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PREPARING EDIBLE COATS FROM CHITOSAN REINFORCED WITH ANTIOXIDANTS EXTRACTED FROM PLANT RESIDUES AND THEIR USE IN BIO-PACKAGING FOR SOME FISH PRODUCTS.

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Abstract

The current study dealt with the preparation of fish products (tablets) from the sea fish that was purchased from the local markets in Basrah province, which was preserved by refrigeration after conducting the formation process for fish products and divided into three groups. With sorbitol and polyvinyl alcohol only. As for the third group, it was wrapped in chitosan wraps with sorbitol and polyvinyl alcohol and supported with aqueous and alcoholic plant extracts prepared from plant leaves (Sidr leaves, mint leaves, grape leaves and olive leaves) and from different peels (potato peels and pomegranate peels) and were placed in the refrigerator for 14 days, when extended (1, 5, 10, 14) days of cryopreservation, and the following was reached: 1- The packaging process plays a major role in maintaining the quality and freshness of the prepared fish products, as the group is covered with a membrane made of chitosan with sorbitol and polyvinyl alcohol and the group coated with chitosan with sorbitol and polyvinyl alcohol and supported by water and alcohol plant extracts were better than the unwrapped in terms of preserving the chemical composition For processed and refrigerated fish products for 14 days. 2- The excelled of coats manufactured from chitosan with sorbitol and polyvinyl alcohol and fortified with aqueous and alcoholic plant extracts in maintaining the chemical and physical indicators of processed and cold-preserved fish products compared to uncoated products coated with chitosan with sorbitol and polyvinyl alcohol. 3- The superiority of coats manufactured from chitosan with sorbitol and polyvinyl alcohol and fortified with aqueous and alcoholic plant extracts in preserving the sensory properties of processed and cold-preserved fish products compared to uncoated products coated with chitosan with sorbitol and polyvinyl alcohol. 4- It was found that the aqueous and alcoholic extract of pomegranate is better than the rest of the water and alcoholic extracts of plant residues (peels, leaves) in preserving the chemical composition and sensory characteristics of the prepared fish products. 5- Aqueous and alcoholic extracts of plant residues (peels, leaves) contain many phenolic and flavonoid compounds, which are important antioxidants in maintaining human health and safety.

Keywords: edible coats, chitosan reinforced, antioxidants, plant residues, fish products

Introduction

Food safety, preservation, prolongation of its shelf life, reduction of pollution and spoilage during handling and storage are among the matters that occupied the attention of producers and consumers and in line with the recent development and modern technologies in food manufacturing to meet the increasing nutritional requirements of humans and to meet the consumer’s desire to stay away from what is industrial for food ingredients and to secure the health aspect of the consumer, The interest in foods fortified with antioxidants has increased because of the negative effects of oxidation on food quality because it is the main cause of loss of nutritional value and the occurrence of undesirable flavours (McElhatton et al., 2007). There are approximately 1500 chemicals that are used in the manufacture of packaging materials, and some of them are used to improve quality or as an aid in manufacturing. Studies and research confirmed that some packaging materials have a toxic effect and the ability to spread from the packaging material to the product being packaged in addition to the environmental and health problems resulting from the difficulty of disposing of packaging materials (Baldwin, 2012).The environmental pollution caused by packaging materials has become one of the essential points that depend on choosing the optimal packaging method, especially with the increase in human consumption after the last decade, where it reached more than 250 million tons annually, especially packaging materials, plastic materials that originate from petrochemicals (Mohanna and Al Sibai, 2000) , Which led to the consumer's search for good quality food free of chemical preservatives. Therefore, the use of bioactive substances in food packaging was made to reduce the use of non-biodegradable plastics. The biomaterials represented by natural plant or animal materials such as polysaccharides, proteins and fats are degradable, non-toxic and environmentally friendly (Nemet et al., 2010), In addition to their suitability for the production of edible coats, whether they are from polysaccharides such as chitosan and proteins such as whey proteins, starch and grains, where these coats have spread widely and have been used in food packaging and have become an alternative to the use of traditional packaging materials (Saputra et al., 2015). Chitosan is a naturally occurring biopolymer suitable for forming edible and biodegradable coats and sheaths. It has good mechanical properties, as well as the ability to retain gas and moisture. It also extends the shelf life of foodstuffs, as it acts as an antidote to many microorganisms. It is prepared commercially by the process of deacetylation of chitin, as chitin is the main component of the exoskeleton of crustaceans such as shrimp, lobster and crab (Pascall and Lin, 2013).

The study aim:

The choice of packaging or food packaging system depends on the characteristics of the food to be packed or preserved, whether it is fresh (vegetable or animal) or a manufactured food substance, as each substance has its own physical and chemical characteristics and the appropriate storage conditions for them, given the environmental problems caused by the use of industrial plastics, the increase in global demand for biopolymers, and due to the lack of local studies regarding the use of waste from various sources (plant and animal), The trend was towards the production of antioxidants and phenolic compounds from sources such as waste, and then providing them and using them to enrich or strengthen membranes made from the residues of crustaceans (shrimp shells), which are by-products of fishing and marketing operations, and then produce fish products that are kept in refrigeration for daily consumption or weekly, and follow-up on the extent to which they retain their quality and quality, and the manifestations that occur to them, whether positive or negative, during the preservation period that does not exceed two weeks, Thus, this topic is at the core of providing integrated food in terms of nutritional and health value. In short, the aim revolves around the production of bio-casings that can be used in packaging fresh fish products or prepared for refrigeration in order to prolong their preservation; This is from animal waste.

