



***ROLE OF TASTE GENETIC VARIATIONS IN SWEET, FATTY AND SWEET-FATTY TASTE PERCEPTION AND FOOD INTAKE AMONGST OBESE AND NON-OBESE MALAY ADULTS IN MALAYSIA***

**AHMAD RIDUAN BIN BHAUDDIN**

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By

**AHMAD RIDUAN BIN BAHAUDDIN**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in  
Fulfillment of the Requirements for the Degree of Doctor of Philosophy**

**March 2019**

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

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**March 2019**

**Chairman : Associate Professor Roselina Karim, PhD**  
**Faculty : Food Science and Technology**

The genetic variation of taste could explain the variations observed in human perceptions and predict individuals' food choices and intake. However, the current understanding of how taste genetic could affect individual's taste function and perception in various food systems and their relationship towards dietary intake is limited. Thus, the study was conducted to examine the effects of genetic variation on taste (in terms of taste of receptor polymorphism and Propylthiouracil (PROP) status on sweet and / or fat perceptions of different food models and also food intake between obese and obese subjects.

A total of 88 obese subjects (means age of  $27.6 \pm 6.24$  years and BMI of  $33.46 \pm 3.60$   $\text{kgm}^2$ ) and 92 non-obese subjects (means age of  $25.86 \pm 5.28$  years and BMI of  $21.79 \pm 2.35$   $\text{kgm}^2$ ) were genotyped for TAS1R2 gene at rs35874116, rs9701796, and rs12033832, TAS1R3 gene at rs307355, rs35744813), CD36 gene at rs1761667, rs1527483, and rs1049673 and TAS2R38 gene at rs613798. PROP taster status (e.g. supertaster, medium taster and non-taster) were determined using paper disk rating. Three type of samples namely blank taste solution (sweet taste - sucrose solution; fatty taste (oiliness) - linoleic acid solution), singular taste food (sweet – rose flavored pudding; fatty (creaminess) – 'bubur chacha') and binary taste food (sweet-fatty taste – 'bubur chacha') were evaluated for taste intensity and hedonic responses using general Labelled Magnitude scale (gLMS) and general Labeled Hedonic Scale (gLHS). Subjects completed 3 days food record (2 weekdays, 1 weekend) and 2 set of food frequency questionnaires (sweet food and fatty food) to assess their habitual food consumption and dietary intake.

Overall, there are significant differences in term of weight and BMI between obese and non-obese subjects. In contrast, no significant differences was found on socio-demographic characteristic variables between both groups. Obese and non-obese subjects

did not differ on the sweetness, oiliness and creaminess rating of tasting samples except for binary taste food, the 'bubur chacha'. rs12033832 of TAS1R2 gene and rs1761667 of CD36 gene was associated with taste intensity and liking rating of blank solution and single taste food but not in sweet-fatty mixtures in both obese and non-obese subjects. Individuals with AA genotype for both genes perceived greater taste intensity rating and give lower liking rating of tasting samples. In contrast, PROP taster status was associated with taste intensity and liking rating of all type of samples. Regardless of BMI status, supertaster rated higher taste intensity and had lower mean liking ratings in most of samples. BMI status and PROP taster status seem to play a role in sweet-fatty taste optimal preference. Non-taster - obese subjects preferred higher fat content (8.75%) in stimuli compared to only 6.6% of fat in supertaster – non-obese subjects. Assessment of dietary intake revealed that obese subjects differed significantly on energy and protein intake compared to non-obese subjects. No significant difference was observed among PROP taster status on the subject's habitual sweet or fatty food consumption for both BMI groups.

In conclusion, taste receptor gene variant was shown to be responsible for the variation of individuals' taste sensitivity but are not related to taste liking and food intake. Furthermore, the influence of taste receptor gene variances on perception was demolished as the stimuli become more complex (e.g binary taste system). Thus, it can be concluded that taste receptor gene variances and PROP taster status did not seem to play a major role in human taste perception and food intake among obese and non-obese subjects.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**FUNGSI VARIASI GENETIK RASA TERHADAP PENERIMAAN RASA MANIS, BERLEMAK DAN MANIS-BERLEMAK SERTA PENGAMBILAN MAKANAN DI KALANGAN OBES DAN BUKAN OBES MELAYU DEWASA DI MALAYSIA**

Oleh

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Variasi genetik rasa dapat menjelaskan variasi yang dilihat dalam persepsi rasa manusia dan meramalkan pilihan makanan dan pengambilan individu. Walau bagaimanapun, pemahaman semasa tentang bagaimana genetik rasa boleh memberi kesa terhadap fungsi rasa dan persepsi individu dalam pelbagai sistem makanan dan hubungan mereka terhadap pengambilan makanan adalah terhad. Oleh itu, kajian ini dijalankan untuk mengkaji kesan variasi genetik terhadap rasa (dari segi polimorfisme reseptor rasa dan Propylthiouracil (PROP) terhadap persepsi rasa manis dan / atau lemak dalam model makanan yang bebezakan dan pengambilan makanan di antara subjek obes dan bukan obes.

