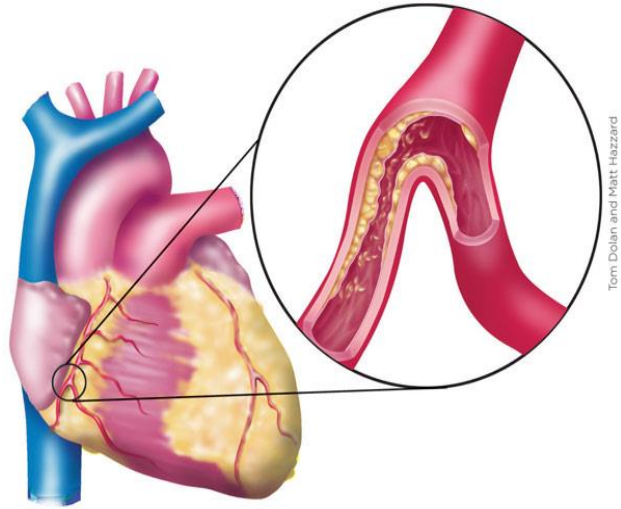
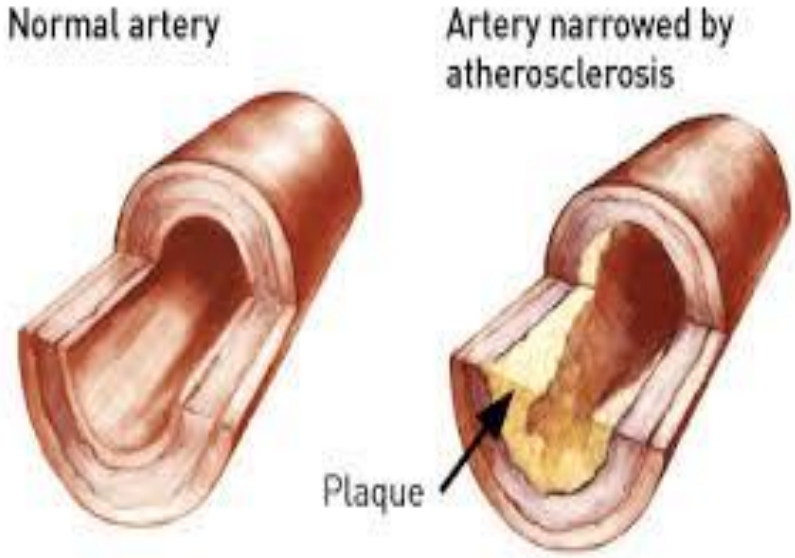
Shoolini University

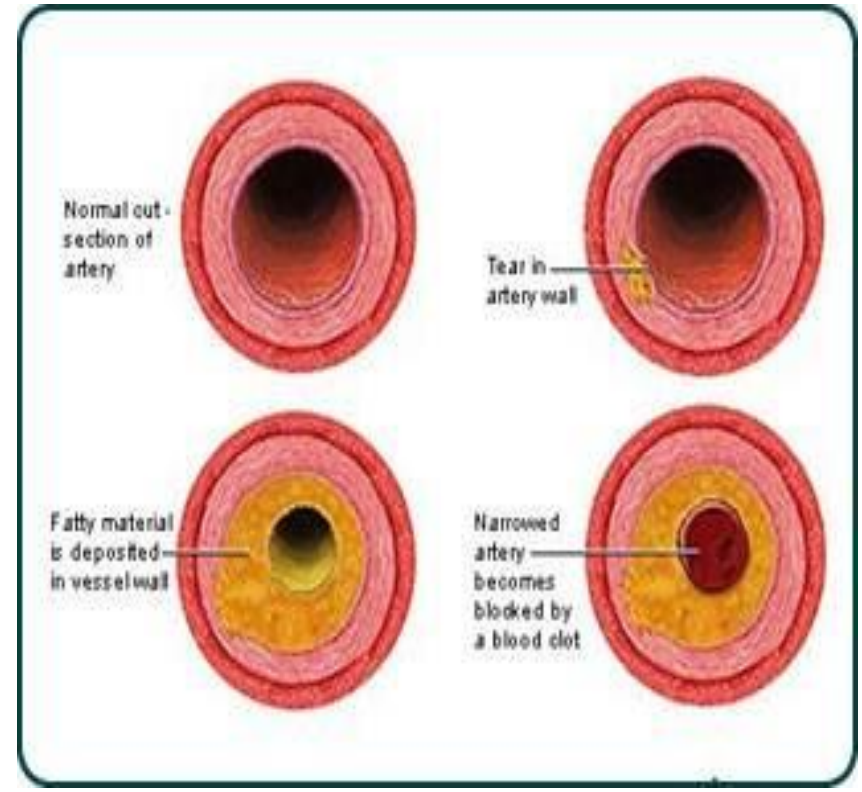
# ESU 009– Nutraceuticals for special situation such as coronary heart disease

