

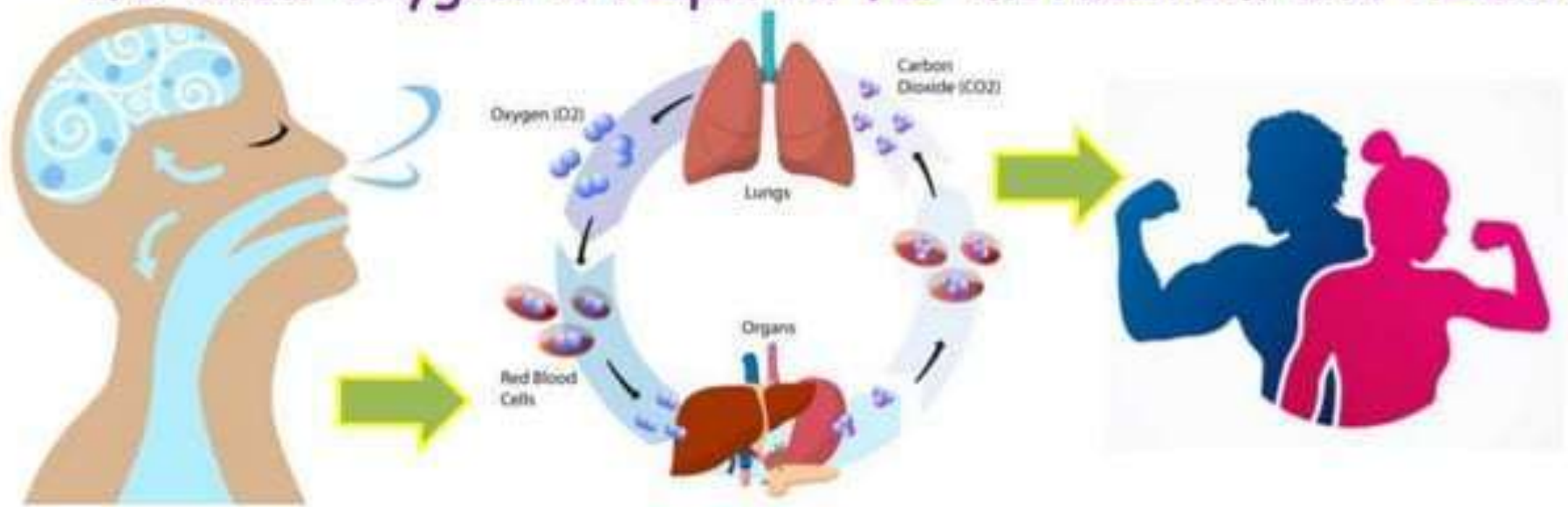
FREE RADICALS AND ANTIOXIDANTS



Learning Objectives

- What is respiratory burst?
- What is free radical and ROS?
- How free radicals are generated?
- What are the types of free radicals?
- Examples of free radicals.
- Properties of free radicals.
- Effects of free radicals.
- What is Anti oxidants?
- Types of Anti oxidants.
- Functions of Antioxidants.
- Oxidative stress
- Effects of oxidative stress on health.
- Diagnostic stress markers
- **Stress busters.**

We know oxygen is required for metabolism and health



But do we required in these forms for health?



Electron Transport Chains

Two types

Mitochondrial

Electron Transport Chain

Phosphorylating

Participate in ATP formation

NAD-FAD-Fe⁺²

Microsomal

Electron Transport Chain

Non-phosphorylating

Participate in Hydroxylation and desaturation

NADPH- Cyt-P₄₅₀

Reduced Fe(II) CytP₄₅₀ complex react with O₂ to form

1. H₂O
2. O' added to Organic substrate - [O' + H+ OH]

What is Respiratory burst?

