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A REVIEW ON BIO-PRESERVATIVE EFFECT OF ESSENTIAL OILS AS AN ANTIOXIDANT AND ANTIMICROBIAL AGENTS ON READY-TO-EAT CHICKEN SAUSAGES

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Abstract
Meat is a good source of protein in the human diet, but it is very susceptible to microbial attack, resulting in foodbor ne illnesses in customers, resulting in financial and health costs. During the killing and shipping of meat, it becomes infected. Because of favorable conditions such as storage temperature, pH, texture, and content of meat, as well as ra w meat transit methods, microorganisms grow prevalent. During the storage or preparation of meat, microbes change the structure of the protein and generate disagreeable odors. As a result of these developments, the consumer's perce ption and pleasure with meat quality have shifted. The deterioration of the meat mostly arises in fat-containing parts. Usually, environmental oxygen affects the unsaturated fatty acids and ultimately causes the oxidation and deteriorati on of meat. The factors which spoiled the meat quality are the high amount of oxygen, water holding capacity, natura l pH, and lower connective tissue content. Chicken meat provides a lot of nutritional benefits features such as a high concentration of polyunsaturated fatty acids and low other lipid content. The majority of fresh poultry meat products are sold at refrigerated temperature at 2-5ºC. During refrigeration, there are two ways of meat spoilage oxidative ran cidity and microbial growth. Spoilage of fresh poultry meat causes the economic loss to the produces and also cause the quality problem, shelf life, and safety. To remove bacteria and extending the shelf life of food products synthetic preservatives have been widely used all over the world. Although artificial preservatives may give rise to a health pr oblem for consumers in a long-term period of usage. Synthetic antioxidants like butylated hydroxyanisole (BHA) an d butylated hydroxytoluene (BHT) are popular for their capability to stop the free radical chain reaction of lipid pero xidation. Chicken sausage is a minced meat product that has seen a dramatic increase in consumption throughout the world. Sausage manufacture involves several handling steps which increase the chances of contamination by pathoge ns or spoilage. This review mask the effect of pathogenic bacteria in sausages by adding essential oils (clove and cin namon oil). These essential oils will act as antioxidant and antimicrobial agents on ready-to-eat chicken sausages. It is concluded from the present study that essential oils of clove and cinnamon are good as an antioxidant and antimicr obial on ready-to-eat chicken sausages in prolonging the shelf life of chicken sausages at room temperature as compa red to control sample. By adding natural component rather than using the synthetic compounds.
[Rida Zubair, Javeria Amin, Muhammad Tuseef, Maira Anam, Muhammad Abubakar Khalid, Tayyaba Gull, Summa ia Fordos, Shahnshah E Azam, Muhammad Fahad Latif.**A REVIEW ON BIO-PRESERVATIVE EFFECT OF E SSENTIAL OILS AS AN ANTIOXIDANT AND ANTIMICROBIAL AGENTS ON READY-TO-EAT CHIC KEN SAUSAGES**.*Life Sci J* 2022;19(11):28-44]. ISSN 1097-8135(print);ISSN2372-613X (online). http://www.lifesciencesite.com. 05.doi:10.7537/marslsj191122.05.

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Introduction

Poultry meat is high in omega-3 fatty acids, which are necessary polyunsaturated fatty acids. The number of fatty acids can easily increase in poultry meat rather than other meat. Likewise, most of the higher nutritional intake is possible (Petrou *et al.,* 2012). Among all of the food, meat is the most significant food because it provides large levels of protein, necessary amino acids, minerals, and other nutrients, as well as being the most important source of B-complex vitamins (Hygreeva *et al.,* 2014). Chicken meat provides several nutritional advantages, including a high concentration of polyunsaturated fatty acids and a low quantity of other lipids. Mostly fresh chicken meat items are marketed at refrigerated temperature 2-5ºC. During refrigeration, there are two ways of meat spoilage oxidative rancidity and microbial growth. Spoilage of fresh poultry meat results in economic losses for producers as well as issues with quality, shelf life, and safety (Krishan *et al.,* 2014).

Meat is a perishable product that provides ideal conditions for the growth of several bacteria. Chemical, physical, and enzymatic processes all contribute to the deterioration of meat. Meat becomes unfit for human consumption due to the breakdown of meat constituten such as fat, protein, and carbohydrate which cause the off odor or off the flavor of the meat. As a result, it is necessary to control meat spoilage to extend the shelf life of meat and preserve its flavors, texture, and nutritional value (Kozacins *et al.*, 2012).

