COATING ON MEAT AND MEAT PRODUCTS : A REVIEW

Vaibhav Sharma [1], Atul Bhojraj Jambhulkar [2]

Department of Food Technology and Nutrition, School of Agriculture, Lovely Professional University, Phagwara, 144411, India.

Abstract

Due to the acute handiness of nutrients in meat and alternative meat originated product, its wide consumed still as distributed worldwide. But, it conjointly creates an acceptable atmosphere for the expansion of spoilage and unhealthful microorganisms. Within the modern market, there's an honest demand for organic food with a high nutritive worth, particularly foods while not chemical additives. during this regard, edible coatings Associate in Nursing films with natural antimicrobials in meat and meat-oriented merchandise build an increased preservation mechanism that forestalls the unfold of spoilage microorganisms in raw and processed meat merchandise. The EFCs have vivid effectiveness on the meat and meat merchandise in line with the meat's supply and geared toward microorganisms as well as the standard of the compound used and anti-microbial properties as per its storage condition. To complement the merchandise preventability, quality, and reach the market demand coatings area unit applied. These defend the merchandise from discoloration, loss of wetness, and guarantee an ideal market look. This review consists of the researched knowledge from the studies on EFC, conducted over the last 10 years, and aims at analyzing the benefits, disadvantages, coating strategies of meat and meat originated merchandise to satisfy industrial needs. It any emphasizes the facts of however the microorganism properties of edible films and coatings work on conserving the character meet preservation of the meat and meat merchandise while not conveyance a couple of amendment in style, color, and nutritionary quality.

Keywords- Prevention mechanism, EFC, meat products, spoilage, microorganism.

1. Introduction

To preserve the acceptable alimentary attributes, vivid food process strategies are adopted by the meat-oriented food makers and packaging industries. The strategies of Coating meats and meat merchandise with edible films and coats created with super molecule and polios are largely applied to avoid the spoilage of merchandise. The meat and meat merchandise are a decent supply of the human diet that contains essential amino acids and proteins with a high biological price that is commonly the substitute for vegetable nutrition (Anderson U.R 1960). The manufacturer and packaging trade worries with the preservation of this extremely alimentary price with edible oil and super molecule created coatings. The super molecule and polios films work as a most well-liked preservation system on the meat merchandise because it may be a sensible atomic number 8 barrier. Meat is liable to the expansion of microorganisms within the presence of atomic number 8 that eventually causes spoilage and reaction. However, the best risk of spoilage in animal-oriented food allegedly has painted the economic loss of the makers and consumer's health-related hazards. The centers for sickness management report around fifty million cases as well as death cases of 3500 within the U.S influenced by the meat-oriented food spoilage. Likewise, rejection of a correct spoilage hindrance method will lead to a rustic to very large economic loss and sickness. Together with the persistently increasing market and transport and distribution system, the necessity for guaranteeing the fresh foods for a decent time (Cagri Z.Ustonol 2004). This distribution system includes different steps like the handling and putting for transportation and sport the supermarkets. Edible films and coatings are applied to the surface of the food by spraying and spreading within the final product of processed food. The surface protects the food from atomic number 8 and alternative unhealthful microorganisms. The edible films are made up of food-grade fibro genic suspensions and are solely applicable once a definite method. The coatings and edible films are usually totally different within their thickness

