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Original Article

A Study on Antioxidant from Natural Origin

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ABSTRACT

Antioxidants Are The Defense System Of The Body Against The Damage Of Reactive Oxygen Species, Which Is Normally Produced During The Various Physiological Processes In The Body. There Are Various Sources Of These Antioxidants Like Endogenous Antioxidant Present In The Body And Exogenous Food Source. In Recent Decades, Alternate Of Synthetic Food Antioxidants By Natural Ones Has Fostered Interest On Vegetable Sources And The Screening Of Inexpensive Raw Materials Particularly From The Agriculture For Identifying New Antioxidants. Polyphenols Are The Significant Plant Compounds With Antioxidant Activity, Though Not The Only Ones. Some But Not Only Restricted To Biological Properties Such As Anticarcinogenicity, Antimutagenicity, Antiallergenicity, And Antiaging Activity Have Been Reported For Natural And Synthetic Antioxidants. Among The Sources Of Natural Antioxidant's, The Most Important Are Those Coming From Routinely Consuming Vegetables And Fruits; However, Antioxidant From Other Plant And Agriculture Waste Should Not Be Ignored.

Keywords: Antioxidant, Natural Origin, Endogenous Antioxidant

INTRODUCTION

Antioxidant Are Nutraceuticals Whose Deficiency States Are Associated with Variety of Dreaded Disease Conditions, Namely, Cardio-Vascular Diseases, Diabetes, Cataracts, Rheumatoid Arthritis, Alzheimers Disease and Many Other. Phytochemicals Might Exert Antioxidant Action*in-Vivo* or In Food by Inhibiting Generation of Reactive Oxygen Species (ROS) Or by Directly Scavenging Free Radicals. Certain Compounds May Act *in Vivo*as Antioxidants by Rising the Level of Indogenous Antioxidant Defenes By Up-Regulating Expression Of The Genes In Coding Synergists Are Substance Which On Their Own Have Little Antioxidant Effect But May Enhance The Effect Of True Antioxidants By Reacting With Heavy Metal Ions Which Catalyse Auto-Oxidation. [1] Natural Antioxidants Compound Can Be Classified as Vitamins, Carotenoids, Hydroxycinnamatesand Flavanoids. Among All the Above, Flavanoids Is the Largest Group Of Antioxidants Which Are Almost Ubiquitous In Nature In Most Of The Fruits, Vegetables And Plant. The Various Types of Natural Antioxidant and Their Dietary Source Are Given In Table superoxide Dismutase (SOD), Catalase Or Glutathione Peroxidase. Antioxidant Can Be Broadly Derived into Three Categories

a) True Antioxidants
b) Reducing Agents
c) Antioxidant Synergist.

True Antioxidant React with Free Radicals and Block the Chain Reaction of The Free Radicals. Reducing Agent Have A Lower Redox Potential and Readily Get Oxidized and Are Found Effective Against Oxidizing Agents. [2] Oxygen Is an Essential Chemical Element in The Metabolism of Aerobic Organisms. However, It May Trigger Unfavorable Reactions, And There Has Been A Growing Interest In Studying The Role Of Its Reactive Species. Reactive Oxygen Species (ROS) Include Free Radicals Like the Superoxide Anion, Singlet Oxygen, Lipid Peroxides and The Hydroxyl Radical. These Reactive Species Are By-Products of The Normal Cellular Energy Production and Functional Activities, Presenting an Important Role In Cell Signaling, Apoptosis, Gene Expression And Ion Transportation. Nevertheless, If ROS Level Increase Intensely, It Can Results in Damage of Many Molecules, Including Proteins, Lipids, RNA and DNA, Since They Are Highly Reactive. Furthermore, The Production of

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Free Radicals Is Not Only Associated with The Normal Metabolic Processes in The Human Body (Endogenous Sources), But Can Also Be Due To Environmental Factors (Exogenous Sources) Such As Stress, Ozone Radiation, Pollution, Pesticides And Industrial Chemicals. [3,4,5,6,7,8] When Higher Production Of ROS In Relation To Their Removal By Biological Systems (Antioxidant Defenses) D Ion Transportation. Nevertheless, If ROS Levels Increase Intensely, It Can Result In Damage Of Many Molecules, Including Proteins, Lipids, RNA And DNA, Since They Are Highly Reactive. Furthermore occurs, It Is Called Oxidative Stress.

➢ **Antioxidants**

Vitamins C or Ascorbic Acid Is Often Claimed To Be An Important Antioxidant In Be Due To Free Radical Scavenging By Ascorbate And Dehydroascorbate Radical. Vitamin E Or -Tocopherol Delays Lipid Peroxidation by Reacting with Chain- Propagating Peroxy Radicals, Faster Than These Radical Can React with Proteins Or Fatty Acid Side-Chains. B-Carotene Has Remarkable Antioxidant Properties By Interacting With A Free Radical To Form B-Carotone-Derived Radical Which In The Presence Of Oxygen Forms A Peroxyl Radical.[10,11,12] Antioxidants Act At Different Levels In The Oxidative Sequence, Involving Lipids And The Extent To Which Oxidation Of Fatty Acids And Their Esters Occurs Depends On The Chemical Nutraceuticals Are The Medicinal Or Nutritional Components That Includes A Food, Plant Or Other Naturally Occurring Material That Is Used For Improvement Of Health By Prevention Or Treatment Of Disease. Their Prominent Health Benefits Can Be Found In The Domain Of Cardiovascular, Mental, Joint, Skin And Womwns Health Some Of The Nutraceuticals Are Prominently Used For Prevention Of Cancer And Others For Enhancement Of Sport Performance And Weight Management. Some of These Substances Can Be Isolated, Purified, Concentrated And Formulated In Variety Of Dosage Form, However Some Are Used Directly As Functional Food. Some Of These Isolated Naturally Nutraceuticals Substances And Herbs Which Are Used As Functional Foods Has Been Discuss Below.

