



IIT KHARAGPUR



NPTEL ONLINE
CERTIFICATION COURSES

Organic Farming for Sustainable Agricultural Production

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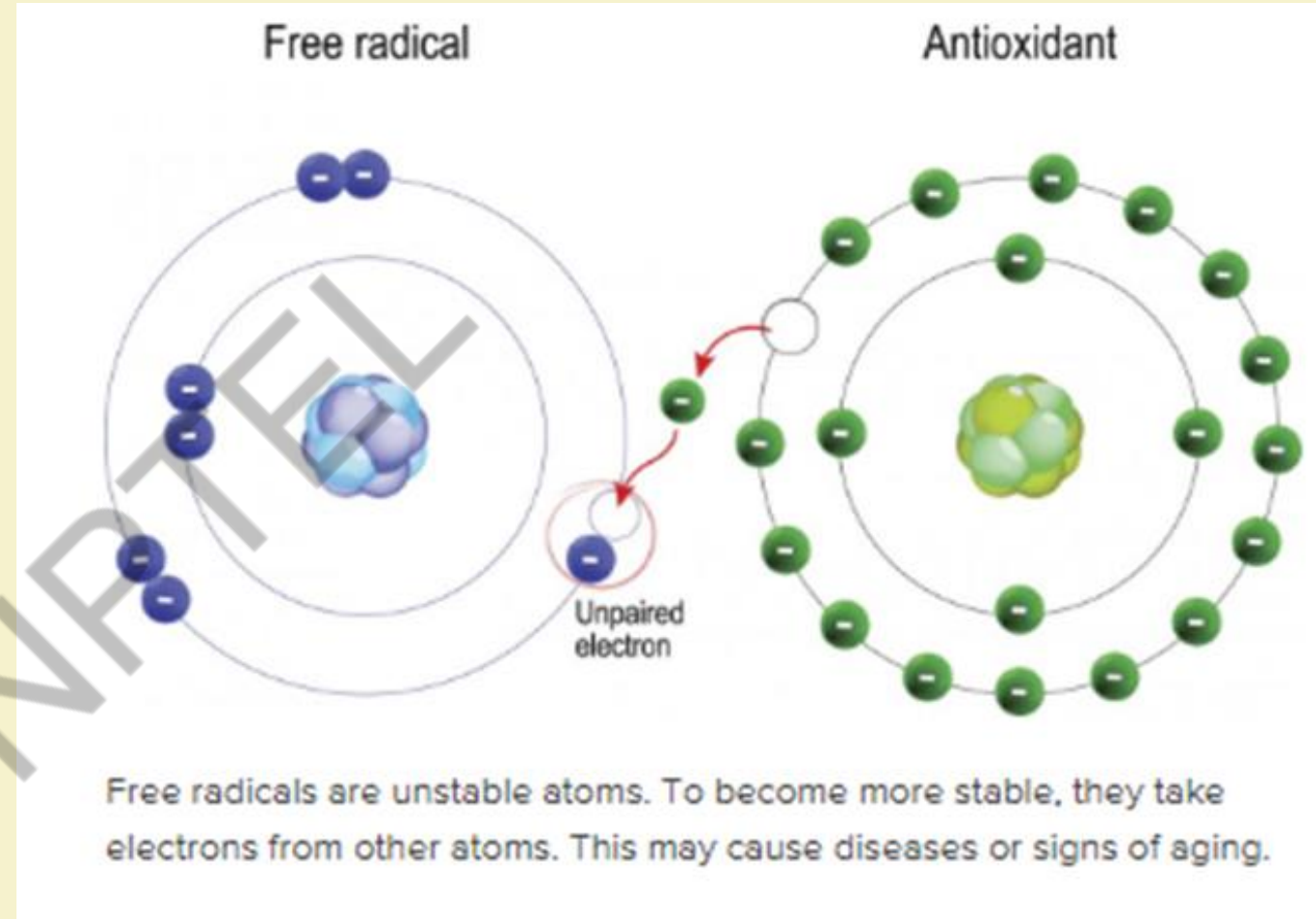
Agricultural and Food Engineering Department

Lecture 36 : Organic Food and Human Health

FREE RADICALS

Free radicals are unstable atoms that can damage cells, causing illness and aging.

