Kufa Journal of Engineering
Vol. 15, No. 3, July 2024, P.P. 213-230
Article history: Received 27 April 2024, last revised 18 May 2024, Accepted 19 May 2024

GELATIN AND ARABIC GUM-BASED FOOD COATING FOR FOOD PACKAGING

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https://doi.org/10.30572/2018/KJE/150312

ABSTRACT

This review discusses the Arabic gum and gelatin-based films used in the food packaging industry. Gelatin is an essential biopolymer derivative of collagen. Various industries widely use it due to its technological and functional characteristics. Several constituents can be used as additives to recover their characteristics and requests. Antioxidants, antimicrobials, and other agents are used to increase customer attention and extend the food products shelf life. Food packaging is planned to protect food products, offer essential information related to the food, and make food handling suitable for consumer delivery. The Arabic gum and gelatin blend is suitable for keeping fruit and vegetables fresh for a long time due to the blended film's ability to cover the food and protect it from microbial and environmental effects. The film's composition of natural components that are safe to eat forms a protective layer to prevent gas, oxygen, and humidity.

KEYWORDS

Arabic gum, food packaging, gelatin, Food degradation.

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1. INTRODUCTION

Food industries use natural polymers as packaging materials to ensure the food products safety, but they must be economically practical and safe for human health and the environment (A.J. Hussain and Al-Khafaji, 2020; Abdullah Jabar Hussain and Al-Khafaji, 2020; Al-Khafaji and Falah, 2020; Sallal et al., 2022, 2024; Kadhim, Sallal and Al-Khafaji, 2023). The food deterioration is resulting from oxidation decay and microbial decay as shown in Figs. 1 and 2. Arabic gum and gelatin-coating film are natural materials that protect food from degradation fast and are therefore used in food packaging. Fragments happened during transport, processing, storage, and marketing for food like strawberries, kiwi fruit, grapes, sweet cherries, pears, and mangoes. Gelatin and Arabic gum film protects fruits and vegetables like strawberries and tout and gets good food quality, safety, and shelf-life extra time. Food packaging using Arabic gum and gelatin should control the release of in-system design by using different methods of polymer matrix modification to work as an antimicrobial and anti-oxidant and enhance processing (Han et al., 2018; Prosekov, Asyakina and Dyshlyuk, 2018).