Seramai 88 subjek obes (min umur -  $27.6 \pm 6.24$  tahun dan BMI -  $33.46 \pm 3.60 \text{ kgm}^2$ ) dan 92 subjek non-obes (min umur -  $25.86 \pm 5.28$  tahun dan BMI -  $21.79 \pm 2.35 \text{ kgm}^2$ ) digenotipkan bagi gen TAS1R2 pada variasi rs35874116, rs9701796, dan rs12033832, gen TAS1R3 pada variasi rs307355, rs35744813), gen CD36 pada variasi rs1761667, rs1527483, dan rs1049673 dan gen TAS2R38 pada variasi rs613798. Status perasa PROP (cth. Superperasa, medium dan bukan perasa) telah ditentukan menggunakan perkadaran cakera kertas. Tiga jenis sampel iaitu larutan rasa kosong (rasa manis - larutan sukrosa; rasa berlemak (berminyak) - larutan asid linoleik), makanan rasa tunggal (puding berperisa ros; lemak (berkrim) - 'bubur chacha' dan rasa binary (rasa manis- lemak - 'bubur chacha') dinilai untuk intensiti rasa dan tindak balas hedonik menggunakan skala magnitud berlabel umum (gLMS) dan Skala hedonik berlabel umum (gLHS). Subjek melengkapkan 3 hari rekod makanan (2 hari bekerja, 1 hujung minggu) dan 2 set soalan berkaitan kekerapan makanan (makanan manis dan makanan berlemak) bagi menilai tabiat pengambilan makanan dan pengambilan makanan.

Secara keseluruhan, terdapat perbezaan yang signifikan bagi ukuran berat dan BMI di antara subjek obes dan bukan obes. Namun, tiada perbezaan yang signifikan diperolehi

bagi semua pembolehubah sosio-demografi di antara kedua-dua kumpulan. Subjek obes dan bukan obes adalah tidak berbeza bagi penerimaan rasa manis, rasa berminyak dan berkrum untuk penilaian sampel kecuali bagi makanan perisa binari, 'bubur chacha'. Varians rs12033832 pada gen TAS1R2 dan rs1761667 pada gen CD36 mempunyai hubungkait dengan intensiti rasa dan darjah kesukaan bagi larutan kosong (larutan sukrosa dan asid lenoleik) dan makanan rasa tunggal tetapi kaitan adalah tidak wujud dalam sampel campuran manis-lemak bagi kedua-dua subjek obes dan bukan obes. Individu yang mempunyai genotip AA untuk kedua-dua gen memberikan penilaian intensiti rasa yang lebih tinggi dan memberi tahap kesukaan sampel yang lebih rendah. Sebaliknya, status perasa PROP mempunyai hubungkait dengan intensiti rasa dan penilaian kesukaan bagi semua jenis sampel. Tanpa mengambilkira status BMI, perasa super memberikan nilai intensiti rasa yang lebih tinggi dan mempunyai nilai tahap kesukaan yang lebih rendah dalam kebanyakan sampel. Status BMI dan status perasa PROP memainkan peranan dalam penentuan nilai optima bagi penerimaan rasa lemak dan manis. Subjek bukan perasa dan obes memilih kandungan lemak yang lebih tinggi (8.75%) dalam stimuli berbanding hanya 6.6% lemak dalam superperasa dan bukan obes. Penilaian pengambilan makanan menunjukkan bahawa subjek obes adalah berbeza secara signifikan terhadap pengambilan tenaga dan protein berbanding subjek bukan obes. Tiada perbezaan yang signifikan di kalangan status PROP perasa pada tabiat makanan manis atau lemak untuk kedua-dua kumpulan BMI.

Sebagai kesimpulan, variasi gen reseptor rasa memainkan peranan terhadap variasi kepekaan rasa individu namun ianya tidak mempunyai hubungkait dengan penerimaan rasa dan pengambilan makanan. Selain itu, pengaruh variasi gen reseptor rasa adalah tidak wujud kerana rangsangan menjadi lebih kompleks (contohnya, sistem perisa binari). Oleh itu, dapat disimpulkan bahawa variasi sel reseptor rasa dan status perasa PROP adalah tidak memainkan peranan utama dalam persepsi rasa manusia dan pengambilan makanan di kalangan subjek obes dan bukan obes.

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I certify that a Thesis Examination Committee has met on 21 March 2019 to conduct the final examination of Ahmad Riduan bin Bahauddin on his thesis entitled "Role of Taste Genetic Variations in Sweet, Fatty and Sweet-Fatty Taste Perception and Food Intake Amongst Obese and Non-Obese Malay Adults in Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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## TABLE OF CONTENTS

	<b>Page</b>
<b>ABSTRACT</b>	i
<b>ABSTRAK</b>	iii
<b>ACKNOWLEDGEMENT</b>	v
<b>APPROVAL</b>	vi
<b>DECLARATION</b>	viii
<b>LIST OF TABLES</b>	xiv
<b>LIST OF FIGURES</b>	xvi
<b>LIST OF ABBREVIATIONS</b>	xix
<b>CHAPTER</b>	
<b>1 INTRODUCTION</b>	<b>1</b>
1.1 Background of Study	1
1.2 Problem Statement	3
1.3 Research Hypothesis	4
1.4 Objectives	4
1.5 Conceptual Framework	4
1.6 Scope of Study	5
1.7 Significance of the Study	7
<b>2 LITERATURE REVIEW</b>	<b>8</b>
2.1 Obesity – A Major Health Risk Factor	8
2.2 Food Environment and Increasing of Obesity Epidemic	8
2.3 Taste Perception and Dietary Behavior	9
2.4 Taste Perception and Body Weight	10
2.5 Physiology of Taste	12
2.6 Taste Transduction	14
2.7 Taste Receptor	15
2.7.1 Sweet Taste Receptor	16
2.7.2 Oral Fatty Taste Receptor	17
2.7.3 Bitter Taste Receptor	18
2.8 Genetic Variation Studies of Taste Perception	19
2.9 Genetic Variation of Taste Receptor Gene and Taste Perception	20
2.9.1 Sweet Taste	20
2.9.2 Fatty Taste	22
2.9.3 Bitter Taste and PROP taster status	24
2.10 Variations in Taste Receptor Gene and Food Intake	26
2.11 Translating Taste Gene Variation to Obesity Intervention Program and the New Role of Food Industry	28
2.12 Measuring Taste Perception	30
2.12.1 Taste Threshold and Suprathreshold	30
2.12.2 Intensity Rating and Hedonic Test	32
2.12.3 Sweet and Fatty Taste Perception: Taste-taste Interaction	32
2.12.4 Scaling Procedures in Measuring Taste Response	34
2.13 Measuring Food Intake	35