Lecture 12

# Role of Nutraceuticals in Cardiovascular Diseases




Normal artery
Artery narrowed by atherosclerosis
Plaque


Normal cut-section of artery
Tear in artery wall
Fatty material is deposited in vessel wall
Narrowed artery becomes blocked by a blood clot

# Various CVD'S

- Arrhythmia (problems with the heartbeat, irregular heartbeat)
- Angina (chest pain, discomfort, or tightness)
- Coronary artery disease (CAD) narrowing of the blood vessels (coronary arteries) that supply oxygen and blood to the heart.
- Heart failure
- Stroke
- Blood clotting disorders
- Atherosclerosis

# What are the risk factor for cardiovascular disease?

According to the National Health Service (NHS) UK,

- **Hypertension** (high blood pressure): If hypertension is poorly controlled, the artery walls may become damaged, raising the risk of developing a blood clot.
- **Smoking** - regular smoking can narrow the blood vessels, especially the coronary arteries.
- **Hyperlipidemia** (high blood cholesterol) - there is a higher chance of narrowing of the blood vessels and blood clots
- **Unhealthy eating:** Diets which lack adequate amounts of fruit, vegetables, fiber, whole grains and essential nutrients are not good for cardiovascular health..
- **Stress** - hormones associated with (mental) stress, such as cortisone, raise blood sugar levels. Stress is also linked to higher blood pressure

# Health burden of cardiovascular disease worldwide

- CVDs are the leading cause of deaths globally - more people die from CVDs than anything else
- The majority (80%) of CVD deaths occur in low and middle-income countries.
- CVDs occur equally in men and women
- Twenty-five million people will die from CVDs annually by 2030 - most of the deaths being due to stroke and heart disease
- The majority of CVDs are preventable if people addressed their risk factors.
- Hypertension (raised blood pressure) is responsible for 7.5 million deaths each year

# What are Nutraceuticals ??

- A food (or part of food) that provides health or medical benefits including prevention and/or treatment of disease.
- The term *"nutraceutical" was* coined from *"nutrition" and "pharmaceutical" in 1989 by* Stephen DeFelice, MD, founder and chairman of the Foundation for Innovation in Medicine (FIM)

**TABLE 1. CLASSIFICATION OF NUTRACEUTICALS**

| Chemical constituent | Source | Potential benefit |
|---|---|---|
| **1.Carotenoids (Isoprenoids)** | | |
| **a. Lycopene** | Tomatoes, pink grapefruit, guava papaya, watermelon | Antioxidant activity, protects against formation of cancer mainly prostate, bladder, cervical, leukemia. |
| **b. Lutin** | Corn, avocado, eggyolk, spinach | Anticancer activity (colon), cataracts, protects the eyes against development of age related muscular degeneration. |
| **c. β-Carotene**<br><br>**d. α-carotene**<br><br>**e. α-cryptoxanthin**<br><br>**g. Zeaxanthin** | Carrots, various fruits and vegetables<br>Carrots<br>Oranges&tangerines<br>Corn, avocado | Antioxidant activity which neutralizes free radicals, protect cornea against UV light. Antioxidants, anticarcinogenic<br>Antioxidants, anticancer<br>Protects eye from macular degeneration and cataracts |
| **2.Dietary fibres** | | |
| **a. Soluble fibre** | Legumes, oats, barely, some fruits | Anticancer, helpful in maintaining the digestive tract |
| **b. Insouble fibre** | Whole grain foods<br>Wheat and corn bran, nuts | Anticancer(colon), helpful in maintaining the digestive tract |
| **3.Polyphenolic compounds** | | |
| **a. Flavonones** | Citrus fruits | Antioxidants, Anti cancer |
| **b. Flavones** | Fruits, Vegetables, Soyabean | Antioxidants, Anti cancer |
| **c. Flavonols** | Onions, apples, tea, broccoli | Antioxidants |
| **d. Anthocyanins** | Blueberries, Blackberries, black Raspberries | anti-oxidants, counteracts inflammation in the body, Lower blood sugar levels in people with diabetes. |
| **e. Phenolic acids** | Berries, legumes. | Phenolic acids reduce oxidation of LDL cholesterol. Reduce formation of cancer. |
| **f. Resveratrol** | Dark grapes, Raisins, berries, peanuts | lowers total serum cholesterol increasing HDL |
| **g. Curcumin** | Turmeric root | strongly anti-inflammatory and strongly anti-oxidant, effective anti anti-clotting agent |
| **4.Fatty Acids** | | |
| **a. Omega 3 Fatty Acids(PolyUnsaturated Fatty Acids)** | Salmon, Flax seed | Potent controllers of the inflammatory processes, Maintenance of brain function, Reduce cholesterol disposition. |