According to historical data, canning, curing, drying, smoking, and fermenting were conventional techniques for preventing meat deterioration and extending its shelf life. However, new methods for preserving the wholesomeness, appearance, nutritious value, composition, tenderness, flavor, and juiciness of meat have been created. Meat can be preserved to increase its shelf life and making better its quality. The incorporation of preservatives (ascorbic acid) and storage at 5°C are the most effective ways to prevent meat deterioration and extend the life of meat and other meat products (Dave and Ghaly, 2011).

In the human diet meat is a good source of protein but it is very susceptible to microbial attack, resulting in foodborne illnesses in customers, resulting in financial and health costs. During the killing and shipping of meat, it becomes infected. Because of favorable conditions such as storage temperature, pH, texture, and content of meat, as well as raw meat transit methods, microorganisms grow prevalent (Ahmad *et al.*, 2013).

During the storage or preparation of meat, microbes change the structure of the protein and generate disagreeable odors. As a result of these developments, the consumer's perception and pleasure with meat quality have shifted (Ozden and Gokog, 2007). Meat rotting occurs primarily in fat-containing areas. Normally, ambient oxygen affects unsaturated fatty acids, resulting in oxidation and meat degradation. The factors which spoiled the meat quality are the high amount of oxygen, water holding capacity, natural pH, and lower connective tissue content (Serdarog and Felekog, 2001).

Food safety issues in the mutton, poultry, and beef industry is a big deal in present days all over the world and are explosively conveyed in the international conference and livestock industries (Scharff, 2012). Meat safety and quality have become a big problem in the food industry in recent years. Microorganisms gain access to food from contaminated water and food of animal origin through cross-contamination, as well as disposal issues, improper treatment of meat animal manure, an inadequate inspection of foodborne illness and food handling activities, and poor farm implementation of food safety programs. *Campylobacter, Salmonella*, and *E.coli* influence the safety and quality of raw meat, whereas *L. monocytogenesis* is a worry in ready-to-eat items. Variations in product processing, animal production, changing customer needs, rising demands for ready-to-eat foods, greater meat consumed around the world, more consumers at risk, and increased consumer knowledge all contribute to these concerns becoming more criticals (Sofos, 2008).

Chicken meat and its items have been expanding prevalence and widely spread globally. Among these chicken products sausages is one of the most popular foodstuffs (Sallam *et al*., 2004). Sausages are meat products manufactured from the grinding of fresh meat and taking meat from different categories like chicken, beef, fish, buffalo, and swine. Sausages provide the human body with essential vitamins, lipids, minerals, energy, and protein with a good biological value just like cold meat. Nature and richness of protein make these products fundamental nourishment for a balanced food proportion (Devi *et al*., 2020).

Many ready-to-eat and ready-to-cook meat items have been developed for customers. However, the majority of these items contain certain barriers to microbial activity. Refrigeration is mostly used to manage temperature variations in ready-to-eat items. Before serving, ready-to-eat meat products required no or minimal heat preparation. The majority of illnesses are linked to Ready-to-eat foods that have not been heated before consumed (Mytle *et al.*, 2006).

Although lipid degradation and microbial growth occur in sausages during the storage period which affects the quality attributes of these products. Nutritional quality and changes in flavor are affected by due to lipid oxidation. However, food poisoning and meat deterioration can give rise to economic losses and major public health hazards due to microbial contamination. Consequently utilization of suitable agents which have both properties as an antioxidant and antimicrobial activity which may help maintain the standard of meat, prevent economic losses and enhancing the shelf life of meat and meat items (Sallam *et al*., 2004).

Under normal storage of meat and meat products, the oxidation of proteins, lipids, and pigments are the most common phenomena. In the oxidation of lipid, the development of hydroperoxides aids new degradation reactions which give rise to nasty volatile compounds, like ketones, alcohols, aldehydes, and acids. Furthermore, oxidation of protein may lead to changes in the physicochemical properties and amino acids, thus results in a decline in their bioavailability, palatability, dissolved property, and proteolytic activity. This oxidation of myoglobin to oxymyoglobin and metmyoglobin has a negative effect on products by producing brown pigments (Paterio *et al*., 2018).

Herbs are plants that can be utilized fresh or dried. Herbal plants are used to manufacture a variety of medicines to treat a variety of ailments. Pepper, cinnamon, rosemary, and clove are among the spices used. Spices are utilized in fragrance, cosmetics, pharmaceuticals, and a variety of other sectors because they are flavorful and have medicinal characteristics (Vangalapati *et al*., 2012).

Plants are the pure organic and essential origin of materials for the cure of a variety of illnesses, infectious diseases, and the manufacturing of various organic source medicines. The demand for new antimicrobial drugs is increasing as pathogenic microorganisms develop antibiotic resistance. Cinnamon essential oils and extracts have been utilized for natural therapies, pharmaceuticals, and alternative medicines for thousands of years. Plants have a tremendous impact on the quality of health treatment (Hamedo, 2015).

