DOI :10.31357/fapsmst.2015.00395

CHARACTERIZATION OF RICE AND RICE STARCH OF DIFFERENT CULTIVARS

BY

LAKSHITHA KANAGESWARAN

A THESIS SUBMITTED TO THE DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY, FACULTY OF APPLIED SCIENCES UNIVERSITY OF SRI JAYEWARDENEPURA FOR THE DEGREE OF MASTER OF FOOD SCIENCE AND TECHNOLOGY

DECLARATION

"I declare that this thesis submitted by me for MSc. degree in Food Science and Technology at the University of Sri Jayewardenepura. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work"

K. Lakshitha
K. Lakshitha
(MSc Student)

08-12-2015
Date

DECLARATION

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

Dr. (Mrs.) Indira Wickramasinghe
Senior Lecturer,
Department of Food Science & Technology,
Faculty of Applied Sciences,
University of Sri Jayewardenepura,
Sri Lanka.

Dr. S. Balakumar,
Senior Lecturer,
Department f Biochemistry,
Faculty of Medicine,
University of Jaffna,
Sri Lanka.

DEDICATION

I dedicate this to my family, supervisors, friends and fellow members without whom it was almost impossible for me to complete my thesis work.

TABLE OF CONTENTS

TABLE OF CONTENTS.....i
LIST OF TABLES.....vi
LIST OF FIGURES.....vii
ACKNOWLEDGMENTS.....viii
LIST OF ABBRIVIATIONS.....x
ABSTARCT.....xi

CHAPTER 1.....1
1.0 INTRODUCTION.....1
1.1 General objective.....3
1.2 Specific objectives.....3
CHAPTER 2.....4
2.0 LITERATURE REVIEW.....4
2.1 History of rice cultivation in Sri Lanka.....4
2.1.1 The two main cultivation seasons.....5
2.2 Origin of rice and distribution.....5
2.3 Rice taxonomy and botany.....6
2.4 Importance of rice.....8
2.5 Rice varieties.....9
2.6 Structuregrain.....12
2.6.1 Longitudinal section of rice grain.....12
2.7 Gross nutrient composition.....14
2.7.1 Moisture content in rice.....15
2.7.2 Protein.....16
2.7.3 Starch.....17
2.7.4 Amylose.....17
2.7.5 Lipid.....19
2.7.6 Non-starch polysaccharides.....19
2.7.7 Ash and mineral content.....20
2.7.8 Resistant starch.....21
2.8 Post production operations.....22
2.8.1 Harvesting.....22
2.8.2 Threshing.....22

2.8.3 Drying 24

2.8.4 Cleaning 24
2.8.5 Milling 25
2.8.6 Grading 27
2.8.7 Storage 27
2.9 Physical characteristics 28
2.9.1 Seed quality 29
2.9.2 Grain quality 31
2.10 Milling characteristics 33
2.10.1 Milling degree (bran percentage) 35
2.10.2 Husk percentage 35
2.10.3 Milling recovery 36
2.10.4 Head rice 36
2.10.5 Broken rice 37
2.10 Characteristics of rice starch 37
2.10.1 Water binding capacity, swelling power,and solubility pattern 37
CHAPTER 3 39
3.0 MATERIALS AND METHODS 39
3.1 Cleaning of glasswares 39
3.2 Determination of moisture 39
3.2.1 Materials 39
3.2.2 Method 39
3.3 Standard curve for glucose by 3,5-dinitrosalicylic acid (DNS) method 40
3.3.1 Materials 40
3.3.2 Method 40
3.4 Determination of total sugars 41
3.4.1 Materials 41
3.4.2 Method 41
3.5 Determination of crude protein 42
3.5.1 Materials 42
3.5.2 Method 43
3.6 Determination of total fat 44

3.6.1 Materials 44
3.6.2 Method 44
3.7 Determination of dietary fibre 45
3.7.1 Materials 45
3.7.2 Method 46
3.8 Determination of resistant starch 47
3.8.1 Materials 47
3.8.2 Method 48
3.9 Determination of Ash 49
3.9.1 Materials 49
3.9.2 Method 49
3.10 Isolation of Starch 50
3.10.1 Materials 50
3.10.2 Method 50
3.11 Determination of amylose 51
3.11.1 Materials 51
3.11.2 Method 51
3.12 Determination of swelling power and solubility 52
3.12.1 Materials 52
3.12.2 Method 52
3.13 Determination of water binding capacity 53
3.13.1 Materials 53
3.13.2 Method 53
3.14 Determination of Physical characteristics 53
3.14.1 Determination of seed Length and width 53
3.14.2 Determination of Thousand (1000) rough rice weight 54
3.14.3 Determination of rough rice hardness 54
3.14.4 Determination of rough rice bulk density 54
3.14.5 Determination of brown ricedimension 55
3.14.6 Determination of thousand brown rice weight 55
3.14.7 Determination of brown rice hardness 55
3.14.8 Determination of brown rice colour 56
3.14.9 Determination of polished rice colour 56