Considering Their Important Health Effects, The Efficient Extraction Methods Of Natural Antioxidants, Appropriate Assessment Of Antioxidant Activity As Well As Their Main Resources From Food And Medicinal Plants Are Drawing Great Attention In Food Science And Nutrition. To Improve The Extraction Efficiency Of Antioxidant Components From Plant Materials, Several Green Nonconventional Methods Have Been Developed For Reducing Operational Time And Usage Of Organic Solvents, Such As Ultrasound-Assisted Extraction, Microwave-Assisted Extraction, Enzyme-Assisted Extraction, Pressurized Liquid Extraction, Supercritical Fluid Extraction, High Hydrostatic Pressure Extraction, Pulsed Electric Field Extraction And High Voltage Electrical Discharges Extraction. Moreover, To Further Assess the Antioxidant Capacities Of Extracts From Natural Products, Especially Those Frequently Consumed By People, Different Evaluation Assays Have Been Developed, E.G., Trolox Equivalence Antioxidant Capacity (TEAC) Assay, Ferric Ion Reducing Antioxidant Power (FRAP) Assay, Oxygen Radical Absorbance Capacity (ORAC) Assay, Inhibiting The Oxidation Of Low-density Lipoprotein (LDL) Assay, Cellular Antioxidant Activity Assay, Etc. These Assays Have Been Used for Ranking the Antioxidant Plants and Recommending Best Antioxidant Foods for Consumption. This Review Is Aimed At Summarizing The Extraction Methods of Natural Antioxidants, Assessment Methods Of Antioxidant Activity And Their Main Resources From Food And Medicinal Plants. [16,17,18,19,20]

Natural Nutraceuticals Substances: -

Certain Medicinal or Nutritional Components in Plants, Animals or Marine Sources Are Present in Very Small Proportion Such Components Can Be Isolated and Used as Supplement for Specific Health Benefit Or For Prevention Or Treatment Of Ill Health Polyunsaturated Fatty Acids, Glucosamine, Chondroitin, Methylsulphonylmethane, Melatonin, Carnitine, Octacosanol, Resveratrol, Etc., Are Such Substances That Cause Amelioration Of Health. [1]

Table No.1 Naturally Occurring Antioxidants

Antioxidants	Sources
Vitamins	
Vitamin C	Citrus Fruits, Vegetables
Vitamin E	Grains, Nuts, Oils
Carotenoids	
Carotene	Carrots, Sweet Potato
Lycopene	Tomatoes
Beta-Carotene	Carrots, Sweet Potato, Green Vegetables
Xanthophylls	
Beta-Cryptoxanthin	Mango, Papaya, Oranges
Lutein	Banana, Egg Yolk, Green Vegetables
Zeaxanthin	Paprika
Hydroxycinnamates	
Ferulic Acid	Cabbage, Spinach, Grains
Caffeic Acid	White Grapes, Olive, Spinach
Flavanoids	
Flavone	
Rutin	Buckwheat, Tobacco, *Eucalyptus* Spp.
Luteolin	Lemon, Red Pepper, Olive
Flavonols	
Quercetin	Onion, Apple Skin, Black Graps
Kaempferol	Grape Fruit, Tea
Flavonone	
Naringin	Citrus Peel
Taxifolin	Citrus Fruit
Chalcones	
Liquiritin	Liquorice
Anthocyanidins	
Cyanidin	Grapes, Strawberry
Delphnidin	Aubergin Skin
Catechins	
Epicatechin Gallate	Green Tea Polyphenols
Epigallocatechin Gallate	Green Tea Polyphenols

➢ **Classification of Antioxidants** Antioxidants Are Grouped into Two Namely.

(1) Primary or Natural Antioxidants.
(2) Secondary or Synthetic Antioxidants

(1) Primary or Natural Antioxidants

They Are the Chain Breaking Antioxidants Which React with Lipid Radicals and Convert Them Into more Stable Products Antioxidants of This Group Are Mainly Phenolic.

Antioxidants Minerals

These Are Co Factor of Antioxidants Enzymes. Their Absence Will Definitely Affect Metabolism of Many Macromolecules Such Carbohydrates. Examples Include Solenium, Copper, Iron, As Zinc and Manganese Anti-Oxidants Vitamins It Is Needed for Most Body Metabolic Functions. They Include Vitamin C (Figure 1). Vitamin E, Vitamin B

Phytochemicals - These Are Phenolic Compounds That Are Neither Vitamins nor Minerals. These Include:

Flavonoids:

These Are Phenolic Compounds That Give Vegetables, Fruits, Grains, Seeds Leaves, Flowers and Bark Their Colours, Catechins Are the Most Active Antioxidants In Green And Black Tea And Sesamol. Carotenoids Are Fat Soluble Colour In

Fruits and Vegetables. Beta Carotene, Which Is Rich in Carrot And Converted To Vitamin A When The Body Lacks Enough Of The Vitamin, Lycopene, High In Tomatoes And Zeaxantin Is High In Spinach And Other Dark Greens. Herbs and Spices-Source Include Diterpene, Rosmariquinone, Thyme, Nutmeg, Clove, Black Pepper, Ginger, Garlic and Curcumin and Derivatives.

(2) Secondary or Synthetic Antioxidants

These Are Phenolic Compounds That Pedorm The Function of Capturing Free Radicals and Stopping the Chain Reactions.

i. Butylated Hydroxyl Anisole (BHA) Ii.
ii. Butylatedhydroxyrotoluene (BHT) Iii.
iii. Propyl Gallate (PG) And Metal Chelating Agent (EDTA).
iv. Tertiary Butyl Hydroquinone (TBHQ)
v. Nordihydroguaretic Acid (NDGA). Primary or Natural Antioxidants [21,22,23]

Extraction Methods of Antioxidants from Foods and Medicinal Plants

Extraction Is the First and Crucial Step for Studying the Natural Antioxidants from Plants (Figure 1). Many Extraction Factors Play Important Roles in The Extraction Efficiency, Such as Type and Concentration Of Extraction Solvent, Extraction Temperature, Extraction Time, And Extraction Ph. Among Them, The Solvent Is One of The Most Influential Factors. Numerous Solvents Have Been Used for The Extraction Of Antioxidants From Food And Medicinal Plants. The Selection of Solvents Is Based on The Chemical Nature And Polarity Of Antioxidant Compounds To Be Extracted. Most of The Phenolics, Flavanoids And Anthocyanins Are Hydro Soluble Antioxidants. The Polar and Medium Polar Solvents, Such As Water, Ethanol, Methanol, Propanol, Acetone And Their Aqueous Mixtures, Are Widely Used For Extraction. [24,25,26,27] Carotenoids Are Lipid-Soluble Antioxidants, And Common Organic Solvents, Such As The Mixtures Of Hexane With Acetone, Ethanol, Methanol, Or Mixtures Of Ethyl Acetate With Acetone, Ethanol, Methanol, Have Been Used For Extraction. [28,29,30]. Various Extraction Procedures, Including Conventional Extraction Methods and Non-Conventional Extraction Methods, Can Be Chosen to Extract Antioxidants from Food and Medicinal Plants. The Conventional Extraction Methods Are Mainly Hot Water Bath, Maceration and Soxhlet Extraction, Which Are Very Time-Consuming and Require Relatively Large Amounts Of Organic Solvents With Low Extraction Yields. Furthermore, The Long Heating Process Such as Hot Water Bath and Soxhlet Extraction May Lead to the Degradation of the Thermolabile Compounds.

