Bio Availability of Vitamin A and Mango Fruit in Sindh Pakistan

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BIO AVAILABILITY OF VITAMIN 'A' AND MANGO FRUIT IN SINDH PAKISTAN.

Abstract.

Vitamin 'A' is a fact soluble vitamin. It is essential for the promotion of normal growth, nutrition prevention of deficiency and diseases. Its essential to tissue health, especially in preventing pre-cancerous cells from becoming cancerous. It is needed for skeleton development and normal function of all tissues. Although vitamins are manufactured by plants but they also present in animals diet and regulate metabolism and help in conversion of carbohydrates and fats into energy. Sindh is having a good source of vitamin 'A' in form of mango fruit. The various varieties of mangoes have difference concentration of beta-carotene, which are a precursor of vitamin 'A', and body covert it to vitamin 'A' (retinal) as body demand arises. This way it remains store in the body for quite sufficient time. That is the reason the Sindh's people have shown only once in a while vitamin 'A' deficiency symptoms.

General.

According to the definition of vitamins.

Vitamins, organised ferments or substances of unknown composition present in certain food stuffs, as in fresh or green vegetables and uncooked fruits, certain oil and fats. They are required in minute quantity and their absence leads to certain maladies or disorders. In order to ensure correct nutrition certain amount of various vitamins are needed. Vitamins generally are adversely affected or even destroyed by heat or desiccation (1). All the vitamins or their immediate precursors needed for humans nutrition are made by plants (2). Vitamins are accessory food factors (organic compounds found in plants and animals), necessary for our growth, reproduction and good health. They are required in small quantities in order to avoid a vitamin deficiency. Vitamins are needed for body metabolism and are essential part of enzyme system of the body. Vitamins are the substances existing in small quantities in certain food stuffs, the presence of which in the diet is considered essential of promotion of normal growth and nutrition and prevention of deficiency and diseases. Vitamins are manufactured by plants and are also present in animals. They regulate metabolism and help in conversion of carbohydrates and fats into energy. Peppers, green mature fruit contain certain, vitamin B and ascorbic acid. The cabbage leaves are excellent source of carotene (pro-vitamin A), ascorbic acid, minerals as well as source of thiamine and riboflavin (3). Retinal is found in foods of animal organ, especially liver, the liver of fish is a rich source of vitamin A. It can also obtained from milk, butter, cheese and egg. Apricots also contain vitamin 'A' along with vitamin 'B Complex' niacin, potassium, calcium, phosphorus and iron. Grape fruit is rich in ascorbic acid, but not rich with vitamin 'A'. While oranges are rich in vitamin 'A'. Its vitamin content depend upon the high quality, durability, low production cost, large size fruit and dependable bearing of trees.

The vitamins present naturally in plants and animals are more in concentrated form. Vitamins supplied by fruit, vegetables and root crops. Some examples are as under:

Vitamin	Name	Source
A	Retinol.	From carotene in dark green leaves, tomatoes, carrots, papayas.
B_1	Thiamine.	Pulses, green vegetables, fruit (cereal grains have B1 in germ and outer-seed coat).
B_2	Riboflavin.	Green leafy vegetables and pulses.
B_6	Pyridoxin.	Banana, peanuts.
Vitamin V	Niacin (nicotinic acid).	Pulses, peanuts.
Folacin	Folic acid.	Dark green leaves, broccoli, spinach, beets, cabbage, lettuce, and avocados.
C	Ascorbic acid.	Dark green leaves, spinach, cauliflower, sweet pepper, citrus, guava, mango, papaya.

Fruits can supply more than 1/3 or requirements of calories, vitamins and minerals to mankind (5).

Fruits present in Sindh as a source of Vitamin ‘A’ are as under:

More than 1000IU Excellent	500-1000 IU Good	100-500 IU Fair	Less than 100 IU Poor
Loquat.	Orange.	Banana.	Fig.
Mango.	Tangerine.	Watermelon.	Grapes.
Papaya.			Guava.
Passion fruit.			Mulbery.