Rapid release of ROS, Super oxide anion, $O_2^{\cdot -}$, H_2O_2

Normally They are utilised for immunological defence, cell signalling and fertilization in Animal

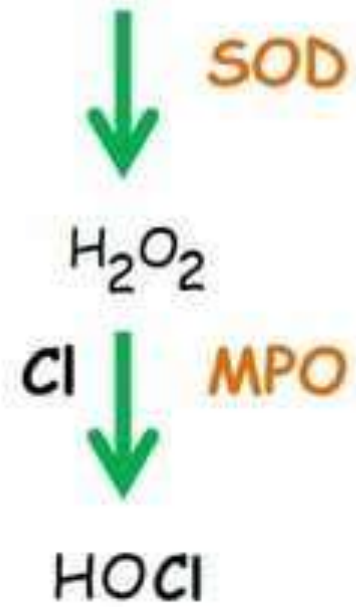
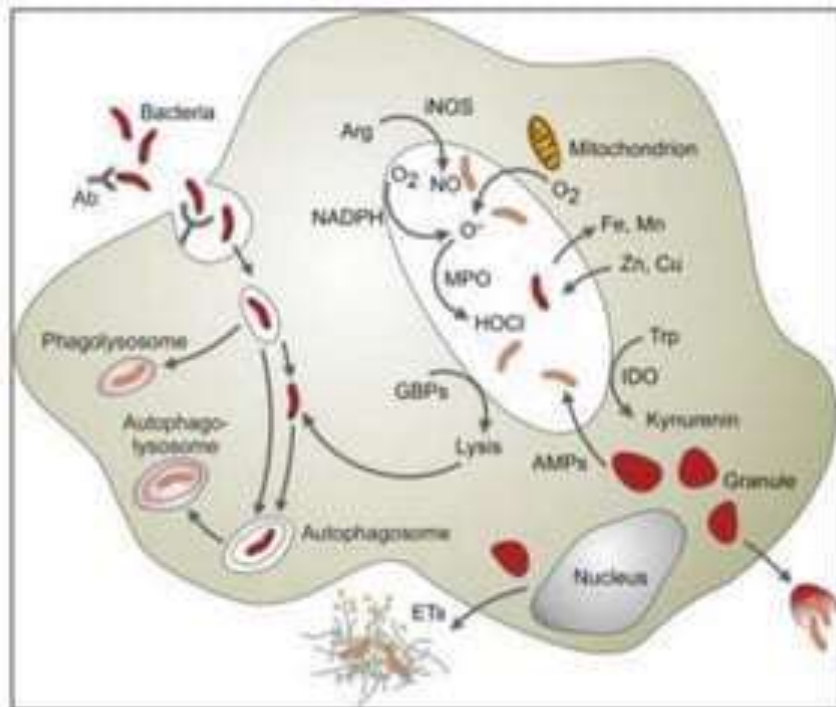
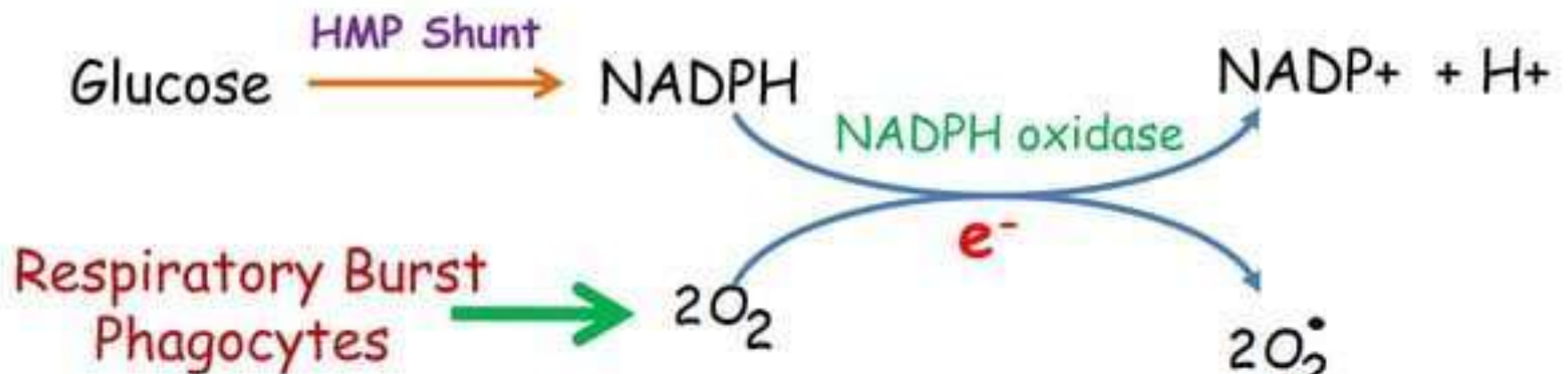
Essential for degradation of internalized bacteria/ pathogen [innate immunity]

