A study on the use of resin in food coating, Liquidambar orientalis

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Abstract

The process of coating foodstuffs for specific purposes is widely used today. In recent years, in addition to "coating as packaging", "coating by forming an edible film layer" has been a subject that has been studied extensively. In this study, the resin (GAR) of the oregano tree (Liquidambar orientalis) dissolved in thyme water was used as a pre-coating component in the coating of the foodstuff. This mixture, which is completely natural and has no residue or toxicity risk, also has antibacterial, antifunga (Boydağ, 2003; Bagamboula et al., 2004). However, it was deemed sufficient to adhere to the food surface with adequate strength and hold the material for coating. One of the advantages of this mixture is that it can be used in pure form with the desired colour, taste, smell, and top coating materials. This mixture was used as an adhesive for coating, pre-coating and wrapping materials. It was concluded that the composition used was essential for public health for consumers.

Keywords: Frankincense resin, Thyme, Food coating, Antibacterial, Public health

Introduction

Foods undergo physical, chemical and microbiological changes during storage. Heat application, such as heating or cooling, is one of the oldest known methods to extend the shelf life of foods and preserve their composition. In addition to heat, various methods such as reducing water activity, smoking, curing, salting, pH control, addition of antimicrobial substances, storage under controlled conditions and packaging are used. (Appendini and Hotchkiss., 2002; Ayana and Turhan., 2009; Çağrı et al., 2002; Galus et al., 2015; Jin et al., 2009; Mastromatteo et al.,2009; McCormick et al., 2005; Rojas-Grau et al., 2007; Theivendran et al., 2006). Packaging is the protectors or wrappers that protect food from all kinds of environmental effects, such as air, light, heat, chemical effects, microorganisms, and physical force, which can be listed as external effects. Covering material or factors that function as important as packaging or are even more critical provides the preservation of the food and improves its physical properties without changing its content. The deterioration of grain, whole, combined parts and similar structures of food are basically microbiological, while chemical and physical factors are also essential in the deterioration of food. (Boydağ et al., 2003; Yıldız et al., 2016; Gürbüz et al., 2013; Özdemir and Floros., 2008; Sarıkuş .,2006; Suppakul et al.,2003).

What is meant by coating with preservatives is the process of coating the outer surface of the food with physical, chemical or biological materials to extend the shelf life of the food and to help it not be affected by external effects with permeable, semi-permeable, selectively permeable and impermeable substances or processes. None of the food's sensory (organoleptic) properties, such as taste, smell, consistency, texture and appearance, must be changed during this coating process. Thus, in addition to sensory properties, its originality is maintained for a long time without deterioration. Antimicrobial packaging, one of the active coating or packaging methods, is a new approach that ensures food safety by reducing the number of live microorganisms in food. Edible films and coatings from coating systems containing antimicrobial substances can be applied to foods such as dairy products, meat and meat products, fruits and vegetables. Their functions are to delay or prevent the development of live microorganisms in food and thus increase the shelf life and quality of the food. (Appendini and Hotchkiss., 2002; Bonilla et al., 2012; Boydağ et al., 2003; Yıldız ve Yangilar., 2016; Oliveira et al., 2007; Ramos et al., 2016). These systems, which are used in coating and packaging, affect the factors such as oxygen, odour, and moisture that can pass from the environment to the food and from the food to the environment by limiting them. Oxygen, carbon dioxide, ethylene, moisture absorbers, aroma diffuser/absorber systems, films and coatings containing antimicrobial substances can be examples of active packaging systems (Hagenmaier et al., 2012; Kaymak, 2005; Min et al., 2005; Moreira et al., 2009; Oliveira et al., 2007; Pires et al., 2008; Donhowe and Fennema 1994; Hong et al., 2009; Kristo et al., 2008; Suk et al., 2009).

The most commonly used antibacterial coating methods are antibacterial films and surface coatings. Antimicrobial films/coatings interacting with the food surface reduce the reproduction rate of some microorganisms in the food or prevent contamination from the external environment, thus reducing the number of living microorganisms. It is crucial in terms of food safety, preserving the freshness of the food and ensuring its shelf life, quality and organoleptic properties.

In antibacterial packaging, natural polymers, natural products or nanocomposite products are used as packaging materials, and natural products and nano coatings are seen as the food preservation materials of the future. Although the plastic packaging materials used today are safe, economical and convenient, they create environmental problems because they do not undergo biodegradation.