Plants and plant extracts have potent antioxidant properties. The majority of these extracts have anti-inflammatory and anti-cancer effects. Cinnamon is used in a variety of foods to provide flavor and fragrance. It's antifungal as well as antibacterial. Cinnamon can also be used to cure nausea, diarrhea, and wound healing. Cinnamon improves glucose levels in type 2 diabetics (Sakr and Albarakai, 2014).

Plants have always been widely used and valued for their medicinal and aesthetic properties. For various healthcare needs, around 60% of the world's population has traditionally relied on medicinal herbs and extracts. The use of medicinal plants for food preservation and medical purposes has been conducted for a long time. Medicinal plants are extremely valuable economically all around the world. Plant extracts have antibacterial properties and are commonly utilized as antibacterial agents. Many plant extracts and essential oils have been proven to suppress microbes associated with food spoilage, both gram-negative and gam-positive bacteria. Plant extract antibacterial compounds have gained extensive attention since they have fewer negative effects on the body, have a wider range of applications, are less expensive and have a higher tolerance. Plant components with varied therapeutic characteristics include leaves, bark, fruits, stems, flowers, and roots (Kumar *et al*., 2012).

To remove microbes and extending the shelf life of food items artificial preservatives have been widely used all over the world. Although artificial preservatives may give rise to a health problem for consumers in a long-term interval of usage (Barbosa *et al.*, 2009). Antioxidants that are synthesized like butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are popular for their capability to stop the free radical chain reaction of lipid peroxidation. Regrettably, it has been unknown that they can increase carcinogenesis in humans for the usage of long term. In the previous years, there has been a continuously rising interest in the natural antioxidant constituents of various medicinal plants, due to their ability in controlling the process of lipid peroxides and level of free radicals (Schmidt *et al.*, 2006). So looking for up-to-date and possible natural antimicrobial agents from different origins like plants, microbe metabolites and spice extracts for food products applications has been expanding remarkably (Ghabraie *et al.*, 2016).

To enhance the life, and safety of food products plants are a good source of biologically active compounds which have been broadly used both ordinarily and commercially (Barbosa *et al.*, 2009). The antimicrobial activities of some spices and their constituents have been recorded. Previous studies revealed that onion, cloves, garlic, cinnamon, sage, thyme, and further spices, retard the growing of both gram-negative, gram-positive foodborne pathogens, or spoilage bacteria, molds, and yeast (Hoque *et al*., 2008).

The antibacterial activities and biological properties of essential oils have been ascribed to phenolic compounds, like carvacrol, eugenol (2-methoxy- 4-2 propenyl phenol), and thymol. These composite have hydrophobic attributes and interlinkage with different sites of the microbial cell (Barbosa *et al.*, 2009).

Since ancient times cinnamon and clove oil have been used in foods as antioxidant and antimicrobial agents. Vital antimicrobial constituents in cinnamon and clove have appeared are cinnamaldehyde and eugenol. Sequentidly which have been given particular concentrations to find their antimicrobial activities against foodborne microbes. Eugenol has been appeared to retard the growth of *(Listeria, Monocytogenes,* and *E.coli* 0157:H7). Cinnamaldehyde has been appeared to retard the growth of *S. aureus*, *Salmonella typhimurium, and E.coli* 0157: H7 (Hoque *et al.,* 2008).

Anticarcinogenic, antimicrobial, and antifungal properties of sesquiterpenes have been reported in cloves (Sharma *et al*., 2020). Although the microbial shelf life of a huge group of fresh meat and fish products has been extending by applying EO of *Cinnamomum zeyulanicum* (applied in Nacl/ lactic acid marinade) then oregano and thyme EO during successive cooled storage in air (Van Haute *et al.*, 2017).

Salmonella, Escheria coil, staphylococcus aures, and *Listeria monocytogenes* is harmful bacterium that is usually found in meat. The live animal carries the pathogenic bacteria and processing conditions support to grow them. (Kakar *et al.,* 2012). Toxins are abnormal, heat-resistant proteins. They take 3 hrs in vitro at 100 ºC and take only 10-40 minutes at 121 ºC to destroy the toxins. They counter digestive enzymes and gastric acidity. The major toxins producing microorganisms are bacteria (*Salmonella, Listeria, Yersinia, Staphylococcus, Jejuni, Clostridium, Campylobacteria, Escherichia*) viruses, and molds (Devi *et al*., 2020).

