release their stored energy for our use. Carbohydrate must be burned or oxidized if energy is to be released. An oxidation study of monosaccharide by different oxidizing agents is of special importance due to their biological relevance. The catalyzed oxidation provides a mild reaction condition and also gives an understanding of carbohydrate mechanism, because they can undergo a wide variety of reactions and give rise to different products. A brief report on some oxidation studies was also report.

Bharat Singh, Anirudh kumar singh, Anamika <sup>[16]</sup> have been reviewed those mechanistic studies of aqua chloro rhodium (III) catalysis in potassium iodate oxidation of 1,2-propanediol in acidic medium: A kinetic approach, Indian Journal of Chemistry-SectionA, IJCA Vol.50A (05) [May 2011]. The kinetics of homogeneously Rh (III) catalysed oxidation of 1, 2-propanediol by acidic solution of potassium iodate at constant ionic strength of the medium has been investigated at 308 K. The reaction follows complex kinetics, being first order in  $[KIO_3]$ , zero order in 1,2-propanediol and inverse fractional order in both  $[H^+]$  and  $[Cl^-]$ . The first order rate constant increases linearly with increase in  $[Rh(III)]$  in its lower concentration range but as the concentration of Rh (III) is increased towards the higher range, the rate constant becomes almost constant, indicating positive fractional order in  $[Rh(III)]$ . Variation of ionic strength of the medium and successive addition of mercuric acetate (used as  $I^-$  ions scavenger) has a positive effect on the rate of the reaction.  $IO_3^-$  and  $[RhCl_5(H_2O)]_2^-$  have been postulated as the reactive species of  $KIO_3$  and Rh (III), respectively. Activation parameters for the slow and rate-determining step of the proposed mechanism, which involves the formation of the most activated complex,  $[Cl_5Rh(HO \rightarrow Hg)]$ , prior to the slowest step, have been obtained from rate measurements at 30, 35, 40 and 45°C. The rate law conforming to the observed kinetic results has been derived. The main oxidation products have been identified as acetic acid and formic acid.

L. Pushpalatha [Afinidad LXVIII, 551, Enero-Febrero <sup>[17]</sup> has been studied that Kinetics and mechanism of oxidation of galactose and mannose by N-Bromonicotinamide (NBN). Kinetic investigation of oxidation of galactose and mannose, by alkaline solution of N-Bromonicotinamide (NBN) has been carried out in the temperature range 305-325K. The reaction shows first order in [alkali]. Both oxidations are of fractional order in [substrate] and inverse first order about oxidant. Addition of nicotinamide (NA) shows a retarding effect. Increase in ionic strength of the medium has no effect on the rate. Effect of temperature on the rate of oxidation has been followed to show the validity of Arrhenius equation and various activation parameters have been computed. The stoichiometry of the reaction was found to be 1:1. HOBr has been postulated as the reactive oxidizing species. The products of oxidation are the respective aldonic acids

Ezekiel Odebunmi, (University of Ilorin) & Adeniyi S Ogunlaja <sup>[18]</sup> has been indicated that Kinetics of oxidation of D-arabinose and D-xylose by vanadium (V) in the presence of manganese II as homogeneous catalyst. Kinetics of oxidation of D-arabinose and D-xylose by acidic solution of vanadium (V) ions in the presence of manganese (II) has been reported. First-order dependence of the reaction rate was observed on [sugars] and  $[H^+]$  at low concentrations throughout the oxidation reaction and a zero-order dependence on [sugar] and  $[H^+]$  was observed at high concentrations. First-order kinetics with respect to  $[Mn(II)]$  was also observed throughout the oxidation for both sugars. The results indicate the effect of  $Cl^-$  concentration is negligible. The reaction rates increase with the ionic strength of the medium. Various activation parameters were evaluated and provide further support to the proposed mechanism. Formic acid was reported as one of the oxidation products of these sugars.

Samson Owalude, Ezekiel Odebunmi, Adeniyi S Ogunlaja <sup>[19]</sup> have been elucidated that Kinetics of oxidation of D-Arabinose and D-Xylose by Vanadium (V) in the presence of Manganese II

as homogeneous catalyst. Kinetics of oxidation of D-arabinose and D-Xylose by acidic solution of Vanadium (V) ions in the presence of manganese (II) has been reported. First-order dependence of the reaction rate was observed on [sugars] and  $[H^+]$  at low concentrations throughout the oxidation reaction and a zeroth-order dependence on [sugar] and  $[H^+]$  was observed at high concentrations. First-order kinetics with respect to  $[Mn(II)]$  was also observed throughout the oxidation for both sugars. The effect of  $Cl^-$  concentration was found to be negligible. The reaction rates increases with the ionic strength of the medium. Various activation parameters were evaluated and provide further support to the proposed mechanism. Formic acid was reported as one of the oxidation products of the sugars.

Anthony Obike <sup>[20]</sup> has been find out that Kinetics and mechanism of oxidation of D-xylose and L-arabinose by chromium (VI) IO NS in perchloric acid medium. The kinetics of oxidation of D-Xylose and L-Arabinose by Cr (VI) ions in perchloric acid medium have been investigated spectrophotometrically under pseudo-first-order conditions. The reactions exhibit first-order rate dependence each on the substrate and oxidant. The order with respect to  $[H^+]$  is unity while no effect on the reaction rate is found with respect to the ionic strength. The Arrhenius ( $E_a$ ) and thermodynamic activation parameters ( $\Delta H^\ddagger$ ,  $\Delta S^\ddagger$  and  $\Delta G^\ddagger$ ) are evaluated and the reaction mechanism is interpreted in terms of formation of a 1:1 intermediate complex between a protonated chromic acid molecule and a neutral sugar molecule in sharp contrast to the results of our earlier studies on the  $C_6$  and  $C_{12}$  sugars.

