



UNIVERSITI PUTRA MALAYSIA

***TRANS FATTY ACID IN SELECTED MALAYSIAN FOODS AND ITS
ASSOCIATION WITH INTAKE PATTERN AND CONTENTS IN HUMAN
MILK OF LACTATING MOTHERS IN BANDAR BARU BANGI, MALAYSIA***

AKMAR ZURAINI BINTI DAUD

FPSK(m) 2012 5

**TRANS FATTY ACID IN SELECTED MALAYSIAN FOODS AND ITS
ASSOCIATION WITH INTAKE PATTERN AND CONTENTS IN HUMAN
MILK OF LACTATING MOTHERS IN BANDAR BARU BANGI,
MALAYSIA**

By

AKMAR ZURAINI BINTI DAUD

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfillments of the Requirements for the Degree of Master of Science**

June 2012

As I was writing this thesis, I realized that without my parents I would not be here today. So, I dedicate this thesis to them,

Hj. Daud bin Hamzah

Hjh. Jamaiah bt Zainuddin

in remembrance of their loves, guidance and sacrifices.

May Allah bless both of you.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

TRANS FATTY ACID IN SELECTED MALAYSIAN FOODS AND ITS ASSOCIATION WITH INTAKE PATTERN AND CONTENTS IN HUMAN MILK OF LACTATING MOTHERS IN BANDAR BARU BANGI, MALAYSIA

By

AKMAR ZURAINI BINTI DAUD

Chairman: Prof. Madya Dr. Norhaizan Mohd Esa, PhD

Faculty: Medicine and Health Sciences

Many countries have enforced regulation on TFA content in food labelling except for Malaysia. The unknown amount of TFA in local food have been hypothesized to impact the health, as well as disruption on nutritional value of human milk. The presence of TFA in human milk have been implicated in significant “displacement” of essential fatty acid, making the milk less energy dense. Therefore, the objectives of this study were to determine the TFA intake of Malaysian lactating mothers in association with human milk composition. The study consists of two parts; Part 1: Analysis of TFA content in selected food; bakery products, snacks, milk and dairy products, cooking oils and semisolid fats, fast food, breakfast cereals, *roti canai*, chapatti, thosai, drinking cereals, sweetened milk and ice cream and Part 2: Determination of pattern of intake for selected Malaysian food and TFA content in human milk among lactating mothers. The results from Part 1 showed that the highest amount of TFA was found in fast food which was $<0.001\text{g} - 8.49\text{g}/100\text{g}$ lipid or $<0.001\text{g} - 1.97\text{g}/100\text{g}$ food whereas, the lowest amount was found in snack, which was $<0.001\text{g} - 1.89\text{g}/100\text{g}$ lipid or $<0.001\text{g} - 0.57\text{g}/100\text{g}$ food. Besides that, TFA level in most of food tested is still reasonably low. In terms of TFA isomers, major isomers found in studied samples were linoelaidic acid (18:2*t*9,12) (41.19%) and elaidic acid (18:1*t*9) (35.87%),

whereas, other isomers were lower than 20%. In Part 2 of this study, there were 101 lactating mothers recruited from Klinik Kesihatan Bandar Baru Bangi. Information on sociodemographic, reproductive data, anthropometric, Food Frequency Questionnaires (FFQ) score for 7 food groups and dietary consumption parameters were collected for this part. The TFA content in human milk was $2.94 \pm 0.96\%$ fatty acid which is considered low as the detected value is less than 4% fatty acid. The most abundantly found TFA isomer in human milk is linoelaidic acid (18:2*t*9,12) ($1.44 \pm 0.60\%$ fatty acid) whereas vaccenic acid (18:1*t*11) ($0.15 \pm 0.12\%$ fatty acid) was found to be the least. From sub experiment result, the daily intake of TFA 18 lactating mothers is $1.27 \pm 0.26\text{g}/100\text{glipid}/\text{day}/\text{person}$ which is below as compared with countries like US and Denmark. The relationships between frequencies food consumption and TFA level in human milk were assessed using non-parametric Spearman Rho test (SPSS version 15). The results showed only 10 of the food items; bun, chicken burger, shortening, powdered milk, cheese burger, sweetened milk, blended oil, mayonnaise, corn oil and ice cream were identified to give an effects towards total TFA and TFA isomers in human milk. None of the dietary parameters observed give any effect on total TFA in human milk. In regards to lipid composition of human milk, the finding showed that, total TFA in human milk could decrease Arachidonic acid AA (20:4) content but have no effect on total fat, linoleic acid (18:2), Eicosapentanoic acid (EPA) (20:5) and Docosahexaenoic acid (DHA) (22:6) content. It was demonstrated that, lipid composition of human milk was not significantly affected by current TFA intake. It was probably due to low consumption of TFA among lactating mothers. The extensively usage of palm oil by Malaysian population may also contribute to low consumption of TFA.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