| | | |
|---|---|---|
| **b.Monosaturated fatty acids** | Tree nuts | Reduce risk of coronary heart disease |
| **5.Isothiocyanates**<br>**a. sulporaphane** | Cauliflower,broccoli, cabbage, kale, Horseradish | May enhance detoxification of undesirable compounds and bolster cellular antioxidant defences |
| **6.Phenols**<br>**a. Caffeic acid,**<br>**b. Ferulic acid** | Apples, pears, citrus fruits, some vegetables | May bolster cellular antioxidant defenses;<br>may contribute to maintenance of vision and heart health |
| **7.PlantStanols/Sterols**<br>**a. Stanol/sterol esters** | Fortified table spreads, stanol ester dietary supplements | May reduce risk of coronary heart disease |
| **8. Tocotrienol**<br>**(Isoprenoids)** | Grains, Palm<br>Oil | Anticancer (breast cancer),<br>Promotes cardiovascular health |
| **9. Saponins** | chickpeas and soybeans | Lowers cholesterol level,<br>Anticancer activity (colon) |
| **10. Probiotics/Prebiotics**<br>**Lactobacilli, bifidobacteria** | Yogurt, other dairy and non dairy Applications | May improve gastrointestinal health and systematic Immunity |
| **11.Minerals**<br>**Calcium,selenium, potassium, zinc, copper** | **Food** | Important constituent of balance diet |
| **12.Polyols**<br>**Sugar**<br>**alcohols**<br>**(xylitol, sorbital)** | Fruits | Reduces risk of dental caries |
| **13.Sulfides/Thiols**<br>**Dithiothiones** | Cruciferous vegetables | May contritube to maintenance of healthy immune function |
| **14.Gulcosinolates** | Cruciferous vegetables,<br>Cauliflower | Anticancer (bladder cancer) |
| **15.Phytoestrogens** | | |
| **a.Isoflavanes**<br>**(genistein,daidzein)** | Soy beans, legumes | Lowers LDL cholesterol antioxidant, anticancer(prostate, breast, bowel) |
| **b. Liganans** | Flaxseed, rye, vegetables | Inhibit the development of breast cancer and colon cancer |
| **16. Alkaloids** | | |

**Table 2. LIST OF MARKETED NUTRACEUTICALS**

| Marketed Nutraceutical | Category | Ingredients | Manufacturer |
|---|---|---|---|
| Weight smart [tm] | Nutritional supplement | Vitamins and trace elements | Bayer corporation, Morristown,NL, USA |
| Omega woman | Immune supplement | Antioxidants, vitamins and phytochemicals (*eg.* Lycopene, and resveratrol) | Wassen, Surrey, U.K. |
| Rox® | Energy drink | Taurine, caffeine and glucuronolactone | RoxAmerica,Spartanburg, SA, USA |
| Proteinex® | Protein supplement | Predigested proteins, vitamins, minerals and carbohydrates | Pfizer Ltd., Mumbai, India |
| PNer plus™ | Neuropathic pain supplement | Vitamin and other natural supplement | NeuroHelp,SanAntonio, Texas, USA |
| Mushroom optimizer™ | Immune supplement | Mushrooms,polysaccharides and Folic acid | Jarrow formulas, Los Angeles, CA, USA |
| Chaser™ | Hangover supplement | Activated calcium carbonate and vegetable carbon | Living essentials, Walled lake, MI, USA |
| Calcirol D-3® | Calcium supplement | Calcium and vitamins | Cadilla healthcare limited, Ahmedabad, India. |
| Appetite Intercept™ | Appetite suppressant | Caffeine, tyrosine and Phenylalanine | Natrol, Chatsworth, CA, USA |
| Betafactor® capsules | Immune supplement | Beta –glucan | Ameriden® international Inc.,USA |
| Tozal Eye Health formula | Improved vision | Omega 3 fatty acids, zinc, antioxidants and lutein | Ameri Sciences, USA |
| Snapple-a-day™ | Meal replacement beverges | Vitamins and minerals | Snapple beverges group, USA |
| Brainspeed Memory® | Brain health | Blend of vitamins and minerals | Natrol, USA |
| Red bull ® | Energy drink | Taurine, caffeine and Glucuronolactone, b-group vitamines | Austrian red bull GmbH |
| 5-Hour energy® | Energy drink | Vitamins, tyrosin,Taurine, malicacid,caffeine, Glucuronolactone, | Living essentials, USA |
| WelLife® | Amino acid supplement | Granulated-L-glutamine | Daesang America Inc., Hackensach, NJ, USA |
| Pediasure® | Nutritional supplement | Protein, vitamin and other natural supplement | Abbott nutrition |
| Threptin® Diskettes | Protein supplements | Proteins and vitamin B | Raptakos, Brett & Co. Ltd., Mumbai, India |
| Olivenol™ | Dietary supplement | Natural antioxidant, hydroxytyrosol | Cre Agri, Hayward, CA, USA |
| Beneflora® probiotic | Maintain gastrointestinal health | Lactobacillus acidophilus, bifidobacterium bifidum | Nupro, USA |
| Ferradol Food® Powder | Nutrition supplement | Carbohydrates, proteins, Niacinamide, calcium, iron, zinc, vitamins | Pfizer Limited , india |
| Muscle Optimeal® | Meal replacement drink mix | Protein, vitamines, dietary fibres, xylitol and trace elements | Jarrow formulas, USA |
| Revital ® | Daily health supplement | Ginseng , vitamins and minerals | Ranbaxy |
| becadexamine® | Nutritional supplement | mutivitamins | Glaxosmith kiln |
| Glowelle® | Beauty drink | antioxidants, vitamins and botanical and fruit extracts | Nestlé |