Ogunlaja *et al.* (2009) have been reported that the kinetics and mechanism of oxidation of D-arabinose and D-xylose by acidic solution of Chromium (VI) in the presence of Mn (II). First-order dependence of the reaction rate was observed on sugars,  $HClO_4$  at low concentrations and a zero-order observed for sugars at a higher concentration. First-order kinetics with respect to Mn (II) throughout its variation was observed in the oxidation of both sugars. The  $Cl^-$  and ionic strength effect was found to be negligible. Formic acid and Erythronic acid were reported as the product of oxidation for both sugars. The rate of oxidation of the sugars follow the order xylose>arabinose (Ogunlaja *et al.*, 2009). Ashok Kumar Singh, Rashmi Srivastava, Shalini Srivastava, Jaya Srivastava <sup>[22]</sup> have been studied that N-bromosuccinimide oxidation of maltose and D-galactose using chloro-complex of Rh (III) in its nano-concentration range as homogeneous catalyst: A kinetic and mechanistic study. Kinetics of oxidation of maltose (mal) and d-galactose (gal) by protonated N-bromosuccinimide ( $N^+BSH$ ) using chloro-complex of Rh (III) in its nano-concentration range as homogeneous catalyst have been investigated at 40°C for the first time. Almost constant values of pseudo-first-order rate constant ( $k_1$ ) throughout the variation of N-bromosuccinimide (NBS) in the oxidation of both the reducing sugars clearly demonstrate that order of reaction with respect to [NBS] is unity. First-order kinetics with respect to each [Rh (III)], [Sugar] and  $[H^+]$  is evident from the observed values of  $k_1$  which increase in the same proportion in which the concentration of each reactant is increased. Negligible effects of variations of  $[Hg(II)]$ ,  $[Cl^-]$  and [succinimide] on the rate of oxidation of each reducing sugar have been observed. Variations in ionic strength ( $\mu$ ) and dielectric constant (D) of the medium have not influenced the oxidation rates. Protonated N-bromosuccinimide,  $N^+BSH$ , and chloro-complex of Rh (III),  $[RhCl_5(H_2O)]^{2-}$ , have been postulated as the reactive species of NBS and Rh (III) chloride in acidic medium, respectively. Various activation parameters have been calculated using pseudo-first-order rate constant ( $k_1$ ) values observed at four different temperatures. The proposed mechanism, involving most reactive activated complex formed as a result of interaction between the complex species  $[RhCl_5 \cdot NHBBr]^-$  and a sugar molecule is supported by kinetic orders, spectrophotometric evidence, positive entropy of activation and observed zero effect of dielectric constant and

ionic strength of the medium. Almost constant values of composite rate constant ( $k'$ ) observed for the variations of [sugar], [NBS], [Rh (III)] and  $[H^+]$  in the oxidation of each reducing sugar provide further support to the proposed reaction path. The main oxidation products of the reactions were identified as arabinonic acid and formic acid in case of maltose and lyxonic acid and formic acid in case of d-galactose.

Sheila Srivastava and Shalini Singh <sup>[23]</sup> have been studied that Kinetic study of Rh (III) catalyzed oxidation of sucrose by sodium periodate in acidic medium. The kinetics of rhodium (III) catalyzed oxidation of sucrose by sodium periodate in acidic medium has been studied in the temperature range 30-50 °C The reaction is carried out in the presence of mercuric acetate as a scavenger for bromide ion. The rate shows first order kinetics with respect to the oxidant i.e., sodium periodate and Rh (III) for sucrose. Negligible effect of mercuric acetate and ionic strength of the medium was observed and the reaction showed no effect of  $[Cl^-]$  and  $[H^+]$  on the reaction rate for sucrose. A suitable mechanism in conformity with the kinetic observations has been proposed and the thermodynamic parameters computed.

Ashok Kumar Singh, Reena Singh, Jaya Srivastava, Shalini Rahmani, Shalini Srivastava, Z <sup>[25]</sup> Mechanistic studies of oxidation of maltose and lactose by  $[H_2OBr]^+$  in presence of chloro-complex of Rh (III) as homogeneous catalyst, an ion and a neutral molecule in the rate determining step leading to the formation of a less polar most reactive activated complex. Kinetic studies in homogeneously Rh (III)-catalyzed oxidation of reducing sugars, i.e. maltose and lactose, by N-bromoacetamide (NBA) in the presence of perchloric acid have been made at 40 °C using mercuric acetate as  $Br^-$  ion scavenger. The results obtained for the oxidation of both reducing sugars show first-order dependence of the reactions on NBA at its low concentrations, which shifts towards zero-order at its higher concentrations. First-order kinetics in  $[Rh(III)]$  and zero-order kinetics in [reducing sugar] were observed. Positive effect of  $[Cl^-]$  was observed in the oxidation of both maltose and lactose. Order of reaction was found to be one and half (1.5) throughout the variation of  $[H^+]$  in the oxidation of both maltose and lactose. An increase in the rate of reaction with the decrease in  $[Hg(OAc)_2]$  and  $[NHA]$  was observed for both the redox systems. The rate of oxidation is unaffected by the change in ionic strength of the medium. The kinetics of the homogeneously Pd (II) catalyzed oxidation of d-mannose (Man) and maltose (Mal) by N-bromoacetamide (NBA) in perchloric acid medium, using mercuric acetate as scavenger for  $Br^-$  ions as well as co-catalyst, have been studied in the temperature range 35-50°C. The reactions exhibit first-order kinetics at low concentrations of sugars (Man and Mal) and NBA, tending to zero-order at high sugar and NBA concentrations. The oxidation rate is directly proportional to  $[Pd(II)]$ , while inverse fractional order in each of  $[H^+]$ ,  $[Cl^-]$  and [acetamide] was found. A positive effect on the rate of the reaction was observed on successive addition of  $[Hg(OAc)_2]$ , whereas change in ionic strength ( $\mu$ ) of the medium has no effect on the reaction velocity. Formic acid and arabinonic acid (for both reducing sugars, i.e. Man and Mal) were identified as main oxidation products of reactions. The various activation parameters have also been evaluated.

