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Review Article

A Review on Studies and Research on Oil Hydrolysis

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ABSTRACT

Various compounds are synthesized from different types of raw materials. Different type of oils such as palm kernel oil, crude oil, fats; andiroba oil, crambe oil, animal extracted oil etc. are promising raw materials. Compounds such as palmitic, oleic and stearic acids can be synthesized from these types of raw materials. Hydrolysis of oil is essential and important step in synthesis of various compounds. Investigations are reported on oil hydrolysis and factors affecting it. Current review summarizes research and studies on hydrolysis with emphasis on oil hydrolysis.

Key words: Conversion, kinetics, enzymes, temperature, substrate.

INTRODUCTION

The production of compounds by using different raw materials in food industry calls for proper study of the reactions involved. Biochemical reactions are employed for synthesis of various compounds. [1-3] Biocatalysts are employed for better yield. [4,5] Enzyme catalyzed reactions are selective in nature and use of proper operating conditions and enzymes yields excellent results [6-8] Immobilization of enzyme generally yields better results than non immobilized enzyme catalysis. [9,10] Investigations are reported on synthesis of various compounds such as ethanol, amino acids, lactic acid, citric acid etc. by biological pathways. Hydrolysis of oil is essential step in synthesis of various compounds from oil. Current review summarizes research and studies on hydrolysis with respect to its kinetics and affecting parameters.

RESEARCH AND STUDIES ON OIL HYDROLYSIS

Antia et.al carried our research on hydrolysis of palm kernel oil. [11] At 360^{0}C and water oil ratio of 1.622, they obtained degree of hydrolysis 96.85%. Using 24 atm. pressure and 268^{0}C temperature they obtained maximum hydrolysis in 5 hours. They carried out statistical analysis to estimate activation energy and frequency factor from Arrhenius equation. Serri et.al carried out preliminary studies on hydrolysis of cooking palm oil using C. rugosa Lipase. [12] They carried out hydrolysis using phosphate buffer and iso-octane solvent. For starting the reaction, they added C. rugosa. They observed that the conversion was initially high and it decreased with time. They obtained highest conversion for hydrolysis time of 90 minutes. The optimum temperature was observed to be 45^{0}C. PH vale of 7 was suitable.

Lee et.al carried out an investigation on hydrolysis of palm oil in to oleic acid. [13] They investigated the kinetics of the enzymatic hydrolysis of palm olein. They used immobilized lipase from Asperigillus niger in the process. They analyzed the potential of substrate inhibition using initial velocity analysis. Salgado et.al used

Andiroba seed in enzymatic hydrolysis of crude oil and isolated acylglycerides. [14] Andiroba oil, according to them, is promising source of palmitic, oleic and stearic acids. Adawiyah et.al investigated effect of water activity and glass transition on fat hydrolysis in a food model system. [15] They used commercial lipase for hydrolysis reaction at six levels of water content and water activity. They observed that moisture content in food models affects the rate of enzymatic fat hydrolysis. Also it was found that above BET monolayer, hydrolysis reaction rate increased significantly. They concluded that the enzymatic fat hydrolysis reaction was more relevantly described by water activity concept.

Archuleta carried out studies on non catalytic hydrolysis of fats and oils. [16] According to him, continuously sparging superheated steam through high temperature fat at atmospheric pressure can results into significant degree of hydrolysis. He designed a bench-scale hydrolyser. The feasibility of steam hydrolysis was investigated by him. Also soybean oil and beef tallow were tested for steam hydrolysis. He carried out experiments at various temperatures and fat/steam feed ratios. It was observed that over 95% fatty acids were present in the readily separated organic portion of the overhead product.

Minami and Saka carried out investigation on two-step supercritical methanol method for biodiesel production. [17] They observed that higher reaction temperature resulted in higher fatty acid formation. According to them, esterification reaction was an important step for high quality biodiesel fuel production. Also they explained that the fatty acid acts as catalyst in its own formation. So with, amount of FA produced the rate of FA formation increases. Reaume and Ellis investigated the use of isomerization and hydroisomerization reactions to reduce the cloud point of eight different fats and oils. [18] They observed that low saturated fatty acid resulted in decrease in cloud point whereas high saturated FA resulted in increase in cloud point. Their results indicated that branching can reduce the cloud point.

Enzymatic hydrolysis of crambe oil was studied by Tao and him. [19] They carried out research in order to develop effective reaction pathway to isolate EA from other fatty acids in high erucic acid (HEA) oils. They also studied effect of various parameters such as water content, lipase concentration, mixing intensity, and reaction temperature. They found that the reaction selectivity was unaffected by these parameters. The reaction rate was significantly affected by these parameters. In hydrolysis, they found that water content played an important role by affecting interfacial area.

Limpanuparb et.al investigated the methanolysis and hydrolysis reactions of glycerol triacetate. [20] Under acid-catalyzed and base-catalyzed conditions, they studied twelve elementary steps of triacetin methanolysis. They studied factors affecting the free energy of reaction and activation energy such as substitution, methanolysis / hydrolysis position, solvent and face of nucleophilic attack. Murty et.al reviewed investigations on immobilized lipase technology for the hydrolysis of oils. [21] They discussed various methods used for enzyme immobilization such as adsorption, ionic bonding, covalent binding, cross-linking, entrapment, and encapsulation. They also studied kinetics of enzyme reaction and deactivation. According to them, cost, yield and purity are three important factors in selection of a new technology in a manufacturing plant. According to these studies, limiting factors in the use of immobilized enzyme bio reactors are high cost of the enzymes involved in the biotransformation of the lipids and the engineering problems because of heterogeneous and/or micro aqueous nature of biochemical reactions.

Ali and Abdurrhman determined the free fatty acids (FFA) in palm oil. [22] They used flow injection titrimetric method with cooling agent salicyladhyde-2, 4-

dinitrophenylphenylhydrazone (SDPH). They optimized flow injection parameters such as carrier, reagent concentration, flow rate, size of mixing chamber and injection volume. They observed a good correlation between the present method and the official methods applied for the determination of FFA in palm oil samples. Ramakrishnan et.al investigated enzymatic extraction of fish oil. [23] In their investigation, they used alcalase enzyme at three enzyme concentrations. They observed that due to the formation of brown pigments from the reaction of carbonyls, the oil obtained after enzymatic hydrolysis was dark in color. These carbonyls were produced from oxidation of polyunsaturated fatty acids with amino acids and proteins. They also observed that buffer addition increased the formation of emulsion. By using 2 percent enzyme and 4 hours hydrolysis, they obtained 75-76 percent oil yield.

Deepika et.al carried out an investigation on oil extraction methods. [24] They also studied influence of these methods on Omega-3 content from cultured salmon. According to them, Salmon by-products are excellent source of polyunsaturated fatty acids. They compared the efficiency of different oil extraction techniques from salmon gut, head and frame. They observed that the oil extracted using enzymatic methods had slightly higher fatty acid content than the heat extracted oil. Their study also suggested that the oil had good quality standards. It was also suitable for various nutraceutical applications.

CONCLUSION

Cost, yield and purity are three important factors in selection of a new technology in a manufacturing plant. According to some investigations, the fatty acid acts as catalyst in its own formation. So with, amount of FA produced the rate of FA formation increases. In hydrolysis, water content played an important role by affecting interfacial area. The enzymatic fat hydrolysis reaction can be relevantly described by water activity concept.

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