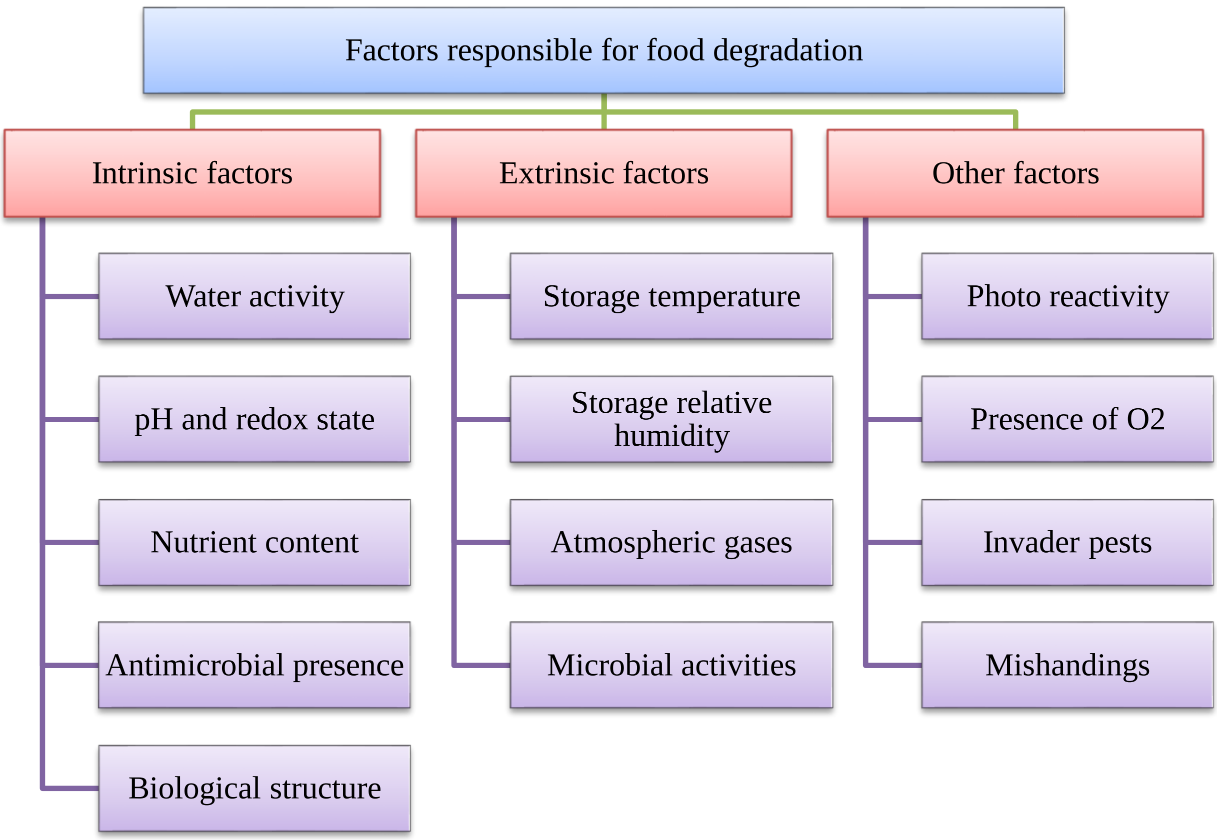


Fig. 1. Food degradation factors.

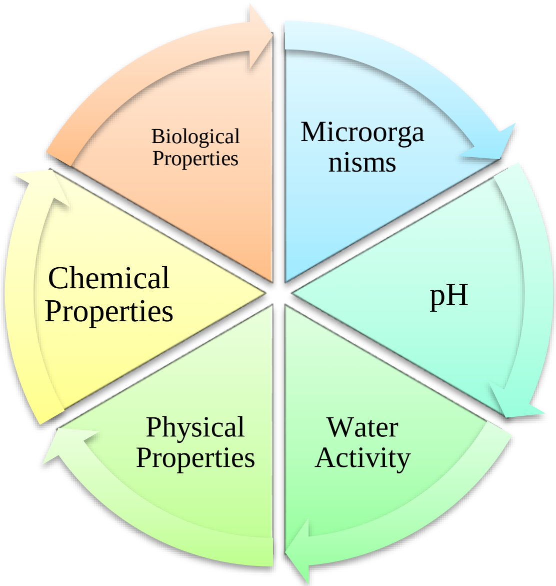
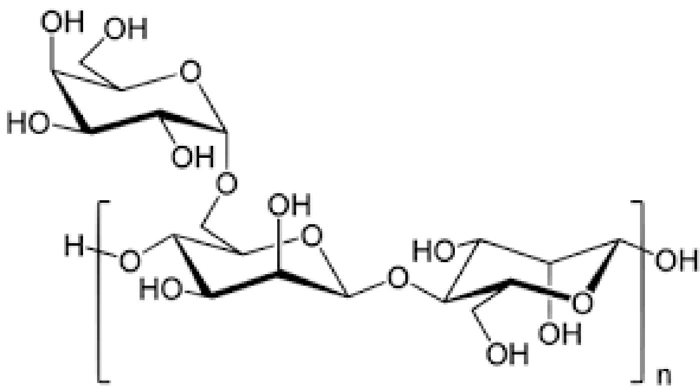


Fig. 2. Factors effect on shelf life of food.

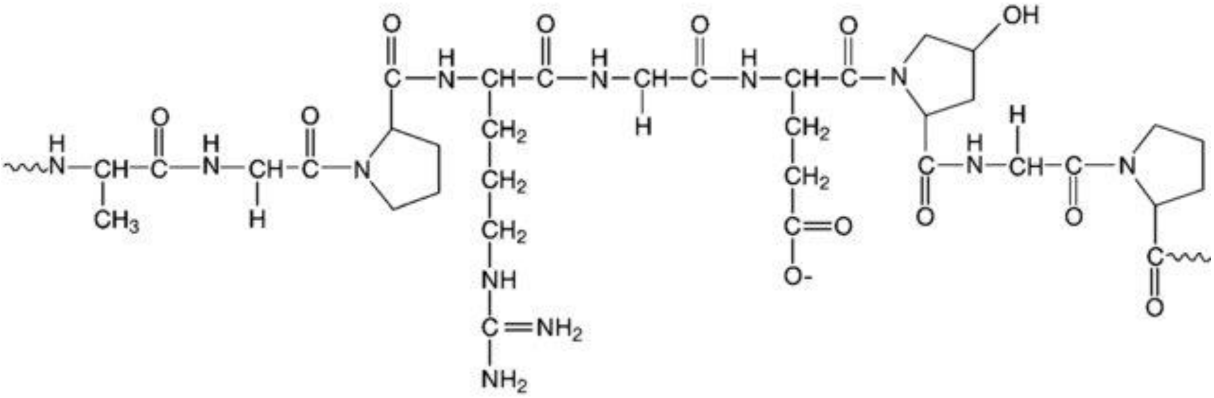
Gelatin is a natural water-soluble protein-like aqueous solution with polypeptide chains. It is found in the limited hydrolysis of collagen and animals' bones, fish, pig skin, tissues, skin, and muscles. Its structure resembles stable molecules in fibres connected by covalent bonds. Gelatin is used due to its biodegradability, biocompatibility, excellent film solution characteristics, good mechanical stability, and low cost (Prosekov, Asyakina and Dyshlyuk, 2018; Zainol et al., 2020).