On the basis of observed kinetic data for Rh (III)-catalyzed oxidation of maltose and lactose by NBA in acidic medium, it has been concluded that: 1.  $(H_2OBr)^+$  is the reactive species of NBA in acidic medium. 2.  $[RhCl_4(H_2O)_2]$  is the reactive species of Rh (III) chloride in acidic medium. 3. There is formation of a most reactive activated complex,  $[RhCl_4(H_3O)(H_2OBr)]^+$ , between reactive species of Rh(III) chloride and reactive species of NBA in acidic medium. 4. Hg (II) as one of the reactants plays the role of inhibitor in addition to its role as Br ion scavenger. 5. Positive entropy of activation observed for the oxidation of maltose and lactose supports the interaction between  $[NHA] \times 10^4 (mol\ dm^{-3})$   $[Rh(III)]$  T/ Rate(s) maltose, lactose. Plots

between [Rh (III)] T/rate and [NHA] at 40 °C. [NBA]=  $6.66 \times 10^4 \text{ mol dm}^3$ , [Sugar] =  $2.00 \times 10^2 \text{ mol dm}^3$ , [Rh (III)]=  $3.79 \times 10^6 \text{ mol dm}^3$ , [HClO<sub>4</sub>] =  $10.00 \times 10^1 \text{ mol dm}^3$ , [Hg(OAc)<sub>2</sub>] =  $7.14 \times 10^4 \text{ mol dm}^3$ , [Cl] =  $3.00 \times 10^3 \text{ mol dm}^3$ .

Ashok Kumar Singh, Jaya Srivastava, Shahla Rahmani, Vineeta Singh [26], have been studied that Pd (II)-catalysed and Hg (II)-co-catalysed oxidation of D-glucose and D-fructose by N-bromoacetamide in the presence of perchloric acid: a kinetic and mechanistic study. The kinetics of Pd (II)-catalysed and Hg (II)-co-catalysed oxidation of D-glucose (Glc) and D-fructose (Fru) by N-bromoacetamide (NBA) in the presence of perchloric acid using mercury (II) acetate as a scavenger for Br<sup>-</sup> ions have been studied. The results show first-order kinetics with respect to NBA at low concentrations, tending to zero order at high concentrations. First-order kinetics with respect to Pd (II) and inverse fractional order in Cl<sup>-</sup> ions throughout their variation have also been noted. The observed direct proportionality between the first-order rate constant (k<sub>1</sub>) and the reducing sugar concentration shows departure from the straight line only at very higher concentration of sugar. Addition of acetamide (NHA) decreases the first-order rate constant while the oxidation rate is not influenced by the change in the ionic strength (μ) of the medium. Variation of [Hg (OAc)<sub>2</sub>] shows a positive effect on the rate of reaction. The observed negative effect in H<sup>+</sup> at lower concentrations tends to an insignificant effect at its higher concentrations. The first-order rate constant decreases with an increase in the dielectric constant of the medium. The various activation parameters have also been evaluated. The products of the reactions were identified as arabinonic acid and formic acid for both the hexoses. A plausible mechanism involving HOBr as the reactive oxidising species, Hg (II) as co-catalyst, and [PdCl<sub>3</sub>.S]<sup>-1</sup> as the reactive Pd(II) sugar complex in the rate-controlling step is proposed.

Kabir-Ud-Din, Mohd Sajid Ali, Zaheer Khan [27] have been find out that Effect of surfactant micelles on the kinetics of oxidation of D-fructose by cerium(IV) in sulfuric acid medium. Kinetics of the oxidation of D-fructose by cerium (IV) has been investigated both in the absence and presence of surfactants (cetyltrimethylammonium bromide, CTAB, and sodium dodecyl sulfate, SDS) in sulfuric acid medium. The reaction exhibits first-order kinetics each in [cerium (IV)] and [D-fructose] and inverse first-order in [H<sub>2</sub>SO<sub>4</sub>]. The Arrhenius equation is found to be valid for the reaction between 30–50 °C. A detailed mechanism with the associated reaction kinetics is presented and discussed. While SDS has no effect, CTAB increases the reaction rate with the same kinetic behaviour in its presence. The catalytic role of CTAB micelles is discussed in terms of the pseudophase model proposed by Menger and Portnoy. The association constant K<sub>s</sub> that equals to  $286 \text{ mol}^{-1} \text{ dm}^3$  is found for the association of cerium (IV) with the positive head group of CTAB micelles. The effect of inorganic electrolytes (Na<sub>2</sub>SO<sub>4</sub>, NaNO<sub>3</sub>, NaCl) has also been studied and discussed.

S. Srivastava, A. Awasthi, and K. Singh [28], have been worked that Ruthenium (III) Catalyzed Oxidation of Cyclopentanol and Cyclohexanol by N-Bromoacetamide. Kinetic investigations on Ru (III)-catalyzed oxidation of cyclopentanol and cyclohexanol by acidic solution of N-bromoacetamide (NBA) in the presence of mercury (II) acetate as a scavenger have been carried out in the temperature range of 30–45°C. Similar kinetics was followed by both the cyclic alcohols. First-order kinetics in the lower concentration range of NBA was observed to tend to zero order at its higher concentrations. The reaction exhibits a zero-order rate dependence with respect to each cyclic alcohol, while it is first order in Ru (III). Increase in [H<sup>+</sup>] and [Cl<sup>-</sup>] showed positive effect, while successive addition of acetamide exhibited negative effect on the reaction rate. Insignificant effect of sodium perchlorate, D<sub>2</sub>O, and mercury (II) acetate on the reaction velocity was observed. Cationic bromine has been proposed as the real oxidizing species. Various thermodynamic parameters

have been computed. A suitable mechanism in agreement with the kinetic observations has been proposed.