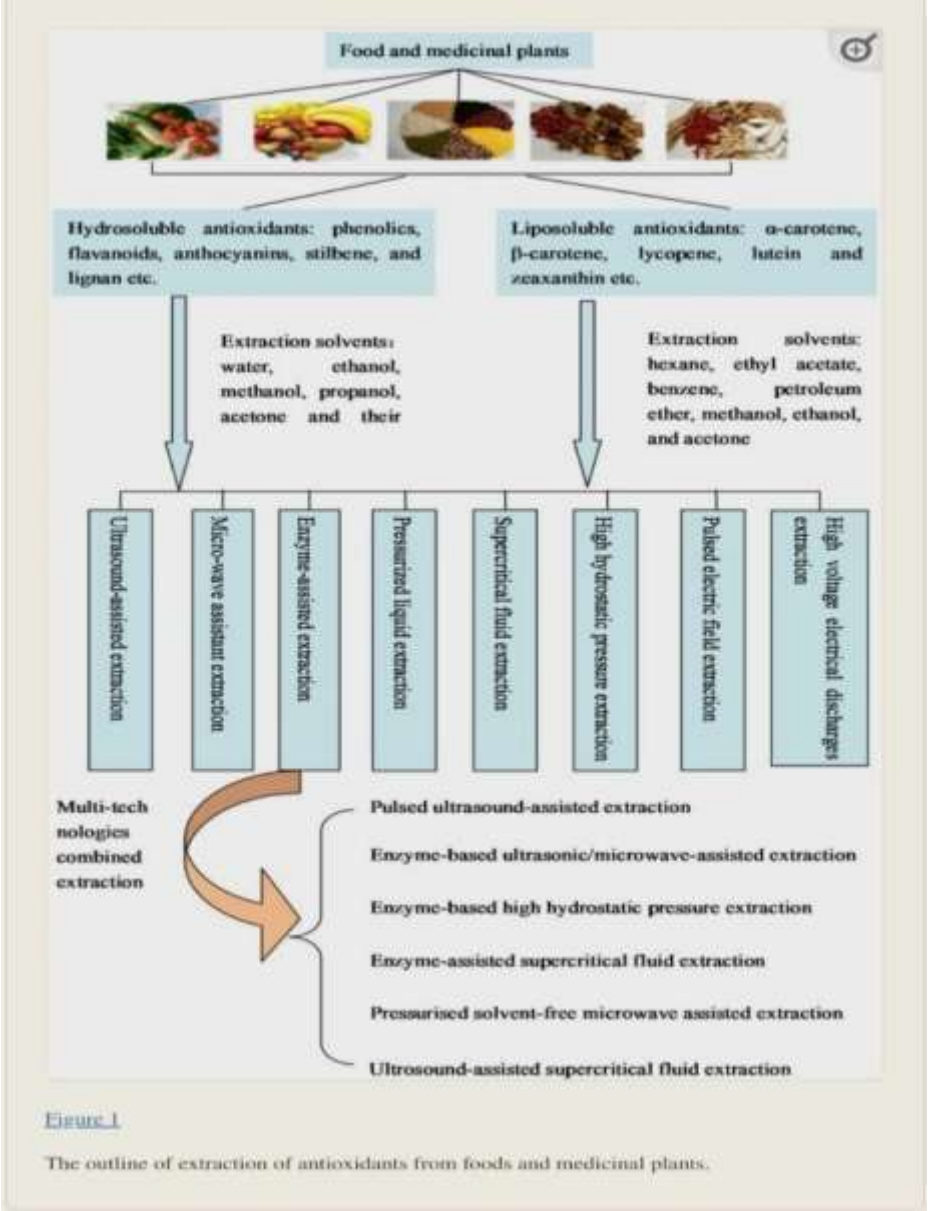

Fig NO.1theoutline Of Extraction

1.Ultrasound-Assistedextraction (UAE)