Although the utilization of essential oils in food as a natural preservative is restricted due to their powerful organoleptic effect in food that can influence the sensory properties of foods that are accepted by consumers (Khorsandi *et al.,* 2019). Sausages are a ground meat product that is becoming increasingly popular around the world. The main reasons for degradation and decreasing the shelf life in minced meat products are lipid degradation and microbiological growth (Das *et al*., 2012). The usage of ready-to-eat (RTE) meat products is increasing as people's lifestyles change, demanding more convenience in their diets (Jang and Lee, 2012).

The prevention and management of emerging infections come with careful food production, raw product handling, and completed food preparation. To limit the danger of carcass infection, it is critical to maintaining cleanliness throughout slaughterhouses operations according to HACCP basis and regulations of goods manufacturing practices for meat and poultry production. To limit the frequency of emerging infections in the food chain, public health authorities must implement effective epidemiological surveillance and control programs. Food handlers and customers must also be educated on food safety principles. Antimicrobial careful use can help prolong their effectiveness by reducing severe public health issues including antibiotic resistance and cross-resistance in select dangerous bacterial strains (Montserrat and Yuste, 2010).

Antioxidants like BHT and BHA have long been utilized in food production to extend shelf life and keep nutritional quality during storage. Consumers urge the use of natural substances to improve food quality due to the negative effects of synthetic preservatives. So edible covering is the ideal option for food manufacturers to meet consumer needs because it has no harmful effects and can be consumed as a portion of food (Sathivel, 2005).

When utilized in food goods, clove oil is a great organic antioxidant, preservative, and flavor improver. Clove oil has been shown in studies to reduce the growth of yeast and mold (Muppalla *et al*., 2014). Clove oil is obtained from the clove tree's leaves, stems, and flowers by a distillation process (*Eugenia aromatic*). Clove oil can prevent the growth of bacteria and mold in food goods. Clove oil is classified as a GRAS by the FDA at a level of not more than 1500ppm in all food products, and the World Health Organization recommends a daily dose of 2.5mg/kg body weight (Gulcin *et al*., 2012).

Volatile and essential oils derived by extraction, fermentation, and distillation from therapeutic and aromatic plant sources containing buds, roots, flowers, and leaves have strong antibacterial properties. In the market, there are about 300 essential oils to choose from. Because of their flavor and biological properties, essential oils have been employed in a variety of food items for numerous years. Essential oils from thyme, oregano, clove, balm, coriander, and rosemary have demonstrated a greater ability for usage as an antibacterial agent in meat products (Jayasena and Jo, 2013).

REVIEW OF LITERATURE

The word "chicken meats" mentions whole chicken carcasses and pieces, as well as deboned bird meat. Poultry has gained consumer and producer acceptance as a result of annual growth rates of 10% to 15%. Chicken flesh contributes around 37% of total meat, and poultry is the leading contributor. Shortly, more growth is projected. This could be attributed to the fact that chicken flesh is a low-calorie food that nutritionists suggest, as well as its great digestibility, popularity, taste, price, and lack of religious prohibitions. . Chicken is a healthy meat source with minimal fat and cholesterol levels when compared to other meat types. It is also a rich source of protein. Meat should be of good quality to reduce microbial attacks and make sure that consumers are eating a safe product that is not spoiled and does not contain any pathogens that cause foodborne sickness. A foodborne illness has been linked to the consumption of poultry meat products (Bhaisare *et al*., 2014).

Customers prefer poultry meat because of its variety, flavor, and ease of availability. Not only because of the product itself, but also because of its various varieties, packaging, and positioning, poultry meat is very familiar. Unlike other meat industries, the chicken sector has successfully responded to various customer demands by producing valuable items that focus on customer health and alleviate concerns, so enhancing poultry reputation (Michel *et al.,* 2011).

Chicken meat has long been thought to be a source of a significant percentage of human food-borne disease. Microbiological hazards carried mostly by fit animals, such as *Salmonella, Yersinia enterocolitica*, and *Campylobacter jejuni*, are identified in the linked study as causing the majority of food-borne hazards to human health. Poultry flesh is a perishable food item that has become extremely harmful as a result of the proliferation of bacteria (Turantas *et al.,* 2015).

In most slaughterhouses, the processing of poultry meat is nearly the same, with a few minor variances or differences in a few phases. Slaughtering such as killing, bleeding, neck cutting, and stunning, gutting, scaling, plucking, chilling, and inside or outside washing are all common stages. As for this, as raw material, send these carcasses to food processors and marketplaces. Some phases pose sanitary dangers to users, such as in the case of cutting and chilling rooms, where bacteria are frequently transferred from one product to another due to the use of unwashed cutting floors or even hands (Escudero-Gilete., 2014).