Zaheer Khan et. al. (2004) [29] have been observed that Kinetics and mechanism of the oxidation of D-fructose by vanadium (V) in H<sub>2</sub>SO<sub>4</sub> medium. The oxidative degradation of D-fructose by vanadium (V) in the presence of H<sub>2</sub>SO<sub>4</sub> has an induction period followed by autoacceleration. The kinetics and mechanism of the induction period have been studied at constant ionic strength. The reaction was followed spectrophotometrically by measuring the changes in absorbance at 350 nm. Evidence of induced polymerization of acrylonitrile and of reduction of mercuric chloride indicates that a free-radical mechanism operates during the course of reaction. Vanadium (V) is only reduced to vanadium (IV). The reaction is first and fractional order in [V (V)] and [D-fructose], respectively; but dependence on [H<sup>+</sup>] is complex. At constant [H<sub>2</sub>SO<sub>4</sub>], sodium hydrogensulfate accelerates the reaction. The effect of added sodium sulfate on the H<sub>2</sub>SO<sub>4</sub> and HSO<sub>4</sub>-catalyzed reaction is also reported. The activation parameters E<sub>a</sub> =  $118 \text{ kJ mol}^{-1}$ , ΔH<sup>#</sup> =  $116 \text{ kJ mol}^{-1}$ , ΔS<sup>#</sup> =  $-301 \text{ JK}^{-1} \text{ mol}^{-1}$ , and ΔG<sup>#</sup> =  $213 \text{ kJ mol}^{-1}$  are calculated and discussed. Reaction products are also examined, and it is concluded that oxidation of D-fructose by vanadium (V) involves consecutive one-electron abstraction steps.

Rashmi Tripathi, Santosh K. Upadhyay, (2004) [30] have been discussed that Kinetics of oxidation of reducing sugars by catalytic amount of osmium (VIII) in presence of periodate. The kinetics of oxidation of some reducing sugars viz. glucose, galactose, fructose, maltose, and lactose by osmium (VIII) in presence of sodium metaperiodate in alkaline medium have been investigated. The reactions are zero order in periodate. The order of reaction in substrate and OH<sup>-</sup> decreases from unity to zero at higher [substrate] or [OH<sup>-</sup>], respectively. Rate of oxidation is proportional to [Osmium (VIII)]. Osmium (VIII) serves as an effective oxidant which oxidizes reducing sugars and itself reduces to osmium (VI). Role of IO<sub>4</sub><sup>-</sup> is to regenerate osmium (VIII) from osmium (VI). An evidence for the complex formation between osmium (VIII) and reducing sugar has also been obtained.

Ashok Kumar Singh, Vineeta Singh, Shahla Rahmani, Ajaya Kumar Singh, Bharat Singh (2002) [31] has been developed that Mechanism of Pd (II) and Hg (II) co-catalyzed oxidation of mannose and maltose by acidic solution of N-bromoacetamide. The kinetics of the homogeneously Pd (II) catalyzed oxidation of d-mannose (Man) and maltose (Mal) by N-bromoacetamide (NBA) in perchloric acid medium, using mercuric acetate as scavenger for Br<sup>-</sup> ions as well as co-catalyst, have been studied in the temperature range 35-50 °C. The reactions exhibit first-order kinetics at low concentrations of sugars (Man and Mal) and NBA, tending to zero-order at high sugar and NBA concentrations. The oxidation rate is directly proportional to [Pd (II)], while inverse fractional order in each of [H<sup>+</sup>], [Cl<sup>-</sup>] and [acetamide] was found. A positive effect on the rate of the reaction was observed on successive addition of [Hg (OAc)<sub>2</sub>], whereas change in ionic strength (μ) of the medium has no effect on the reaction velocity. Formic acid and arabinonic acid (for both reducing sugars, i.e. Man and Mal) were identified as main oxidation products of reactions. The various activation parameters have also been evaluated. A plausible mechanism from the results of kinetic studies, reaction stoichiometry and product analysis is proposed.

In Pd(II) catalyzed oxidation of Man and Mal by N bromoacetamide in the presence of perchloric acid, the activated state will be less polar caused by reactants [PdCl<sub>3</sub>S]<sup>-</sup> and [Hg-OBr]<sup>+</sup>. Positive entropy of activation in the oxidation of Man and Mal is due to desolvation of the activated state rather than reactants. The order of frequency factor being the same for both reducing sugars clearly indicates the operation of single mechanism in the present study of oxidation of reducing sugars by NBA in presence of Pd(II) as homogeneous catalyst.

Ashok Kumar Singh, Vineeta Singh, Shahla Rahmani, Ajaya Kumar Singh, Bharat Singh, (2003) <sup>[32]</sup> have been proposed that Mechanism of Pd(II) and Hg(II) co-catalyzed oxidation of D-mannose and maltose by acidic solution of N-bromoacetamide. The kinetics of the homogeneously Pd (II) catalyzed oxidation of d-mannose (Man) and maltose (Mal) by N-bromoacetamide (NBA) in perchloric acid medium, using mercuric acetate as scavenger for Br<sup>-</sup> ions as well as co-catalyst, have been studied in the temperature range 35–50°C. The reactions exhibit first-order kinetics at low concentrations of sugars (Man and Mal) and NBA, tending to zero-order at high sugar and NBA concentrations. The oxidation rate is directly proportional to [Pd (II)], while inverse fractional order in each of [H<sup>+</sup>], [Cl<sup>-</sup>] and [acetamide] was found. A positive effect on the rate of the reaction was observed on successive addition of [Hg(OAc)<sub>2</sub>], whereas change in ionic strength ( $\mu$ ) of the medium has no effect on the reaction velocity. Formic acid and arabinonic acid (for both reducing sugars, i.e. Man and Mal) were identified as main oxidation products of reactions. The various activation parameters have also been evaluated. A plausible mechanism from the results of kinetic studies, reaction stoichiometry and product analysis is proposed.

