International Journal of Pharmaceutical research and Applications
Volume 8, Issue 6, Nov.-Dec. 2023, pp: 561-574 www.ijprajournal.com ISSN: 2456-4494

Review on Antioxidant Property of Various Natural and Synthetic Agents

Sibiya. S, Yokeshvaran. R, Silambarasan. P, Hardha. B*, Senthil kumar. M
Sree Abirami college of pharmacy, Coimbatore-21

Date of Submission: 09-11-2023 Date of Acceptance: 24-11-2023

ABSTRACT:
The review's major goal is to emphasize the antioxidant qualities. The review includes information on several natural and synthetic compounds' antioxidant properties. Natural substances such torilis leptophylla, caffeic acid, etc. Synthetic substances such as thiazolo(4,5-b) pyridine and 3-aryl phthalides. Antioxidants remove free radicals from the body's cells and mitigate or stop oxidation-related damage. Hydroxyl Radical Antioxidant Capacity Assay, Trapping Antioxidant Parameter, and Total Oxyradical Scavenging Capacity Assay are a few of the tests used to measure antioxidant activity. It is thought that antioxidants are harmless when administered appropriately. Antioxidants are believed to be safe when used properly. However, some antioxidants are potentially dangerous when used in high doses. Antioxidants such as beta-carotene and vitamin E can cause serious side effects when used in high doses.

KEYWORDS-Antioxidant, Caffeic acid, Acacia, Acetic acid, Indole.

I. INTRODUCTION:

Antioxidants are compounds that stop oxidation, a chemical process that can generate free radicals (also referred to as autoxidation). The degradation of organic materials caused by autoxidation. Autoxidation includes living organisms. Industrial products such as polymers, fuels, and lubricants are frequently added antioxidant to extend their useful lives. Additionally, antioxidants are added to food to stop food from going bad, especially the rancidification of oils and fats. Antioxidants are compounds that stop oxidation, a chemical process that can generate free radicals (also referred to as autoxidation). Organic substances are degraded as a result of autoxidation. Autoxidation includes the organisms that live [1]. Industrial products, such as polymers, fuels, and lubricants are frequently added antioxidant to extend their useful lives. Additionally, antioxidants are used to preserve food and rancidification of fats & oils. Cells under oxidative stress can be protected from damage by antioxidants like glutathione, mycothiol, or bacillithiol as well as enzyme systems like superoxide dismutase. The dietary antioxidants are vitamins A, C, and E [2]. They are well recognized, but the term "antioxidant" has also been used to describe a number of other dietary components that only show antioxidant activities in vitro and have no evidence of antioxidant properties in vivo. Antioxidant dietary supplements that claim to keep people healthy or prevent diseases in humans have not been proven to do so [3].

"Synthetic or natural compounds that either stop or delay a product's degeneration or have the power to mitigate the detrimental effects of oxidation on animal tissues. Free radicals and other oxygenated molecules produced as a result of these processes are referred to as "reactive oxygen species" (ROS). While certain endogenous antioxidants are produced by the body, dietary antioxidants may offer an additional line of defense. Flavonoids and other polyphenolics, vitamins C and E, and carotenoids are the most common dietary antioxidants [4]. Many herbs and botanicals also contain antioxidants. Oxidation is a chemical reaction that produce free radicals, leading to chain reaction that may damage cells. Antioxidants such as thiols or ascorbic acid are stopped by these chain reactions. Antioxidants are substances that stop air oxidation. Antioxidants are employed to stop the oxidative breakdown of pharmaceutically useful components. In order to keep chemicals like iodide or ferrous ions from oxidizing, they are utilized in pharmaceutical formulations that contain these compounds. It should be safe and nontoxic and effective at a very low concentration. It should also exhibit reasonable chemical stability [5].

International Journal of Pharmaceutical research and Applications
Volume 8, Issue 6, Nov.-Dec. 2023, pp: 561-574 www.ijprajournal.com ISSN: 2456-4494

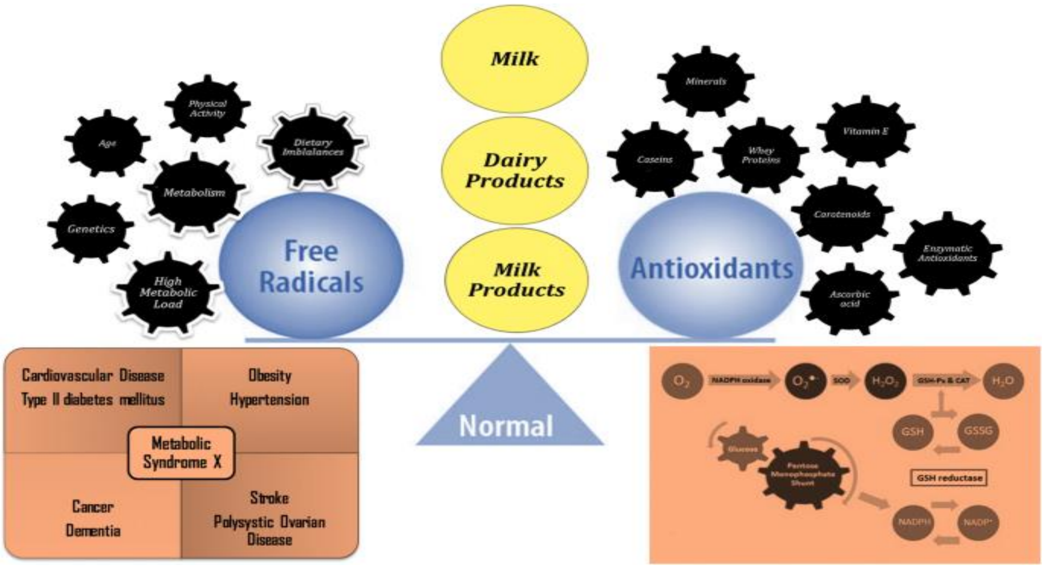

Fig 1. ANTIOXIDANT ACTIVITY

MEDICINAL PLANTS

Medicinal plants are globally valuable sources of new drugs in the united states, about 118 of the top 150 prescription drugs are based on natural sources. Additionally, approximately 25% of recommended medications in affluent countries come from wild plant species, while up to 80% of individuals in underdeveloped countries completely rely on herbal medicines for their basic healthcare. India is one of the world's twelve mega biodiversity hubs and has a diverse floral diversity. Placing fourth among Asian countries and tenth among countries with abundant plant resources. The global trade is an intergovernmental body that controls trade with medicinal plants internationally. The severely inadequate statistical information on production trade that is now accessible is the main challenge in studying the global trade in herbal drugs [6]. The world health organization (WHO) estimated that 80% of the population of developing countries rely on traditional medicines, mostly plants drugs, for their primary health care need. The demand for medicinal plants is said to be increasing year by year. According to estimates in India there are 960 different types of medicinal plants that are traded, 178 of which have annual consumption levels that exceed 100 metric tons [7]. A sizeable section of the Indian population relies on medicinal plants for their livelihood and health security. These plants also provide a vital source of raw materials for the traditional medicine and herbal industries. The development of new medications uses medicinal plants, which are also crucial to maintaining human health. These plants have been used from prehistoric times to present day. These plants based medicinal are consumed in all civilizations. It is thought that herbal medicines can benefit the body while having no negative impacts on a person's life [8].

