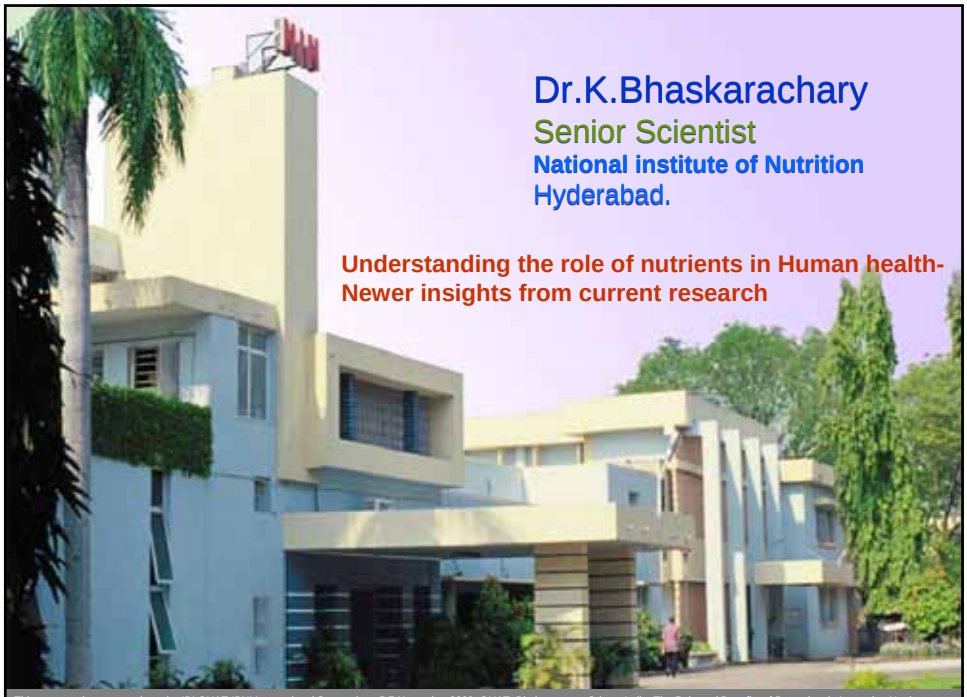

Dr.K.Bhaskarachary
Senior Scientist
National institute of Nutrition
Hyderabad.

## Understanding the role of nutrients in Human health- Newer insights from current research

*This presentation was made at the IPI-OUAT-IPNI International Symposium, 5-7 November 2009, OUAT, Bhubaneswar, Orissa, India. The Role and Benefits of Potassium in Improving Nutrient Management for Food Production, Quality and Reduced Environmental Damage.*

**Inspite of the progress made by the world and India-Food of nutritional quality-denied to millions**

**850 millions world wide hungry**

**In India**

**260 millions suffer from Hungry**

**50% of rural children malnourished**

**40% of the world's under weight children**

**>50% women Anemia**

**57% Children Vitamin A**

**30% of new born LBW ( <2.5 Kg)**

**Cancer**

**25-30 lakhs cancer cases at any given point of time**

**Over 8-10 Lakh new cases**

**3 lakh Death occur annually**

**1 out of 15 men**

**1 out of 12 women have the risk of developing cancer**

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Eating is one of the life's greatest pleasures

- Food Choice
- Taste
- Cost
- Convenience
- Taboos



The total production of fruits in the world is around 370 million MT.

India ranks first in the world with an annual output of 32 million MT

India is the second largest producer of vegetables in the world (ranks next to China) and accounts for about 15% of the world's production of vegetables. The current production level is over 71 million MT

Consumption-India

Fruits 27g/ cu/day (100)

Leafy vegetables 16g/cu/day (40)

