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Review Article

UNDERSTANDING THE CORELATION OF AMA CONCEPT AND FREE RADICAL THEORY WITH A CLINICAL INTERPRETATION

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4	Abstract
*Correspondence	Abstract
Dr. Shreevathsa	Than any other Medical science, Ayurveda is much more comprehensive in both its philosophical and scientific
HOD. P.G. Department of Avurveda	background. It's a common belief that a principle which can be experimented or demonstrated in laboratory is
Siddhanta Government Avurveda	science; otherwise it's a philosophy. It may be; why the subject of fundamental principle was neglected many a
Medical College Mysore India	times. In real sense Science means truth which can be demonstrated in laboratory or not; may be experimented
Notical Conege, Mysore, mana	in test tube or not. In the present article the theory of Ama has taken into consideration to justify the
DOI 40 5005/0004 (000 04040	philosophical depth of Ayurveda with its contemporary scientific understanding. The cause for production of
DOI: 10.7897/2321-6328.01318	Ama, way of its formation, characteristics and nature of affecting Dosa-Dhatu-Malas almost matches with the
	contemporary concept of Free radical theory. Therefore a sincere effort has been made here to understand the
	co-relation between these two theories by clinical evaluation of 20 cases of Amavata (Rheumatoid arthritis).
	Both the concepts are tried to compare many ways which helps to understand the pathology of the disease in
Article Received on: 29/07/13	better way. The study points that in a similar fashion how Ama reflects the severity of disease in Ayurveda so
Accepted on: 18/09/13	is free radical as per contemporary science. It can also be concluded that the value of Lipid peroxide measured
	from serum, which is an indicator of Free radical can be a future parameter to measure the depth of pathology.
	Keywords: Ama, Free radicals, Rheumatoid arthritis, Lipid peroxide.

INTRODUCTION

Ayurveda, the ancient medical system and the science of life can be considered as the art of healing and prolonging life. Philosophical and scientific base of Ayurveda is the rich store house of hidden treasure of principles and practices. As per Ayurveda, disease state is due to disturbances or deviation in the equilibrium of Dosa-Dhatu-Mala. The proper knowledge behind correction cannot be obtained without understanding the depth of pathology. Ama is an important factor in pathology of any disease. This concept resembles with contemporary concept of Free radical theory. The procedure to measure Lipid peroxide value previously was carried by Dr. A. Raghu in his thesis entitled with- The Concept of Bala with special reference to Body Defense Mechanisms¹.

Objectives of the Study

- To study the role of Ama in pathology.
- To study the role of Free radical in or for the pathological condition of Ama.
- To understand the pathology of Rheumatoid Arthritis based on the concept of Ama and Free radical.

Conceptual Review of Ama

Concept of Ama has been stressed in Ayurveda with its vast application. Ama (as per the different classics) can be understood as:- Incompletely digested food ,Un-processed

food, Food which is undergoing the process of digestion, Partially digested matter, Matter which require further Parinama.² When this entity is retained in the body, they gradually produce impairment in the micro and macro channels of the body. It creates the condition of Srotavaigunya and can be converted into any form of disease. It may be the cause why Ayurveda has given much importance to the concept of Ama than amaya.³ As per the contemporary physiology a variety of transforming and trans mutating substances are present in the body like enzymes, hormones, catalysts etc. When these are unable to function properly or entirely then different metabolites are formed which are not acquired by the body. On further these go on accumulating in different systems affecting their normal functions. With the language of Ayurveda these can be considered as Ama. The formation of Ama can be understood as follows:

- Dietetic indiscretions leading to formation of Ama: anasana (abstinence from food), heavy or indigestible food, putrefied food, ajirna (indigestion), over eating, ingestion of unwholesome food, cold or stale food or excessive fry and dehydrated food etc.
- Adverse effects of therapeutic measures like vamana, virechana, snehana lead to Ama formation: Emaciation or wasting by other systemic diseases.

- In compatible Desa, Kala.
- Volitional inhibition and production of natural urges.
- Anxiety and emotional instabilities: i.e. bhaya (fear complex), moha, irsa, udvega, lobha, mana etc.