Natural antioxidants are obtained from the biological system. Antioxidants activities that possessed on human diet that contains an array of different compounds. Vitamin C, tocopherols, carotenoids, flavonoids, antioxidant polysaccharides and amino acids & its compounds are the most prominent representatives of dietary antioxidants. Intake of antioxidant rich diet protects against deleterious degenerative diseases [9]. The need of antioxidants in food industry is not only to preserve flavor and color and increase the shelf life of food, but also as components of nutraceutical food. This calls for the use of exogenous food additives, such as antioxidants made from nature or synthetically. In foods system natural occurring antioxidants mechanism are often lost during processing or storage. Antioxidants work best at very low concentrations; at greater dosages, harmful effects may result. On the other side, the need to investigate alternative natural and likely safer sources of food antioxidants has been prompted by the greater production cost and reduced effectiveness of commonly used natural antioxidants like ascorbic acid, tocopherol, etc [10]. The wastes and by-products of fruits and vegetables like seeds, peel and pomace are abundant sources of antioxidants, but these have not been conventionally used as additives. It is completely metabolized. It has a broad range of solubility. They expense

International Journal of Pharmaceutical research and Applications
Volume 8, Issue 6, Nov.-Dec. 2023, pp: 561-574 www.ijprajournal.com ISSN: 2456-4494

depends upon source and extraction process. It has the wide range of antioxidant activity [11].

Chemically synthesized petroleum-based antioxidants known as synthetic antioxidants are used largely to "retard lipid oxidation" in order to stabilize and protect refined oils and fats in food products. Four widely used synthetic antioxidants in food industry are BHA (butylated hydroxyanisole), BHT (butylated hydroxy toluence), PG (propyl gallate), TBHQ (tert-butyl hydroxyquinone) [12]. A range of synthetic antioxidants are authorized to protect against oxidation of unsaturated lipids for use in animal feed. These include butylated hydroxytoluence, ethoxyquin, butylated hydroxyanisole, octylgallate and propylgallate. Maximum residue limits do not currently exist in the European union of synthetic antioxidants in food products of animal origin [13]. However, Maximum Residue Limits have been adopted for such compounds in some countries, including Japan. In recent years the use of synthetic antioxidants in fish feed ingredients, fish feed and subsequent carry over to farmed fish fillets has received increasing attention from a food safety perspective. The information in the literature on synthetic antioxidants is contradictory and they are reported to have properties as antioxidants, pro-oxidant, anti-carcinogens, carcinogens and as a tumor promoter. Butylated hydroxyanisole (tert-butyl-4-hydroxyanisole) is a synthetic phenolic antioxidant, authorized as a food additive in the European union for certain food products including cake mixes, cereal based snack foods and milk powder [14]. Toxicity of synthetic antioxidants having both positive and negative points. Positive points are it has anticarcinogenic properties, antimutagenic properties, inhibition of cholesterol oxidation, no cancer of other health hazard risks, inhibition of foodborne pathogens. Negative points are cytotoxic affects, adverse effects on major organs: kidney, liver and lungs, enhancement of carcinogenesis have to be at least 1500fold greater than that in human exposure, non- typical mode of cell death, suppression of humoral immunity, cytotoxic towards mono cryptic leukemia cells resulting in apoptosis and DNA damage, co-administration with sodium nitrite promoted forestomach carcinogenesis [15].

II. SYNTHETIC ANTIOXIDANTS

Chemically produced petroleum-based antioxidants known as synthetic antioxidants are mostly employed to "retard lipid oxidation" in order to preserve and stabilize the refined oils and fats found in food products and food systems. These synthetic compounds, such as butylated hydroxyanisole, butylated hydroxy toluence, propyl gallate, and others, are the most potent antioxidants and have been allowed for use in food by the Food and Drug Administration [16].

2.1. INDOLE ACETIC ACID-BASED TRI-AZO MOIETIES:

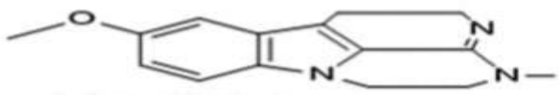

Fig.2.METRALINDOL

The prevention and treatment of microbial infections have advanced significantly as a result of novel strategy development and advances in combinatorial chemistry. The threat posed by microbial resistance to the public's health is still a major issue for the scientific community. Increased morbidity and death could be a result of resistant infections. Organic chemistry includes a sizable amount of heterocyclic compounds. The creation of novel classes of heterocycles while taking into consideration economic and environmental concerns is one of the main concerns of contemporary scientists. The fact that heterocycles with three hetero atoms in symmetrical places exhibit a variety of pharmacological actions makes them more commonly investigated [1]. As components of numerous licensed medications, heterocycles containing nitrogen are receiving a lot of attention; triazoles have demonstrated a variety of therapeutic actions. Three nitrogen and two carbon atoms make up the five-membered ring structure of triazole, which can also exist as two isomers: 1, 2, 4-triazole and 12, 3-triazole. Out of these, 2, 4-triazoles have received the most attention due to their robust binding capability and stability [2]. A very diversified class of substances having antibacterial, antifungal, anti-inflammatory, and anticancer properties are 1, 2, 4-triazole-containing heterocycles and those with 1, 2, 4-triazoles as condensation products with another nucleus system. A wide variety of chemotherapeutic actions of Schiff bases have been observed; the presence of azomethine on Schiff bases is due to their extensive chemical and biological characteristics. Extended bioactivity is also influenced by transferrable

International Journal of Pharmaceutical research and Applications
Volume 8, Issue 6, Nov.-Dec. 2023, pp: 561-574 www.ijprajournal.com ISSN: 2456-4494

protons and the capacity to create intermolecular hydrogen bonds. One of the most prevalent naturally occurring nitrogen molecules, indole is well known for its wide range of biological and chemical properties [1]. A few commercially available medications are included in the indole nucleus' poly pharmacological actions, which are related with it. Synthetic molecules contain sulfur-containing substances. The production of free radicals results from regular oxygen consumption in the body. When something is wrong with the natural antioxidant mechanism, the accumulation of these free radicals may lead to cytotoxic interactions with the body systems and may damage to genes. DPPH is one of the most widely used methods for evaluating the antioxidant ability of compounds. DPPH turns from purple to yellow, which indicates the synthetic compounds scavenging potential. The reducing power of a molecule determines its antioxidant potential; the addition of hydroxy and methoxy groups to the benzene ring improved the reducing power or indicated prospective antioxidant activity [2]. However, shifting Hydroxybenzaldehyde from position three to position four revealed a considerable decrease in lowering potential. The degree of basicity of the nitrogen atom, i.e., how active the molecule will be in terms of its reducing potential, also plays a crucial influence. No one of these produced compounds was able to demonstrate encouraging activity in the DPPH assay [2].