2.14	Summary	36
<b>3</b>	<b>MATERIALS AND METHODS</b>	<b>37</b>
3.1	Introduction	37
3.2	Study Design	37
3.3	Sampling Method	37
3.4	Recruitment and Selection of Subjects	37
3.5	Sample Size	38
3.6	Data Collection and Laboratory Analysis	38
3.6.1	BMI Measurement	38
3.6.2	Sensory Testing	39
3.6.3	Stimuli and Sample preparation	39
3.6.4	Testing Procedures	43
3.7	Gene Polymorphism Analysis	45
3.7.1	Buccal Cell Collection	46
3.7.2	Genomic DNA Extraction	46
3.7.3	DNA Quantity and Quality	46
3.7.4	Polymerase Chain Reaction (PCR)	47
3.7.5	Polymerase Chain Reaction – Restriction Fragment Length Polymorphism (PCR - RFLP)	49
3.7.6	Gel Electrophoresis	50
3.7.7	Visualization	50
3.8	Food Intake Measurement	50
3.8.1	Food Frequency Questionnaire	50
3.8.2	Analyzing Food Frequency Questionnaire	51
3.8.3	Food Record	52
3.8.4	Analyzing Food Record	52
3.9	Statistical Analysis	52
<b>4</b>	<b>RESULTS AND DISCUSSIONS</b>	<b>54</b>
4.1	Sociodemographic Characteristic of Subjects	54
4.2	Distribution of Genotype and PROP Taster Status among Obese and Non-obese subjects	55
4.3	Comparison of Sweet Taste Perception between Obese and Non-obese Subjects and their Association with TAS1R Gene Variants	57
4.3.1	Sweet Suprathreshold Rating and Acceptance between Obese and Non Obese Subjects	57
4.3.2	The Association between PROP Taster Status and Variant of TAS1R Genes with Sweet Suprathreshold Rating between Obese and Non-obese Subjects	60
4.3.3	Influence of PROP taster Status and Variant of TAS1R Genes on Sweet Perception in Food products	64
4.4	Comparison of Fatty Taste Perception between Obese and Non-obese Subjects and Their Association with TAS1R Gene Variants	68
4.4.1	Oral Fatty Sensitivity and Acceptance between Obese and Non-obese Subjects	68
4.4.2	Effect of PROP Taster Status and CD36 Gene Variants toward Oral Fatty Taste Suprathreshold Rating Between Obese and Non-obese Subjects	71

4.4.3	Influence of PROP taster Status and Variant of CD36 genes on Oral Fatty Taste Acceptance in Food products	76
4.5	Comparison of Sweet-Fatty Taste Perception between Obese and Non-Obese Subjects and their Association with Taste Receptor Gene Variants	80
4.5.1	Intensity and Hedonic Rating of Sweet-Fatty Mixtures Between Obese and Non-obese Subjects	80
4.5.2	Hedonic Responses of Sweet-Fatty Mixtures between Obese and Non-Obese Subjects	82
4.5.3	The Association between CD36 Gene Polymorphism (rs1761667),TAS1R2 Gene (rs12033832) Variant and PROP Taster Status	83
4.5.4	Effect of Variant of TAS1R2 gene (rs12033832) and PROP Taster Status on Sweetness Rating	84
4.5.5	Effect of CD36 Gene Polymorphism (rs1761667) and PROP Taster Status on Creaminess Rating	85
4.5.6	Influence of CD36 Gene Polymorphism (rs1761667), Variant of TAS1R2 Gene (rs12033832) and PROP Taster Status on Liking Rating	86
4.5.7	Determination of Sugar and Fat Levels for Maximal Liking using Response Surface Method	87
4.6	Influence of PROP taster status on Dietary Intake and Habitual Food Consumption among Obese and non-obese Subjects	92
4.6.1	Habitual sweet and fatty food consumption between obese and non-obese subjects	92
4.6.2	Differences in dietary intake between obese and non-obese subjects	93
4.6.3	Influence of PROP Taster Status toward Habitual Sweet Food Intake	94
4.6.4	Effect of PROP Taster Status on Habitual Fatty Food Intake	95
4.6.5	Influence of PROP Taster Status on Dietary Intake and Sugar Consumption	96
<b>5</b>	<b>SUMMARY, CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH</b>	<b>98</b>
5.1	Summary	98
5.2	General Conclusion	99
5.3	Recommendations for Future Research	99
	<b>REFERENCES</b>	<b>101</b>
	<b>APPENDICES</b>	<b>134</b>
	<b>BIODATA OF STUDENT</b>	<b>166</b>
	<b>LIST OF PUBLICATIONS</b>	<b>167</b>