ASID LEMAK TRANS DALAM MAKANAN MALAYSIA TERPILIH DAN HUBUNGKAITNYA DENGAN CORAK PENGAMBILAN DAN KANDUNGAN DALAM SUSU IBU DIKALANGAN IBU-IBU LAKTASI DI BANDAR BARU BANGI, MALAYSIA

Oleh

AKMAR ZURAINI BINTI DAUD

Pengerusi: Prof. Madya Dr. Norhaizan Mohd Esa, PhD

Fakulti: Perubatan dan Sains Kesihatan

Kebanyakan negara telah giat menguatkuasakan peraturan pelabelan dengan meletakkan kandungan asid lemak trans (TFA) pada label makanan kecuali Malaysia. Jumlah ketidakpastian TFA yang wujud dalam makanan tempatan telah dihipotesis dapat memberi kesan kepada kesihatan dan mengganggu nilai nutrisi susu ibu. Kehadiran TFA dalam susu ibu terlibat dengan “penggantian” asid lemak penting secara signifikan dan menyebabkan berkurangnya kandungan tenaga dalam susu ibu. Oleh itu, objektif kajian ini adalah untuk menentukan pengambilan TFA bagi ibu-ibu laktasi di Malaysia dan mengkaji perkaitannya dengan komposisi TFA dalam susu ibu. Kajian ini mengandungi dua bahagian; Bahagian 1: Analisis kandungan TFA dalam makanan Malaysia terpilih dan bahagian 2: Penentuan corak pengambilan makanan Malaysia yang terpilih dan kandungan TFA dalam susu ibu di kalangan ibu-ibu laktasi. Keputusan dari bahagian 1 menunjukkan bahawa jumlah tertinggi TFA adalah dalam makanan segera iaitu $<0.001\text{g} - 8.49\text{g}/100\text{g}$ lipid atau $<0.001\text{g} - 1.97\text{g}/100\text{g}$ makanan manakala jumlah TFA paling rendah adalah dalam snek iaitu $<0.001\text{g} - 1.89\text{g}/100\text{g}$ lipid atau $<0.001\text{g} - 0.57\text{g}/100\text{g}$ makanan. Selain itu, jumlah kandungan TFA dalam kebanyakan makanan yang dikaji adalah agak rendah.

Bagi isomers TFA, isomer utama yang ditemui dalam sampel yang dikaji ialah asid linoelaidik (18:2*t*9,12) dengan peratusan sebanyak 41.19% dan asid elaidik (18:1*t*9) dengan peratusan sebanyak 35.87%. Manakala isomer lain menunjukkan kandungan peratusan kurang daripada 20%. Dalam bahagian 2, seramai 101 ibu-ibu laktasi telah terlibat dalam kajian ini yang mana mereka telah direkrut dari Klinik Kesihatan Bandar Baru Bangi, Selangor. Maklumat mengenai sosiodemografi, data reproduktif, antropometri, skor FFQ (Kekerapan pengambilan makanan) untuk 7 kumpulan makanan dan parameter pengambilan dietari juga dikumpulkan untuk bahagian ini. Kandungan TFA dalam susu ibu ialah $2.94 \pm 0.96\%$ asid lemak dimana nilai ini diambilkira sebagai rendah kerana ianya kurang daripada 4% asid lemak. Isomer TFA yang paling banyak dijumpai dalam susu ibu ialah asid linoelaidik (18:2*t*9,12) ($1.44 \pm 0.60\%$ asid lemak) manakala isomer paling rendah dijumpai ialah asid vasetik (18:1*t*11) ($0.15 \pm 0.12\%$ asid lemak). Daripada keputusan sub eksperimen, pengambilan harian TFA bagi 18 orang ibu laktasi ialah $1.27 \pm 0.26\text{g}/100\text{g lipid/sehari/individu}$ iaitu kurang dibandingkan dengan negara seperti US dan Denmark. Hubungan antara kekerapan pengambilan makanan dan paras TFA dalam susu ibu dianalisis menggunakan ujian tidak berparametrik *Spearman Rho* (SPSS versi 15). Keputusan menunjukkan bahawa hanya 10 jenis makanan; bun, burger ayam, lemak sayuran, burger keju, susu tepung, susu pekat manis, minyak campuran, mayonis, minyak jagung dan ais krim telah dikenalpasti boleh memberi kesan terhadap isomer TFA dalam susu ibu. Tiada dietari parameter yang memberikan kesan kepada jumlah TFA dalam susu ibu. Merujuk kepada kandungan lipid dalam susu ibu pula, kandungan TFA merendahkan kandungan asid Arakidonik (AA) (20:4) manakala kandungan jumlah lemak, asid linoleik (18:2), asid eikosapentanoik (EPA) dan asid Dokosahexaenoik (DHA) (22:6) pula tidak dipengaruhi. Ini menunjukkan bahawa kandungan lipid dalam susu ibu tidak dipengaruhi secara signifikan oleh pengambilan TFA. Ini mungkin