2.2. 2- METHOXYPHENOL DERIVATIVES:

Atoms, molecules, or ions with an unpaired electron in orbit are known as free radicals. They are continuously produced by the body and can become hazardous when they are in large concentrations or when the body's natural antioxidant defenses are not functioning properly. Free radicals can harm DNA, proteins, and lipids in cells and tissues when present in high concentrations [3]. The human body does have vital defense mechanisms against free radicals in the form of enzymes such glutathione peroxidase, catalase, and superoxide dismutase. However, oxidative stress develops as a result of imbalances between the generation and detoxification of free radical species. Serious illnesses like cancer, atherosclerosis, aging, immunosuppression, inflammation, ischemic heart disease, diabetes, and neurological conditions can result from this [4]. By providing an electron, antioxidants can safely interact with free radicals, stop the reaction, and change the radical into a harmless molecule. Therefore, antioxidants lessen oxidative stress, shielding the cells from oxidative harm. Examples of natural methoxyphenol used in perfumes, detergents, air fresheners, and cosmetics include eugenol and isoeugenol. Eugenol is shown to have strong antioxidant properties and is also utilized as a component of zinc-oxide eugenol cement in dentistry. In addition, apocynin is an effective inhibitor of the nicotinamide adenine dinucleotide phosphate oxidase complex, and eugenol reduces the metal-mediated low density lipoprotein oxidation by serving as a physiological antioxidant in vivo. Other naturally occurring phenols with antioxidant characteristics include eugenol, creosol, apocynin, and isoeugenol [4].

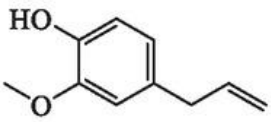

Fig.3.EUGENOL

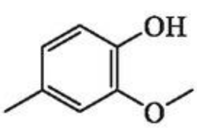

Fig.4. CRESOL

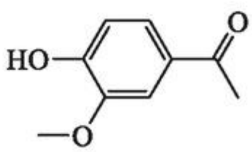

Fig.5. APOCYNIN

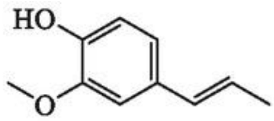

Fig.6. ISOEUGENOL

Given the extensive harm that reactive oxygen species do to biological macromolecules, the development of novel antioxidant chemicals has taken on medicinal importance. As a result, intensive study has been devoted to finding novel antioxidants to stop damage caused by radicals. We focused on designing, synthesizing, characterizing, and assessing the antioxidant activity of newly created methoxyphenol derivatives in this study [3]. Based on elemental analysis, infrared and 1D-Nuclear magnetic resonance spectrum data, the structures of the numerous produced compounds were confirmed. Uncorrected melting points were discovered using a Gallenkamp melting point device. Derivatives of methyl phenol have been shown to have a wide range of therapeutic effects, the majority of which are dependent on its antioxidant characteristics [4]. Methoxyphenol derivatives with structural modifications that may have improved physicochemical, antioxidant, and therapeutic capabilities have recently been developed in an effort to increase the therapeutic usefulness of this compound. The six different methoxyphenol derivatives were all produced for this study's antioxidant activity tests. The first compound, 5-(4-hydroxy-3-methoxybenzyl)-2,2-dimethyl-1,3-dioxane-4,6-dione-4, was made by condensation of 2,2-dimethyl-1,3-dioxane-4,6-dione 1 and 4-hydroxy-3-methoxybenzaldehyde 2 in an acid-catalyzed reaction. To create pure compound 4, the resulting material was recrystallized from hot ethyl acetate-hexane. Based on results from spectroscopic and elemental analyses, the compound's structure was validated. A stretching vibration of the hydroxyl group was detected via the IR spectra [3].

2.3. NARINGIN BASED HYDRAZONE AND OXIME DERIVATIVES:

A class of phytogenic polyphenolic chemicals known as flavonoids are present in many different types of human diets and have a variety of physicochemical properties and chemical structures. In actuality, researchers have looked at the chemical structures and medicinal potentials of about 4000 identified flavonoid compounds. Due to their different medicinal properties, this group of naturally occurring chemicals has recently drawn attention from scientists all over the world [5]. However, numerous studies on flavonoids have supported their therapeutic potential for a variety of illnesses, including cancer, bacterial inflammations, oxidative stress, allergies, viral infections, and diabetes. Organic chemistry includes a diverse class of molecules known as oxime and hydrazone derivatives. A wide range of biological effects, including antioxidant, antibacterial, anticancer, anxiolytic, anticonvulsant, anti-inflammatory, depressive, antihypertensive, anti-tuberculosis, and antifungal activity, are possessed by the development of novel hydrazone-containing compounds [6]. To enhance its pharmacological properties, it was necessary to semi-synthesize novel hydrazone and oxime derivatives from naringin. The antioxidant activity of recently developed molecules was determined, and the outcomes were compared to those of the original substance, naringin, and with the positive control, trolox. Naringin semi-synthetic derivatives and Trolox standard's percentages of antioxidant activity were computed. Potential free radical scavenging capability is more effective antioxidant chemical than Trolox [6]. By scavenging superoxide anion, singlet oxygen, and lipid peroxy radicals as well as stabilizing free radicals involved in oxidative processes through hydrogenation or complexing with oxidizing species, naringin derivatives had the potential to act as antioxidants in vitro or cell-free systems. In the current investigation, oxime and hydrazone derivatives were used to partially synthesize three different molecules. In addition to having antibacterial action against the four strains of bacteria under study, Hydrazone had strong antioxidant activity that was nearly identical to Trolox. These findings can point to the molecule as a prospective candidate for the production of pharmacological formulations that might be antioxidant [5].