The gelatin and Arabic gum structures are seen in Fig. 1. At pH between 4.7 and 5.6, it exhibits hydrocolloid capabilities and has anionic features. However, beyond this pH range, it demonstrates cationic qualities. One of the drawbacks of this is that the particles formed might become brittle under certain circumstances of temp, pH, and ionic strength. The chemical cross-linking technique was used to enhance these features. Gelatin is typically used to preserve fruit, fish, meat, and vegetables (Masti et al., 2016; Alexandre et al., 2019).

Gelatin and Arabic gum can be created hydrophilic films; therefore, there is less resistance against water and gases with needed mechanical, optical, and protective characteristics at low virtual humidity (PADIL and ČERNíK, 2014; Tsai *et al.*, 2015). Gelatin, which has glycine, alanine, and hard blocks, is not a good protector against water vapour because of its hydrophilic nature (Rocha-Selmi *et al.*, 2013; Prosekov, Asyakina and Dyshlyuk, 2018). The mechanical characteristics improve by adding calcium, lactic acid tan, nic acid, and Arabic gum. Alteration of inhibitory characteristics is completed by forming cross-links, for which various aldehydes can be used. Coalescing gelatin with polymers like Arabic gum and essential oils (EO) significantly recovers the presentation of polymer films (Ramos et al., 2016; Alexandre et al., 2019).



a- Arabic gum structure (Nie *et al.*, 2013)



b. Gelatin structure (Duconseille *et al.*, 2015)

Arabic gum is a complex mixture of glycoproteins and polysaccharides. It involves a blend of calcium, potassium, and magnesium salts, which are polysaccharide acids. Arabic gum is usually cast off in food trades as a stabilizer, thickener, emulsifier, and encapsulating. They are used in food, medicine, glue, and fabric (Tsai *et al.*, 2015; Zainol *et al.*, 2020).

Biodegradable materials are modified to provide numerous alternatives for producing green packaging that enhance mechanical strength, thermal stability, antioxidant, and antimicrobial activity by improving their biodegradability. Modified biodegradable materials like tea tree essential oils and Arabic gum improve thermal stability (Ramos *et al.*, 2016). Prosekov et al. (Prosekov, Asyakina and Dyshlyuk, 2018) studied the materials used in biodegradable packaging made from gelatin and polyunsaturated. The films from gelatin and polysaccharides were produced by drying the solutions of the components tested at different temperatures. The results showed that most samples have acceptable certification to find the optimal composition of biodegradable packaging materials.

1.1. Food packaging of gelatin- Arabic gum coating Films

The blend of gelatin and Arabic gum is used for sweet products due to its gelling effects and forming agent, hydrophobic exhibiting different functional characteristics to form an honorable food product (Rocha-Selmi *et al.*, 2013; Tsai *et al.*, 2015; do Nascimento *et al.*, 2020)**.**

The drawback of using gelatin is its ability to swell when used in foodstuffs with a high-water content. Therefore, many research studies were performed to calculate the global result of adding changed substances, such as crosslinkers like Arabic gum, firming agents, and plasticizers with antimicrobial or anti-oxidant characteristics (Han *et al.*, 2018; Alexandre *et al.*, 2019; Zainol *et al.*, 2020).

(Masti et al., 2016) established the ability to produce cross-links to alter gelatin. Hydrogen bonding is created between water and free hydroxyl sets of amino acids. Combining Arabic gum with gelatin increases gel strength compared with untreated gelatin. Mixing gelatin with other biopolymers, like starch and chitosan, develops food packaging products.

Gelatin and Arabic gum coating films are cast off to keep or widen the food products' shelf-life. Food packaging must be skillful in addressing antimicrobial and anti-oxidant issues in system design. Tables 1 and 2 represent gelatin additives in coating films for food packaging.

