

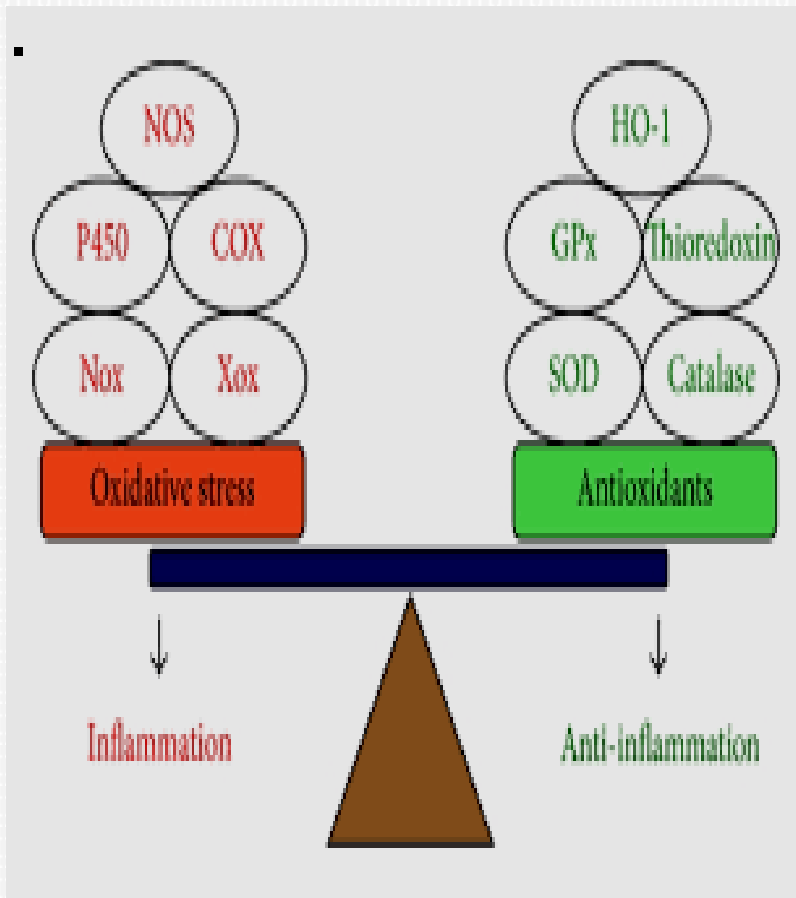


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ANTIOXIDANTS

- ❖ Antioxidants are man-made or natural substances that may prevent or delay some types of cell damage caused by free radicals, unstable molecules that the body produces as a reaction to environmental and other pressures.
- ❖ They are sometimes called “free-radical scavengers.”
- ❖ The sources of antioxidants can be natural or artificial.

