

**A study of carotenoids of mango fruit and
mango based products and their *in-vitro*
bioavailability**

by

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**Thesis submitted to the University of Sri Jayewardenepura for
the awarded of the Degree of Doctor of Philosophy in Food
Science on 2009**

The work described in this thesis was carried out by me under the supervision of Prof. A Bamunuarahchi , Prof. U.G. Chandrika and Prof. K.K.D.S.Ranaweera and a report on this has not been submitted in whole or in part to any university or any other institution for another Degree / Diploma.

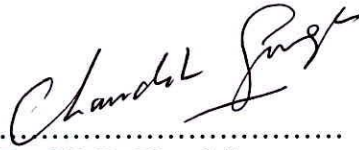
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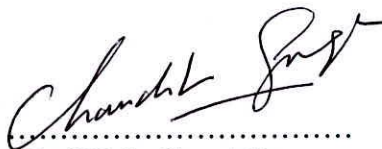
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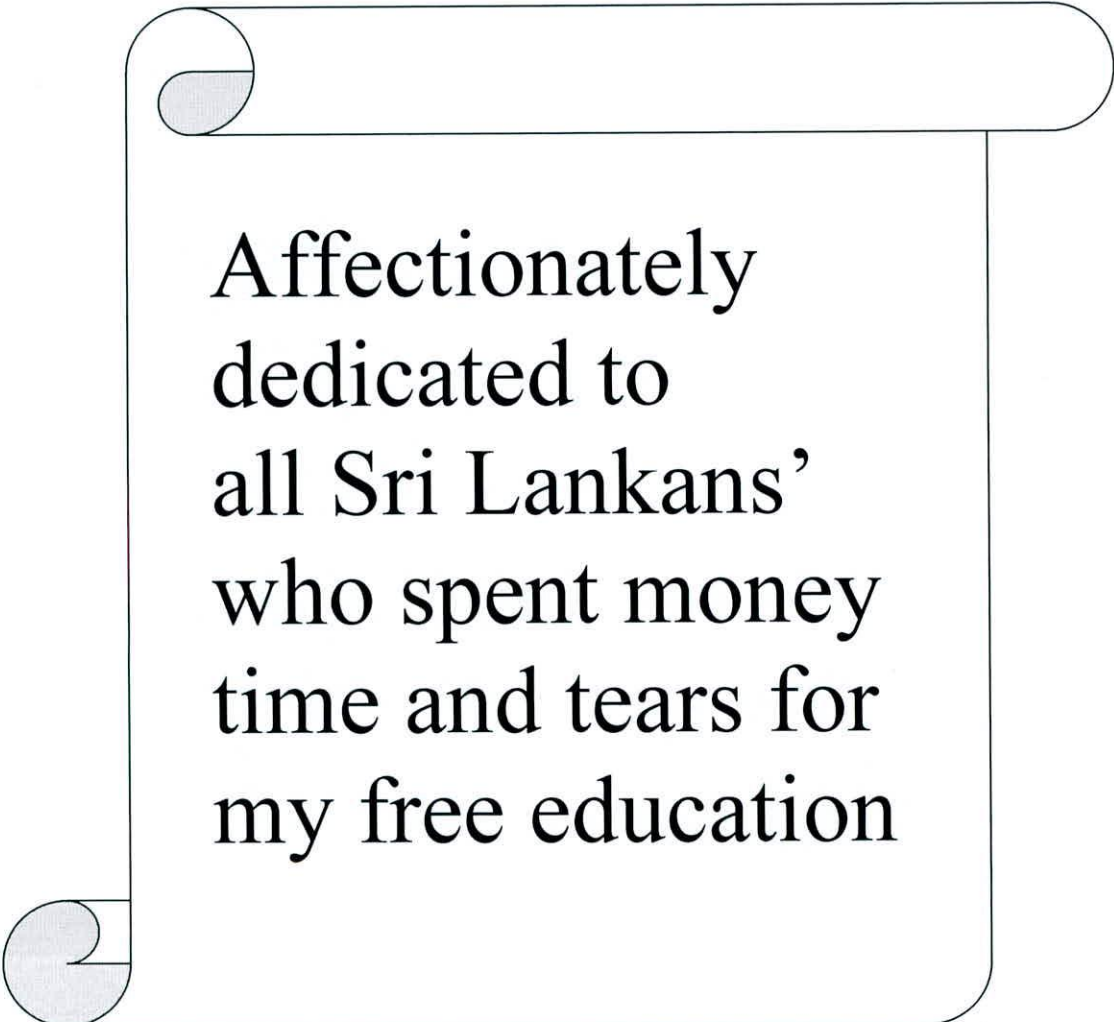
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Affectionately
dedicated to
all Sri Lankans'
who spent money
time and tears for
my free education

