FOODS AND NUTRITION NEWS

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CAROTENOIDS - HUMAN HEALTH

Carotenoids have attracted the interest of researchers from various fields such as chemistry, biochemistry, biology, food science and technology, medicine, pharmacy, and nutrition for more than a century, and these fascinating compounds continue to be intensely investigated. The knowledge of the importance of carotenoids in human health is not new. For years it has been known that β-carotene plays an essential role as the main dietary source of vitamin A. Deficiency of vitamin A, particularly in the third world countries, accounts for blindness in 250,000 to 500,000 children a year according to estimates by the World Health Organization. More recently, protective effects of carotenoids against serious disorders such as heart disease, cancer and degenerative eye disease have been recognized stimulating intensive research into the role of carotenoids as antioxidants and possibly as regulators of the immune system. Thus far there have been over 700 naturally occurring carotenoids identified and as many as 50 may be absorbed and metabolised by the human body. Of these, 14 carotenoids have been identified in the human serum. Common carotenoids include β-carotene Lycopene, Lutein, Zeaxanthin, and α-carotene.

Structure of the carotenoids:

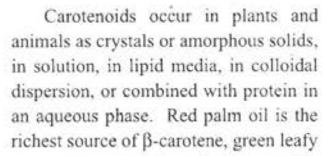
The structural feature of carotenoids is an extensive conjugated double bond system, consisting of alternative double and single carbon-carbon bonds. It is referred as the chromophore and is responsible for the ability of the carotenoids to absorb light in the visible region, consequently their strong colouring capability. Minimum seven double bonds are needed for a carotenoid to impart colour, phytofluene, with five such bonds is colour less. The colour deepens as the conjugated system is extended, thus lycopene is red. Cyclization causes some impediment to the colour. The intensity and hues of food colour depends on the type of carotenoid and their concentration etc.

Sources and bioavailability :

Carotenoids occur in plants and animals as crystals or amorphous solids, in solution, in lipid media, in colloidal dispersion, or combined with protein in an aqueous phase. Red palm oil is the richest source of β-carotene, green leafy vegetables and yellow fruits are other rich sources of β-carotene. Bioavailability of β-carotene is more in fruits and vegetables when it is located in lipid droplets than when it is organised in pigment protein complexes, because releasing β-carotene from lipid molecule is easier than from the protein molecule.

Classification of Carotenoids:

Carotenoids can be classified in terms of their nutritional and other biological activities. By using singlet oxygen quenching as the selected



biological action, four categories might be defined as type 1, biologically and nutritionally active (β-carotene); type 2 biologically active but nutritionally inactive, at least in mammals (Canthaxanthin); type 3, biologically inactive but nutritionally active (β-apo-14, carotenal) and type 4, biologically and nutritionally inactive (phytoene).

Biological Action:

The biological action of carotenoids can be considered in three different terms. 1) Functions 2) Actions and 3) Associations. Functions might be defined as essential roles that carotenoids play at least under certain defined conditions. The absence of the carotenoids therefore leads to impaired physiological capability and possibly death. Actions might be considered as physiological or pharmacological responses to the administration of carotenoids. The responses, which may be either beneficial or adverse, however are not essential for physiological well being. Associations define correlations between carotenoids and some physiological or medical end point that may or may not show a causal relationship.

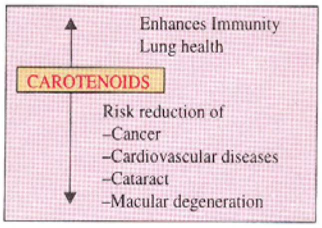
Carotenoids in Blood and Tissues:

Human plasma contains a complex mixture of structurally diverse carotenoids such as β-carotene, α-carotene, lycopene, cryptoxanthins and lutein etc. They are transported in human plasma exclusively by lipoproteins. Approximately 75% of the hydrocarbon carotenoids (β-carotene and lycopene) were associated with low density lipoproteins (LDL) and the remaining 25% with the high density lipoproteins (HDL). The specific study on the distribution of β-carotene showed that 79% of the total serum β-carotene in LDL, 8% in HDL and 12% in very low density lipoprotein (VLDL). The major determinants of serum carotenoid levels include many factors such as dietary intake, destruction in the gastro intestinal tract, efficiency of absorption and metabolism and rate of tissue intake. The cellular components of blood such as erythrocyte membranes and leucocytes also contain carotenoid pigments. In case of tissues, adipose tissue and liver are probably the quantitatively important sites of deposition of carotenoids in humans.