S. M. Desai, N. Halligudi, S. Nandibewoor, (2002) <sup>[33]</sup> have been inquired that Kinetics and mechanism of ruthenium (III)-catalysed oxidation of allyl alcohol by acid bromate-autocatalysis in catalysis. The kinetics of oxidation of CH<sub>2</sub>=CHCH<sub>2</sub>OH with KBrO<sub>3</sub> in the presence of Ru (III) catalyst in aqueous acid medium has been studied under varying conditions. The active species of oxidant and catalyst were HBrO<sub>3</sub> and [Ru (H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup> respectively. The autocatalysis exhibited by one of the products, i.e., Br<sup>-</sup>, was attributed to the formation of a complex between the bromide ion and Ru(III). A composite scheme and rate law were proposed. Reaction constants involved in the mechanism have been evaluated.

Ashok Kumar Singh, Vineeta Singh, Ajaya Kumar Singh, Neena Gupta, Bharat Singh (2002) <sup>[34]</sup> have been carried out Kinetics and mechanism of Ru (III) and Hg(II) co-catalyzed oxidation of D-galactose and D-ribose by N-bromoacetamide in perchloric acid. Kinetics of oxidation of reducing sugars D-galactose (Gal) and D-ribose (Rib) by N-bromoacetamide (NBA) in the presence of ruthenium (III) chloride as a homogeneous catalyst and in perchloric acid medium, using mercuric acetate as a scavenger for Br<sup>-</sup> (minus sign) ions, as well as a co-catalyst, have been investigated. The kinetic results indicate that the first-order kinetics in NBA at lower concentrations tend towards zero order at its higher concentrations. The reactions follow identical kinetics, being first order in the [sugar] and [Ru (III)]. Inverse fractional order in [H<sup>+</sup>] and [acetamide] were observed. A positive effect of [Hg (OAc) (2)] and [Cl<sup>-</sup>] was found, whereas a change in ionic strength ( $\mu$ ) has no effect on oxidation velocity. Formic acid and D-lyxonic acid (for Gal) and formic acid and L-erythronic acid (for Rib) were identified as main oxidation products of reactions. The various activation parameters have been computed and recorded. A suitable mechanism consistent with experimental findings has been proposed.

Ajaya Kumar Singh, Shahla Rahmani, *et al.* (2001) <sup>[35]</sup> have been showed that Mechanism of iridium (III) catalyzed oxidation of reducing sugars by N-bromosuccinimide in acidic medium. The kinetics of iridium (III) catalyzed oxidation of mellibiose and cellobiose by N-bromosuccinimide (NSB) in HClO<sub>4</sub> in the presence of [Hg (OAc)<sub>2</sub>] as a scavenger for Br<sup>-</sup> has been investigated. The reactions are zero order with respect to both sugars, and first order in NBS. The order in Ir (III) decreases from unity to zero at high iridium (III) concentration. A negative effect on the oxidation rate is observed for [H<sup>+</sup>], [Cl<sup>-</sup>] and succinimide. Ionic strength and [Hg (III)] do not influence the oxidation rate and HOBr and [IrCl<sub>5</sub>H<sub>2</sub>O]<sup>2-</sup> are postulated as the oxidizing and catalytic species. A mechanism conforming to the observed kinetic data is proposed.

Ajaya Kumar Singh, Tapish Gupta, V.K. Singh <sup>[36]</sup>, have been showed that Kinetics and mechanism of Pd(II) chloride catalyzed oxidation of D (-) fructose and D (-) mannose by acidic solutions of N-bromosuccinimide. The kinetic data obtained in Pd(II) chloride catalyzed oxidation of D(-) fructose and D(-) mannose by acidic solution of N-bromosuccinimide (NBS) in the presence of mercuric acetate shows first-order kinetics in Pd(II). First-order dependence on NBS and substrate i. e. fructose and mannose, at low concentration range tends to zero order at higher concentration range. A negative effect of [H<sup>+</sup>] ion, [Cl<sup>-</sup>] ion and addition of succinimide is observed. Insignificant effect of ionic strength and mercuric acetate on reaction rate was observed. Various activation parameters have been computed. The products of the reaction were identified as the corresponding acids. A suitable mechanism in conformity with the kinetic results has been proposed.

The kinetics of oxidation of epimeric aldo and D-(L) keto sugars, namely D-glucose, D-mannose, D-fructose and L-sucrose by trivalent manganese in aqueous sulphuric acid media has been studied. The experimental data indicate a first order dependence on sugar concentration and fractional order dependence on oxidant. Variation of [HSO<sub>4</sub><sup>-</sup>], [SO<sub>4</sub><sup>2-</sup>], [F<sup>-</sup>], [P<sub>2</sub>O<sub>7</sub><sup>4-</sup>], [ClO<sub>4</sub><sup>-</sup>], [Cl<sup>-</sup>] or [NO<sub>3</sub><sup>-</sup>] hold hardly any effect on the rate of oxidation (Reddy *et al.*, 1996).