Literature Review

Plants and their importance:

Consumption of fruits and their juices is beneficial for health by reducing the risk of vascular diseases as well as reducing the risk of high blood pressure, stroke and other diseases because the fruit contains beneficial nutrients, such as monounsaturated fatty acids, vitamins and antioxidants (Ibrahim et al. al., 2018). The proliferation of free radicals can cause protein degradation and DNA mutation leading to cancer, heart disease, neurodegenerative disease, diabetes, inflammation as well as senescence (Owoade et al., 2019). Synthetic antioxidants such as BHT and BHA are used to maintain food quality and safety and extend their shelf life, and many studies have shown that synthetic antioxidants may be dangerous to humans. Therefore, studies have directed towards the use of natural antioxidants of plant origin (Pande and Akoh, 2009).

Recent studies have focused on the extraction of phenolic compounds from plant sources as they are natural antioxidants against many diseases caused by free radicals, and the role of phenolic compounds as antioxidants is due to their electron donation (Yizhong et al., 2004). The plant parts represented by stems, roots, leaves, seeds and flowers are important sources of phenolic compounds such as flavonoids, cumarines, tannins, carotenoids, vitamin C and folic acid.). Fruit and vegetable peels, in particular, are wastes that are disposed of by throwing them in waste, which leads to environmental pollution. It is possible to use them as edible coats while at the same time extending the shelf life of the manufactured packaged product (Khattak and Rahman, 2017 and Fritsch et al., 2017). The plant extracts of the peels play a role in preserving the products, as they act as antioxidants and antimicrobials, especially in processed meats for the purpose of preserving them for a longer period of time and maintaining their quality (Ibrahim et al., 2018)).

Fruits and vegetables used in the study:

Pomegranate :

The scientific name is Punica granatum L. It belongs to the Punicaceae family, is cultivated in tropical and subtropical regions (Gil et al., 2000), and is a rich source of phenolic compounds such as tannins and Pelleterne (Kulkarni et al., 2004), and the peels of the pomegranate are used. Treating cough and diarrhea, and treating mouth ulcers. It is also a tonic for the heart, and has a role in reducing inflammation and fighting tumors (Williamsan, 2002).

Grapes:

The scientific name . Vitis vinifora L. It belongs to the Vitaceae family. It is cultivated in hot regions (Al-Mayah, 2001). The grape is a fruit that has many uses, not only as a fruit, but in its many forms, such as juices, raisins, grape vinegar and jams. The fruits have various shapes and colors, including red, white and violet, and the color varies according to the presence of phenolic compounds, especially anthocyanins, which are responsible for the color gradients in grapes. Its cultivation is spread all over the world, but at first it was in Central Asia and the Mediterranean basin (Al-Khoury, 2017). The presence of tannins in grapes is in the form of complex esters and consists of sugars and phenolic acid. Grapes also contain other phenolic compounds such as anthocyanins, polyphenols, procyanidins and flavonoids (Duda-Chodak and Tarko, 2007), and it has a role in revitalizing the kidneys and strengthening the kidneys.).

Mint: Spearmint

The scientific name is Mentha pamiroalaica, and it belongs to the Labiatae family, which includes approximately 220 genera (Abu Zaid, 1992). Mint is an aromatic plant that spreads in the tropical and tropical regions of the world. It is a source of volatile essential oils, and the volatile oil found in mint is light yellow or colorless and has a spicy taste and contains menthol and has antioxidant activity because it contains polyphenols that have a role in preventing disease (Al-Hashimi, 2013).

Potatoes:

The scientific name is Solanun tuberosum L. and it belongs to the family Solanaceae, and it is a major agricultural crop around the world, as it is an important and cheap food and is used in many food industries, and gives a lot of energy higher than other vegetables. It occupies the fourth place after wheat, rice and corn, and it is rich in mineral elements and amino acids, and its original home is South America, from which it moved to Europe and the world (Al-Nuaimi and Jarallah, 2017).

jujube:

The scientific name is Frangula alnus, and it belongs to the family Rahamnaceae, and is found in tropical and subtropical regions with a hot or temperate climate (Rayan, 2019). It is considered one of the well-known medicinal plants since ancient times, as it is used in folk medicine for its multiple benefits. jujube leaves contain many effective ingredients, the most important of which are alkaloids, including the soaps Spinanina and Jujube, which are responsible for the anti-microbial activity. Antioxidants, phenols, pectins, fats, tannic acid, tannins and terpenes (Al-Rawi, 1988).

Olive:

The scientific name is Olea europea and it belongs to the olive Oleaceae family. The olive tree is one of the oldest trees and its original home is the Mediterranean Basin (Guinda et al., 2004. It is an evergreen tree, and statistics show that it occupies about eight million hectares in different countries of the world et al. 2004) ., Tabera) The main use of the olive tree was in order to benefit from the oil in food (Gordon et al. 2001, but recently the leaves of this tree have been given attention because of the compounds they contain of medical importance (Somova et al., 2003; Benavente et al., 2000).

Free-Radical and Antioxidants

Fats, oils and foods containing high levels of fats are subjected to deterioration when stored at high temperatures for a long period of time. This damage is called oxidation, and the products of the oxidation process cause a decrease in nutritional value and unacceptable changes in sensory qualities, such as a change in the taste, smell and color of foodstuffs (Gorden, 2001). There are many factors that contribute to the oxidation process, including exposure to light, the presence of epoxidase enzyme, and exposure to high temperatures (Minawi and Mohsen, 2007). Avoiding the occurrence of oxidation is very important for the manufacturer and for anyone who has a relationship with food, starting from the producer to the consumer. Rancidity is divided into three types: oxidation rancidity, hydrolytic rancidity, and ketotic rancidity (Drummond, 1997). Oxidative rancidity is the most prevalent and occurs in oils that contain a high amount of polyunsaturated fatty acids with multiple double bonds, and occurs due to the interaction of the oil with oxygen, which leads to chemical changes in taste and smell (19et al., 20 Esfarjani). Antioxidants are among the widely distributed chemical compounds in nature that have multiple mechanisms of action, the most important of which is their interaction with free radicals in oil or fat and the formation of stable and inactive products (Pokorny and Korczak, 2001). Antioxidants were described by Methew and Abraham (2006) as phenolic compounds that have an effective role in preventing the negative effects of free radicals as well as the effect of active oxygen groups, and thus they work to prevent food oxidation in addition to their role as antioxidants within the human body (Invivo) Hall (2001) indicated that antioxidants can be divided according to their mechanism of action into:

1- Primary antioxidants: they play a role in inhibiting free radicals in fats and oils, examples of which are phenolic compounds.

