

Carotene Content in Sweet Potato Varieties and its Retention after Processing

L I L A B A B U

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Introduction

- **Carotenoids-ubiquitous in nature**
- **C40 terpenoid compound (condensation of 8 isoprene units)**
- **To date approx. 700 known naturally occurring carotenes**
- **Function in plants - photoprotection, free radical quenching, attractive visual colours**
- **In humans- nutritional supplement, natural colourants, prevention of several chronic and degenerative diseases**

Importance in human nutrition and health

- **Provitamin A activity-**
β & α carotene, β cryptoxanthin
- **Antioxidant activity**
astaxanthin, cryptoxanthin, lutein, zeaxanthin
- **Health protective**
 - **Treatment of AMD (lutein & zeaxanthin)**
 - **Neurological & age related disorders**
 - **Anticarcinogenic**

Sweet Potato and Carotenoids

- **A myriad of flesh colours**
White, cream, light yellow, yellow and bright orange
- **Reported range**
0 - 22 mg/100gfw
- **A viable diet based approach to alleviate vit A deficiency**
VITAA project
- **Bioavailability**
more from sweet potato and fruits than from dark green vegetables
(Castenmiller & West 1998, Huang et al, 2000)

Variation in flesh colour of sweet potato tubers as a measure of carotenoids concentration



Experimental Approach

- **Tubers of 105 days maturity**
- **Immediately processed after harvest**
- **Extracted with hexane : acetone 60:40 stabilised with BHT**
- **Partition chromatography**
- **Dry over anhydrous sodium sulphate**
- **Spectrophotometry 450 nm**
- **Calculation using pure β carotene (Sigma)**

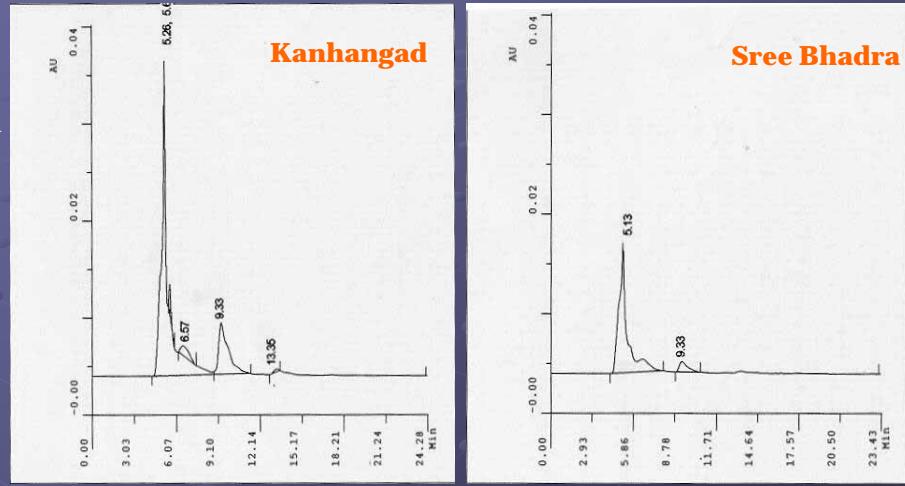
Total carotenoids in sweet potato varieties

Varieties	Carotenoids mg/100gfw	β carotene Content
Sree Arun	0.35 ± 0.2	0.11
Varsha	0.55 ± 0.3	0.02*
Sree Bhadra	1.27 ± 0.5	0.094
Sree Varun	2.38 ± 0.74	2.09
Kanhagad	2.5 ± 0.85	0.56
Sree Nandini	2.8 ± 0.36	1.36
Sree Ratna	4.5 ± 0.35	3.10
Gouri	9.6 ± 0.8	8.16
362/7	10.8 ± 1.05	ND
Sree Kanaka	14.2 ± 3.02	13.77
Kamala Sundari	16.0 ± 2.15	15.15

