



reactions, setting off a chain reaction. Most free radicals unlike foreign invaders such as bacteria and viruses, are produced as a normal part of the body's use of oxygen but their production is not limited to oxygen based only. They are also generated by non-oxygen based molecules and atoms. In healthful conditions a sufficient number of these components are used in the body. The remaining ones kill bacteria or virus and the defense mechanism of the body acts upon the remaining ones and the life process goes on. The main protective enzymes which the body uses to counter the effect of excess free radicals are Superoxide dismutase (SOD), Catalase and Glutathione peroxidase. They scavenge and neutralise excess free radicals. If the defense mechanism of the body fails to combat them or they are not properly utilised in the body, these tiny silent killers pose a threat by injuring tissues, their proteins and fat contents, RNA and DNA thereby producing disease conditions like cancer, ischaemic heart diseases, triggering the process of atherosclerosis, ageing, tumour and what not.

### **Concept and Correlation in Ayurveda :**

The Indian system of medicine holds the view that all the diseases are caused by the derangement of metabolism (agni). The food that we eat can nourish the body through agni alone and not by itself. So much so that the life and death of an individual depends upon the proper or improper functioning of the agni. The central gastro-intestinal metabolic factors i.e., jatharagni, five intermediary metabolic factors i.e. bhutagnis and seven tissue metabolic factors i.e. dhatwagnis constitute the thirteen types of agni or metabolic factors in Ayurveda. Two types of products, one having nutritive property and the other is waste product are available in the process of digestion and metabolism.

They support one another and maintain the continuity of mutual association and nourishment of the body tissues.

The metabolic process may be defective at three levels that is at the level of gastro intestinal tract, at the level of intermediary metabolism in the liver and at the level of tissue metabolism. This product of metabolic disorder is technically called ama which literally means unripe. In the context of metabolism, it would mean defective or incomplete metabolism. And according to the Ayurvedic understanding the defective metabolic process is at the base of every type of disease excepting those which result from direct trauma.

The production of ama which is acute to begin with may tend to become chronic. In the acute condition it may cause the disease conditions like fever, diarrhoea and dysentery etc., in the sub acute and chronic form mal-absorption, hepatic disorders and disease of the liver, ascitis, anaemia, diabetes, rheumatism, atherosclerosis, cardiovascular and neurodegenerative diseases and cancer. The superfluous production of free radicals in the scope of Ayurveda can be correlated with the production of ama which is said to be unripe, putrified and poisonous, which, if unchecked, is subjected to functional and organic disorders as stated above.

The ama having the precursors of different diseases in the form of highly reactive electrochemically unstable atoms and molecules (free radicals) is the initiator in the neurohumoral, metabolic and cytoplasmic events (tridosas). The improper enzymatic and hormonal activity including that of enzymatic free radical scavengers and decreased defense mechanism of the body (ojokshaya) at the cellular level are the important factors to allow the free radicals to cause havoc in the form of different

diseases.

### **Management**

The strength of the enzymatic activities at the cellular level (dhatwagni) depends upon the central gastro intestinal metabolic factors (jatharagni) and the defense mechanism (ojabala) depends upon the proper digestion of the nutritive elements, their uninterrupted delivery to the target cells which subsequently results into the replenishment of the body tissues.

The management of free radicals according to the Ayurvedic inference aims at correcting both internal as well as external environment of the body to achieve unison with the nature.

### **Diet, Digestion and Purification :**

As excellent food and digestion are critical to robust health, Ayurveda has contributed one of its branches on the subject of diet and digestion by suggesting different techniques for improving digestion and treating digestive disorders including the selection of proper food according to the digestive capacity (agnibala) of an individual. Proper conversion of food into bodily substances depends upon the potency of the jatharagni. Impaired digestion and metabolic process is dealt in Ayurveda with the concept of appetiser and digestive (dipana and pacana) drugs. It is because, that most of the treatment modalities of this system contain such drugs. The optimal maintenance of jatharagni results in the maintenance of different levels of metabolism thus restricting the formation of ama. Alongwith, it also ensures the proper activity of enzymatic free radicals scavengers.

In order to render the body free from ama, pollutants and other pathogenic impurities, if accumulated, five purifactory processes (panca karma therapy) have been detailed.

### **Biological Rhythms**

The ideal health involves the orchestration of billions of elements cells, nerves, muscles, liagaments, bones, joints, tendons, organs, glands, system, humors and senses by intelligently observing the circadian (dina carya and ratri carya) and circannual (rtu carya) rhythms as discussed in detail in Ayurveda. This idea of a connection between patterns of order in nature and in the human body was clear to the physician seers of Ayurveda millennia ago.