## LIST OF TABLES

Table	Page	
2.1	Overview of studies reporting sweet taste perception and sweet taste receptor gene variants in different population	21
2.2	Overview of studies reporting fatty taste perception and fatty taste receptor gene variants in different population	23
3.1	Subject's inclusion and exclusion criteria for this study	38
3.2	Taste solution concentration for suprathreshold testing	40
3.3	Amount of sugar added in sweet taste perception stimulus	41
3.4	The ingredients used to make five different fat level of ' Bubur Chacha'	42
3.5	Amount of added stimulus in 16 samples	43
3.6	Details of selected genes and single nucleotide polymorphisms	45
3.7	Primer sequences, PCR conditions, Amplicon Sizes of SNPs in the study	48
3.8	Details of restriction enzymes and allele size in the RFLP procedures	49
3.9	Conversion factor used to estimate food intake (serving/day) based on frequency of intake	51
3.10	Statistical analysis involved throughout the study	53
4.1	Socio demographic characteristics of subjects	54
4.2	Genotype frequency and PROP taster status distribution among obese and non-obese subjects	55
4.3	The association between gene polymorphisms and PROP taster status with suprathreshold sweet taste sensitivity	61
4.4	The association between gene polymorphisms and PROP taster status with suprathreshold fatty taste sensitivity	72
4.5	Genotype distribution of CD36 gene variant (rs1761667) and TAS1R2 gene variant (rs12033832) according to PROP Taster Status	83
4.6	Daily intake (in standard servings) of fatty food groups in obese and non-obese subjects	92
4.7	Daily intake (in standard servings) of sweet food groups in obese and non-obese subjects	93



4.8	Daily energy, macronutrients and sugar intakes in obese and non-obese subjects	93
4.9	Daily intake (in standard servings) of sweet food groups in obese and non-obese subjects according to PROP taster status	94
4.10	Daily intake (in standard servings) of fatty food groups in obese and non-obese subjects according to PROP taster status	96
4.11	Daily energy, macronutrients and sugar intakes in obese and non-obese subjects according to PROP taster status	97



## LIST OF FIGURES

Figure	Page	
1.1	Conceptual framework of the study	5
1.2	Operational framework of study	7
2.1	Variables intervening between taste function and food intake	9
2.2	The morphology of taste bud and their localization	13
2.3	Schematic representation of different taste bud cells and intragemmal fibres	14
2.4	Taste transduction mechanisms in taste cell	15
2.5	Comparison of market share between foods industries (healthy products) compared to pharmaceutical industries (only medical needs)	29
2.6	Schematic illustration of the relationship between chemical concentration, detection threshold, and suprathreshold	32
4.1	Sweet suprathreshold rating in aqueous sucrose solution between obese and non-obese subjects	58
4.2	Sweet intensity rating of rose-flavored pudding at different sugar concentrations between obese and non-obese subjects	59
4.3	Sweet liking rating of rose-flavored pudding at different sugar concentrations between obese and non-obese subjects	60
4.4	Suprathreshold rating of sucrose solution among 12033832 genotype; (a) Obese (b) Non-obese	63
4.5	Suprathreshold rating of sucrose solution among PROP taster status; (a) Obese (b) Non-obese	64
4.6	Means Sweetness rating of rose flavored pudding among rs12033832 genotype; (a) Obese (b) Non-obese	65
4.7	Means sweetness rating of rose flavored pudding among PROP Taster Status; (a) Obese (b) Non-obese	65
4.8	Means liking rating of rose flavored pudding among PROP taster status; (a) Obese (b) Non-obese	67
4.9	Means liking rating of rose flavored pudding among rs12033832 genotype; (a) Obese (b) Non-obese	68

4.10	Oral fatty suprathreshold rating (oiliness) between obese and non-obese subjects	69
4.11	Creaminess intensity rating of ‘bubur chacha’ at different fat concentrations between obese and non-obese subjects	70
4.12	Means liking rating of ‘bubur chacha’ at different fat concentrations between obese and non-obese subjects	71
4.13	Suprathreshold rating of Linoleic acid solution based on rs1761667 genotype; (a) Obese (b) Non-obese	74
4.14	Suprathreshold rating of linoleic acid solution based on PROP taster status; (a) Obese (b) Non-obese	75
4.15	Mean creaminess rating of ‘bubur chacha’ based on rs1761667 genotype; (a) Obese (b) Non-obese	76
4.16	Mean creaminess rating of ‘bubur chacha’ based on PROP taster status; (a) Obese (b) Non-obese	77
4.17	Mean liking rating of ‘bubur chacha’ based on rs1761667 genotype; (a) Obese (b) Non-obese	78
4.18	Mean liking rating of ‘bubur chacha’ based on PROP taster status; (a) Obese (b) Non-obese	78
4.19	Means of sweetness ratings for sugar-fat mixtures as a function of sucrose concentration by obese and non-obese subjects	81
4.20	Means of creaminess ratings for sugar-fat mixtures as a function of added fat by obese and non-obese subjects	81
4.21	Hedonic responses profiles for sugar/fat mixtures as a function of sucrose concentration in obese and non-obese subjects	82
4.22	Means in sweetness rating for sugar/fat mixtures as a function of sugar concentration among subjects; stratified by BMI status x PROP Taster Status	84
4.23	Means in creaminess rating of sugar/fat mixtures as a function of sugar concentration among subjects; stratified by BMI status x PROP Taster Status	85
4.24	Means liking rating for sugar/fat mixtures as a function of sugar concentration among subjects; based on BMI status x PROP Taster Status	86
4.25	Response surface contour for hedonic response to different levels fat and sugar combination in samples; (a) obese (b) non-obese	88
4.26	Response surface contours for hedonic response to different fat and sugar combination in samples; (a) Non-taster (b) Medium taster (c) Supertaster	89