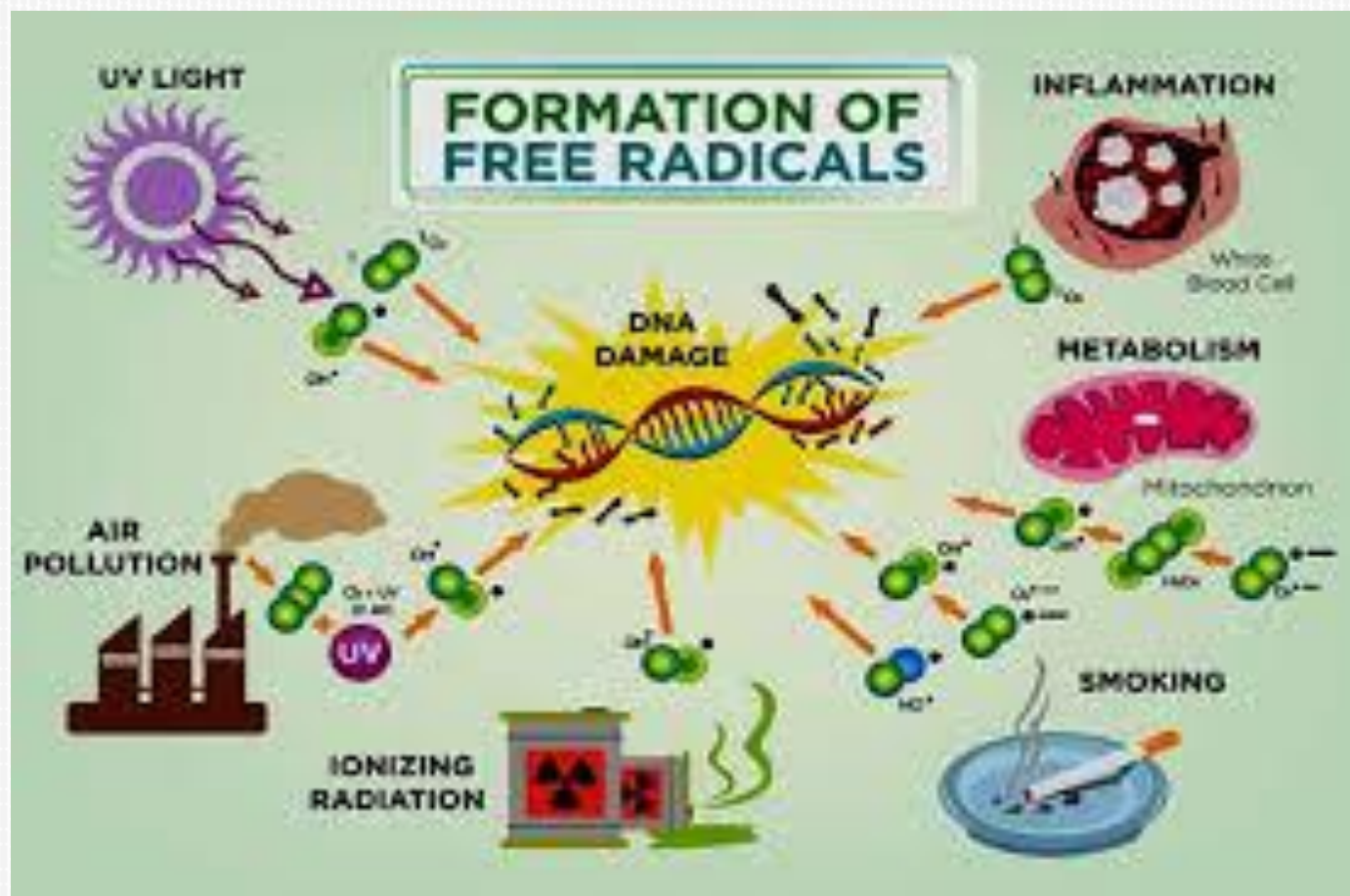
Anti-oxidant act as:-



- radical scavenger
- hydrogen donor,
- electron donor
- peroxide decomposer,
- singlet O₂ quencher,
- enzyme inhibitor,
- synergist,
- metal-chelating agents

FREE RADICALS

- ❖ Free radicals are waste substance produced by cells as the body processes food and reacts to the environment.
- ❖ If the body cannot process and remove free radicals efficiently, oxidative stress can result.
- ❖ This can harm cells and body function. Free radicals are also known as reactive oxygen species (ROS).

