

**Development of a Value Added Bread using Kithul  
(*Caryota urens*) Flour**

**By**

**Dissanayaka Mudiyansele Chathuri Neranjala  
Kumari Senanayake**

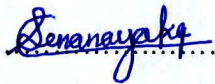
**Thesis submitted to the University of Sri Jayawardenapura in  
the partial fulfillment of the requirement for the award of the  
Degree of Master of Science in Food Science and Technology.**

## Declaration

The work described in this thesis was carried out by me under the supervision of Dr. Indira Wickramasinghe Senior Lecturer, Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayawardhanapura and a report on this has not been submitted in whole or in part to any University for any other Degree/Diploma.

07.12.2015

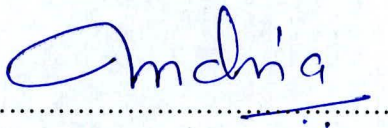
Date



D.M.C.N.K. Senanayake

## Declaration

I certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.

  
.....

Dr. Indira Wickramasinghe

Senior Lecturer,

Department of Food Science and Technology,

Faculty of Applied Sciences,

University of Sri Jayawardanapura,

Sri Lanka

Date : .....7/12/2015.....

## List of content

| <b>Content</b>                                   | <b>Page</b> |
|--|-------------|
| List of content .....                            | i           |
| List of Table .....                              | vi          |
| List of Figures .....                            | vii         |
| Acknowledgement .....                            | viii        |
| Abbreviations .....                              | ix          |
| Abstract .....                                   | x           |
| <b>Chapter 1            Introduction</b>         | <b>1</b>    |
| 1.1 Introduction .....                           | 1           |
| 1.2 Objectives .....                             | 4           |
| General objective .....                          | 4           |
| Specific objectives .....                        | 4           |
| <b>Chapter 2            Literature Review</b>    | <b>5</b>    |
| 2.1 Classification of <i>Caryota urens</i> ..... | 5           |
| 2.2 Distribution .....                           | 6           |
| 2.3 Morphology .....                             | 6           |
| 2.4 Cultivation .....                            |             |
| 2.5 Uses .....                                   | 8           |
| 2.6 Medicinal values .....                       | 9           |
| 2.6.1 Ayurvedic recommendation .....             | 9           |
| 2.6.2 Therapeutic uses .....                     | 9           |
| 2.6.3 Side effects .....                         | 10          |

|   |    |
|---|----|
| 2.7 Kithul ( <i>Caryota urens</i> ) Flour .....               | 10 |
| 2.7.1 Chemical composition of Kithul flour .....              | 11 |
| 2.7.2 Uses of Kithul flour .....                              | 12 |
| 2.8 Bread .....   | 13 |
| 2.8.1 History of bread .....                                  | 14 |
| 2.8.2 Types of bread .....                                    | 14 |
| 2.9 Basic ingredients of breads .....                         | 16 |
| 2.10 Major Steps of bread preparation .....                   | 19 |
| 2.11 Nutritional properties of breads .....                   | 22 |
| 2.12 A healthy diet with bread .....                          | 24 |
| 2.13 Chemistry of bread .....                                 | 24 |
| 2.14 Shelf life of Bread .....                                | 26 |
| 2.14.1 The microbiological shelf life of bread .....          | 26 |
| 2.14.2 Microbial growth in bread .....                        | 27 |
| 2.14.3 Physical methods to extend mould free shelf life ..... | 30 |
| 2.14.3.1 Pasteurization .....                                 | 30 |
| 2.14.3.2 Modified atmosphere packaging (MAP) .....            | 31 |
| 2.14.4 Packaging materials of Bread .....                     | 32 |
| 2.15 Health effects of White bread .....                      | 33 |
| 2.16 Sensory Evaluation .....                                 | 36 |