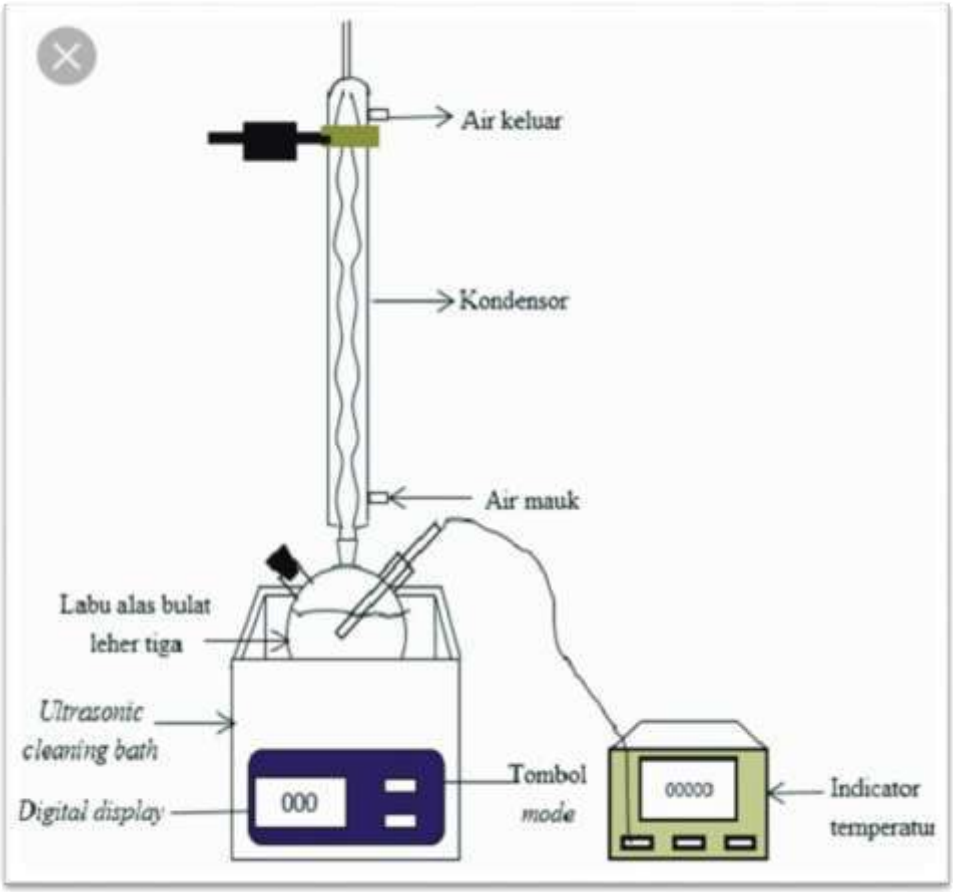

Fig No.2 Ultrasound Assisted Extraction

Ultrasound Assisted Extraction (UAE) Has Been Applied Widely In The Last Three Decades As An Efficient Extraction Method In The Food And Pharmaceutical Industries. [34] The Mechanism Is Based on The Cavitation Phenomenon. The Spread Of Ultrasound In Liquid Systems Is Via A Series Of Compression And Rarefaction Waves, Which Can Induce The Production Of Cavitation Bubbles Within The Fluid. [35] The Size Of These Bubbles Grow Over The Period Of A Few Cycles Until Reach A Critical Point, Then These Bubbles Collapse And Release A Great Quantity Of Energy, Which Would Generate Extreme Temperatures (5000 K) And Pressures (1000 Atmospheres) At Room Temperature. During the Ultrasound Assisted Extraction of Bioactive Components from Plant Materials, The High Temperature and Pressure Would Destroy the Cell Walls, Facilitate the Release Of Bioactive Compounds From Plant Cell Walls And Enhance The Mass Transport. The Heat Transfer Of UAE Is From Outside Of The Plant Cell To The Inside, Which Is In The Opposite Direction Of Microwave Assisted Extraction. [36]

2. Microwave-Assisted Extraction (MAE)

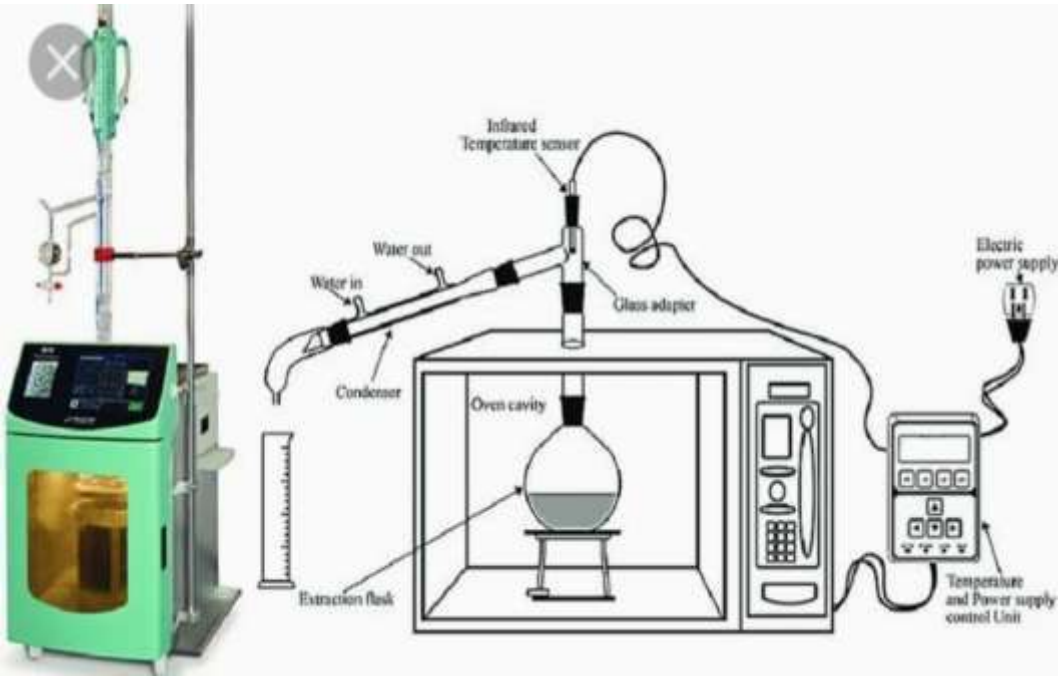

Fig No.3 Microwave-Assisted Extraction (MAE)

Microwave Is an Electromagnetic Radiation. During MAE, Microwave Can Deliver Energy to Solvent and Plant Matrix and The Energy Can Be Absorbed By Molecules Inside Plants, Particularly The Polar Molecules. The Severe Thermal, Localized Pressures And Mechanical Stress Caused By Microwave Significantly Change The Physical Properties Of The Cell Walls And Finally Result In Rupture Of Cell Walls And Release Of Target Components.[37,38] Since Microwave Irradiation Was Applied For The First Time In 1986, There Have Been Various Studies On MAE In The Recovery Of The Antioxidants From Plant Materials.[39,40] MAE Is Not Adaptable For The Extraction Of The Thermally Labile Antioxidants Due To The Thermal Effect From Microwave Irradiation, Which Might Result In The Reduction Of Extraction Yield. In Addition, MAE Is Only Applicable to The Extraction Solvents That Must Be Able to Absorb Microwaves. [41,42]