Pathogenic microbes such as *Salmonella*, *Staph aureus, E.coli, Campylobacter*, and *Listeria* were frequently identified in poultry flesh and poultry products. *Aeromonas*, *Clostridium perfringens*, and *Yersinia enterocolitica* have the potential to be major microbes for poultry meat products in some situations. *Salmonella, Campylobacter,* and *Listeria,* to a lesser extent, are the primary bacteria that cause food-borne diseases in the poultry meat business. The most prevalent cause of food poisoning is *Staphylococcus aureus*, and the sign of staphylococcal food poisoning commonly appears 1 to 6 hours after eating. Nausea, stomach pains, diarrhea, and vomiting are frequent symptoms (Bhaisare *et al*., 2014).

Meat is a perishable product that provides ideal conditions for the growth of several bacteria. Chemical, physical, and enzymatic processes all contribute to the deterioration of meat. According to historical data, ancient methods for preventing meat spoilage and extending its shelf life included canning, salting, drying, smoking, and fermentation. However, new methods for preserving meat's wholesomeness, appearance, nutritional value, composition, tenderness, flavor, and juiciness have been created. Meats shelf life and quality can be extended using preservation techniques. Preservatives by ascorbic acid and storage at 5°C in the dark area are the most effective ways to prevent meat deterioration and extend the shelf life of meat and meat products (Dave and Ghaly, 2011).

One of the most important elements determining the quality and safety of chicken meat after it is delivered to the market places is its shelf life. The less shelf life of chicken meat at refrigeration temperatures can be attributed to the component of meat, as well as deterioration causing microbes present throughout the chicken growing and production process. Microbes can also develop at a low temperature, and their metabolic activities have been identified as food spoilage. The shelf life of meat is determined by the primary load of microorganisms, indicating the need for sanitary practices, circumstances, and control at various stages of the manufacturing process. A change in the sensory qualities of chicken meat was used to identify decomposition processes. Changes in sensory qualities, the level of microbe contamination, and the metabolic activities of microorganisms were all related to the ammonia concentration of chicken flesh in the majority of cases (Kozacins *et al.*, 2012).

Microbes found in food of poultry meat, *Salmonella*, and *Staphylococcus aureus* were investigated. These pathogens were isolated from the meat of the chicken. And immunological and biochemical tests were performed to check their occurrence and antimicrobial resistance. The research showed that out of 209 samples of poultry meat, 5.26 percent samples were contaminated with *Salmonella* and 18.18 percent samples were contaminated with *S.aureus*. Tetracycline resistance was found in 72.72 percent of Salmonella isolates. In addition, 44.37 percent of *S.aureus* isolates were resistant to tetracycline. Salmonella isolates demonstrated resistance to six antibiotics while *S. aureus* showed multi-drug resistance as well (Akbar and Anal, 2013).

Despite the use of many preservation methods, food poisoning remains a major problem for consumers and the food business. Furthermore, the increasing appearance of Methicillin-resistant *Staphylococcus aureus* isolates was demonstrated. Spice was traditionally used to cure several diseases or as preservatives, and it was well documented that spice extracts have antibacterial properties. The study looked at the antibacterial properties of spices, as well as how they affected the growth of Methicillin-resistant *Staphylococcus aureus* (MRSA). Using the microdilution method, different quantities of aqueous essence of spices were prepared to determine the minimum inhibitory concentration and the minimum bacterial concentration of spices' watery essence against MRSA. Cinnamon aqueous extract was found to be the most productive at a minimum concentration of 7.8125 mg/ml, compared to other spices where the MIC value of cumin was 15.625 mg/ml and coriander extract was less effective at 31.25 mg/ ml. Cinnamon and cumin extracts were found to be rich sources of antibacterial components and can be used as natural preservatives in a variety of foods (El- Aziz and Ali, 2013).

Foodborne pathogenic bacteria are the most familiar source of food poisoning. Foodborne sickness is caused by the usage of infected items. Foodborne infections are spread mostly by polluted raw materials, cross-infection in processing premises, or unsanitary food handling. Pathogenic microorganisms have been separated from several poultry meat items. The agar diffusion method was used to determine pathogen susceptibility. To achieve maximum growth for evaluating the inhibition zones, the isolated bacteria were cultured on nutrient agar media and incubated at

30°C for 24 hours. The essential oils from the green sections of Cinnamon were shown to be the most active (Rafique *et al.,* 2012).

The enterotoxins were created by *Staphylococcus aureus*. Foodborne illness caused by staphylococcal enterotoxins (SEs) is a common occurrence after consuming tainted meat or dairy products. By inadequate handling and afterward storage at high temperatures, these items became infected with *S. aureus*. Violent vomiting, diarrhea, and nausea are all common symptoms. Although staphylococcal enterotoxins were the most common source of food intoxication all over the world (Argudin *et al.,* 2010).