Moreover, they cause permanent undesirable effects at the molecular level due to chemical interaction with the food substance. Therefore, studies and searches on the use of natural polymers derived from proteins, polysaccharides and lipids, which are biodegradable, can be consumed with food, reduce the total amount of solid waste and do not cause any environmental concerns, as coating materials for packaging are becoming widespread. These natural polymers are the most studied coating materials in recent years to be used instead of synthetic packaging materials or to reduce their use. These materials, essential for public health, are vital in "food safety-public health". (Arcan and Yemenicioğlu., 2009; Çağrı et al., 2002; Galus and Kadzinska.,2015; Hasanhocaoğlu Yapıcı et al., 2015).

Films containing antibacterial substances can be defined as thin film layers produced from edible polymers applied to the surface of food. Using edible films in active packaging is a new approach to food safety. Antibacterial films are used not only in food technology but also in textiles and other similar areas that concern human health for preservation and hygiene. (Jausovec et al., 2008). Moreover, it is an area that is open to development and highly emphasized. Food coatings are generally desired to be effective in preserving for a long time. The fact that they are easy to obtain requires simple production technology, are cheap, and are obtained from natural compounds, which makes this area attractive. However, due to the variety in their functional properties and the fact that their biological biodegradation is different, coating materials are also a subject of much debate. The essential features of natural coatings are that they do not harm nature or cause public health problems for consumers because they are natural. (Hagenmaier, et al., 2012; Hong et al., 2009; Moreira et al., 2009; Pires et al., 2008; Saraç and Şen., 2014).

The white sweetgum (Spice tree) Liquidambar orientalis is a perennial tree that grows in the Mediterranean region and is in decline. It grows wild in the Marmaris, Milas, Köyceğiz and Fethiye districts of Muğla province. The tree known as the white sweetgum also grows in India and the Arabian peninsula, but its species and amount are pretty limited in our country. Its gum (resin) is famous for its known benefits since ancient times and its use as incense. This plant resin, which has always been used for healing stomach disorders and respiratory tract diseases, has become a frequently used treatment product in modern medicine (Sarıkuş, 2006; Saraç ve Şen., 2014). It has anti-inflammatory, antiseptic, sedative, digestive, diuretic, tonic and mental benefits related to central nervous system functions. It is used as a tonic or for various purposes in cosmetics to rejuvenate the skin and eliminate wrinkles. It is also used as a traditional medicine in the form of a mixture in the healing of wounds. It is available as a cosmetic in different forms and mixtures for dermatological use. In studies conducted on its content as a cosmetic drug and prodrug, α and β-pinenes, camphene, limonene, cineole, terpinene, linalool, hexanol, styrene, terpineol, borneol and cinnamate have been detected. (Hong et al., 2009; Sarıkuş., 2006; Saraç and Şen., 2014; Suk et al., 2009; Hasanhocaoğlu Yapıcı et al., 2015).

In studies conducted on food coatings, various coatings of different food materials are made using different technological processes. Various purposes and changes are targeted for these coatings. Many coatings are produced from natural, semi-natural and artificial components or by mixing these components in different proportions in a controlled manner. The most emphasised issue in this broad field of study is the studies conducted on edible films that have been given antimicrobial properties by adding antibacterial substances. Some studies emphasise the protection of sodium caseinate-based antibacterial films containing natural antimicrobial substances such as sodium lactate, calcium oxalate and nisin and chemical antimicrobial substances such as potassium sorbate. It has been reported that these films have antimicrobial activity against many microorganisms, including L. monocytogenes. Films containing nisin were found to be more effective against L. monocytogenes and S. typhimurium in terms of antimicrobial activity than films containing sodium lactate and potassium sorbate. It is known that chitosan films added with garlic oil, potassium sorbate or nisin have antimicrobial activities against microorganisms such as E. coli, S. aureus, S. typhimurium, Listeria monocytogenes and Bacillus cereus. Similarly, it is known that whey protein-based films containing lactoferrin, lysozyme or lactoperoxidase have antimicrobial activities against S. enterica and E. coli O157:H7. They all have antibacterial effects against microorganisms at different rates, but lactoperoxidase has been shown to have more potent antibacterial activity. It has been reported that whey protein films containing lactoperoxidase (%0.15 g/g) ultimately inhibit S. enterica and E. coli O157:H7 microorganisms. (Ayana and Turhan., 2010; Çağrı et al., 2002; Donhowe and Fennema., 1994; Işık et al., 2013; Mastromatteo et al., 2009; McCormick, et al., 2005; Ramos et al., 2016; Santiago-Silva et al., 2009; Sarıkuş, 2006; Saraç and Şen., 2014; Suk et al., 2009; Suppakul et al., 2003).