3.15 Determination of milling characteristics 56
3.15.1 Material 57
3.15.2 Method 57
3.16 Statistical analysis 58

CHAPTER 4 59
4.0 RESULTS AND DISCUSSIONS 59
4.1 Proximate analysis 59
4.1.1 Moisture content 59
4.1.2 Total sugar content 60
4.1.3 Crude protein content 61
4.1.4 Total fat content 61
4.1.5 Resistant starch content 62
4.1.6 Dietary fiber content 62
4.1.7 Ash content in rice flour 63
4.2 Properties of rice starch 66
4.2.1 Amylose content in rice starch 66
4.2.2 Swelling power water solubility of rice starch 68
4.2.3 Water binding capacity of rice starch 69
4.3 Physical characteristics 69
4.3.1 1000 Rough rice weight 69
4.3.2 1000 Brown rice weight 69
4.3.3 Length and width of rough rice 74
4.3.4 Size and Shape of brown rice 75
4.3.5 Hardness of rough rice and brown rice 77
4.3.6 Bulk density of rough rice 77
4.3.7 Colour of brown rice and polished rice 78
4.4 Milling characteristics 80
4.4.1 Husk percentage 80
4.4.2 Bran percentage 81
4.4.3 Broken rice yield 81
4.4.4 Head rice yield 83
4.4.5 Total milling recovery of rice 84

CHAPTER 5 ..... **86**

5.0. CONCLUSIONS AND RECOMMENDATIONS **86**

5.1 CONCLUSION 86

5.2 RECOMMENDATIONS 88

6.0 REFERENCES **89**

APPENDICES **93**

Appendix 1: Ten rice varietal Analysis of Variance (ANOVA) with eight proximate composition 93

Appendix 2: Ten rice varietal Analysis of Variance (ANOVA) with properties of Rice starch 95

Appendix 3: Eight rice varietal Analysis of Variance (ANOVA) with physical characteristics 96

Appendix 4: Eight rice varietal Analysis of Variance (ANOVA) with milling characteristics 99

LIST OF TABLES

Table 2.1: Proximate composition of rough rice and its milling fractions at 14%..... 15

Table 2.2:Vitamin and mineral content of rough rice and its milling fractions at.....21

Table 2.3:Quality of paddy threshed by tractors and mechanical threshers 23

Table 2.4: The threshing efficiency in mechanical threshing is significantly higher..23

Table 2.5: Classification of rough rice based on length and width.....31

Table 2.6: Classification of brown rice based on size 32

Table 2.7: Classification of brown rice based on shape 33

Table 4.1: Proximate Composition parameters means for ten rice varieties 64

Table 4.2: Properties of rice starch of each varieties.....67

Table 4.3 : Varieties grouped based on amylose content 68

Table 4.4 : Physical characteristics of rough rice 71

Table 4.5 : Physical characteristics of brown rice 72

Table 4.6: Varieties grouped based on the thousand rough rice weight.....73

Table 4.7 : Varieties grouped based on the thousand brown rice weight 73

Table 4.8: Varieties grouped based on the length of rough grain.....74

Table 4.9: Varieties grouped based on the shape of rough rice 75

Table 4.10: Varieties grouped based on the size brown rice 76

Table 4.11: Varieties grouped based on the shape of brown rice.....76

Table 4.12: Colour content of rice varieties 79

Table 4.13: Milling characteristics of rice varieties 82

LIST OF FIGURES

Figure 2.1 Scientific classification 6

Figure 2.2 Rice Varieties 9

Figure 2.3 Structure of grain 12

Figure 2.4 Endosperm cell 13

Figure 2.6 AmylopectinStructure 17

Figure 2.5 Amylose structure 17

Figure 4.1 : Plot of absorbance at 550nm against glucose concentration 60

Figure 4.2 : Proximate Composition 65

Figure 4.3: Plot of absorbance at 620 nm against concentration of amylose (mg/ml) for 67

Figure 4.4: L*, a*, and b* values of brown rice 79

Figure 4.5: L* value between brown rice and polished rice 80

Figure 4.6: Relationship between head rice (%) and broken rice (%) 84

Figure 4.7: Relationship between head rice percentage and total yield 85

I wish to express my sincere thanks to Dr. Champathi Gunatileke who greatly assisted me to do the research at Institute of Post Harvest Technology, Anuradhapura.