As the body ages, it loses its ability to fight the effects of free radicals. The result is more free radicals, more oxidative stress, and more damage to cells, which leads to degenerative processes, as well as "normal" aging.



FREE RADICALS AND DISEASES

Various studies and theories have connected oxidative stress due to free radicals to:

- Central nervous system diseases, such as Alzheimer's and other dementias
- Cardiovascular disease due to clogged arteries
- Autoimmune and inflammatory disorders, such as rheumatoid arthritis and cancer
- Cataracts and age-related vision decline
- Age-related changes in appearance, such as loss of skin elasticity, wrinkles, graying hair, hair loss, and changes in hair texture
- Diabetes
- Genetic degenerative diseases, such as Huntington's disease or Parkinson's

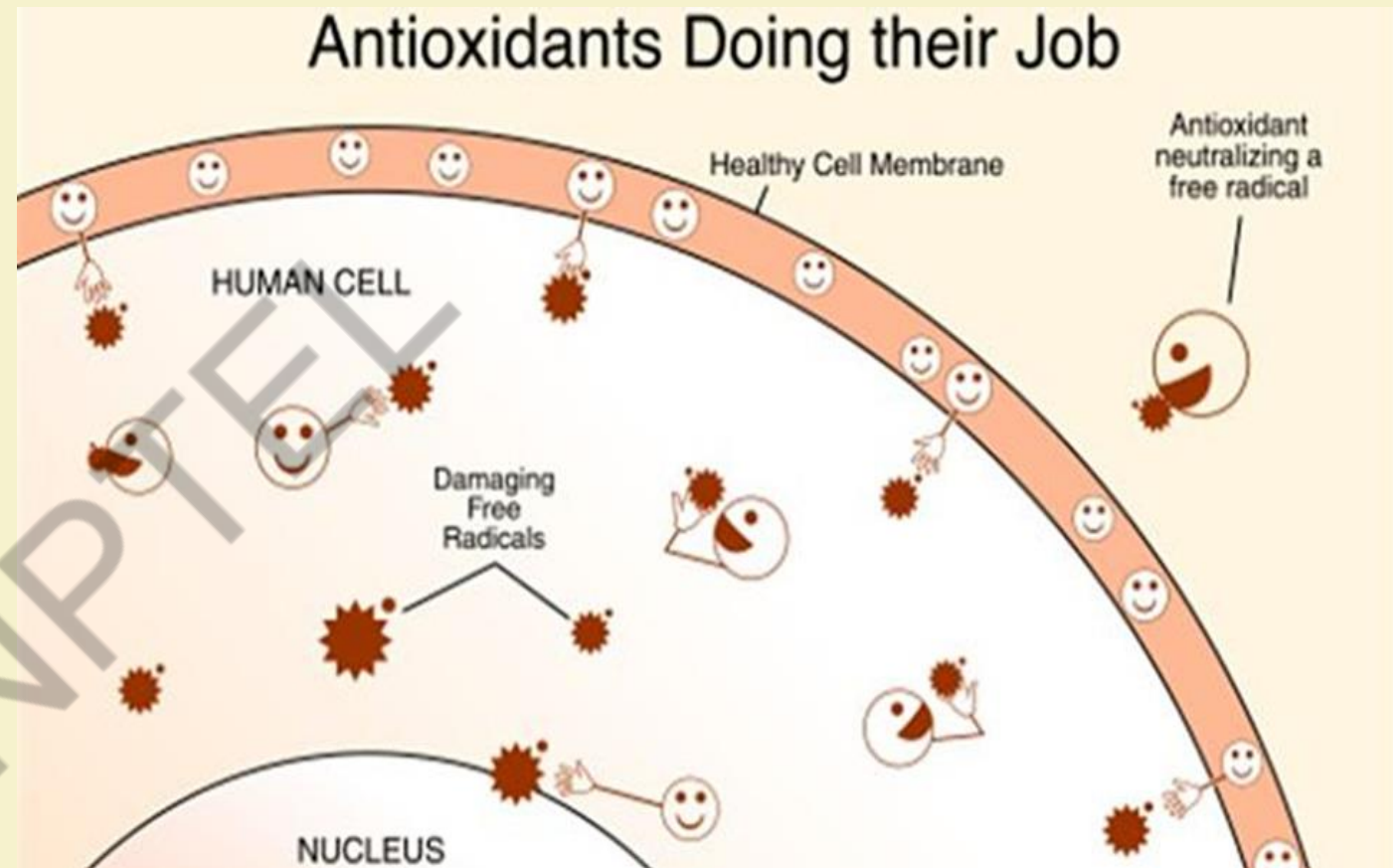
IMPLICATED DISEASE STATES



Antioxidants and Free radicals

Antioxidants are chemicals that lessen or prevent the effects of free radicals. They donate an electron to free radicals, thereby reducing their reactivity. What makes antioxidants unique is that they can donate an electron without becoming reactive free radicals themselves.

No single antioxidant can combat the effects of every free radical. Just as free radicals have different effects in different areas of the body, every antioxidant behaves differently due to its chemical properties.



Antioxidants for Diseases Control

Cancer:

- The damage to cells caused by free radicals, especially the damage to DNA, may play a role in the development of cancer and other health conditions.
- Antioxidants are chemicals that interact with and neutralize free radicals, thus preventing them from causing damage.
- The body makes some of the antioxidants that it uses to neutralize free radicals. These antioxidants are called endogenous antioxidants. However, the body relies on external (exogenous) sources, primarily the diet, to obtain the rest of the antioxidants it needs. These exogenous antioxidants are commonly called dietary antioxidants. Fruits, vegetables, and grains are rich sources of dietary antioxidants. Some dietary antioxidants are also available as dietary supplements