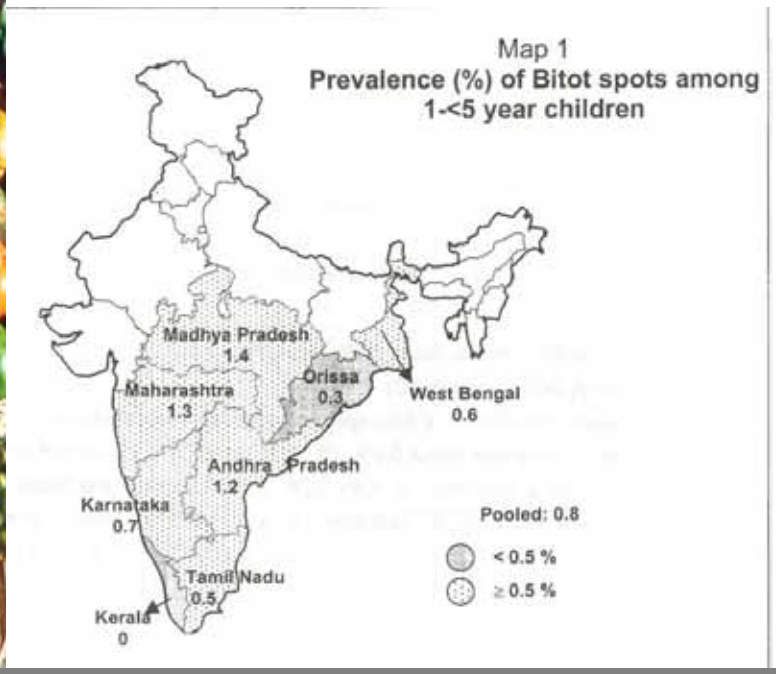
Other vegetables 49g/cu/day (60)

Roots and tubers 60g/cu/day (50)

## Micronutrients?

- Vitamin A
- Iron
- Iodine
- Folic acid
- calcium



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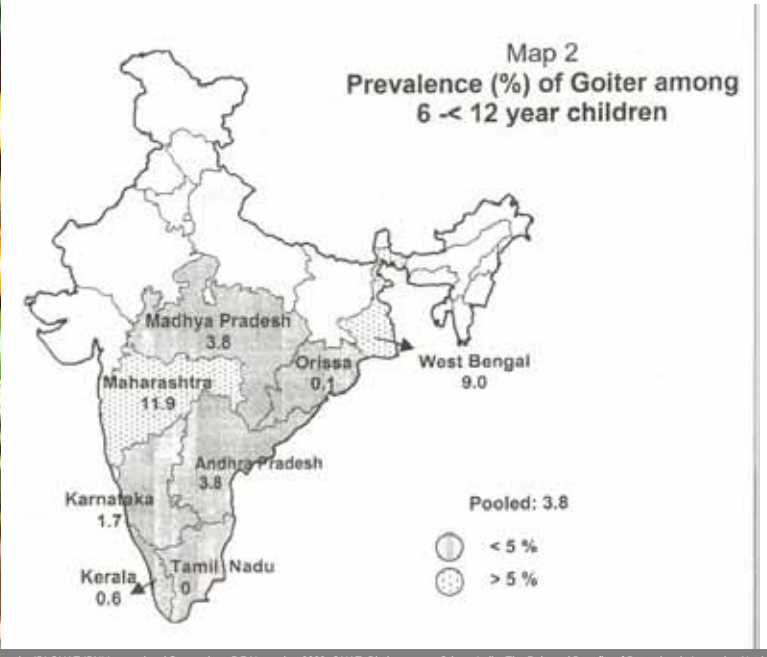
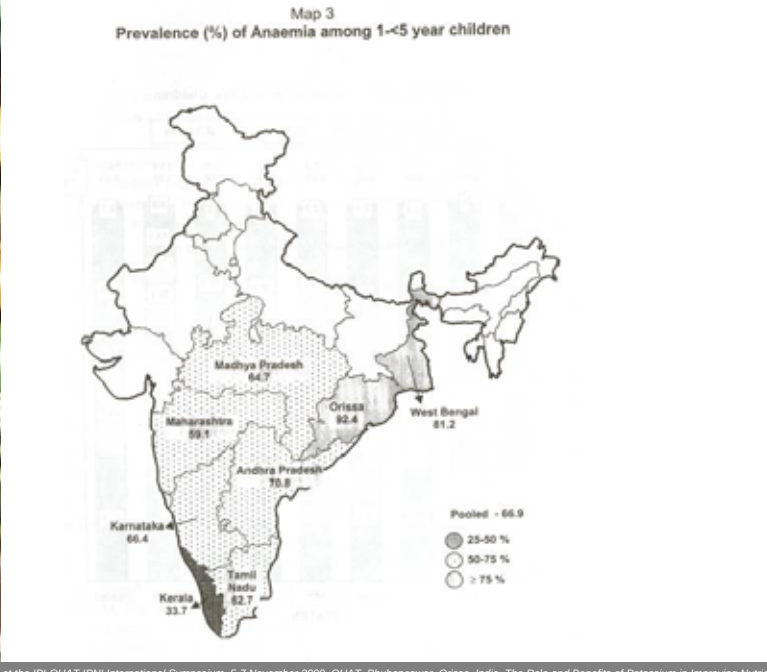