2.4. 3-ARYLPHTHALIDES:

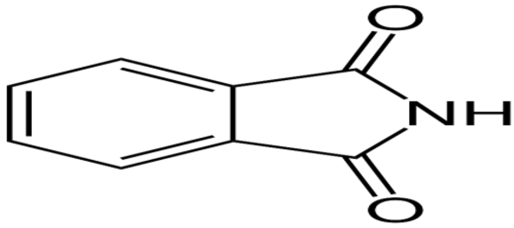

Fig.7. PHTHALIMIDE

Phthalides are a very modest class of naturally occurring metabolites generated by a diverse range of plants, including species that are used in traditional medicine all over the world, as well as fungi from terrestrial and marine settings. These natural products are distinguished structurally by the presence of a 1(3H)-iso benzo furanone nucleus, whose substitution patterns give this class of chemicals a wide range of structural variety [8]. As a result, the aromatic ring of the phthalide frequently contains hydroxy or alkoxy groups, while it is also possible to find sugars and moieties that are derived from terpenoids or alkaloids. Most naturally occurring phthalides exhibit alkyl chains, spirocycles, and aromatic rings in the -lactone ring, either by themselves or as components of more complicated substructures. Additionally, substances with a partly reduced aromatic ring and dimer phthalides often referred to as natural products. Phthalides are a class of natural chemicals [7]. Mycophenolic acid and 3-n-butylphthalide are two interesting substances. In organ transplantation, mycophenolic acid, which was first discovered in Penicillium stoloniferum, is utilized as an immunosuppressive medication. It is widely known that substances with free phenolic groups have antioxidant characteristics, and in particular, that the naturally occurring 3-arylphthalide iso pestacin has a strong capacity to scavenge free radicals. However by adding methoxy groups can boost the antioxidant activity of both straightforward phenolic compounds and molecules with conjugated systems, such stilbenes and flavonoids [7]. Despite the fact that substances containing sulfur have been shown to

International Journal of Pharmaceutical research and Applications
Volume 8, Issue 6, Nov.-Dec. 2023, pp: 561-574 www.ijprajournal.com ISSN: 2456-4494

lower oxidative stress, our findings are not conclusive. 3-hydroxyphthalide and substituted arenes were combined in a dehydrative coupling reaction, which produced a number of 3-arylphthalides with high functional group tolerance, good yields, and levels of site selectivity. The phthalides proof that minor structural alterations to aryl ring derivatives have a significant impact on their antioxidant property. The potential effects on the implicated signaling pathways are revealed by the decrease in mRNA levels of classical pro-inflammatory cytokines [8].

2.5. C-3 SUBSTITUTED INDOLE DERIVATIVES:

A group of fifteen indole derivatives with C-3 substitutions were created and studied. Three in vitro antioxidant experiments were used to test the antioxidant activity of each derivative, and the derivative containing the pyrrolidine di thio carbamate moiety was the most effective at scavenging free radicals and reducing Fe^{3+} to Fe^{2+}. In order to quench the free radical, a potential hydrogen and electron transfer process is proposed [9]. The observed antioxidant activity also requires the stability of the indolyl radical and the presence of an unsubstituted indole nitrogen atom, and this activity is highly dependent on the type of substituent that is immediately attached to the methylene group at the C-3 position. Human red blood cells have been used as a cell model to study the interactions of derivatives with cell membranes. Concentration-dependent hemolytic activity and Red Blood Cells shape change were observed for a number of substances. Derivatives' cytoprotective effects are principally caused by interactions with the components of Red Blood Cells membrane [10]. Serotonin and its derivatives, such as 5-hydroxytryptofol, 5-methoxytryptamine, and 5-methoxytryptofol4, warrant special consideration among natural and synthetic antioxidants. Fuvastatin has cytoprotective properties against the Fenton reaction's peroxide anions and hydroxyl radical-induced oxidative stress. It is a synthetic inhibitor of 3-hydroxy-3-methylglutaryl coenzyme A reductase with a unique structure of a mevalono lactone derivative of a fuorophenyl-substituted indole. Compound’s antioxidant properties have been linked to a number of pathways, including hydrogen atom transfer and single electron transfer. DPPH scavenging, Fe^{2+} chelating activity have reducing ability utilized to measure the antioxidant activity of indole derivatives. The maximum scavenging activity was demonstrated by derivatives [10]. Our findings imply that the first hydrogen or electron abstraction from the indole ring could be used to explain how active gramine derivatives scavenge DPPH radicals. One electron is moved from the nitrogen atom, and a cation radical is created on it. A hydrogen atom can also be transferred from the antioxidant molecule to the DPPH radical in the form of the N-H group, creating a resonance-stabilized indolyl radical suggested the precise process for C-3 sulfenyl indoles [9]. The presence of various functional groups with various electronic and lipophilic properties directly connected to the methylene group at the C-3 position is a crucial component of the structure of the analyzed derivatives that significantly influences the efficiency of scavenging the DPPH radical (apart from the indole ring and N-H group). It has been reviewed that different functional groups at the indole nucleus' C-3 position of the methylene group can alter the derivatives' capacity to act as antioxidants [9].

2.6. NOVEL DERIVATIVES THIAZOLO(4,5-b) PYRIDINE:

This review describes the synthesis of new (5,7-dimethyl-2-oxo-thiazolo[4,5-b] pyridine-3-yl)-acetic acid hydrazide derivatives and the assessment of their antioxidant properties. To produce compounds with an acceptable pharmacological profile, the base heterocycle was transformed using the processes of acylation, [2+3] cyclo condensation, Knoevenagel condensation, and alkylation. The scavenging action of the produced compounds on 2,2 diphenyl-1-picrylhydrazyl radicals was used to assess their antioxidant activity in vitro [11]. It has been difficult in recent decades to develop an antioxidant chemical that is both efficient and secure. The function of reactive oxygen species in food, medication, and even living systems has drawn more and more attention. Free radical production is linked to aerobic cells' typical physiological metabolism. Due to their high reactivity, free radicals can attack membrane lipids and produce carbon and per oxy radicals that lead to lipid per oxidation [12]. As a result, researchers from numerous fields have developed a greater interest in naturally occurring antioxidants as well as related synthetic derivatives that may offer active ingredients that mitigate the effects of oxidative stress. The production of condensed heterocycles with high antioxidant efficiency requires synthesis advancements. Due to their iso-steric closeness to the structure of pyrine and pyrimidine bases, thiazolo pyridines exhibit a broad range of biological functions [12]. Derivatives of thiazolo pyridine have also been employed as delicate analytical tools. Therefore, it is important to continue investigating ways to modify thiazolo[4,5-b]pyridine-2-ones chemically in order to produce new active molecules. The 2,2-diphenyl-1-picrylhydrazyl free radical's capacity to scavenge free radicals served as the basis for measuring the antioxidant activity. Due to its excellent stability in a methanolic solution and bright purple color, the DPPH radical has found numerous applications. The absorbance decreases as a result of antioxidants reducing radicals [11]. In a basic media, its reduction results in 2,2-diphenyl-1-picrylhydrazine or the equivalent anion. Other odd-electron species that provide para-substitution products at phenyl rings are scavenged by the DPPH radical. The DPPH method is hailed as straightforward, speedy, and practical approach for screening the radical scavenging capacity of many samples. The DPPH approach is appealing for evaluating freshly synthesized compounds to scavenge radicals and to identify prospective antioxidant medication candidates because of these advantages. The 5,7-dimethyl-3H-thiazolo[4,5-b]pyridine-2-ones were found to have antioxidant action. Some of our compounds were discovered to be more effective when compared to currently available antioxidants [12].