- Examples of dietary antioxidants include beta-carotene, lycopene, and vitamins A, C, and E (alpha-tocopherol).

Antioxidants for Diseases Control

Cardiovascular Diseases:

- Even though supplements did not prove beneficial in avoiding heart problems, foods that are sources of antioxidants are still recommended.
- Eating a diet rich in antioxidant-containing foods, such as fruits, vegetables and whole grains, is linked to a reduced risk of cardiovascular (heart and blood vessels) disease.

Asthma

Symptomatic asthma in adults is associated with a low dietary intake of fruit, the antioxidant nutrients vitamin C and manganese, and low plasma vitamin C levels. These findings suggest that diet may be a potentially modifiable risk factor for the development of asthma (Patel et al. 2006)

Patel, B.D. Welch, A. A. Bingham, S. A. Luben, R. N. Day, N. E. and Wareham, N. J. 2006. Dietary antioxidants and asthma in adults. [Thorax](#). 2006 May; 61(5): 388–393.

Cardiology update

26 June 2012

Antioxidant enzyme reduces CVD risk

Kate Aubusson

high activity of a particular antioxidant enzyme could significantly reduce the risk of cardiovascular disease, say the authors of a **new study**, after finding patients with a combination of low levels of the enzyme GPx3 and low HDL cholesterol were at greater risk of dying from CVD than patients with diabetes or pack-a-day smokers.

After comparing the GPx3 samples of 130 participants who died from CVD and 240 controls, the prospective study found patients with a combination of low GPx3 activity and low HDL cholesterol were up to six times more likely to die from CVD than patients with low levels of



The combo is a "major CVD risk"

HDL and high GPx3 activity.

"The serum GPx3 [glutathione peroxidase] activity was inversely and linearly correlated with CVD mortality, including coronary heart disease, other atherosclerotic disease and stroke," the authors from the US, South Korea and Norway reported in *PLoS ONE*.

The authors concluded the combination was a "major risk factor for CVD."

"In fact those with this combination appear to be at a greater risk of CVD mortality than that attributed to moderate hypertension, diabetes mellitus, smoking a pack of cigarettes per day or a LDL in the 200 mg/dL range," they wrote.

