THE OPTIMUM OPERATING CONDITIONS FOR EXTRACTION OF CHLOROPHYLL FROM *Alternanthera sessilis* (Linn.), CULTIVATED IN SRI LANKA

MASTER OF SCIENCE

MAM JINASENA

UNIVERSITY OF MORATUWA
SRI LANKA

SEPTEMBER 2010

THE OPTIMUM OPERATING CONDITIONS FOR EXTRACTION OF CHLOROPHYLL FROM *Alternanthera sessilis* (Linn.), CULTIVATED IN SRI LANKA

BY

MAM JINASENA

THIS THESIS WAS SUBMITTED TO THE
DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING
OF UNIVERSITY OF MORATUWA
IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE
DEGREE OF MASTER OF SCIENCE

DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING
UNIVERSITY OF MORATUWA
MORATUWA
SRI LANKA

SEPTEMBER 2010

Declaration

The work submitted in this dissertation is the result of my own investigation, except otherwise stated. It has not already been accepted for any degree, and is also not being concomitantly submitted for any other degree or diploma in any other university. It does not contain any material previously published, written or orally communicated by another person, to the best of my knowledge and belief.

MAM Jinasena

10th of September, 2010

We endorse the declaration by the candidate.

Supervisors

Dr. ADUS Amarasinghe
Prof. (Mrs) BMWPK Amarasinghe
Dr. MAB Prashantha

Acknowledgement

My profound gratitude and sincerest appreciation go to the supervisors, Dr. ADUS Amarasinghe, Prof. (Mrs.) BMWPK Amarasinghe and Dr. MAB Prashantha; head of the department, senior lecturer of the department (Dpt. of Chemical & Process Engineering) and lecturer of ITUM, University of Moratuwa, respectively, whose support was vital to this research. Their encouragement, guidance and expert help was invaluable.

The support given by the staff of the Post Graduate Studies Division and the Senate Research Grant was always encouraging. Special thanks go to Dr. S Walpolage and Dr. (Mrs.) SHP Gunawardena for their suggestions and the encouragement given as the members of the progress review panel. Gratitude goes to Dr. PG Rathnasiri, the course coordinator of 'MSc/PG Diploma in Sustainable Process Development', for allowing me to study the subject "Computational Fluid Dynamics" as my coursework component.

Appreciation is extended to Dr. J Manatunga, head of Environment Division, Dpt. of Civil Engineering, University of Moratuwa, and the technical staff of the Environmental Engineering Laboratories of both departments, Dpt. of Civil and Chemical Engineering, for the help given in the spectrophotometric analysis.

Critical help needed in laboratory work, was given by Ms. Amali Wahalathanthri, the laboratory technician of the Food Processing Laboratory of Dpt. of Chemical & Process Engineering. She went out of her way to help me to carry out the experiments and to gather the background knowledge. Also appreciated is the valuable support given by the academic and non- academic staff of the Dpt. of Chemical & Process Engineering.

Finally I would like to thank all the colleagues of the PG Division of the Dpt. of Chemical & Process Engineering and my family, for the help and cooperation given.

MAM Jinasena

Contents

List of Figures

List of Tables

Abstract

Chlorophyll is widely extracted for industrial applications and is a key topic of scientific and commercial interest. *Alternanthera sessilis*, which is known as mukunuwenna in Sri Lanka, is one of best selections for the extraction of chlorophyll due to the good extraction efficiency, availability and low cost.

In this work, the optimum operating conditions for the extraction of chlorophyll from *A. sessilis* using solvent extraction were studied using buffered 80% aqueous acetone. The results revealed that the best solvent volume to *A. sessilis* weight ratio, which gives the highest yield of chlorophyll, was 5 ml/g. The effect of temperature and the extraction time on the extraction was also studied. The optimum temperature of extraction is 50°C and the optimum time of extraction is 45 minutes. The mass transfer of chlorophyll from *A. sessilis* at 20°C and 30°C was modeled mathematically, using general mass transfer equations. The experimental results showed that the degradation of chlorophyll beyond the temperature of 30°C is significant. The saturation solubility of chlorophyll *a* was 54.06 and 107.6μg/ml and that for chlorophyll *b* was 23.13 and 29.68 μg/ml at the temperatures of 20 and 30°C respectively.

Furthermore, the optimum pre-processing method and the storage conditions were studied as post harvest operations for *A. sessilis*. The optimum method of pre processing was identified as mechanical grinding. For one day storage, ambient air conditions (indoor) were the optimum conditions; and for a longer storage time it was the refrigerator conditions (15°C).

Using the extract, commercial chlorophyll, Sodium copper chlorophyllin has produced with a 33.3% conversion of chlorophyll and its derivatives, using a modified process. The kinetics of degradation of chlorophyll of the produced sodium copper chlorophyllin follows a first order relationship between the concentration and the time. The relationship between the rate constant and the temperature follows the Arrhenius behavior. The activation energy for chlorophyll *a* and *b* are 3.014 and 2.78 kcal/mol respectively. The rate constants for chlorophyll *a* and *b* at different temperatures are also obtained.