Health benefits:

β-carotene

Since 1982 the United States National Academy of Sciences and some governmental agencies have repeatedly emphasized the importance of consuming carotene rich foods in the prevention of cancer. The reason why this β-carotene has come into limelight is because, new discoveries that imply its benefits and heavy commercial promotion. Evidence supporting β-carotene's anticancer properties comes from epidemiological studies, animal studies on cultured cells, tissues, and organs. Various degrees of association of low intake of vegetables, fruits, and/or carotenoids with increased cancers of various sites have been demonstrated in several prospective epidemiological studies. In recent times, the efficacy of antioxidants in immune related diseases also has become a topic of interest. Since AIDS is a disease of the immune system, new strategies that incorporate specific nutrinets to improve immune function may provide alternative and/or supplemental approaches for therapy in HIV infected patients. Nutrient supplementation may improve host resistance to HIV infection, especially in persons with a symptomatic HIV infection who may also be beneficial in establishing anti HIV



immunity in healthy individuals. Hence, in the present situation the intake of β-carotene has become essential to the human beings not only for the VAD (Vitamin A deficiency) population but also for others to protect them selves from the dreadful diseases.

Lycopene

Interest in lycopene began in the late 1980's when it was found that the antioxidant activity of lycopene was twice that of beta-carotene. By the late 1990's, over 70 studies have looked for a link between diets high in tomatoes (as a source of lycopene) and a lower risk of cancer, Studies suggest that diets rich in tomato (specially the processed tomato products) intake may account for a reduction in the risk of several different types of cancer. The strongest evidence is for a protective effect against cancers of the lung, stomach, and prostate gland. There may also be a protective benefit against cancers of the cervix, breast, oral cavity, pancreas, colorectum, and esophagus. More recently, serum levels have been shown to inversely related to the risk of heart disease as well.

Lutein and Zeaxanthin

These carotenoids are recently identified which are found in the retina composing the macular pigment. They function to protect photoreceptor cells from light-generated oxidants. Because of this, they play a key role in the protection of a common form of blindness known as age-related macular degeneration (ARMD). Studies have been conducted demonstrating that the levels of both Lutein and Zeaxanthin in the retina can be enhanced with foods rich in these compounds and that these levels correlate inversely with the incidence of ARMD. Dietary sources include kale, mustrd greens, spinach, corn, celery, broccoli, lettuce, parsley and green peas. Increase in clustering of adverse health behaviours (cigarette smoking, alcohol intake, and sedentarism) was associated with decreased serum concentrations of α-carotene, β-carotene, β-cryptoxanthin, and lutein/zeaxanthin in the 3 racial/ethnic groups. The importance of lutein and zeaxanthin is becoming more apparent with recent research, and increasing consumption of these nutrients can purportedly enhance lung function.

α-carotene

α-carotene is similar to β-carotene in its biological activity with the exception that it is a more potent antioxidant and smaller amounts are converted to vitamin A. Serum levels are generally between 10 and 20% of β-carotene levels and like β-carotene are inversely associated with cancer. Dietary sources are much the same as for β-carotene.

Scientific knowledge of beneficial role of various nutrients/non-nutrients for the prevention and treatment of specific diseases is rapidly accumulating. At the same time, novel technologies-including *biotechnology* and specifically *genetic engineering* have created an era where scientific discoveries, product innovations, and mass production will be possible as never before. Some achievements of agricultural biotechnology are production of carotene rich staple foods such as rice and oils like canola and mustard through gene modification. Sweet potato, cantaloupe, Squash, Pumpkin fruit, Capsicum and Carrot appears to have genetic potential to improve these crops as sources of provitamin A. The challenge before the food technologists is that to produce more and more carotene rich foods and to process, preserve and supply to the population of both rural and urban. Since most of these carotenoids are from fruit and vegetable sources, which are generally considered highly perishable, processing and preserving these products not only helps the human beings for leading a healthy life but also helps the nation in several ways.

Research

Fruits

Value Added β-carotene rich Mango Powders

Mango powders were developed from ripe mango pulp (85%) using milk concentrate (5%) and wheat flour (10%) as additives by vacuum dehydration (Fig.1). These poweders were intended to incorporate in recipes involving minimum cooking. The milk concentrate was used as a source of fat for better absorption of β-carotene, and wheat flour was used to serve as a base for the powder. The varieties Baneshan, Suvarnarekha, Totapuri and their three blends were found suitable for production of mango powders.