2- Metal ion-holding antioxidants: They bind metal ions and convert them into inactive forms, such as citric acid.

3- Antioxidants that stabilize hydroxides: They have the ability to prevent the breakdown of hydroxides by free radicals, such as phenolic compounds.

4- Antioxidants that inhibit single oxygen: these convert single oxygen into triple oxygen, examples of which are carotenoids.

5- Antioxidants called auxiliaries: they enhance the action of primary antioxidants, examples of which are ascorbic acid and citric acid.

Explain Prior et al. (2005) that natural phenolic compounds have the ability to act as primary and secondary antioxidants.

The amino acid cysteine and glutathione are considered antioxidants, as they work to form enzymes that prevent oxidation, such as glutathione peroxidase, which are abundantly present in white meat (Mansour, 2005).

Decker et al. (2005)showed that antioxidants are divided into two categories based on their way of stopping or inhibiting the oxidation process:

The first section: It is called the primary antioxidants, and this unites or reacts with the free radical and turns it into a stable product by giving it a hydrogen atom as shown in Figure (1).

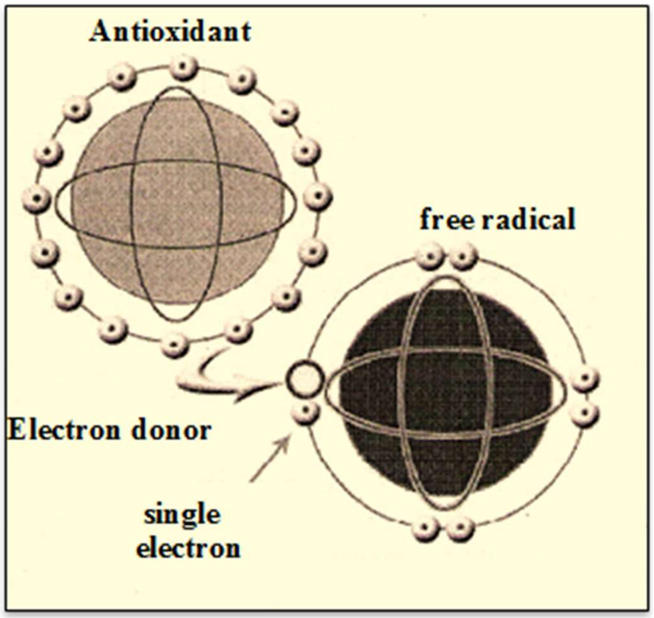

Figure 1: Giving an electron from the antioxidant (Oufnace, 2006)

The second section: They are called secondary antioxidants, and they have the ability to inhibit the oxidation process by binding metals, decomposing peroxides, and inhibiting enzymes that help in the oxidation process.

The human body has a defense system against free radicals.

As cells have the ability to produce enzymes that have an antioxidant role called antioxidant defense, thus reducing the proliferation of free radicals, and working to repair the damage resulting from them, including the enzyme glutathione peroxidase (GPx) and superoxide dismutase, TawahaS (2005).Teow (2005) explained that free radicals can be formed as a result of external factors, such as exposure to polluted air, cigarette smoke or radiation, and that these molecules are unstable and active looking for electrons in order to reach a stable state.The cells of the body use oxygen to burn carbohydrates, proteins and fats in order to generate energy, thus forming free radicals, which are unstable molecules and lose an electron. (NO), (Hydroxyl (OH) (Attaur-Rahman and Choudhary, 2001).The free radicals attack the vital molecules to obtain the electron, which causes damage to fats and proteins, and when they attack the genetic material of the cell DNA, many changes occur that promote the spread of cancer cells (Nakiboglu et al., 2007).Govindarajan et al. (2005) showed that the body has a kind of antioxidants that it takes through the food that is eaten and that vegetables and fruits are a major source of antioxidants such as phenolic compounds and vitamin C, in addition to the presence of industrial antioxidants used in food preservation such as Butylated Hydroxy Toluene (BHT Hydroxy) and (Buty Anisole (BHA Tert-Butylated Hydroxy Quinone (TBHQ) and this reaction is the most widespread of antioxidants:

X + AH · XH + A

The first step in the anti-oxidation activity of phenolic compounds is the transfer of a hydrogen atom. An example of this is the phenolic compound Hydroquinone, which has the ability to block or prevent the chain reaction of free radicals by giving a hydrogen atom from the two hydroxyl groups present on the phenolic ring as a result of the formation of the phenolic ring Its interaction with semi-quinone and hydroperoxides (Nawar, 1985).