RB increases 10 to 20 fold oxygen consumption

NADPH oxidase generate SO from oxygen in phagocytes

Phagocytic cell use this for killing Bacteria, Toxin

Respiratory Burst - Bactericidal activity



MPO - Myeloperoxidase in polymorphs

BUT

Leading cause of death

- Heart disease - 32 to 45%
- Cancer - 23 to 30%
- Strokes - 07 to 10%
- Renal diseases - 20 to 40%
- Lung disease, Pneumonia, Asthma,
- Diabetes mellitus, Liver disease,
- Neurodegenerative disease [PD, AD, MS]

>90% disease incidences involve

FREE RADICAL DAMAGE

What is stable atom?

An Atom having octet electronic configuration in their outer most orbit



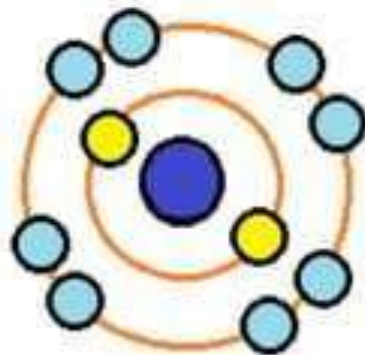
Healthy
stable atom

Inert Gases

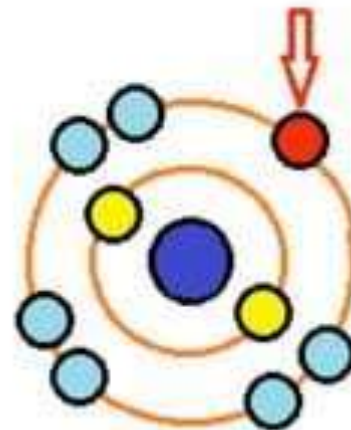


What is free radicals?

An atom having unpaired electron in outer most orbit



Healthy
stable atom



Free radical



What is free radicals?

- Any molecule having one or more unpaired electrons
- Highly unstable and chemically reactive



- **Free radicals – ROBBERS**
- They are Deficient in energy
- They attack and snatch energy from the other cells to satisfy themselves



What are the types?

- Free Radicals are Mainly of three types
- Reactive oxygen species [ROS]
- Reactive Nitrogen species [RNS]
- Reactive metabolites and intermediates