# The Nutraceutical Triple-Play in CVD

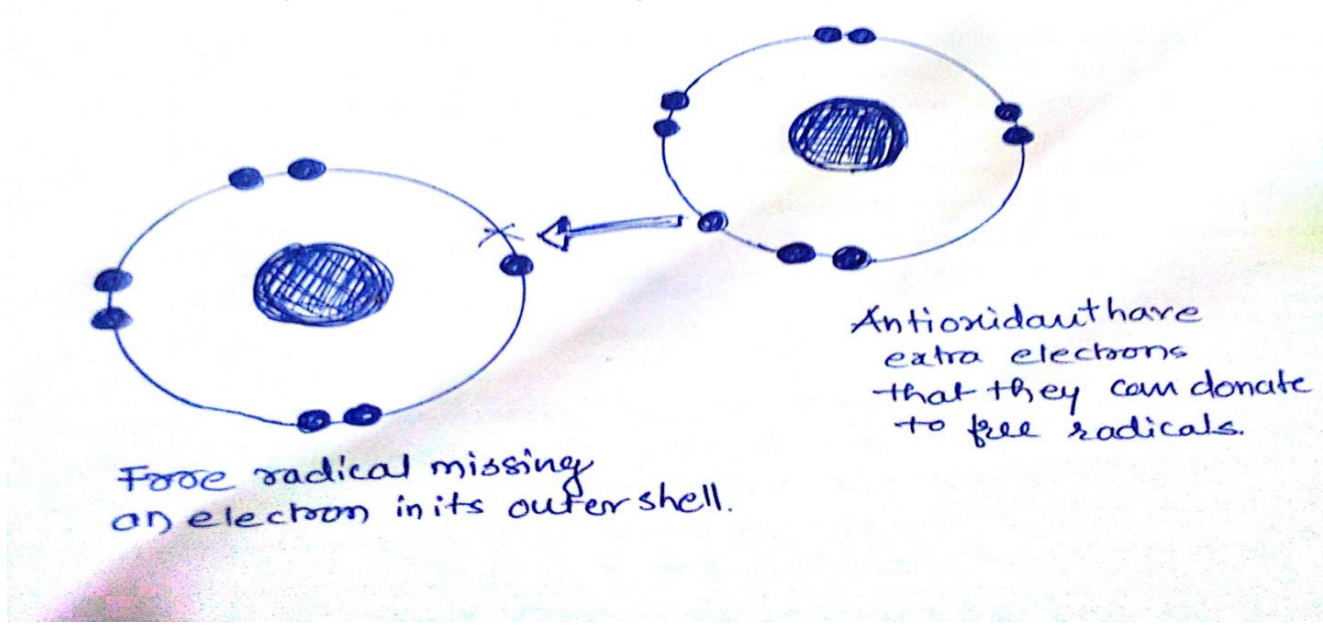
Averting vascular disease is now a central calling for the Nutraceutical industry. This is because the mechanisms of vascular damage have increasingly indicated a major culprit: a lack of nutrition hygiene.

There are three strategies Nutraceutical can offer to prevent and reverse vascular disease.

1. The first is to reduce circulating levels of LDL-cholesterol

   by forming micelle with bile salts as it contains cholesterol.

2. The second strategy is to reduce the possibility of oxidation by neutralizing radicals with antioxidants.




3. The third is to reduce artery plaque through fibrinolytic activity. A fibrin clot, is broken down a product of coagulation. Enzyme plasmin cuts the fibrin mesh at various places leading to production of fragments that are cleared by kidney and liver.