Several features must be restrained when preparing this kind of system, including the chemical food’s nature, organized release storage, additives, plans, and the mechanical and physical characteristics of film packaging (Tsai *et al.*, 2015; Babić, Balanč and Milašinović, 2018; Prosekov, Asyakina and Dyshlyuk, 2018).

Oliveira et al. explored the fraternization of gelatin films and cashew gum in creating cleaner bags, dissolvable films, and compost encapsulates. Barrier characteristics are enhanced with a higher gelatin content, and to get the highest flexibility of the material, the gelatin and cashew gum biodegradable film is designated an advanced biodegradation rate likened to the gelatin film. (Alexandre et al., 2019; Neves et al., 2019)

Additives like plasticizers, tea extract compounds, and Arabic gum developed the characteristics of gelatin as anti-oxidants; therefore, the functional characteristics of films improved and increased the shelf life of food-packed products (Alavi Talab et al., 2010).

Also, the good chemical interactions between the gelatin and Arabic gum permitted the development of a strong and flexible film. Its low permeability to water is also visually clear and apparent, which are favorite features in food packaging (Alavi Talab *et al.*, 2010; Neves et al., 2019).

The commonly used method neutralizes charged positive gelatin and negatively Arabic gum, which gives a homogenous mixture suitable for food packaging film. Therefore, this blended film protects the products from the effects of the environment (Ramos *et al.*, 2016; Neves et al., 2019).

In food packaging, the gelatin used with AuNP nanoparticles as indicators exhibits an irreversible color change when the temperature changes for a known period, and this is true for all product types. The amount of the bleach indicator was proportional to the duration of exposure (de Oliveira, Paula and de Paula, 2014).

Many tenders and usages could be found in the photographic, cosmetic, pharmaceutical, packaging, and food industries. Usually, gelatin and Arabic gum mixtures are cast off to deliver dairy products, sugary juice, Bakery yeast, stabilization, and gelling in food production. Many factors limit gelatin film's physical and mechanical characteristics, such as waterlessness, display to light, and contact with oxygen. Also, the drawback to using it is that since the highly hygroscopic gelatin nature, it has an affinity to swell or be melted once laying in connection with the surface, so Arabic gum was added to it (Alavi Talab *et al.*, 2010; Neves et al., 2019). (Babić, Balanč and Milašinović, 2018) studied reducing packaging waste by using films made from gelatin added to tea extract that are good nominees for manufacturing semi-soft cup-shaped products that might be utilized to protect vegetable substances. The simple solvent method used to prepare films has good mechanical characteristics. The optical features result of the films indicate that these systems have a charismatic clear and gold-yellow transparent appearance.

Table 1. Different mixtures are cast off as vigorous condiments in gelatin coating used as films (Ramos et al., 2016).

Gelatin	Activating Additive	Major Advantages
Fish gelatin	Origaram palyare L-EO	• Improvement of barrier capability, solubility, WVP to ultraviolet light • Improvement of anti-microbial characteristics
Fish gelatin	Nanoencapsulation Origamum palace L-EO	• Improvement of primary thermal stability • High flexible and low resistant films • Reduction in WVP • Demonstrated anti-microbial action
Eovine gelatin	Bacteriocins and flavonoid ester prunin laureate	• Functional characteristics maintenance. • Improvement of synergistic impact and anti-microbial characteristics
Gelatin	Silver nanoparticles	• Improvement of UV barrier, water vapour and hydrophobicity • Compacted surface structure • Effective anti-bacterial action
Gelatin	Zinc-oxide nanoparticles	• The structural crystalline • Improvement of elongation, WVP, water contacting angle, moisture amount and thermal stability at break • Effective anti-bacterial action
Fish gelatin	Cinnamon EO nanoliposomes	• Reduction of WVP, water amount, water-soluble and tensile strength. • Enhancement of anti-microbial stability and maintained release impact.