In Sindh we also grow banana, which contain plenty of protein, vitamin A, B, C and minerals, including iron, magnesium, phosphorus and potassium (6). In Sindh we also grow papaya which are good source of calcium and excellent source of vitamin ‘A’ and ‘C’ they contain some of vitamin ‘B’ and ‘G’.

Mango as a source of vitamin 'A'.

Sindh is located in the southern part of Pakistan having sub-tropical climate. It not only grow a large numbers of vegetables like: carrot, cabbage lecture, peas, pumpkin, spinach, squash, beans, lettuce and parsley which are good source of vitamin 'A'. But the main fruit crops of Sindh is mango, its scientific name is Mangifera Indica. It belongs to Anacarbiaceae family. In the year 1994-95 the area under mango production in Pakistan was 88,300 hectares, while in that Sindh was 38,700 hectares. The mango production in Pakistan was 8,83,700 tonnes while in Sindh its production was 285,300 tonnes. Mango is a rich source of carbohydrates and vitamin 'A'. Although it also contain other minerals and vitamins as well. Its composition are in table below.

Mango Composition.

Food value per 100g.

Ingredient	Value in Grams and Milligrams
Calories.	**62.1 - 63.7**
Moisture.	78.9 - 82.8 g
Protein.	0.36 - 0.40 g
Fat.	0.30 - 0.53 g
Carbohydrates.	16.20 - 17.18 g
Fibre.	0.85 - 1.06 g
Ash.	0.34 - 0.52
Calcium.	6.1 - 12.8 mg
Phosphorus.	5.5 - 17.9 mg
Iron.	0.20 - 0.63 mg
Potassium.	Nil.
Vitamin-A.	1.35 - 1.072 mg
Thiamine.	0.20 - 0.073 mg
Riboflavin.	0.025 - 0.068 mg
Niacin.	0.025 - 0.707 mg
Tryptophan.	3 – 6 mg
Vitamin-C.	7.8 - 172.0 mg

When green mangoes cut into thin slices and dried, still they retain 75% or more of their vitamin C after being stored at 24 to 30° for 6 months. Although mango fruit are low in calcium, phosphorus and iron but are rich in vitamin A. The nutritive value of many fruits and vegetables are destroyed during food processing like; homogenising stabilising, anti-oxidation and chelated procedures.

Fruits of all varieties of mangoes apparently are much better source of vitamin A than oranges and fair source of vitamin B and G. Different varieties varies greatly in vitamin C content. Usually fruits have no vitamin A, but those having yellow or orange colour contain carotene other carotenoid pigments. These pigments are precursors or pro-vitamin A, they can be changed by the body to vitamin A, which is colourless. The carotenoids are complex tetraterpenes - yellow to red pigments that occur in many different kind of tissue. Common members of this group include carotene (composed exclusively of carbon and hydrogen) and xanthophyll composed of oxygen in addition to carbon and hydrogen. The most wide spread carotenoid is the orange pigment B-Carotene, which splits in the digestive tract of animal and human and give rise to two molecules of weight, while other fruits like: banana, berries, grapes, black currant, orange mandarin, papaya and watermelon contain carotenoids inform of Lutein, Cryptoxanthin, Lycopene, alpha-carotene, Beta-carotene (8).

Carotenoid levels in the ripe pulp of some mango cultivars.

Cultivar	Carotenoids (mg. 100 $^{-1}$ fresh weight)	Reference
Carabao.	2.75	Morga et al., 1979.
Nam Dokmai.	4.78	Kasantikul, 1983.
Badami.	8.92	John et al., 1970.
Dashehari.	5.44	Mann and Singh, 1976.
Alphonso.	4.76	Ramana et al., 1984. Subramanyam et. al., 1976.
Haden.	6.82	Vazquez-Salinas and Lakshminarayana, 1986
Irwin.	3.23	
Kent.	5.46	
Keitt.	3.87	Medlicott, 1985.
Tommy Atkins.	> 5	Medlicott et al., 1986.
Kensington.	5.06	Mitchell et al., 1990.

Chemical composition of sucking mango varieties (9).