Table of content

		Page
I	LIST OF TABLES	vi -vii
II	LIST OF FIGURES	viii - xi
III	ACKNOWLEDGEMENTS	xii
IV	ABSTRACT	xiii -xiv
	CHAPTER I : INTRODUCTION	1
	1.1 Background	1
	1.2 Importance of Mango (<i>Mangifera indica</i>) as a source of carotenoids	3
	1.3. Objectives of the study	5
	CHAPTER II : REVIEW OF LITERATURE	8
	2.1 Carotenoids	8
	2.1.1 Chemistry of carotenoids	8
	2.1.2 Stability of carotenoids	12
	2.1.3.Mechanism of carotenoid degradation	13
	2.1.4.Biosynthetic pathway of carotenoids	15
	2.1.5.Factors affecting the carotenoid composition of fruits and vegetables	18
	2.2 Impact of carotenoids on human health	21
	2.2.1 Vitamin A and its importance on human health	22
	2.2.2. Assessment of vitamin A Status	23
	2.2.3 Hypervitaminosis A	26
	2.2.4 Bioavailability of pro vitamin A carotenoids	27
	2.2.4.1 Factors that affect carotenoid bioavailability	28
	2.2.5. Pro vitamin A activity of carotenoid	30
	2.2.6 Antioxidant functions of carotenoids	32

2.2.7. Carotenoids as food colours	34
2.3 Mango (<i>Mangifera indica</i> L.)	37
2.3.1 Ripening process of mango	41
2.3.2 Mango(<i>Mangifera indica</i> L.) carotenoids	42
2.3.2.1 Stability of mango carotenoids under different conditions	44
2.4 Important carotenoids in vegetables and other common fruits.	44
2.4.1 Important carotenoids in green Leafy vegetables.	44
2.4.2 Important carotenoids in root crops.	45
2.4.3 Important carotenoids in common Sri Lankan fruits other than Mango.	45
2.5. Guide line for carotenoid analysis	46
2.6. Chemical test for carotenoids	48
2.7 Intestinal absorption of dietary carotenoids	48
2.7.1 The theory for <i>in vitro</i> bioaccessibility carotenoids.	49
CHAPTER III : MATERIALS AND METHODS	52
3.1 Extraction of carotenoids from three mango varieties (Karuthacolamban, Beti amba and Gira amba)	52
3.1.1 Selection of samples	53
3.1.2. preparation of samples	54
3.1.3. Isolation of carotenoids	54
3.2 Saponification of carotenoids	55
3.3. Separation and identification of carotenoids	56
3.3.1. Separation of carotenoids by Open Column Chromatography (OCC)	56
3.3.2. Separation of carotenoids by Thin Layer Chromatography (TLC)	59
3.3.3. Separation of carotenoids by High Performance Liquid Chromatography (HPLC)	60
3.4. Chemical tests for the positions of substituents of carotenoids	62
3.4.1. Acetylation of Primary and Secondary Hydroxyl Group	63

3.4.2. Methylation of allylic Hydroxyl Group	63
3.4.3 Epoxide- Furanoid rearrangement	64
3.4.4 .Reduction of a conjugated carbonyl group	64
3.4.5.Iodine catalized cis – trans isomerization	64
3.5 Production process of mango based products (i.e. jam , cordial and osmotically dehydrated mango)	64
3.5.1. Jam manufacturing process	64
3.5.2. Cordial manufacturing process	67
3.5.3. Osmotically dehydrated mango manufacturing process	69
3.6. <i>In vitro</i> bioaccessibility of pro vitamin A carotenoids	71
3.6.1. <i>In vitro</i> bioaccessibility of pro vitamin A carotenoids in selected mango varieties	73
3.6.2. <i>In vitro</i> bioaccessibility of pro vitamin A carotenoids in mango based Jam	74
3.6.3. <i>In vitro</i> bioaccessibility of pro vitamin A carotenoids in mango based Cordial	74
3.6.4. <i>In vitro</i> bioaccessibility of pro vitamin A carotenoids in Osmotically dehydrated mango.	74
3.7. Effect of storage conditions on the provitamin A carotenoid profile of Beti amba variety	75
3.7.1 Effect of storage temperature on the provitamin A carotenoid profile of Beti amba variety	75
3.7.2 Carotenoid profile of Beti amba variety under artificial ripening environment	76
3.8. Distribution of carotenoids within the mango flesh	76
3.9. Development of sensory web for selected mango varieties	76
CHAPTER IV :RESULTS	77
4.1 Extraction and Isolation of carotenoids (i.e. Karuthacolamban, Beti amba and Gira amba)	77

