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A Review of the antioxidant properties of herbal polysaccharides

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Abstract: - *In the last few years, variety of polysaccharides are extracting from totally difference flavourer origin, that have already been looked into medical specialty operations. At present, inhibitor activity of diverse Herbal polysaccharides is being studied in depth. Eleven polysaccharides are taken from the leaves of the clotbur var. herkules, succulent barbadensis, hollyhock officinalis var. robusta, ribwort var. libor, aerial components and root of asterid dicot genus fulqida var. sullivantii, stems of magnoliid dicot genus aquifolium, and peach-tree (Prunus persica) gum exudates. The polysaccharides were looked into his or her ability to prevent soyabean peroxidation phospholipid liposomes by Ohio radicals. The best inhibition was discovered with glucuronoxylans of A. officinalis var. robusta and P. lanceolata var. libor, aerial parts. Their inhibitory activity was responsible for around 69% of the activity of alpha-tocopherol, the reference substance. Eight polysaccharides had activity ranging from 20% to 45%, whereas the fructofuranan from P. lanceolata var. libor roots was much inert. The strategies of collection and their advantages and drawbacks, unique styles of in vitro antioxidant assay, elements affecting of antioxidant interest of bioactive polysaccharide and latest research on bioactive polysaccharide from natural reassets with the antioxidant sports has been mentioned in this summery.*

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I. Introduction: -

Several polysaccharides have been discovered in natural resources and have been shown to exhibit biochemical properties or bioactivities such as antioxidant, antibacterial, antidiabetic, anticancer, immunomodulatory, and nutraceutical etc[1,2]. These bioactive poly- saccharides are utilised in healthcare for those who desire to return to using naturally derived products, which is one of the most visible influences of the modern period. The advntages of bioactive polysaccharides derived since many natural origins, such as animal, plant, algae, and microorganism, used to treat a variety of human ailments.[2-4] Conventional drug delivery strategies, such as pills, capsules, syrup, and decoction, are unable to overcome the above-mentioned limitations of herbal pharmaceuticals. Nanotechnology in herbal medicine, on the other hand, has demonstrated enormous success in the delivery of natural drugs[5]. The majority of these bioactive herbal polysaccharides have been studied previously identified as major food origin for humans.

For example, starch is well-known as a component in a variety of meals that account for half of the energy in the human diet. Carbohydrates hydrolyze to glucose in the digestive tract, which is a vital energy source and is required for blood cell and brain growth [6-7].

- ***How antioxidants work together rather than against one another***

Other unique features of the location and activities of carotenoid shall certainly be discovered as scientific research progresses.

This will explain why one form of antioxidant does not have to be rejected chemical to be able to accept another. They might take out in specialized cells and tissues, giving some overlapping protection, but we required a range of them to provide the optimum shielding.

Surprisingly, antioxidants, like nutrients, operate together. Professor Lester Packer of the University of California at Berkeley is one of the world's leading antioxidant scientists. Carotenoids related with vitamins E and C, as he and coworkers recently indicated. It was shown that beta-carotene even when low-density lipoprotein is exposed to oxidative stress it is consumed in large quantities [8].

- ***Herbs high in antioxidants***

Plant antioxidant factors are made up of constituent non-vitamin or mineral substances that have been demonstrated to have radical-scavenging abilities, as well as nutrients that have been shown to have radical-scavenging abilities. Plant-based medicines may contain flavonoids, polyphenols, and flavoproteins in add to alpha-tocopherol, ascorbate, carotenoids, and zinc. Additionally, few plants or specific merger of herbs in formulations may work as antioxidants by in distinct tissue locations, scavenging superoxide or increasing superoxide dismutase activity. Polyphenols' scavenging effects on activated mutagens and carcinogens, carotenoids' quenching of singlet oxygen and radicals, many compounds' antioxidant effects, including ascorbic acid and polyphenols, the inhibition of activating enzymes by some flavanols and tannins, and the induction of oxidation and conjugation by some flavanols and tannins some flavanols and tannins are all examples of evidence from experiments for the activation mechanisms of cancer-prohibits agents in Antipromotion mechanisms include carotenoids' antioxidant properties and the membrane stabilizing consequence of polyphenols, as well as the suppression of proteases produced by chemicals from soybeans[9]