Varities	TTS (%)	Acidity (%)	Sugar			Vitamins		
			Reducing (%)	Non-reducing (%)	Total (%)	A (IU)	C (mg/100g)	Total amino acids (mg/100g)
Yakuti.	16.2	0.42	2.3	10.8	13.1	723	23.4	30.3
Gilas.	17.4	0.33	2.2	10.2	12.4	1191	30.7	40.9
Sukul.	15.0	0.61	1.9	9.1	11.1	1042	26.3	40.9
Gaurjit.	18.2	0.2	2.4	11.7	14.2	1893	14.2	58.0
Safeda Jauhari.	18.0	0.35	2.4	10.7	13.2	2085	30.8	57.0
Mithwa.	15.5	0.50	2.9	9.4	12.3	510	22.9	55.1
Sinduri.	13.5	0.66	2.1	8.6	10.7	339	15.0	20.0
CD at 5%.	2.6	0.23	0.2	0.7	1.3	43.2	4.2	5.8

Proximate chemical composition of ripe mangoes.

Variety	Moisture (%)	TSS °Brix	Titratble acidity (%)	pH		Sugars			Carote-noids (mg/100g)	
					Vitamin C (mg/100g)	Red	Non-Red	Total	Total	Beta
Alpho-nso.	81.95	17.6	0.15	4.7	60.7	3.23	12.33	16.22	8344	4764
Bangan-pali.	82.10	17.0	0.40	4.3	-	6.80		16.6		
Cheruk urasam.	79.80	19.0	0.29	4.2	-	4.10		15.3		
Haden.	82.80	18.9	0.22	4.9	32.1	3.50		16.22		
Irwin.	83.10	16.7	0.12	4.5	45.7	6.00		13.71	9212	4617
Keit.	79.46	18.4	0.11	4.8	13.9	4.46		13.60	5902	2292
Kent.	-	21.0	0.12	-	23.5	5.50		20.90	927	277
Pairi.	84.2	15.0	0.14	5.8		5.40	7.7	13.50	5729	2613
Peddara sam.	81.9	18.0	0.57	4.2		5.60		16.0	927	277
Sensa-tion.	-	15.7	0.15	4.4	55.0	4.30	9.0	13.30		
Tota-puri.		16.8	0.80	3.8	19.5	5.3	6.0			
Zill.		15.9	0.16	4.6	14.0	3.2	10.9	14.1		

Physiology.

Vitamin A, either as pre-formed retinol and its esters or as pro-vitamin A carotenoids, absorb upper part of the small intestine. About 80% of ingested vitamin A is absorbed. This is incorporated into chylomicrons and passes through the lymphatic into the systemic circulation, where it is bound to lipoprotein. Most of it is taken up by liver, where storage takes place in stellate cells as palmitate. From there retinol is released to parenchymal cells and packaged with retinol binding protein and transthyretin for transport in the circulation to target cells.

Carotenoid bioavailability factors.

- Carotenoid species.
- Concentration.
- Food matrix.
- Dietary fat.

Carotenoid species.

The vitamin A activity of Beta-Carotene is about 1/6 of that retinol and other pro-vitamin carotenoid are 1/12 of that retinol.

Concentration.

Carotenoid are absorbed by passive diffusion and the proportion absorbed decreases as the amount in the meal increases.

Food matrix.

In green leaves carotene is firmly bound to proteins in the chloroplasts. In other vegetables and fruits, where it is not involved in photosynthesis, it is usually found more loosely bound in lipid droplets. Cooking and grinding tend to release carotene from the binding matrix, but if excessive, may destroy the carotene.

Absorption.

Muscosal cell absorb carotene from lipid micelles and therefore sufficient fat is required for micelle formation. Vitamin E (tocopherol) also improves absorption. Other dietary components, such as pectin, cellulose, chlorophyll and lycopene (a non-pro-vitamin carotenoid) may reduce the bioavailability of Beta-carotene.

Parasites.

Ascaris lumbricoides and Giardia lamblia and intestinal infestation with other parasites are common in developing countries and significantly impair absorption of vitamin A, especially in young children (11) ibid.

Function of vitamin A in the body.