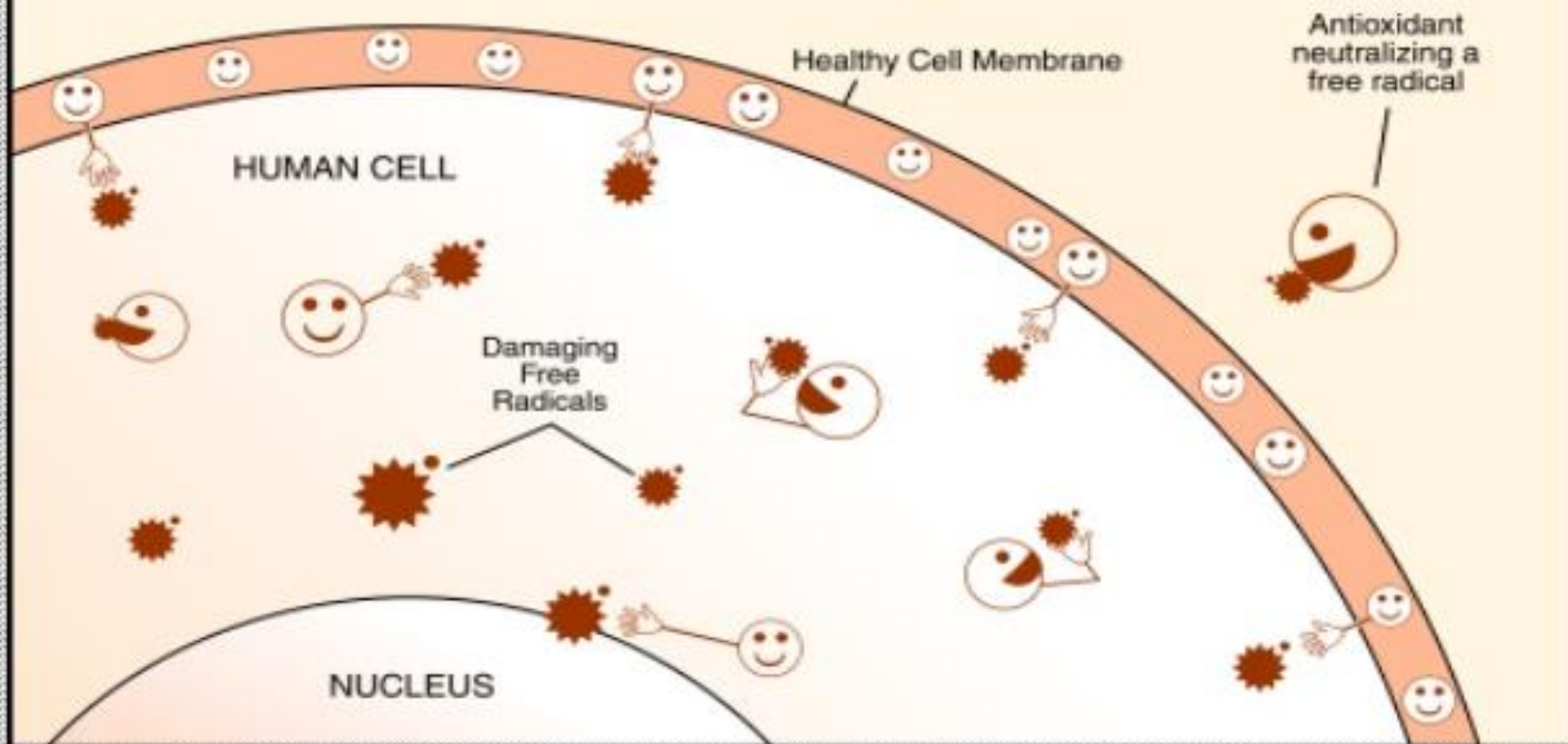


Oxidative Stress

- ❖ Factors that increase the production of free radicals in the body can be internal, such as inflammation or external, for example, pollution, UV exposure, and cigarette smoke.
- ❖ Oxidative stress has been linked to heart disease, cancer, arthritis, stroke, respiratory diseases, immune deficiency, emphysema, Parkinson's disease and other inflammatory or ischemic conditions.