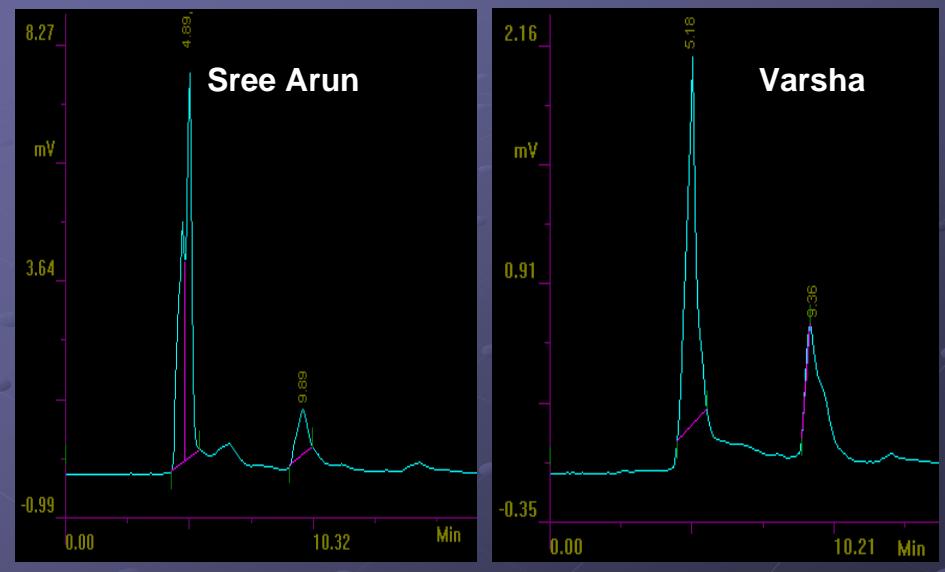
HPLC of carotenoids

- Carotenes lyophilised/ evaporated under vacuum
- Taken into hexane, filtered and injected
- RP C 18 column, 25 ° C
- Method of Khachik et al,1986.
isocratic system. methanol: acetonitrile: methylene chloride:hexane (22:55:11.5:11.5)
- Calculated using RF of Sigma β carotene

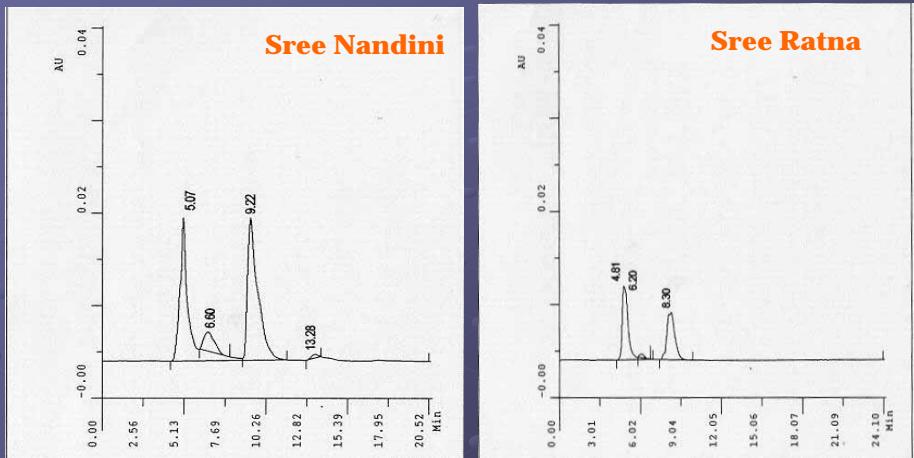
Carotenoid profile in cream fleshed tubers