Map 2
Prevalence (%) of Goiter among
6 -< 12 year children
Madhya Pradesh
3.8
Orissa
0.1
West Bengal
9.0
Maharashtra
11.9
Andhra Pradesh
3.8
Karnataka
1.7
Pooled: 3.8
< 5 %
> 5 %
Kerala
0.6
Tamil Nadu
0



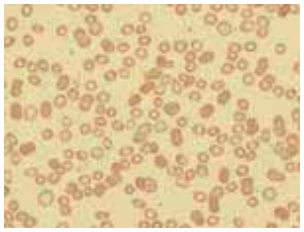

Map 3
Prevalence (%) of Anaemia among 1-<5 year children
Madhya Pradesh
64.7
Orissa
82.4
West Bengal
81.2
Maharashtra
59.1
Andhra Pradesh
70.8
Pooled - 66.9
25-50 %
50-75 %
> 75 %
Karnataka
66.4
Tamil
Nadu
62.7
Kerala
33.7

Vitamin A Deficiency

Iodine deficiency disorders

Deficiency??

NTDs are birth defects that occur when the neural tube does not form correctly



Anemia



Natural product use
- Ancient Times
- Folk Medicine
- Around the World
- Primitive Cultures Used

- Plants → Medicine
- Plants → Toxic Substances for killing animals
- Plants → Religion rites

- Basis for therapeutic drugs in modern day medicine

## Free Radicals

•Some free radicals arise normally during metabolism. Sometimes the body's immune system's cells purposefully create them to neutralize viruses and bacteria.

• pollution, radiation, cigarette smoke and herbicides can also spawn free radicals.

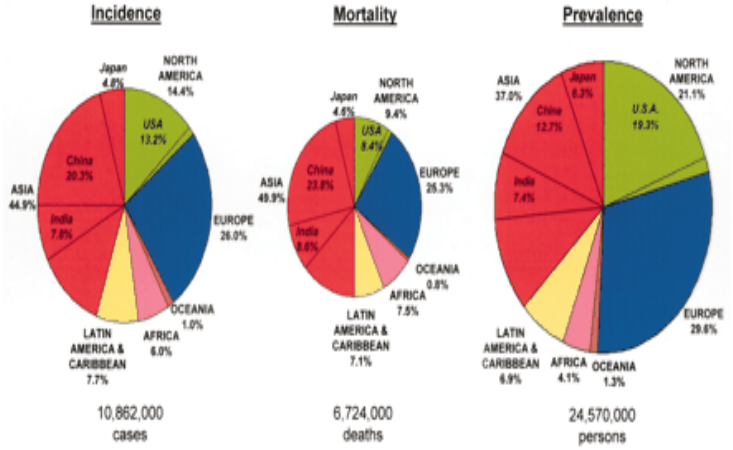
•Normally, the body can handle free radicals, but if antioxidants are unavailable, or if the free-radical production becomes excessive, damage can occur. Of particular importance is that free radical damage accumulates with age.

## Antioxidants

•The vitamins C and E, are thought to protect the body against the destructive effects of free radicals. Antioxidants neutralize free radicals by donating one of their own electrons.

• The antioxidant nutrients act as scavengers, helping to prevent cell and tissue damage that could lead to cellular damage and disease






## Overall Cancer Rates

The numbers of new cancer cases range from 2.2 million cases in China (20.3% of the world total) and 1.6 million in North America (14.4%) . For the world as a whole, the sex ratio for cancer deaths is 1.3 (M:F).Overall, the cancers with high fatality (lung, stomach, liver, esophagus) are more common among men than women.