however each facilitates to prevent the rot in the meat from vivid organic chemistry processes over time. The coatings and films incorporate natural antimicrobial agents to include active practicality in extending the period by preventing dioxide, oxygen, and vapor. A victimization edible coating within the meat product has been incorporated by each food and packaging trade to create a positive market impression and avoid loss. The edible coatings that are used industrially are largely edible and might be referred to as food grade (J. H. Han and A. Gennadios 2005).These are sprayed on the layers of the food and thought of as Associate in nursing inescapable a part of the ultimate product process. Besides, the films and coating might sound like chemical substances however they're manufactured from edible things. The strategy of packaging the ultimate product includes drying the spray or the coat and it's created certain that the coating stays on the food for an extended length and keeps protective it from obtaining rotten. From general observation, it's been detected that the most distinction between coatings with films is within the thickness of their answer. In keeping with a former study, throughout the twelfth century, food coatings were employed in China for shielding the fruits and alternative edible things that contained water and were wont to get rotten quicker. The 1st food coating was fancied and eventually employed in the fifteenth Century to preserve food from milk in Japan. This was followed by the preservation mechanism in the European nation, within the early sixteenth century that was regionally referred to as larding. It was in style in Europe for coating meat food merchandise. Once the nineteenth century, the U.S was having speedy manufacture in dairy farm factories and their packaging (Umaraw, P., & Verma, A. K. 2017).The meat and meat-headed food merchandise were quite obvious during this context. The U.S had fancied its formation of coating that was created with gelatin that had the biological property to safeguard meet and alternative meet headed product factory-made within the factories. Since that point, the meat food trade has been growing quickly, and currently, edible coatings are used with a lot of developed formulae. The ambiance of globalization is continually influencing the makers to involve in a very competitive market and survival. This is often serving within the growth of a lot of international quality of processed food and meat merchandise that ensures sturdy and preserved characters of the food. Industries also are keeping the property in mind whereas manufacturing edible food coatings and films. During this context, this paper is commissioned to specialize in the standard and effectiveness of each type of coverings of meat and meat-oriented food merchandise as they need minimum variances. The standard and up to date advancements, safety measures within the strategies of applying them within the food also is mentioned (Hashemi, M., Daneshamooz, S 2020).

2. Meat Products and Effectiveness of EFC on Them

Meat product square measures the primary alternative of standard food habits for seventy-nine of the whole international population. The meat and meat product square measure invariably high on demand because of its style and high macromolecule nutritionary worth. The meat-oriented foods together with fish, egg, and different poultry product cowl major elements of our food habits for their high animal macromolecule content. Following Codex Alimentarius's rationalization, meat could be an appropriate and healthy consumption alternative for the physique. The large demand for meat products has resulted in an additional than 250 million a lot of total meat production worldwide together with eighty-seven million a lot of poultry production in 2014. As determined from such graphs, meat production and also the meat-oriented food process trade usually share a significant part of the financial system within the United States of America, South America, and different large meat-producing nations. (Zhang, W., Xiao, S., Samaraweera, H 2010). Eventually, meat production and process cowl an honest grip over international economic distribution that has mandated the preservation technology of meat product as a daily item needed to match the target quality. To avoid such market dominance and maintain an equivalent market, the impression keeps the high-quality protein-filled and nutritionally high edible coating edible films on a persistent demand. The studies are reportable that within the second world countries, consumption of meat in 2010 won't to be thirty-two metric weight units. /capita and in 1st world country it was 72kg. / Capita. It's been over ten years of changes within the food habits, market, improvement in population graph that has influenced the demand and market structure for the meat and meat-oriented product. Meat spoilage is that the main downside that the total bar method is centralized. The rot in meat could be a natural reaction to microorganism growth and fast reaction. These square measure the built-in biological problems that cause meat spoilage and might be prevented or delayed by coatings. On the opposite hand, the meats square measure is assumed to be a

sensitive element that gets affected in its quality whereas slaughtering and handling strategies subsequently. (Suderman DR, Wiker J, Cunningham FE 1981). The post-slaughter treatment of the meat extremely determines the standard of the merchandise. Aside from this, the pH content within the meat, subject to the method, is that the leading cause chargeable for the nutritionary worth and style of the ultimate packed product. The post-slaughter actions like laundry the meat, freezing, quantity of animal starch within the meat together with the temperature of the place the meat is kept, all play vital factors in deciding the edible quality of the merchandise. The microorganism reactions within the meats have an effect on the meat in its texture, taste, and acid content. Usually, it'd cause slime formation, a deterioration within the quality of the weather reduces the flexibility of the meat to carry water within the tissues that pave the manner for fast spoilage. The most practical square measures of the coatings are discovered from finding out these analyses of effects. Within the presence of Antimicrobial organisms and different identical parts in an edible meat product, outbreaks of spoilage come about in vivid ways in which. Most ordinarily, whereas process, cooking, mix with different foods whereas the storage system, the meat product carries a likelihood to urge contaminated by morbific organisms from different foods. AN industrial product is handled, slaughtered by common knives, stored, comes in grips with a staff of the manufacturing plant, market. Though these organisms don't exist whereas cookery out of warmth nevertheless a number of them survive for his or their toxins. Within the year 1998, a colossal health problem was unfolded within the USA because of the consumption of meat for the presence of enteric bacteria in it. Enteric bacteria cause food poisoning and infrequently true bacterial infection is additionally caused by consumption of such contaminated meat products.