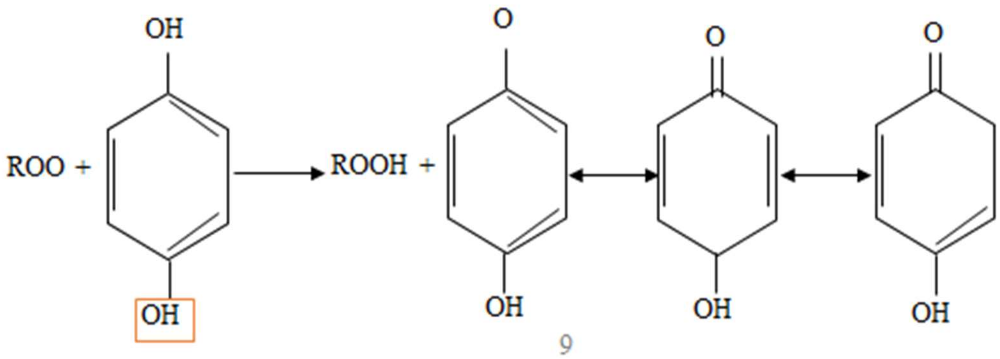

Figure (2): Giving a hydrogen atom from the two hydroxyl groups and forming a semi-quinone and hydroperoxides compound (Nawar, 1985)

There are many types of natural and artificial antioxidants that are added to foodstuffs for the purpose of protecting them from damage and spoilage, and there are more than 800 types of phenolic compounds that are found in vegetables and fruits, and they are considered primary and naturally occurring antioxidants (Pietta, 2000).

Plants Extractions as Antioxidants

The number of hydroxyl groups, their location, and their ability to give hydrogen has an effect on their work as an antioxidant, in addition to the presence of second groups that have the ability to give hydrogen, represented by NH and SH (Zheng and Wang, 2004)).

The effectiveness of the antioxidant phenolic compounds in the extracts is due to the property of the Redox, which makes it able to give hydrogen and prevent the activity of free radicals formed as a result of auto-oxidation of fats and oils, in addition to its chelating agent with metals and its ability to prevent the effectiveness of some enzymes (Rice - Evans et al., 1995). studied by Alonso et al. (2004) Antioxidant properties of aqueous extracts of several types of fruits and found that fruits that contain large amounts of anthocyanins, especially grapes, have a high capacity as antioxidants at a rate of 86.75%, because these pigments help in the termination of oxidation Explain Rehman et al. (2004) that soybean oil containing potato peel extract at a concentration of 1600 and 2400 ppm that was stored at 45°C showed a decrease in the values of the peroxide number, as it was 9.0 and 10.0 mEq/kg and after 60 days of storage, and showed that the extract Potato peels have natural antioxidants that have the ability to inhibit the oxidation of fats or oils during storage periods and at high temperatures. Hakim (2006) was able to prolong the storage period of soft cheese and cream by treating it with Sidr leaf extract and black tea extract with BHT, then the storage was refrigerated for two weeks and then the two products were evaluated sensory and microbially. Juntachote et al. (2007) Dried holy basil powder and its ethanolic extract in the process of preserving minced and cooked meat that was stored at a temperature of 5 ° C for 14 days. The results showed that dried basil powder, which was added with different concentrations, had the ability to reduce the value of peroxide compared to The ethanolic extract in both treatments and the peroxide value was 14.63 mEq/kg for basil powder at a concentration of 0.07% and 14.77 mEq/kg for the ethanolic extract at a concentration of 0.02%, and these values were less than its value of 21.75 mEq/kg in the comparison sample and after 14 days of storage. Grape fruit is one of the fruits rich in phenolic compounds, including anthocyanin pigment, which has antioxidant properties in addition to its multiple health benefits, as it is widely used in the fields of food manufacturing (Yildiz and Eyduran, 2009). Among Cai et al. (2004) In a study conducted to show the ability of phenolic acids and flavonoids that were extracted from 112 Chinese medicinal plants as antioxidants, the hydroxyl groups in these compounds had an important role in capturing free radicals, Myricetin, Quercetin, Kaempferol, and Myricetin compounds, and Kaempferol compounds with the highest efficacy. It is oxidized because it contains more hydroxyl groups.

The antioxidant activity of phenolic compounds in aqueous and alcoholic extracts of onion, potato and lemon peels was measured by (Al-Qatefi, 2019), as it was found that all extracts gave high results compared to industrial antioxidants, and the 0.5% concentration gave the best results. Surveswaran et al. (2007) There is a direct relationship between the antioxidant activity and the total content of phenols for 133 medicinal plants found in India, as it was found that plants containing 70% phenolic acids and 53% flavonoids in addition to tannins gave the highest antioxidant capacity. Duda-Chodak and Trako (2007) studied the antioxidant properties of grape and apple seeds and peels, as the peels were better than seeds in their ability to prevent oxidation based on the presence of flavonoids and phenolic acids in them compared to seeds, and Nickavar et al. (2008b) that the alcoholic extract of the five types of Mentha has the ability to scavenge free radicals by giving hydrogen and ending the oxidation process and thus behaving like primary antioxidants and reducing the risks of free radicals on active molecules and thus food preservation.

Synergistic Effect

Salmah et al., (2005) showed that the mixture of honey and alcoholic extract of Sweet Basil has the ability to treat wounds in laboratory mice due to its antimicrobial activity produced by phenolic compounds in addition to the high amount of carbohydrates in honey. Azizkhani and Zandi (2009) showed that the mixture consisting of tocopherol, lecithin, and alcoholic extract of rosemary plant was effective in maintaining the stability of margarine and prolonging its shelf life compared to BHT used as a synthetic antioxidant.