disebabkan pengambilan TFA yang rendah di kalangan ibu-ibu laktasi. Penggunaan minyak kelapa sawit secara meluas oleh penduduk Malaysia juga boleh menyumbang kepada pengambilan TFA yang rendah.



ACKNOWLEDGEMENTS

Bismillahirrahmaanirrahiim

In the name of Allah, The Most Gracious, The Most Merciful

I am grateful to a number of people who giving me the spirit and courage throughout this research projects especially to Associate Professor Dr Norhaizan Mohd Esa, my inspired supervisor. She is giving me personal attention, excellent advice and motivates me the way of developing a good research. I also would like to acknowledge my co-supervisor, Associate Professor Dr Azrina Azlan and Dr Chan Yoke Mun for their comments, advice and supports. Thank you very much. It really was a great and unforgettable experience to run this research under their supervision.

My special profound gratitude to the staff of Nutrition Laboratory, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (Puan Suriati Ali Hanafiah, En Syed Hasbullah, Puan Che Maznah and En Simon) to guide me in laboratory works.

My special note of appreciations also dedicated to all my friends who assist me to complete this study and my family for their support and encouragement and understanding. My special thanks also dedicated to Jabatan Perkhidmatan Awam (JPA) who sponsored my study fees along my study period. Last but not list, I thanks to other people who contributed to this research to be successful whether they are knowingly or unknowingly helped me throughout this research.

I certify that an Examination Committee has met on **date of viva voce** to conduct the final examination of **Akmar Zuraini binti Daud** on her Master of Science thesis entitled “An analysis of trans fatty acid (TFA) in selected Malaysian foods and its association with pattern of intake and contents in human milk of lactating mothers in Bandar Baru Bangi” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the relevant degree.

Members of the Examination Committee were as follows:

Zaitun bt Yassin, PhD

Associate Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Chairman)

Loh Su Peng, PhD

Lecturer
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Internal Examiner)

Rosita binti Jamaluddin, PhD

Lecturer
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Internal Examiner)

Wan Abdul Manan bin Wan Muda, PhD

Professor
Pusat Pengajian Sains Kesihatan
Universiti Sains Malaysia
(External Examiner)

SEOW HENG FONG, PhD

Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Norhaizan Mohd Esa, PhD

Associate Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Chairperson)

Azrina Azlan, PhD

Associate Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Member)

Chan Yoke Mun, PhD

Lecturer
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Member)