Table: 1 Chroma and hue values of meat with and without an edible coating during storage.

	Storage (days)	CON	EC	ECR	ECO	p-value
L*	1	40.22±2.11Aa	39.38±1.68Aab	38.53±1.68Aab	37.30±1.55Ab	0.012
	7	38.74±1.82Aa	34.62±1.19Bb	36.13±1.19Bb	36.53±2.63ABb	<0.001
	14	36.23±1.56Ba	33.61±2.33Bb	34.24±1.46Bab	34.85±2.06Bab	0.043
	p-value	<0.001	<0.001	<0.001	0.020	
a*	1	13.25±1.36Ab	15.71±1.77Ba	15.01±0.92Ba	16.32±2.18Ba	0.001
	7	11.24±0.51Bb	17.88±1.43Aa	17.05±1.42Aa	18.30±1.28Aa	<0.001
	14	8.29±0.87Cb	15.15±1.26Ba	15.72±1.77ABa	16.32±1.91ABa	<0.001
	p-value	<0.001	0.001	0.011	0.001	
b*	1	14.07±1.04Ab	18.69±0.99Ab	17.43±1.54ABa	17.67±0.53ABa	<0.001
	7	12.71±0.54Bb	18.67±0.65Aa	18.74±0.73Aa	18.61±0.57Aa	<0.001
	14	10.65±0.43Cb	16.55±1.25Ba	17.08±1.25Ba	17.45±1.26Ba	<0.001
	p-value	<0.001	<0.001	0.012	0.017	
Chroma	1	19.34±1.56Ab	24.83±2.90Aa	22.96±1.68Ba	24.85±0.84ABa	<0.001
	7	16.94±0.74Bc	25.57±0.47Aa	25.56±1.61Aa	26.26±0.80Aa	<0.001

	14	13.60±0.79Cc	22.34±1.15Bb	24.22±1.67ABa	23.59±2.19Bab	<0.001
	p-value	<0.001	0.001	0.006	0.001	
Hue						
	1	44.04±0.68Cc	46.45±0.99Ab	48.42±1.86Aa	46.14±2.37Ab	<0.001
	7	49.22±1.25Ba	40.66±1.81Bc	43.90±2.51Bb	41.95±1.48Bbc	<0.001
	14	51.95±1.71Aa	45.43±2.62Ab	46.64±1.46Ab	45.66±2.64Ab	<0.001
	p-value	<0.001	<0.001	<0.001	<0.001	

3. Types and Classifications of Edible Films and Coatings

Edible films and coatings play the role of a hindrance between the food skin and the surrounded environment. As per growing consumer demands, bio-based biodegradable film coatings are being a more preferable choice, as synthetic coatings never break down in the environment. The major sources are agricultural biopolymers and raw-material sources from the marine. It works as a barrier between the freshness of the food and the environmental elements. In the preparation of edible films, the waste of natural materials is very less that makes it much environment friendly. Other than that, antimicrobial agents, antioxidants, enzymes, vitamins, and minerals are already incorporated in it.

The following diagram shows some functional structure of edible films and coatings.