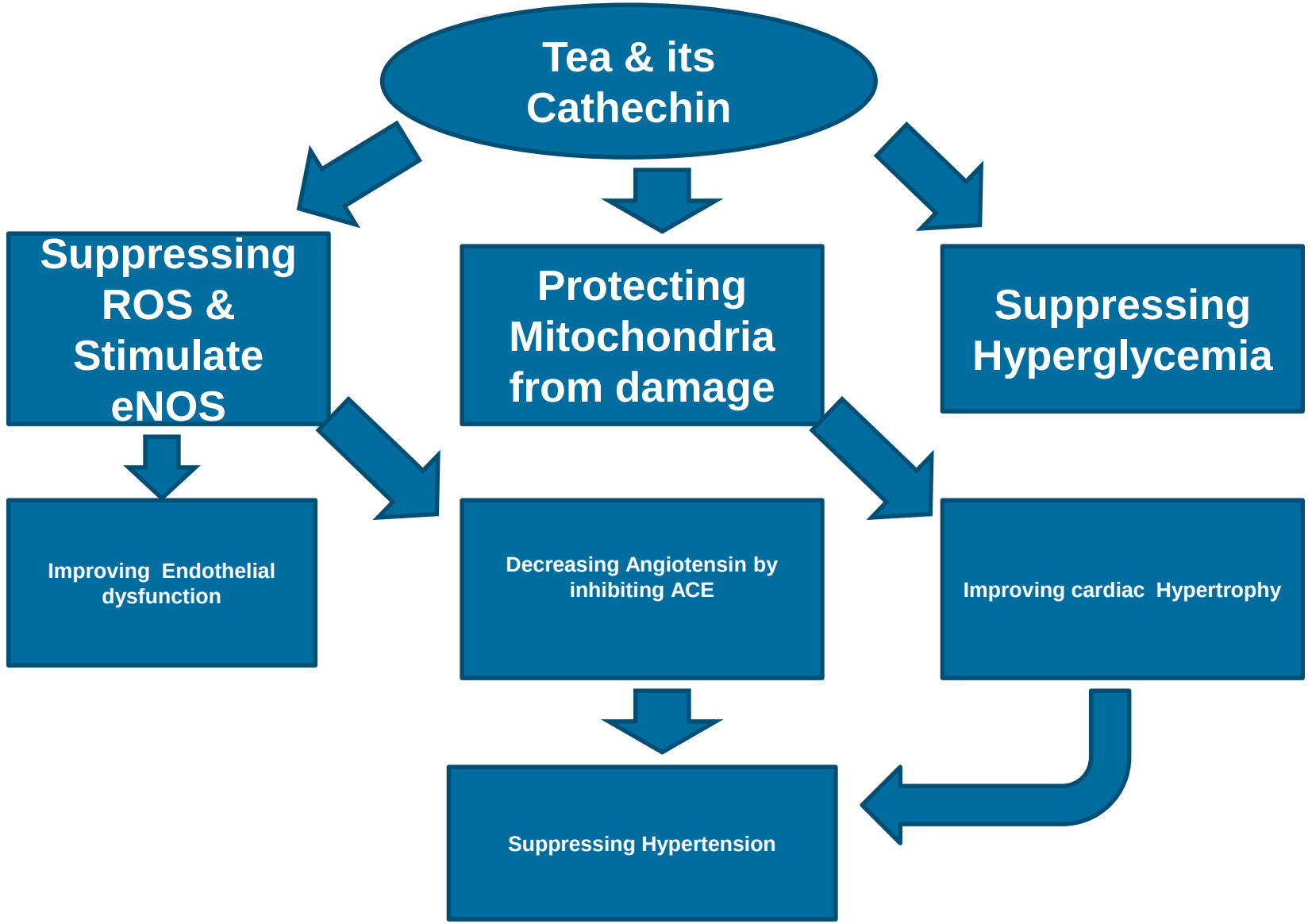
# NUTRACEUTICALS PLAYS ROLE IN VASCULAR DISEASES

## ❑***Sterols, Phenols & Flavones***

- Plant-derived sterols compete with cholesterol to form micelles with bile salts. This reduces cholesterol's absorption into the bloodstream.
- All plants contain sterols such as stimasterol, beta-sitosterol and campesterol. Significant amounts appear in vegetables, nuts and seeds.
- Significant stanol content is found in avocados, pumpkin seeds, cashews, rice bran, and others. Plants favored for sterol and stanol extraction include corn, soybeans and wheat.
- A unique commercial form of sterols is Microphyte.

- Phenols have been shown to reduce cholesterol levels and LDL oxidation. Polyphenolic cathechin which is present in Green tea (*Camellia sinensis*) reduces the CVD by enhancing antioxidant activity

- Oxyphyte is now a days available products of polyphenolic extracts of green tea, apple, pomegranate and red grape.




AngII: Angiotension Stimulate Hypertrophy. ACE: Angiotensing Converting Enzyme
ROS: Reactive Oxygen Species. eNOS: nitric Oxide Synthase

# Chemical composition of various Tea (mg/g)

| Component | Green Tea | Black Tea |
|---|---|---|
| Total Cathechin | 150-200 | 40-60 |
| Caffeine | 20-60 | 20-60 |
| Theanine | 8-20 | 5-10 |
| Theaflavins | -- | 5-20 |
| Thearubigins | -- | 60-180 |

## ❑ Super Fibers

- Dietary fiber found in plant foods (fruits,vegetables and whole grains) and is essential to maintain healthy digestive system.
- Two types of fiber i.e. soluble fiber (gums & pectins) which can dissolve in water which helps to lower blood fat and maintain blood sugar. E.g. beans, fruit such as strawberry & banana and oat products, barley, and
- Insoluble fibers cant dissolve in water, so directly passes through the digestive tract and helps to trap cholesterol, toxins etc. that are then expelled through feces. E.g. cellulose, hemicelluloses in bran, leafy vegetables.