|                  |   |           |
|------------------|---|-----------|
| <b>Chapter 3</b> | <b>Materials &amp; Methodologies</b>                            | <b>38</b> |
| 3.1              | Selection of formula for Kithul flour incorporated              |           |
|                  | Wheat Bread preparation .....                                   | 38        |
| 3.2              | Bread Preparation Process .....                                 | 40        |
|                  | 3.2.1 Process flow chart of bread preparation process .....     | 41        |
| 3.3              | Determination of volume/mass ratio .....                        | 42        |
|                  | 3.3.1 Materials .....   | 42        |
|                  | 3.3.2 Method .....  | 42        |
| 3.4              | Determination of Moisture content by oven drying method         | 43        |
|                  | 3.4.1 Materials .....   | 43        |
|                  | 3.4.2 Method .....  | 44        |
|                  | 3.4.3 Calculation .....   | 45        |
| 3.5              | Determination of Total Fat percentage by acid hydrolysis method | 45        |
|                  | 3.5.1 Materials .....   | 45        |
|                  | 3.5.2 Method .....  | 46        |
|                  | 3.5.3 Calculation .....   | 47        |
| 3.6              | Determination of crude protein percentage by Kjeldahl method    | 47        |
|                  | 3.6.1 Materials .....   | 47        |
|                  | 3.6.2 Method .....  | 48        |
|                  | 3.6.3 Calculation .....   | 49        |
| 3.7              | Determination of crude fiber .....                              | 50        |

|  |    |
|--|----|
| 3.7.1 Materials .....  | 50 |
| 3.7.2 Method .....   | 51 |
| 3.7.3 Calculation .....  | 52 |
| 3.8 Determination of Ash percentage by Direct method .....       | 53 |
| 3.8.1 Materials .....  | 53 |
| 3.8.2 Method .....   | 54 |
| 3.8.3 Calculation .....  | 55 |
| 3.9 Determination of pH by using pH meter .....                  | 55 |
| 3.9.1 Materials .....  | 55 |
| 3.9.2 Method .....   | 56 |
| 3.10 Determination of Mineral content by                         |    |
| Inductive Coupled Plasma (ICP -OES) .....                        | 56 |
| 3.10.1 Materials .....   | 57 |
| 3.10.2 Method .....  | 57 |
| 3.10.3 Calculation .....   | 58 |
| 3.11 Determination of Total Carbohydrate percentage .....        | 58 |
| 3.11.1 Calculation .....   | 58 |
| 3.12 Determination of Energy Generation by 100 g of sample ..... | 59 |
| 3.12.1 Calculation .....   | 59 |
| 3.13 Determination of shelf life of the final product through    |    |

|   |           |
|---|-----------|
| Microbiological Tests .....                                   | 59        |
| 3.13.1 Materials .....  | 59        |
| 3.13.2 Method .....   | 60        |
| 3.14 Determination the sensory properties of Kithul bread     |           |
| with comparing the other breads in the market .....           | 61        |
| 3.14.1 Materials .....  | 61        |
| 3.14.2 Method .....   | 61        |
| <b>Chapter 4 Results &amp; Discussion</b>                     | <b>62</b> |
| 4.1 Results of selection of formula for Kithul flour          |           |
| incorporated Wheat Bread preparation .....                    | 62        |
| 4.2 Composition of selected final bread product .....         | 64        |
| 4.3 Results of Volume/Mass ratio of Kithul bread .....        | 65        |
| 4.4 Proximate Analysis results of Kithul bread .....          | 65        |
| 4.5 Results of mineral content analysis in Kithul bread ..... | 68        |
| 4.6 Results of Shelf life determination of Kithul bread ..... | 69        |
| 4.7 Results of sensory evaluation in Kithul bread with        |           |
| comparing other breads in the market .....                    | 70        |
| <b>Chapter 5 Conclusion</b>                                   | <b>73</b> |
| Recommendation  | 74        |
| References  | 75        |
| Appendices  | 77        |