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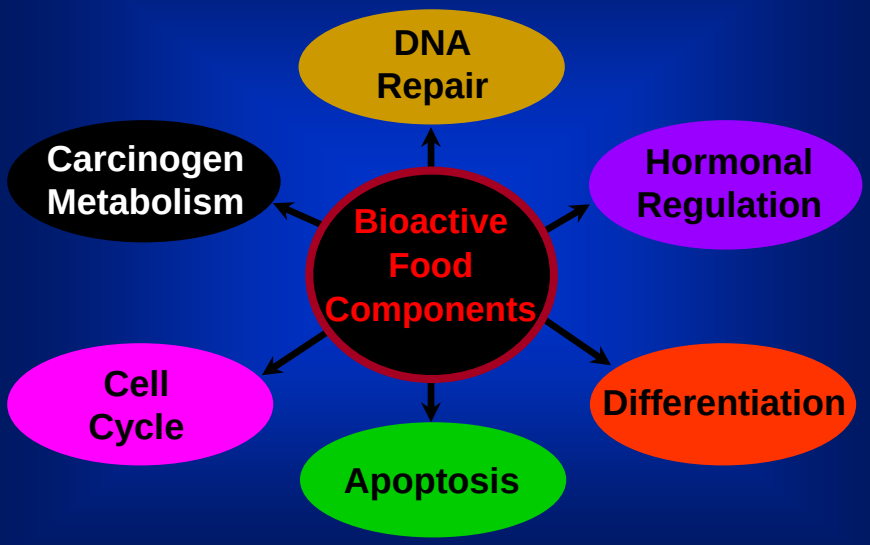
## Diet May Influence Genetic & Epigenetic Events Associated with Several Cancer Processes






- Studies demonstrate that maximal dietary intake is not always correlated with optimized dietary benefit.
- For example, quercetin a flavonoid that has been demonstrated to work optimally at very low concentrations in protecting against cancerous cell proliferation and the action of carcinogen PhIP (2-amino-1-methyl-6-phenylimidazo
  [4, 5 b] pyridine) found in cooked meat.
- Similar effects may be found for other phytochemicals.
- This also illustrates the importance of taking a cautious approach to any research to increase phytochemicals with putative beneficial under the premise of " more is better".

Cholesterol –

Animal Foods


Plant foods



## Which Bioactive Food Components Are Important for Cancer Risk?

Essential Nutrients: Ca, Zn, Se, Folate, C, E

Non-Essential Nutrients:

Phytochemicals- Carotenoids, Flavonoids, Indoles, Isothiocyanates, Allyl Sulfur

Zoochemicals - Conjugated linoleic acid, n-3 fatty acids, small molecular weight proteins

Fungochemicals - Several compounds in mushrooms (e.g., anti-aromatases – CLA?, tryosinases)

Bacteriochemical - Food fermentation products (e.g., enterolactone) and those resulting from intestinal microflora (e.g., equol, butyrate)

# List of phytochemicals and foods in which they are prominent

The following is a list of phytochemicals present in commonly consumed foods.

***Phenolic compounds***

- **monophenols**
  - Dillapiole – dill, parsley.
  - carnosol – rosemary.
  - carvacrol – oregano, thyme.
  - rosemarinol – rosemary.
- **flavonoids (polyphenols)** – red, blue, purple pigments.
  - *flavonols*
    - quercetin – red and yellow onions, tea, wine, apples, cranberries, buckwheat, beans.
    - gingerol – ginger.
    - kaempferol – strawberries, gooseberries, cranberries, peas, brassicates, chives.
    - resveratrol – grape skins and seeds, wine, nuts, peanuts.
    - rutin – citrus fruits, buckwheat, parsley, tomato, apricot, rhubarb, tea.
  - *flavanones*
    - hesperidin – citrus fruits.
    - silybin – blessed milk thistle.
  - *flavones*
    - apigenin – chamomile, celery, parsley.
    - tangeritin – tangerine and other citrus peels.