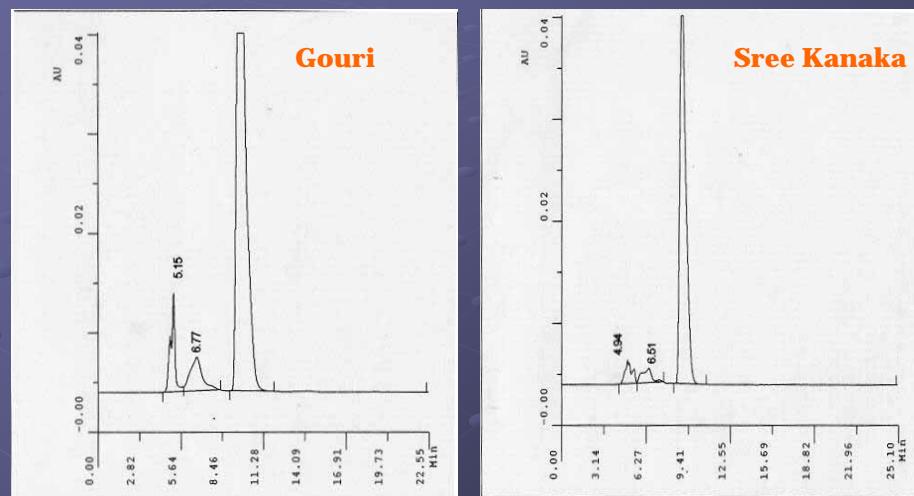
HPLC profile of Carotenoids in Cream fleshed tubers



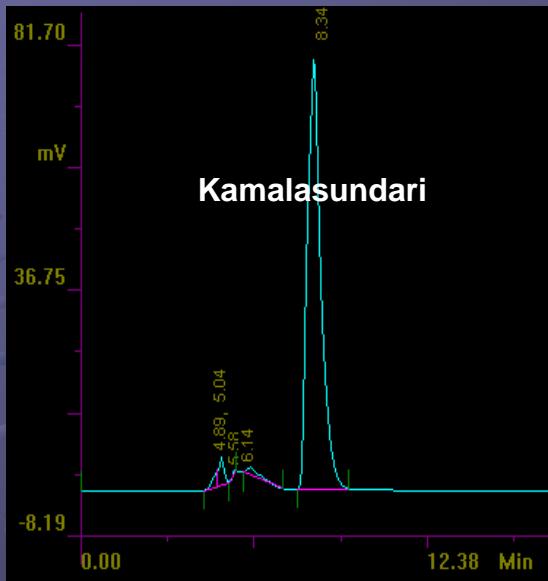
HPLC profile of Carotenoids in yellow fleshed varieties



HPLC profile in orange fleshed varieties



HPLC profile of Carotenoids in orange fleshed varieties



Changes on processing

- o Loss /enhancement / isomerisation
- o Cis- forms increased significantly
(Quackenbush,1987, Chandler and Schwartz 1988)
- o **Tempt affects xanthophylls more than hydrocarbons**
- o In carrots and Spinach, boiling and pureeing enhances bioavailability(Mosha et al., 1997, Edwards et al.,2002)
- o Dietary vehicles influences assimilation and bioavailability