## List of Tables

|   |    |
|---|----|
| Table 2.1 Classification of <i>Caryota urens</i> .....  | 5  |
| Table 2.2 Results of identification and Chemical composition test of Kithul<br>flour collected from different growing areas in Sri Lanka..... | 12 |
| Table 2.3 Uses of Kithul flour in food and nonfood industry .....   | 13 |
| Table 2.4 – Comparison of nutritional values in bread with other foods.....   | 23 |
| Table 2.5- Nutritional values of bread.....   | 24 |
| Table 3.1 Ingredients according to the maximization of Kithul<br>flour usage in bread preparation.....  | 39 |
| Table 4.1 – Summarized estimated medians and sum of ranks for each attribute  | 62 |
| Table 4.2 – The 25% Kithul flour incorporated wheat bread formula.....  | 64 |
| Table 4.3 – Volume/Mass ratio of Kithul bread.....  | 65 |
| Table 4.4 – Results of proximate analysis (on wet weight basis).....  | 65 |
| Table 4.6 – Summarized estimated medians and sum of ranks for each attribute  | 71 |

## List of Figures

|   |    |
|---|----|
| Figure 2.1- Morphology of Kithul ( <i>Caryota urens</i> ) .....                   | 7  |
| Figure 3.1 – Process flow chart of bread preparation .....                        | 41 |
| Figure 4.1 – The Spider web diagram for estimated median of attributes.....       | 63 |
| Figure 4.2 – Final Kithul bread product .....                                     | 64 |
| Figure 4.3 – Proximate nutritional results of Kithul bread .....                  | 66 |
| Figure 4.4- Mineral content of Kithul bread .....                                 | 69 |
| Figure 4.5 – Yeast colonies of Kithul bread in 10-1 and 10-2 dilution series..... | 70 |
| Figure 4.6 – The Spider web diagram for sum of ranks of attributes .....          | 72 |

## **Acknowledgement**

- First and foremost I would like to give my sincere and grateful thanks to Dr. Indira Wickramasinghe, Senior Lecturer, Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayawardhanapura, for the kind assistant and guidance given throughout the period of this research project.
- I wish to forward my sincere thanks to all academic and non-academic staff of Department of Food Science and Technology , University of Sri Jayewardenepura, for their invaluable guidance and support to carry out this study successfully.
- My grateful thanks go to Mr. Jagath Wijesinghe, the head chef in Lanka Premier Foods (Paan Paan) for his valuable support and guidance throughout this research project.
- I'm deeply thankful to all staff members of Chemical and Microbiology laboratories in SGS Lanka (Pvt) Ltd. for their kind technical support to carry out the analysis work successfully.
- Finally I would like to thank my ever loving mother, all family members and colleagues for their enormous support on numerous occasions for making this research a success

## Abbreviations

|                 |                           |
|-----------------|---------------------------|
| °C              | Celsius                   |
| CO <sub>2</sub> | Carbon dioxide            |
| NCDs            | Non Communicable Diseases |
| ppm             | Parts per million         |
| min             | Minutes                   |
| g               | Gram                      |
| ml              | Milliliter                |