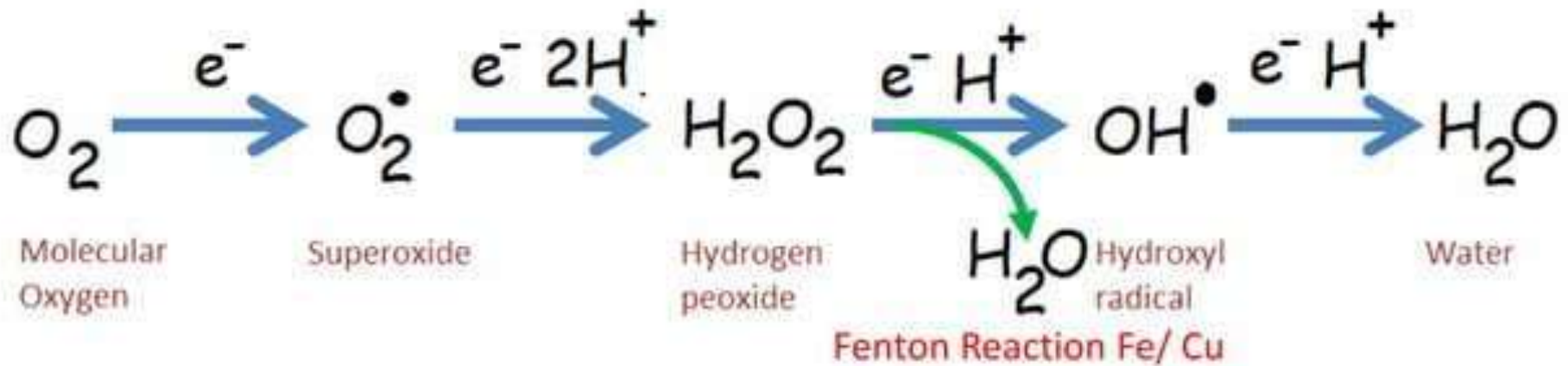
Examples of free radicals

Reactive oxygen species	Reactive Nitrogen species
Super oxide O_2^-	Nitric oxide NO'
Hydrogen peroxide H_2O_2	Peroxy nitrite $ONOO'$
Hydroxyl radical OH^-	
Singlet Oxygen 1O_2	Reactive metabolite
Hydroperoxyl radical HOO^-	Lipid peroxide radical ROO^-

Source of free radicals

Endogenous	Exogenous
Immune cell activation	Air and Water pollution
Lipid peroxidation	Tobacco smoking
Arginine metabolite, Oxidation of Heme	Alcohol consumption
Mental stress	Exposure to heavy metal toxins
Infection, Inflammation	Drugs and medication
Ischemia	Radiation and UV light
Cancer	

How free radicals are generated?



Most free radicals in biological system are derivatives of Oxygen [ROS]

Derivatives of Nitrogen [RNS],

Reactive metabolites or intermediates

Properties of free radicals

1. Unstable
2. Highly reactive
3. Having very short life
4. Generates new free radicals by chain reaction
5. Cause damage to biomolecules, cell and tissue

Functions of free radicals

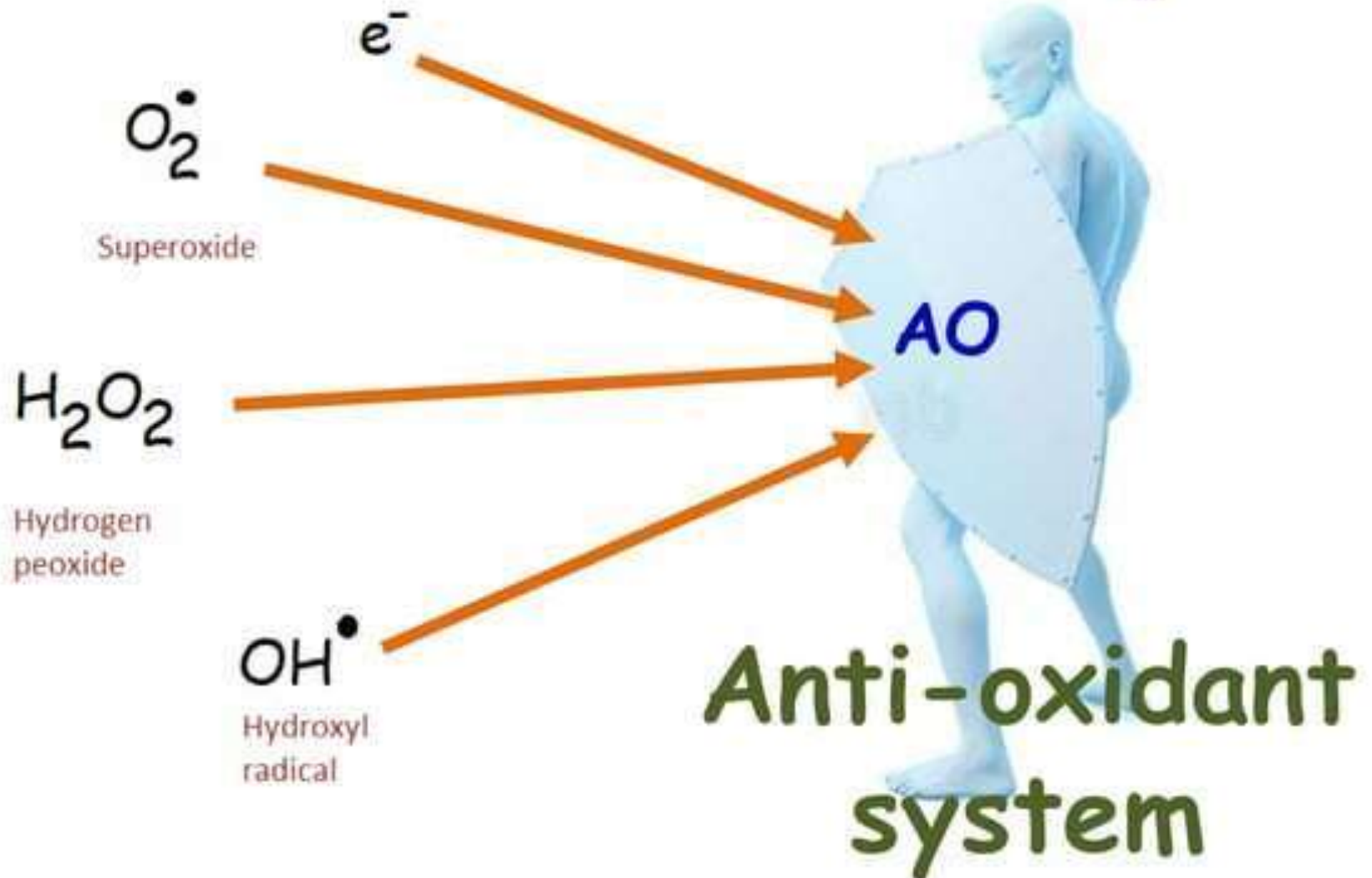
- Have two fold job, When in **balanced state -helpful**
When [loose balance] **unbalanced-damage** cell