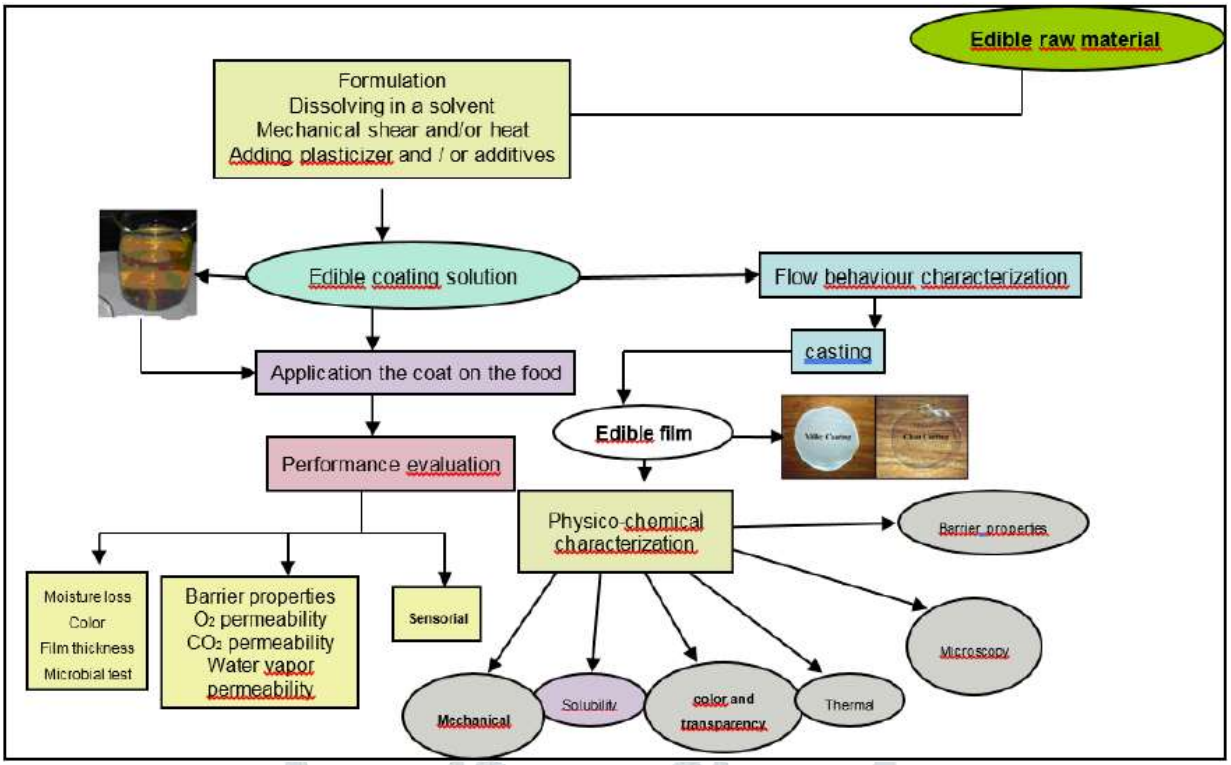

Fig: 1 Functional flow chart of edible films and coatings.

3.1. Two aspects are considered in the preservation of fresh meat

1. To maintain the color oxygen is required.
2. Degradation of cured meat is possible in contact with oxygen.

Keeping these two parameters in mind, the shape and form of the material of films are selected.
There are three major categories of materials that are used to make edible film coatings for meat and meat products:

1. **Hydrocolloids.**
2. **Lipids.**
3. **Composites.**

3.2. Types of Hydrocolloids:

- Protein,
- Polysaccharides (Cellulose derivatives, Starch, chitosan, alginate).

3.3 Types of Lipids:

- Fatty acid,
- Wax,
- Acylglycerol.

3.4. Types of Composites:

This is a combination of both Hydrocolloids and Lipids.The type is selected based on the aesthetic appearance of the film and its properties to be a good barrier against oxygen.

4. Polysaccharide Based Films

4.1. Components

- Starch
- Alginate
- Dextrin's
- Pectin
- Chitosan

Polysaccharides based films are most commonly used for meat packaging. Some major properties of such films are:

1. Nontoxic
2. Easily available
3. Selective permeability to oxygen and CO2.
4. Naturally hydrophilic.

These films have a low water vapor resistance which helps easy water movement across the film. As a result, water is never condensed which can effectively cause microbial spoilage.

5. Technical developments

5.1. Protein-Based Films

Composition:

Animal proteins like collagen gelatin whey protein, casein; plants like rice, peanut, wheat, corn, soybean. Films and coatings made of protein are better barriers against oxygen and CO2 as they stick to the hydrophilic surface of meat very well. But they have poor water diffusion resistance properties. When proteins are combined with carbohydrates they show much stronger properties with the closely attached matrix and hydrogen-bonded network structure. In some processes, beeswax and oleic oils are added to the protein to increase its poor water permeability quality. This way the surface charge and molecular size of the films are improved. For pork meat packaging a kind of protein film is used that contains tea extracts and soluble dried grains with rich antioxidant activities. Edible films containing whey protein have increased antioxidant prevention for frozen cooked meatballs. For oxidative stability of ground beef patties, films made of a combination of soy and oregano are used. The photolytic enzymes of meat products may cause allergic reactions to sensitive people, as protein films can be susceptible to the enzymes. This is one shortcoming of protein films despite all their good qualities. (Shivendu Ranjan, Nandita Dasgupta 2012).