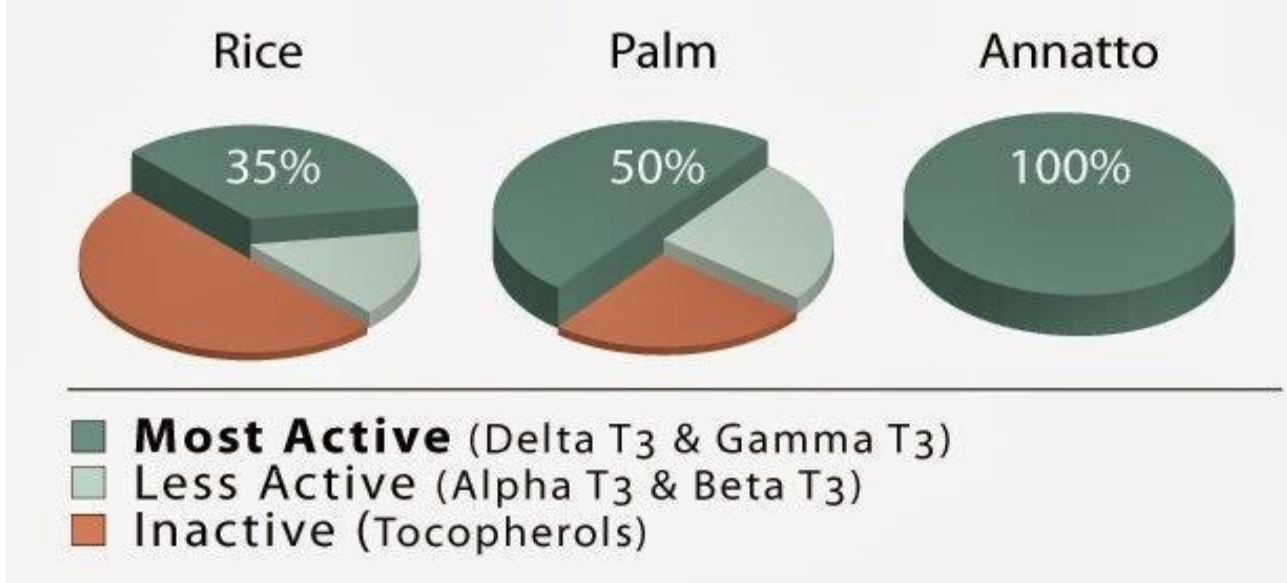
## ❑Fats for Vascular Health

- The cardiovascular benefits of omega 3 oils are no secret.
- Sources : Marine plants, algal sources such as
  - Alpha linolenic acid (ALA), Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA)
  - Vegetable oil such as soyabean, sunflower and nut like Peanuts and Almonds
- Omega 3 consumption appears to reduce the risk of LDL oxidation by reducing diacylglycerol acyltransferase (DGAT) activity in the liver.
- Diets high in saturated fats, trans-fats and fried foods tend to increase VLDL-c and LDL-c levels. This is not necessarily applicable to dairy, however. Dairy is high in conjugated linoleic acid (CLA). As it significantly lowered VLDL-c and triglycerides.
- Furthermore, dairy tripeptides such as valine-prolyl-proline (VPP) and isoleucine-proline-proline (IPP) from cultured dairy products have been shown to be vascular-healthy.

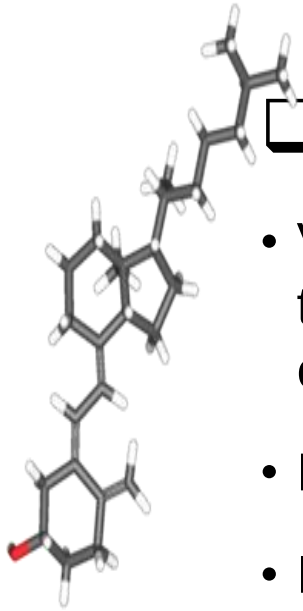
## ❑ ***Tocotrienols***

- Tocotrienols are members of a subgroup of the vitamin E family, which includes tocopherols. Both tocotrienols and tocopherols are antioxidants, but only tocotrienols have been shown to reduce cholesterol, inhibit certain cancers and manage diabetes.


- The positive effects of tocotrienols on cholesterol levels result from their ability to down-regulate a liver enzyme involved in cholesterol synthesis i.e. **3-hydroxy-3methyl-glutaryl-CoA** (HMG-CoA reductase). This down-regulation results in a suppression of the activity of the enzyme.
- ***Sources:*** *Annatto,* Palm oil, cereal grain and rice bran.