### Oxidation of sugar alcohols on acidic medium

A several as Rekha Rani Dwivedi, *et al.* <sup>[37]</sup> have been studied that Kinetics and mechanism of ruthenium (III) catalyzed oxidation of Inositol by Trichloroisocyanuric acid in aqueous acetic acid medium. The Inositol has much biological significance associated with it and plays an essential role in the pharmaceutical chemistry. Inositol plays different vital roles in synthesis of oligosaccharides, gene expression, and signal transduction membrane tethering and auxin perception. In present paper explored kinetics and Mechanistic study of oxidation of Inositol by trichloroisocyanuric acid which has been investigated in water-HOAc-water medium. The reaction is of pseudo first-order in [TCICA], fractional order in [inositol] and first-order in [Ru<sup>3+</sup>] ion. The velocity of the reaction increases with increase the Dielectric constant of medium and solvent polarity. Effect of temperature has been studied and thermodynamic parameters are calculated and a suitable mechanism has been suggested. Acetaldehyde was identified as an end-product of oxidation.

Bharadwaja kumar, Sanjeev kumar sinhab, C.N.M. Himanshu <sup>[38]</sup> have been observed the Oxidation of Inositol by cerium (iv) In acidic medium: a kinetic study. The oxidation of inositol by cerium (IV) has been studied experimentally in the acidic medium at fixed ionic strength and temperature. The reaction showed a first order dependence with respect to [Ce (IV)] and less than 1st order kinetics in both [H<sup>+</sup>] and [INOS]. By increasing the values of both ionic strength and dielectric constant of the reaction medium which increases the rate of oxidation reaction. The addition of Ce (III) products to the reaction mixture does not show any significance or increase in the rate of reaction. The oxidation product of inositol has been identified by the chemical reactions and tools and spectroscopically insole. The compatible mechanism for the oxidation reaction has been put forward and the rate law associated with the reaction mechanism has been derived. The activation experimentally.

Amrita srivastava, Swarn Lata Bansal (2017) <sup>[39]</sup> have explored Ruthenium (III) Catalysed Oxidation of D-Sorbitol by Chloramine T in Perchloric Acid Medium: A Kinetic and Mechanistic Approach. The kinetics of Ru (III) catalysed oxidation of sorbitol by acidic solution of Chloramine T in the presence of mercuric acetate as scavenger is investigated in the temperature range 30<sup>0</sup>-50<sup>0</sup> C. First-order kinetics in the lower concentration range of CAT was observed to tend to zero order at

its higher concentration. The reaction follows zero-order kinetics in sorbitol while it is first order in Ru (III). Increase in  $[H^+]$  and  $[Cl^-]$  showed positive effect while successive addition of sodium perchlorate showed negligible effect on the reaction rate. The main product of oxidation is corresponding acid. Cationic  $Cl^-$  has been proposed as the real oxidising species. Various thermodynamic parameters have been computed. A suitable mechanism in agreement with the kinetic observations has been derived.

Amrita srivastava, Swarn Lata Bansal <sup>[40]</sup> have been carried out that kinetic studies on the mechanism of oxidation of adonitol with Ru (III) by acidic chloramine T. The kinetics of oxidation of adonitol by chloramine T has been investigated at 40 °C in different acid concentrations. At low acid concentration (0.08–0.50M), simultaneous catalysis by  $H^+$  and  $Cl^-$  ions is noted. The rate shows a first-order dependence on Chloramine T and Ru (III), but is independent of adonitol. The influence of mercuric acetate was found to be insignificant. The rate remains same with the variation in the ionic strength of the medium indicating the involvement of non-ionic species in rate-determining step. There were no free

radicals during the course of reaction. The reaction product was identified by FTIR and UV spectroscopic techniques. Kinetic runs were performed at different temperatures and thermodynamic parameters were computed. A mechanism consistent with observed parameters is proposed and rate law is derived. The probable active species of catalyst and oxidant have been identified in acid media.

Ahmed Fawzy, A.Zaafarany Ishaq, M. Altass Hatem, H. Morad Moataz, Jabir Alfahemi <sup>[41]</sup> have been dignosed that Kinetics and Mechanism of Permanganate Oxidation of Inositol in Perchloric and Sulfuric Acids Solutions. The kinetics of oxidation of inositol (INOS) by permanganate ion in both perchloric and sulfuric acids solutions was studied using a spectrophotometric technique at a constant ionic strength of 1.0 mol dm<sup>-3</sup> and at 25 °C. In both acids, the reactions showed a first-order dependence with respect to [permanganate], whereas the orders with respect to [INOS] were found to be less than unity. The effect of acids concentrations suggests that the reactions were acid-catalyzed with fractional-second-order kinetics in  $[H^+]$ . Variation of either ionic strength or dielectric constant of the medium had no effect significantly on the oxidation rates. The reactions mechanism adequately describing the kinetic results was proposed. In both acids, the main oxidation products of inositol were identified by spectral and chemical tools as the corresponding monoketone derivative, namely inosose. Under comparable experimental conditions, the oxidation rate in sulfuric acid was approximately three times higher than that in perchloric acid. Regarding to the second-order rate constants of these reactions, the activation parameters have been evaluated and discussed.

Ratnakaram VenkataNadh, Y. Lakshman Kumar, R.Venkata Nadhand, P.S. Radhakrishnamurti, (2016) <sup>[42]</sup> have been viewed that Kinetics of ruthenium(III) catalyzed oxidation of biologically important sugar alcohols (myo-ino-sitol, D-sorbitol, and D-mannitol) by dichloroisocyanuric acid was carried out in aqueous acetic acid per-chloric medium. The reactions were found to be first order in case of oxidant and ruthenium (III). Zero order was observed with the concentrations of sorbitol and mannitol whereas, a positive fractional order was found in the case of inositol concentration. An inverse fractional order was observed with perchloric acid in oxidation of three substrates. Arrhenius parameters were calculated and a plausible mechanism was proposed.