For example, silymarin, a well-known hepatic antioxidant derived from the milk thistle (Silybum marianum), prevents liver injured by rummage free radicals and another way. The death cap mushroom, Amanita phalloides, has extremely poisonous chemicals that protect the liver from alcohol and pharmaceutical injury, as well as poisoning. Surprisingly, there is no evidence that the amanita poisons are mitigated by free-radical rummage effects. Instead, silymarin is thought to compete with amanita toxins for the same receptor on cell membranes. Again, modern laboratory science validates and elucidates milk thistle's liver-protective properties, which have been known in For almost 2000 years, traditional medicine has been used[10].

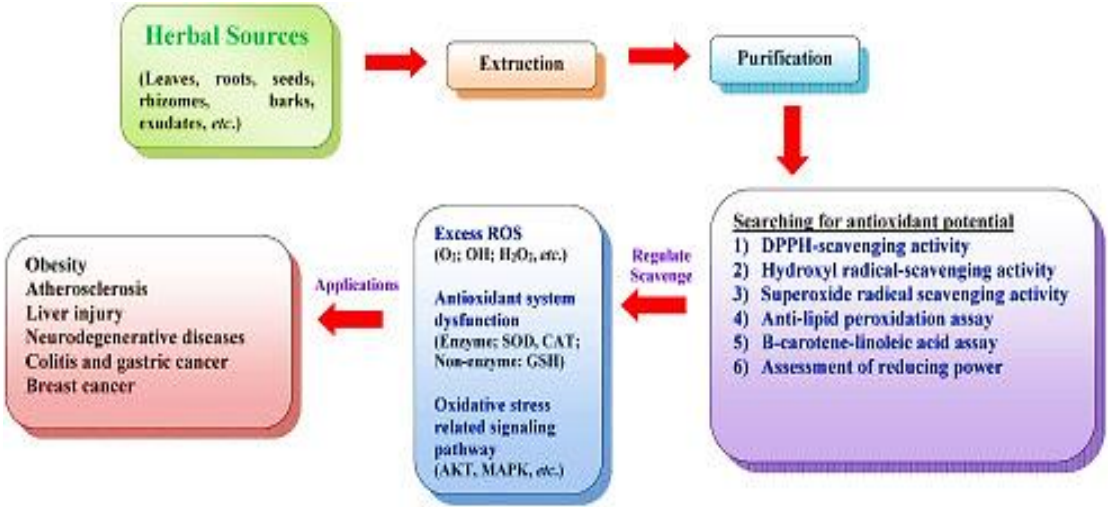


Fig 1: - Antioxidant activity of polysaccharides

Herbs have antioxidant effects:

1. Licorice: Scientific name: *Glycyrrhiza glabra*; Parts used: root.

Dosage: 1 teaspoon of the root or underground stem, cooked for about half an hour 0.5 to 1.0 quarts water in a closed container at a low boil. Allow the liquid to cool in the container slowly after it has been closed. Drink 1 to 2 cups per day, chilled, 1 tablespoon at the time. Presence of a triterpene saponin called glycyrrhizin, which is nearly Sugar is fifty times sweeter and has a potent cortisone-like effect, is primarily to blame for the wide range of pharmacological consequence of licorice rhizomes and roots.

Humans who take 6-8 ounces (a large amount) of licorice candy every day for several weeks have been "poisoned" due to the According to medical literature, the licorice extract in the candy has cortisone-like properties. Patients can return to normal after getting proper treatment. In collation to the very modest amount present in additions, the above amount of this chemical is highly substantial. Licorice rhizome and as well as root also contain the lot of mucilage. After water mixing, the resulting product has a nice odour and flavour, on irritated mucous membranes, it works well as a demulcent. like a sore throat. lycyrrhizin has been demonstrated to be just as effective as effective as codeine at repressing coughing in one research.