***Organosulfides***

- **dithiolthiones (isothiocyanates)**
  - sulphoraphane – brassicates.
- **thiosulphonates (allium compounds)**
  - allyl methyl trisulfide – garlic, onions, leeks, chives, shallots.
  - diallyl sulfide – garlic, onions, leeks, chives, shallots.

***Indoles (glucosinolates)***

- indole-3-carbinol – cabbage, kale, brussels sprouts, rutabaga, mustard greens.

***Protein***

- **protease inhibitors** – soy, seeds, legumes, potatoes, eggs, cereals.

***Other organic acids***

- oxalic acid – orange, spinach, rhubarb, tea and coffee, banana, ginger, almond, sweet potato, bell pepper.
- phytic acid (inositol hexaphosphate) – cereals, nuts, sesame seeds, soybeans, wheat, pumpkin, beans, almonds.
- tartaric acid – apricots, apples, sunflower, avocado, grapes.

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- **lignans (phytoestrogens)** – flax seeds and flour, whole grains, berries.
  - silymarin – artichokes, milk thistle.
  - matairesinol – flax seed, sesame seed, rye bran and meal, oat bran, poppy seed, strawberries, blackcurrants, broccoli.
  - secoisolariciresinol – flax seeds, sunflower seeds, sesame seeds, pumpkin, strawberries, blueberries, cranberries, zucchini, blackcurrant, carrots.

***Terpenes (isoprenoids)***

- **carotenoids (tetraterpenoids)**
  - *carotenes* - orange pigments
    - alpha carotene – to vitamin A, in carrots, pumpkins, maize, tangerine, orange.
    - beta carotene – to vitamin A, in dark, leafy greens and red, orange and yellow fruits and vegetables.
    - gamma carotene
    - delta carotene
    - lycopene – tomatoes, grapefruit, watermelon, guava, apricots, carrots.
    - neurosporene
    - phytofluene – star fruit, sweet potato, orange.
    - phytoene – sweet potato, orange.

    - xanthophylls - yellow pigments
    - cantaxanthin – paprika - Did you mean Canthaxanthin.
    - cryptoxanthin – mango, tangerine, orange, papaya, peaches, avocado, pea, grapefruit, kiwi.
    - zeaxanthin – spinach, kale, turnip greens, maize, eggs, red pepper, pumpkin, oranges.



**phenolic acids**

- ellagic acid – walnuts, strawberries, cranberries, blackberries, guava, grapes.
- gallic acid – tea, mango, strawberries, rhubarb, soy.
- salicylic acid – peppermint, licorice, peanut, wheat.
- tannic acid – nettles, tea, berries.
- vanillin – vanilla beans, cloves.
- capsaicin – chilli peppers.
- curcumin – turmeric, mustard. (Oxidizes to vanillin.)

**hydroxycinnamic acids**

- caffeic acid – burdock, hawthorn, artichoke, pear, basil, thyme, oregano, apple.
- chlorogenic acid – echinacea, strawberries, pineapple, coffee, sunflower, blueberries.
- cinnamic acid – aloe.
- ferulic acid – oats, rice, artichoke, orange, pineapple, apple, peanut.
- coumarin – citrus fruits, maize.

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- *flavan-3-ols*
  - catechins – white tea, green tea, black tea, grapes, wine, apple juice, cocoa, lentils, black-eyed peas.
- *anthocyanins (flavonals)* – red wine, many red, purple or blue fruits and vegetables.
  - pelargonidin – bilberry, raspberry, strawberry.
  - peonidin – bilberry, blueberry, cherry, cranberry, peach.
  - cyanidin – red apple & pear, bilberry, blackberry, blueberry, cherry, cranberry, peach, plum, hawthorn, loganberry, cocoa.
  - delphinidin – bilberry, blueberry.
  - malvidin – bilberry, blueberry.

*isoflavones (phytoestrogens)*

daidzein (formononetin) – soy, alfalfa sprouts, red clover, chickpeas, peanuts, other legumes.

genistein (biochanin A) – soy, alfalfa sprouts, red clover, chickpeas, peanuts, other legumes.

glycitein – soy.

*dihydroflavonols*

*chalcones*

*coumestans (phytoestrogens)*

coumestrol – red clover, alfalfa sprouts, soy, peas, brussels sprouts.