4.27 Response surface contours for hedonic response to different fat and sugar combination in samples; (a) Obese + Non-taster (b) Obese + Medium taster (c) Obese + Supertaster (d) Non-obese + Non-taster (e) Non-obese + Medium taster (f) Non-obese Supertaster

91



## LIST OF ABBREVIATIONS

ANOVA	analysis of variance
ATP	adenosine triphosphate
BMI	Body Mass Index
°C	degree of Celcius
cm	centimeter
CD36	cluster of differentiation 36
DNA	Deoxyribonucleic acid
DT	Detection threshold
FFQ	Food Frequency questionnaire
g	gram
GCPR	G protein-coupled receptors
gLMS	general Labeled Magnitude Scale
h	hour
Kg	kilogram
L	liter
LCFA	long chain fatty acid
LMS	labelled magnitude scale
MAF	minor allele frequency
ME	magnitude estimation
min	minute
mL	milliliter
MT	Medium taster
NHMS	National Health and Morbidity Survey
NT	Non-taster
Nacl	sodium chloride

PROP	6-n-propylthiouracil
PTC	phenylthiocarbamide
rpm	revolutions per minute
RT	Recognition threshold
RSM	Response Surface Methodology
SNPs	Single Nucleotide Polymorphism
ST	Supertaster
TRC	taste cell receptor
w/v	weight/volume
$\mu\text{L}$	microliter



# CHAPTER 1

## INTRODUCTION

### 1.1 Background of Study

Obesity is a major public health problem that contributes to high mortality around the globe. In 2016, it was reported that about 13.0% of adults are obese and 39.0% are overweight worldwide (WHO, 2018). Obesity is caused by the imbalance of energy intake and energy expenditure where all the energy intake is obtained from the food consumed. The changes in diet and lifestyle last three decades are believed play a role in the increase of obesity epidemic (Wardle, 2007; Ramachandran and Snehalatha, 2010). Furthermore, the excess consumption of extrinsic sugar and fat are reported the major contributors to individuals' weight gain (Seidell, 1998; Bray *et al.*, 2004; Berkey *et al.*, 2004; Mazlan *et al.*, 2006; Drewnowski, 2007; Avena *et al.*, 2009; Besnard, 2016; Proserpio *et al.*, 2016).

Taste significantly determines food choice and preference among humans. There is increase attention in taste perception and preferences to dietary behaviors. Interestingly, previous studies demonstrated that difference in taste receptor gene account for differences in taste perception and preference among individuals, which influence human food consumption and weight status (Chamoun *et al.*, 2016). Even though the differences of taste perception due to genotype and phenotype predict individuals' food preference, however, the link to habitual food consumption and weight gain remain ambiguous (Garcia-Bailo *et al.*, 2009; Dotson *et al.*, 2010; Chamoun *et al.*, 2016). Several studies had demonstrated that obesity affects individuals' taste sensitivity and food consumption due to long-term metabolic effect (Matsushita *et al.*, 2009; Newman *et al.*, 2013; Asano *et al.*, 2015).

The relationship between taste and weight gain via food intake and preference was discovered since 1960's. The recognition that tasters and non-tasters have different body shapes serves as the interest in this topic. Individuals who are sensitive toward phenylthiocarbamide (PTC) and/or 6-n-propylthiouracil (PROP) are known as 'tasters' and tend to be ectomorphs (a thin and angular body type), whereas non-tasters, individuals who are not sensitive toward PTC and/or PROP) tend to be endomorphs (generous body proportions) (Keller *et al.*, 2002; Duffy, 2004; Bartoshuk *et al.*, 2006; Tepper, 2008). This trait is inherited via a recessive pattern, with about 25.0% of the population are classified as 'non-tasters' while the remaining 75.0% are 'tasters'. The TAS2R38 gene is responsible for the variations in the PTC and PROP sensitivity (Bufe *et al.*, 2005; Kim *et al.*, 2005; Tepper *et al.*, 2008). The variations in taste sensitivity due to PTC/PROP is also associated with preferences for bitter fruits and vegetables (Drewnowski, *et al.*, 2001; Feeney, 2011; Feeney *et al.*, 2014; Nagai *et al.*, 2017), sweet foods (Gent and Bartoshuk, 1983; Prescott *et al.*, 2001; Prescott *et al.*, 2004; Zhao and Tepper, 2007; Lee *et al.*, 2008), added fats (Tepper and Nurse, 1997; Kamphuis and Westtererp-plantenga, 2003; Kirkmeyer and Tepper, 2005), spicy foods (Drewnowski *et al.*, 2001; Rupesh and Nayak, 2006) and alcoholic beverages (Duffy *et al.*, 2004; O'Brien *et al.*, 2010). Thus, the findings on the relationship between PROP status, taste perception and dietary intake pattern lead to the

investigation on genetic taste as the potential marker of human food consumption and body weight status.

Recent advancements in genetic technology provide affordable instruments and tools to conduct more studies on taste genetic variation and its linkage to taste perception and food intake. The genes that encode for taste receptors have been identified, include the TAS2R gene family for bitter taste (Adler *et al.*, 2000; Chandrashekar *et al.*, 2000; Matsunami *et al.*, 2000) and TAS1R family for sweet and umami tastes (Bachmanov and Beauchamp, 2007; Bachmanov *et al.*, 2011). In addition, the fatty acid transporter, CD36 is identified as the putative taste receptor for fat (Laugette *et al.*, 2005).