The researcher concluded that adding 2% glycyrrhetic acid to hydrocortisone, a "poor anti-inflammatory drug," considerably increases its strength. The authors recommended that patients gain hydrocortisone with glycyrrhetic acid to reduce Corticosteroids have negative side effects. Glycyrrhizin has also been shown to have antiviral properties. Glycyrrhizin repressed Epstein-Barr virus, cytomegalovirus, and hepatitis B virus, according to a 1979 study. Glycyrrhizin has been used to treat chronic hepatitis B in Japan for more time. As a result, it's been recommended that glycyrrhizin could be useful in the treatment of HIV.

Intake of high amounts of licorice has been linked to negative side effects. In immoderate doses, glycyrrhizin can cause hypokalemia and hypertension. People with heart issues or high blood pressure should avoid taking significant amount of licorice or its component for these reasons [11-16]

2. Ginkgo: - Scientific name: *Ginkgo biloba* (G. biloba). Useable parts: Leaves.

Dosage: To 1 pint of water, add about 0.5 ounce of leaves Boil water separately and pour it over the plant material, steeping for 5-20 minutes, depending on the desired outcome. 1 to 2 cups every day, hot or warm, at bedtime and when you wake up. G. biloba extract's free-radical scavenging activities have been shown to be at least as constructive as uric acid, a powerful, naturally occurred antioxidant. The plant extraction also has the ability to prevent the creation of radicals, which uric acid lacks. Ginkgo study has continued in a variety of different fields. Vascular disorders, brain function, impotency, dopamine production, swelling, and asthma are among the most interesting and relevant findings. Tebonin is a ginkgo leaf extract that is sold as a supplement. Tebonin has been proven in clinical studies to cause vasodilation and enhanced blood flow, particularly in deeper-seated medium and small arteries. The rate of blood flow in capillaries and end arteries is maximized. Tebonin reduced dizziness and memory loss in elderly people. Ginkgo biloba has proven to a beneficial plant.

Ginkgolides and bilobalides have a structure in common. In the vegetable kingdom, this is unique. Another double-blind, placebo-controlled trial revealed. This traditional Chinese herbal remedy provides a significant advantage. Twenty-one patients had mild to moderate memory impairment. For six months, participants with impairment were monitored while taken in medication. Ginkgo biloba extract, standardized They were all over the top. 50 years old. The extract has a flavonoid glycoside content of 24 percent and Terpenes account for 6% of the total. The findings demonstrate that G. biloba extract "had anti-inflammatory properties." In senior individuals, it has a positive influence on mental efficiency. Organic memory impairment is mild to moderate. origin." Sixty individuals with arterial erectile dysfunction were given a daily dose of 60 mg of a Ginkgo biloba extract.

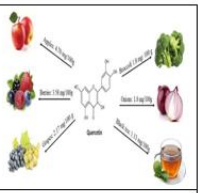
After 6 months, 50% of the individuals were able to obtain penile erections once more. More than half of the individuals who remained improved in some way. Another study indicated that G. biloba extract may protect human kidney and liver damage induced by the immunosuppressive medication cyclosporin A, which is used in transplants. This herbal supplement was found to be just as beneficial as vitamin E and glutathione in preventing such harm, adding to our knowledge of the need of using nutritional and herbal supplements in modern therapy. Ginkgo's anti-allergic and anti-asthmatic properties have also been established. Allergic inflammation, anaphylactic shock, and asthma have all been linked to platelet activating factor in pathophysiological situations. In a randomized, double-blind, placebo-control crossover study of 7 atopic asthmatic patients, when compared to placebo, ginkgo dramatically reduced the bronchial allergen challenge. [17-20]

3. Ginger: - Scientific name: *Zingiber officinale*; Part uses: Rhizome.

Dosage: 1 pint of water to 1 ounce of rhizome Separately boiled water, then pour it's over the plant material and let it sharp for 5 to 20 minutes, depending on the desired effect. 1 to 2 cups, hot or heated 2 glasses of coffee per day. Ginger is becoming increasingly popular as a cure for motion sickness. In the United States, ginger tea has long been used to alleviate coughs and asthma induced by allergies or inflammation. The soft drink ginger was created from the common folkloric use of this medicinal plant, and it is still a popular beverage for stomach upset treatment.