Mechanism of Anti-oxidants

Antioxidants Doing their Job

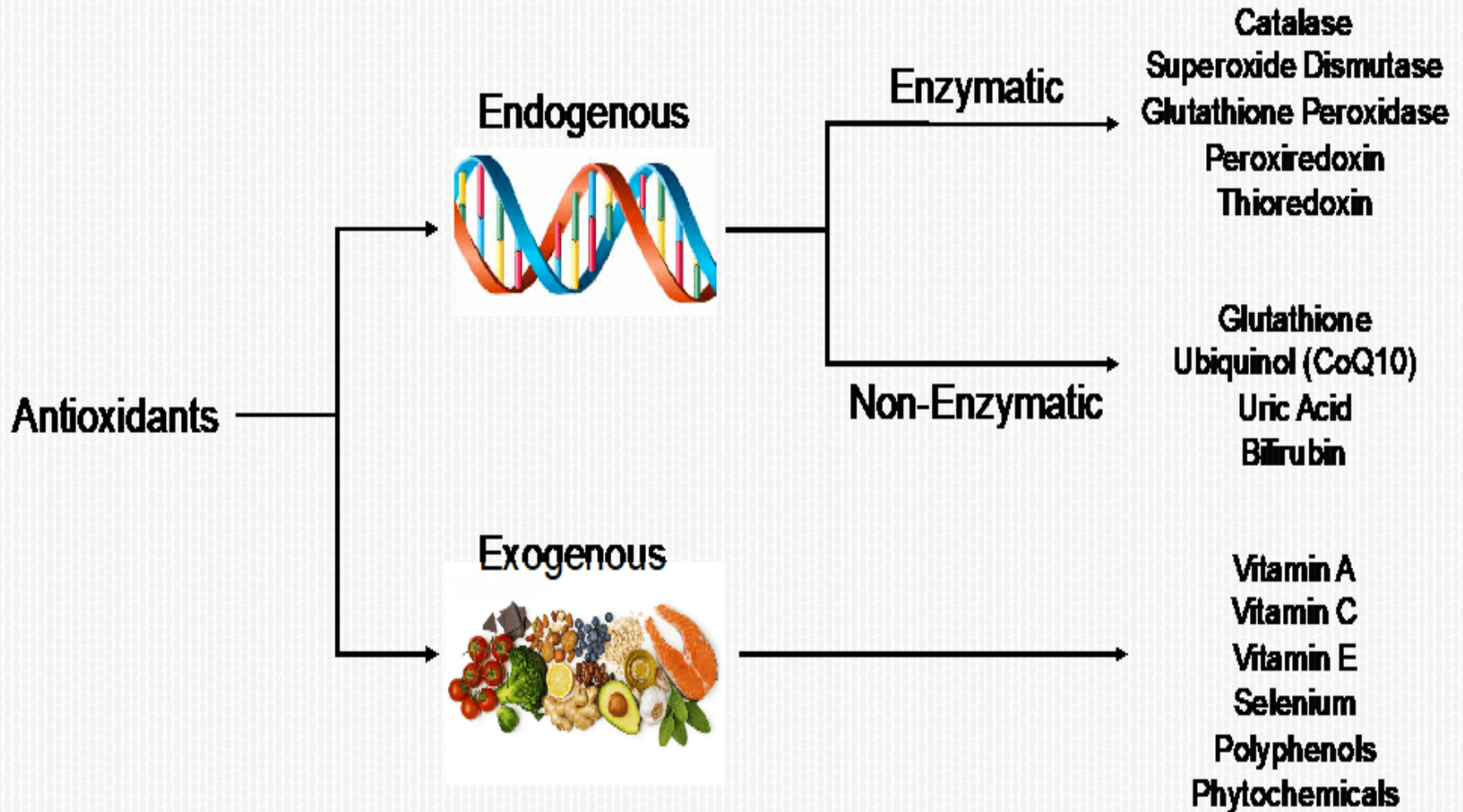


ANTIOXIDANTS

- ❖ The keyword here is variety.
- ❖ Try to get as many fruits and vegetables with different colors when you plan your meals and go to the grocery store.
- ❖ An array of color in your diet will give you the widest range of beneficial antioxidants.



Anti-oxidant Types



Exogenous Anti-oxidants

- ❖ Antioxidants that come from outside the body are called exogenous antioxidants.
- ❖ Certain plant-based foods are thought to be rich in antioxidants. Plant-based antioxidants are a kind of phytonutrient, or plant-based nutrient.
- ❖ Examples of exogenous antioxidants include vitamins(C,E),minerals(Se, Cu, Zn, Mn) and phytochemicals such as carotenoids, lycopene, lutein, and zeaxanthin.

Exogenous Natural Anti-oxidants

Exogenous antioxidants	Dietary sources
Vitamin C (ascorbic acid/ascorbate)	Bell peppers, strawberries, kiwi, Brussels sprouts, broccoli
Vitamin E (tocopherols, tocotrienols)	Vegetable oil and its derivatives (margarine, salad dressing), nuts, seeds
Carotenoids (α -carotene, β -carotene, zeaxanthin, lutein, lycopene, β -cryptoxanthin, etc.)	Orange and red vegetables and fruits (carrots, tomatoes, apricots, plums) and green leafy vegetables (spinach, kale)
Polyphenols (flavonols, flavanols, anthocyanins, isoflavones, phenolic acid)	Fruits (apples, berries, grapes), vegetables (celery, kale, onions), legumes (beans, soybeans), nuts, wine, tea, coffee, cocoa
Trace elements (selenium, zinc)	Seafood, meat, whole grains

VITAMIN C

- ❖ Best-known antioxidant offers a wide-variety of health benefits which include protecting body from infection and damage to body cells, helping produce collagen and helping in the absorption of iron.
- ❖ Ascorbic acid is a redox catalyst which can reduce, and thereby neutralize, reactive oxygen species such as hydrogen peroxide.
- ❖ It is maintained in its reduced form by reaction with glutathione, which can be catalysed by protein disulfide isomerase and glutaredoxins.