When the studies are reviewed, it is seen that they are generally on rapidly perishable materials and plants rich in essential fatty acids such as whey, basil, coriander, olive leaf, marjoram, cinnamon, clove, lemon, citrus fruits, lemongrass, anise, bay leaf and thyme have been used. Using these plant contents, it aims to coat rapidly perishable food products such as processed animal products such as salami, sausages and smoked meats. For this purpose, the substances mentioned above have been combined with thyme oil, which has antimicrobial effects at different rates. It has been proven that films containing carvacrol, the main component of thyme, have a more potent antimicrobial effect on E. coli O157:H7 than other films (Ayana and Turhan., 2009; Mastromatteo et al., 2009; McCormick et al., 2005; Min et al., 2005; Ramos et al., 2016; Rojas-Grau et al., 2007; Theivendran et al., 2006). Regarding the antibacterial effect, garlic and thyme are the most commonly used natural coating materials. When the two are compared, it is seen that thyme has a very significant antibacterial superiority. According to their contents, it is understood from the studies that carvacrol is more effective than allicin. (Boydağ ve ark., 2003; Moreira et al., 2009; Ramos et al., 2016; Rojas-Grau et al., 2007; Sarıkuş., 2006; Suppakul et al., 2003; Theivendran et al., 2006).

Pre-coating in foodstuffs generally creates a natural coating material that can be combined with sauce holders and natural colourants used as food, with antibacterial, antifungal, antiparasitic and protective properties. This aims to prepare the ground with natural products that will not harm public health, especially for dry or liquid coating. This study aims to develop a completely natural coating material and prepare a food wrapping natural food coating that can be used both as a pre-coating and an intermediate coating material. It is a preliminary idea and a basis in this field. It is to produce an intermediate product that will ensure that the sauces used mainly for dried nuts stick to the surface, are harmless regarding public health, can be controlled and are easy to analyze. This study aims to provide both protection and a healthy extension in shelf life due to its antibacterial, antimycotic and antiparasitic effects. It provides the opportunity to coat a large amount of foodstuff with a valuable and effective, very low-weight coating material that can be obtained naturally. It can be applied to multiple applications in this field, such as rotation (drum), injection, spraying, dipping, or pouring. Since the substances used are not reactive, they do not deteriorate the properties of the food to be coated, thus reducing the possible toxicological risk with the coating material in terms of public health. Since the taste, smell and colour of the coating material used are not very distinct, it also offers the opportunity to be used with the desired taste, colour, smelling substance and material in the food. Thus, this study aims to obtain a food coating material that can offer all these goals together and has not been tried before.

Materials and Methods

The plant material used in this study was obtained from products offered for sale. Thyme infusion, which is very well known among the public, was prepared with 500 g of dried thyme purchased from a herbalist in Bahçelievler, Istanbul. This infusion was briefly called ‘’thyme water’’. A Thyme water-sink tree resin mixture was obtained by dissolving the GAR in the prepared thyme water at a temperature not exceeding 80 °C. Nut varieties were dried without sauce from the same place, and the sauces were obtained as powder from a commercial dried nut business. The ability of the obtained mixture to hold the sauce on the nuts was tested. While extraction techniques such as Soxhlet, percolation, steam distillation, and ultrasonication are currently used in the preparation of the mixture, infusion was preferred because it is a straightforward application technique. In order not to cause any possible confusion, it was not deemed appropriate to purchase the thyme water we used from the market.

Thyme water was heated to 80 °C and added to 50 ml tubes as 40 ml. For each 40 ml of thyme water, 1 g, 2 g, 3 g, 4 g, 5 g and 10 g of GAR were ground and weighed, then added to 50 ml tubes. Three identical batches were prepared from each weight. Thus, 2.5, 5, 7.5, 10, 12.5 and 25% mixtures were obtained, respectively. The tubes were placed in a 10-slot and mixed with a mechanical mixer first. Then, they were kept in an ultrasonic mixer until a uniform, invisible distribution was achieved to the eye. This period, kept until a homogeneous distribution was completed, was from 10 min to 30 min. Homogeneous distribution was achieved in the first 10 min in 2.5, 5 and 7.5% samples. In 10%, 12.5% and 25% samples, the complex and greyish GAR particles dissolved and dispersed in 25-30 minutes in parallel with the concentration. At 25% concentration, the dissolution was not complete and sedimented in the form of small particles. It was seen that the 25% concentration was problematic in terms of homogeneous distribution, organoleptic properties and sediment and that a uniform efficiency could not be obtained in practice.