### **Behaviour, Emotions and the Senses :**

Human body is not a frozen lake. It is a turbulent river of ever changing thoughts, emotions, sentiments moods, priorities, loyalties and interests. And it all depends upon the psychic traits of the individual whether intelligent (satvika), energetic (rajasika) or dull (tamsika). It is on account of this only that stress has been laid down in the Indian scriptures upon satvika mental make up which is characterised by knowledge, critical scientific reasoning, courage and sharp memory. Fibrous and vegetarian diet and fruits are rich in the qualities which increase intelligence (satva guna) thereby limiting the production of free radicals and induction of natural free radical scavengers in the body. Although ageing and death are inevitable, yet this sort of life style and mental make up surely and certainly delays the process of ageing and disease, adding life to the years if not years to life. Our ancient seers always perceived of healthy life of over hundred years by adopting these traits. The speedy return of west towards vegetarianism contradictory to Rudyard Kiplings saying, "The East is East and the West is West and never the twain shall meet" is transformation of this ideology. It is purely on account of satva guna that qualities like

mental equipoise, clarity of thought, assertiveness, cheerfulness, power of reasoning etc. are generated. Apart from it the mental pollution by negative thoughts such as those of jealousy, anger, greed, possessiveness, stressful conditions are accompanied by high plasma levels of glucocorticoids and catecholamines, increase in lipid free radicals and reduction of natural free radical scavengers. Here also the Ayurvedic system cautions us against the deleterious effect of such emotions by observing good conduct (acara rasayana) thereby neutralising all the mental pollution by giving room to the positive feelings of forbearance, non violence, non stealing and celibacy. This type of psychic make up obviously decreases the production of free radicals by bringing a change in the life style thereby inducing more of free radical scavengers.

### **Revitalisation :**

It was well within the knowledge of Ayurvedists of yore that human machinery unlike the machinery employed in factories and industries is susceptible to stressful conditions which can result into faulty functions or its total breakdown. In order to combat similar conditions, the provision of revitalisation (rasayana therapy) was already made. Rasayana therapy aims specially at the promotion of strength and vitality. The usefulness of this therapy has been so described, "it contributes to the longevity, promotion of memory and intelligence, immunity against disease and decay, preservation of youth, lustrous complexion and voice and the maintenance of optimum strength of the body and senses." It confers the capacity for the achievement of what is said and the command of the respect and regard of people and the promotion of bodily glow. Various measures comprehended by

this therapy are known by a single term, rasayana, because they conduce to the replenishment of body elements (rasa and other dhatus). In this series a number of drugs have been prescribed to be used in different ways. The important among them are *Bacopa monnieri* Linn. (Brahmi) *Ocimum sanctum* Linn. (Tulsi), *Withania somnifera* Dunal. (Aswagandha), *Tinospora cordifolia* Meirs. (Guduci), *Acorus calamus* Linn. (Vaca) and *Phyllanthus emblica* Linn. (Amalaki). These and similar drugs are being used with success by Ayurvedic physicians till date. Various scientists and researchers from different disciplines have proved their efficacy as immunomodulators, antistress and adaptogenic agents which decrease acetyl choline, catecholamines, 5 HT levels and increase serotonin and endorphins in the brain tissue. Once the immune system is potentiated, the menace of free radicals will be solved to a great extent.

### **Role of Clarified Butter :**

The alien concept of discarding the use of clarified butter (ghee) and the use of unsaturated fats as cooking medium or otherwise also does not hold good. In Ayurvedic system of medicine a number of medicines are either prepared in ghee or they contain ghee as a major constituent. It has now been proved that digestion, absorption and delivery to a target organ is crucial in obtaining the maximum benefit from any formulation. This is facilitated by ghee. Since active ingredients are mixed with ghee, they are easily digested and absorbed. Lipophilic action of ghee facilitates transportation to a target organ and final delivery inside the cell because cell membrane also contains lipid. This lipophilic nature of ghee facilitates entry of the formulation into the cell and its delivery to the mitochondria, microsome and nuclear

membrane. In the process of evaluating the activities of natural compounds, it has been found by means of sophisticated research that when herbs are mixed with ghee, their activity and utility gets potentiated many times.

Moreover, ghee contain carotene and vitamie E and both are known antioxidants. In Ayurvedic texts the properties of ghee have been given in detail - Bhavaprakasa, an authority on Ayurveda says, "Ghee is a rejuvenator, tasty, good for eyes, digestive stimulant, support glow and beauty, enchances stamina and sharpens memory, protects the body from various diseases and promotes longevity." We find Carvaka Darsana saying, "Yavata Jiveta Sukhama Jiveta, Rnama Krtva Ghrtama Pibeta (As long as you are alive, live happily and use ghee even at the cost of borrowing). Although said in some different context, yet it advocates the regular use of ghee.

### **Concept of Free Radicals Scavenger in Ayurveda :**

It has been told to us that acute myocardial infarction and revascularisation affected either by surgical bypass, baloon angioplasty or thrombolytic therapy causes ischaemia and reperfusion myocardial injury leading to a sudden burst of oxygen free radicals. The same probably applies to patients suffering from cancer and other degenerative diseases. If we could find out these people in the formative stages of their diseases and give them extra free radicals scavengers like SOD, we could prevent their disease.