# Antihypertensive Nutraceuticals and Functional Foods:

Nutraceutical:The term *nutraceutical* was coined in the 1990's by Dr. Stephen DeFelice. He defined *nutraceutical* as: 'A nutraceutical is any substance that is a food or a part of a food and provides medical or health benefits, including the prevention and treatment of disease.

**Functional food or medicinal food** is any fresh or processed food claimed to have a health-promoting or disease-preventing property beyond the basic function of supplying nutrients.

The general category of functional foods includes processed food or foods fortified with health-promoting additives, like “vitamin-enriched" products.

Fermented food with live cultures are considered as functional foods with probiotic benefits

**Low Sodium Foods:**

Market for Low and reduced –salt foods and beverages is growing worldwide.

Sodium helps to regulate fluid balance and maintains blood volume and blood pressure.

Our diet contains very high level of sodium but relatively low potassium, calcium, and magnesium.

Recommended –sodium -2.4g , Potassium- 3.4g,

Western world-3.3g and 4.1g, China 7.2g and 1.8g, India 3.6g

Reason- Hypertension- Less intake of Potassium and More intakes of sodium.

He etal(2002) –meta analysis-strongly suggests modest and long-term reduction in population salt intake can reduce-stroke deaths-coronary deaths.



## Garlic:

Historically Garlic used as a food and medicine.

Crushed garlic-Allicin,Ajoene, Allylcysteine and saponin

Allicin_loers BP and Cholesterol.

Garlic effect within 2-6h and maintaines up to 24h.

Recent study _metaanalysis-reports garlic is very effective in BP patients-8.4 SBP and 7.3 in DBP.

Garlic –ACE activity lowers-also reducing Prostaglandins-vasoconstriction-also NO and as a antioxidant-Peroxynitrite.

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# Onion:

Onion –worldwide-raw,cooked,dried,powedered,pickled

Rich in phenolic acids.Diet5% dried onion-lowers BP.

Varities matter.

Green leafy type-white sheath.

Onion-Welsh

lowers BP that too raw onion not cooked one. Suggesting thermal degradation of active ingredients.

Mechanism-NO.

3-mercapto-2-methylpentan-i-ol- scavenges peroxynitriteand saves NO.Also inhibition of the production of angiotensinIIAnother study clearly shown inhibition calcium influx independent of its effect oon NO.

Qercetin-730mg/day-reduced BP significantly.



# Ginger:

Ginger-food –medicine

Ginger crude extarct-lowers BP

Phenylephrine vascular constriction (80 mm)-10 times higher with ginger crude extarct.

Calcium channel blocking effect( Verapamil)-ginger crude extarct.

Gingerone_peroxynitrite-improving endothelium functionality.

Shogals and Gingerols- active pricples.

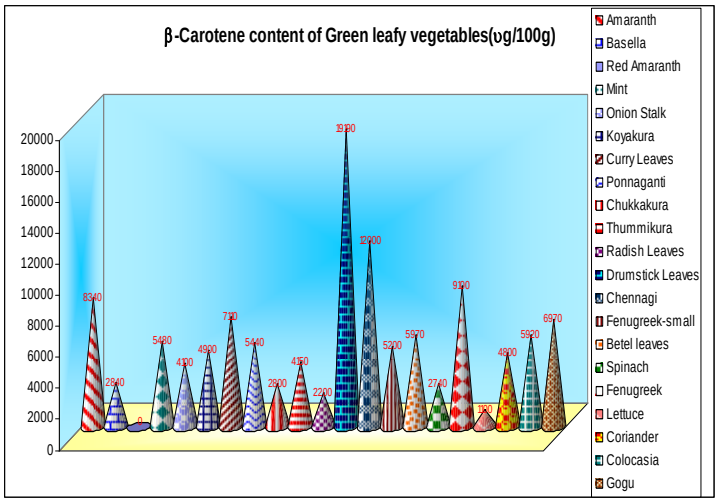
**Potassium (mg/100g)**

| | |
|---|---|
| Amla | 225 |
| Apple | 75 |
| Banana | 88 |
| Lime & Orange | 490 |
| Mango, Ripe | 205 |
| Papaya, Ripe | 69 |
| Tomato, Ripe | 146 |