The obtained 2.5, 5, 7.5, 10, 12.5, and 25% solutions were treated on dried chickpeas, shelled peanuts, fresh pistachios, and almonds by sprinkling, mixing, simply spraying and dipping. In the process, whether there was a homogeneous distribution on the surface, sufficient adhesiveness and changes in organoleptic properties were examined. The samples taken from the application were treated with two powder sauces used to produce dried nuts. After the sauce was applied by dipping, sprinkling-mixing and spraying methods, the nuts were dried at 50 °C for one hour. After drying, it was rested for one hour and cooled. The change in odour, taste, sauce retention ability and flavour were evaluated organoleptically.

Results and discussion

In the organoleptic examinations, all three application types of the three series were evaluated from high to low concentrations. In the 25% concentration of the sweet gum tree resin mixture dissolved in thyme water, there was no complete dissolution, clumping, or high sediment level. No efficiency was obtained from using this non-homogeneous and sediment-containing structure in all three application methods. In the sprinkling-mixing and dipping methods, it was observed that the sediment was dispersed in the form of coarse particles, and the unmelted resin was mixed in the form of irregular particles in all types of nuts. It was concluded that this material containing coarse sediment could not be sprayed. The organoleptic examinations determined that the thyme smell was dominant in the products using 12.5% GAR solution and that GAR slightly changed the taste and smell. The sauce retention and stickiness occurred at a sufficient level. The sauce was significantly affected by both thyme and resin flavours. It was observed that these features encountered in sprinkling and mixing were more pronounced in the dipping method and that they changed the sauce in food and the properties of the food being sauced to a great extent.

In the 10% thyme water-GAR mixture, it was observed that the sauce retention ability was at a reasonable level in the first two of the sprinkling-mixing, spraying and dipping methods. Still, it was affected by the flavour of the mixture. In the dipping method, it was observed that the odour of the thyme water-resin mixture was more pronounced and that the 10% mixture changed the flavour of the Although a small amount of thyme and GAR odour was detected in the 7.5% mixture, the change was acceptable. It was observed that the taste and odour change from organoleptic changes were not evident in the sprinkling-mixing and simply spraying and that it did not cause a significant change in the taste of the sauce and the dried nuts. In the dipping method performed at this concentration, the thyme taste and odour were felt more clearly than the sauce and the food.

It was observed that the odour and taste did not change in the treatment with the 5% solution, and the surface adhesive property was obtained in sufficient amounts. It was observed that the sauce-holding ability was adequate for each type of nut in all three methods. It was observed that the taste and odour were distinctly specific to the sauce and the dried nuts at this concentration. Although a very slight odour was felt, the odour of the sauce and the dried nuts was evaluated as more dominant. Although dried nuts that did not stick to the sauce were seen in places in the sprinkling-mixing method, this situation was considered insignificant because it was in trace amounts.

In those using 2.5% GAR, although the smell of thyme was not felt, it was observed that the sauce-holding stickiness occurred in places on the surface. It was observed that the sauce did not have a sufficient level of adhesive properties. It was concluded that this would not provide equal and adequate stickiness on all surfaces. It was evaluated that there was no loss of flavour from the sauce and nuts. GAR-thyme water formed an indistinct smell and taste. Although it did not change the taste and aroma of the nuts, the sauce did not provide sufficient stickiness to the nuts in all three samples.

Studies have shown that the extract of the leaf of the sage tree has an antibacterial effect on sea bass fish and provides longer preservation (Hasanhocaoğlu Yapıcı ve ark., 2015). Studies have shown that the extract of the leaf of the sage tree has an antibacterial effect on sea bass fish and provides longer preservation. (Mastromatteo et al., 2009), It has been reported that the protective effect of carvacrol exhibits more effective antimicrobial activity than many natural compounds. (Rojas-Grau et.al., 2007). Uçan and Mercimek (2013 Uçan and Mercimek (2013) reported that chitosan films, a natural biopolymer formed by the deacidification of chitin, have antimicrobial activity against foodborne bacteria, moulds and fungi. Although the material used in our study preserves food through coating, it is new. It has been concluded that using food coatings is especially important in the triangle of low waste, clean environment, and healthy long-life food, especially the protective effect of carvacrol. (Yıldız and Yangılar; 2016).