Chitosan

Its chemical name is 2-deoxy-b-D-glucopyranose and its molecular formula is C6H11O4N) n) al., 2013) (Gavhane et al. Chitin was discovered in 1811 by the French scientist Henri Branconnot, through a study he conducted on the mushroom called Agaricus, and in 1894 the derivatives of the chitin compound were named chitosan by Hope Seyle, and then polymers witnessed a great demand in all fields of medicine from 1930-1940, during the period from 1930-1940 Shaji et al., 2010)), that chitosan and chitin and their products have received very great attention as a result of its natural abundance and its multiple uses in addition to its ability to degrade and being non-toxic

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(Pati and Dash, 2013; Saputra et al., 2015), and chitosan was discovered by the world Rouget and that in 1859 when chitin was treated with a concentrated potassium hydroxide solution and then dissolved in dilute acid or iodine, and this compound was called modified chitin. (Doris, 2010, and in 1934 patents were given to two researchers, one of them was the result of manufacturing casings made of chitosan and the second was the result of Synthesis of chitosan from chitin through an acetylation process (Karteek et al., 2010).Chitosan is obtained from chitin after treating chitin with a base compound and complete or partial removal of the acetylation groups. Among the fields, including medical, pharmaceutical and food manufacturing (Bansal et al., .2011; Patria, 2013).Chitosan is a positively charged multiple biopolymer because it possesses a free amine group, which gives it the great ability to unite or chemically bond between molecules that have a negative charge such as fats, proteins and some metal ions. It is the second largest substance in nature after cellulose and is found in the outer covering of insects and the walls of insects. Fungal and crustacean cells (Shahidi et al., 1999.)

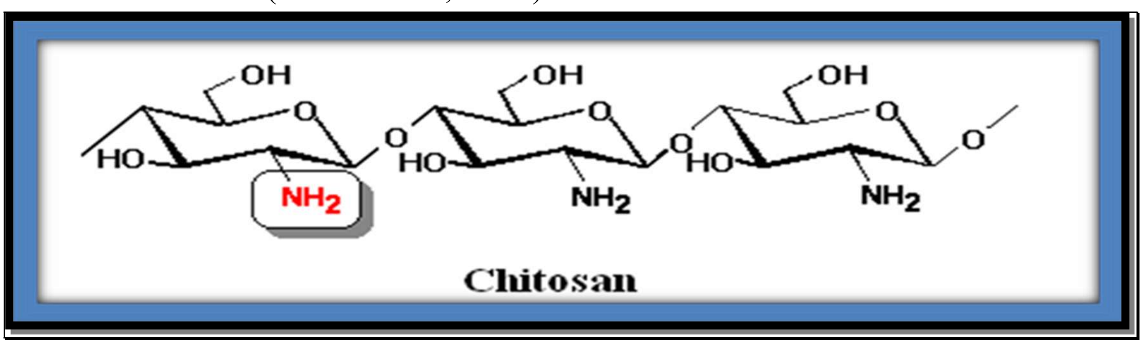

Figure (3): shows the chemical structure of chitosan (Shaji et al, 2010).

Male Gavhane et al. (2013) that chitosan, chitin and cellulose are similar to each other in functional and physicochemical properties as they are from natural sources due to the similarity in structure, but the difference between them is through the acetamide group present in the second carbon atom of the chitin compound, as well as the amine group present in the chitosan in addition to the E hydroxyl group in the cellulose. -Hefian et al., 2014) The difference between chitosan and chitin in the degree of solubility occurs through the removal or removal of acetyl groups, thus changing the insoluble chitin to the soluble compound (chitosan) that has the ability to dissolve in acids in addition to the amine group present in the second carbon atom, and this is what distinguishes chitosan from ketene. Which has an acetyl N-acetyl group at the second carbon atom, and chitin and cellulose are insoluble polymers in water. When acetylation reaches 50% or more, chitosan becomes soluble at a pH less than 6.2 (Luo and Wang, 2013). Chitosan is produced when acetyl groups are partially removed from multiple units of D-glucosamine and N-acetyl-D-glucosamine. (1–4) (Dutta et al., 2004).

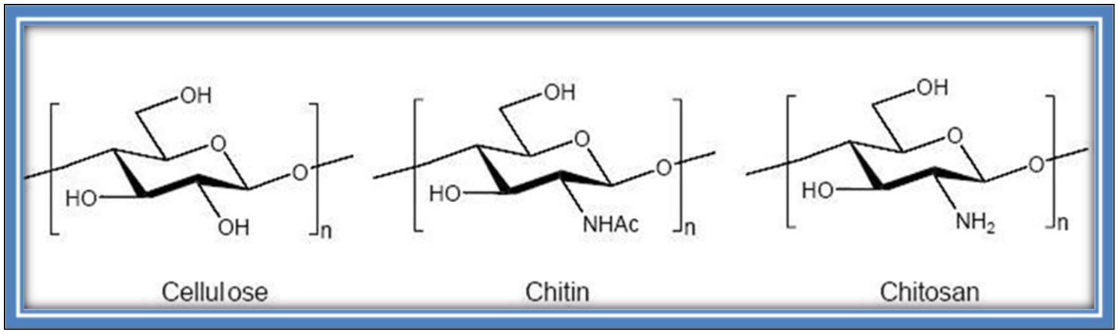

Figure (4): shows the chemical structure of chitosan, chitin and cellulose (Nadarajah, 2005)

The physicochemical properties of chitosan depend on the type of chitosan, its natural source and method of preparation, in addition to its chemical characteristics and the degree of its impact on the properties and applications of chitosan, including the degree of acetylation (Doris, 2010.