3. Enzyme-Assisted Extraction (EAE)

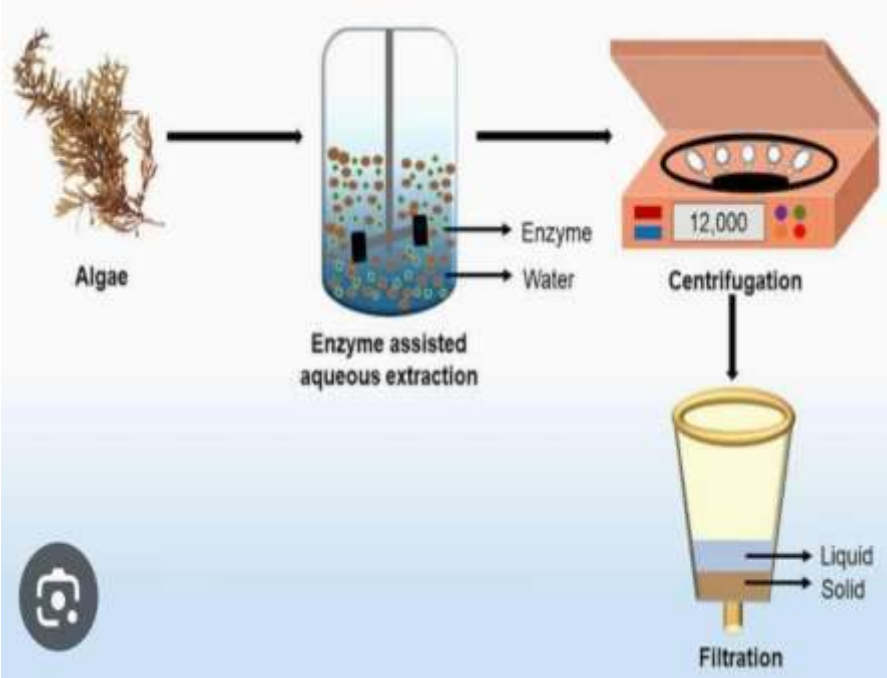

Fig No.4 Enzyme-Assisted Extraction (EAE).

Enzymes Have the Properties Of High Specificity And High Efficiency. Enzyme-Assisted Extraction (EAE) Is A Potential Green Extraction Method Because Of The Mild Extraction Conditions and Barely Any Effect On The Environment. [43] The Enzymes Could Degrade the Compositions and Destroy The Structural Integrity Of Plant Cell Wall, Which Enhance The Release Of Bioactive Compounds. Cellulase, Pectinase, Hemicellulase and B-Glucosidase Are Extensively Used in the EAE. These Enzymes Can Be Obtained from Various Materials Such as Bacteria, Fungi, Vegetable and Fruit Extracts, Or Animal Organs. [43,44] EAE Techniques Have Been Shown to Improve the Extraction Efficiencies for Antioxidants Including Phenolics, Flavonoids, Anthocyanins, And Carotenoids. [45,46]

4. Pressurized Liquid Extraction (PLE)

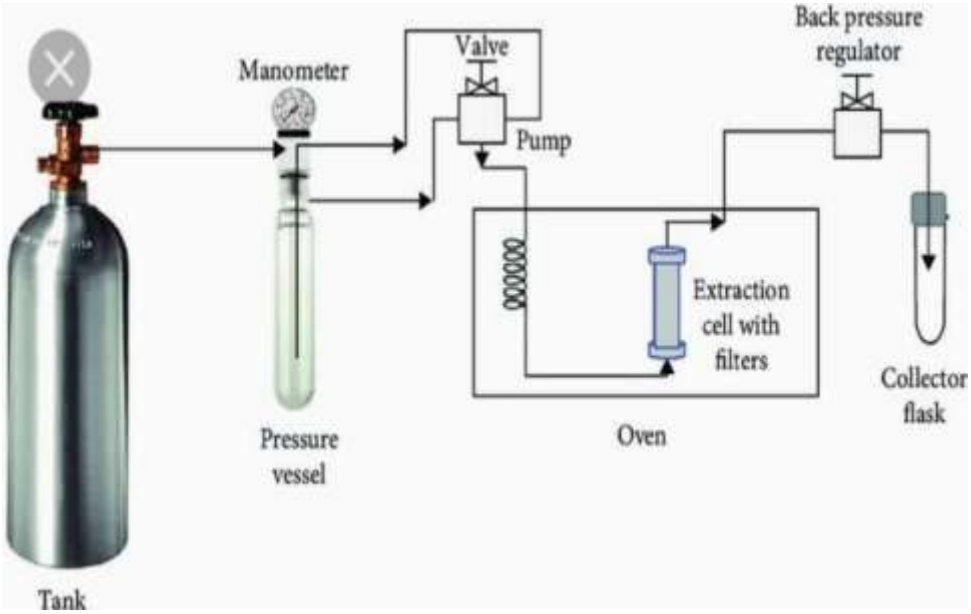

Fig No.5 Pressurized Liquid Extraction (PLE)

PLE Is Based on The Use Of Solvents At Elevated Temperature And Pressure To Extract Target Components From Various Matrices. [47,48] By Elevating The Pressure, The Temperature Of Solvent Under Liquid State Can Be Above Its Boiling Point At Normal Temperature, Which Can Enhance Masstransfer Rate And Promote The Solubility Of The Analytes. The Wide Ranges Of Temperature From Room Temperature To 200 °C And Pressure From 35 To 200 Bar Can Be Applied In PLE. When The Extraction Solvent Is Water, PLE Is Also Called Sub-Critical Water Extraction (SWE). When the Water Is Heated To 200–250 °C In SWE, It Can Be Maintained In Liquid State, While The Dielectric Constant (E) Of Water Is Decreased From 80 To 30–25, Which Is Close To The Dielectric Constant Of Some Organic Solvents Such As Ethanol Or Methanol. The Closed Dielectric Constants Mean The Similar Polarity Of The Organic Solvent. Although Not Viable For Every Application, The Use Of SWE Can Be Regarded As An Effective Alternative To Organic Solvents In Some Applications. Due To Free Of Organic Solvents, SWE Is Perceived As The "Greenest" Of The Ples. [48]