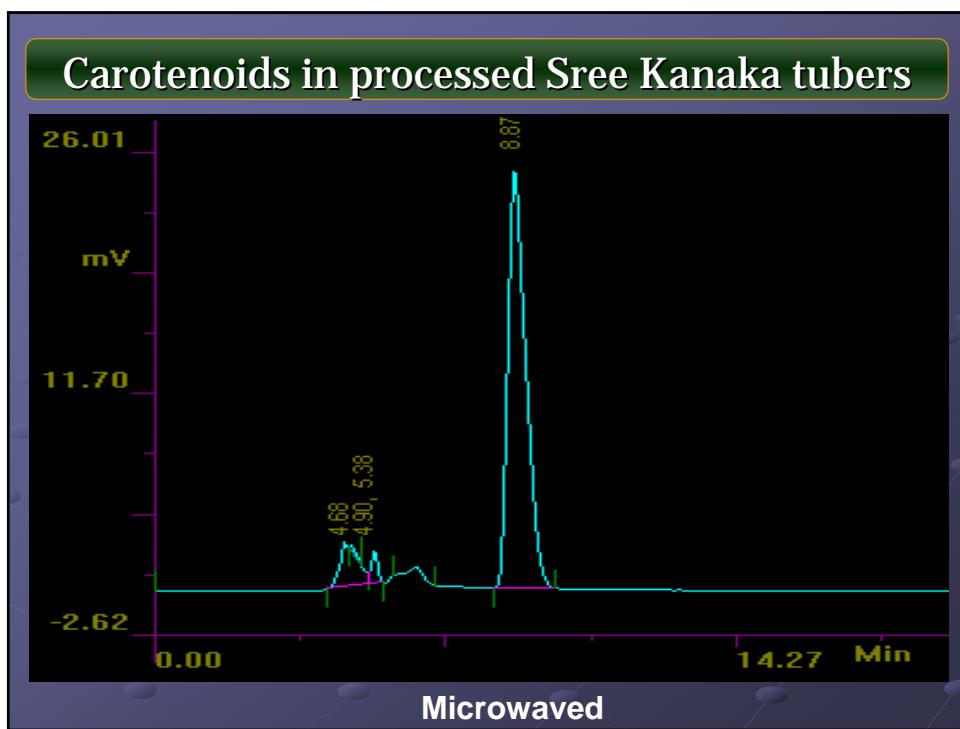
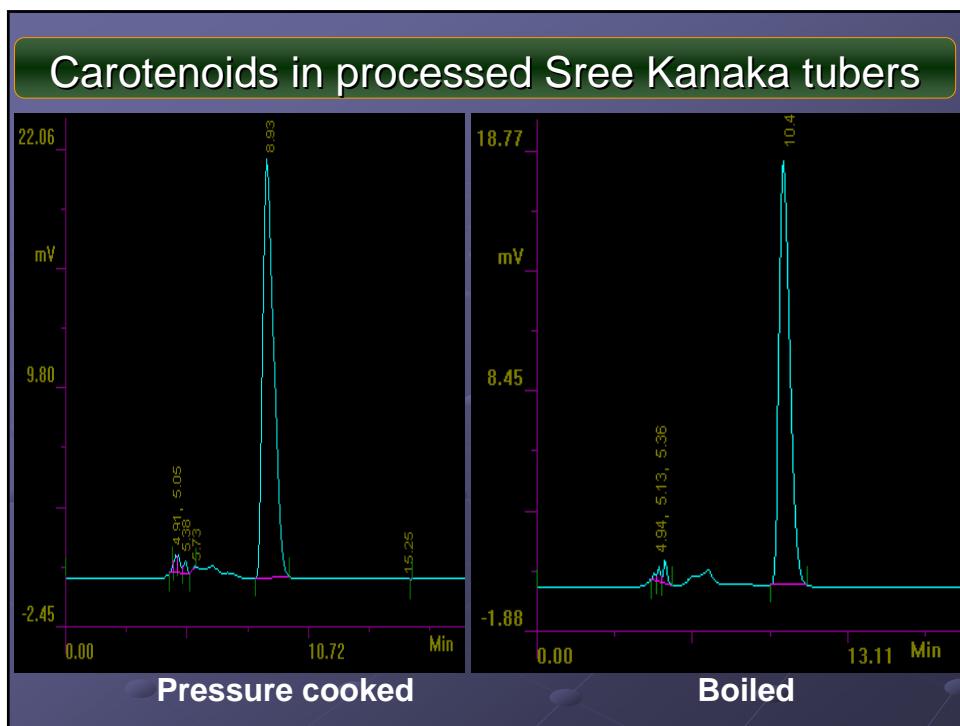
Studies on retention of carotenoids on processing

- Boiling – tuber cubes: water, 1:4 ratio/ whole tubers immersed in water
- Baking in microwave oven in convection mode-170 °C
- Microwave cooking 1:2 cubes : water ratio at 850 W till soft
- Blanching- into boiling water, 2 mts
- Steaming and pressure cooking- in a pressure cooker

Retention of carotenoids on processing

Variety	Processing method	Carotenoids mg/100 gfw	% loss / gain
Sree Kanaka 1" cubes	Raw	14.25 ± 2.0	-
	Blanched	15.75 ± 1.5	+ 10.52
	Boiled	16.0 ± 1.25	+12.28
	Microwaved	16.5 ± 0.8	+ 15.79
	Steamed	12.8 ± 1.8	-10.18
	Baked	10.69 ± 1.0	- 28.56
	Sundried & powdered	3.56 ± 0.5*	-75.02