- The annatto bush, an oily plant is the only natural compound in the world that offers pure Tocotrienols without the accompanying Tocopherols. Furthermore, annatto Tocotrienol has the highest Tocotrienol concentrations with 150 – 300 times fewer Tocopherols than rice and palm sources.




## ❑ Vitamin D (Calciferol)

- Vitamin D acts as a hormone, regulating more than 200 genes throughout the body. It does an impressive amount of work. For example, vitamin D:
- Keeps abnormal cells from multiplying in breast and colon tissues
- Helps regulate blood pressure in the kidney
- Helps regulate blood sugar levels in the pancreas

➢Its direct effects on the arterial wall may protect against atherosclerosis through the inhibition of macrophage cholesterol uptake as  and foam cell formation, reduced vascular smooth muscle cell proliferation, and reduced expression of adhesion molecules in endothelial cells.

❑Sources :  sunlight, Fish oils, Egg yolk, Butter, Liver and in fortified foods

# ❑ Pantethine

- It is a dimeric form of pantothenic acid (vitamin $B_5$)
- The biologically active co-enzyme similar to vitamin B5 is the precursor for coenzyme A.
- Pantethine further reduces cardiovascular risk by inhibiting platelet clumping and the production of the inflammation-producing chemical, thromboxane A2 (CVR).
- Pantethine (300 mg 3 times daily) reduced serum triglycerides 32%, total cholesterol 19%, and LDL cholesterol 21%; HDL cholesterol levels increased 23% (Arsenio et al. 1986, Murray 1996b).


- **Sources:** Milk, Egg, Peas, Starchy vegetables and Cereals.

## ❑ Positive Claims of Pantethine

1. Boosts energy and athletic ability.
2. Lowers Cholesterol and protects against

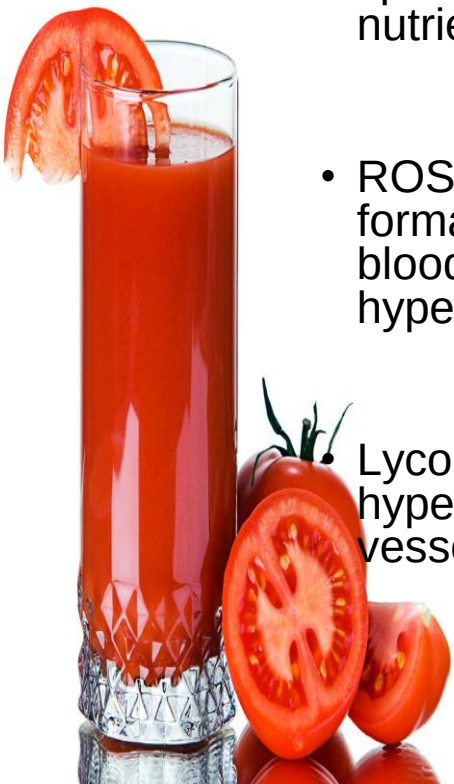
   Cardiovascular Disease.
3. Speeds Wound Healing.
4. Detoxifies Alcohol.
5. Stimulates Immunity.
6. Prevents Hair Loss and Graying of Hair
7. Retards Aging


## ❑ Lycopene

- It is a bright red carotene and carotenoid pigment and phytochemical

- **Sources** : Abundant in tomato, papaya, watermelon, carrot, pink guava and pink grapefruit. Also concentrated tomato products such as tomato paste, canned pizza sauce as cooked tomato products provide better lycopene than raw tomato products.