Ginger is a artifact and has traditionally been used to treat headaches and toothaches. The mechanism that causes ginger to have anti-inflammatory properties is unknown. The activity is in the same way that a nonsteroidal anti-inflammatory medication does drug. This common spice has a higher biological activity than others. (Through cyclo-oxygenase inhibition) than a prostaglandin inhibitor. Garlic with onion by slowing down the metabolic pathways that are involved. An inflammatory response is slowed. According to one study, the Danish. Between the ages of 25 and 65, women consumed either 70 or 80 calories per day. For a week, eat 5 g raw onion or 5 g raw ginger every day. The author discovered that thromboxane production may be monitored. Showed ginger, more than onion, decreased thromboxane production. By over 60%, production has increased. This backs up Ayurveda's claims. This popular spice and its anti-aggregator have a "prescription "effects. The oils of these herbs prevent the fatty acid oxygenase from platelets, therefore minimizing the clumping of these blood cell components, according to a previous study of how some of the active components of ginger (and onion) function inside human cells. Thirty women with hyperemesis gravidarum participated in a double-blind, randomized crossover experiment in 1991. A placebo was used in place of ginger. Seventy percent of the women said they enjoyed the period when they were taking the ginger. A more objective study confirmed the subjective emotions, as the usage of ginger resulted in much higher comfort. Scientists from Japan revealed that extracts of ginger prevented stomach ulcers by up to 97 percent in rats in a series of trials. Because of the ingredients of zingiberene, the primary terpenoid, 6-gingerol, and the pungent principle, the authors concluded that the folklore use of ginger in stomachic preparations was helpful [21-24].

4. Schizandra: **-** Scientific name: *Schizandra chinensis*; Parts used: Berry.
Dosage: - 1 to 2 g per day, taken as a pill or capsule. Antibacterial (equivocal results), sympathomimetic (stimulant), resistance stimulation, liver-protective, anti-toxic, anti-allergenic, depressive, glycogenesis stimulant, and antioxidant benefits are just a few of the biological properties of this fascinating plant. It's also a legendary "tonic," as this herb protected mice from the narcotic and sleepy effects of alcohol and pentobarbital, as well as exposure to the highly deadly ether. The authors suggested that schizandra could be a valuable therapeutic treatment for reversing central nervous system depression as a result of these findings. This antidepressant activity was predicated on the idea that depression could be caused in part by adrenergic depletion as a result of extreme psychogenic stress. A fascinating examination of race horse performance likely to back up the folklore assertions. Polo horses fed this species' berry extract had a reduced increase in heart rate during exercise, a faster recovery of respiratory function, a lower plasma lactate level, and better performance. The arachidonic cascade promotes the synthesis of leukotrienes, which may play a role in the development of inflammatory disorders. Schizandra protects the liver while also stimulating the immune system by suppressing the arachidonic acid cascade, two critical functions of an excellent adaptogen. In a fascinating non-Western investigation, mice were given schizandra and other plants to assess their "tonifying and revitalizing yang" abilities. The scientists took measurements of the animal's body weight, thymus weight, leukocyte count, and other "yang" indicators. They discovered a link between the amount of herb consumed (as hot water extracts) and better immune function. They also detected a marked anti-fatigue quality, as evaluated by reduced parasympathetic nervous system excitability. There was no evidence of toxicity. In 1992, the antioxidant activity of dibenzo-cyclooctene lignans obtained from Schizandra While schizandra is a fairly safe herb with a long history of use, one provider of a standardized extract advises epileptics with high intracranial pressure or severe hypertension, as well as individuals with "high acidity," to avoid it [25-32].
5. Quercitin: **-** In higher plants, quercitin is the most prevalent flavonoid. It's primarily found as a glycoside like rutin, isoquercitrin, quercitrin, hyperin, and quercimeritrin, but it's also isolated in the free state from the Compositae, Passiflorae, Rhamnaceae, and Solanaceae families, where it's mostly found on leaf surfaces, in fruits, and in bud extracts[33]. Quercitin is a potent antioxidant that lowers superoxide anions levels in both enzymic and nonenzymic systems. Its antiulcer and gastroprotective properties, particularly against ethanol damage, were established in a recent animal study. The cytoprotective action was influenced by numerous interconnected pathways, including the activation of prostaglandin and inhibition of leukotriene synthesis, as well as the antioxidant characteristics of quercitin. The best effective dose for preventing necrosis was 200 mg/kg (a very high dose) given 120 minutes before delivering ethanol to experimental animal[33].