6. Lipid Coatings

Composition:

Animal oil and vegetable oils and fats like fatty acids, triglycerides, butter, coconut, palm; Waxes; Natural resins like olibanum, chicle; essential oil extracts like citrus fruits essence, camphor, mint; emulsifiers. Lipid coating is probably the oldest food film coating that came into use. The first one was produced in Japan from soymilk, called Yuba. Back in 16th century England, people used to cover cut meats in fats. This process was known as 'larding'. After that many lipid coatings were produced on a large scale that helped to prevent the quality of meat. In one of these processes, meat was coated with melted liquefied fat and then kept aside so that a film can grow. This extended the freshness even when meat was refrigerated. Different kinds of wax had been used as a coating to frozen meat such as Carnauba, Candelilla, Beeswax, Jojoba, Paraffin, etc. Some coatings

help to cut down off-flavors, the loss of moisture, and maintain the proper color of meat: A combination of mono, di, and triacylglycerols in alcohol, acylated acylglycerol that contains chlortetracycline, acetylated acylglycerol mono, and di.
Another way to improve the shelf life of meat products is to use: Carboxylic acid mixed with or without paraffinic acid and triacylglycerol. Acetylated mono acyl glycerol can be used for vacuum-packed meats. Lipids incorporated in emulsion coating have also shown some substantial results as a film (Krochta JM, De Mulder-Johnston C (1997)). The most popular and commercially produced edible coatings for meat products are sausage casings and collagen films. Although lipid films are good barriers to resist water vapor, their mechanical strength is low and oxygen is easily permeable. So they are often combined with hydrophilic materials through an emulsion formation.

7. Composite Edible Films

There are some parameters based on which composite coatings are optimized.

1. Mechanical properties.
2. Transparency.
3. Consumers' demand and adaptability.
4. Transport handling situations.

Superior quality composite films are made of sodium alginate and methoxy pectin combined. Moisture resistance quality can be improved by adding lipids but that on the other hand affects transparency issues.

7.1. Nano composite Film

Barrier and mechanical properties that cannot be achieved by using macroscopic components can be done by using bio nano-composite materials for edible packaging.
This film is a matrix that is composed of two incompatible phases. These phases are separated from each other. The nanocomponents increased the bend of the curves of the path through which liquids penetrate the coatings. Thus barrier properties are improved.
It has been found that a nanocomposite film made of whey protein and rosemary essential oil can strengthen the microbial and sensory quality of refrigerated lamb meat. (Zivanovic S, Chi S, Draughon AF 2005)

7.2 Pullulan Film

It is a type of biopolymer, polysaccharide film. Aureobasidium pullulans are the major production source. It has no color and no taste. It is oil resistant and kind of impenetrable to oxygen. As researchers have found it is almost as good as plastic as a material for meat packaging. It is safely edible and does not hamper the quality of the food. Even it has characteristics to improve the shelf life of meat. Coming in direct contact with the meat surface it gets completely dissolved and starts releasing an antimicrobial.

7.3 Incorporation of Other Additives

Many potential advantages of edible films as carriers of varied additives (e.g., flavors, antioxidants, coloring agents, vitamins, probiotics, and nutraceuticals) justify continued analysis within the world of active packaging. However, solely antioxidants square measure investigated extensively. though oxygen-barrier properties of edible films and coatings could crop would like for Europhilic stabilization, antioxidants square measure utilized in edible coatings to supply a great deal of protection to meat and poultry product.
The incorporation of antioxidants like gallic or ascorbic acids into gum coatings to increase the number of poultry products has been reported as early as 1948(Stoloff et al. 1948; Allingham 1949). Antioxidants were incorporated into a mixture of lard and oil coating containing nutrient acid–fatty acid triacylglycerol, that was wont to coat freeze-dried and up to now meats, to boot as beef steaks, pork chops, and beef cubes (Sleeth and

Furgal 1965). Thiobarbituric acid levels were considerably reduced in meats to that antioxidant-containing coating were applied, compared to those of non-coated controls (Sleeth and Furgal 1965). Pork chops treated with alginate–starch coatings containing nutrition were reported to be juicier and less prone to macromolecule activity, compared to the untreated controls. However, they still developed off-flavors (Hargens-Madsen et al. 1995). Herald et al. (1996) reported that turkey breasts wrapped in corn zein films containing butylated hydroxyanisole (BHA) had a lower hexanal content than samples packaged in polyvinylidene chloride (PVDC).