Natural preservatives are becoming more popular as an alternative to the chemical additions that have been questioned in recent years. As a result, the antibacterial effects of essential oils such as thyme, clove, and garlic against *Staphylococcus aureus*, as well as their involvement in extending the shelf life of minced meat, were investigated. The sensory investigation revealed that utilizing thyme, clove, and garlic oils in chilled minced beef has considerable benefits. All of the essential oils utilized had a significant impact on the number of *S. aureus* bacteria. Furthermore, the results showed that as the oil concentration increased, bacterial counts reduced. As a consequence, the concentration of 1.5 percent of each oil provided the maximum effectiveness, with thyme oil showing the highest activity followed by clove and garlic oils (Ibrahim *et al.,* 2016).

Spices and spice extracts are generally thought to be safe due to their long history of use and lack of recorded side effects. Cinnamaldehyde is a component of cinnamon extract that is primarily responsible for the flavor of cinnamon and has antibacterial properties. Cinnamaldehyde alters the structure and function of the bacterial membrane (Shen *et al*., 2015).

Spices come in a variety of forms, including whole, ground, and extracts, and can be used in a variety of dishes. The emergence of new food-borne disease outbreaks caused by pathogenic microbes is raising concerns about food safety. Chemical preservatives and synthetic antimicrobials are ineffective at inactivating or inhibiting the growth of spoilage and harmful microorganisms. The use of chemical preservatives regularly increases microbial resistance. The antibacterial activity of various extracts is directly related to their phenolic content. Antioxidants help to protect your cell from harm caused by free radicals. Spices, fruits and vegetables, and other foods are high in antioxidants (Asim et al., 2013).

Due to its unique aroma, cinnamon (*Cinnamon zylenicum*) is widely employed in the food sector. It also contains antibacterial, anticandidal, hypocholesterolemic, antiulcer, analgesic, and antioxidant properties. Cinnamon is a tropical evergreen bush that belongs to the *Lauraceae* family. The barks, leaves, and roots of the Cinnamon plant are all edible. Its essential oils are utilized in medicine. It is often used as a significant component of various delectable recipes around the world due to its distinct odor. Cinnamon is a spice with exceptional pharmacological qualities that are used to treat glucose resistance and type 2 diabetes. Cinnamon is used as a pain reliever and antipyretic for colds, amenorrhea menstrual irregularity, fever, myalgia, muscle pain, arthralgia, arthritic pain, and headaches (Pandey *et al*., 2014).

Cinnamon is a genus of diverse hundred species that can be found in Asia and Australia. The majority of the species are aromatic plants, and they are evergreen shrubs and trees. *C.zeylanicum* is the primary origin of the cinnamon bay and leaf oil. It's a Sri Lankan native. Distillation is used to extract volatile oil from a variety of Cinnamon species. *Cinnamon zeylanicum*, *C. camphor*, and *C. cassia* produce the most important oils for world trade. Other Cinnamon species produce oils that are distilled on a much smaller scale and utilized locally or exported (Jayaprakasha *et al.,* 2002).

Cinnamaldehyde (75%) was the most common chemical detected in stem bark oil, while camphor was found in root-bark oil (56 percent). Cinnamon bark oil has a lovely scent with a sweet and spicy flavor. It is mostly employed in the flavoring sector, where it can be found in a variety of meat and food flavoring, sauces, tobacco tastes, pickles, baked goods, cola-type drinks, confectionery, and therapeutically preparations. Along with Eugenol as the main component, there were 53 components in Cinnamon Leaf Oil (Naveed *et al*., 2013).

Cinnamon bark had 65-80 percent Cinnamldehyde and 5 to 10% Eugenol content. The cinnamon leaf contains 1-5 percent Cinnamaldehyde and 70-95 percent Eugenol, whereas root bark contained 60% Camphor. Cinnamon buds contain 27.38 percent Alpha Bergamotene, 78 percent Terpene hydrocarbons, 9% Oxygenated terpenoids, and 23.05 percent Alpha Copaene. Flowers of *Cinnamomum cassia* contain 7.97 percent Trans-alphabergamotene, 41.98 percent E-Cinnamyl acetate, and 7.2 percent Caryophyllene oxide (Vangalapati *et al.,* 2012).