Sources of Chitosan

Chitosan is prepared from the chitin found in the skeleton of insects, fungi and marine invertebrates, as it is not found in higher animals and plants. Crustaceans have chitin (30-20)%, while the proportion of calcium carbonate, phosphate and protein is (30-50%) (40-30)% respectively (Einbu, 2007; Pati and Dash, 2013).Although chitin is found in nature, the main commercial source of chitosan is marine crustaceans (Susana et al., 2012). The work of Paulino et al. (2006) extracted chitin from species of silkworms for the preparation of chitosan, and the extracted quantity was low, but the product was distinguished by a very high purity that reached 4.23%, which is very low compared to the percentage extracted from crustaceans. Al-Sagheer et al. (2009) conducted a study on the process of extracting chitin from crab, shrimp and squid shells in the Arabian Gulf. Microwave was used during the process of removing acetyl aggregates, thus reducing the time of the heating process from 10 hours to 10-15 minutes, and the percentages of chitin were 19.13% 20.8% 7.40% and 21.26%. Bansal et al. (2011) that the main marine sources for preparing chitosan are shrimp and crab, as they are washed, grinded and turned into a powder, then the proteins are removed and treated with a solution of sodium hydroxide at a concentration of (5-3%) and salts are removed with dilute hydrochloric acid with a concentration of (5-3%), After that, the chitin is treated with a solution of sodium hydroxide at a concentration of (50-40)%.Puvvada et al. (2012) extracted chitosan from (shrimp) shells through several steps, the first of which was to remove salts with dilute hydrochloric acid with a concentration of 1%, then the proteins were removed with a solution of sodium hydroxide at a concentration of 2% for a period of two hours, after which the chitin was treated with a solution of sodium hydroxide at a concentration of 50% For a period of two hours at a temperature of 100 °C.George et al. (2011) Extraction and purification of chitosan from the biomass of Aspergillus flavus, Phoma sp., Cladosporium cladosporioides, which were isolated from four medicinal plants using acid and alkaline treatment, the quantity was (31.1, 57, (25.2 mg/g). Isa et al. (2012) extracted chitin from four marine sources (lobster, snail, crabs and shrimp) and the highest amount extracted from shrimp shells was 8.15% and the lowest extracted amount was from sea snail with a rate of 0.44%. Ushakumari and Ramanujan (2012) conducted a study of the chemical composition based on the dry weight of shrimp shells. They found that the percentages of ash, protein, fat and moisture were (28.4, 30.0, 2.1, 15.5) %, while chitin was 24.8% K. They explained that the difference of these percentages Refer to the season and type of crustacean. Kumari and Rath (2014) were able to extract chitosan and chitin from the shells of Labeo rohit fish through several steps and their physicochemical properties were studied. Walke et al. (2014) prepared chitosan from shrimp shells after removing protein, minerals and acetyl group. The antioxidant properties and physicochemical properties were studied and compared with commercial types of chitosan, which are dissolved in acid and with an acetylation degree of 75% and 85%, and chitosan dissolved in water. They found that the lack of chitosan has an acetylation degree of % 85 Low thermal stability.

The antimicrobial activity of chitosan

Dutta (2009) showed that the mechanism of chitosan against a wide range of microorganisms is represented by the interaction process between the positive charges of its amino groups and the negative charges of microbial cell walls, which leads to the sedimentation and agglomeration of protein and nuclear and cellular materials. Explained by Susana et al. (2012) The anti-microbiological activity of chitosan is that it is an impermeable substance and works to form a solid layer on the surface of the cell of the organism, thus preventing the entry of food into the cells of living organisms. In addition, chitosan of low molecular weight enters faster into the nuclear fluid of the cell of the organism. This affects DNA replication and inhibits protein and mRNA synthesis. Fajardo et al. (2010) was able to encapsulate cheese with chitosan that contains the antinatamycin and study its effect on the microbial and physicochemical properties of cheese by doing three treatments, the first without encapsulation, the second coated with chitosan only, and the third coated with chitosan and the antibiotic, as the results showed a decrease in the number of living organisms In the cheese sample coated with chitosan with antibiotic compared to other samples after 27 days of storage, it was shown that chitosan membranes have a role in preventing the growth of living organisms and prolonging the storage period of cheese. Chitosan has a high ability to reduce auto-oxidative activity and microbial content, as it has a strong activity against microorganisms and thus control spoilage in vegetables and fruits (Mohan et al., 2012.Tareq et al. (2013) showed that the highest activity level of chitosan against microbial content was at 0.1 concentration.

The Antioxidant Efficacy of Chitosan:

The antioxidant activity of chitosan

Some compounds have the ability to reduce or prevent oxidation when they are added to foodstuffs that contain fats, and the basis of their action is to give an atom or hydrogen atoms to the fatty acid. Oxidation is the process of breaking the chain of self-oxidation reactions (Sajdi and El-Baqer, 1983).Chitosan is a natural antioxidant used to preserve and protect foods containing fats from spoilage, and its antioxidant potential is affected by its molecular weight, as the ability to inhibit the rancidity process increases with its low molecular weight (Luo and Wang, 2013).Aider (2010) clarified that chitosan acts as a barrier between the product and the external environment and thus reduces the entry of oxygen into the food and in this way it hinders the oxidation process. Fish covered with chitosan coats can be preserved for 21 days in refrigerated storage.Among Rajalakshmi et al. (2013) that chitosan showed the ability to prevent the spread of oxygen species and thus prevent the oxidation process in foods, and that chitosan extracted from natural sources has a role as an effective antioxidant, as it has the ability to protect the body from free radicals, and that chitosan can be mixed with many compounds that They are characterized by being biologically active. Examples include phenolic compounds, essential oils, proteins, lipids, and pigments et al., 2013) (Lopez-Mata. Meat is an oxidatively perishable food that gives a rancid flavour, and because chitosan has antioxidant activity, it can delay the oxidation reactions of fats (No et al., 2002; Rajalakshmi et al., 2013).Susanti et al. Studying the effectiveness of chitosan as an antioxidant for tuna slices, and they used the method of dipping tuna slices in the prepared chitosan solution. Preservation was conducted for different periods of time, and they showed that chitosan had a role in delaying the oxidation process of tuna slices.

