

A conceptual study on understanding *Ama* concept with special reference to free radical theory

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Abstract

Ayurveda speaks the main cause of diseases is rooted in the impairment of the body's main fire, called *Agni*, the fire of digestion. Ayurveda views the health of the body as the functioning of a biological fire-governing metabolism. If this essential part is functioning effectively, the whole body will be nourished, full of life and vibrancy. Altered digestive functioning can lead to the production of *Ama*, a toxic material that initiates and promotes disease processes throughout the body. In the same way, free radicals are also found to be the root cause of many diseases. The majority of free radicals that damage biological systems are oxygen-free radicals, and these are more generally known as "Reactive Oxygen Species" (ROS). These are the main by-products formed in the cells of aerobic organisms, and can initiate autocatalytic reactions so that molecules to which they react are themselves converted into free radicals to propagate the chain of damage. Here we shall discuss about properties of both *Ama* and Free Radicals. The present article attempts to correlate the concept of Free radical with the concept of *Ama*.

Keywords: *Agni*; *Ama*; Free Radicals; Reactive Oxygen Species (ROS)

1. Introduction

1.1. Concept of *Ama*

According to Ayurveda proper diet and its digestion are main pillars of life. An improper diet or error in digestive process results in production of *Ama*, a toxic material that initiates and promotes disease processes. Whatever we ingest in our body through the mouth, in any form it does not get assimilated in the body in same form. The ingested food material undergoes a series of physical and chemical transformation before it is rendered acceptable by the body tissues. The transformation takes place by the action of a particular *Agni* on the ingested food material of particular substance. The transformation process entirely, depends upon the strength of this *Agni*. Stronger the *Agni*, quicker is the transformation and better transformation too. If this *Agni* is weak the transformation will be incomplete. Concept of *Ama* [1] has been stressed in Ayurveda with its vast application. *Ama* can be understood as:

- Incompletely digested food, Un-processed food,
- Food which is undergoing the process of digestion,
- Partially digested,
- Matter which requires further *ParinAma*.

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When this entity is retained in the body, it gradually produces impairment in the micro and macro channels of the body. It creates the condition of Srotovagunya that can lay the foundation of disease processes or can be converted into any form of disease [2]. This is the why Ayurveda has given much importance to the concept of *Ama*. As per the contemporary physiology a variety of transforming substances are present in the body like various enzymes, hormones, catalysts etc. When these are unable to function properly then different metabolites are formed which are not acquired by the body, further these go on accumulating in different systems affecting their normal functions. As per Ayurveda these can be considered as *Ama*.

1.2. Concept of Free Radicals

Oxygen, which is an indispensable element for life, can under certain situations cause severe deleterious effects in the human body. Most of the potentially harmful effects of the oxygen are due to the formation and activity of number of chemical compounds, known as Reactive oxygen species (ROS), which have tendency to donate oxygen to other substances resulting in formation of oxygen radicals and several non-radical oxidizing agents such as HOCl (Hypochlorous acid), hydrogen peroxide, ozone, etc. Many such reactive species are free radicals and have a surplus of one or more free floating electrons rather than having matched pairs and are therefore, unstable and highly reactive. This unstable configuration creates energy which is released through reactions with adjacent molecules, such as proteins, lipids, carbohydrates, and nucleic acids. These are the main by-products formed in the cells of aerobic organisms, and can initiate autocatalytic reactions so that molecules to which they react are themselves converted into free radicals to propagate the chain of damage.

A wide variety of oxygen free radicals and other reactive species can be formed in the human body and food system. *Ama* is not a single entity but is a generalized term which can be applicable for many malformed substances in the body and responsible for the production of various diseases. In the same way free radicals are also found to be the root cause of many diseases in contemporary science. [3, 4, 5]

2. Discussion

2.1. Similarities in *Ama*-free radical Cause of formation

2.1.1. Manas Hetu

Consumption of food in state of mental stress due to *Kama*, *Krodha*, *Lobha*, *Moha*, *Irshaya*, *Shoka*, *Bhaya*, *Lajja*, *Chinta*, *Mano Udvega*, *Manoglani* [6] etc. are important factors responsible for indigestion of food and production of *Ama* in the body.

Mental stress is known to trigger or enhance the production of Free Radical.

2.1.2. Mithya Ahara

Improper dietary habits cause *Agnimandata* leading to the production of *Ama* [7]

The types of food we eat can alter the degree of oxidative stress in the body. For example, 'advanced glycation end products' (AGE's) that are formed during the frying/ crisping of foods increase oxidative stress in the body so can lead to production of Free Radicals.