Amrita Srivastava and Swarn Lata Bansal (2015) <sup>[43]</sup> have been evaluated that Kinetic and Mechanistic Study of Ru (III) Catalyzed oxidation of Galactitol by Chloramine-T: in Acidic medium, in the presence of mercuric acetate as chloride ion scavenger. The results showed zero order kinetics with respect to galactitol and first order with respect to Ru (III) and chloramine-

T. There is no effect of sodium perchlorate, KCl and mercuric acetate show zero effect on reaction rate. Various activation parameters have been computed. Galatonic acid has been identified as the products, and a suitable mechanism consistent with observed kinetic results has been proposed.

A. Srivastava, S.L. Bansal (2015) <sup>[44]</sup> have been analysed that kinetics and mechanism of Ruthenium (III)catalysis in the oxidation of erythritol by chloramine-T. The kinetic investigations of Ru (III) catalyzed oxidation of erythritol (1, 2, 3, 4-tetrahydroxybutane) by chloramine-T (CAT) in  $HClO_4$  in the presence of  $Hg(OAc)_2$  as scavenger for  $Cl^-$  have been investigated. The reactions are zero order with respect to alcohol and first order w.r.t of CAT. The reaction rate is first order with respect to  $[Ru(III)]$  and zero order is found for perchloric acid, KCl and  $NaClO_4$ . Mercuric acetate does not influence the reaction rate. Suitable mechanism in conformity with the observed kinetic data is proposed and thermodynamic parameters are computed.

A. Srivastava, S.L. Bansal <sup>[45]</sup> have been going over Ru (III) Catalyzed oxidation of D-Manitol by chloramine- T in acidic medium: a kinetic study. The kinetics of Ru (III) catalyzed oxidation of manitol by Chloramine T has been in perchloric acid medium in the presence of mercuric acetate as chloride ion scavenger. The reaction rate shows zero order kinetics with respect to Mannitol and first order with respect to  $Ru(III)$  and CAT. There is no effect on sodium perchlorate, KCl and mercuric acetate shows zero effect on reaction rate. A suitable mechanism consistent with observed kinetic results has been proposed. Keywords- Ru (III) chloride, Chloramine T, mercuric acetate, kinetics

Jayant I. Gowda, Sanjeevaraddi R. Sataraddi, Sharanappa T Nandibewoor (2012) <sup>[46]</sup> have been probed that Oxidation of xylitol by a silver (III) periodate complex in the presence of osmium (VIII) as a homogeneous catalyst. The kinetics of the osmium (Os (VIII)) catalyzed oxidation of xylitol (XYL) by a silver (III) periodate complex (diperiodatoargentate (III)) (DPA) in an aqueous alkaline medium at 298 K and at a constant ionic strength of 0.06 moldm<sup>-3</sup> was studied spectrophotometrically. The reaction between DPA and xylitol in an alkaline medium exhibits 1:2 stoichiometry (XYL:DPA). The reaction is of first order in  $[Os(VIII)]$  and  $[DPA]$  and has a negative fractional order in  $[IO_4^-]$ . It is apparent that it has less than the unit order in  $[XYL]$  and  $[OH^-]$  under the experimental conditions. The main oxidation product was identified as 2,3,4,5-tetrahydroxypentanoic acid by FT-IR and LC-MS spectral studies. A probable mechanism was proposed and discussed. The activation parameters with respect to the slow step of the mechanism were computed and discussed and thermodynamic quantities were also calculated. The active species of the catalyst and oxidant have been identified.

Sheila Srivastava and Parul Srivastava have been investigated that Kinetics and mechanism of oxidation of D-mannitol by potassium bromate in aqueous acidic medium.

Kinetic investigation in Rh (III) catalyzed oxidation of D-Mannitol <sup>[47]</sup> in an acidified solution of potassium bromate in the presence of  $Hg(OAc)_2$  as a scavenger, have been studied in the temperature range of 30°-45°C. Increase in concentration of oxidant and  $H^+$  ion showed fractional positive order and fractional inverse order respectively. The influence of  $Hg(OAc)_2$ , ionic strength and  $Cl^-$  ion on the rate was found to be insignificant. First order kinetics was observed in case of catalyst Rh (III),  $Rh^{+3}$  being its reactive species. The order of reaction w.r.t. substrate is zero. The various thermodynamic parameters were calculated from rate measurements at 30, 35, 40 and 45 °C respectively. A suitable mechanism in conformity with the kinetic observation has been proposed and the rate law is derived on the basis of obtained data.

Rajeshwari V. Hosahalli, Anita P. Savanur, Sharanappa T. Nandibewoor, Shivamurti A. Chimatar <sup>[48]</sup> have been explored

that Ruthenium(III)-mediated oxidation of D-mannitol by cerium(IV) in aqueous sulfuric acid medium: A kinetic and mechanistic approach. The oxidation of D-mannitol by cerium (IV) has been studied spectrophotometrically in aqueous sulfuric acid medium at 25 °C at constant ionic strength of 1.60 mol dm<sup>-3</sup>. A micro amount of ruthenium (III) (10<sup>-6</sup> mol dm<sup>-3</sup>) is sufficient to enhance the slow reaction between D-mannitol and cerium (IV). The oxidation products were identified by spot test, IR and GC-MS spectra. The stoichiometry is 1:4, i.e., [D-mannitol]: [Ce (IV)] = 1:4. The reaction is first order in both cerium (IV) and ruthenium(III) concentrations. The order with respect to D-mannitol concentration varies from first order to zero order as the D-mannitol concentration increases. Increase in the sulfuric acid concentration decreases the reaction rate. The added sulfate and bisulfate decreases the rate of reaction. The active species of oxidant and catalyst are Ce(SO<sub>4</sub>)<sub>2</sub> and [Ru(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup>, respectively. A possible mechanism is proposed. The activation parameters are determined with respect to a slow step and reaction constants involved have been determined.