* Computed into fresh weight



Retention of carotenoids on processing

Sree Ratna

Processing methods	carotenoids mg/100gfw	% loss/ gain
Raw	4.4 ± 0.3	--
Boiled	3.0 ± 0.3	-31.82
Blanched	3.4 ± 0.1	-22.73
Microwaved	2.8 ± 0.2	-36.36
baked	2.3 ± 0.7	- 47.72

Retention of carotenoids on processing

Kanhangad

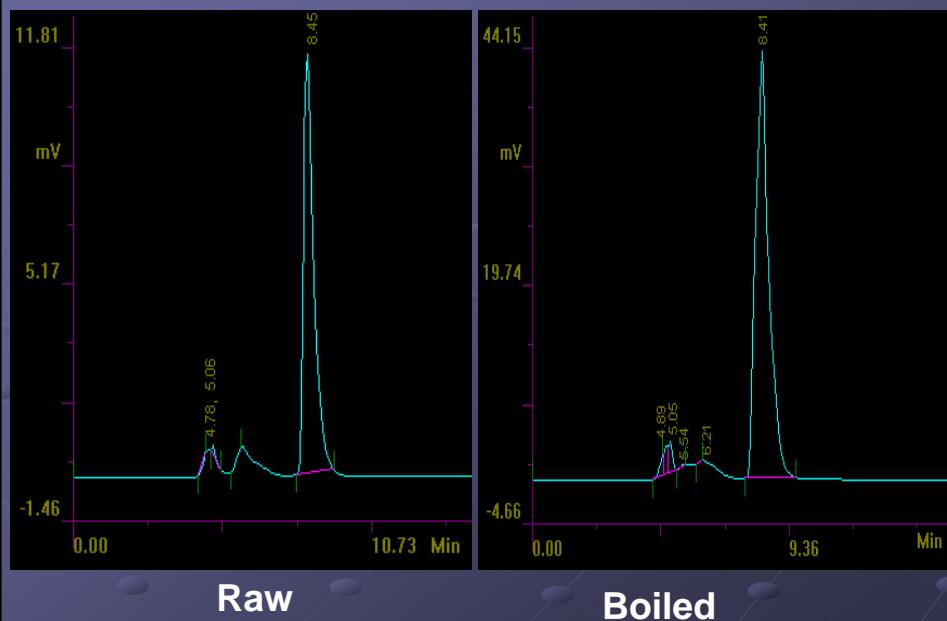
Processing methods	Carotenoids mg/100gfw	% loss/gain
Raw	2.6 ± 0.5	-
Boiled	1.64 ± 0.7	-36.92
Blanched	2.15 ± 0.8	-17.31
Microwaved	1.62 ± 0.6	-37.69

Retention of carotenoids on processing

- Whole Tubers

Variety	Processing Methods	Carotenoids mg/100gfw	% loss/gain
Gouri	Raw	9.8	-
	Boiled	12.4	+ 26.0
Kamala sundari	Raw	15.8	-
	Boiled	19.0	+ 20.25

Retention of Carotenoids in cooked Gouri tubers



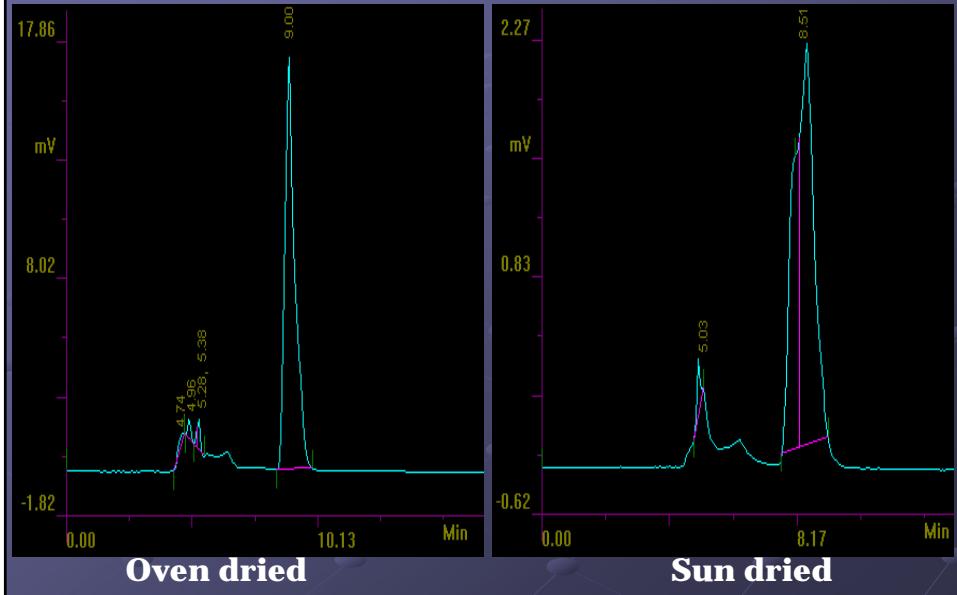
Retention of carotenoids in sweet potato flours