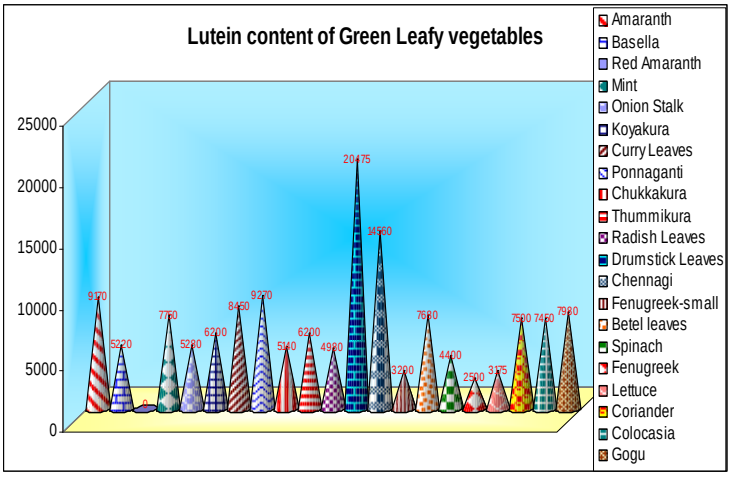


**Dietary fiber (mg/100g)**

| | |
|---|---|
| Amla | 7.3 |
| Apple | 3.2 |
| Banana | 1.8 |
| Lime & Orange | 1.1 |
| Mango, Ripe | 2.0 |
| Papaya, Ripe | 2.6 |
| Tomato, Ripe | 1.7 |



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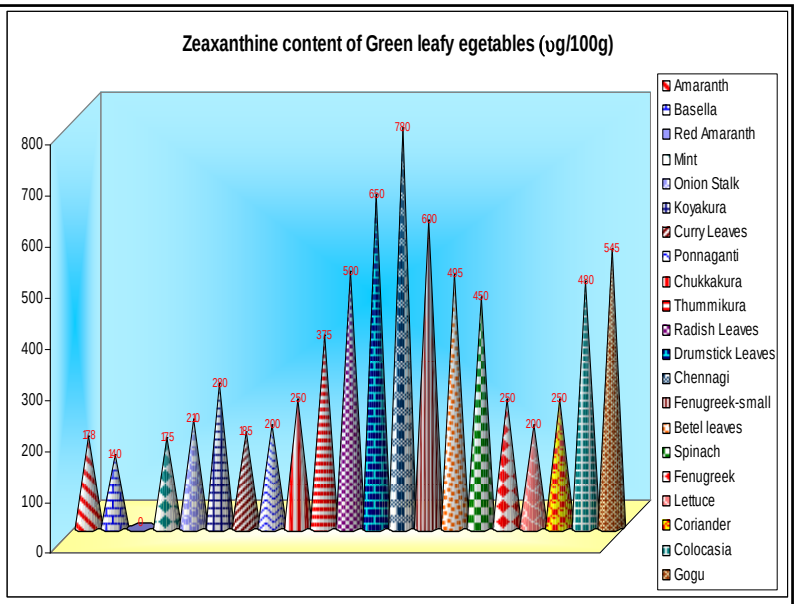





**RDA**

Energy 2425 Kcal/d

Protein 60g/d

Fat 20g/d

Vitamin-A 600µg/d (2400µg/d)

B1 1.2mg/d

B2 1.4 mg/d

B3 16mg/d

B6 2mg/d

B9 100 µg/d

B12 1µg/d

Vitamin-C 40 mg/d

Vitamin-D 200-400 Iu/d

Ca 400mg/d

Fe 28mg/d

I 150µg/d

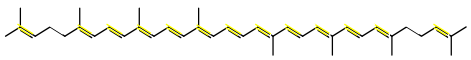
## Polyphenols in Foods and Beverages mg/100g or mg/l

| | |
|---|---|
| Barley……1200-1500 | Green tea leaves..30,000 |
| Sorgum……..170-10260 | Green tea bev..750-1050 |
| Pigeon pea….380-1710 | Cocoa beans……15,000 |
| Cashew nuts……34 | Coffee beans……10,000 |
| Onion……..…100-2025 | Coffee bev….1300-3700 |
| Grape ……..50-490 | White wine…...200-300 |
| Black current..140-1200 | Red wine…….3000 |
| Orange juice…370-7100 | Beer……...60-100 |