Apart from these some other aspects can also be evaluated to understand the concept of Ama in a better way. They are:

- Improperly digested food leading to the formation of Ama. It produces symptoms like: Avipakwa, Asamyukta, Durgandha, Bahupicchila and Sadana etc.
- Accumulated mala in deep tissue is also called as Ama.
- The first stage of Dosa dusti can be called as Ama.
- Ama is compared with the spoiled Kodrava especially due to its poisonous effect.
- Since Ama possesses gunas like sita-sthira-dravapichhila-guru-manda-snigdha-sthula etc it increases kleda or secretion in srotas. It has a great affinity as well as resemblance to kapha.

From above all references it can be understood that the concept and formation of Ama depends upon the key factor i.e. Agni. Slight hypo functioning of this biological Agni lead to the formation of many metabolic toxins, leads to the ill effects of cells, tissues, organs, channels etc. This linearity of activities can be observed in the contemporary concept of free radical theory.

Concept of Free – Radical Theory

A species of atoms having the capacity of independent existence and unpaired electron at outermost orbit, very reactive chemically is called as free radical.⁴ In general it gives up or accepts an electron to stabilize their unpaired electron. In this process of acceptation and donation of free electron it will make another free radical. Most of the cases that newly produced free radical become unstable thus it can be react with another free radical, forming a chain of radical reaction with a search and destroy mission.⁵ One will be happy by listening that about 5 % of inhaled oxygen

converted to reactive oxygen species (ROS) i.e. free radical like O₂,OH, lipid peroxide etc. Among them lipid peroxide is more harmful being its life span is more than 07 seconds. In place others are extremely potent but short live (fraction of second). Lipid peroxide damages low density lipoprotein which carries cholesterol in such a way that it is no longer accepted by normal LDL receptors, which further lead to cholesterol deposition. Cell membranes are structurally made up of large amount of PUFA which are highly susceptible to oxidative attack. This brings in changes of membrane fluidity, permeability and disruption of cellular metabolic functions. Oxidation of the membrane lipoproteins, glycoloxidation and oxidation of DNA are the main cellular consequences of oxidative stress -ultimately leading of cell death. This damaged cells release various necrotic factors, protease enzymes present in the lysosomes and ROS which helps to attack the adjacent cell.

Correlation between Concept of Ama and Free Radical Theory

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. The linearity between the concepts of Ama and Free radical can be evaluated as follows (Table 1) and (Table 2).

Observing this linearity between the concepts of Ama and Free-radical theory i.e. especially the nature of their reaction to normal cell or atom, patients of Amavata (Rheumatoid Arthritis) were selected for the better understanding about their role on pathology. Depth understanding of pathology helps to cure the diseases also in a better way.

MATERIAL AND METHODS

A series of 20 patients diagnosed as Amavata were selected randomly from OPD of IPGT and RA, Jamnagar, India.

Criteria	Ama	Free radical
1.General	Generalized term which can be applied for many	The root cause of many diseases in contemporary science. ⁶
identification	malformed substances in the body which are	
	responsible for the production of various diseases.	
2.Production	Ama produces whenever there is malfunction of Agni	Free radicals are said to be produced in the body in abundance
	in the body	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.
3. Cause of	Mithya ahara vihara- Faulty dietary practices	Exogenous factors like pollutants, dangerous chemicals, certain
formation		food products, cigarette smoking etc lead to the formation of Free-
		radical (which are also the variety of Mithya ahara and vihara).
4.Ama with Visha	Ama is produced from vishaja dravyas like biological	Certain toxic substance like heavy metal produces free radicals.
origin	toxin, Gara visha, visha from Virudddha ahara etc.	Auto-oxidation, consequent inactivation of small molecules such
		as reduced Thiols, flavins and electron transfer etc. are few such
		processes by which free radical formation also goes on inside the
		body.
5. Types or	The body contains 100 trillion nos. of cell. Each cell of	Total number / types of free radicals are still not known.
classification	the body has its own Agni and depending upon it many	Depending upon the site and method of production many different
	different types of Ama can be produced.	forms of free radicals are produced
6.Ama as	Ama is also an intermediary metabolite in the process	Certain enzymes produce radicals as intermediary substances,
intermediate	of digestion which is also harmful to body.	which are supposed to go into further metabolism, but they
metabolites		somehow jump out of the normal metabolic cycle and work as
		harmful entities.