Gelatin	Activating Additive	Major Advantages
Fish skin gelatin	Citronella EOs and Peppermint	• Improvement in antimicrobial characteristics
Fish gelatin	Gingko leaf, ginger, grape seed or green tea	• Improvement in antioxidant characteristics
Bovine gelatin	Brown seaweed Ascoplryfliem nadosum	• Increasing hydrophilicity • Improvement in antioxidant characteristics
Gelatin capsules Residues	Residue powder of beetroot	• Improvement of antioxidant characteristics • Primary thermal stability maintenance
Bowine gelatin residue	Residue fibre of carrots obtained from minimally processed carrots	• Highly barrier, thermal and optical characteristics • Capacity for protective sunflower oil from essential rancidity reaction
Pork gelatin	Ethanolic hop extraction	• Improvement of antioxidant characteristics
Gelatin	Tea polyphenols	• Improvement of antioxidant characteristics
Fig skin gelatin	Hydrolyzable chestnut tannin	• Improving antioxidant and antimicrobial features
Beef gelatin	Sodium octanoate, Artemix Consa 152/NL, Auranta FV, and Articoat DL.P 02	• Improving antioxidant and antimicrobial features at various degrees • Improvement in oxygen transmission rate
Bovine hide gelatin	Lavender and oregano EOs	• Improving antioxidant and antimicrobial features

Table 2. Different mixtures are cast off as vigorous condiments in gelatin coating in various uses (Ramos *et al.*, 2016)**.**

Gelatin	Active Additive	Uses	Main Benefits
Skate skin gelatin	Thyme EO	Chicken tenderloin (wrap)	• Improvement of antimicrobial characteristics • Extended chicken tenders shelf-life • Increasing elongation at break
Grouper bone gelatin	Pepper, clove and Chitosan EOs	Fish steaks (coating)	• Improvement of antimicrobial characteristics • Extended the fish steaks shelf-life • No substantial variations in the visual aspect
Gelatin	Free/encapsulated tea polyphenols	Sunflower oil packaging	• Improvement of anti-oxidant characteristics • Good oxidation inhibitory impact over more than 40 storage days.
Food grade gelatin	Orange leaf EO	Shrimps (coating)	• Extending the shelf-life • Improvement of antioxidant and antimicrobial characteristics

The synthesis of these substances takes place once the intermolecular interactions between protein chains are intensified by the molecular structures action. This results in a change in their hydrophilic nature and facilitates the creation of robust covalent connections within the protein film network (Luangapai, Peanparkdee and Iwamoto, 2019; Salehi, 2020).

Gelatin-based films' weaknesses include a tendency to swell or be dissolved once put in contact with the foodstuffs surface with high water amount. Many research investigation assess the overall impact of adding various ingredients, including crosslinkers, and antimicrobial or antioxidant properties, like Arabic gum, to advance gelatin's functional properties and food goods' shelf-life (Ramos et al., 2016). The development in the properties happens when adapting their hydrophilic characteristic or helping the creation of strong covalent bonds in the protein film network (do Nascimento et al., 2020).

The degree of swelling of Arabic gum/gelatin depends on the percentage increase relative to the dried film's initial weight. The swelling behaviour of different films is affected by the concentration of Arabic gum. The swelling behaviour increases when Arabic gum increases and depends on water affinity to migration; high molecular weight and hydrophilic, Arabic gum might delaying water vapour movement by enhancing the interaction between the water absorbed and Arabic gum (Khodaei, Oltrogge and Hamidi-Esfahani, 2020; Łupina, Kowalczyk and Kazimierczak, 2021).

(Pakzad, Alemzadeh and Kazemi, 2013) studied the encapsulation of microcapsules containing gelatin/Arabic gum with peppermint oil produced by complex coacervation utilizing tannic acid as a hardening agent. Other parameters, such as the amount of tannic acid and wall materials, investigated the size of particles and the efficiency of the acid. The findings displayed that particle size and efficiency improved with increasing the core and wall amount and decreased with increasing tannic acid. The discharge of microcapsules was examined in the stomach and duodenal fluid. The microcapsules free the utmost of the core material in virtual gastric fluid.

(Łupina, Kowalczyk and Kazimierczak, 2021) studied Astaxanthin antioxidants that were combined into 75/25 gum arabic/gelatin (GAR75/GEL25) and water-soluble soy polysaccharides/gelatin blend films in altered amounts (0, 0.25%, 0.5%, 1%). The result illustrated good compatibility between the GEL and polysaccharides. Creating on-time essential for 50% release, the film displayed an around four-fold slower release rate of the GAR-based films, resulting in more potent antioxidant activity (quarter-scavenging time (t25%ABTS) = 0.22–7.51 min) in comparison to the based films (t25%ABTS = 0.91–12.94 min). The increase in the astaxanthin amount was accompanied by regularly decreased solubility and the release rate.