4.1.1. Selection of samples	77
4.2. Separation and identification of carotenoids (i.e. Karuthacolamban, Beti amba and Gira amba)	78
4.2.1. carotenoids profile of variety karuthacolamban	79
4.2.2 Carotenoid profile of variety Beti Amba	83
4.2.3. Carotenoid profile of variety Gira Amba	87
4.3. Carotenoid profile of mango based products	91
4.3.1. Carotenoid profile of Jam	91
4.3.2. Carotenoid profile of Cordial	92
4.3.3. Carotenoid profile of Osmotically dehydrated mango	93
4.4 <i>in vitro</i> bioaccessibility of pro vitamin A carotenoids in the mango varieties(i.e. Karuthacolamban , Beti amba and Gira amba)	94
4.4.1 Mango variety – Karuthacolamban	94
4.4.2 Mango variety – Beti amba	95
4.4.3. Mango variety- Gira amba	95
4.5 Pro vitamin A carotenoids and their <i>in vitro</i> bioaccessibility of mango based products (i.e. Jam , Cordial and Osmotically dehydrated mango).	97
4.5.1. Mango Jam	98
4.5.2. Mango Cordial	98
4.5.3. Osmotically dehydrated mango	99
4.6. Effect of storage conditions on pro vitamin A carotenoids of the selected mango variety.	100
4.6.1. Effect of artificial ripening on pro vitamin A carotenoids	102
4.7. Results of the sensory evaluation	103
CHAPTER V :DISCUSSION	110
CHAPTER VI :CONCLUSION	131
REFERENCES	134

APPENDIX I- List of publications and communications from the study	148
APPENDIX II – Spectrums relevant to the major carotenoids	149

LIST OF TABLES

		Page
Table 1.1	Categorization of individuals depending upon the income, literacy and other social background	2
Table 1.2	Different mango cultivars recommended for different agro-climatic zones	4
Table 2.1	Structures and characteristics of common food carotenes	10
Table 2.2	Structures and characteristics of common food xanthophylls	11
Table 2.3	All trans and β -carotene and vitamin A activity of fresh and froze carrots as affected by cooking time.	21
Table 2.4	Safe level of vitamin A intake	22
Table 2.5	Interpretation of plasma vitamin A and carotene levels	25
Table 2.6	Factors that affect carotenoid bioavailability	29
Table 2.7	Common (animal based) food sources for vitamin A and β -carotene	36
Table 2.8	Common (plant based) food sources for β -carotene	37
Table 2.9	World production status of mango	39
Table 2.10	World production status of mango	41
Table 4.1	Maturity indices applied in selection of all three mango varieties for the study	78
Table 4.2	Moisture content of selected mango varieties	78
Table 4.3	Results of the chemical tests for mango carotenoids (Variety Karuthacolamban).	82
Table 4.4	Results of the chemical tests for mango carotenoids (Variety Beti amba).	86
Table 4.5	Results of the chemical tests for mango carotenoids (Variety Gira amba).	90
Table 4.6	Quantity and the invitro bioaccessibility of β -carotene as a	97

	provitamin A carotenoid in the Mango varieties.	
Table 4.7	Quantity and the invitro bioaccessibility of β -carotene as a provitamin A carotenoid in the Mango based products.	100
Table 4.8	Effect of temperature and artificial ripening treatment on the provitamin A Carotenoid (β -carotene)	103
Table 4.9	Tabulated category scores for the hedonic test for the selected mango varieties	104
Table 4.10	Mean values for sensory parameters	105