Harmful effects of free radicals

1. Damage bio-membrane [lipid peroxidation]
2. Protein oxidation loss of protein function.
3. Damage to Glycation effect on receptors and signalling
4. DNA damage mutation and cancer

**Harmful
free radicals**

Defence system



What is Anti-oxidants?

A Compound that donate electron to free radical and make them stable



Anti-oxidant



Free Radical

Definition: Compounds that inhibit oxidation and prevent the ill effect of free radicals.

Types of Anti-oxidants

Enzymes	Vitamins	Minerals	Metabolites
Glutathione peroxidase	Vitamin E	Selenium	Glutathione
Catalase	Vitamin C	Zinc	Uric acid
Superoxide dismutase	Beta Carotenoids	Copper	Bilirubin
peroxidase	Vitamin A	Iron	Ceruloplasmin
Lactoferrin	Alpha lipoic acid		Transferrin
			Heptoglobin

Types based on action of Anti-oxidants

1. Scavenging or Primary Anti-oxidants	Vitamin E, Vitamin C, Carotenoids, Uric acid, Polyphenols, Flavanoids
2. Preventive or Secondary Anti-oxidant	SOD, Peroxidase, Catalase, Lactoferrin, Carotenoids,
3. Repair Anti-oxidants	Glutathione,

Functions of Anti-oxidants

1. Boost immune system
2. Protect against the effect of carcinogen
3. Neutralize ROS
4. Protect from oxidative damage to genetic material [DNA]

Brain

Depression,
Stroke
Memory loss,
AD, PD

Heart & blood vessels

Hypertension
Arteriosclerosis
Ischemia,
Cardiomyopathy

Eyes

Cataract
Retinal disease

Oxidative stress

Lungs

Asthma
Chronic bronchitis

Aging
Cancer
DM

Inflammation

Bone

Rheumatism
Arthritis

Kidneys

Glomerulonephritis
Chronic Renal failure

Oxidative stress markers.

- **Direct markers**

- **Lipid peroxidation [LPO]**
- Thiobarbituric acid reactive substances [TBARS], Malondialdehyde [MDA]
- Isoprostane
- **Protein carbonyl [PC]**

Indirect Markers

- SOD
- Catalase
- Glutathione reductase
- Glutathione peroxidase
- Glutathione s transferase
- Vitamin -E, C, A

Thank you