5. Supercritical Fluid Extraction (SFE)

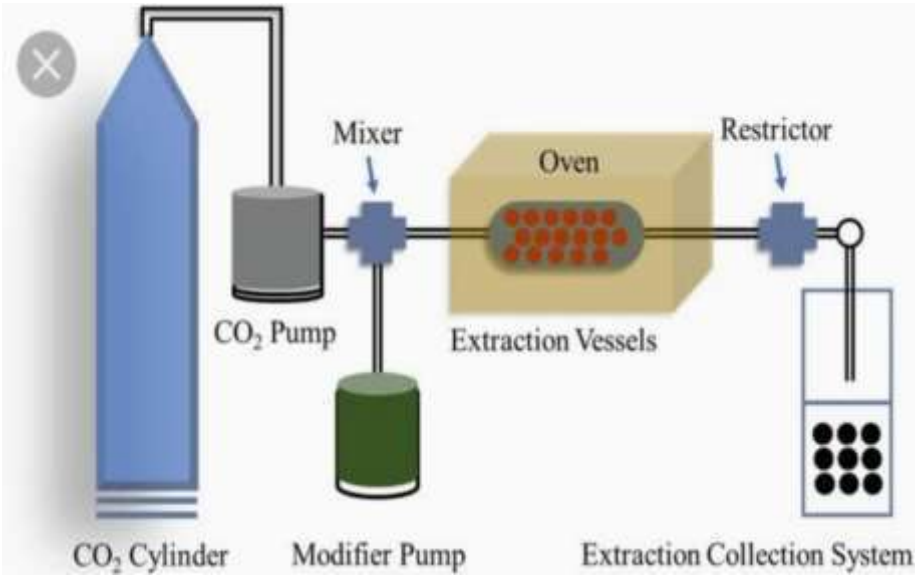

Fig No.6 Super-Critical Fluid Extraction (SFE)

Supercritical Fluid Extraction (SFE) As A Sustainable Green Technology Has Been Extensively Applied Since The Past Decades. Over The Critical Pressure (Pc) And Temperature (Tc), The Solvent Can Be Transformed Into The Supercritical State, Which Shows Liquid-Like (Solvent Power, Negligible Surface Tension) And Gas-Like (Elevated Diffusivity And Low Viscosity) Properties.[49,50,51] Even Though PLE And SFE Have In Common That They Conduct Under Medium-To-High Pressures, SFE Operate Using Solvents At Temperatures And Pressures Above Their Critical Points, Whereas PLE Is Based On The Use Of Liquids At Temperatures Above Their Normal Boiling Points. Compared with Normal Liquids, Supercritical Fluids Could Enhance Transport Properties, Which Can Diffuse Easily Through Solid Materials And Therefore Obtain Faster Extraction Rates. SFE Utilizes The Outstanding Physicochemical Properties Of Supercritical Fluids (SF) To Extract Target Components From Various Matrices. SFE Basically Contains Two Major Steps: Firstly, The Soluble Compounds From The Plant Material Are Extracted By The Supercritical Solvent, Then These Compounds Are Separated From The Supercritical Solvent By Rapidly Reducing The Pressure, Increasing The Temperature, Or Both. [50,51]

Therapeutic Uses of Antioxidants:

1. Anti-Cancer Agents in Medicinal Chemistry:

a) . Lanthanides as Anti-Cancer Agents:

A Lot of Metal-Based Drugs Are Widely Used in The Disease Treatment of Cancer. The Clinical Success of And Colitis Aging 'Cisplatin and Other Platinum Complexes Is Limited By Significant. Side Effects Are Acquired or Intrinsic Resistance. Therefore, Much Attention Has Focused on Designing New Coordination Compound with Improved Pharmacological Properties and A Broader Range of Antitumor Activity. Strategies for Developing New Anti-Cancer Agents Include the Incorporation of Carrier Groups That Can Target Tumor Cells with High Specificity.

b) Lycopene as A Potential Anti-Cancer Agent:

Dietary Chemoprevention Has Emerged as A Cost-Effective Approach To Control Most Prevalent Chronic Diseases Including Cancer. In Particular, Tomato And Products Are Recognized To Confer A Wide Range Of Health Benefits. In Addition To Its Antioxidants Properties, Lycopene Shows An Array Of Biological Effects Including Cardio-Protective, Anti- Inflammatory, Anti-Mutagenic And Anticarcinogenic Activities. The Cancer Activities Of Lycopene Have Been Demonstrated In Both Vitro And In Vivo Tumour Models

c) Selenium Derivatives as Cancer Preventive Agents:

The Role of Selenium In The Prevention Of Cancer Has Been Recently Established By Laboratory Experiments, Clinical Trials And Epidemiological

Data, Consequently, Selenium Supplementation Has Moved From The Realm Of Correcting Nutritional Deficiencies To Pharmacological Intervention, Especially In The Clinical One Of Domain Of Cancer, Chemoprevention And In The Control Of Heart Failure.

2.Applications of Lipoic Acid:

Lipoic Acid Protects Against Diseases Of Aging. This Offer Powerful Antioxidant Protection Against Three Common Afflictions (Two Of Them Potentially Disastrous) Association With The Aging, Stroke, Heart Attack And Cataracts. It Does It By Suppressing The Action Of Free Radicals In The Cells Of The Brain, Heart And Eyes. Lipid Acid Has An Unusual Relationship With Four Other Important Antioxidants: Glutathione, Coenzyme-Q10. Vitamin C And Vitamin E. Lipoic Acid Not Only Acts As A Primary Antioxidant In Brain Cells But Serves To Boost Glutathione Levels Through The Antioxidant Network Interactions.

3. Acute Central Nervous System Injury:

Oxidative Stress Has Been Implicated as A Potential Contributor to Acute Central Nervous System (CNS) Injury by Ischemic Or Haemorrhagic Stroke Or Trauma. Free Radicals Can Cause Damage to Cardinal Cellular Components Such as Lipids, Proteins and Nucleic Acid E.G. DNA Leading to Subsequent Cell Death By Modes Of Necrosis Or Apoptosis. The Damage Can Become More Widespread Due to Weakened Cellular Antioxidant Defence Systems. Moreover, Acute Brain Injury Increases The Level Of Excitoxic Amino Acids (Such As Glutamate), Which Also Produce ROS, Thereby Promoting Parenchymatous Destruction.