Ascorbic Acid Sources

Citrus fruits (including oranges, grapefruits and tangerines), Broccoli, Brussels sprouts, cantaloupe, cauliflower, grapefruit, leafy greens (turnip, mustard, beet, collards), honeydew, kale, kiwi,, papaya, snow peas, strawberries, sweet potato, tomatoes, and bell peppers (all colors)



Vitamin E

- ❖ Vitamin E is the collective name for a set of eight related tocopherols and tocotrienols which are fat-soluble vitamins
- ❖ Vitamin E works with other antioxidants such as vitamin C to offer protection from some chronic diseases.
- ❖ Protects body from cell damage that can lead to cancer, heart disease and cataracts as we age.
- ❖ Vitamin E is found in vegetable oils, wheat germ, whole-grains and fortified cereals, seeds, nuts and peanut butter.

Vitamin E Sources

- Almonds,
- avocado,
- Swiss chard,
- leafy greens (beet, mustard, turnip),
- peanuts,
- red peppers,
- spinach (boiled),
- and sunflower seeds



Mineral Anti-oxidants- Selenium

- × **Selenium** is a powerful antioxidant that may help protect the heart and body from developing certain types of cancer.
- × Foods high in selenium include: Brazil nuts , Yellow fin tuna, Halibut ,Sardines, in oil with bones , Ham, barley, brown rice

TOP 10 SELENIUM FOODS

1	Brazil Nuts		544 mcg (100% DV) 1 OZ (6-8 nuts)	6	Turkey (boneless)		31 mcg (44% DV) 3 OZ
2	Yellowfin Tuna		92 mcg (100% DV) 3 OZ	7	Beef Liver		28 mcg (40% DV) 3 OZ
3	Halibut (cooked)		47 mcg (67% DV) 3 OZ	8	Chicken		22 mcg (31% DV) 3 OZ
4	Sardines (canned)		45 mcg (64% DV) 3 OZ	9	Egg		15 mcg (21% DV) 1 LARGE
5	Grass-fed Beef		33 mcg (47% DV) 3 OZ	10	Spinach		11 mcg (16% DV) 1 CUP

COPPER



- ❖ It act as a pro-oxidant (causes free radical damage) and an antioxidant.
- ❖ Copper is composed of a powerful antioxidant enzyme and ceruloplasmin, a protein responsible for transporting iron to your tissues.
- ❖ Not getting enough copper affects the levels of selenium, iron, catalase, and glutathione — all powerful antioxidants.
- ❖ Foods high in copper include: Oysters, Black beans, Soy protein powder, Granola, Tomato puree

MANGANESE

- ❖ Like copper, manganese is a powerful antioxidant.
- ❖ Manganese superoxide dismutase (MnSOD) is the main antioxidant enzyme in the mitochondria of every cell in the body.
- ❖ Foods highest in manganese are: Pecans, Brown rice, Pineapple, Almonds, Pineapple juice