## Types of Bioactive Compounds May Vary with New Varieties

**Tomato Varieties**



## Why Fruits and Vegetables?

### Fruits and Vegetables and the Prevention of Cancer

| Decreases Risk Convincing | Decreases Risk Probable | Decreases Risk Possible |
|---|---|---|
| ▪ Mouth and pharynx | ▪ Larynx | ▪ Liver* |
| ▪ Oesophagus | ▪ Pancreas | ▪ Ovary |
| ▪ Lung | ▪ Breast | ▪ Endometrium |
| ▪ Stomach | ▪ Bladder | ▪ Cervix |
| ▪ Colon, rectum* | | ▪ Prostate* |
| | | ▪ Thyroid |
| | | ▪ Kidney* |

*Vegetables only

Food, Nutrition and the Prevention of Cancer: A Global Perspective American Institute for Cancer Research, 1997



## Fruits, Vegetables & Cancer Prevention

| Variety or Category | % Positive |
|---|---|
| Vegetables | 80% (59/74) |
| Fruits | 64% (36/56) |
| Raw vegetables | 87% (40/46) |
| Cruciferous Vegetables | 69% (38/55) |
| Allium vegetables | 77% (27/35) |
| Green vegetables | 77% (68/88) |
| Carrots | 81% (59/73) |
| Tomatoes | 71% (36/51) |
| Citrus Fruit | 66% (27/41) |

WCRF/AICR Expert Committee Conclusions

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Fruits and Vegetables, Blood Pressure, and Cholesterol

(Potassium,sterols,Dietary fiber)

Fruits, Vegetables, and Cancer

(Tocopherols,Lycopene,xanthophylls)

Fruits, Vegetables, and Gastrointestinal Health

( Cryptoxanthine,Insoluble and soluble dietary fiber)

Fruits, Vegetables, and Vision

(Vitamin A, Carotenes,Lutein, Zeaxanthine)



| **How much nutrition an US$80 million investment can buy, by intervention** | | |
|---|---|---|
| **Supplementation** | | **Plant breeding/Biofortification** |
| Provides vitamin A supplementation to 80 million women and children in South Asia **for two years**, 1 in 15 persons in the total population, at a cost of 25 cents for delivery of each pill, each effective for 6 months. | Provides iron fortification to 33 percent of the population in South Asia **for two years**. Costs of fortification are estimated to be 10 cents per person per year. | **Develops 6 nutrient-dense staple crops for dissemination to all the world's people for consumption year after year. This includes dissemination and evaluation of nutritional impact in selected countries.** |

1. Be as lean as possible without becoming underweight.
2. Be physically active for at least 30 minutes every day.
3. Avoid sugary drinks. Limit consumption of energy-dense foods (particularly processed foods high in added sugar, or low in fiber, or high in fat).
4. Eat more of a variety of vegetables, fruits, whole grains and legumes such as beans.
5. Limit consumption of red meats (such as beef, pork and lamb) and avoid processed meats.
6. If consumed at all, limit alcoholic drinks to 2 for men and 1 for women a day.
7. Limit consumption of salty foods and foods processed with salt (sodium).
8. Don't use supplements to protect against cancer.

**Special Population Recommendations**

9. It is best for mothers to breastfeed exclusively for up to 6 months and then add other liquids and foods.
10. After treatment, cancer survivors should follow the recommendations for cancer prevention.

***And always remember – do not smoke or chew tobacco.***




**Do You Have ANTI Virus ?**

- **Mad Cow**
- **Bird Flu**
- **Chikun Gunya***
- **Swine Flu**

**Next in Line ?**

- **Goat Flu**
- **Fish Flu**

Choose a variety of different fruits and vegetables.

Include dark-green, leafy vegetables; yellow, orange, and red fruits and vegetables; cooked tomatoes; and citrus fruits.