The mango powders (Fig.2) prepared from ripe mangoes contained 3.1 to 3.8 mg/100 and 4.65 to 5.8-mg/100 g beta-carotene and total carotene respectively. Additionally they are fair sources of protein (10.9-12.58 g/100g), fat (3.0–3.35 g/100g), ascorbic acid (52-76mg/100g), iron (1.59-5.2 mg/100g) and calcium (122-145mg/100g). Mango powder from Basneshan had the highest while Totapuri had the lowest total and β-carotene content. The mangoes with highest initial concentration of total and β-carotene content had highest total and β-carotene content after vacuum dehydration.

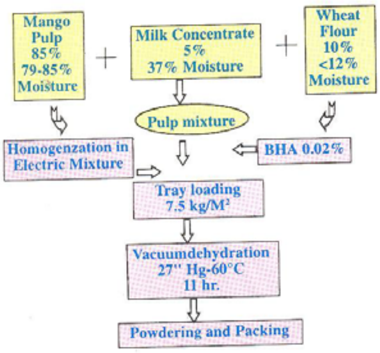


Fig. 1 Mango Powder preparation

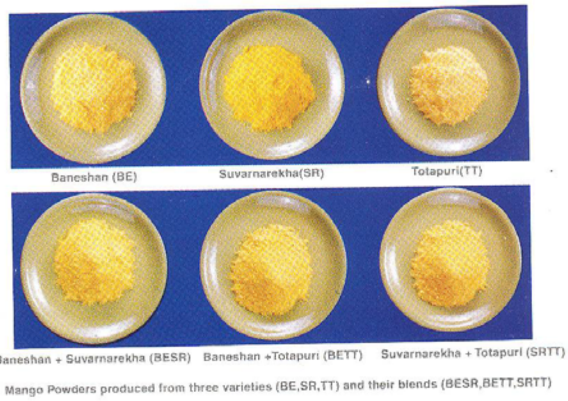


Fig.2 Mango powders from three varieties of mangoes and their blends.

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BHA Improved Retention of β-carotene

Butylated Hydroxy Anisole (BHA) was added to the pulp mixture (pulp, milk concentrate and wheat flour) in the preparation of mango powders at different concentrations to study the suitable level of addition. Three concentrations of BHA viz., 0.01%, 0.015%, 0.02% and a control were used. The pulp mixture was vacuum dehydrated at 27" Hg, 60°C temperature. Addition of BHA significantly improved β-carotene retention in mango powder (Table 1). With the increasing levels of BHA from 0.01 to 0.02 percent, β-carotene was also increased from 2.95 to3.85 mg, However significant increase was not seen in β-carotene content with the increase of BHA from 0.015 to 0.02 percent. The results indicated that BHA has a protective effect on retention of β-carotene in mango powders.

Table 1. Effect of added Butylated Hydroxy Anisole (BHA) on β-carotene retention

Percent BHA added	β-carotene (mg)*
Control	2.45
0.01	2.95
0.015	3.75[a]
0.02	3.85[a]

* Significant difference $p<0.05$
a–no significant difference

Retention of Total and β-carotene Content in Mango Powders During Storage

Vacuum dehydrated Mango powders from Baneshan (BE), Suvarnarekha (SR), Baneshan + Suvarnarekha (BESR), and Suvarnarekha + Totapuri (SRTT) blends were produced using mango pulp, milk concentrate and wheat flour. These powders were packed in two types of pouches made out of flexible packaging material namely polyester poly (40.2 μm) and metallized polyester poly (12μm)/polyethylene (40.2μm).

Significant reduction of total carotene content was observed during the storage of mango powders from different varieties and blends. The loss was significantly effected by the type of package as well as by the source of the powder (Table 2.). The percent loss of total carotene was significantly lower (43.6%) in the MPP packed powders than that of PP packed powders (61.7%), which was obviously due to the packaging material's permeability for oxygen and the light. Retention of total carotene was 72 to 75% up to 2nd month, 65 to 68% up to 4th month and 52 to 57% up to 6th month in MPP packaged pouches. In PP packaged pouches the retention ranged from 61% to 68%, 49 to 61% and 34 to 49% up to 2,4,6 months respectively.