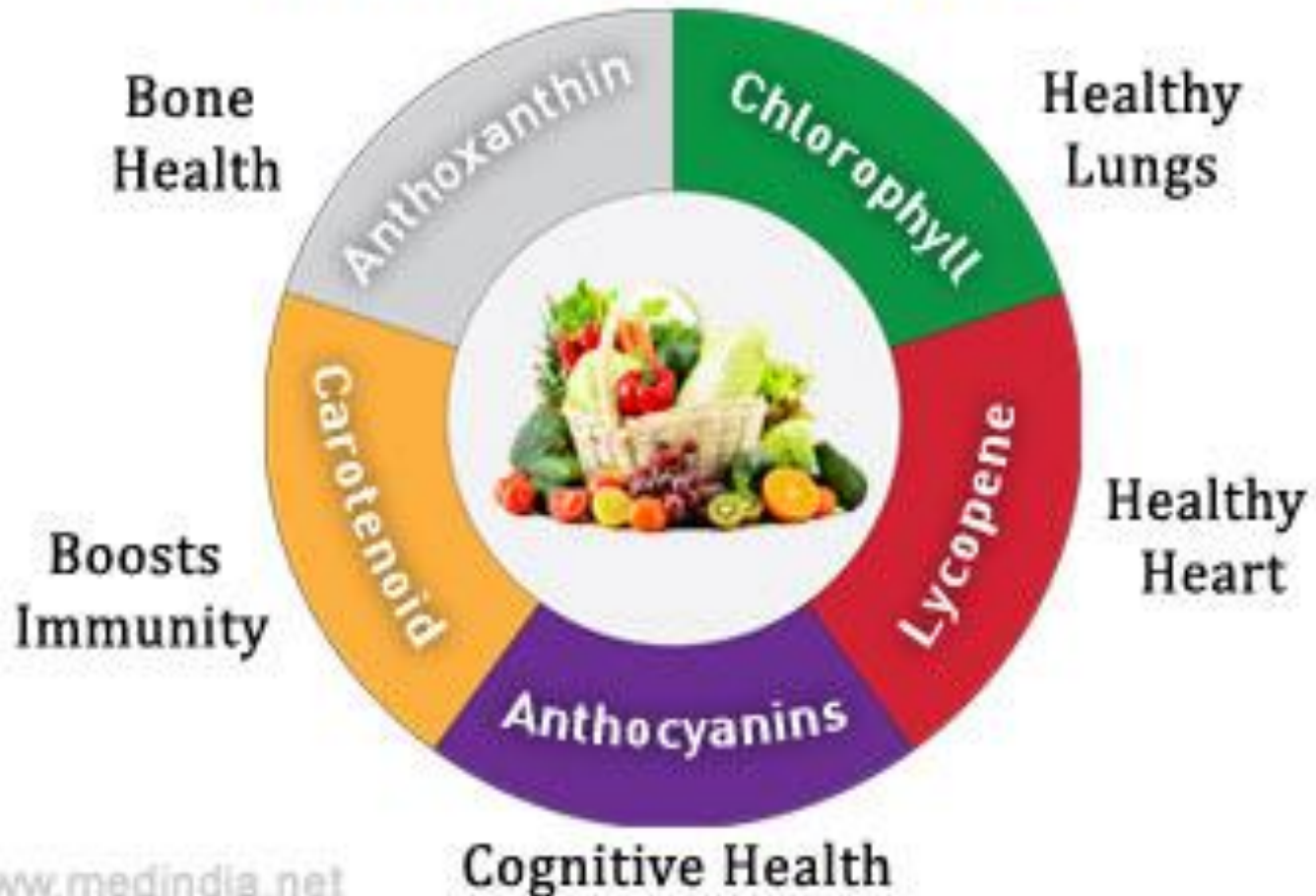
IRON



- ❖ This nutrient helps protect the cell from damage (oxidation).
- ❖ It's found in two forms: iron connected to a special protein that helps with absorption (heme) and one without the attached protein (nonheme).
- ❖ Nonheme iron is found in plant foods and fortified foods, while meat, seafood, and poultry contain both nonheme and heme iron. (18)
- ❖ Foods high in iron include: Oysters, White beans, Dark chocolate, Beef liver