I would also like to show my gratitude Mrs. S. Sritharan, Mrs. K. Niththiyanantharajah and Mr. K. Thayananthan, Technical staff, Department of Biochemistry.

I take this opportunity to express my gratitude to staffs of Faculty of Agriculture, University of Jaffna, Palmyrah Research Institute, Kaithady, Jaffna and Staffs of IPHT and laboratory technicians.

I would also like to thank to Mr. N. Niththiyanantharajah, Mr. T. Santhiramoorthy, Mr. M. Sutharsan, Mr. V. Jeyabalasundaram, Mr. Balasingham, Mr. P. Mohan and Mr. P. Kirupanantharajah for their assistance and cooperation.

Last but not the least, I would like to thank my family, especially to my parents, my brother and my husband who provided me with unending encouragement and support to complete my tasks.

LIST OF ABBRIVIATIONS

FAO	Food and Agriculture Organization
ANOVA	Analysis of Variance
AOAC	Association of Official Analytical Chemists
DMRT	Duncan's Multiple Range Test
IRRI	International Rice Research Institute
B.C	Before Christ
DNS	Dinitrosalicylic acid
At	Ambalangoda
Bg	Bathalagoda
PB	Protein Body
CRH	Carbonized Rice Husk
RHA	Rice Husk Ash
KI	Potassium Iodide
NaOH	Sodium Hydroxide
KOH	Potassium hydroxide
CuSO4	Copper Sulphate
K2SO4	Potassium Sulphate
HCl	Hydrochloric acid
DF	Dietary Fiber
RS	Resistant starch

ABSTRACT

This study was carried out to find the physical, chemical characteristics of rice and rice starch of traditional and improved rice cultivars namely Motaikarupan, Morungan, Pachachperumal, Suwenthal, Pusparaga, Atakari, BG300, At308, BG406, BG250.The proximate composition for the ten varieties were variable with respective ranges being moisture 13.390% to 9.460%, total sugar 86.45% to 79.45%, crude protein 8.15 % to 5.79 %, total fat 3.5400% to 2.2150%, resistant starch 0.69% to 0.405%, ash 1.6900% to 0.8950%, Dietary fiber 4.10% to 2.20%. All these result were found to be significantly different ($P< 0.05$).The starch properties including amylose content, water solubility, swelling power and water binding capacity were estimated for ten rice varieties, varied from 30.8010% to 23.2005%, 8.4695% to 4.7900%, 12.57% to 10.2300%, 3.1028% to 2.4400%, respectively ($P< 0.05$).Analysis of milling quality parameters of the eight rice varieties were showed that there is a significant different ($P< 0.05$).The husk content 21.0101% to 18.4601%, bran content 10.5495% to 6.5575%, total recovery 73.3290% to 67.8850%, head rice 67.5902% to 22.9010%, broken rice 67.2780% to 5.2500%. The physical properties of rough rice and brown rice were analyzed. According to rough rice length the rice varieties were classified into three groups, long (1 variety), medium (5 varieties) and short (2 varieties) and they were further classified based on their width rough rice were classified into two groups as semi spherical (3 varieties), semi long (5 varieties).With brown rice length the rice varieties were grouped into two groups as medium (6 varieties) and short (2 varieties) and also grouped in three based on the length to width ratio as slender (2 varieties), medium (5 varieties) and bold (1 variety). Based on the thousand rough rice weights, the varieties were categories into 7 ranges; below 15grams (1 variety), 15-18grams (2 varieties), 18 to 21grams (1 varieties), 21 to 24grams (1 variety), 24 to 27 (1 variety), 27 to 30 (1 Variety), 33 to 36 (1 variety) and the brown rice were also grouped into 5 according to their thousand grain weight ranges; below

15 grams (1 variety),15 to 18 grams (2 varieties),18 to 21grams (2 varieties), 21 to 24 (1 variety), 24 to 27 (2 varieties).Bulk density of the rough rice were ranged from 0.6615g/ml to 0.6110g/ml ($P< 0.05$).The hardness of rough rice and brown rice were stated 112N to 51.6N and 46.6N to 20.4N respectively. The color of brown rice stated according to L*,a* and b* values, 62.453 to 44.230 ($p<0.05$), 9.597 to 0.640 ($p<0.05$), 17.927 to 10.860 ($p>0.05$) respectively and the color of polished rice L* value was ranged from 71.63 to 68.29 ($p<0.05$)