2. CHEMICAL CROSS-LINKING

Chemical cross-linking of food polymers happens rapidly once food is grown and processed. The chemical cross-linking attitudes include the creation of covalent bonds between food polymers. Many cross-linking agents have been found helpful in biopolymer uses. The cross-linking –polymer appliance interaction is subjective on the polymer structural affiliation. Generally, cross-linking agents interrelate with functional groups of polymers like vegetal phenolic have currently been exposed for gelatin-Arabic gum cross-linking (Ramos et al., 2016; Alexandre et al., 2019; Salehi, 2020).

Biological cross-linking involves using enzymes to change the polymer's functional characteristics. Several enzymes may cross-link proteins, with transglutaminase being the most frequently utilized catalyst. The acyl-transfer reaction occurs between the γ-carboxyamide set of a peptide-bond glutamine residue and different primary amines. Multiple studies have demonstrated the capacity of transglutaminase to form cross-links in gelatin (Gomez-Estaca *et al*., 2016; Ramos *et al*., 2016; Manaf *et al*., 2018).

Cross-linking occurs when hydrogen bonds form between the carbonyl groups of gelatins and the hydroxyl groups of tannic acid. The film's swelling capacity was intentionally engineered to facilitate the absorption of water by the cross-linked microparticles. Once, the behaviours with the greatest tannic acid content are associated with the lowest magnitudes. Thus, intermolecular cross-linking often involves the expansion of polymers, internal cross-linking, and increased matrix stiffness (Gomez-Estaca *et al*., 2016; Alexandre *et al*., 2019).

3. ENCAPSULATION BY COACERVATION

(Manaf et al., 2018) study encapsulation by coacervation, a phase split-up of one or several hydrocolloids from the initial solution. It blended similarly under specific pH, temperature, and solution composition. Chemical agents or cross-linking strengthen the capsules using single polymers, including ethyl cellulose or gelatin. In contrast, complex coacervation covers the removal of two oppositely charged polymers in an aqueous solution. Gelatin and Arabic gum are used in encapsulating materials to deliver biodegradable films due to the natural components, considered biopolymers, improved by adding another biodegradable raw material like different oils (Łupina, Kowalczyk and Kazimierczak, 2021).

The technique primarily utilized is neutralization among adverse custody Arabic gum and positive custody gelatin (Gomez-Estaca *et al*., 2016; do Nascimento *et al*., 2020). The issue is intended to use a universal equation, which depends on Fick's law of diffusion for a polymeric system, as formula 1. Meanwhile, (M_t / M_∞) is the fractional release at period t. Mt refers to the releasing percentage at a specific period, M∞ refers to the total released material, k refers to a constant typical of the polymer encapsulated polymer, and n refers to the coefficient of diffusion (Gomez-Estaca *et al.*, 2016; Manaf *et al.*, 2018).

$$Mt / M\infty = ktn \quad (1)$$

4. ANTIMICROBIAL AGENTS

Cornelia Vasile and Mihaela Baican study the antimicrobial additive materials in coating with films-based gelatin for food packets used to elongate food shelf-life by postponing deterioration processes confidential the suite by consuming natural additives. The natural mixes are used in active packing plans to modify synthetic additives. Additive materials could be developed from dissimilar sources, excluding fungi, plants, algae, bacteria, animals, and by-products prepared throughout vegetable and fruit processing (Martucci *et al.*, 2015; Arman Alim, Mohammad Shirajuddin and Anuar, 2022).

(Martucci *et al.*, 2015) studied EOs utilized in eatable films by utilizing films-based gelatin oregano or lavender EOs and a blend of them (50:50) at 0 and 6000 ppm. Gram-negative bacteria like Escherichia coli(E coli) and Gram-positive bacteria Staphylococcus aurous were designated to estimate the antimicrobial action of the films.

The findings indicated that the microorganisms showed empathy to vigorous films, displaying minor standards of inhibition zone for S. aureus related to E. coli (Salehi, 2020; Ghasemizad *et al.*, 2022). Related effects were initiated by Alparslan et al. as soon as they reviewed the antimicrobial action of gelatin-based films with orange leaf EO alongside five food-borne bacteria through the agar well-diffusion process. The gelatin film covering 2% vigorous oil exposed the main antimicrobial result beside all microorganisms (Ghasemizad *et al.*, 2022).

The added variations among Gram-positive and Gram-negative bacteria may result from the incidence of a thin peptidoglycan layer in Gram-negative bacteria, which are more resistant to EOs (Ramos *et al.*, 2016; Ghasemizad *et al.*, 2022).