Only about 50 carotenoids when consumed be converted by enzymes in the walls of the small intestine of man and animals to vitamin A (or retinol), Beta-carotene is the main form of pro-vitamin A in human dietaries. Retinol is esterified in the body and palmilate is the usual storage form of the vitamin, Beta-carotene is about 1/6 as effective as retinol, other provitamin carotenoil only 1/12.

Vitamin A is needed for night vision. It is the starting substance from which rehodopsin or visual purple is made. Visual purple is the pigment which is found in the lining of the back of the eye, the retina, help us to see in the dark. An estimated 200-300 million children under the age of 5 are at risk of vitamin A deficiency. Every year, 500,000 of then go blind, many of them dying within months with associated infectious (11). 90% of the World's estimated 42 million blind population live in the Southern Countries (12). Improved vitamin A nutrition would be expected to prevent approximately 1.3 - 2.5 million deaths annually among children aged under 5 years. Improvement of vitamin A status in young child population leads to a reduction in all causes mortality rates of about 23% (13). Any where between 10,000 - 25,000 units of vitamin 'A' a day, is good safe amount for the average person, even if he is taking a lot of vitamin A in vegetables (14).

Vitamin A requirements. (15)

Retionol Equivalent (RE) per day (1 RE = lug retinol).

- Child 1-6 400 RE
- Adult women. 500 RE
- Men. 600 RE
- In Pregnancy. 600 RE

Vitamin A function.

- Vision (night, day, colour).
- Epithelial cell integrity against infectious.
- Immune response.
- Haemopoicsis.
- Skeletal growth.
- Fertility (male and female).
- Embryogenesis.

Vitamin A is important not only for vision but also for growth, cell division and overall resistance to infections. Is also needed for the development of bone and teeth and essential for healthy skin cells and maintenance of mucous membranes. Its aids in the growth and repair of body tissues and plays an important role in the immune system in fighting infections, it is also needed for good eye sight and right vision. Vitamin A function is, to build resistance to infections, especially of the respiratory and urinary tract, promote normal growth and vision, aid in preventing various eye diseases, maintain skin moisture for clear healthy skin, promote digestion and appetite and work together with calcium and phosphorus in bone formation (16). In some Russian experiments, large dosages, of vitamin A and E given to a persons were reported to increase strength, cause disappearance of facial wrinkles and headaches, improve sleep, and return colour to grey hair (17). Vitamin A and D should be taken at the same time. Vitamin A and E, along with moderate but adequate mounts of essential poly-unsaturated fatty acids, also to help protect the cells from uric-acid production. Improperly balanced protein can increase uric acid production, especially if the diet is high in glycine (an amino-acid abundant in gelatin) 18. Vitamin E helps prevent the oxidation of vitamin A. It also helps decrease cholesterol (19).

According to National Health and Nutrition Survey in 1971-72, tissue of axatives and enemas, tend to wash the vitamins out of intestinal tract. The survey suggested that elderly people should be advised to avoid the use of oil-based laxatives since they tend to carry away vitamin A, and other fat soluble vitamins, and thiamine (20).

When air is polluted with ozones and nitrous oxide these chemicals are present in smog and effect the body in two ways: Firstly they directly oxidise lung tissue, causing disease and reduce the boy's ability to abstract oxygen from air. Second the oxidising chemicals destroy the vitamin A in the lung tissue, so it increases the risk of cancer. Even if one take adequate. Vitamin is needed for the health of mucous membranes. Vitamin A deficiency decreases the lung efficiency, like of defence against carcinogens, unless the lungs are protected by supplementary vitamin E, which acts as antioxidant and protects the lungs, including tissue stores of vitamin A.

Deficiency of vitamin A and its effect on body deficiency of vitamin A cause night blindness (nyetalopia), dry, rough skin and thicknessing of the cornea of the eye (Xerophthalmia) which may lead to ulceration and blindness also leads to, failure of normal bone and tooth development, disease of epithial cell and membranes of nose, throat, and eyes, also decrease the body resistance to infection. The deficiency of vitamin A can adversely affect the ovaries and testicles of rats and reduces the mobility of sperm in laboratory animals (21). Deficiency cause scaly skin, decrease appetite and vigour, defective teeth and gums increase susceptibility to infection, retarded growth.