- Shade dried & powdered
- Ovendried at 60°C & powdered
- Lyophilised and powdered
- Extracted, purified and concentrated
- Spectroscopy and HPLC

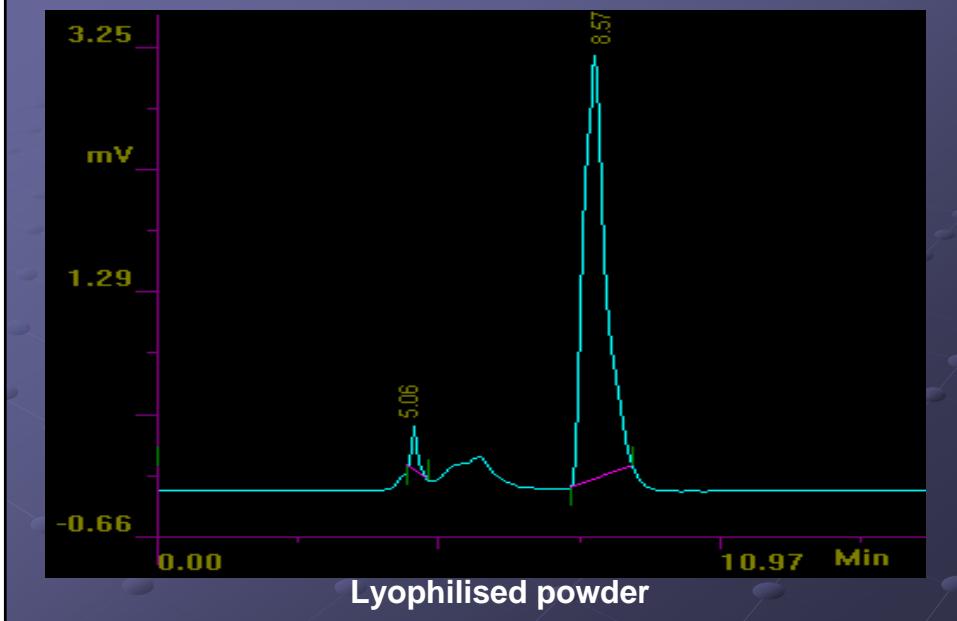
Retention of carotenoids in sweet potato flours

Variety	Method for flour preparation	Carotenoids mg/100gdw	β carotene mg/100gdw
Sree Kanaka	Shade dried & powdered	46.55 ± 1.0	29.79
	Oven dried & powdered	35.16 ± 1.0	36.20
	Lyophilised & powdered	70.5 ± 0.3	68.45

Carotenoids in flour from oven dried and sun dried chips of Sree Kanaka



Carotenoids in processed Sree Kanaka tubers



Salient Findings

- **β-carotene content directly correlated with intensity of flesh colour**
- Varieties can be grouped into three, based on carotenoid composition
- Orange fleshed tubers are rich in β-carotene and can serve as a cheap and viable source of provitamin A
- Processing detrimental to cream and yellow fleshed varieties than orange fleshed ones

Salient Findings

- Processes employing wet heat such as boiling enhances carotene content
- Microwaving best for retention of visible colour
- Baking and oven drying leads to losses
- Lyophilising retains carotenes far better than other drying methods for flour preparation