III. NATURAL ANTIOXIDANT

Many Indians depend on medicinal plants for their livelihood and health security, and the traditional medicine and herbal industries also heavily rely on these plants as a major supply of raw materials. New medications can be made from medicinal plants. Human health benefits of medicinal plants are significant. From ancient times to the present, these plants have been employed. All cultures use these plant-based medications [16]. It is thought that herbal medicines can benefit the body while having no negative impacts on a person's life. Additionally, the use of medicinal herbs has grown as a significant industry that can sustain the economy. The use of medicinal plants for health is practiced through herbal therapies and treatments that might become new cultural customs. A significant portion of the flora is made up of medicinal plants, which provide raw materials for use in a variety of industries [22].

3.1. CAFFEIC ACID DERIVATIVES:

Due primarily to their antioxidant capabilities and the consequent human health benefits, plant extracts have recently attracted increasing interest in the food business. Caffeoylquinic acids, di caffeoyl quinic acids, and other caffeic acid derivatives are included in the group of chlorogenic acids. Acids such as 5-O-caffeoylquinic acid, 4-O-caffeoylquinic acid, and 3-O-caffeoylquinic acid are included in the category of CQAs [13]. Almost every living plant contains caffeoylquinic acids, but coffee is the main dietary supply for people. These substances are also found in quite high concentrations in potatoes (Solanum tuberosum), particularly in variants with colored flesh. Popular herbs like thyme, oregano, and rosemary are excellent suppliers of phenolic chemicals. Thyme and rosemary are well known for having high levels of ferulic acid and caffeic acid, respectively [14]. Although consumers and food manufacturers are familiar with these medical plants, there are other, better-known plants whose extracts can be employed as food additives due to their high presence of various pro-health chemicals. Caraway one of these plants, is used in folk medicine to treat diarrhea, bronchopulmonary diseases, or to enhance liver function. Carvacrol, carvone, -pinene, limonene, -terpinene, linalool, carvenone, and p-cymene are the main components of caraway, along with a number of phenolic acids such gallic, syringic, neochlorogenic, cryptochlorogenic, and caffeic acid. Coltsfoot a herb with a long history in Chinese medicine and Eastern Europe, is a member of the Asteraceae family [14]. The quercetin-glycosides in this plant, among other things, are what give it its antioxidant properties. Calcium is abundant in dandelion. Due to its choleretic, diuretic, anti-rheumatic, and anti-inflammatory qualities, this plant is used therapeutically. Phytochemical substances identified from dandelion include cinnamic acid, coumarins, and flavonoids. The lovage plant (Levisticum officinale L.), which has powerful antioxidant capabilities and is beneficial to health. Lovage contains phenolic chemicals in both the roots and leaves [13]. As a medicinal plant, tarragon is used to treat pyrexia, diabetes, parasite infections, and stomach pain. This plant's alcoholic preparations can prevent platelet aggregation. Estragole, phellandrene, iodine, tannins, methyl coumarins, chavicol, and rutin are some of the plant's main components. The potential for, for instance, reducing fat and acrylamide in finished products is linked to new opportunities for employing plant extracts. Water preparation

International Journal of Pharmaceutical research and Applications
Volume 8, Issue 6, Nov.-Dec. 2023, pp: 561-574 www.ijprajournal.com ISSN: 2456-4494

followed by extraction is the cheapest method of obtaining plant extracts, while ethanol or methanol produce better results that can't be utilized in food production due to its toxicity [14]. Detailed information on the content of caffeic acid derivatives in herb and spice plant extracts is not compiled in the scientific literature, despite substantial research into the chemical makeup of diverse plants [13].

3.2. NATURAL ANTIBIOTICS- GRAM POSITIVE & GRAMNEGATIVE BACTERIA:

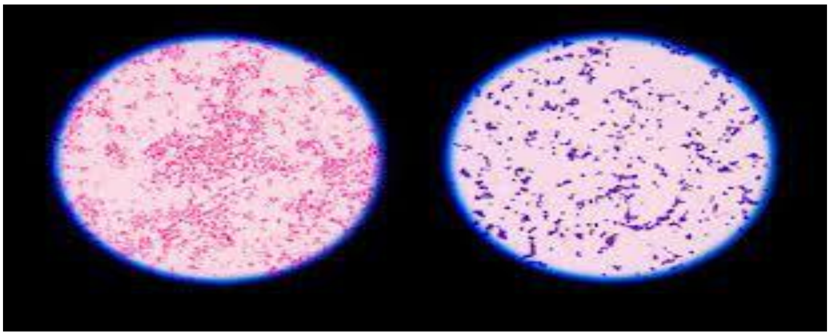

Fig. 8. GRAM POSITIVE AND GRAMNEGATIVE BACTERIA

Human civilization is aware of microbes because of both their helpful and harmful impacts. Microorganisms can create pathogenic infections and diseases that can damage the body and occasionally result in death when their symbiotic relationship with one another exceeds a certain threshold. This is a serious worry, especially in developing nations. The early treatment of bacterial pathogenesis requires pinpointing the exact location of the infection in the body. Antibiotics with a broad spectrum of activity fight both Gram-positive and Gram-negative bacteria [15]. Long shelf life, nontoxicity to humans, solubility in bodily fluids, affordability, long-lasting antibacterial impact, and minimal likelihood of bacterial resistance to the agent are all qualities that a good antibiotic should possess. The greatest public health concern in the world today is pathogenic bacterial resistance, which poses a serious threat because all these ideal standards for an antibiotic are difficult to achieve when creating synthetic antibacterial agents [16]. New synthetic antibacterial drugs are being developed less frequently to combat the threat of bacterial resistance. And it's likely that, as a result of the steadily rising degree of bacterial resistance, harmful bacteria could eventually stop responding to antibiotic therapy, which would be a bad development in human history. Polyphenols, Vitamins, and Carotenoids are organic chemicals that are mostly taken from natural sources and are crucial components of the body's natural defensive system. Due to their vast chemical diversity, which offers powerful therapeutic effects and prevents microbes from copying them to develop resistance, natural antioxidant-based antibacterial products should become our primary focus as synthetic antibiotic resistance is constantly increasing [16]. Bacteriostatic antibiotics prevent bacterial development and may also kill bacteria, while bactericidal antibiotics kill the bacterial cell. The first antibiotic, Penicillium notatum, a fungus that lives in soil, was discovered by Alexander Fleming. Although certain previously used antibiotics have proven to be quite efficient in treating bacterial infections, stronger antibacterials are still required because bacteria cannot replicate their chemical structure. Plants produce a wide range of secondary metabolites (phytochemicals) that are engaged in their defense mechanisms. It is known that important classes of these compounds, including as antioxidants have positive impacts on human health [15]. Phytochemicals' appealing antioxidant properties draw attention since they may replace manufactured antioxidants, which have negative effects on human health including cancer. Although the exact method of action of antioxidants as antibacterials is still unknown, several studies indicate that the attributed antibacterial activity involves three main mechanisms: suppression of nucleic acid synthesis, cytoplasm leakage, and outer membrane permeability. Gram-positive and Gram-negative bacteria have very different cell wall compositions because Gram-positive bacteria lack an outer membrane and contain an extensive layer of peptidoglycan and lipoteichoic acid [16]. The outer membrane of gram-negative bacteria is made up of phospholipid, protein and a thin coating of peptidoglycan. The osmotic protection of bacterial