They hypothesised high levels of GPx3 activity in HDL particles would reduce oxidised lipids to their nontoxic metabolites, a protective function that may decrease vascular injury.

PLoS ONE, June 2012.
doi:10.1371/journal.pone.0038901

Antioxidants	Effect on Health
Polyphenol	<p>Inhibit oxidation of LDL, Inhibit platelet aggregation, Improve endothelial dysfunction</p> <p>Lower risk of myocardial infarction, Effect anticarcinogenic, Prevent neurodegenerative diseases, Protect against neurotoxic drugs, treatment of diabetes, treatment to prevent osteoporosis, Inhibit non-heme iron absorption</p>
Cu, Zn, Mn, Se Other carotenoids	Cofactors of antioxidant enzymes, Protection against oxidation of lipids, proteins and DNA. Abduction and free radical scavenging

Antioxidants	Effect on Health
Vitamin C	Protects against cancers, Protects from heart disease, Improvement of the health of cartilage, joints and skin, Maintaining a healthy immune system, Improvement in the antibody production, Increase in the absorption of nutrients
Vitamin A	Prevents coronary heart disease, Prevents the formation of blood clots Decreases incidence of breast and prostate cancers, Brain protection, Reduces long-term risk of dementia, Decreases risk of Parkinson's disease

Rajendran, P., Nandakumar, N., Rengarajan, T., Palaniswami, R., Gnanadhas, E.N., Lakshminarasaiah, U., Gopas, J. and Nishigaki, I., 2014. Antioxidants and human diseases. Clinica Chimica Acta, 436, pp.332-347.

Organic Food and Health

- In the “ Monastery Study” (Fuchs et al., 2005) improvement of physiological parameters was found among seventeen nuns eating biodynamic foods for one month. Nuns on biodynamic diet had lower blood pressure and better immune status. They also evaluated their physical fitness, intellectual acuity and overall well-being much better in this period. Moreover, they declared less headaches and presented better ability to handle stress.
- According to PARSIFAL study (14,000 children, 5 European countries) children representing anthroposophic lifestyle, including biodynamic and organic food, were found to have less allergies and lower body weight in comparison to group consuming market, conventionally produced foods (Alfven et al., 2006). At the same time the results of the KOALA Birth Cohort Study in the Netherlands (3,000 mothers and children) stated the consumption of organic dairy products with lower eczema risk in children (Kummeling et al., 2008).

Fuchs, N., Huber, K., Hennig, J. & Dlugosch, G. 2005. Influence of biodynamic nutrition on immunological parameters and well-being of post-menopausal women. Proceedings of the 1st scientific FQH conference in Frick, pp. 63-67