Phytonutrients

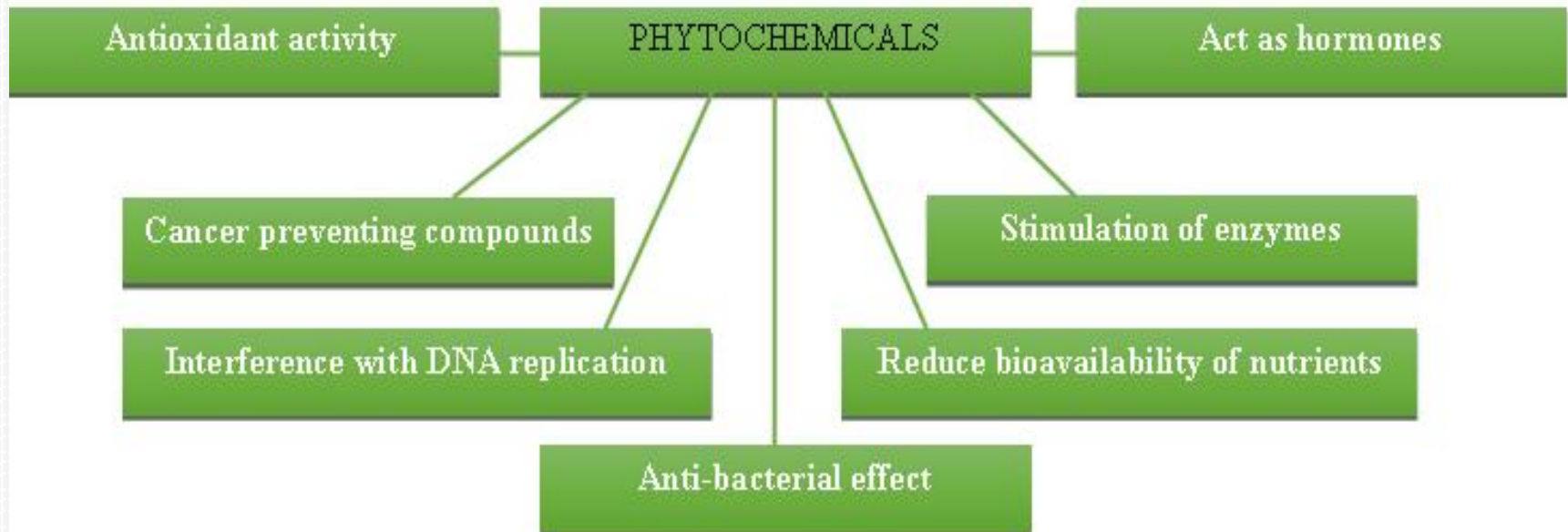
PHYTONUTRIENTS



PHYTONUTRIENTS

- ❖ These are chemical compounds found in plants, and they have a variety of possible health benefits for the body, including antioxidant activity.
- ❖ Flavonoids, flavones, catechins, polyphenols, and phytoestrogens are all types of antioxidants and phytonutrients, and they are all found in plant-based foods.
- ❖ Each antioxidant serves a different function and is not interchangeable with another. This is why it is important to have a varied diet.
- ❖ **Phenolic compounds:** Quercetin catechins resveratrol coumaric acid, anthocyanins.

Functions of Phytochemicals



Phytonutrients	Foods		Benefits ¹⁻⁷
Red			
<ul style="list-style-type: none"> + Lycopene + Elagic acid + Anthocyanidins 	<ul style="list-style-type: none"> + Apples + Watermelon + Strawberries + Raspberries + Cranberries 	<ul style="list-style-type: none"> + Pomegranates + Cherries + Beets + Grapefruit + Red peppers 	<ul style="list-style-type: none"> + Protects against cancer and heart disease + Regulates blood pressure and glucose levels + Supports prostate, urinary, and DNA health
Green			
<ul style="list-style-type: none"> + Flavonoids + Isoflavones + Lutein + Isothiocyanate 	<ul style="list-style-type: none"> + Broccoli + Spinach + Avocados + Kiwi 	<ul style="list-style-type: none"> + Zucchini + Bell peppers + Kale 	<ul style="list-style-type: none"> + Supports eye, liver, and cell health
Purple			
<ul style="list-style-type: none"> + Resveratrol + Anthocyanins + Phenolics + Flavonoids 	<ul style="list-style-type: none"> + Eggplant + Blueberries + Blackberries + Figs + Raisins + Prunes 	<ul style="list-style-type: none"> + Acai berry + Black beans + Purple cabbage + Cauliflower + Onion 	<ul style="list-style-type: none"> + Supports artery, bone, brain, and heart health
Yellow/Orange			
<ul style="list-style-type: none"> + Carotenoids + Lutein 	<ul style="list-style-type: none"> + Carrots + Pumpkin + Pineapple 	<ul style="list-style-type: none"> + Oranges + Squash 	<ul style="list-style-type: none"> + Supports healthy growth and development + Supports eye health
White			
<ul style="list-style-type: none"> + Allicin + Indoles 	<ul style="list-style-type: none"> + Onions + Mushrooms 	<ul style="list-style-type: none"> + Cauliflower + Pears 	<ul style="list-style-type: none"> + Supports bone and circulatory-system health + Protects against cancer and heart disease