The β-carotene content of all the mango powders was also reduced during storage. The loss ranged from 40-45 percent in MPP packed powders where as in powders packaged in PP pouches

Table 2 : Total and β-carotene content of vacuum dehydrated mango powders packed in flexible packing material and stored at ambient temperature

Storage Period (mo)	Packaging Type	*Total and β-carotene content (mg/100g)*							
		BE		SR		BESR		SRTT	
		Total carotene	β-carotene	Total carotene	β-carotene	Total carotene	β-carotene	Total carotene	β-carotene
0		5.80	3.8	4.90	3.2	5.27	3.4	4.80	3.1
2	PP	3.5 (60.3)	2.69 (70.74)	3.18 (64.89)	2.24 (70.0)	3.58 (67.91)	2.24 (65.88)	3.26 (67.91)	2.11 (68.06)
	MPP	4.23 (72.93)	2.96 (77.84)	3.72 (75.88)	2.46 (76.87)	3.89 (73.81)	2.41 (70.88)	3.45 (71.87)	2.10 (67.74)
4	PP	2.9 (50.)	2.24 (58.91)	2.49 (50.70)	1.85 (57.81)	2.63 (49.90)	1.76 (51.76)	2.35 (48.95)	1.58 (50.96)
	MPP	3.9 (67.0)	2.73 (71.79)	3.28 (66.91)	2.24 (70.0)	3.58 (67.93)	2.21 (65.00)	3.12 (65.0)	1.9 (61.29)
6	PP	2.03 (34.9)	1.63 (42.86)	1.96 (39.91)	1.34 (41.87)	1.79 (33.96)	1.36 (40.00)	2.20 (45.83)	1.20 (38.7)
	MPP	3.42 (58.82)	2.47 (64.96)	2.84 (57.93)	1.95 (60.93)	2.89 (54.82)	1.39 (56.76)	2.54 (52.91)	1.70 (54.83)

PP : Poltester poly, MPP: Metallized polyester poly/polyethylene
Figures in parenthesis indicate percent retention

the loss ranged from 58 to 62 percent during storage. The retention of β-carotene ranged from 65 to 70.7% and 66-74% up to 2nd month (in MPP and PP packaged powders respectively), 57.4% and 64.9% and 50.9%-58.9% upto 4th month (in MPP and PP packaged powders respectively) and 46.7%-53.9% and 38.7%-42.8% up to 6th month (in MPP and PP packaged powders respectively). The study revealed that during the storage, BE powder had consistently higher concentration of β-carotene followed by BESR, SR and SRTT powders. Powders with higher initial concentration retained higher β-carotene during storage.

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Rate Constants and Half-Life Periods of β-carotene in Mango Powder

The rate constants for degradation of β-carotene in mango powders packed in two types of packaging material were determined. The degradation followed the first order reaction. Obviously, the rate constants are higher in the PP packaged powders than the MPP packaged powders. Among the four powders studied, BE powder had lowest rate constant and SRTT had highest rate constant. The maximum half-life period was in BE mango powder followed by SR, BESR and SRTT. This study indicated that the stability of β-carotene in BE mango powder was highest among the four powders (Table 3) studied.

Table 3. Rate constants and half-life periods of the four mango powders.

Mango powder	β-carotene (mg) $k(x10^{-3})$		Half-life period (days)	
	PP	MPP	PP	MPP
BE	4.53	2.28	152.9	303.9
SR	4.67	2.63	148.3	263.4
BESR	4.98	2.97	139.5	233.3
SRTT	5.14	3.19	127.38	217.4

PP: Polyester poly, MPP: Metallized polyester poly/polyethylene

Effect of Processing and Storage of Papaya Products on Total and β-carotene content

Papaya is a tropical fruit and mostly used as a table fruit only. Papaya is considered nutritious due to substantial presence of total carotene in general and β-carotene in particular. Papaya products are not available and hence five products namely nectar, fruit bar, cheese, toffee and cereal based powder were developed. They were stored at room temperature for 9 months and storage changes were monitored. The retention of total and β-carotene in the developed products following processing and storage were recorded. After processing, the retention of total carotene was highest in cereal based powder (74.1%) followed by nectar (72%), fruit bar (67%), toffee (40%) and cheese (35%). A similar trend was observed in the case of β-carotene except for nectar, which scored highest (75.6%). On storage of papaya products for three months, maximum retention of total and β-carotene was observed ranging between 80 to 89 per cent. The retention decreased with increase in storage period. The retention was minimum in all the products following nine months storage. Following processing and storage, the retention of total and β-carotene ranged between 20 and 44 per cent. Significant changes were observed between all storage periods for both total and β-carotene except in the case of β- carotene content of toffee. The study revealed highest loss in total and β-carotene in all the five products, following processing (Table 4.)

