

**Production and optimization of ethanol through RSM using
food processing industry waste: whey**



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**PRODUCTION AND OPTIMIZATION OF ETHANOL
THROUGH RSM USING FOOD PROCESSING
INDUSTRY WASTE: WHEY**

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MS

IN

ENVIRONMENTAL SCIENCES

BY

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Session: 2015-2017

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Lahore, Pakistan



In the name of

ALLAH,

The most Compassionate,

The most Merciful

**“Research is what I’m doing when I
don’t know what I’m doing”**

- *Wernher von Braun*

RESEARCH COMPLETION CERTIFICATE

Certified that the research work contained in this thesis titled, “**PRODUCTION AND OPTIMIZATION OF ETHANOL THROUGH RSM USING FOOD PROCESSING INDUSTRY WASTE: WHEY.**” has been carried out and completed by MUBASHAR MUSHTAQ, ID: 15001255001. The quantum and the quality of the work contained in this thesis is adequate for the award of degree of MS/M.Phil.

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DECLARATION

I MUBASHAR MUSHTAQ S/O MUHAMMAD MUSHTAQ ID: 15001255001 Session 2015-2017 have declare that the matter printed in the thesis dissertation titled “**Production And Optimization Of Ethanol Through RSM Using Food Processing Industry Waste: Whey**” which I here with submit for the research Qualification **M.S Degree In Environmental Sciences** To the Department of Chemistry, School of Science, University of Management and Technology, Lahore, Pakistan is apart from the recognized assistance of my supervisors, my own work and has not previously has been submitted as research work, thesis or publication in any form in any University, research institution etc. in Pakistan or abroad to obtain a research diploma or degree.

Dated: _____

(MUBASHAR MUSHTAQ)

DEDICATION

I dedicate this thesis in the memory of our beloved Prophet Hazrat Muhammad (P.B.U.H) and my parents especially to my father (MUHAMMAD MUSHTAQ) without your motivation, love and prayers, I could never be able to advance in life.

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ABSTACT

The current research on production of ethanol from dairy waste was achieved for cost-effective and eco-friendly reasons, generally for its usage as an alternate to petrol centered fuel. In this research, ethanol production on whey utilizing *S. cerevisiae* was studied. First, prior to fermentation, lactose, chief sugary constituent of the whey, must be enzymatically hydrolyzed with lactase (β -galactosidase) to gain the fermentable sugars galactose and glucose. Second, the experimental work was based on the Central Composite Design (CCD) to evaluate the effects of various process parameters such as glucose (1-5g), yeast extract (0.5-2.5g), pH (4.5-6.5), incubation period (3-7days) and inoculum size (1-5ml) on ethanol production. Lastly, the data gained from CCD design was imperiled to analysis of variance (ANOVA). Results indicate that, all the studied factors had important effect on the ethanol yield with probability (P) value less than 0.05. Moreover, optimized results show that optimal values of glucose, yeast extract, pH, and incubation period and inoculum size were investigated 3g, 1.5g, 5.5, 5days and 3ml respectively. Under these optimal conditions, fermentation process produced significant ethanol concentration of 9.753 g/100ml after 5 days of incubation.

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INTRODUCTION

1.1 What is whey?

Whey is watery remnant formed during the isolation of casein and fat from the milk, mainly contributes to dumping issues in livestock trade and needs traditional and cheap resolutions. Whey contains 85-95% of total milk and holds 55% milk nutrient substances. These nutrients contain 4.5- 5 % w/v lactose, 0.6- 0.8 % w/v hydrophilic proteins 0.4- 0.5 % w/v lipids and 8- 10 % w/v inorganic salts. Whey indicates a significant threat to environment due to its production in large amount, also it contains significant organic component. Biological oxygen demand (BOD) of whey is 35,000 ppm and chemical oxygen demand (COD) is 68,000 ppm (Dahiya & Vij, 2012).

Cheese whey consists of approximately (7%) total solids which contain proteins (10-12%), inorganic salts (8%), and fat (3%) and (74%) minerals (S. H. KIM, Morr, Seo, & Surak, 1989). Key proteins β -lactoglobulin and α -lactalbumin along with bovine serum and immunoglobulins are also present in whey. Other significant trace proteins including lactoferrin are also present in whey (Onwulata & Huth, 2008).