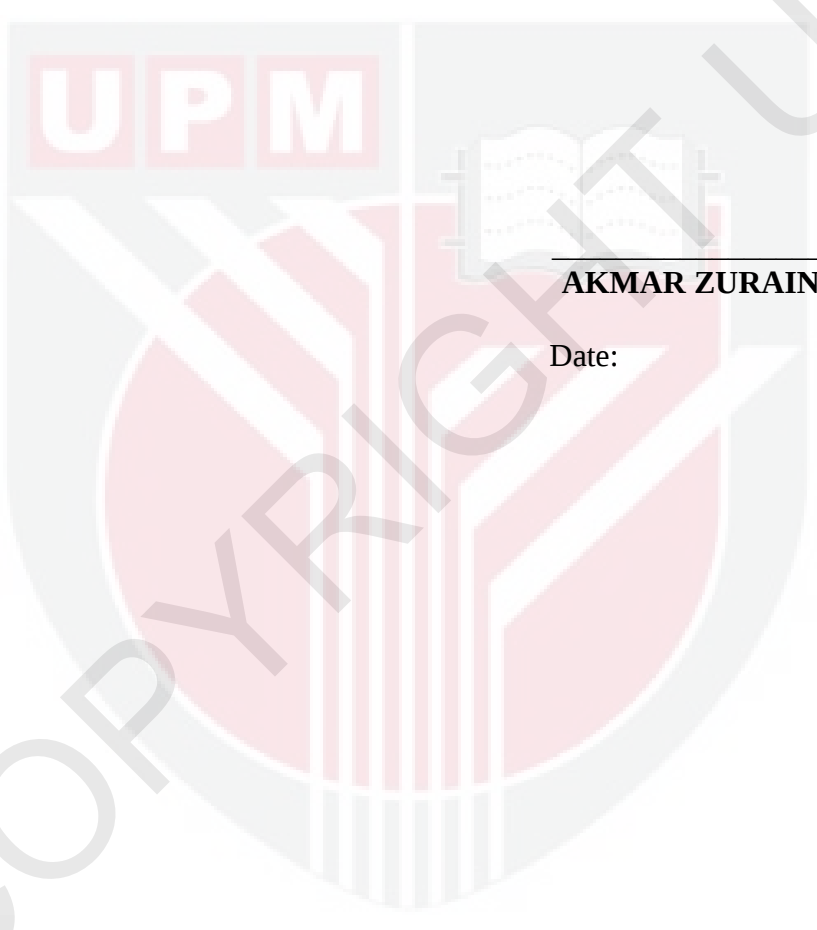
BUJANG BIN KIM HUAT, PhD

Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I declare that the thesis is my original work except for the quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

The logo of Universiti Putra Malaysia (UPM) is a shield-shaped emblem. It features a red and white stylized design with a central vertical element and a horizontal bar across the middle. The letters 'UPM' are prominently displayed in the upper left corner of the shield.

AKMAR ZURAINI BINTI DAUD

Date:

TABLE OF CONTENT

	Page
ABSTRACT	ii
ABSTRAK	iv
ACKNOWLEDGEMENT	vii
APPROVAL	viii
DECLARATION	x
LIST OF TABLES	xv
LIST OF FIGURES	xvi
LIST OF ABBREVIATION	xviii
LIST OF APPENDICES	xix

CHAPTER

1	INTRODUCTION	1
2	LITERATURE REVIEW	
	2.1 <i>Trans</i> fatty acid (TFA)	9
	2.2 Human milk	16
	2.3 TFA intakes	22
	2.4 Dietary habits	25
	2.5 Legislation on TFA	28
3	ANALYSIS OF <i>TRANS</i> FATTY ACIDS (TFA) IN SELECTED FOODS	
	3.1 Introduction	31
	3.2 Materials and methodology	
	3.2.1 Chemicals/reagents and equipments	32
	3.2.2 Sample collection and preparation	33
	3.2.3 Quantification of TFA	35
	3.2.4 Statistical analysis	39

3.3. Results	
3.3.1 Actual total TFA content	40
3.3.2 Absolute total TFA and its isomers content	49
3.4 Discussion	56
3.5 Conclusion	66

4

DETERMINATION OF FOOD CONSUMPTION PATTERN AND TFA CONTENT IN HUMAN MILK OF LACTATING MOTHERS

4.1 Introduction	68
4.2 Materials and methodology	
4.2.1 Study design	69
4.2.2 Sample size calculation	70
4.2.3 Data collection	72
4.2.4 Quantification of TFA	77
4.2.5 Statistical analysis	79
4.3. Results	
4.3.1 Sociodemographic, reproductive data and anthropometric measurements for lactating mothers	80
4.3.2 FFQ score and TFA intakes (3-day composite food)	82
4.3.3 Dietary consumption parameters	88
4.3.4 Lipid composition of human milk	93
4.3.5 The association between sociodemographic, reproductive data and anthropometric measurements data with TFA content in human milk	95
4.3.6 The association between food consumption and TFA intake (3-day composite food) with TFA and its isomers content in human milk	95
4.3.7 The association dietary parameters with TFA and its isomers content in human milk	99
4.3.8 The association between human milk TFA and its isomers with other fatty acid	102
4.4 Discussion	104
4.5 Conclusion	115

**SUMMARY, GENERAL CONCLUSION
AND RECOMMENDATIONS FOR
FUTURE RESEARCH**

5.1 Summary	117
5.2 General conclusions	121
5.3 Recommendations	122
5.4 Limitations of study	123
5.5 Implications of study	123

REFERENCES

125

APPENDICES**BIODATA OF STUDENT****LIST OF PUBLICATIONS**