4. Effect of Processing and storage of papaya products on Total and β-carotene content

Nutrients and Papaya Products	Fresh fruit	Processing changes		Storage Changes							Retention on processing and storage
		Mean	Retention (%)	'0' Months	'3' months		'6' months		'9' months		
					Mean	Retention (%)	Mean	Retention (%)	Mean	Retention (%)	
Total Carotene											
Nectar	0.25	0.18	72.0	0.18	0.16	88.9	0.14	77.8	0.11	61.1	44.0
Fruit bar	5.0	3.35	67.0	3.35	2.95	88.1	2.42	72.2	1.81	54.0	36.2
Cheese	2.4	0.84	35.0	0.84	0.73	86.9	0.62	73.8	0.48	57.1	20.0
Toffee	2.6	1.04	40.0	1.04	0.89	85.6	0.76	73.1	0.59	56.7	22.7
Cereal based powder	7.13	5.28	74.1	5.28	4.33	82.0	3.55	67.2	2.48	47.0	34.8
β-carotene											
Nectar	0.041	0.031	75.6	0.031	0.025	80.6	0.021	67.7	0.018	58.1	43.9
Fruit bar	1.46	0.99	67.8	0.99	0.86	86.9	0.73	73.7	0.56	56.6	38.4
Cheese	0.63	0.22	34.9	0.22	0.18	81.8	0.17	77.3	0.14	63.6	22.2
Toffee	0.72	0.29	40.3	0.29	0.25	86.2	0.22	75.9	0.19	65.5	26.4
Cereal based powder	1.56	1.15	73.7	1.15	0.97	84.3	0.8	69.6	0.56	48.7	35.9

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Vegetables

Total Carotene and β-carotene content of Non-Traditional Green Leafy Vegetables

A study was under taken to know the total carotene and β-carotene content of non-traditional green leafy vegetables (GLVS) available in Nellore and Prakasam districts of Andhra Pradesh. From the non-traditional green leafy vegetables identified a total of '10' were analysed for total carotene and β-carotene content in the study.

The total carotene of the selected leaves varied from 11.73 mg/100g (*payilaku*) to 37.41 mg/100g (*duradagundaku*) and the β-carotene ranged from 3.90 mg/100g (thummikura) to 17.05 mg/100g (durdagundaku) (Table 5). The percent of total carotenes to β-carotene varied from 29.99% to 49.10%. Bhaskarachary et al. (1992) also estimated total carotenes and β-carotene content in 17 less familiar leafy vegetables of A.P. Seven of these were found to be relatively rich in carotene. The total carotenes of the seven leaves varied from 185 mg per kg (18.50 mg/100g) to 480 mg per kg (48 mg/100g) to 125 mg per kg (12.50 mg/100g). The per cent of total carotenes to β-carotene varied from 15.40% to 48.50%. The lowest per cent of β-carotene to total carotenes is observed in *gurugaku* (29.99%) and the highest per cent in *payilaku* (49.10%)

Total 5 : Total carotene and β-carotene content of the non-traditional GLVs

Sl. No.	Non-Traditional GLVs	Total carotene (mg/100g)	β-carotene (mg/100g)	% of β-carotene to total carotene
1	Chenchalaku (Digera arvensis)	47.08 ±1.08	16.66 ±0.24	35.38 –
2	Elukajamudaku (Nerremia emarginata)	32.72 ±0.52	10.32 ±0.13	31.54 –
3	Avisaku (Sesbania grandiflora)	32.05 ±0.78	11.90 ±0.72	37.12 –
4	Gurugaku (Celosia argentia)	15.37 ±0.50	4.61 ±0.52	29.99 –
5	Duradagundku (Ischnemone indica)	37.41 ±0.65	17.05 ±0.53	45.57 –
6	Thummikura (Lucas aspera)	12.19 ±0.67	3.90 ±0.58	31.99 –
7	Payilaku (Trianthema portulacastrum)	11.73 ±0.38	5.76 ±0.78	49.10 –
8	Atikamamidi (Boerhavia difuss)	15.17 ±0.78	6.10 ±0.16	40.21 –
9	Boddaku (Tinospora cordifolia)	15.91 ±0.33	5.20 ±0.86	32.68 –
10	Pippinta (Acalypha indica)	33.31 ±0.74	10.81 ±0.59	32.45 –