Olive leaf was assessed by Irene Albertos et al. as an anti-oxidant and antimicrobial factor in eatable films calculated for cold-smoked fish Protection (Albertos *et al.*, 2017). Olive leaf powder and its extract were definite alongside Listeria monocytogenes (Martucci *et al.*, 2015; Tripathi, 2016; Asiyanbi *et al.*, 2017) Escherichia coli O157:H7 and Salmonella enterica showed antibacterial action in contradiction of L. monocytogenes in agar diffusion tests, and E. coli and S. enterica have no practical result. The antimicrobial and anti-oxidant actions of the films increased with the increase in OLE (water /ethanol extract) concentration in their formulations. (Brasil *et al.*, 2012) cast off multifaceted antimicrobial eatable coverings built on gums to improve fresh-cut papaya features. Their results displayed that a layer-by-layer mixture of microencapsulated antimicrobials was helpful in the collective shelf life and class of papaya. That is because Covered papaya was stable, sustained colour, high β-carotene contented, indicated lower juice leakage, and had the highest organoleptic suitability (Raghav, Agarwal and Saini, 2016; Tripathi, 2016; Waheed, 2016; Vasile and Baican, 2021).

(Anvari and Chung, 2016) examined Composite coacervation with Arabic gum and gelatin and concluded that adding Arabic gum improved the antimicrobial characteristics. Adding Arabic gum and Cr2O3 nanoparticles similarly augmented the antimicrobial characteristics after adding the carroty peel-constructed film. The examples' mechanical characteristics and water vapour absorbency improved (Raghav, Agarwal and Saini, 2016; Ghasemizad *et al.*, 2022).

5. ANTI-OXIDANT AGENTS

Vigorous packaging is attentive to the growth of original food wrapping materials with anti-oxidant agents from natural bases, including plant and Arabic gum spice extracts, as a replacement for artificial anti-oxidants, including butylated hydroxytoluene or hydroxy anisole due to artificial anti-oxidants must be limited in their usage as food extracts (Pirsa and Aghbolagh Sharifi, 2020).

Usual anti-oxidants display plenty of capability to regulate fat oxidation confidential the food set oxidative procedures which basis the degradation of lipids, pigments, and proteins, was restricted research lessons done to improve the concluding characteristics and applicability of foodstuff packing and to cover the shelf-life of foodstuff crops depending on gelatin films and layers combined with anti-oxidant extracts (Shakila *et al.*, 2012; Ali *et al.*, 2013).

(Zainol et al., 2020) studied the physicochemical characteristics of the sensorial chart of 5 pastile specimens made from a mixture of belimbing buluh fruit juice added to different ratios of Arabic gum and gelatin. The physical and physicochemical characteristics were enhanced by adding 16 % Arabic gum and other gelatin ingredients at 16% and another ingredient. Also, the quality of plumbing pastille fruit was improved using gelatin and Arabic gum as anti-oxidants. (Salehi, 2020) studies eatable film coating products like fruits to extend shelf life using Arabic gum, gelatin, and other ingredients like chitosan, gelatine mesquite, basil seed, and guar. The result shows that the increase of 20% glycerol to eatable covering solutions, including 1% gum, was enough to reach the advanced decrease in the weight loss of vegetables and fruits. Also, the treatment benefited the ripening process, which changed fruit quality like Mellon plum, orange papaya, banana, apricot, and mango, post-effect ageing, involving weight loss and acidity, softening, and colour change.

Extracts added from grape seed, green tea, and ginger cast-off for their exceptional anti-oxidant stuff, owing to selected mixtures in their arrangements, including polyphenolic mixes in green tea extract (Hosseini *et al.*, 2016; Tosati *et al.*, 2017). Addition Arabic gum as anti-oxidant planes of 0-5%, and chromium oxide nanoparticles (Cr2O3 NPs) at 0-3% ranks, calculated by (Ghasemizad *et al.*, 2022) the adding study carroty peel-based films. The findings revealed a primary growth in weight loss, tensile strength, water vapour permeability, and Young's modulus of film specimens by growing the ratio of cooperation gum and nanoparticles.

The primary methods used for nanoencapsulation of antioxidants and antimicrobials are outlined: The inclusion of colloids into nanocarriers formed from biological polymers, the encapsulation of nonbiological polymers using cyclodextrin, the use of electrospraying and electrospinning processes, and the encapsulation of carbon nanotubes and nanocomposites (Ali *et al.*, 2013; Ramos *et al.*, 2016).