Control of vitamin A deficiency.

- Supplementation.
- Fortification.
- Diet diversification.
- Infectious disease control.
- Disaster relief.
- Plant breeding.

The adult RDA (age 15 up) for vitamin A is 5000 international units for men and 4000 IU for women. Pregnancy and nursing increases the body need. The variety of factors determine the person's need including height, weight, age, activity-level, stress, smoking, alcohol intake, use of birth control pills, pregnancy, breast feeding, infection and environmental conditions as air pollution.

The various vegetables and their vitaminA. IU units

Vegetables	Quantity	Vitamin 'A' (IU)
Asparagus, green from raw.	1 cup	1,310
Beans, thick seeded.	1 cup	390
Beet green, leaves, stem.	1 cup	7,400
Cabbage raw.	1 cup	90
Carrots, raw, without crown and tips scraped.	1 cup	7,930
Cauliflower, raw, chopped.	1 cup	70
Corn, sweet, kernal	1 cup	580
Cucumber, slices, with peel.	6 large pieces.	70
Lettuce raw, leaves.	1 outer or 2 inner leaves.	150
Onion raw, chopped.	1 cup	Traces
Parsley raw, chopped.	1 cup	300
Peas green, whole.	1 cup	1,170
Potato - cooked, backed.	1 potato.	Trace
Spinach raw, chopped.	1 cup	4,460
Tomato raw, (3 per 12 oz pkg).	1 tomato	1,110

The various fruits and their vitamin IU units.

Fruit	Weight/Size	Quantity	Vitamin 'A' (IU)
Apple raw, un-peeled without cores	About 3 per Ib	1 apple	120
Apricot without pits.	About 12 per Ib	3 apricots	2,890
Banana without peel.	About 2.6 per Ib	1 banana	230
Dates, whole, without pits.		10 dates	40
Grape fruit.	Medium, 3 ¾ in diameter.	½ with pell	540
Grapes.	Thompson seedless.	10 grapes.	50
Mango.		1 mango.	437
Honeydew melon with rind and seed.		1/10 melon	60
Oranges.	2 5/8" diameter.	1 orange	260
Papaya, raw.	½ in cubes.	1 cup.	2,450
Peaches.	2 ½" diameter.	1 peach.	1,330
Pear, raw.	2 ½" diameter.	1 pear.	30
Pineapple raw sliced.		1 cup.	110
Plums without pits.		1 plum.	160
Rasin, seedless.		1 cup	30
Watermelon, raw with rind and seed.		1 wedge	2,510

Toxic effects of Vitamin 'A'.

Prolonged, over dosage of vitamin A can cause reptureing of lysosome membranes, which could accelerate the ageing process. Adequate amounts of magnesium, choline, vitamin C and E in the diet can help prevent over dosage reaction to vitamin A and D. Vitamin A act as antioxidant/free Radical Deactivator, membranes stabiliser, cardiac protection and oxygen - use factor (22). Toxic condition called hyper-vitaminosis A, some of symptoms are lack of appetite, hard tender lump of bone of extremities, irritability, head ache, tissue of the lips, loss of hair and Jaundice. Vitamin A in excess show toxicity sign like: hair loss, nausea, vomiting, diarrhoea, bone pain, headache, scaly skin, fatigue, liver enlargement and mental disorders such as depression anorexia (loss of appetite) drying of skin bone fragility and enlargement of the spleen.

Dietary modification.

- The ACC/SCN Consulting Group 1994 suggested following modifications:

- Nutrition education or communication often using a social marketing approach, to improve practices related to the consumption of available vitamin A rich food source.

- Horticultural intervention (or home food provisioning like home gardening, that aim to increase availability of vitamin A-rich food).

- Economic/food policies affecting availability, price and effective demand of vitamin A rich food.

- Technological advances concerning food preservation, plant breeding etc.

Conclusion.

It is necessary to avoid smoking, excessive intake of poly-unsaturates foods, consume more roughages, avoid artificially coloured foods and avoid too much of any one carcinogen by eating a diverse diet.

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