LIST OF FIGURES

		Page
Figure 1.1	Outline of the methodology for the study of mango variety for carotenoid	6
Figure 1.2	Outline of the methodology for study of Pro vitamin A carotenoids in mango based products.	7
Figure 1.3	Outline of the methodology for study of storage factors affecting Pro vitamin A carotenoids mango variety Beti amba	7
Figure 2.1	The carotenoid biosynthesis pathway	17
Figure 2.2	A schematic out line the path of β -carotene (β -C) as its moves out from the food into the intestinal wall	28
Figure 2.3	Biological fate of β -carotene inside the body	31
Figure 2.4	Type two sensitizer activity of carotenoids	33
Figure 2.5	Health promoting functions or actions attributed to the carotenoids	34
Figure 2.6	General procedure for carotenoid analysis	47
Figure 2.7	Flow diagram of <i>in vitro</i> method	50
Figure 2.8	A schematic illustration of <i>in vitro</i> digestion method	51
Figure 3.1	Jam manufacturing process	66
Figure 3.2	Cordial manufacturing process	68
Figure 3.3	Osmotically dehydrated mango manufacturing process	70
Figure 4.1	Photographs of three mango varieties	77
Figure 4.2	HPLC Chromatogram for variety Karuthacolamban (esterified form)	79
Figure 4.3	HPLC Chromatogram for variety Karuthacolamban (saponified form)	80

Figure 4.4	Separation pattern and eluting solvents of carotenoids from saponified Karuthacolamban extract on the MgO : Hypoflosupercel (1:1) column.	80
Figure 4.5	UV visible absorption spectra of β – carotene	81
Figure 4.6	Thin layer silica –gel chromatogram of carotenoids (variety karuthacolamban) developed with 5% methanol in toluene	81
Figure 4.7	HPLC Chromatogram for variety Beti amba (esterified form)	83
Figure 4.8	HPLC Chromatogram for variety Beti Amba (saponified form)	84
Figure 4.9	Separation pattern and eluting solvents of carotenoids from saponified Beti Amba extract on the MgO : Hypoflosupercel (1:1) column.	84
Figure 4.10	UV visible absorption spectra of β – carotene	85
Figure 4.11	Thin layer silica –gel chromatogram of carotenoids (variety Beti Amba) developed with 5% methanol in toluene	85
Figure 4.12	HPLC Chromatogram for variety Gira amba (esterified form)	87
Figure 4.13	HPLC Chromatogram for variety Gira Amba (saponified form)	88
Figure 4.14	Separation pattern and eluting solvents of carotenoids from saponified Gira Amba extract on the MgO :Hypoflosupercel (1:1) column.	88
Figure 4.15	Figure 4.15 visible absorption spectra of β – carotene	89
Figure 4.16	Thin layer silica –gel chromatogram of carotenoids (variety Gira Amba) developed with 5% methanol in toluene.	89
Figure 4.17	HPLC Chromatogram for variety Beti Amba (As a raw material for mango based products).	91

Figure 4.18	HPLC Chromatogram for Mango based products (Jam).	92
Figure 4.19	HPLC Chromatogram for Mango based products (Cordial).	93
Figure 4.20	HPLC Chromatogram for Mango based products (Osmotically dehydrated mango).	93
Figure 4.21	HPLC Chromatogram for variety Karuthacolamban (for <i>in vitro</i> bioaccessibility)	94
Figure 4.22	HPLC Chromatogram for variety Beti Amba (for <i>in vitro</i> bioaccessibility)	95
Figure 4.23	HPLC Chromatogram for variety Gira Amba (for <i>in vitro</i> bioaccessibility)	96
Figure 4.24	HPLC Chromatogram for jam (for <i>in vitro</i> bioaccessibility)	98
Figure 4.25	HPLC Chromatogram for cordial (for <i>in vitro</i> bioaccessibility)	99
Figure 4.26	HPLC Chromatogram for Osmotically dehydrated mango (for <i>in vitro</i> bioaccessibility)	99
Figure 4.27	HPLC Chromatogram for the mango stored at room temperature.(saponified form)	101
Figure 4.28	HPLC Chromatogram for the mango stored at 20 ° C. (saponified form)	101
Figure 4.29	HPLC Chromatogram for the mango stored at -2 °C.(saponified form)	102
Figure 4.30	HPLC Chromatogram for the mango stored at room temperature with carbide	102
Figure 4.31	Sensory web diagram for the variety of Gira Amba	106
Figure 4.32	Sensory web diagram for the variety of Beti Amba	107
Figure 4.33	Sensory web diagram for the variety of Karuthacolamban	108
Figure 4.34	Sensory web diagram for the selected mango varieties	109