However, the association between taste perception via genetic polymorphism with food consumption and individuals' weight status is not straightforward (Duffy, 2004; Hayes *et al.*, 2008; Chamoun *et al.*, 2016). Moreover, most of the previous studies focus on the relationship between taste perception and body mass index (BMI) rather than comparing body weight status (e.g. obese vs. non-obese) (Stewart *et al.*, 2010; Cox *et al.*, 2015). Apart from that, the literature focus on the conventional sensory methodology (e.g. taste threshold) in response to genetic variations in taste between individuals (Fushan *et al.*, 2010; Daoudi *et al.*, 2015; Dias *et al.*, 2015; Melis *et al.*, 2015; Mrizak *et al.*, 2015; Sayed *et al.*, 2015). Thus, there are questions regarding the reliability and practicality of the method in predicting real taste experience, which involves stimuli's concentration and different types of food (Bartoshuk *et al.*, 2006; Webb *et al.*, 2015).

Food is complex and exists in myriads of taste and flavor. The oral sensations from the sensory attributes influence how much the food is liked and consumed, in which affects the energy density of the diet (Cox *et al.*, 1998; Birch, 1999; Kato, 2012; Overberg *et al.*, 2012; Jayasinghe *et al.*, 2017). However, the preference for simple or complex foods may involve the interaction either between taste-taste component in simple food or taste-odor, color, texture in complex food (Keast and Breslin, 2003). The interactions result in suppression or synergy between the taste components (e.g. sweet, fatty taste) or between the sensory attributes (e.g. texture, odor, color). It is unclear how taste variations in terms of genetic perspectives influence taste perception of taste interactions in food system and translate them to human food preference and intake (Hayes and Duffy, 2007; Hayes and Duffy, 2008; Li *et al.*, 2014). Thus, further studies are required to determine the influence of taste variation on human food preference using single and mixture of food system to provide understand the potential interactions that may increase or decrease specific sensations within the food (Liang *et al.*, 2012; Zhou *et al.*, 2016; Proserpio *et al.*, 2017).

A better understanding of the role of genetic variation in taste on human taste perception and preference is necessary because the response depends on food intake behavior and linked to body weight regulation. Furthermore, the knowledge in the influence of taste receptor gene variants and PROP taster status on taste perception and food intake behavior is useful to identify the strategy to overcome the rising prevalence of obesity in the future. However, there are many issues in human feeding behavior due to several factors (e.g. metabolic condition and food properties). Hence, more studies are needed to clarify and provide better understanding regarding this matter.



## 1.2 Problem Statement

Genetic variations in taste receptor and PROP taster status are highlighted as the potential marker in human taste perception and link to obesity via food intake (Garcia-Bailo *et al.*, 2009; Grimm and Steinle, 2011; Chamoun *et al.*, 2016). However, it is unclear how variation in taste receptor affects taste perception of different types of food (e.g. simple food vs. complex food), particularly for sweet-fatty food. In fact, little is known on how the taste genetic (e.g. taste receptor polymorphism) and long-term metabolic effect (e.g. obesity) are involved in human taste perception and preference. There are gaps in the current knowledge of the use of taste genetic as valuable marker for human food consumption and obesity development.

To date, out of six taste modalities, sweet and fatty taste are extensively studied due to their linkage to the current energy-dense food (high in sugar and fat) consumption pattern and weight gain worldwide, which becomes the focus of this research. Earlier studies employed the conventional method to measure taste sensitivity; e.g. taste threshold in response to genetic variation in taste perception between individuals, particularly on taste gene receptor variants. However, taste threshold is a poor predictor of suprathreshold response because low level of taste stimulus does not represent the real taste experience. In addition, food does not always have singular taste (simple system), most of them are comprised of a combination of tastes, flavors or sensory characteristics (complex system), which contribute to either suppression or synergy interactions in food. Therefore, the investigation on the genetic variation in taste receptor at suprathreshold concentration in food system can provide better understanding of how genetic variations in taste receptor plays a role in determining human taste perception and how it is related to food consumption and obesity occurrence.

Meanwhile, some studies show that obesity reduces taste sensitivity among individuals due to the habitual sweet or fatty food intake. The reduction in taste signaling cascade from the taste receptor to brain is due to the habitual intake (Newman *et al.*, 2013). However, the effects vary between the obese subjects, which imply there are other 'variation factors' that drive the taste sensitivity and perception among obese individuals. In addition, the factors can be responsible for the variations in food intake and preferences between humans (including lean individuals), which influence body weight regulation.

There is evidence that variations in taste gene receptors play a role in taste variability and food intake among individuals. Candidate polymorphism study on taste receptor genes involving PROP taster status can serve as potential marker in explaining any potential association. However, the difference in the effect of genetic variation between obese and non-obese due to their metabolic regulation is unknown. Furthermore, genetic variation also varies in the population, most studies done before on this matter are only limited to Caucasian and African populations. Currently, there are no data on the association between genetic variation on taste with taste perception and food intake in Asian population, especially Malaysia. Therefore, more studies are needed to develop better understanding of taste receptor polymorphisms, taste perception and food intake measures in a population such as Malaysia. With the use of obese (treatment) and non-obese (control) samples to compare their taste receptor polymorphisms, taste perception and food intake measures, a

better understanding of how taste receptor gene variation and PROP taster status are linked to food intake and weight gain or management can be obtained.

### **1.3 Research Hypothesis**

The hypotheses in this study are as follows: –

- 1 Sociodemographic characteristic are comparable between the obese and non-obese subjects
- 2 Obese subjects have significantly lower sweet and fatty taste sensitivity as compared to lean subjects;
- 3 PROP taster status and genetic variation have significant influence on sweet and fatty taste perception of the obese and non-obese Malay subjects;
- 4 PROP taster status and genetic variation have significant influence on binary combination of sweet-fatty taste perception of the obese and non-obese Malay subjects;
- 5 PROP taster status significantly affect the sweet and fatty food intake pattern of the obese and lean subjects.