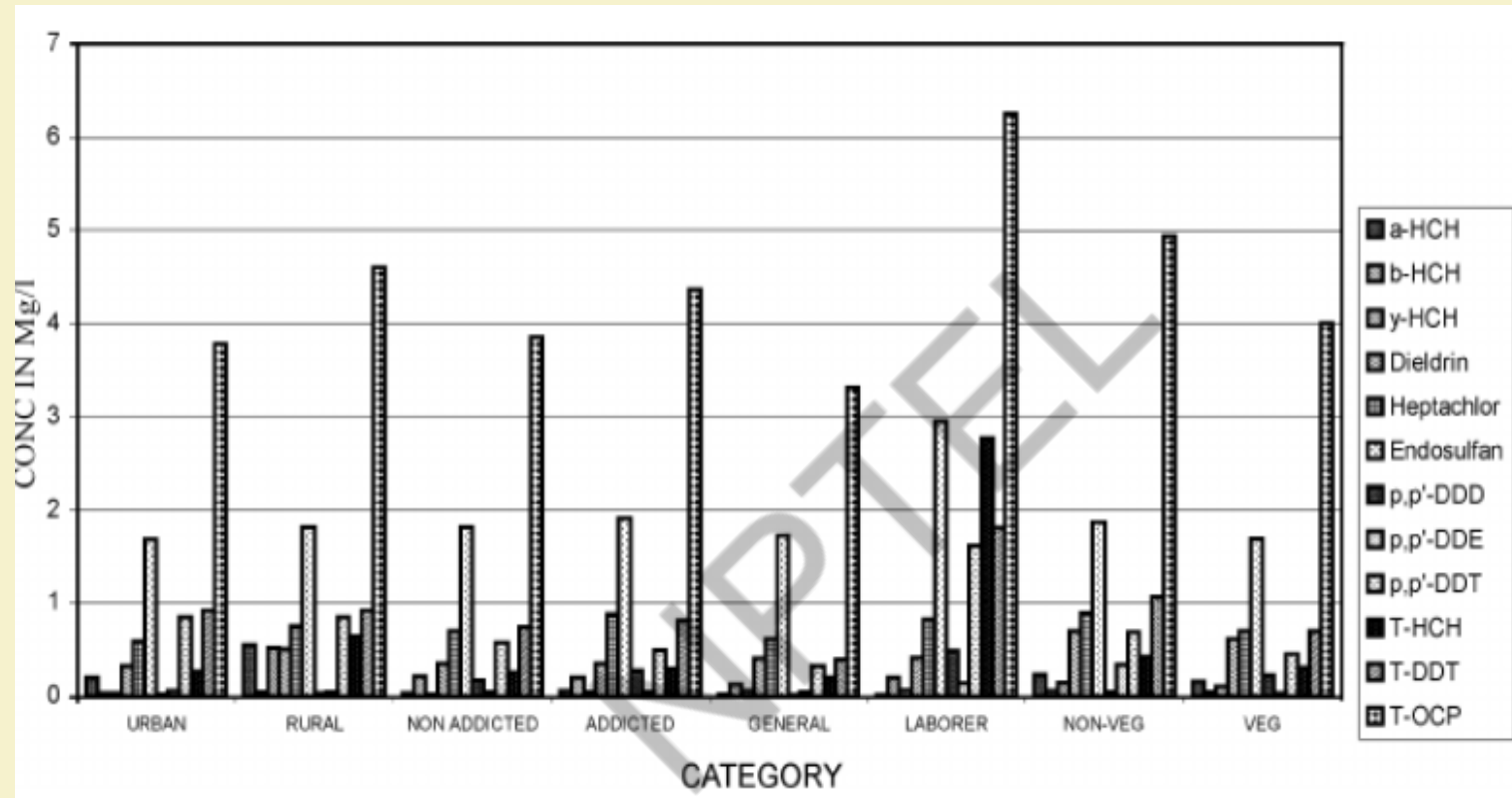
Alfven, T., Braun-Fahrlander, C., Brunekreef, B., von Mutius, E., Riedler, J., Scheynius, A., van Hage, M., Wickman, M., Benz, M.R., Budde, J., Michels, K.B., Schram, D., Ublagger, E., Waser, M. & Pershagen, G. 2006. Allergic diseases and atopic sensitization in children related to farming and anthroposophic lifestyle - the PARSIFAL study. *Allergy* 61(4), 414-421

Kummeling, I., Thijs, C., Huber, M., van de Vijver, L.P., Snijders, B.E., Penders, J., Stelma, F., van Ree, R., van den Brandt, P.A. & Dagnelie, P.C. 2008. Consumption of organic foods and risk of atopic disease during the first 2 years of life in the Netherlands. *Br. J. Nutr.* 99(3), 598-605.

Organic Food and Health

- Pesticide residues belong to dangerous food contaminants, known to exert carcinogenic, genotoxic, neuro-destructive, endocrine and allergenic effects and found usually in higher contents in conventionally produced plant foods. There is scientific evidence that dietary exposure of children to organophosphorus pesticides, measured on the basis of the level of pesticide metabolites in urine samples, is much lower on organic than on conventional diet. It can be concluded that consumption of organic foods provides a protective effect against exposure to organophosphorus pesticides commonly used in agricultural production (Curl et al., 2003; Lu et al., 2006).
- Better repair of bacterial DNA and decrease of cancer cells proliferation on organic vs. conventional plant materials. Animal studies indicated better fertility indexes and increased immune parameters in organically fed animals.