Nanoliposomes, including olive-leaf extract with many phenolic compounds and anti-oxidant and antimicrobial actions, were added to yoghurt, enhancing its anti-oxidant action. No insignificant changes in colour and sensorial qualities were experiential, suggesting that olive-leaf phenolics can be deceived in nano applications and could raise the nutritious rate of products like yoghurt (Ali, Ziada and Blunden, 2009; Pirsa and Aghbolagh Sharifi, 2020).

(Gómez-Estaca *et al.*, 2014) institute that anti-oxidant packaging materials are life-progressing by joining anti-oxidant managers into the packaging film walls to perform their kind of act, dropping the attendance of sensitive oxygen type inside the headspace by liberating anti-oxidant mixes into the food product.

Marilia Alves and Luana studied functional foods developed using pequi oil in an encapsulation method to produce bioactive molecules that are hydrophobic and sensitive to high temps. They use pequi oil, cashew gum, and gelatin through complex coacervation. When released, pequie oil is rich in acidic pH. When the pH reaches 2 for the CG/GE matrix, the encapsulation efficiency for CG/GE and GA/GE is 72.53%. The results show that cash with gelatin collection appears bright as an encapsulation matrix, particularly for food use (do Nascimento *et al.*, 2020).

6. OTHER INGREDIENTS

As discussed before, gelatin film draws back due to its inclines to swell; otherwise, it melts simply by interacting with food through its moral barrier characteristics to carbon dioxide and oxygen. Furthermore, gelatin films exhibit lower mechanical strength than synthetic ones (Uranga *et al.*, 2018). So, gelatin can be mixed with dissimilar materials to get bio-composite films and coatings combined with Arabic gum and other components. Hydrophobic substances involving oils and lipids were utilized to advance gelatin films' water vapour barrier possessions. Bertan et al. assessed the interest of elemi oil at different ratios (1- 20) %, w/w of dry gelatin in the examples (Ali, Ziada and Blunden, 2009).

Gelatin-based films have been charity combined with chitosan as a glaze to decrease colour deterioration from red to brown as an importance of a regular growth of seen myoglobin in the meat's surface, mostly due to oxygen explanation and fat oxidation of beef steaks (Ramos *et al.*, 2016).

(Khodaei, Oltrogge and Hamidi-Esfahani, 2020) studied composite films produced of tragacanth gum, gelatin, and Arabic gum with a simple centroid design with mechanical and physical characteristics. The results illustrated that the interactions between ingredients had quadratic impacts on thickness and swelling. The availability of blended films decreased the swelling and thickness. Adding the gums advanced elongation and tensile strength at the blended films break.

(Williams and Phillips, 2004) detected that the blend of gelatine and Arabic gum formed an excellent texture and sensual approval and could similarly decrease the cost of manufacture. Moreover, it improved the antioxidant, antimicrobial, and mechanical characteristics after adding other components, such as waxes, oils, and stearic acid.

(Arab et al., 2022) studied edible film based on gelatin-Persian gum using design experts and mixture design. The result showed that Persian gum and Glycerol significantly affected the physicochemical properties of eatable film. Mathematical optimization was created based on optimization aims, and the ideal point with the chief interest (0.78) was obtained. The relation of each dependent variable in the best formula was 0.5. This film has a clear look in terms of colour and a suitable amount of tensile strength and heat seal ability; therefore, it can cover foods and increase the product's shelf life.

Adding Arabic gum and gelatin improved the acceptance and appearance of belimbing buluh pastille, a beneficial component in food manufacturing. The newly advanced preparation had appropriate features for oral management, such as adding stearic acid and corn flour. Sensory assessment findings indicated that pastilles were successfully measured utilizing belimbing buluh fruits correlated with gelatin and Arabic gum (Salehi, 2020).

(de Barros ALEXANDRE et al., 2024) Cast-off pequi oil microparticles in a cashew gum and gelatin matrix cross-linked with tannic acid. Cross-linked were formed by variable concentrations of biopolymers (0.5-1.5%) and tannic acid (0.3%—8.1%), expending a rotating essential complex plan. Cashew gum, gelatin, and oil ratios were 2:1:1 (m/m/m) at pH 4.5. The cross-linking process was achieved with tannic acid as other ingredients for 30 minutes at 40 degrees centigrade.

Arabic gum gelatin film weakness appeared in food products including vegetables and fruit coated with films to retard degradation processes since the gas's transportation (CO_2 and O_2) and water vapour. Comprehensive research on new techniques for Arabic gum gelatin-based film formation is desirable to recover its characteristics (Tsai *et al*., 2015).

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