				
1. Licorice	*2. Ginkgo*	*3. Ginger*	*4. Schizandra*	*5. Quercitin*

Bioactive polysaccharide extraction from herbal sources: -

The purpose of extracting herbal polysaccharides with bioactive polysaccharides is to isolate the polysaccharides in their purest form and expose the polysaccharides' harmful intrinsic bioactivity. Dilute alkali extraction is another common polysaccharide extraction method. In recent years, various approaches enzyme-assisted extraction, ultrasound-assisted extraction, microwave-assisted extraction, subcritical water extraction, ultra-high-pressure extraction, and so on and decompression/vacuum extraction have been utilized to boost the percent yield. Purity, molecular weight, and percentage yield, and validity of polysaccharides are all used in the extraction process methodology. Herbal sources, temperature, pressure, duration, medium pH, volume of extraction medium, and so on are all important elements for extracting herbal polysaccharides.

- ***Extraction with hot water****:* - Polysaccharides are commonly extracted using the hot-water extraction method [34-35]. The raw components are blended with a specific boiling for 15–360 minutes with a litre of filtered water at 100 degrees Celsius. To obtain a a high production of bioactive polysaccharides as a percentage of total sugars, this extraction process necessitates a longer duration, a higher liquid-to-solid ratio, a higher temperature, and a higher strength. Because it is relatively affordable, this method is still success and largely regarded as a conventional poly- saccharide procedure for extraction. Extraction with hot water is a technique that has been used for a long time is currently being utilized to extract bioactive components from herbs with great success. Few studies, however, think that only hot water extraction is possible distinguish foreign polysaccharides since they don't harm the cell membrane. As a result, extracting polysaccharides using this approach necessitates

a higher temperature. In order to improve output conditions, for polysaccharide Mathematical models such as single-factor, orthogonal, response surface methodology (RSM) based on Box-Behnken design (BBD) or central composite rotatable design (CCRD) are employed in the hot-water extraction process. If the extraction has a low viscosity, the leftovers can be easily filtered. If the extraction has a low viscosity, the leftovers can be easily filtered. If the residue is visible, centrifugation can be used to remove it.