### **1.4 Objectives**

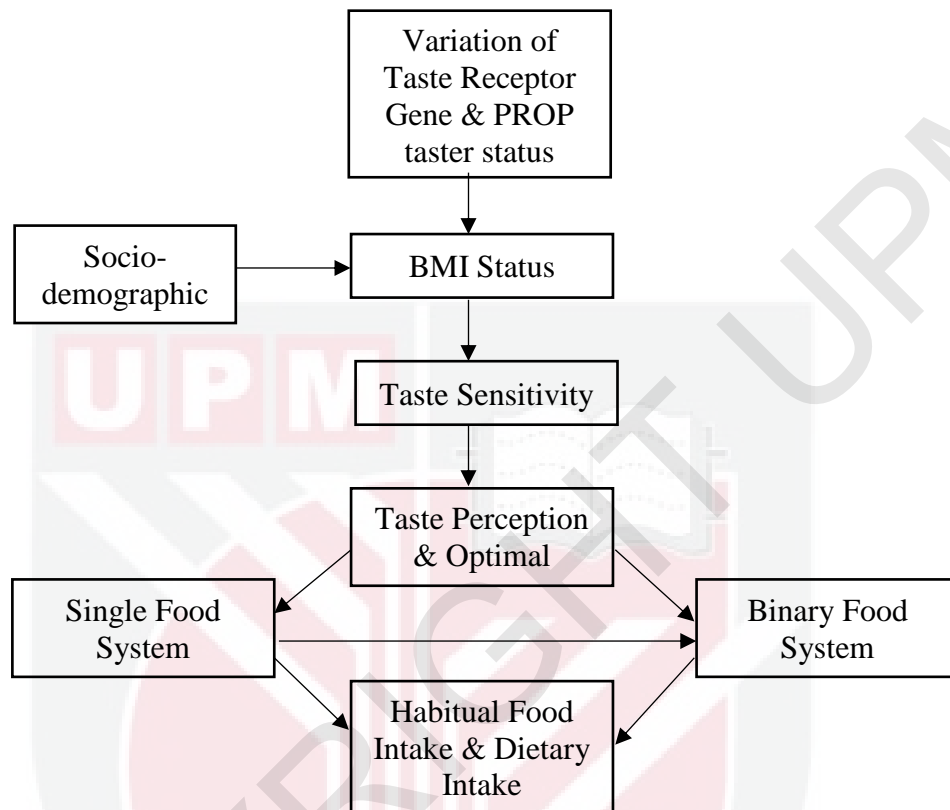
The main objective of this research is to develop better understanding of the effect of genetic variation in taste and PROP taster status on sweet and fatty taste perception and food intake among the obese and non-obese subjects. Therefore, the specific objectives of this study are: -

1. To determine and compare the sociodemographic characteristics and taste perception differences between obese and non-obese Malay subjects
2. To determine the effect of genetic variation in taste on sweet and fatty taste perception of obese and non-obese Malay subjects;
3. To examine the effect of genetic variation in taste on binary combination of sweet-fatty taste perception of obese and non-obese Malay subjects;
4. To measure the influence of PROP taster status on dietary intake and habitual consumption between obese and non-obese Malay subjects

### **1.5 Conceptual Framework**

Figure 1.1 shows the overall study concept. Individuals' body mass index is reflected by the variation in taste receptor gene and PROP taster status. In addition, sociodemographic factors are also associated with BMI status. Obese individuals have lower taste sensitivity and prefer higher taste in products. However, the variations in taste receptor gene and/or PROP taster status between the individuals (obese vs. non-obese) may trigger different sensitivity and perception between the groups, thus leads to different taste perception and preferences for food products. On the other hand, the effect varies based on food system

(single vs. binary). The association between those variables is consistent in simple food system as compared to the binary food system. The association between any variables (variations in taste receptor gene and/or PROP taster status and/or BMI status) plays a role in individuals' habitual food intake and dietary intake.