Figure 5.1	Acetylation of 1 ^{ty} and 2 ^{ty} hydroxyl groups	117
Figure 5.2	Methylation reactions of allylic hydroxyl groups	118
Figure 5.3	Epoxide- furanoid rearrangement	119

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**Study of carotenoids of mango (*Mangifera indica*) fruit and mango based products
and their *in vitro* bioavailability**

By Matara Arahchighe Jagath Wansapala

ABSTRACT

Vitamin A is an important micronutrient of animal origin responsible for structure and functioning of the skin, mucous membrane and maintaining of a good vision. Low-income, poor educational background and cultural and religious practices discourage the intake of recommended amount of vitamin A through animal sources. Therefore the attention should be given to the naturally available and affordable provitamin A sources such as green leafy vegetables, certain root crops and most of the fruits.

The major objectives of this study were to qualitatively analyze the carotenoid profile in three popular mango varieties namely “Karuthacolamban”, “Beti Amba” and “Gira Amba” grown in the three different agro climatic regions of the Sri Lanka, quantification and *in vitro* bioavailability of pro vitamin A content in all three varieties with a view to updating the database. The impact of different process conditions on the stability of provitamin A carotenoids in mango based products (ie. jam, cordial and osmotically dehydrated mango) were also studied. Sensory characteristics of the selected mango varieties were comparatively studied and the sensory web was developed for each variety.

A reversed phase HPLC method has been developed for the study for the separation and extraction of the carotenoids in crude and saponified extracts from the “Karuthacolamban”, “Beti Amba”, “Gira Amba” and mango based products. All fruits with the same maturity

indices were selected from local market and the cultivars were identified by Horticultural Crop Research and Development Institute Gannoruwa, Kandy, Sri Lanka.

Carotenoids from mango were extracted according to the method described by Rodriguez Amaya (1999), which involved extraction of carotenoids, partition to petroleum ether, separation of carotenoids by Open Column Chromatography (OCC), identification of carotenoids using Ultra violet Visible absorption spectra (maximum absorption and spectral fine structure), order of elution in OCC and chemical tests. Purity of the identified carotenoids were further confirmed by using the High Performance Liquid Chromatography with photo diode array detection (C_{18} column Spherisorb ODS2, $5\mu\text{m}$, $4.6\text{mm} \times 150\text{mm}$; gradient elution of mobile phase of Methanol, Acetonitrile and 0.05% Tri ethyl amine in Ethyl acetate). The HPLC analysis of crude extract of variety Karuthacolamban highlighted the existence of four main peaks which had UV- Visible spectra similar to those reported for violaxanthin, neoxanthin, β -carotene and α -cryptoxanthin. The HPLC analysis of crude extract of “Beti Amba” and “Gira Amba” varieties highlighted the existence of three main peaks which had UV- Visible spectra similar to those reported for violaxanthin, neoxanthin, and β -carotene. A saponification step of crude extracts indicated the existence of esterified violaxanthin, neoxanthin, and α -cryptoxanthin. The Variety “Karuthacolomban” contains $2.7 \pm 0.3 \mu\text{g/g}$ (Fresh weight), the variety “Beti Amba” contains $2.6 \pm 0.3 \mu\text{g/g}$ (Fresh weight) and the variety “Gira Amba” ($0.18 \pm 0.6 \mu\text{g/g}$ (Fresh weight) of β - carotene as the principal pro-vitamin A carotenoid. The amount of in vitro bioavailability β - carotene was highest in the “Beti Amba” variety (29.6%) than “Karuthacolomban” (24%) and “Gira Amba” (20.30%).

Thus, this study has indicated that varietal difference does not exist in the content but bioavailability of β -carotene in mango.

The percentages of destruction of β - carotene in jam, cordial and osmotically dehydrated mango during the process were recorded as 89%, 78% and 66% respectively. The in vitro bioaccessibility of β - carotene in all three products were recorded as 67 %, 25 % and 64% respectively. Higher amounts of provitamin A carotenoids ($1.43\pm 0.3 \mu\text{g/ g}$ Fresh weight) were obtained under Room temperature ($28 \text{ }^\circ\text{C}$) and the lowest amount of provitamin A carotenoids ($0.20\pm 0.3 \mu\text{g/ g}$ Fresh weight) were recorded at $-2 \text{ }^\circ\text{C}$. The provitamin A carotenoids content of artificially ripened mango was ($0.30\pm 0.3 \mu\text{g/ g}$ Fresh weight) lower than that of the natural. The highest sensory values were recorded “Gira amba” variety.