Table 1: Linearity between Ama and Free Radical

Table 2: Linearity between Ama and Free Radical in Properties

Criteria	Ama	Free radical
1. Avipakvam	This indicate that Ama exist in an incomplete metabolic state. (Incompletely digested/metabolized form of food).	Free radical is an atom/molecule that contains one or more unpaired electron, which requires neutralization by Antioxidants ^{7.8} .
2.State of their existence	Ama when produced remains in free state and hence termed asamyuktam.	Free -radicals also remain in free state.
3. Durgandham.	Ama the unprocessed metabolite has a quality Durgandha	Free radical causes the damage to cell membrane and leads to purifications as well as foul smell formation.
4.Bahupicchilam	Because of this quality Ama sticks to normal healthy body tissues very quickly.	To seek stability in their structure Free-radicals are also quickly attack the healthy molecules of the body and thus setting a chain reaction with search and destroy mission. ⁹
5.Sadanam sarvagatranam	Ama affects the whole body tissues.	The cells throughout body are continuously exposed to these damaging molecules

Inclusion Criteria

- Age- 35 65 years, either sex.
- Morning stiffness- more than 6 week's duration.
- Pain in 3 / more than 3 joints- more than 6 weeks duration.
- Pain in hand joints- more than 6 weeks duration.
- Symmetric arthritis- more than 6 week's duration.
- Presence of rheumatoid factor- nodules
- Serum rheumatoid factor- positive
- Radiographic changes.

Exclusion Criteria

- Age below 35 and more than 60 years.
- Secondary complication Severely damaged joint, bed ridden patient, pleuro-Pericardial disease etc.
- Serious illness Hepatic / Renal failure.
- With other variety of arthritis- gouty arthritis, tuberculosis arthritis.

Criteria for Analyzing Data

- Chief complaints of Rh. Arthritis
- Sign and symptoms of Ama.
- Physical examinations.
- Laboratory investigations
- Lipid peroxide value.

A scoring pattern has been followed based on the following parameters. The scoring pattern is follows (Table 3).

Chief Complaints of Rh. Arthritis

The chief complaints of Rh. Arthtritis evaluated for the study includes: Pain, morning stiffness, tenderness and swelling (Table 3 – Table 6)

Table 3: Scoring of Pain

Pain	Score
No pain	0
Occasional pain, no medication	1
Frequent pain ,medication required	2

Table 4: Scoring of Morning Stiffness

Morning stiffness	Score
No stiffness	0
Early morning stiffness – up to 30 minutes.	1
Early morning stiffness -more than 30 minutes.	2

Table 5: Scoring of Tenderness

Tenderness	Score
No tenderness	0
Tenderness but bearable	1
Tenderness but unbearable	2

Table 6: Scoring of Swelling

Swelling	Score
No swelling	0
Swelling on pitting	1
Swelling + recover after withdrawal of pressure	2

Signs and Symptoms of Ama

The signs and symptoms evaluated for the study includes agnimandya, asya vairasyata, angamarda, alasya, vid vibandha and bala bhransa. (Table 7 - Table 12)

Table 7: Scoring of Agnimandya

Agnimandya	Score
No Agnimandya	0
Occasional Agnimandya	1
Frequent Agnimandva	2

Table 8: Scoring of Asya Vairasyata

Asya Vairasyata	Score
Normal taste of mouth	0
Occasional unpleasant taste	1
Frequent unpleasant taste	2

Table 9: Scoring of Angamarda

Angamarda	Score
No Angamarda	0
Occasional angamarda but patient is able to do usual work	1
Frequent angamarda that patient is unable to do routine	2
work	

Table 10: Scoring of Alasya

Alasya	Score
No alasya	0
Starts work in time with efforts	1
Interruption affect in the completion of work	2