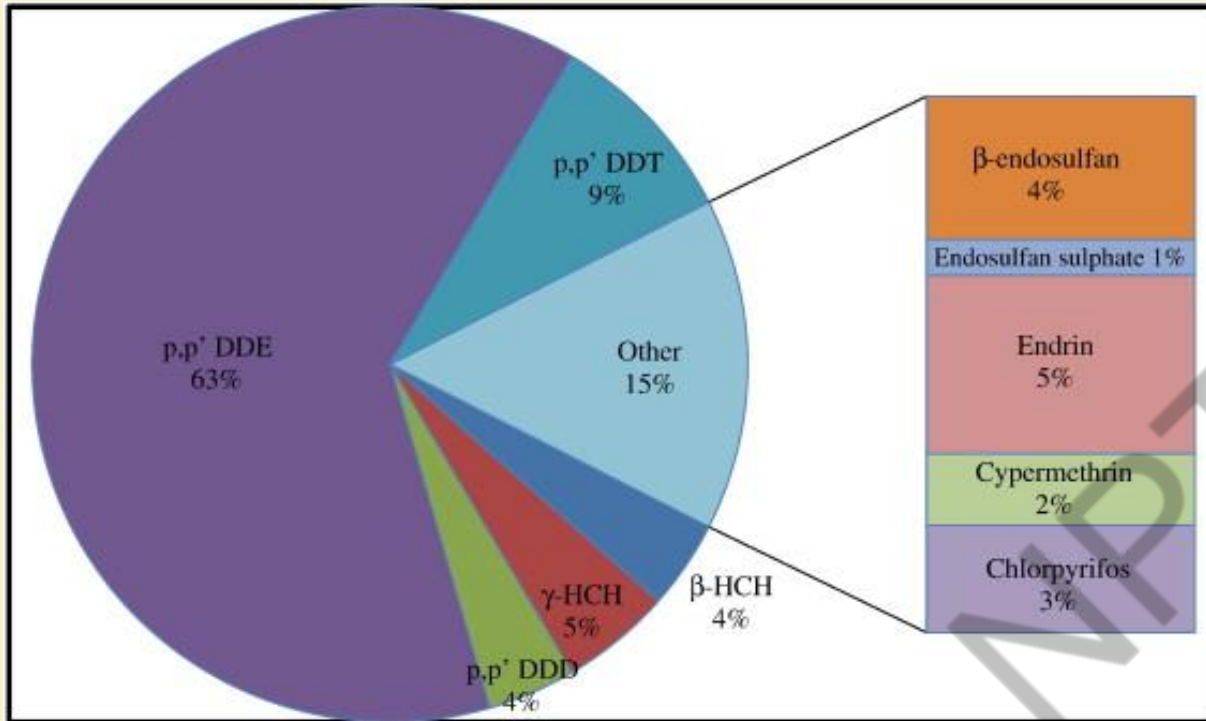
Pesticides Residues in Food Chain



Comparison of residue of organochlorine pesticide in blood of lactating mother from different category

Kumar, A., Baroth, A., Soni, I., Bhatnagar, P. and John, P.J., 2006. Organochlorine pesticide residues in milk and blood of women from Anupgarh, Rajasthan, India. Environmental monitoring and assessment, 116(1-3), pp.1-7.

Pesticides Residues in Food Chain



Percentage composition of pesticides in human breast milk

National and international comparison of HCH and DDT residue levels (ng g⁻¹ lipid wt.) in human breast milk

Country	Year	HCHs	DDTs
Canada	1996	23	470
Australia	2003	80.3	319.6
USA	2004	19	65
India			
Nagaon	2010	2717	3206
Delhi	2006	340	1500
Kolkata	2005	670	1100
Ludhiana	1993	5290	17910
Punjab	1998	8609	18211
Punjab	2012	199.6	1914

Bedi J., Gill JPS, Aulakh RS, Kaur P., Sharma A., Pooni PA. 2013. Pesticide residues in human breast milk: Risk assessment for infants from Punjab, India, Science of The Total Environment, 463-464: 720-726