Because cinnamaldehyde is a key component and is unstable and exists in multiple forms, the Cinnamon essential oil EO has greater antibacterial action in dry form than aqueous extract. Weitherhin, diterpenes mucilage, proanthocyanidins, eugenol, and cinnamic acid are among the active components of cinnamon (Chaudhary and Tariq, 2006). The cinnamon essential oil contains cinnamic aldehyde (62.09 percent), but *Cinnamon zeylanicum* from Sri Lanka had caryophyllene (4.1 percent), eugenol (74.9 percent), and benzyl benzoate of some quality. Cinnamon essential oil had 68.95 percent cinnamaldehyde as the predominant component of *C.zeylanicum* bark (Sessou *et al.*, 2012).

In the recent decade, the number of methods for measuring phytochemicals in herbaceous, foods, nutraceuticals, and other nutritive supplements has expanded. Clove oil is made by distilling the clove tree's flowers, stems, and leaves. Various in vitro antioxidant assays were used to evaluate clove oil, including, azino-ethylbenzthiazoline, radical scavenging activity, diphenyl picryl free radical (DPPH) scavenging, ferric thiocyanate determined total polyphenols activity, Fe3+Fe determined by total reducing ability. At a concentration of 15l g/mL, clove oil reduced 97.3 percent lipid peroxidation of linoleic acid and lanoline acid emulsion. Excellence antioxidant substances such as butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), Trolox, and a-tocopherol, when tested under the same conditions, showed inhibition of 84.6,95.4, 95.6, and 99.7 percent on peroxidation of linoleic acid emulsion at 45 lg/mL, respectively. Clove oil also had DPPH, hydrogen peroxide scavenging, ferric ions (Fe^{3+}) reducing power, superoxide anion radical scavenging, and ferrous ions (Fe^{2+}) chelating activity (Gulcin *et al.*, 2012).

Clove has been approved as the "champion" of all antioxidants. The Oxygen Radical Absorption Capacity (ORAC) test was developed by the United States Department of Agriculture to compare anti-oxidant efficiency. Clove has a value of over 10 million ORAC units. Clove oil contains 400 times the antioxidant activity of wolfberries or blueberries in a single drop. Clove has been used for millennia for its medicinal properties. It works well as a home medicine for a variety of symptoms and diseases. Clove buds have a variety of medical and recreational purposes in addition to their culinary usage. The clove spice is consumed in large quantities in household kitchens all around the world. The clove is used commercially to make clove oil, which has active ingredients that have antioxidant, antifungal, antiviral, antimicrobial, anti-diabetic, anti-inflammatory, antithrombotic, anesthetic, pain relief, and insect repellent qualities. The major ingredient responsible for the clove bud's therapeutic qualities is eugenol. Clove's synonyms, chemical components, phytopharmacology, and therapeutic applications are all covered (Milind and Deepa, 2011).

Perishable things include meat and meat items that required additives to keep them safe from spoiling due to pathogenic bacteria and foodborne microorganisms. New searches for the product have been developed without the use of artificial preservatives which search for new antibacterial sources components. The capability of essential oils as antibacterial agents in meat and meat items has been shown which have been utilized since prehistoric times to meet these objectives. Coriander, rosemary cinnamon, thyme, clove, oregano, and sage among other spices, have demonstrated a stronger ability to check and suppress microbe growth. However, the essential oils are organic products, their feature must be assessed before usage to permit the Generally Recognized as Safe (GRAS) designation. The concentration and quality of metal-containing compounds (BAC) found in their structure are linked to their activity, making them very essential qualities. They don't have an isolated mechanism of action that can be ascribed to them. Once extracted, these chemicals inhibit gram-positive pathogens more than gram-negative bacteria. The major mechanism of action is membrane rupture. Because of their acute properties and the possibility of interlinkage with meat compounds, their use in combination with further essential oils, incorporated as a part of an active film, increases their bioactivity without affecting the final product's quality (Paterio, 2021).

Meat and poultry consumption is linked to foodborne illnesses. Several microbes were earlier unknown (new pathogens), while remaining have just emerged as foodborne pathogens (emerging pathogens), and remaining have grown in potency or become connected with other items emerging pathogens and evolving pathogens. Aside from gastroenteritis, a lot of these pathogens can cause serious sickness. Serotypes of *Campylobacter jejuni* O:19 are usually causing food-borne illness. Serotypes of *Salmonella Typhimurium* DT104 have been discovered to be multi-drug resistant, and salmonella can cause persistent reactive arthritis. Consumption of undercooked, infected ground beef has been linked to many outbreaks of *Escherichia coli* enterohemorrhagic, complications may arise such as thrombotic thrombocytopenic and purpura hemolytic uremic syndrome. Because of the severity and non-enteric nature of the disease cause septicemia, meningitis or meningoencephalitis, and abortion and its capability to multiply at refrigerated temperatures, *Listeria monocytogenes* is a major public health problem. From raw poultry meat, and meat products *Arcobacter butzleri* is a possible foodborne pathogen that has been isolated. Meanwhile, its function in human sickness is unknown (Mor-Mur and Yuste, 2010).