## **Development of a Value Added Bread using Kithul (*Caryota urens*) Flour**

**By D.M.C.N.K. Senanayake**

### **ABSTRACT**

Bread is believed to be the basic food that supports life. Nowadays, junk food is popular the world over and the situation is the same in Sri Lanka too. Most of the foods are based on milled wheat flour which is less nutritious. Due to this the risks of diabetes, obesity and other health defects have increased. In order to address this issue needed to introduce a substitute for wheat flour in bread preparation up to certain extent. Kithul (*Caryota urens*) flour was selected as the substitute. The maximization of Kithul flour usage in bread was determined by preparing few bread samples of different concentrations of Kithul flour. Sensory evaluation was carried out by 37 untrained panelists. Obtained data were analyzed according to the Friedman test at 95% level of significance. The 25% Kithul flour incorporated wheat bread was selected as the best sample by sensory evaluation. Then the selected bread was analyzed for proximate composition. It was found that 55.34% carbohydrate, 7.61% crude protein, 0.48% total fat, 0.4% crude fiber, 1.34% ash and 34.08% moisture content. pH and Volume/Mass ratio of the bread were determined according to SLS standards. pH of the bread was 5.31 at 25<sup>o</sup>C and Volume/Mass ratio was 2.53. Mineral composition was evaluated using Inductive Coupled Plasma (ICP-OES). Essential minerals were found in the selected bread such as Ca 426.45 ppm, Mg 503.39 ppm, Na 281.30 ppm, K 106.80 ppm, Fe 42.40 ppm and Zn 36.80 ppm. Microbial evaluation was done to determine the shelf life. After wrapping by using low density polyethylene, the shelf life of the bread was 36 hours at room temperature (28<sup>o</sup>C), without adding preservatives. If wrapped by low density polyethylene it could be extended up to 48 hours. Finally the sensory properties evaluated in the developed bread by using untrained panelist with two more breads available in the local market. The developed Kithul bread could have a demand in the Sri Lankan market depending on the customer evaluation. The prepared bread was nutritious, healthier and safe for all consumers including vegetarians.

## **Chapter 1**

### **Introduction**

#### **1.1 Introduction**

In today's fast paced lifestyle, it is difficult to imagine our lives without bread – cheap and adaptable staple food which is widely accepted in all parts of the world in different forms and holds cultural significance as well apart from nutrition element. Application of bread ranges from daily meal for a wage worker to offering as a welcome gesture in royal society, not to mention in countries like India, chapatti (a form of bread) is an important part of the meal served with curry or other food items.

The main building block of bread is flour which is mixed with other ingredients depending on the taste, aesthetics and nutrition requirement. Flour is a powdery substance obtained by fine grinding of food grains like wheat, rice, rye, maize, barley etc. These grains are full of starch and proteins which is crucial to bread preparation.

The flour when mixed with water, chemical leavening agents such as yeast, steam, fats, sugars, salts - each component in one or other way helping flour fermentation. Fat apart from leavening effect, helps to keep the bread fresh and tender. Sugar facilitates the fermentation as well as enhances taste and crust color of the bread.

Nutritionists and dieticians worldwide recommend to incorporate pure cereal, raw fruits and vegetable and dietary fibers, while cautioning not to take food with high fats, sugar, salt and alcohol as these have adverse effect on the human body. Low cost breads which

we encounter day to day contains reasonable amount of fats and sugar. Therefore, search for an alternative and more pure form of bread becomes the need of the hour.

According to the data from the World Health Organization, 220 million people in the world were suffering from diabetes mellitus in 2011 and this number will increase 336 million by 2030. At least 2.8 million adults die each year as a result of being overweight or obese. Obese and overweight are closely related with many health issues such as diabetes, cardiovascular diseases and certain cancers.

In order to prevent those non communicable diseases up to certain extent, the consumption of high starchy foods such as refined wheat breads should be reduced. Two possible approaches can be used to reduce wheat bread consumption namely introducing alternative foods for wheat breads or replacing some part of wheat flour by using nutritious flour.

Kithul flour is one such alternative of traditional flour e.g. when mixed with certain proportions with the wheat flour, it provides the nutrition without addition of fat and sugar during bread manufacturing. Kithul Flour is high fiber gluten (starch) substitute, special porridge helps to cure gastric and digestive disorders and acts as a healthy substitute to normal flour.

Kithul is a palm tree, *Caryota Urens* (botanical name), may grow to a height of 40 - 50 feet and a girth of 4-6 feet. Kithul trees are very famous in Sri Lanka and serves as a source of both edible and non-edible products. Furniture made from timber is non-edible products while Edible products are Kithul trickle (honey), Kithul toddy (contains 5% alcohol), Kithul jaggery (substitute for sugar) and Kithul flour.