PREPARATION AND CHARACTERIZATION OF ACTIVATED CARBON FROM *Areca catechu* NUTS AS AN ADSORBENT FOR THE REMOVAL OF OPTILAN RED AND GLIMEPIRIDE

A Dissertation

Submitted for the Fulfillment of Requirement for the

Master of Science in Chemistry

By

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RECOMMENDATION LETTER

This is to certify that the dissertation work entitled "**Preparation and characterization of activated carbon from *Areca catechu* nuts as an adsorbent for the removal of optilan red and glimepiride''** has been carried out by **Santwana Pathak** as a partial fulfillment for the requirement of M.Sc. Degree in Chemistry under my supervision. To the best of my knowledge, this work has not been submitted to any other degree in this institute.

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BOARD OF EXAMINER AND CERTIFICATE OF APPROVAL

This dissertation entitled "**Preparation and characterization of activated carbon from *Areca catechu* nuts as an adsorbent for the removal of optilan red and glimepiride**", by Santwana Pathak, under the supervision of Assoc. Prof. Dr. Susan Joshi, Central Department of Chemistry, Tribhuvan University, Nepal, is hereby submitted for the partial fulfillment of the Master of Science (M.Sc.) in Chemistry.

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DECLARATION

I, “Santwana Pathak”, hereby declare that the work presented herein is genuine work done originally by me and has not been published or submitted elsewhere for the requirement of a degree program. Any literature, data or works done by others and cited in this dissertation has been given due acknowledgement and listed in reference section.

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DEDICATION

Dedicated to my father, **“Late Durga Pd. Pathak”**

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ABSTRACT

A series of activated carbons have been prepared from *Areca catechu* nuts of 425 µm by chemical activation with ortho-phosphoric acid (in the ratio of 0.4:1,0.7:1,1:1,1.5:1 and 2:1), potassium hydroxide (in the ratio 1:1) and zinc chloride (in the ratio 1:1) at 400°C in an inert atmosphere of nitrogen using tube furnace. The methylene blue number and iodine number obtained for the activated carbons were in the range of 108 to 405 mg/gm and 690 to 1080 mg/gm respectively, activated carbon impregnated with ortho-phosphoric acid in the ratio 1:1 (AC-1C) having the highest methylene blue number of 405.243 mg/gm and iodine number of 1080.122 mg/gm. The FT-IR comfirmed the presence of functional groups such as $\upsilon_{OH,}$ $\upsilon_{C=O}$, υ_{C-O-C}, $\upsilon_{C=C}$. The SEM images confirmed the porous structure of the activated carbons. The amorphous structure of the activated carbons was ascertained by XRD patterns. The q_m values of AC-1C for the adsorption of methylene blue, optilan red and glimepiride were found to be 434.782, 909,090 and 140.845 mg/gm respectively from Langmuir adsorption isotherm. The adsorption kinetics of optilan red and glimepiride on activated carbons were found to follow pseudo-second order kinetics with k_2 value of 2.245×10^{-3} and 3.21×10^{-4} gm/mg.min. These experimental results indicated that the *Areca catechu* nuts can be used as precursor materials for the preparation of high surface area nanoporous activated carbon as an adsorbent.

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ABBREVIATIONS

a_{MB}	Occupied surface area by one molecule of methylene blue
A	Absorbance or optical density
AC	Activated carbon
b	Langmuir's constant (K_L)
BET	Brunauer, Emmett and Teller
C_e	Equilibrium concentration
C_o	Initial concentration
C_t	Concentration at time 't'
FT-IR	Fourier Transform Infrared Spectroscopy
gm	Gram
K_1	Pseudo-first order rate constant
K_2	Pseudo-second rate constant
K_F	Freundlich's constant
L	Litre
L/mg	Litre per miligram
L/min	Litre per minute
Meq	Miliequivalent
mm	Milimeter
m^2/gm	Meter square per gram
mg/gm	Miligram per gram
mg/g min	Miligram per gram minute
mg/L	Milligram per litre
ml	Millilitre
n	Adsorption intensity
nm	Nanaometer
N_a	Avogadro's number
pH	Negative logarithm of hydrogen ion concentration
ppm	Parts per million
q_e	Amount adsorbed at equilibrium time
q_m	Maximum adsorption capacity
q_t	Amount adsorbed at time 't'
R-1	Raw precursor

Rem %	Removal percentage
R^2	Regression coefficient
S	Specific surface area of adsorbent
SEM	Scanning Electron Microscopy
V	Volume
W	Weight