The aim of the present investigation is to enhance bioethanol production using microorganisms from agricultural feedstocks through fermentation process. Bioethanol has been used as an organic solvent and it is widely used as a blend in gasohol, petrol, and diesel. The demand of bioethanol as a blend is increasing due to the depletion of crude oils, cost of raw materials, and their increase in prices. As the bioethanol demand is increasing, there is a need to search alternative bio-energy resources, efficient microorganisms, potential feedstocks, and the new methodology is needed to develop to enhance bioethanol concentrations.

To bring out facts, experiments were conducted on the biochemical analysis of mahua flower (Madhuca indica) for its suitability as a raw material on bioethanol productions. Nowadays, microorganisms are also playing important roles in the production of fuel energy. The present investigations were carried out on the optimization of physico-chemical and nutritional parameters that effect bioethanol fermentations. The physico-chemical properties of bioethanol, types of beverages, production of bioethanol using fermentation, uses, and worldwide bioethanol production are discussed in introduction chapter-I.

Literature review of downstream and upstream process on bioethanol production, biochemical composition of Mahua flower (Madhuca indica) and their uses, history of fermentation, types of feedstocks, microorganisms for alcoholic fermentations, methods of bioethanol productions. The effect of factors on bioethanol productions and Response surface methodology (RSM) are discussed in the chapter-II.

In the chapter-III, Mahua flowers were examined for its potentiality on bioethanol productions which include determination of total moisture content, total fermentable sugars using Anthrone method, estimation of total reducing sugars with Dinitrosalicylic acid (DNS)
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reagent, estimation of protein content in mahua flower with miller’s method and estimation of crude fat. The microorganisms are used in bioethanol fermentations, preparation of yeast culture medium, preparation of bacterial culture medium, preparation of fermentative medium, determination of total cell count with Hemocytometer. The estimation of total viable yeast cells is possible by the method using Methylene blue reagent and determination. An attempt has been made to bring out the fact that bioethanol concentrations in fermented medium by gas chromatography. The high ethanol productions are realized by the methods of optimizations of physico-chemical and nutritional fermentative conditions and optimizations of fermentative conditions by Response surface methodology (RSM). The Central Composite Designs for three factors at a time on bioethanol production by Medium-I and Medium-II were discussed.

In the chapter-IV, The experiments were conducted on the effect of physico-chemical and nutritional factors that effect on bioethanol fermentations using mahua flower (*Madhuca indica*) as a substrate in 5 litre batch bioreactor. During the course of experiments, design of Medium-I and Medium-II were developed on the bioethanol productions using standard optimizations and the statistical optimizations, respectively. As a result, the experimental results on bioethanol productions include growth of microorganisms, selection of microorganisms, effect of physical parameters include Substrate concentration, pH, Temperature, Agitation, Inoculum volume, Inoculum age were discussed.

The experimental outcomes on the experimental results on the effects of chemical and nutritional parameters on bioethanol fermentation were discussed, that include the effects of nitrogen source, Copper chloride, Manganese chloride, Magnesium chloride, Zinc sulphate, Vitamin, Amino acids, Phosphorus, Ethylene diamine tetraacetic acid, Potassium phosphate, Calcium chloride, Cobalt chloride, Ferrous sulphate, Oxygen, Sodium chloride
and effect of organic nitrogen source like Peptone, Urea and Yeast using standard optimizations and statistical optimizations are discussed.

In the Vth chapter, the optimum bioethanol productions brought about by physico-chemical and nutritional factors of Medium-I in 5 litre bioreactor were compared with bioethanol productions by Medium-II in combination with *Saccharomyces cerevisiae*-3190. The fermentation efficiency of yeast strain *Saccharomyces cerevisiae*-3190, comparison of experimental yields of bioethanol with theoretical yields of bioethanol productions, bioethanol productivity, and the bioethanol as blend in petrol were discussed.

To conclude, the mahua flower (*Madhuca indica*) has been proved as a potential substrate on bioethanol fermentations. The yeast strain *Saccharomyces cerevisiae*-3190 has substantiated as an osmotolerant and high bioethanol tolerant in high gravity fermentation medium. It is also clear that the application of response surface methodology on bioethanol fermentations gave high content of bioethanol. The economic importance of bioethanol yield as blend in petrol using mahua flower (*Madhuca indica*) was discussed in the chapter-VI.

In the chapter-VII, Bibliography was given on the investigation of bioethanol fermentation. The chemical raw materials which are used in bioethanol fermentation process, Units and measurements, and the response surface methodology (RSM) were mentioned in Appendix-I, Appendix-II and Appendix-III.