Conclusions

It is a fact that this experimental mixture does not require technology and that there is no chemical or artificial carrier other than natural products. In addition, since the mixture is natural, it seems possible to use it with all kinds of sweeteners and coatings. It is considered vital that it is a natural adhesive in sauces, especially in the dried fruit sector, and that it adds value to food components in terms of effectiveness. It is also evaluated that thyme's antibacterial, insecticidal, and antifungal activity as a protective function will be an added value. (Hasanhocaoğlu Yapıcı et al., 2015; Chorianopoulos et al., 2008; Rojas-Grau et al., 2007).

In this trial study, it was observed that the 25% thyme water-GAR concentration was quite dense, the thyme smell was dominant, the bitterness of GAR was evident, it left a residue, and it was not possible to use it because it did not show a uniform distribution. It was observed that the thyme smell suppressed the sauce mixture at a concentration of 10%, and the slightly bitter taste originating from GAR changed the unique taste of the food. In every experiment applied at these high concentrations, there was a physical dissolution problem and organoleptic change in the food substance, respectively, which made it impossible to use. It is seen that it is impossible to use it due to these negativities.

In the 7.5% concentration of the mixture, it was seen that the organoleptic properties specific to the food were preserved in sprinkling-mixing and spraying, and the thyme smell was felt. In the dipping method, it was seen that this smell was more dominant and suppressed the sauce smell. It will likely be possible to use sprinkling-mixing and spraying in this sauce adhesion and coating concentration. In the dipping method, since there is an organoleptic change, although we could not use it, it is thought that it can be a usable mixture with a third mixture or by taking measures to correct its organoleptic properties.

Although there is a trace amount of odour in the foodstuff with the thyme water-GAR mixture at a concentration of 5%, it was important that no bitterness originating from the resin was observed, and the taste and flavour of the foodstuff were preserved. Similarly, it was evaluated that this mixture would be ideal for dried nuts due to the pronounced sauce smell. It was concluded that the 5% mixture can be used in simple sauces.

It has been observed that the mixture does not have sufficient function at a concentration of 2.5% and does not meet the requirements for sauce adhesion and surface retention. The prepared mixture is certainly a natural composition, has a low commercial cost, and will make a positive contribution to the organism due to the medical activities of the resin without causing a profound organoleptic change in the food it covers. The GAR-thyme water composition we use can be used as a coating product without causing a change in colour, texture, taste and smell in food. GAR is also essential to be used primarily in mental concentration and not being distracted. It adds additional medical value to the food; in short, it functions as a nutraceutical. (Ayana ve Turhan., 2010; Chorianopoulos et al., 2008**;** Gürbüz ve ark., 2013; Moreira et al., 2009; Saraç ve Şen., 2014). Since thyme contains "carvacrol" as the main component and contains many flavonoids, it inevitably provides a very special and superior protection to the food since its antibacterial, antiparasitic and antifungal effects and resin properties are added. These issues are also important in terms of public health and nutrition. When using the gum tree resin alone, it is possible to use it, although it lacks the protective effects obtained from thyme. The effect specific to the resin can be obtained from this use. It has been seen that the 5% mixture is sufficient to hold all kinds of sauces and materials in the form of powder, particles and thin pellets that we want to stick to the surface of the food. It has also been found vital that it does not require a technological or any other special process due to its easy dissolution in water. Since the GAR-thyme water mixture is vague in colour, it will not cause a problem giving the desired colour to the applied food when used with any food dye or colourant. Since it will not provide an additional contribution to the analysis of food components' fat, carbohydrates, and protein content, it is also essential that the micro elements of the food are preserved as they are. Although no study was found on the GAR-thyme mixture used in this study, it can be a good pre-coating. It can be used as a coating or as a fixing (adhesion) material to be coated on the foodstuff. It is also essential to prepare the ground for studies to be carried out on coating and adhesion materials that do not pose a risk to public health but can also be protective in foodstuffs used in the context of natural coatings and binders.

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