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Effect of traditional Processing on β-carotene

A study was conducted to see the effect of processing on β-carotene content in 46 forest green leafy vegetables (GLVs) collected and consumed by tribals of Andhra Pradesh, South India. The GLVs were processed following the methods used by the tribals and analysed for total carotenoids (TC) and β-carotene (BC) contents using high performance liquid chromatography (HPLC). The GLVs contained TC and BC contents in the range of 6.36 to 35.64 and 2.24 to 14.05 mg % respectively. Boiling GLVs in large amount of water (1:2) with or without draining off the water is the common practice followed by the tribals prior to product preparation. Effect of boiling on percent retention of BC in 46 GLVs showed a wide variation of 6 to 97 percent. Among the traditional products of the tribals with GLVs, curry prepared with cooking water retained was found to have the maximum retention of BC followed by shallow fried and ground to make chutney. GLVs cooked with tamarind extract showed the least retention (0.43-3.52%) of BC. However, some of the forest GLVs found to be more stable to heat in that they retained maximum (75 to 98%). BC after heat processing had high vitamin A activity. This Work was carried out under ICAR adhoc research project "Screening of forest foods consumed by tribals for β-carotene content".

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Retention of β-carotene in stored Dehydrated Green Leafy Vegetable Powders

Green leafy vegetable powders from amaranth (Amaranthus gangeticus), curry leaves (Murraya koenigii), gogu (Hibiscus cannabinus) and mint (Mentha spicata) and their blends. (Blend 1-Amaranth: Mint, 75:25; Blend 2-Curry leaves: Amaranth, 75:25; Blend 3-curry leaves: Gogu, 75:25 and blend 4: Mint: curry leaves, 75:25) were prepared using dehydration technology (cabinet drying) These powders were stored in two types of packaging viz., cost poly propylene (CPP) and Metallized polyester/ low density polyethylene laminate (MPET) at ambient temperature up to 6 months. The change in β-carotene content during storage was studied intermittently (Table 6). The loss of β-carotene from amaranth, curry leaves, gogu and mint powders stored in CPP pouches was 53, 52, 82 and 37 percent respectively after 60 days of storage. After 120 days, the losses were 61, 61, 96 and 58 percent, and after 180 days, the losses further increased to 75, 91, 98 and 81 percent. The loss of β-carotene from amaranth, curry leaves, gogu and mint powders stored in MPET pouches was 60, 45,37 and 62 percent respectively after 60 days of storage. After 120 days, losses were 56,50,84 and 31 percent, and after 180 days, the losses further increased to 67,80,97 and 65 percent.

Among the blends, maximum retention was in blend 1 and minimum in Blend 2 in both the packagings. The percentage retention of β-carotene varied with the type of powder, storage period and the packaging material. Retention of β-carotene was more than 35 percent in amaranth, curry leaves and mint powders up to a period of 120 when stored either in CPP or in MPET pourches. There after, the retention was less than 35 percent. In case of gogu powder stored in CPP, 82 per cent loss of β-carotene was seen by the end of 60 days storage period whereas the loss was slightly lesser (62 percent) in the powder stored in MPET. The study revealed that β-carotene retention was best in mint powder and Blend 1 stored in MPET pouches.

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Table 6. Retention of β-carotene content of green leafy vegetables

Storage Period (Days)	Package Type	β-carotene content (µg/100g) (significant at p<0.5)							
		Amaranth	Curry leaves	Gogu	Mint	Amaranth + mint	Curry leaves + Amaranth	Curry + leaves Gogu	Mint+ Curry leaves
0		93.36	128.70	130.30	113.5	98.09	117.94	124.45	116.52
60	CPP	43.26	61.23	22.64	71.00	84.49	58.65	33.13	40.73
	MPET	51.30	80.78	48.58	90.50	88.29	70.14	49.38	50.08
120	CPP	35.60	49.69	4.11	47.51	26.58	14.33	12.36	26.29
	MPET	40.70	63.30	20.70	77.27	78.84	33.25	30.77	34.29
180	CPP	23.12	11.43	1.32	20.88	25.57	10.89	10.72	17.87
	MPET	30.18	25.30	3.28	39.26	50.18	20.88	22.45	32.29