Table 11: Scoring of Vid Vibandha

Vid Vibandha	Score
No constipation	0
Constipation 1-2 times/week	1
Constipation 3 to 5 times/week,	2
associated with anaha, shula etc	

Table 12: Scoring of Balabhransa

Balabhransa	Score
No balabhransa	0
Feeling of balabhransa	1
Balabhransa associated with RPT suffering	2
of disease	

Physical Examinations

Functional test including walking time, grip power, pressing power, were done to know the functional power of extremities (Table 13). Walking time: Patients were asked to walk a distance of 150 fts and time taken has been recorded.

Table	13:	Scoring	of Walking	Time
		~~~~		

Walking time in seconds	Score
About 60 seconds	0
About 90 seconds	1
About 120 seconds	2

# **Grip Power**

Patients were asked to squeeze the inflamed cuff up to 50 mm of Hg of the Sphygmomanometer and the grip power has been recorded in mms of mercury depending upon the rise of mercury column.

Table	14:	Scoring	of Grip	Power
1 abic		Scoring	or omp	100001

Grip power (mm/Hg) Both for (1) Rt.	Score
Hand and (2) Lt. Hand	
Rise of Mercury column- 100 mm of	0
Hg to 120 mm of Hg	
Rise of Mercury column- 80 mm of Hg	1
to 100 mm of Hg	
Rise of Mercury column- 60 mm of Hg	2
to 80 mm of Hg	

# **Pressing Power**

Similarly when the patient presses the same inflated cuff up to 50 mmof Hg against a table then it is recorded as pressing power.

Table	15:	Scoring	of Pressing	Power
1 abic	10.	Scoring	of I ressing	10001

Pressing power (mm/Hg): Both for (1) Rt. Hand and (2) Lt. Hand	Score
Rise of Mercury column- 100 mm of Hg to	0
120 mm of Hg	
Rise of Mercury column- 80 mm of Hg to	1
100 mm of Hg	
Rise of Mercury column- 60 mm of Hg to	2
80 mm of Hg	

# Laboratory Investigation

ESR as well as Lipid peroxide values were assessed for the study (Table 16 - Table 17).

#### Table 16: Scoring of ESR Reading

ESR reading (mm/1 st H)	Score
< 20	0
21 - 40	1
41 - 60	2

# Lipid Peroxide Value

Free radical damage was assessed by measuring lipid peroxidation with TBARs (thiobarbituric acid reactions) method. Details of the test are as follows.

# Principle

Monaldehyde formed as the end product of free radical damages when react with thiobarbituric acid gives a pink color which has an absorbance at 535 nm.

# Reagents

(1) TBA - TCA reagent - Prepared by mixing 15 g of trichloroacitic acid (TCA) and 375 mg of thiobarbituric acid and making it up to 100 ml. with 0.25 N HCl. (2) 0.25 N HCl - prepared by mixing 2.1 ml of concentrated HCl and 97.9 ml distilled water.

# Procedure

Lipid peroxide (the index for free radical damage) content was calculated by the following method²¹. The Malonaldehyde formed from the breakdown of PUFA serves as a convenient index for determining the content of peroxidation reaction. 0.4 ml of serum with 1.6 ml of distilled water was mixed thoroughly with TCA-TBA HCl. After heating it in boiling water bath for 15 minutes and cooling down, the flocculent precipitate was separated by centrifugation at 1000 g for 10 minutes. Absorbance of sample was determined at 535 nm against blank and OD difference was taken for this observation.

# **Criteria for Scoring**

The range of Lipid Peroxide value observed in all 20 Patients were assessed in following way:-

Table	17:	Scoring	of	Lipid	Peroxide	Value

Lipid Peroxide Value (µmol/ml)	Score
Below 10 (µmol/ml)	0 (Very mild)
11-20 (µmol/ml)	1 (Moderate)
More than 21(µmol/ml)	2 (Severe)

The mild score has considered as normal; because any time, at any state Ama remain present in human system either at Jatharagni or Dhatwagni level.