BETA-CAROTENE

- ❖ Among the 600 or more carotenoids in foods, lycopene and lutein are well-known leaders in the fight to reduce the damage from free radicals.
- ❖ Carotenoids may be effective in helping prevent certain cancers and may help decrease your risk of macular degeneration.
- ❖ ***Carotenoids including beta-carotene and lycopene***: Apricots, asparagus, beets, broccoli, cantaloupe, carrots, bell peppers, kale, mangos, turnip and collard greens, oranges, peaches, pink grapefruit, pumpkin, winter squash, spinach, sweet potato, tangerines, tomatoes, and watermelon.

TABLE 1. Foods in a “Rainbow Diet”

Color	Bioactive Compound(s)	Foods
red	lycopene	tomatoes, watermelon
orange	beta-carotene	carrots, mangos
yellow	flavonoids	lemons, pineapple
green	sulforaphane	broccoli, arugula
blue	anthocyanins	blueberries, plums
purple	resveratrol	grapes, blackberries
white	allicin	garlic, onions

- ❖ **Anthocyanins** -These are found in blue and purple fruits and veggies, such as berries, eggplant, purple potatoes, carrots, and asparagus. These antioxidants help promote blood vessel health.
- ❖ **Resveratrol** - They have been shown to help promote heart and lung health, help prevent certain types of cancer, and reduce inflammation overall. This type of antioxidant is found dark chocolate, red wine, peanuts, and grapes.

- ❖ **Isoflavones**-They're found in soybeans. They may help promote bone health, decrease joint inflammation, ease menopause symptoms, and help protect against breast cancer.
- ❖ **Lycopene** -This is found in tomatoes and tomato products, pink grapefruit, watermelon and red peppers. These help promote prostate and heart health.

- ❖ **Lutein** - This antioxidant is found in spinach, Brussels sprouts, broccoli, lettuce, kale, artichokes, and collard greens. This antioxidant can help promote eye and heart health and may play a role in preventing some cancers.
- ❖ This one is the precursor to vitamin A and this antioxidant is high in orange produce items.

Endogenous Antioxidants (produces in the body)

Enzymes	Superoxide dismutase Catalase Glutathione peroxidase Paraoxanase Glutathione S-transferase Glutathione reductase Thioredoxin reductase Heme-oxygenase Aldehyde dehydrogenase 8-Oxoguanine glycosylase
Non-enzymes	Glutathione Lipoic acid Bilirubin Melatonin Ubiquinol Uric acid
Metal-binding proteins	Ferritin Lactoferrin Metallothionein

Endogenous Enzymes as Anti-oxidants

- ❖ **Superoxide dismutases** (SODs) These are the major antioxidant defense system against free radicals. Formed in the body, they do require copper and manganese to make them work.
- ❖ **Glutathione peroxidase** (GSHPx) This is a cell antioxidant enzyme that reduces hydrogen peroxide to water. Selenium is part of the regulation and translation which means it is a required mineral for this enzyme to activate.
- ❖ **Catalase** (CAT) This is also responsible for changing hydrogen peroxide to water using iron as its assistant (called a cofactor).

Does it Matter Whether the food is Cooked or Consumed Raw?

Depending on the particular food, cooking temperatures and methods can sometimes increase or decrease antioxidant levels. The important thing is that you eat antioxidant-rich foods, so go with your personal preference for preparation—as long as it's not deep frying!

Are added Antioxidants as Effective as those that occur Naturally?

- ❖ Yes, vitamins such as C, A and E can be added to foods – and they often are, such as in orange juice.
- ❖ There is no significant physiological difference between the added antioxidants and the ones occurring naturally in the food source. However, there's also no evidence that taking antioxidant dietary supplements work as well as the antioxidants found in food products.
- ❖ It's important not to overdo it on supplements because there can be too much of a good thing.

The image features a central graphic with a yellow background and a blue border. The text "THANK YOU!" is written in a bold, red, sans-serif font with a blue outline. The words are arranged in two lines: "THANK" on the top line and "YOU!" on the bottom line. The exclamation point is prominent. The entire graphic is set within a white rectangular frame with a red border.

**THANK
YOU!**