Also Exogenous factors like preservatives used in certain food products of today's instant and ready to eat food, pollutants, tobacco, smoke, drugs, xenobiotics, or radiation etc. lead to the formation of Free-radical.

2.1.3. Visha / Toxins [8]

Ama may be formed in the body as a result of *Vishaja Dravyas* or combination of *Vishaj Dravyas* like *Gara Visha*, *Visha* from *Viruddha Ahara* etc. Similarly certain toxic substances like heavy metal produce free radicals. Auto-oxidation, consequent inactivation of small molecules such as reduced thiols, flavins and electron transfer etc. are few such processes that trigger free radicals inside the body.

2.1.4. Mode of Production

Ama

Ama is produced due to inequilibrium of *Agni* at various levels.

Free radical

Free radicals are said to be produced in the body in abundance when equilibrium between its generation and body's primary defense is disturbed which includes the activity of certain enzymes like superoxide dismutase, catalase and glutathione peroxidase.

2.1.5. Classification

Ama

The human body contains about 10¹³ cells. Each cell of the body has its own *Agni* depending upon which many different types of *Ama* can be produced.

Free radical

Total number or types of free radicals are unknown. Depending upon the site and method of production many different forms of free radicals are produced.

2.1.6. Avipakvatva [9]

Ama as an intermediate metabolite

Ama

As per one of the definition, *Ama*, is a food state which is undergoing the process of digestion hence it can be considered that *Ama* exists in an incomplete or intermediate metabolic state. If this state remains in the body as such it can cause various diseases which has to be treated/neutralized after Deepana and Pachana.

Free radical

Certain enzymes produce radicals as intermediary substances, which are supposed to go into further metabolism, but they somehow jump out of the normal metabolic cycle and work as harmful entities.

2.2. State of their existence

Both *Ama* and Free Radical when produced, remains in Free State and hence termed asamyuktam.

Similarities in Guna of *Ama* and Free Radical

2.2.1. Daurgandhaya [10]

Ama

Ama being impartially processed metabolite has a quality Durgandha.

Free radical

Free radical causes the damage to cell membrane and leads to putrefaction as well as foul smell formation.

2.2.2. Bahupichchil [11]

Ama

Ama sticks to normal healthy body tissues very quickly due to its picchil quality.

Free radical

To seek stability in their structure Free radicals try to quickly stick to the healthy molecules thereby attacking the body and thus setting a chain reaction of destruction.

2.2.3. *Sadan sarvagatra*[12]

Ama

Ama affects the whole-body tissues.

Free radical

Free radicals can also *dAmage* the cells of body.

2.3. Similarities in Treatment Free Radical

Antioxidant is the answer to prevent body from the deleterious effects of Free Radicals. An antioxidant is a molecule that inhibits the oxidation of other molecules.

Oxidation is a chemical reaction involving the loss of electrons or an increase in oxidation state. Oxidation reactions can produce free radicals. In turn, these radicals can start chain reactions. When the chain reaction occurs in a cell, it can cause *dAmage* or death to the cell. Antioxidants terminate these chain reactions by removing free radical intermediates, and inhibit other oxidation reactions. They do this by being oxidized themselves, so antioxidants are often reducing agents such as thiols, ascorbic acid, or polyphenols. Plants and animals maintain complex systems of multiple types of antioxidants, such as glutathione, vitamin C, vitamin A, and vitamin E as well as enzymes such as catalase, superoxide dismutase and various peroxidases. Insufficient levels of antioxidants, or inhibition of the antioxidant enzymes, cause oxidative stress and may *dAmage* or kill cells. Oxidative stress is *dAmage* to cell structure and cell function by overly reactive oxygen-containing molecules and chronic excessive inflammation. Oxidative stress seems to play a significant role in many human diseases, including cancers. [13]

Ama

Line of Treatment of *Ama* includes - Langhana, Deepana, Pachana and Sodhana according to the Doshas. [14]. In order to find out a correlation on the basis of treatment between *Ama* and Free Radicals some Deepan drugs as included by Acharya Charak in Deepaniya Mahakashaya -Sunthi, Chitrak, Pippali, *Ama* pachan properties of Mustak, as per Yaajapurishiya Adhayaya and Mishreya, which has been coded by Acharya Sarangdhara in definition of Deepan dravyas are considered here. All of these drugs are proven to be rich in antioxidants. Action of above-mentioned drugs as per Ayurvedic Classics and their antioxidants composition are as mentioned below:

Sunthi, *Zingiber officinale* Roscoe-Zingiberaceae has been included by Acharya Charak in Dipaniya Mahakasaya[15] It contains a number of antioxidants such as beta-carotene, ascorbic acid, terpenoids, alkaloids, and polyphenols such as flavonoids, flavones glycosides, rutin etc. Easily cultivable, *Zingiber officinale* with its wide range of antioxidants is a major source of natural or phytochemical antioxidants. Various studies on the antioxidant properties of ginger species had been confined only to the rhizomes, which have been reported to have tyrosinase inhibiting properties. [16] Mishreya, *Foeniculum vulgare* Mill. Apiaceae Acharya Sarangdhara says Mishreya possesses Deepana properties.[17] It is a biennial medicinal plant belonging to the family Apiaceae (Umbelliferae) is a rich source of vitamin C. A one cup serving of fennel bulb provides 10.5 mg of vitamin C, or 17% of the daily value. Vitamin C boosts the immune system, and also functions as an antioxidant by protecting blood vessel walls from oxidation that contributes to cardiovascular disease. Fennel provides Phytochemical, including Anethole, Rutin and Quercetin, which function as antioxidants. They protect and repair *dAmage* resulting from excessive levels of free radicals. [18] Anand et al reported that fennel seed possesses anticancer activity owing to its antioxidant properties.[19] Chitrak, *Plumbago zeylanica* Linn.-Plumbaginaceae as per Acharya Charak plant possess Deepanaya, Pachaniya properties and is able to cure Gudshotha, Arsha and Shula. [20] Various studies have shown that the root of the plant and its constituents are credited with potential therapeutic properties including anti-atherogenic, cardiogenic, hepatoprotective and neuroprotective properties. Its active ingredient plumbagin have significant antioxidant abilities by free radical scavenging and superoxide radical scavenging assays. The plant roots extract revealed significant antioxidant activity as compared to standard flavonoid (quercetin). [21] In another study, *Plumbago zeylanica*, was tested for its possible in vivo protective effect against cyclophosphamide-induced genotoxicity and oxidative stress in Swiss albino mice.[22]

Mustak, *Cyperus rotundus* Linn.-Cyperaceae is known to exhibit Samgrahi, Deepaniya, Pachaniya properties.[23] The Extract of *Cyperus rotundus* has analgesic, anti-inflammatory, antioxidant and immunomodulatory effects due to presence of flavonoid, tannin and polyphenol contents. [24]

Pippali, Piper Longum Linn.- Piperaceae has been included by Acharya Charak in Deepaniya Mahakasaya. The phytochemical tests in various studies indicated the presence of alkaloids, glycosides, tannins, and flavonoids in the crude ethanolic extract. Several of such compounds are known to possess potent antioxidant activity. [25]

In the light of above mentioned action of Deepana and Pachana drugs and their antioxidant activity, it can be said on the basis of line of treatment also both *Ama* and Free radicals can again be correlated with each other.

3. Conclusion

Summing up above explanation it can be concluded that though *Agni*, the metabolic fire at various levels digests the food thoroughly and nourishes the body systems, but hypofunction or impaired function of these *Agnis* at various levels is the main factor concerned in the formation of *Ama* i.e. improper metabolism produces *Ama*. Further accumulation of byproduct of metabolism as well as metabolic waste that are not properly eliminated or utilized in the body can be considered as *Ama*. Here it is noteworthy that whenever there will be improper metabolism due to impaired functioning of *Agni* then only *Ama* will be formed. Free radicals which are also formed as intermediary byproduct of metabolism, have the tendency to damage various cells of the body. From the entire discussion regarding the various similarities between *Ama* and free radicals in terms of the general definition, properties, types, site of production, mechanism of producing diseases and the line of treatment, we can say that the concept of *Ama* in Ayurveda can be correlated with the Theory of Free Radical in Modern science.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there was no conflict of interest regarding the publication of manuscript.

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Author's short Biography



Dr. Sachinkumar Sahebrao Patil, I am working as a Ayurved Physician, Panchakarma Specialist since 17 Years. I am a BOARD OF STUDIES MEMBER for Paraclinical Ayurved Board of Maharashtra University of Health Sciences Nashik. I am a FACULTY MEMBER for Post Graduate Paraclinical Ayurved Board of Maharashtra University of Health Sciences, Nashik. I am working as a Research Faculty for Research Methodogy and Medical Statistics of Maharashtra University of Health Sciences, Nashik. I am a Ph.D. GUIDE for five Ph.D. Kayachikitsa (Medicine) students and M.D. GUIDE for 26 M.D. Kayachikitsa (Medicine) students out of which 18 M.D. Kayachikitsa (Medicine) students. My research experience is 14 Years. My research interest in Anxiety Disorder, Diabetes Mellitus, Obesity, Hyperacidity, Diarrhoea, Anaemia etc.