**Figure 1.1 : Conceptual framework of the study**

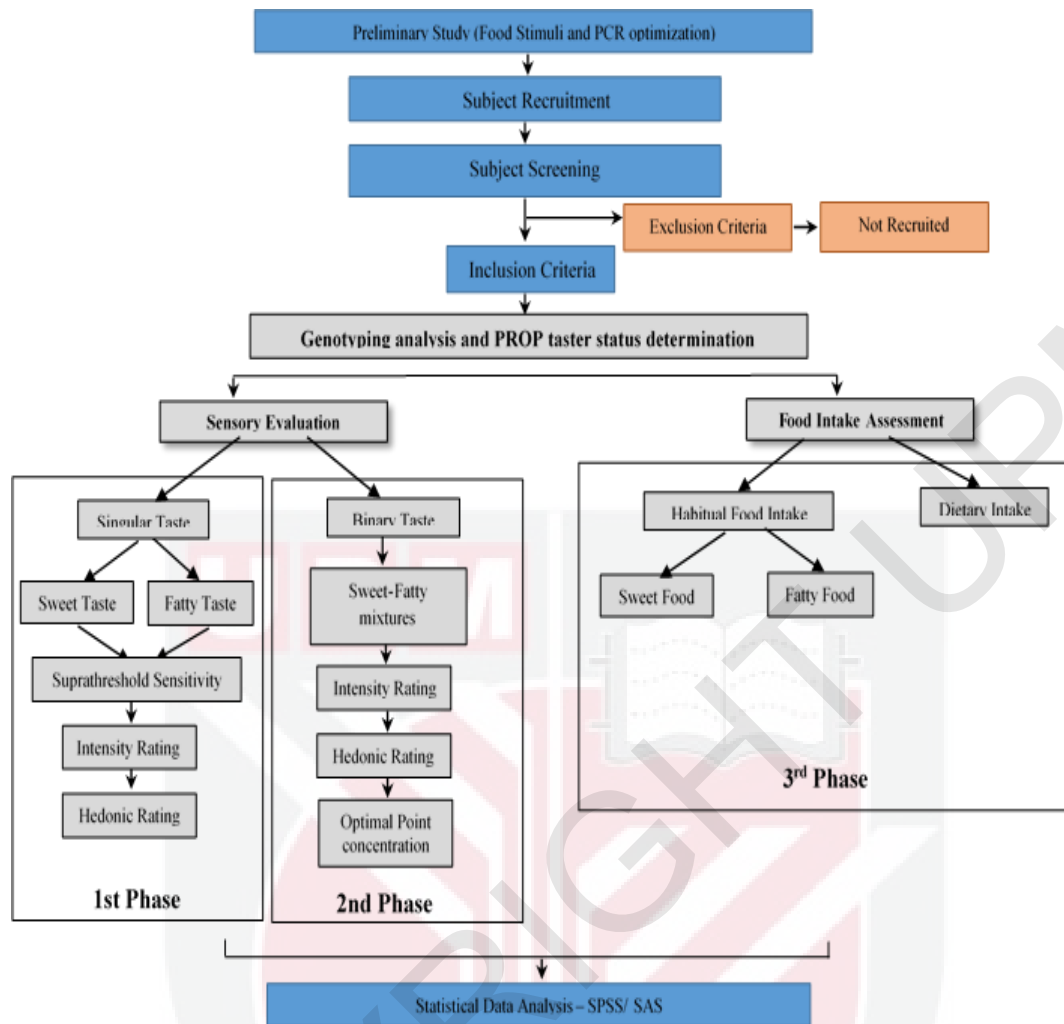
## 1.6 Scope of Study

This study aims to determine to what extent the genetic variation in taste receptor and PROP taster status determines sweet and/or fatty taste perception and food consumption between the Malay obese and non-obese subjects. At first, the screening of subjects was conducted to obtain obese (BMI >30) and non-obese subjects (BMI ranged from 18 to 25) via a questionnaire set. Individuals who meet the inclusion requirement were invited to participate in this study. Genotyping analysis was carried out to determine the subjects' genotype for several taste receptor gene polymorphisms. This included five variants from two sweet taste receptor genes (rs35874116, rs9701796, and rs12033832–TAS1R2 gene; rs307355, rs35744813–TAS1R3), three variants from one fatty taste receptor gene (rs1761667, rs1527483, and rs1049673–CD36) and one variant from bitter taste receptor gene (rs713598–TAS2R38). Meanwhile, PROP disc intensity rating was used to determine the subjects' PROP taster status.

The subjects' taste response was assessed via sensory evaluation. In the first phase, subjects were asked to rate the taste intensity of blank solution (sweetness – sucrose solution; linoleic acid solution - oiliness) and food samples (sweetness – rose-flavored pudding; creaminess – 'bubur chacha'), as well as hedonic rating of food samples at 5 concentrations of the respective taste stimuli. The effect of gene polymorphisms and PROP taster status toward subjects' taste response was analyzed using repeated Analysis of Variance (ANOVA) measure.

Gene polymorphisms including PROP taster status that are associated with taste response in the first phase was further analyzed for their effect of sweet-fatty mixture taste response (binary taste) in the phase two. Subjects reported the sweetness, creaminess and hedonic rating of 4x4 factorial design of sweet-fatty mixtures ('bubur chacha'), which are varied in terms of levels of added sugar (5%-20% w/v) and fat (32%-65% v/v). Again, the repeated ANOVA measure was used to evaluate the effect of gene polymorphism and PROP taster status on taste response of sweet-fatty mixture. In addition, response surface modelling (RSM) was used to identify the levels of sugar and fat for maximal liking.

In the final phase, subjects recorded the food they consumed for 3 days (2 weekdays, 1 weekend) and completed 2 sets of questionnaires (sweet food and fatty food). Macronutrient and total sugar intake were analyzed from 3 days food intake and the total intake (serving size) for each group were analyzed from FFQ. At this stage, only gene polymorphisms or PROP taster status that are associated with taste responses in the phase 1 and phase 2 were analyzed to further investigate their effect on the habitual food intake and dietary intake among the subjects. Figure 1.2 shows the operational framework of this study.



**Figure 1.2 : Operational framework of study**

### 1.7 Significance of the Study

In this research, the influence of genetic variations in taste (including PROP taster status) on sweet or/and fatty taste and their association with human consumption were obtained. A better insight on genetic variation, particularly the taste receptor gene variants, their interaction and the influence of the human sweet or/and fatty taste perception; either of the singular or binary taste food system can be discovered. In addition, the association between the genetic variants and individual food consumption was studied to have a better understanding of the overall relationship between genetic variation and eating behavior. The findings from this study can provide insight for health institutions to tailor a better obesity prevention mechanism and develop personalized nutrition products by food industries for the Malaysian population. This can be done by identifying specific groups or individuals who are at risk of unhealthy diet with high fatty food consumption based on their genetic background and taste responses.

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