- ***Dilute alkali extraction method****:* - The alkali water extraction method produces a very high yield of polysaccharides and is superior to hot-water extraction. At room temperature (27°C), the raw material is suspended in 0.1 M sodium hydroxide for 24 hours before being heat on 97°C for six hours. The unaltered residue is removed using the supernatant, and centrifugation is then gathered. Finally, hydrochloric acid is used to dry the recovered material. Polysaccharides from Mauritia flexuosa edible fruits were extracted used to dilute alkali, demonstrating that alkali water extraction yielded higher percentage yields of polysaccharides than water extraction[36].
- ***Alcohol- fermentation precipitation method***: - The two forms of fermentation-alcohol precipitation methods are precipitation within the cell and (ii) precipitation outer the cell[37]. The cell wall of mycelium was removed using the intracellular precipitation procedure. This method for polysaccharide extraction uses extracellular precipitation, which includes the following steps: (a) Mycelium is collected and then centrifuged using fermented liquid., (b) inclusion of necessary amount of distilled water and mycelium measuring, (c) hot water extraction followed by centrifugation, and (d) collection of supernatant components, ethanol precipitation, and washing with organic solvent followed by low-temperature drying. The processes described above are utilized to aqueous-soluble polysaccharides extracted from intracellular polysaccharides chemicals, and alkaline-soluble polysaccharides found within cells are extracted for intracellular polysaccharides; for example, mycelium is extracted using the dilute alkali leaching method. Many polysaccharides are extracted using the extracellular precipitation approach; Collecting myceliums, for example, is fermented with ethanol., centrifuged, followed by a low-temperature rinse with an organic solvent [38].
- ***Extraction process aided by enzymes****:* Extraction process aided by enzymes is a quick approach for extracting polysaccharides, and it has the ability to extract polysaccharides with higher yields than traditional approaches [39]. This approach, however, is reliant on an enzymatic response that pierces the cell membrane at appropriate rates of solvent consumption. Various enzymes, including xylanase, cellulase, pectinase, and mannose, are typically utilised in the manufacture of bioactive polysaccharide in this approach[40]. It's worth noting that the extraction method aided by enzymes has a number of advantages, including low cost, shorter extraction times (20–60 minutes), excellent precision, and room-temperature stability (particular compound cleavage)[41]. In one study, extraction aided by enzymes of pomegranate peels (such as, cellulose, pectinase and mannose) had the highest yields of 27.3 percent. When compared to alkaline treatment, extraction aided by enzymes (cellulose) of banana peels has been proven to be more successful[42]. Similarly, enzyme assisted extraction (pectinase) of orange peels yielded a a greater yield percentage [43]. Although extraction aided by enzymes has the advantages listed above, it also has certain disadvantages, such as temperature regulation and degradation throughout the extraction process are two issues that will require more research in the future. [44].
- ***Microwave assistance extraction method****:* - Microwave-assisted polysaccharide extraction is a new technology for extracting polysaccharides[45]. The material is carefully heated utilizing microwave and electromagnetic energy in this procedure, resulting in the remove of the cell wall as well as cell membrane. The lowered polarization of molecule can also be increased. Processes aided by microwaves have several inhibit, including cost effectiveness, environmental friendliness, reduced use by organic solvent, and reduced time. Compared to other extraction processes, this method uses less energy and delivers better percentage in yields. Microwave-assisted extraction techniques have been employed by many researchers to extract soluble polysaccharides from plants[46-48]. The microwave-assist approach with surface extraction yields a positive result and the optimize polysaccharide extraction method were used to extract bioactive polysaccharides from red stilbene in a study[49]. The optimum feasible microwave-assisted extraction parameters were 45 minutes, 213 watts of microwave power, 80 degrees Celsius, a liquid-to-material ratio of 26:1, and an extraction period of 1 hour. Red stilbene bioactive polysaccharide has a high content of bioactive polysaccharide 10.11 0.52 percent in these conditions[50].
- ***Method of ultrasonic extraction:*** - Ultrasonic extraction is a technique that uses sound waves to extract material is a revolutionary polysaccharide extraction technology. Extraction, which takes place at high pressures (100–1000 MPa). as well as the temperature (between 20 and 50 degrees Celsius). This method of extraction is commonly used. Because of an environmentally friendly technique developed by the US FDA and widely employed in the industry of food [51]. The best way to get a high percentage yield of Polysaccharides from Borojoa sorbilis fruits were studied under pressures (1200–1800 MPa), durations (1–3 minutes), and temperatures (25–35 C) to achieve an increased yield of 8.28% on at 30 C and 1500 MPa, the molecular weight average is 27.7 kDa [52]. The concentration of extracted bioactive polysaccharide from Guizhou Sambo was determined to be a

maximum of 26.4 percent, which was investigated at a temperature of 64.93C, a raw material to extraction medium ratio of 1:60, ultrasonic power of 178.23 W, and a sonication time of 26.72 minutes [53].