# RESULTS

The data observed from all criteria are presented here in the following tables (Table 18 - Table 23). Table 18 indicates distribution of patients in percentage as per their degree of suffering in Chief complains.

S. No.	Criteria	Symptoms absent		Symptoms present in		Symptoms present in Severe forms	
				Moderate forms			
		Nos. of Pt.	In %age	Nos. of Pt.	In %age	Nos. of Pt.	In %age
01	Pain	04	20.00	10.00	50.00	06	30.00
02	Morning stiffness	01	05.00	10.00	50.00	09	45.00
03	Tenderness	04	20.00	11.00	55.00	05	25.00
04	Swelling	03	15.00	11.00	55.00	06	30.00

Table 19 indicates distribution of patients in percentage as per their degree of suffering in Ama lakshana.

S. No.	Criteria	Symptoms absent		Symptoms present in		Symptoms present in Severe	
				Moderate forms		TOTMS	
		Nos. of Pt.	In %age	Nos. of Pt.	In %age	Nos. of Pt.	In %age
01	Agnimandya	06	30.00	07.00	35.00	07	35.00
02	Asya Vairasya	05	25.00	13.00	65.00	02	10.00
03	Anga marda	03	15.00	09.00	45.00	08	40.00
04	Alasya	03	15.00	09.00	45.00	08	40.00
05	Bala bhramsa	03	15.00	07.00	35.00	10	50.00
06	Mala baddhata	02	10.00	10.00	50.00	08	40.00

Table 19: Degree of Suffering in Ama Lakshana

Table 20 indicates distribution of patients in percentage as per their degree of suffering observed in the criteria under Physical Examinations.

Table 20: Distribution of Patients Based on Observation under Physical Examinations

S. No.	Criteria	Symptoms absent		Symptoms present in Moderate forms		Symptoms present in Severe forms	
		Nos. of Pt.	In %age	Nos. of Pt.	In %age	Nos. of Pt.	In %age
01	Walking Time	01	05.00	09.00	45.00	10	50.00
02	Grip Power (Rt. Hand)	02	10.00	11.00	55.00	07	35.00
03	Grip Power (Lt. Hand)	09	45.00	10.00	50.00	01	05.00
04	Pressing power (Rt. Hand)	06	30.00	14.00	70.00	00	00.00
05	Pressing Power (Lt.Hand)	13	65.00	07.00	35.00	00	00.00

Table 21 indicates distribution of patients in percentage as per their degree of suffering observed in Laboratory investigation (ESR Value).

#### Table 21: Observation On ESR Value

S. No.	Criteria	ESR Value mm/1st H		ESR Value present in		ESR Value present in Severe	
				Moderate forms		forms	
		Nos. of Pt.	In %age	Nos. of Pt.	In %age	Nos. of Pt.	In %age
01	ESR Value	04	20.00	09.00	45.00	07	35.00

Table 22 indicates distribution of patients in percentage as per their degree of suffering observed in Lipid Peroxide Value.

#### Table 22: Observation on Lipid Peroxide Value

S. No.	Criteria	LP Value present in Mild forms		LP Value present in Moderate		LP Value present in Moderate	
		_		forms		forms	
		Nos. of Pt.	LP (µmol/ml)	Nos. of Pt.	LP (µmol/ml)	Nos. of Pt.	LP (µmol/ml)
01	LP Value	05	20.00	10.00	50.00	05	20.00

Table 23 indicates analyzing the data of five criteria (quoted from Table 16 - Table 20) in Normal, Moderate and Severe form.

Table 23: Over All Analysis Based on Assessment Criteria's

S. No.	Criteria	Normal in % age	Moderate in % age	Severe in % age
01	Pain	20.00	50.00	30.00
02	Morning stiffness	05.00	50.00	45.00
03	Tenderness	20.00	55.00	25.00
04	Swelling	15.00	55.00	30.00
05	Agnimandya	30.00	35.00	35.00
06	Asya Vairasya	25.00	65.00	10.00
07	Anga marda	15.00	45.00	40.00
08	Alasya	15.00	45.00	40.00
09	Bala bhramsa	15.00	35.00	50.00
10	Malabaddhata	10.00	50.00	40.00
11	Walking Time	05.00	45.00	50.00
12	Grip Power (Rt. Hand)	10.00	55.00	35.00
13	Grip Power (Lt. Hand)	45.00	50.00	05.00
14	Pressing Power (Rt. Hand)	30.00	70.00	00.00
15	Pressing Power (Lt. Hand)	65.00	35.00	00.00
16	ESR Value	20.00	45.00	35.00
Mean Percentage		21.56	48.43	29.37