PP: Cast Propylene, MPET: Metallized polyester/low density polyethylene laminate
Results expressed on dry weight basis

Effect of Pretreatment and Drying Method on Total Carotenes in Tomato and Green Chillies

Tomato slices, concentrate and powder were prepared using sun, solar and cabinet drying methods. The percent loss of total carotenoids among the various treatments ranged from 21.1 to 78.72 per cent with mean loss ranging from 25.92 to 74.94 per cent. Significantly higher loss was observed in sundried samples and lower in cabinet dried samples. Among the blanching treatments used for tomato slices sodium benzoate treatment retained significantly higher carotenoids than unblanched slices (P<0.05). In green chillies, the percent loss ranged from 57.95 to 7.225 per cent and was significantly higher (P<0.05) in sundried samples than in cabinet and solar dried samples. Mean loss was 22.56 and 33.81 per cent for magnesium oxide soaked chillies and plain water blanched chillies, respectively (Table 7). The difference in the vitamin loss between the treatments was significantly different (P<0.05). Carotenoids and vitamin C losses in tomatoes and green chillies are a manifestation of leaching and oxidation, pretreatments given, availability of oxygen, temperature and time of dehydration, exposure to light, presence of metal ions such as copper and iron which trigger significant loss of colour, and further destroy carotenoids and vitamin C. Blanching also improved the carotenoids retention in dehydrated slices by 25 per cent.

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Anurag. C

Table 7: Total carotenoids content of fresh and dehydrated tomato products and green chillies

Tomato Products/ Treatments	Drying methods used	Total carotenoids (µg/g sample)	Per cent loss*	Mean Value **
Fresh Tomato	–	25.6ᵃ		
1. Tomato slices				
a. Unblanched	Sun	5.448	78.72b	6.416
	Solar	6.350	75.2b	(74.94)b
	Cabinet	7.450	70.9c	
b. Blanched	Sun	6.863	73.24b	8.902
	Solar	8.373	67.3c	(65.23)c
	Cabinet	11.480	56.16d	
c. Blanching with sodium benzoate	sun	8.446	67.01b	11.534
	Solar	11.15	56.55	(59.18)c
	Cabinet	15.00	41.5d	
d. Blanching with sodium bicarbonate	Sun	8.041	68.5b	10.450
	Solar	9.476	63c	(59.18)e
	Cabinet	13.833	46d	
2. Concentrate	Sun	17.5	31.6b	18.966
	Solar	19.2	25c	(25.92)f
	Cabinet	20.2	58.21b	
3. Powder	Sun	10.7	58.21b	18.033
	Solar	18.4	28.13c	(29.56)g
	Cabinet	19.0	25.79c	
Fresh green chillies	–	13.14a	–	–
a. Plain water blanching	Sun	7.106	72.25b	
	Solar	8.803	65.62c	8.698
	Cabinet	10.186	60.22d	(33.81)b
b. Soaking in magnesium oxide	Sun	9.516	62.83b	
	Solar	10.246	59.98c	10.176
	Cabinet	10.766	57.95d	(22.56)c

Values expressed as mean of 2 determinations
* Percent loss calculated with reference to total carotenoids content of fresh tomato
** Indicates mean of sun, solar, and cabinet dried products
() The figure in parentheses represents mean percent loss
Figures carrying the same superscripts are not significantly different (P>0.05)

Tomato Processing and Lycopene

A study was undertaken to know the effect of processing (Blanching, microwave blanching, steaming, pressure cooking, shallow frying and dehydration) on lycopene content of tomato (Lycopersicon esculentum. Mill CV Pusa Ruby). Compared to fresh tomato (1216.3 μg/100g) blanching, microwave blanching and pressure cooking did not show a significant change ($P<0.01$) in lycopene content. However, dehydration and steaming significantly decreased ($P<0.01$) (92.69% and 15.40%) whereas, shallow frying significantly increased ($P<0.01$) (25.11%) the lycopene content.

The main cause of lycopene degradation is reported to be isomerisation (trans to cis form) and oxidation. Dehydration process is reported to cause enhanced isomerisation whereas steaming causes oxidative and thermal degradation of lycopene. Availability of lycopene is also influenced by lipid as it solubilizes and releases lycopene from the plant matrix. Hence it could be suggested that processing of tomato is beneficial to increase the availability of lycopene in the diet.