4. Neurodegenerative Disease:

Oxidative Stress Has A Mechanistic Role In The Development Of Alzheimer's Dementia. Several Lines of Evidence Previously Implied That Oxidative Damage To Lipid Membranes Could Disrupt Normal Neuronal And Glial Cell Functioning, Leading To The Formation Of Amyloid Plaques And To Neuronal Cell Death. Hence, It Is Found That Dietary Intake Of Antioxidants Such As Vitamins E, C And Beta Carotene Might Inhibit The Production Of Free Radicals And Reactive Oxygen Species. Antioxidants Are Also Being Investigated As Possible Treatments For Parkinson's Disease. [57,58]

5. Uses in Technology:

a. Food Preservatives:

Exposure To Oxygen And Sunlight Are The Two Main Factors In The Oxidation Of Food, So Food Is Preserved By Keeping In The Dark And Sealing It In Containers Or Even Coating It In Wax, As With Cucumbers. However, As Oxygen Is Also Important For Plant Respiration, Storing Plant Materials In Anaerobic Conditions Produces Unpleasant Flavours And Unappealing Colours. Consequently, Packaging Of Fresh Fruits And Vegetables Contains An Approximately 8% Are Oxygen Atmosphere. Antioxidants an Especially Important Class of Preservatives As, Unlike Bacterial or Fungal Spoilage, Oxidation Reactions Still Occur Relatively Rapidly In Frozen Or Refrigerated Food. Even Less Fatty Foods Such as Fruits Are Sprayed with Sulfurous Antioxidants Prior To Air Drying. Antioxidant Preservatives Are Also Added to Fat-Based Cosmetics Such as Lipstick and Moisturizers to Prevent Rancidity.

b. Industrial Uses:

Antioxidants Are Frequently Added To Industrial Products. A Common Use Is As Stabilizers In Fuels And Lubricants To Prevent Oxidation And In Gasolines To Prevent The Polymerization That Leads To The Formation Of Engine- Fouling Residues. They Are Widely Used To Prevent The Oxidative Degradation Of Polymers Such As Rubbers, Plastics And Adhesives That Causes A Loss Of Strength And Flexibility In These Materials.

➢ Mechanism of Action of Natural Antioxidants

Natural Antioxidants Have Been Proposed to Have Beneficial Effects on Health and On Different Disease States, Such as Neurodegenerative And Cardiovascular Diseases, Diabetes And Cancer. The Use Of Natural Plant Antioxidant Products To Handle Different Diseases Has Very Ancient Roots; Well Before The Development Of Modern Medicine With Synthetic Drugs And Antioxidants. A Lot Of The

Biological Activities Of Natural Antioxidants Have Been Ascribed To Their Ability To Scavenge Reactive Oxygen Species (ROS) That Counteract Oxidative Stress. In the Last Years, A Multitude Of Studies Have Suggested That Their Classical Hydrogen- Donating Antioxidant Activity Is Unlikely To Be The Sole Explanation For Their Effects. This Special Issue, Concerning New Mechanisms In The Action Of Natural Antioxidants In Health And Disease, Contains Nine Contributions, Seven Research Articles And Two Reviews, And Details Recent Advances On This Topic. In Recent Years, Increasing Attention Has Been Paid To Natural Dietetic Antioxidantsand Their Potential Effect On Human Health.Corsetto Et Al. Focused On Edible Brown Seaweeds, A Rich Source Of Natural Antioxidants, Extensively Investigated For Their Ability To Prevent And/or Counteract Different Diseases. In Particular, The Authors Studied the Possible Mechanisms of Fucusvesiculosus's Antioxidant Action and Considered Its Bioactivity During The Production Of Enriched Rye Snacks. They Used A Multiple-Method Approach, Including Chemical Assays and Cell-Based Bioassays, To Characterize the Potential Mechanisms Of The Antioxidant Action Of Seaweed Extracts. They Demonstrated That The Antioxidant Action Of Fucusvesiculosus Extracts Is Due To Their High Level Of Polyphenols, But Also To Their High Fe2+ Chelating Activity. Moreover, Rye Snacks Enriched with Fucusvesiculosusshowed A Higher Antioxidant Potential, Suggesting The Use Of These Extracts To Design Functional Foods. Fermented Foods Are Considered Prominent Constituents Of The Human Diet Because Of Their Content In Health-Promoting Compounds. Fermentation Is One The Most Ancient Methods Of Food Preparation, Which Increases The Shelf Life And Improves The Flavor Of Food Matrices Like Soy, Milk, Meat, Fruit And Vegetables. Cardiovascular Diseases Are The Leading Cause Of Death In The World, And Atherosclerosis, A Chronic Inflammatory Process That Involves A Complex Of Pathophysiological Effects, Is One Of The Major Risk Factors. The Development Of Atherosclerosis Is Related To The Proliferation And Migration Of Vascular Smooth Muscle Cells (Vsmcs) Following Stimulation With Proinflammatory Cytokines. In Recent Years, Phytochemicals Have Attracted Considerable Attention In The Prevention And/or Counteraction Of Atherosclerosis. The Paper of Chou Et Al. Reported That A Polyphenol-Rich Extract Of Hibiscus Sabdariffa Leaves Was Able To Inhibit Matrix Metalloproteinase Expression And Cell Migration In VSMC A7r5 Cells Pretreated With TNF-A, By Modulating Protein Kinase B (PKB) And Inducing Cell Cycle G0/G1 Arrest By Inducing The Expression Of P53 And Its Downstream Factors. The Extract Could Also Trigger A Decrease In ROS Production Following TNF-A Stimulation. In A Well-Established Atherosclerotic New Zealand White Rabbit Model, The Authors Confirmed The In Vitro Data On The Anti-Atherosclerotic Effect Of Hibiscus Sabdariffa Leaf Extract, Suggesting That This Extract Could Contribute To The Protection Against Atherosclerosis And Consequently Against Cardiovascular Diseases. As Previously Underlined, The Use Of Natural Plant Antioxidant Products Has Very Ancient Origins, But Nowadays Research Has Made Many Steps Forward, And The Evolution Of Separative Techniques Has Made It Possible To Identify Specific Active Antioxidants Compounds In Natural Sources, And Develop Them As Potential Therapeutic Agents. In Recent Years, A Lot Of Studies Have Underlined The Synergic Effect Of Different Natural Compounds When Administered In Combination. On These Bases. Marazzo Et Al. Using A Three-Dimensional Neuronal Cell Culture, Investigated The Protective Effect Of Three Natural Antioxidants (Sulforaphane, Epigallocatechin Gallate, And Plumbagin) Alone Or In Combination, Focusing On Their Activity Against Hydrogen Peroxide-Induced Oxidative Stress. Interestingly, The Treatment with The Combination Of The Three Natural Antioxidants Was More Effective Than The Treatments With The Single Compounds. In Particular, The Combined Treatment Positively Modulated Reduced Glutathione (GSH), Antioxidant Enzymes (Heme Oxygenase 1. Glutathione Reductase and Thioredoxin Reductase) And Insulin- Degrading Enzymes, And Downregulated Nicotinamide Adenine Dinucleotide Phosphate (NADPH) Oxidase 1 And 2, In Respect To Peroxide-Treated Cells. They Suggested That Natural Antioxidants Present In The Chloroplast And Mitochondria Of Plant Cells May Reach The Mitochondria Of Mammalian Cells, And Make Electron Transport And Oxidative Phosphorylation More Efficient. They Concluded Stressing The Fact That, Very Often, In Vitro