Applications of Chitosan

Uses in food processing

Polysaccharides are widely used in the development of food products and their goal is to give important properties as gelling agents or thickeners, and chitosan has many important properties in addition to its use in preserving many foodstuffs (Fernandez-Kim, 2004)). Kong et al. (2010) that the countries of Korea and Japan have used chitosan since 1983 as a food additive, as the demand for consuming foods of good quality and free of microbial contamination increased in addition to a longer storage period.Chitosan has many protective properties that make it versatile in food fields by preserving nutrients and preventing or delaying the growth of microorganisms in addition to improving food quality. Chitosan is a non-toxic and safe substance (Luo and Wang, 2013).Youn et al. (2000) that chitosan has an alternative role to sodium nitrate used in curing sauce, and that its use reduces the use of sodium nitrate, in addition to that its use does not affect the color development and the preservative effect. No et al. (2004) pointed out the effective role of using chitosan as a coagulating agent when making tofu (vegetable cheese made from soy milk) where 6 molecular weights were used under dissimilar processing conditions, and it was found that the shelf life of tofu made with chitosan is longer by 3 days compared to With the shelf life of tofu made with calcium chloride. No et al. (2007)showed that chitosan has a role in increasing the storage period of bread by limiting the growth of microorganisms, as a coating process was carried out on the surface of the dough with chitosan solution prepared with different concentrations (0.1), 1, 1.5) and then dissolved in 1% of acetic acid, and they found that Bread that was covered with chitosan at a concentration of 1% had the least weight loss and the least hardness during the storage period, and the reason for this is due to the role of chitosan in trapping and retaining moisture. No et al. (2007) to the possibility of using types of water-soluble chitosan in maintaining the quality of milk and increasing its storage period and found an increase in the density of milk texture containing chitosan with a high concentration. Chien et al. (2007) used chitosan solution with the following ratios (0, 0.5, 1, 2)% to wrap the mango fruit pieces during storage for seven days, as the mango fruit pieces were kept of their desired quality compared to the control sample that was not acceptable yet. Expiry of the storage period. 2010)) et al. Jirangrate showed that chitosan membranes have an important role in maintaining the quality of eggs without affecting the palatability of eggs, as they act as a barrier to the loss of gases and carbon dioxide during the storage period by keeping the pH of the eggs low. Salman et al. (2011) showed that the use of chitosan gel had an effect on the storage and sensory characteristics of French bread (loofah) when using three types of jelly that vary in molecular weights prepared from shrimp shells. The results showed significant differences in the specific size of bread between the three treatments and the control sample. Raymond et al. (2012) that immersing the surface of green pepper with concentrations (0, 0.5,1, (2%) of chitosan had a positive effect on the qualitative characteristics of pepper by controlling the respiration rate, humidity and microorganisms when storing for 15 days.Di Pierro et al. (2011) making a composite envelope of whey proteins and chitosan with various concentrations and covering ricotta cheese for the purpose of increasing the storage period of cheese at a temperature of 4°C for a period of 30 days.Susana et al. (2012) Chitosan for the purpose of improving the quality of emulsification when making mayonnaise. The results showed that when adding chitosan by 0.1%, depending on the weight of the egg yolk, it raised the emulsifying ability of the yolk by about 10%, and the stability of the mayonnaise emulsion also improved by 9.8% compared to the control sample. Chitosan is used as an emulsifying stabilizer when making mayonnaise .Alak (2012) studied the effect of the packaging process for Salmo trutta fario fish fillets using chitosan solution, and its effect was studied in prolonging the storage period for 12 days, as it was found that chitosan dissolved in acetic acid solution gave better results than using chitosan dissolved in lactic acid solution .Abd and Niamah (2012) observed the effect of adding chitosan at different concentrations on the qualitative characteristics of apple juice, as the experiment included conducting microbial and chemical tests in addition to conducting a sensory test for apple juice, and the results showed success for the process of using chitosan as a purifying agent at a concentration of 0.4 g / liter in 25 ± 2 temperature for 60 minutes, and they found that higher chitosan concentration will maintain juice quality at 0.5 g/L and pH ranges between 3.72-4.22. 2013)) et al. Toan on making chitosan solutions and using them to extend the storage period of bananas and apples to prevent microbial contamination, as the results showed that chitosan has great efficacy as an anti-microbial .Lopez-Chavez et al. (2012) demonstrated the ability to use an effective anti-microbiological packaging by using chitosan dissolved in organic solvents such as lactic and citric acid when covering soft cheese, as it was found that there was a high inhibition of bacteria, molds and yeasts in cheese.

Edible Coats:

Edible wrappings were known in the past and that the first to use them (the Chinese) in the twelfth century, as they were used for the purpose of preserving some types of fruits. Its versatility in food applications (Jooyandeh, 2011 .The edible packaging has witnessed high interest due to the benefits it provides, as it maintains the quality of food during marketing and storage processes, and because it is nutritious and has no side effects, and as a result, it prevents the health risk resulting from the use of plastic packaging materials (Ghavidel et al., 2013 .(Edible wrappers are used in the process of covering food directly, either by immersion, packaging, or by spraying, and thus they act as a barrier to the transmission of gases, moisture and flavoring materials and have a role in preventing contamination or microbial damage, and thus it works to prolong the storage period of food (Misir et al., 2014 ,(In addition to its ability to hold additives and improve the sensory properties of food by adding color or luster, thus making it more acceptable to the consumer (Altieri et al., 2005.(As a result of consumers' desire for good quality food and the environment's need to reduce waste, this led to the interest and search for edible packaging (Shit and Shah, 2014)), and many types of packaging were used in preserving foodstuffs that support the product with a high nutritional value and raise the The marketing desire of the consumer (Mohamed et al., 2013).The cover or membrane that has an important role in the direction of the transfer of properties can be expressed as edible packaging when it is part of the food that is consumed. The purpose of packaging or packaging is to improve the preservation and nutritional properties and delay moisture loss in addition to preserving the product from microbial spoilage (Anker , 2000.The preparation of the membrane is affected by factors including temperature and humidity, and as a result of its hydrophilic properties and its influence on steam, a problem occurs in the direction of biocoats work because water has a direct role in the covers and therefore affects the mechanical and physical properties of the membrane (Bergo and Sobral, 2007). The covers are made of natural polymers, including proteins (whey protein, collagen, casein), polysaccharides (chitosan, starch, cellulose) and fats (paraffin wax, beeswax). Bourtoom, 2009; Pajak et al., 2013) There are terms that have emerged at the present time for expressing packaging, including the term (active packaging), which is to prevent oxygen, determine the level of moisture, and properties that prevent the growth of microorganisms, in addition to the name (intelligent packaging), which has a sensor or indicator for sensing. environment and give a signal to balance the undesirable change in the product (Suppakul et al., 2003). Pascall and Lin (2013) explained that membranes have health benefits by mixing them with nutrients such as vitamins and flavonoids, in addition to their unique properties of being environmentally friendly and biodegradable. The packaging can be divided into industrial packaging and edible or biodegradable packaging. For industrial packaging, the basis of its composition is petrochemical or plastic materials that do not have the ability to degrade, which leads to environmental problems (Ramos et al., 2013; Shit and Shah, 2014). Al-Jaruri (2014) made edible coats from whey proteins with good specifications in terms of transparency and flexibility, and the braided cheese was wrapped in them, where it was found that it preserved the chemical properties of the cheese in addition to the economic feasibility by treating environmental pollutants and solving the pollution problem caused by the accumulation of waste.

Mechanical properties of sheaths (tensile strength and percentage of elongation)

It is one of the necessary properties of edible covers as it is a feature that shows the cohesion and durability of the membrane and it is due to the type of material from which the cover is made, and its cohesion is important to enhance the preservation of mechanical safety of food products during transportation and manufacturing. (Adedeji et al., 2009) The tensile test is one of the tests that are used to measure the flexibility and resistance of the sheath, where the sheath or membrane is subjected to an effort in order to measure the effect of stress in terms of size or length. et al., 2001). Leceta et al. (2013a)showed the effect of using different percentages of glycerol ranging between (0-30%) on the mechanical properties of manufactured chitosan casings, where the results showed an increase in elongation and a decrease in the amount of tensile strength with a high percentage of glycerol that was added. Skurtys et al. (2010) found that polysaccharides coats had a tensile strength that ranged between (10-10) MPa and an elongation percentage between (20-80)%, while the proteins had more elongation and lower tensile strength.

Plasticizer:

They are low-molecular-weight, high-boiling-point, non-volatile organic compounds that are added to edible packaging to improve sensory, mechanical or nutritional properties by increasing their elongation, ductility and resistance to tearing (Skurtys et al.; 2010). The work of Suyatma et al. (2005) on the study of the effect of four types of plasticizers represented by glycerol, polyethene glycol, propylene glycol and ethylene glycol on the thermal and mechanical properties of chitosan sheaths during storage for (20-3) weeks at a temperature of 23°C and a humidity of 50%, as the results showed a decrease in elongation. With the increase in the elasticity of the membranes during the progression of the storage period .Plasticizers work to resist the bonding forces between polymeric chains, as they lead to their dismantling and separation and prevent entanglement in them. Nemet et al. (2010) that the mechanical and buffer properties of the coats change depending on the concentration of the plasticizer or its type, that is, with an increase in the concentration of the plasticizer, the coats become viscous, but when the concentration of the plasticizer decreases, the coats become inelastic. Bourtoom (2008) showed the effect of adding three types of plasticizers represented by glycerol, sorbitol and polyethene glycol at concentrations that were (60-20%) to the edible composite coats made of chitosan and rice starch, and to increase the concentration of the plasticizer had an effect on a decrease in the amount of tensile strength and an increase in the amount of elongation In addition to increasing the solubility in water and vapour permeability.

Reservational properties of edible packaging

Permeability is a name given to the ability of the packaging to sequester gases, nutrients, and dissolved substances in food and fats from one side of the cover to the other, as the low permeability of gases and water vapour is one of the desirable characteristics when packaging (Perez-Gago and Krochta, 1999). The wrappers have sequestering properties, including the retention of vapor and fatty substances in the diet and the diffusion of gases (CO2-O2), as they have a role in providing the necessary protection for foodstuffs (Souza et al., 2009). Membranes made of sugars and proteins have poor moisture retention properties if the humidity is high, but they have suitable barrier properties for gases in addition to transparency and glossiness, while fatty coats have a good ability to retain moisture and have high oxygen permeability, so composite coats made of sugars, fats and proteins are used to obtain On the good features of each type (Jooyanded, 2011).Anker (2000) clarified the necessity of selecting packaging materials based on their ability to retain water and steam and to prevent them from oxygen, as this plays a role in food safety and preservation. Krasniewska and Gniewosz (2012) show that the edible coats are characterized by low gas and water vapor permeability, high adhesion, mechanical resistance, flexibility and structural cohesion. Leceta et al. (2013a) studied the effect of using varying percentages of glycerol (0, 15, 30% in the permeability of oxygen and water vapor on two types of chitosan (one with high molecular weight and the other with low molecular weight). The results showed a rise in permeability with The high percentage of glycerol for the two types of chitosan used, and they indicated that the permeability should be low to prolong the storage period of the packaged food.

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