International Journal of Pharmaceutical research and Applications
Volume 8, Issue 6, Nov.-Dec. 2023, pp: 561-574 www.ijprajournal.com ISSN: 2456-4494

cells is greatly aided by the walls of both Gram-positive and Gram-negative bacteria. Any cell wall damage will reduce the cell's tolerance to osmotic pressure and ionic strength. Numerous studies have shown that Gram-positive and Gram-negative bacteria interact with the bacterial cell wall [15].

3.3. TORILIS LEPTOPHYLLA L:

Fig.9. Torilis leptophylla

Herbal medications have been used since very ancient times. Plants continue to play a significant role in modern medicine despite the advancements seen in recent decades. There have been many medicinal plants examined for their antioxidant capacities. Chemical components are excellent at stopping the byproducts of oxidative stress that are destructive. Even so, the majority of medicinal plants have a high toxicity profile. Many disorders and diseases are brought on by oxidants [17]. The human body has a built-in antioxidant mechanism and a lot of biological processes like the responses that are anti-mutagenic, anti-carcinogenic, and anti-aging come from this property. Antioxidants maintain stability or neutralize free radicals, frequently prior to their attack on targets within biological cell natural has recently attracted interest. Antioxidants have been found in studies on fruits, vegetables, and herbal plants. Medicinal plants' antioxidant content may. they help with the disease protection they provide. The. Natural antioxidant intake has been shown to be negatively correlated with morbidity and mortality from degenerative diseases. Still a major public health issue, liver diseases [18]. It is common knowledge that free radicals harm cells through mechanisms of lipid peroxidation and covalent binding with ensuing tissue damage. Antioxidant substances of natural origin have attracted particular interest. their capacity to scavenge free radicals. The applying Apiaceae family member Torilis leptophylla or Bristle Fruit Hedge, which is a more familiar name. In combat, the plant is very powerful. This supports the use of it as a disinfectant. or antibacterial. the lookout for novel plant-derived natural antioxidants. has risen since then. The various parts of the entire plant's methanol extract T. Leptophylla [17]. Alkaloids, anthraquinones, and cardiac glycosides were all screened using phytochemical methods. tannins, terpenes, coumarins, flavonoids, saponins, phlobatannins, and saponins. In order to protect, antioxidants combat free radicals. Bleaching in a purple-colored solution. DPPH is scavenged through in the method. adding an antioxidant or radical species that changes the DPPH solution's color. the intensity of color. Concentration and potency both affect change. a group of antioxidants. the absorbance dropped significantly. of the reaction mixture suggests a substantial free radical. the test substance's ability to remove free radicals. In the current study, n-butanol, chloroform, and ethyl acetate all demonstrated significant results among the fractions tested. increased inhibition percentage and positive correlation. consisting entirely of phenol [18]. The study's results imply that the phytochemical components in the plant extract have the ability to scavenge free radicals by giving them hydrogen. A significant biological is the superoxide radical. Superoxide anion, despite being a weak oxidant, is a source of reactive oxygen species. Also of strong and harmful hydroxyl radicals. singlet oxygen, both of which are oxidative contributors. This review states that have highest antioxidant capacity [17].

International Journal of Pharmaceutical research and Applications
Volume 8, Issue 6, Nov.-Dec. 2023, pp: 561-574 www.ijprajournal.com ISSN: 2456-4494

3.4. CAESALPINIA VOLKENSII, VERONICA LASIOPUS, ACACIA HOCKII:

Fig.10. CAESALPINIA VOLKENSII

fig.11. VERONICA LASIOPUS

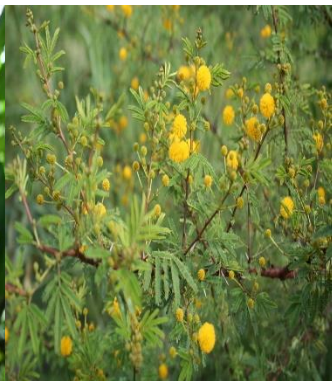

fig.12. ACACIA HOCKII

The main catalyst behind this is oxidative stress among other syndromes, the onset and development of cancer, diabetes mellitus, cardiovascular diseases, neurodegenerative diseases, and inflammatory diseases condition is caused by an excessive amount of free oxygen generation and nitrogen species or their ineffective quenching in the cell. Nitrogen and oxygen free species are unstable molecules are both exogenous and endogenous. Exogenous are the bodily aerobic metabolic processes [19]. Smoke from cigarettes and other chemicals are two sources of free radicals. X-rays, ozone, and medications are a few examples of ionizing radiation others. In contrast, endogenous sources of free radicals include the xanthine oxidase pathway and electron transfer chain reactions during disease states such as ischemia, inflammatory response, and reperfusion injury. The body has an intricate system of anti-oxidant defenses made up of enzymatic and non-enzymatic pathways that, in a healthy physiologic state, maintain a Prooxidants and antioxidants are consistently in equilibrium ensuring health and enzymatic antioxidants catalase, glutathione peroxidase, and superoxide dismutase [20]. Synthetic antioxidants are also hard to come by, expensive, and unstable, which limits how often they can be used. the available alternative and complementary techniques providing something. It has been proven that plants have antioxidant properties provide the body with protection from disease. Polyphenols and vitamins A, C, and E have antioxidant properties in plants. Acacia hockii, Fabaceae is a family of shrubs family. Other Acacia plants are susceptible to illnesses like gout [19]. It has been established that members of the Fabaceae family contain antioxidants. Caesalpinia volkensii belongs to a shrub family of the Caesalpiniaceae prepared from fruit and leaves. Caesalpinia was the subject of this investigation. Volkensii, Acacia hockii, and Vernonia lasiopus were chosen on the basis of their management of ethnomedicine diseases impacted by oxidative stress. Disorders connected to oxidative stress. Reactive oxygen/nitrogen species are produced in greater quantities a reduction in the body's ability to fight off free radicals. For aerobic organisms, oxidative stress will inevitably lead to the generation of reactive oxygen/nitrogen species and in healthy cells, and it happens at a controlled rat. There are many pathological occurrences, including atherosclerosis. neurodegenerative diseases, ischemia-reperfusion injury, and carcinogenesis to safeguard and maintain redox system homeostasis [20]. Complex antioxidant systems, including the body's antioxidant, work to prevent harmful effects of oxidative stress. Both endogenous and exogenous defense mechanisms exist. Carotene is an exogenous source of antioxidants. L-ascorbic acid, -tocopherol, and tocotrienols are examples of vitamin C, which comes from dietary foods, is produced eat. Endogenous antioxidant defense sources include the enzymes that catalyze the scavenging of free radicals, such as superoxide dismutase, glutathione peroxidase, glutathione reductase, and catalase [19].