Antioxidant Measures Do Not Correlate With Antioxidant Action At The Physiological Level. The Conditioned Medium, Obtained From The Ectoine Pre-Treated And UVA-Irradiated Hacat Cells, Downregulated The Tyrosinase, Tyrosinase-Related Proteinsand Microphthalmia-Associated Transcription Factor Expressions In Melanomab16f10 Cells, Thus Inhibiting Melanin Synthesis And Evidencing A Whitening Effect. The Authors Concluded That Ectoine Could Be Suggested As A Potential And Natural-Based Skin Whitening Agent To The Cosmetic Industry. [77]

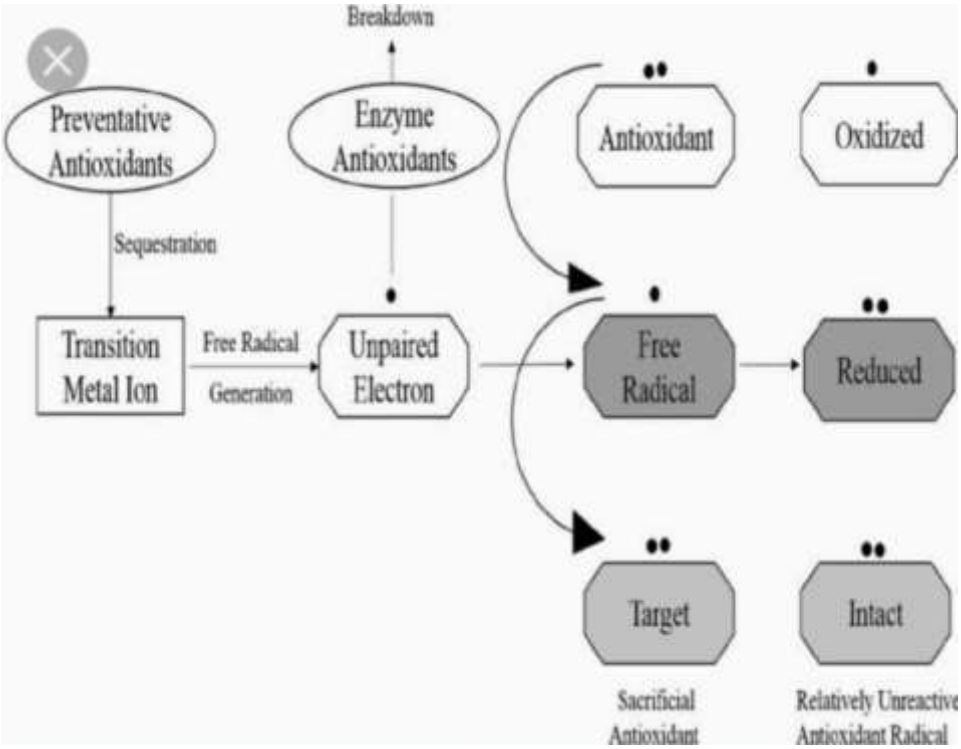

Fig No.7 Mechanism of Action of Natural Antioxidants

In Conclusion, This Special Issue Contributed To Increasing The Knowledge On The Mechanisms Of Action Of Natural Antioxidants, Evidencing Their Pleiotropic Role In The Prevention And/Or Counteraction Of Degenerative Diseases, And Promoting Also Their Application In The Functional Food And Cosmetic Field.

CONCLUSION

Antioxidants from Natural Sources Are Valuable Bioactive Compounds With Well-Demonstrated Potentials For Use In The Food Industry. Beyond Their Application In Functional Food Products, Attention Has Also Been Focused On Their Use As Alternatives To Their Synthetic Counterparts To Increase Product Stability And Avoid Deterioration By Oxidation During Processing And Storage. In The Context Of A Circular Economy, Efforts Are Being Dedicated To The Use Of Natural Antioxidants From Food Byproducts Generated By The Agricultural Industry And From Underexploited Plant Materials. Each Step Between The Extraction And The Application Of Natural Antioxidants Has Already Been A Focus Of Research. Regarding The Extraction Step, The Selection Of The Most Appropriate Techniques Differs According To The Type Of Compounds Targeted For Recovery. More Environmentally Friendly Techniques Have Been Explored To Avoid The Large Amounts Of Solvents Used In Conventional Solvent Extraction Processes. Although Replacing Conventional Technologies By Non-Conventional Ones Hasemerged, Improvements Are Necessary In Terms Of Scaling Up. Concerning The Stabilization Processes After Extraction, Spray Drying Has Been The Most-Used Process, Mainly Due To Its Simple Operation And Scaling Up, Delivering Encapsulated Antioxidants In The Form Of Powder Microparticles, Enabling Easy Manipulation And Dosages. Although These Compounds Are Derived From Natural Sources, Their Applications To Food Products Must Take Into Account Their Dosages And Possible Toxicological Effects. Moreover, Negative Effectson Sensory

Attributes, Especially Flavor and Taste, Imparted By Some Natural Compounds, Have To Be Addressed. This Will Increase the Consumer Propensity To Purchase Food Products Containing Natural antioxidants, Ultimately Contributing To Decreasing The Prices Of These Products.

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