Conclusion

Several types of edible coatings have been applied to meats, poultry, and kinds of seafood over the years. However, all of these systems presently have exhibited certain shortcomings and have not received substantial commercial acceptance. The numerous benefits to be afforded to food processors and consumers by effective edible coating formulations justify further research in this field. As more edible biopolymers are investigated for film formation and as new concepts related to multicomponent edible coating systems are developed, wide commercial exploitation of edible packaging for meats, poultry, and seafood may be realized.

References

ANDERSON, T. R. Manner of handling meat. U.S. Patent 2,948,623, August 9 (1960)

Baldwin EA. (1994) Edible coatings for fresh fruits and vegetables: past, present, and future. In: JMKrochta, EA Baldwin, MO Nisperos-Carriedo (eds) Edible Coatings and Films to Improve Food Quality. Technomic Publishing, Lancaster, PA, pp 25 – 64

Cagri, Z. Ustunol, and E. T. Ryser, "Antimicrobial edible films and coatings," Journal of Food Protection, vol. 67, no. 4, pp. 833–848, 2004.

EFSA (European Food Safety Authority), European Centre for Disease Prevention and Control, The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2010, http://www.efsa.europa.eu/efsajournal.

Helander, I.M., Alakomi, H-L., Latva-Kala, K.,Mattila Sandholm, T., Pol, I., Smid, E. J. et al, . J. Agri. Food Chem., 1995. 46, 3590.

Hashemi, M., Daneshamooz, S., Raeisi, M., Jannat, B., Taheri, S., & Noori, S. M. A. (2020). An overview of antioxidants activity of polysaccharide edible films and coatings contains essential oils and herb extracts in meat and meat products. *Advances in Animal and Veterinary Sciences*, *8*(2), 198-207.

J. C. Buzby and T. Roberts, "Economic costs and trade impacts of microbial foodborne illness," World Health Statistics Quarterly, vol. 50, no. 1-2, pp. 57–66, 1997.

J. H. Han and A. Gennadios, "Edible films and coatings: a review," in Innovations in Food Packaging, J. H. Han, Ed., pp. 239–262, Elsevier Science, New York, NY, USA, 2005.

Krochta JM, De Mulder-Johnston C (1997) Edible and biodegradable polymer films: challengesand opportunities. Food Technol . 51 , 2 : 61 – 74

KAMPER, S.L., AND FENNEMA, O. Use of an edible film to maintain water vapor gradients in foods. Journal of Food Science, 50, 382–384 (1985)

STEMMLER, M. AND STEMMLER, H. Composition for the preparation of coatings on meat and sausage goods. U.S.Patent 3,936,312, February 3 (1976)

Sánchez-Ortega, I., García-Almendárez, B. E., Santos-López, E. M., Amaro-Reyes, A., Barboza-Corona, J. E., & Regalado, C. (2014). Antimicrobial edible films and coatings for meat and meat products preservation. *The Scientific World Journal*, *2014*.

Shivendu Ranjan, Nandita Dasgupta, Proud Saha, Madhumita Rakshit and C. Ramalingam, Adv. Appl. Sci. Res.,2012, 3, 495.

Suderman DR, Wiker J, Cunningham FE (1981) Factors affecting adhesion of a coating to poultry skin: Effects of various protein and gum sources in the coating composition. J. Food Sci . 46, 1010 – 1011

Umaraw, P., & Verma, A. K. (2017). A comprehensive review of the application of edible film on meat and meat products: An eco-friendly approach. *Critical Reviews in Food Science and Nutrition*, *57*(6), 1270-1279.

Zhang, W., Xiao, S., Samaraweera, H., Lee, E. J., & Ahn, D. U. (2010). Improving the functional value of meat products. *Meat Science*, *86*(1), 15-31.

ZABIK, M. E., AND DAWSON, L. E. The acceptability of cooked poultry is protected by an edible acetylated monoglyceride coating during fresh and frozen storage. Food Technology, 17, 87–91 (1963)

Zivanovic S., Chi S., Draughon AF (2005) Antimicrobial activity of chitosan films enriched withessential oils . J. Food Sci . 70 , M45 – 52