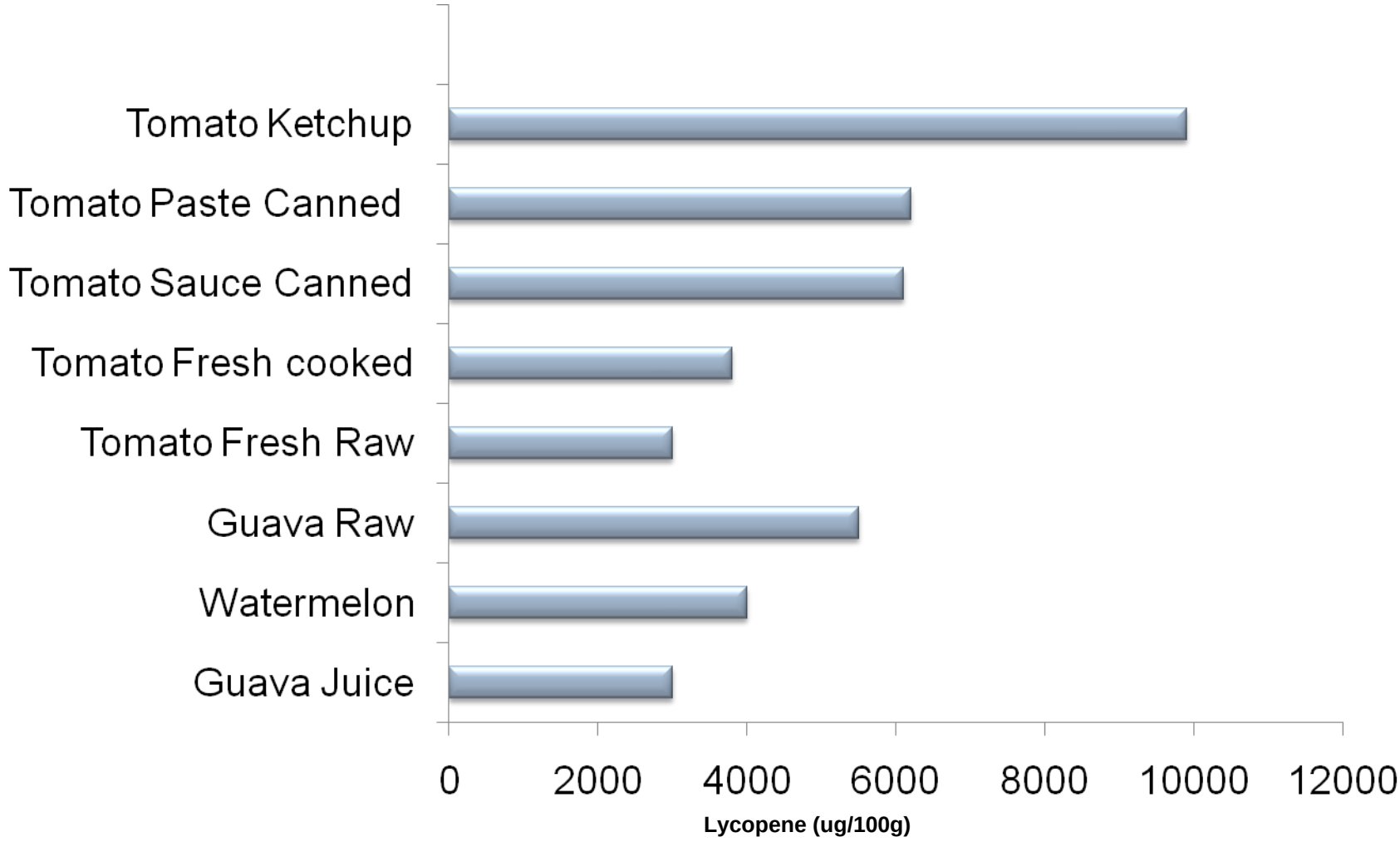
- Lycopene neutralizing hazardous waste products such as reactive oxygen species (ROS) that our bodies normally produce during conversion of nutrients into energy.



- ROS are dangerous compounds that can damage DNA and promote cancer formation. They also damage lipids that are vital to keeping our hearts and blood vessels functioning properly; such damage can lead to development of hypertension.

- Lycopene-containing food products can reduce blood pressure in hypertensive patients by reducing plaque development (hardening of blood vessels).

# Lycopene Content of Selected Foods




Source: Robert E.C. Wildman Handbook of Nutraceuticals and Functional Food

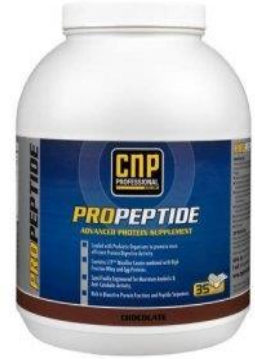
## ❑ Proteins and Peptides:

- Proteins are long-chain polymers of amino acids while peptides represent the shorter forms. They can act as health promoters in 2 ways,
  - ➢ Firstly, by acting as indigestible substances in our digestive tract

    *e.g.* Buckwheat and soybean proteins

  - ➢ Secondly, proteins can be converted into peptides during digestion and are then absorbed into the blood circulatory system.

    E.g. Soya protein (Lunasin is bioactive peptide from ), Milk-based products (α- and ß-lactorphin)




# Conclusion

❖The beneficial effects of functional foods and Nutraceuticals can be concluded that: Reduced risk of cardiovascular diseases, reduced risk of cancer, weight: loss/management, reduced osteoporosis, improved memory, improved fetal health and reduced risk of other many diseases.

❖ Functional Food and Nutraceuticals will be hopeful to good health in the future; it has been convincingly demonstrated to be beneficial for their intended purposes when consumed as part of a generally well-balanced and healthful diet.

❖Also, more information and evidences must be available assist consumer for the correct choosing and using the introduction functional foods and / or nutraceuticals to achieve the promised health benefits.

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# Thank you

Dr. Rahul Thory
School of Bioengineering and Food Technology
Shoolini University
Village Bajhol, Solan (H.P)

+91 9466266628(Mob No.)
rahul.560@shooliniuniversity.com