#### Table 24: Relationship between Age and Lipid Peroxide Value

Criteria	Normal in % age	Moderate in % age	Severe in % age
Mean % age of 16 conventional parameter	21.56	48.43	29.37
Lipid peroxide value (µmol/ml)	20.00	50.00	20.00

#### DISCUSSION

As the disease goes on progressing, patient got more no. of symptoms and respective no. of pathological lesion with physical as well as laboratory foot print. To know the depth of pathology different criteria are analyzed. Assessment shows that pain was absent in 04 (20 %), Morning stiffness absent in 01 (05 %), Tenderness absent in 04 (20 %) and Swelling absent in 03 (15 %) no. of patient respectively. These symptoms moderately present in 10 (50 %), 10 (50 %), 11 (55 %), and 11 (55 %) no. of patient respectively. Again these symptoms were severely present in 06 (30 %); 09 (45 %); 05 (25 %) and 06 (30 %) no. of patient. Agnimandya was absent on 06 (30 %), Asyavairasya was absent in 05 (25 %), Angamarda was absent in 03 (15 %) Alasya in 03 (15 %), Balabhramsa in 03 (15 %) and Malabaddhata in 02 (10 %) no. of patient. These symptoms were moderately present in 07 (35 %), 13 (65 %). 09 (45 %), 09 (45 %). 07 (35 %) and 10 (50 %) no. of patient; whereas the symptoms were severely observed in 07 (35 %), 02 (10 %), 08 (40 %), 08 (40 %), 10 (50 %) and 08 (40 %) no. of patient respectively. Observation on walking time shows that one patient (05 %)cover the required distance by walking with given stipulated time. 02 (10 %) no. of patient had normal grip power in Rt. Hand ,09 (45 %) had normal grip power in Lt. hand. Observing the data under the criteria of Pressing power in Rt. Hand it shows that 06 (30 %) were normal, 13 (65 %) patients were normal in Pressing power in Lt. Hand. Under the given five criteria no's of moderately affected patients were 09 (45 %), 11 (55 %), 10 (50 %), 14 (70 %) and 07 (35 %) respectively. In this same criteria the no. of severely affected patients were 10 (50 %), 07 (35 %), 01 (05 %) respectively. Severe score were not observed in Pressing power in Rt. and Lt Hand. The observed data in ESR value mm/1st H shows that 04 (20 %) patients were with normal score, 09 (45 %) with moderate score and 07 (35 %) with severe score. The Lipid peroxide value observed in this table shows that 05 (20 %) no's of patient were with normal score, 10 (50 %) with moderate score and 05 (20 %) were with severe score. Total 17 criteria's were analyzed in this study. Where initial 16 criteria's are the conventional criteria's (routinely applicable in clinical practice) compared with value of Lipid peroxide. To know the relation the mean percentage of different sufferings in all 16 conventional criteria were compared with Lipid peroxide value. The relationship between age and Lipid peroxide value is exhibited in Table 24.

#### CONCLUSION

As the severity of disease has understood in Ayurveda on basis of Ama concept, similarly the theory of Free-Radical is in contemporary science. Amavata is such a disease that can be very firstly and repeatedly investigated with this parameter and with very low cost. This linearity in data helps to draw a conclusion that like other objective criteria, Lipid peroxide can be important criteria to assess the depth of pathology in the disease Rheumatoid Arthritis. More value of Lipid peroxide directly reflects the severe degree of pathology. Even just to know individual's health status Lipid peroxide value can be useful. Therefore to be free from disease and to be healthy one can do the regular check up of Lipid peroxide value.

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