View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Repository@USM

PUSAT PENGAJIAN TEKNOLOGI INDUSTRI UNIVERSITI SAINS MALAYSIA

BORANG PENYERAHAN DISERTASI MUTAKHIR SATU (1) NASKAH

Nama penyelia: Dr. Lee Lai Kuan

Bahagian: Teknologi Makanan

Saya telah menyemak semua pembetulan/pindaan yang dilaksanakan oleh ~~Encik~~/~~Puan~~/Cik Wan Zulaikha Adrina binti Wan Ahmad Zikri

mengenai disertasinya sebagaimana yang dipersetujui oleh Panel Pemeriksa di *Viva Voce*-nya.

2. Saya ingin mengesahkan bahawa saya berpuashati dengan pembetulan/pindaan yang dilaksanakan oleh calon.

Sekian, terima kasih.

DR. LEE LAI KUAN
Senior Lecturer
School of Industrial Technology
Universiti Sains Malaysia

7/8/2020

(Tandatangan dan cop) Tarikh

GLYCEMIC INDEX VALUES OF INSTANT MULTIGRAIN BEVERAGE: CURRENT KNOWLEDGE AND FUTURE PROSPECTS

by

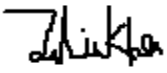
WAN ZULAIKHA ADRINA BINTI WAN AHMAD ZIKRI

A dissertation submitted in partial fulfilment of the requirements for degree of
Bachelor of Technology (B. Tech.) in the field of Food Technology
School of Industrial Technology
Universiti Sains Malaysia

July 2020

DECLARATION BY AUTHOR

This dissertation is composed of my original work and contains no material previously published or written by another person except where due reference has been made in the text. The content of my dissertation is the result of work I have carried out since the commencement of my research project and does not include a substantial part of work that has been submitted to qualify for the award of my degree or diploma in any university or other tertiary institution.



WAN ZULAIKHA ADRINA BINTI WAN AHMAD ZIKRI

JULY 2020

ACKNOWLEDGEMENT

First and foremost praises and deepest gratitude to The Almighty God for His showers of blessings and granted me with good health to complete my research successfully. I would like to express my sincere gratitude to my research supervisor, Dr Lee Lai Kuan for giving me her guidance, support and advice for improvement throughout this research. Without her dedication, this thesis would not be possible.

I am taking this opportunity to express my sincere gratitude to all laboratory assistants, Miss Norita Abdul Kadir, Mr Abdul Ghoni Ruslan and Mr Abdul Rahim Md Sarid for giving their guidance and arranged all the facilities to ease my research journey. I am extending my heartfelt thanks to all my lecturers who gave support and guidance throughout my research journey.

I am extremely grateful to my family especially both of my parents, Wan Ahmad Zikri bin Wan Puteh and Mardiana binti Abdul Rahman for their loves, prayers and constant support throughout my life and my journey. Also, I would like to express my deep and sincere thanks to my course mates and friends for their motivation, moral support and to those who encouraged me whenever I feel demotivated.

May God repay all the kindness of those who gave me support and helped me throughout my research journey until I can complete this thesis successfully.

WAN ZULAIKHA ADRINA BINTI WAN AHMAD ZIKRI

JULY 2020

TABLE OF CONTENTS

	Page
DECLARATION BY AUTHOR	ii
ACKNOWLEDGEMENT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	viii
ABSTRAK	x
ABSTRACT	xi
CHAPTER 1: INTRODUCTION	
1.1 Research Background	1
1.2 Problem Statement	2
1.3 Research Objectives	3
CHAPTER 2: LITERATURE REVIEWS	
2.1 Carbohydrate	4
2.1.1 Starch	5
2.1.1a Starch Digestibility	5
2.1.1b Rapidly Digestible Starch (RDS)	6
2.1.1c Slowly Digestible Starch (SDS)	6
2.1.1d Resistant Starch (RS)	7
2.1.2 Dietary Fibre	7
2.2 Grain	9
2.2.1 Single grain	10

2.2.2 Multigrain 11

2.3 Glycemic Index (GI) and Glycemic Load (GL) 12

2.3.1 Low, Medium and High Glycemic Index (GI) 14

2.3.2 Glycemic Index (GI) Foods 15

2.3.3 Factors Affecting Glycemic Index (GI) 16

2.4 Methodology of Glycemic Index (GI) 16

2.4.1 *In Vitro* Hydrolysis of Starch Method 17

2.4.1a Estimated Glycemic Index Calculations 18

2.4.2 Clinical Trial 19

2.4.2a Area Under the Curve (AUC) Calculations 20

2.5 Protein Digestibility 20

2.6 Amino Acid Profiles 22

2.7 Glycemic Index and Diabetes 23

CHAPTER 3: DISCUSSION

3.1 Determination methods; Current Knowledge & Future Prospects 25

3.2 Nutritional Composition and GI Values 28

3.2.1 Recommended GI Values 29

CHAPTER 4: FUTURE PROSPECTS 31

CHAPTER 5: CONCLUSION 32

REFERENCES 33

LIST OF TABLES

Table	Caption	Page
2.1	Dietary fibre content of various food sources	9
2.2	Nutrients and health benefits of different grains	11
2.3	The average GI of foods derived from few studies	15
2.4	Food factors influencing GI response by MoH Malaysia	16
2.5	Recommended values of essential amino acids by FAO	23
3.1	Nutritional composition and GI values of multigrain flour chapatti and whole wheat flour chapatti	28