Ameena Sadiya
Vijaya Khader

Extension

Seasonal β-carotene Intake of Pre-School Children and Effect of Papaya Seedlings Distribution

A study was carried out to assess seasonal intake and effect of papaya seedlings distribution on β-carotene intake of pre-school children. Four villages were selected from Ranga Reddy District. One village served as control while three villages (villages 1, 2 and 3) were experimental. In village 1, respondents were given papaya seedlings only. In village 2, additionally school children were educated on cultivation, nutritive value, processing of papaya and they were expected to transfer this information to mothers. In village 3, additionally mothers of pre-school children were educated on all the above aspects. Vitamin A intake was assessed in three seasons and expressed daily intake as Consumption Index (CI) and months intake as Usual Pattern of Food (UPF) scores.

Initially, β-carotene intake was similar in control and experimental villages either measured in CI or UPF (Table 8) scores. The intake of β-carotene was highest in rainy season followed by summer and winter. The highest intake in rainy season could be due to availability of green leafy vegetables and in summer it could be due to seasonal availability of mangoes. Following intervention in village 2, β-carotene intake improved in summer. In village 3, β-carotene intake was less than in village 2 in all three seasons and it might be due to involvement of children alone in education programme.

Significant differences were not observed in β-carotene intake of pre-school children in three seasons in control and experimental village, while highly significant differences were observed in villages 2 and 3 whether measured in CI or UPF (Table 8).

Table 8: Significance in seasonal β-carotene intake of pre-school children in selected villages

	Mean Vitamin A intake of pre-school children							
	CI				UPF			
Villages	Rainy (a)	Winter (b)	Summer (c)	C.D. Values	Rainy (a)	Winter (b)	Summer (c)	Critical Difference (0.05% level)
Control Village (47)	3.55	2.64	3.04	0.7714^{NS}	98.72	86.85	89.49	17.2327^{NS}
Experimental								
Village 1 (52)	3.21	3.02	3.81	0.9059^{NS}	75.98	75.87	78.87	12.3023^{NS}
Village 2 (51)	3.35	2.61	5.14^{ab}	0.8770***	71.06	64.98	112.25^{ab}	14.8757***
Village 3 (50)	2.90	2.66	6.08^{ab}	0.8252***	70.24	65.40	103.30^{ab}	11.6039

NS : Not significant *** : Significant at 0.1 % level

Superscript a, b and c indicate significant difference with that column of the same row

K. Aruna
V. Vimala

Seminars attended abroad

Asian Productivity Organisation (APO) sponsored seminar on "Quality Control for Processed Food" held in Hsinehu City, near Taipei in Taiwan from 8th to 14th May 2002. Dr. G. Sarojini, Principal Scientist & Unit coordinator, AICRP-H.Sc. attended the seminar and she is one among 18 participants from APO member countries. The programme was jointly organised and hosted by Food Industry Research and Development Institute, Council of Agriculture and China Productivity Centre for Processed Foods in India, covering the following areas–present status of food industry, quality control measures followed, some success stories behind the popularity of selected food industries, Legislations and National Standardization Systems for Quality and National Food processing Policy.

Certificate courses for income generation:

To encourage self employment by training farm women in Bakery Enterprise - Two training programme in "Cake Preparation" were conducted by the department of Foods and Nutrition, College of Home Science, Hyderabad. The course duration was of ten days offered from 24th April to 3rd May and 21st May to 1st June, 2002. The trainees were farm women from Mahboobnagar District in a group of seven and ten respectively. They were trained in the preparation of different types of cakes, in addition to costing of the product fixing selling price, multiplication for quantity production was also taught. The course was coordinated by Dr. M. Uma Reddy, Professor, Department of Foods and Nutrition. The technical input was given by Ms. Kanwaljit Kaur and Dr. Laxmi Devi in conducting of the training programme under the guidance of Dr. Vijaya Khader. The participants were given certificates at the end of the programme.

ANNOUNCEMENT

A training programme on *Food Quality Measurement and Safety* will be conducted from 22-11-2002 to 12-12-2002 by the Centre of Advanced Studies, Department of Foods & Nutrition, Post Graduate & Research Centre, College of Home Science, Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad - 500 030. TA, Food and lodging expenses of SAU staff will be met by the organizers. Nominations of trainees may be sent to

The Director,
Centre of Advanced Studies,
Post Graduate & Research Centre,
Acharya N.G. Ranga Agricultural University,
Rajendranagar,
Hyderabad - 500 030

Last date for the receipt of nominations : 31-10-2002

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