International Journal of Pharmaceutical research and Applications
Volume 8, Issue 6, Nov.-Dec. 2023, pp: 561-574 www.ijprajournal.com ISSN: 2456-4494

3.5. IN LIPIDS, PROTEIN, VITAMINS:

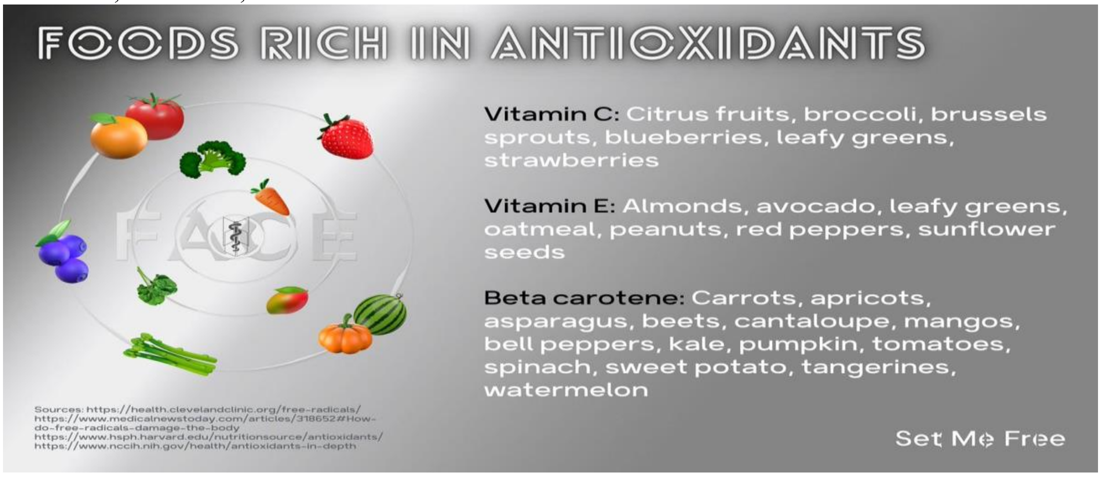

Fig.13. ANTIOXIDANT IN FOODS

The oxidation of lipids and proteins in cells is caused by reactive oxygen species (ROS) and reactive nitrogen species, such as superoxide, hydroxyl, and nitric oxide radicals, in biological systems. These radicals can also damage DNA. The body's antioxidant system typically scavenges free radicals, keeping the right balance between oxidation and anti-oxidation. Agricultural by-product processing businesses are also conceivably significant producers of natural antioxidants [22]. Polyphenols (phenolic acids, flavonoids, anthocyanins, lignans, and stilbenes), Carotenoids (xanthophylls and carotenes), and Vitamins (vitamins E and C) make up the majority of these natural antioxidants derived from plant materials. Common biological effects of these natural antioxidants include anti-inflammatory, antibacterial, antiviral, anti-aging, and anticancer properties. Food science and nutrition are paying special attention to efficient extraction methods for natural antioxidants, adequate assessment of antioxidant activity, and their main sources in foods and medicinal plants due to their major health advantages. In order to improve the extraction efficiency of antioxidant components from plant materials, several ecologically friendly non-conventional approaches have been devised to cut down on operating time and the need for organic solvents [21]. These methods include high hydrostatic pressure extraction, pressured liquid extraction, supercritical fluid extraction, microwave extraction, enzyme extraction, ultrasonic extraction, pulsed electric field extraction, and high voltage electrical discharge. To further evaluate the antioxidant capacities of extracts from natural products, particularly those that people frequently consume, various evaluation assays have been developed. These include the blocking the oxidation of low-density lipoprotein assay, the cellular antioxidant activity assay, the ferric ion reducing antioxidant power assay, the oxygen radical absorbance capacity assay, etc. The general overview of the procedures used to extract natural antioxidants, assess antioxidant activity, and pinpoint their main dietary and medicinal plant sources [22]. Numerous nutritional functions and health advantages of antioxidants produced from foods and medicinal plants are being studied. Due to the reduced extraction time, energy consumption, and use of hazardous organic solvents as well as the higher extraction yields to recover antioxidant compounds from food and medicinal plants, the non-conventional extraction techniques described have the potential to replace or improve existing extraction techniques. However, because of the expensive equipment and laborious installation processes, the majority of them are only suitable for industrial purposes. This review states that crucial area of research in the future will be balancing energy and cost [21].

3.6. ACHILLEA CRITHMIFOLIA, HYSSOPUS OFFICINALIS, TANACETUM PARTHENIUM:

Fig.14. ACHILLEA CRITHMIFOLIA

fig.15. HYSSOPUS OFFICINALIS

fig.16. TANACTUM PARTHENIUM

A variety of synthetic and semi-synthetic antibacterial agents are available for the control of microorganisms; however, bacterial resistance to these antibacterial agents is growing quickly. In addition to the positive effects of bacterial control, the available antibiotics also cause various adverse drug reactions like hypersensitivity and immunosuppression. In order to create alternative antimicrobial drugs, the pharmaceutical industry is motivated. Aromatic plants that contain essential oils are one of the most important natural sources of antimicrobial agents, and many of them are used in traditional medicine primarily to treat infectious diseases. Due to the rising safety concerns surrounding the consumption of synthetic antioxidants, it is now of interest to use cheaper and safer sources of antioxidants from natural sources, especially from plants. Aromatic plants are widely used as nutritional supplements [23]. Polyphenols are the principal phytochemicals that exhibit antioxidant activity. The redox properties of polyphenols are responsible for their antioxidant activity, i. e. free radicals, quenching singlet and triplet oxygen, and breaking down peroxides. Flavonoids are the most prevalent and widely distributed class of phenolic compounds in plants. These are found in most plants and are thought to prevent damage caused by free radicals in a number of ways, including by directly scavenging free radicals and by inhibiting the enzymes that produce free radicals [24]. The antioxidant potential of methanolic extracts from members ofthe Balkan Peninsula. Achillea crithmifolia, Artemisia absinthium, Hyssopus officinalis, Angelica sylvestris, Angelica pancicii, Tanacetum parthenium, and Laserpitium latifolium are among the eight aromatic plants. Achillea grandifolia's chemical makeup also suggests that it may have antimicrobial properties. Pathogenic bacteria isolated from human material were tested by methanolic extracts of the chosen plants. Concerning the studied plants' antibacterial activity, very little information is currently available [24]. As a result, the potential for antioxidants in the methanol extracts was also investigated. They were examined for the presence of phenol and flavonoids. Reducing power, which is regarded as an indicator of antioxidant activity, was assessed using a modified iron (III) to iron (II) reduction assay and the ferric reducing antioxidant power assay. It has two reducing power methods, i.e. iron reducing antioxidant power assay, a modified iron (III) to iron (II) reduction assay, and Following the experimental design, each assay was performed with three independent replicates, and each sample was measured in triplicate [23].