Factors impacting bioactive polysaccharide antioxidant activity:
Polysaccharide conjugates, polysaccharide mixtures in crude polysaccharide extracts, polysaccharide chelating ions, metal ion-enriched polysaccharides, polysaccharide chemical alterations, polysaccharide structural characteristics, and other factors all affect Bioactive polysaccharides' antioxidant properties**.**

• ***Polysaccharide conjugates are a kind of polysaccharide***: - In medicine and the food sector, polysaccharides and their conjugations are used [53,54]. These materials have recently begun to pay attention to biological functions [54]. Polysaccharides from herbal sources do not exist as separate components; instead, they form conjugates with other components such as proteins, amino acids lipids, and so on [54,55]. In isolation, the polysaccharide conjugates show their biological functions as a whole. Tea polysaccharide conjugates protein, neutral carbohydrates, and uronic acid, for example, are all present. [56]. Because of the link between uronic acid and the rummage action of tea polysaccharides, tea polysaccharide conjugate has been shown to have antioxidant activity. The antioxidant activity of tea polysaccharide conjugate was shown to be proportional to the protein concentration. Antioxidant activity and physicochemical properties are generally increased with an increase in protein content in polysaccharides-protein conjugates [56]. Scavenging activity is also provided by polysaccharide peptide-protein conjugates [81]. Phenolic molecules, such as phenolic acids, have also been demonstrated to exhibit scavenging properties [55]. The scavenging actions were attributed to polysaccharide conjugates such as xylans and xylooligo saccharides (wheat bran was used in the extraction) [59,60]. The maximum hydroxyl radical scavenging activity was found in the xylans and protein-free fractions, showing that phenolic acids play an important role. In fact, phenolic polysaccharide conjugates have antioxidant properties. Ferulic acids are type of phenolic acid conjugated with polysaccharides, have been shown to have potent antioxidant properties [60]. Ferulic acid's carboxylic acid groups are covalently conjugated. to the main hydroxylic groups at the carbon-5 position of -L -arabinofuranosyl residues via an ester bond produced. At a dosage of 4 mg/mL, feruloyl oligosaccharides (wheat bran was used in the extraction) blocked 91.7 percentage of erythrocyte hemolysis generated by peroxyl radical and delayed he- molytic commencement for more than 120 minutes in vitro [61]. As a result, poly-saccharide conjugates are capable of exhibiting significant antioxidant activity [60,61].

II. Conclusion: -

The antioxidant activities of multiple bioactive polysaccharides have been studied in recent years, and it has been discovered that they are based on various sources, techniques of extraction, and purification of polysaccharides. According to the literature, herbal materials include a large number of structurally varied and bioactive polysaccharides. The hunt for novel antioxidant polysaccharide from herbal sources has gotten a lot of attention because of its potential use in healthcare. The conflicting results are also seen in comparison to various literatures, and the antioxidant potential of polysaccharide is created to be influenced by structural features, chelating ions, a combination, and polysaccharide conjugation. Obesity, atherosclerosis, liver injury, neurological illnesses, colitis and stomach malignancies, breast cancer, and other diseases are currently being treated with bioactive polysaccharides isolated from natural sources. Many plant polysaccharides are now used as functional antioxidant and nutraceutical components in a variety of meals and pharmaceuticals. Herbal pharmacotherapy has the potential to be a very promising future alternative to conventional treatments. Even though the antioxidant mechanism isn't completely understood, more research in this area is still needed.

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Saibal Chandra Ghorai, et. al. " A Review of the antioxidant properties of herbal polysaccharides." *IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)*, 17(2), (2022): pp. 25-32.