The answer to this question seems to be very simple and easy. But the steps taken in this direction have not borne any fruit. Ingestion of tablets of SOD is not the solution to this problem as the enzyme has rich molecular weight, gets broken down by

digestive juices and becomes ineffective. If given by injection, even then the desired effect is not achieved as its half life is very short ( 6 minutes) and most of it is excreted by the kidneys before it reaches the site where it is required. Naturally, we require a scavenger of free radicals which has an ease of administration and a prolonged and sustained effect.

The Ayurvedic system of medicine here also, is meeting this challenge from the time immemorial. The herbal preparations used in this system in different forms of powders, tablets, fermented liquids and confections etc., are serving this purpose and are ready to face any challenge arising out of free radicals or in the wake of any new pathological condition. It has now been realised that plants and herbs which are grown in proper sunlight have large quantities of free radical scavengers like SOD and other antioxidants with SOD like properties. The antioxidants in plants and herbs are trapped within polymer structures. In order to make low molecular weight antioxidants available for human use special methods of slow heating with uniform gentle stirring have been advocated in this system. By adopting such techniques, large quantities of enzymes protease and amylase are released which help split these polymers and make available low molecular weight antioxidants for the oral use. This plant power which the present day science has started realising is being used by the physicians of Indian system of medicine since the time of the vedas.

### **Pollution Control :**

It has been observed that besides the generation free radicals during metabolism of superfluous components of nuclei of living cells and by the membranes of phagocytes, they are also produced by insecticides, weed

killers, anti cancer agents and chemicals used in processed foods. Atmospheric pollution, no doubt, plays an important role in the production of free radicals. In order to sustain the living process oxygen or prana vayu is an utmost necessity. But atmospheric pollution is there and therefore these free radicals will continue to be produced and harm the body unless they are acted upon by antioxidants in the body or pollution is controlled. It is no denying the fact that ecologists and environmentalists have starting realising this fact. Ozone layer depletion due to wastes of industrial produces and deforestation has plateaued this problem. But thank God it has aroused a consciousness also. Returning from chemical fertilizers, chemical insecticides, processed, preserved and fast foods to the conventional foods, the use of bioactive manure and insecticidal techniques derived from plant kingdom are the positive signs of change in the direction.

### **Conclusion :**

The World Health Organisation has estimated that 80% of the world population relies on traditional medicine for primary health care. It hardly matters whether it is Ayurvedic system, Unani, Siddha, Tibetan, Amchi, Chinese or Korean system. One thing which is common to all these systems is the use of herbal drugs in different forms confirming a state of unison with nature.

We can therefore easily conclude that the problem being posed by the free radicals is not only to be controlled at medical level but also at socio cultural level. Checking environmental pollution, controlling radiation and bringing a perceptible change in the life style of the people holds the key to

the degenerative physical as well psychosomatic diseases of the modern age. Ayurveda can lead the way in this direction and the need of the hour is to bring about an integrated inter-system approach i.e. taking the useful elements of all the system viz., Allopathy, Homeopathy, Unani, Siddha, Amchi etc. It must be remembered that mankind has suffered much due to unnatural living and over exploitation of the natural resources in the vain hope that it would bring relief, satisfaction, peace and comfort. However the experience of last few decades punctuated with the warnings of environmentalists and scientists should be an eye opener for all the well wishers of mankind. Free radicals can be checked and many diseases can be prevented without medicine, if we resort to the ideal way of living by observing circadian and circannual rhythms, creating a state of equilibrium of behaviour, emotions and senses by observing code of conduct as propounded by Ayurveda. It is no denying the fact that prevention is better than cure and the sooner this message goes home to the people the better it will be for them. Let us maintain the orchestral harmony between the man and the nature. Then only we can say, "Sarve Bhavantu Sukhinah, Sarve Santu Niramayah" (let every body be happy, let everybody be disease free).

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सारांश

## मुक्त अणुओं की संतर्जना- आयुर्वेदानुसार इनकी अवधारणा एवं प्रणयन ।

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प्रस्तुत लेख मुक्त अणुओं की संतर्जना एवं इनकी आयुर्वेद के परिपेक्ष में अवधारणा एवं प्रणयन का व्यापक पर्यवेक्षण है। यह लेख मुक्त अणुओं के निर्माण में उत्तरदायी वाहय एवं आभ्यन्तर हेतुओं के विभिन्न पक्षों को, विशिष्ट रूप से पाचन प्रक्रिया की विभिन्न अवस्थाओं में चयापचय क्रियाओं के फलस्वरूप आम की उत्पत्ति को भी प्रतिपादित करता है।

प्रस्तुत लेख का उद्देश्य मुक्त अणुओं के प्रणयन का आहार और पाचन, जैविकल्य, व्यवहार, मनोवेग, अनुभूति, मुक्त अणु अपमार्जिक हेतु, रसायन, घृत उपयोगिता एवं प्रदूषण नियंत्रण के संदर्भ में पुनर्विलोकन करना है ताकि जटिल तकनीकों का कम से कम प्रयोग करके इष्टतम स्वस्थावरस्था की स्थिति को बनाए रखा जा सके जिसके परिणाम स्वरूप से मनुष्य की लयात्मक ऐकरूपता बनी रहे।