IV. CONCLUSION:

In the assays, the synthesized schiff bases produced encouraging findings. Nobody was able to demonstrate the antioxidant potential and promising action of DPPH in Total Antioxidant activity and Tryptophan experiments. The 2-methoxyphenol moiety was successfully added to a number of molecules. The synthetic compounds displayed a variety of potentially beneficial antioxidant properties. Hydrazone and oxime derivatives were used to semi-synthesize three different substances. A strong antioxidant activity was demonstrated by hydrazone. Antioxidant substances with hydroxy groups on their 3-aryl rings demonstrated notable activity. Compound has been found to have potent antioxidant properties. It has been demonstrated that different functional groups at the methylene group at the indole nucleus' C-3 position can modify a derivative's capacity to act as an antioxidant. Two antioxidant activity experiments have demonstrated the strong antioxidant capabilities of the compound containing the pyrrolidine dithiocarbamate moiety. First, the 5,7-dimethyl-3H-thiazolo[4,5-b]pyridine-2-ones were found to have antioxidant action. Some of our compounds were discovered to be more effective when compared to currently available antioxidants. It was discovered that the plant extracts were distinguished by various caffeic acid derivative concentrations, additional caffeic acid derivatives, and varied antioxidant activity. Natural antioxidants, when consumed in their purest form (i.e., when they are extracted from raw extracts), have high antibacterial properties. Natural antioxidants from T. leptophylla can be found in large quantities throughout the entire plant. The methanolic leaf extracts of Caesalpinia volkensii, Vernonia lasiopus, and Acacia hockii, as well as the methanolic stem bark extract of these plants, were found to exhibit significant antioxidant potential. Numerous nutritional functions and health advantages of antioxidants produced from foods and medicinal plants are being studied. Many complex diseases are prevented and treated with medication formulations based on antioxidants.

REFERENCES

[1]. Aggarwal, R., and Sumran, G., et al., an insight on medicinal attributes of 1,2,4-triazoles, chem.205, 112652
[2]. Barbuceanu, S.F., Ilies, D.C., et al., antioxidant activity of 1,2,4,- triazoles class containing diarylsulfone and 2,4-difluorophenyl moieties, 10908- 10925
[3]. Zhihong C, Jeffrey M, Liangli LY et al., relative DPPH radical scavenging capacity assay.J agric food chem 2006;54:7429-36
[4]. Koleva L, Angelova S, Kancheva V et al., antioxidant activity of selected o-methoxyphenol. Izv Him.2018;50
[5]. Raj V. et al., review on the pharmacological activities of Hydrazones derivatives.EC Pharm Sci.2016;2:278-306
[6]. Luo Y, Song R, Li Y, Zhang S et al., biological evaluation of chalcone oxime derivatives. Bioorg Med Chem Lett,2012
[7]. Renzetti, A et al., synthesis of phthalides and alpha beta butenolides by transition metal catalysed activation of C-H bond molecules,2019:24,824
[8]. Chem J, yang, et al., structure -antioxidant activity relationship of methoxy, phenolic hydroxyl, and carboxylic groups of phenolic acids, 2020
[9]. Jasiewicz B et al., antioxidant of thio caffeine derivatives, identification of newly synthesized 8-{(pyrrolidin1-ylcarbonothioyl) sulfanyl} caffeine as antioxidant and highly potent cytoprotective agent, bioorg.med.chem.lett,2016
[10]. Jasiewicz B et al., antioxidant and cyto toxic activity of new di and polyamine caffeine analogue,2018
[11]. Parthasarathy S, Santanam N, Ramachandran S, Meilhac O et al., (1999) oxidants and antioxidants in atherogenesis, an appraisal journal of lipid research
[12]. Riley PA et al., free radical in biology: oxidative stress and the effects of ionizing radiation. IJRB:27-33
[13]. Clifford M. N., Knight S., et al., discriminating between the six isomers of dicaffeoylquinine acid by LC-MS.J. Agric. Food. Chem.2005
[14]. Tsai Y L., Chiou S. Y., et al., caffeic acid derivaives, antioxidant activities Echinacea purpurea flower extracts
[15]. Ramos FA et al., antibacterial and antioxidant activities of quercetin oxidation product from yellow onion (allium cepa) skin journal of agricultural and food chemistry, 2006
[16]. Papuc C et al., plant polyphenols as antioxidant and antibacterial agent for shelf life extension of meat product, food science and food safety,2017
[17]. Wannes WA, Mhamdi B, Sriti et al., antioxidant property of essential oils and methanol extracts from myrtle leaf, stem and flower
[18]. Brand- Williams W,Cuvelier ME, et al.,use of free radical method to evaluate antioxidant property
[19]. W. Zheng and S. Y. Wang et al., “antioxidant activity and phenolic compounds in selected herbs”, journal of agricultural and food chemistry,2001
[20]. .W. brand -williams, C. berset, et al., use of a free radicals method to evaluate antioxidant activity, food science and technology,1995:25- 30
[21]. De Camargo A.C., Bismara Regitano-d’Arce M.A., Telles Biasoto A.C., Shahidi F. et al., Enzyme-assisted extraction of phenolics from winemaking by-products: Antioxidant potential and inhibition of α-glucosidase and

lipase activities. Food Chem. 2016;212:395–402
[22]. Shang Y.F., Kim S.M., Um B. et al., Optimisation of pressurised liquid extraction of antioxidants from black bamboo leaves
[23]. A. Kumaran, R.J. Karunakaran,e al., Antioxidant and free radical scavenging activity of anaqueous extract of Coleus aromaticus Food Chem, 97 (2006), pp. 109-114
[24]. S. Konyalioğlu, C. Karamenderes, et al., Screening of total flavonoid, phenol contents and antioxidant capacities of some Achillea L. species growing in Turkey