LIST OF FIGURES

Figure	Caption	Page
3.1	Flow chart of the steps followed for reference and test food consumption in standard method (clinical trial)	27

LIST OF ABBREVIATIONS

Abbreviations	Caption
%	Percentage
℃	Degree celcius
AACC	American Association of Cereal Chemists
ANOVA	Analysis of Variance
AOAC	Association of Analytical Communities
ASN	American Society of Nutrition
AUC	Area Under The Curve
BMI	Body Mass Index
CHO	Carbohydrate
CVD	Cardiovascular Disease
DM	Diabetes Mellitus
FAO	Food and Agriculture Organization
g	Gram
GDH-FAD	Glucose Dehydrogenaseflavin adenine dinucleotide
GI	Glycemic Index
GL	Glycemic Load
GOD-POD	Glucose Oxidation-Peroxidase
HI	Hydrolysis Index
HDL	High-density lipoprotein
HI	Hydrolysis Index

IDF	Insoluble dietary fibre
kcal	Kilocalorie
M	Molar
mg	Miligram
min	Minute
ml	Millilitre
MoH	Ministry of Health
Na	Sodium
PDCAAS	Protein Digestibility Corrected Amino Acid Score
pH	Potential of Hydrogen
RDS	Rapidly Digestible Starch
RS	Resistant Starch
SD	Standard Deviation
SDF	Soluble dietary fibre
SDS	Slowly Digestible Starch
SEM	Standard Error of the Mean
SPSS	Statistical Package for the Social Sciences
TDF	Total dietary fibre
USDA	United States Department of Agriculture
WHO	World Health Organization

GLISEMIK INDEKS MINUMAN SEGERA BIJIRAN CAMPURAN: PENGETAHUAN SEMASA DAN PROSPEK MASA DEPAN

ABSTRAK

Biji-bijian sering dikonsumsi sebagai makanan tetapi dengan teknologi canggih, biji-bijian dalam bentuk serbuk dapat digunakan oleh pengguna kerana mereka dapat menyiapkannya dengan serta-merta. Produk minuman segera bijiran campuran adalah sesuai untuk orang yang tidak aktif dan ia mempunyai tempoh ketahanan yang lama. Kajian ini bertujuan untuk menentukan nilai indeks glisemik untuk minuman segera bijiran campuran berdasarkan pengetahuan semasa dan prospek masa depan, menilai perbezaan antara kaedah berdasarkan kaedah *in vitro* dan kajian klinikal untuk penentuan indeks glisemik dan mencadangkan nilai indeks glisemik yang disyorkan untuk minum segera bijian campuran berdasarkan kajian terdahulu. Dari hasilnya, kekuatan kajian dalam ujian klinikal lebih besar daripada kaedah *in vitro* kerana ketepatannya. Walau bagaimanapun, kajian sebelumnya menunjukkan bahawa kaedah *in vitro* mempunyai batasan yang lebih sedikit berbanding dengan ujian klinikal yang digambarkan sebagai mahal, memakan masa, sukar dan diperlukan di kalangan manusia yang termotivasi untuk menyelesaikan penyelidikan kajian. Dan dapat disimpulkan bahawa minuman segera bijiran campuran dianggap mempunyai nilai GI rendah berdasarkan beberapa kajian sebelumnya yang dilakukan oleh penyelidik di seluruh dunia. Sebilangan besar produk bijiran campuran dinilai sebagai GI rendah kerana kandungan serat makanannya yang tinggi, kandungan protein yang tinggi dan faktor lain yang menghasilkan tindak balas glisemik yang perlahan ketika memakan produk bijiran campuran. Nilai glisemik yang disyorkan adalah antara 30-40, mengambil jumlah purata iaitu 35.

GLYCEMIC INDEX OF INSTANT MULTIGRAIN BEVERAGE: CURRENT KNOWLEDGE AND FUTURE PROSPECTS

ABSTRACT

Grains often consumed as food but with advanced technology, it is in powdered form which is convenient to consumers as they can prepare it instantly. Instant multigrain beverage product provides longer shelf life and convenient to sedentary people. The study is aimed to study the glycemic index values for instant multigrain beverage based on current knowledge and future prospects, observe the differences between methods based on *in vitro* and clinical trial method for determination of glycemic index and to suggest the recommended glycemic index values for instant multigrain beverage based on previous studies. From the results, the strength of the current study on clinical trial is greater than *in vitro* method because of its accuracy. However, previous studies shown that *in vitro* method have fewer limitations compared to clinical trial that were described as costly, time-consuming, laborious and required participants among human beings that are motivated to complete the study research. And it can be concluded that instant multigrain beverage is considered having low GI value based on several previous studies done by researchers worldwide. Most multigrain products evaluated as low GI due to their high dietary fibre content, high protein content and other studies that resulted in slow glycemic response when consuming multigrain products. The recommended glycemic value between 30-40, averaged as 35.