H. K. Okoro and E. O. Odeunmi (2010) [49] have been observed that Kinetics and mechanism of oxidation of sugar and sugar alcohols by vanadium pentoxide. The kinetics of oxidation of sugars and sugar alcohols by vanadium pentoxide (V<sub>2</sub>O<sub>5</sub>) in acidic medium have been investigated spectrophotometrically under pseudo-first-order conditions and over a wide range of experimental conditions. Each reaction was first order with respect to the substrate and oxidant. The kinetic data for the oxidation by V<sub>2</sub>O<sub>5</sub> solution showed that increase in temperature and sugar concentration increased the rate of the reactions. It was also observed that with increase in pH and KNO<sub>3</sub> concentration, the reaction rate decreased with increase in V<sub>2</sub>O<sub>5</sub> concentration with the exception of fructose which showed significant increase in reaction rates. The mechanism of these reactions involved the formation of a 1:1 intermediate complex. The order of reactivities of the sugars was Maltose > Fructose > Sucrose > Glucose > Sorbitol > Mannitol.

During the course of this work, it was found that the reaction rates were enhanced by increase in temperature, pH, ionic strength and substrate concentration with V<sub>2</sub>O<sub>5</sub> as oxidant. In addition simple and complex sugars are more reactive than sugar alcohols. The mechanism of reaction involved formation of 1:1 intermediate complex confirming that the reaction rate is dependent on rate constant. However, Oxidation with V<sub>2</sub>O<sub>5</sub> has received very little attention over the past years compared with the other oxidant such as KMnO<sub>4</sub>. Therefore, extent of oxidation with the use of V<sub>2</sub>O<sub>5</sub> should be revisited in due course.

H. K. Okoro and E. O. Odeunmi (2009) [50] have been reviewed that Kinetics and mechanism of oxidation of sugar and sugar alcohols by KMnO<sub>4</sub>. The kinetics of carbonate sugars and sugar alcohols by potassium permanganate in oxidation hydrogen / NaOH buffer have been investigated spectrophotometrically under pseudo-first order conditions and over a wide range of experimental conditions. Each reaction is first order with respect to the substrate and oxidant. The kinetic data for the oxidation by alkaline KMnO<sub>4</sub> solution reveal that pseudo-first order rate constants increased as the pH, Ionics strenghts, temperature as well as the KMnO<sub>4</sub> concentration increased. The rate constant also increases with increase in sugar concentration with the exception of sorbitol which its rate constant decreased with increase in sugar concentration. The mechanisms were found to proceed through the formation of enediol intermediate complex. The order of reactivities of sugar and sugar alcohols was sucrose > maltose > sorbitol > glucose > mannitol > fructose. The Arrhenius activation energy and other dynamic activation parameters are reported. At the end of this research work, it was found that the reaction rates were enhanced by increase in temperature, pH, ionic strength and substrate concentration. Oxidation with KMnO<sub>4</sub> was found to be faster compared to V<sub>2</sub>O<sub>5</sub> and other oxidant that has been used before. Therefore, KMnO<sub>4</sub> is

a more powerful oxidizing agent in sugar conversion.

Asim K. Das, Monirul Islam, Ruhidas Bayen [51] have been going over on Studies on kinetics and mechanism of oxidation of D-sorbitol and D-mannitol by cerium (IV) in aqueous micellar sulfuric acid media. The kinetics and mechanism of cerium (IV) oxidation of hexitols, i.e. D-sorbitol and D-mannitol, in aqueous sulfuric acid media have been studied in the presence and absence of surfactants. Under the kinetic conditions, [S] >> [Ce(IV)], where [S] is the total substrate (D-sorbitol or D-mannitol) concentration, the overall process shows a firstorder dependence on [Ce(IV)] and [S]. The process is acid catalyzed and inhibited by [HSO]. From the [HSO] dependence, it has been noted that the both Ce(SO) and Ce(SO) have been found kinetically active. The different rate constants in the presence and absence of surfactants have been estimated with the activation parameters. N acetylpyridinium chloride has been found to retard the oxidation process of hexitols, whereas sodium dodecyl sulfate has been found to accelerate the rate process. All these findings including the micellar effects have been interpreted in terms of the proposed reaction mechanism and partitioning behavior of the kinetically active different species of Ce (IV) between the aqueous and pseudomicellar phase.

Sheila Srivastava and *et al.* [52] have been worked that Kinetics and Mechanism of Rhodium (III) catalyzed oxidation of Mannitol by acidified Sodium periodate. The kinetics of the Rh (III) catalyzed oxidation of mannitol by an acidified solution of NaIO<sub>4</sub> in the presence of Hg(OAc)<sub>2</sub> as a scavenger, have been studied in the temperature range 30-45°C. The rate shows zero order with respect to the substrates and first order with respect to catalyst Rh (III). Negligible effect of mercuric acetate Hg (OAc)<sub>2</sub>, and ionic strength of the medium was observed and the reaction showed no effect of change in concentration of [IO<sub>4</sub>], [Cl<sup>-</sup>] and [H<sup>+</sup>] ion on the reaction rate. A suitable mechanism in conformity with the kinetic observations has been proposed and the thermodynamic parameters computed.

## Conclusion

The analysis of sugar & sugar alcohols is important aspect of environmental monitoring. Catalytic oxidation with trace amounts of metals can be made to react with the chemical agents to form coloured complex or intermediate. we found that the reaction rates were enhanced by increase in temperature, pH, ionic strength and substrate concentration. Oxidation with sugar and sugar alcohols [53-55] with various oxidants in acidic medium is simple, accurate and effective method. The contribution and information through kinetic study will enhance chemical literature to a great extent in journals.

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