Essential oils are used as an alternative for synthetic antioxidants to prevent oxidation reactions and extend the shelf life of meat and meat products. Essential oils are high in bioactive chemicals, making them an effective antioxidant in the meat business. Incorporating these pure organic compounds into product formulation can improve product safety and quality help the meat industry meet health-conscious consumers, it is widely believed that essential oil consumption can improve consumers' health status as it can delay the formation of harmful oxidation products (Paterio *et al.,* 2018).

Oxidation processes in meat and meat products during manufacturing, distribution, and storage cause unwanted physicochemical changes and smells, which harm product quality. This could result in consumer dissatisfaction as well as financial loss. Synthetic antioxidants are one of the most common methods for dealing with this problem. However, as consumers become more health-conscious and prefer natural additives, natural antioxidants rather than synthetic antioxidants. A variety of essential oils EOs have strong antioxidants like phytochemicals and polyphenolic effects and are being investigated in the meat industry as potential replacements to artificial antioxidants. These substances are recognized as Generally Recognized as Safe (GRAS), and they have favorable effects on meat products in preservation processes when used separately or in combination with other essential oils EOs, or additives (Ahmad *et al.,* 2013).

Plant essential oils can be used as a safe alternative to chemical or artificial antimicrobials and antioxidants in the fight against foodborne pathogens and spoilage organisms by reducing lipid oxidation, and so extending the shelf life of minced ground beef. The effectiveness of thyme oil (*Thymus vulgaris*) at concentrations of (1%, 1.5%, and 2%) and cinnamon oil (*Cinnamomum zeylanicum*) at concentrations of (0.5%, 1%, and 1.5%) as natural preservatives, as well as their effects on their chemical, on microbial analysis, and also on sensory properties of ground meat, were investigated when it is stored at 2°C for 12 days of storage period. At varied concentrations, thyme and cinnamon oils improve the sensory characteristics of minced meat, function as antioxidants and antibacterial agents, and extend the shelf life of minced ground meat for 6 days longer than control samples, thyme, and cinnamon. Oils with a higher concentration are more beneficial in terms of meat quality and shelf life than oils with a lower concentration. Different amounts of thyme and cinnamon oils improve the sensory characteristics of minced meat (Shaltout, 2017).

The antioxidant effect of 10 spices more often used in the preparing of a fermented cooked meat sausage was assessed using a hemoglobin peroxidation procedure requiring safflower oil in a water-oil emulsion (10%). When utilized in a dry form, clove, rose petals, and all spices had the greatest antioxidant score. Cloves had the greatest antioxidant index in watery-based microbiological growth, followed by black pepper, ginger, and rose petals. Antioxidant indices were commonly greater in dry-form spice emulsions than in a watery-based microbiological culture (Al-Jalay *et al.,* 2007).

Salmonella pathogens belong to a category of pathogens that are responsible for the majority of food poisoning cases. The impact of basil and rosemary essential oils, as well as their combination, on *Salmonella* subspecies enterica serovar Enteritidis *(Salmonella Enteritidis*) development in chicken flesh, as well as their spoilage-preventive ability at two storage temperatures. The anti-salmonella activity was tested on artificially infected unprocessed and heatly processed meat in food model tests, as well as their impact on surrounding microbe's flora on unprocessed meat. The experiments were carried out at two different temperatures: +4 °C and +18 °C ambient temperature, which favors the spoilage of meat samples and the formation of food pathogens. Physicochemical analysis of meat samples such as color, texture, and cooking loss as well as sensory evaluation of the meat samples, was performed in addition to the microbiological status evaluation. Changes in normal flora indicated that both oils had a considerable effect on microbial meat deterioration, with distinct groups being affected by different treatments. Furthermore, when compared to the control samples, all of the treatments reduced the number of salmonella cells. The results on the physicochemical parameters emphasize e value because they either had a positive impact or did not produce any significant changes in meat standards (Satojanvic *et al.,* 2018).

Moisture, protein, ash, cholesterol, and lipid content, as well the fatty acid component of turkey, Chester, chicken, and common type sausages from major brands, were measured in an experiment. The lipid content of sausages ranged from 4 % (turkey) to 17 % (pork) (common type sausages). The cholesterol content, of Chester and chicken sausages, was 44 mg/100 g, turkey was 46 mg/100 g, and common type sausages had 51mg / 100 g. The majority of the fatty acids were monounsaturated fatty acids with oleic acid as the main compound, with values ranging from 38 % to 43 % in chicken and common-type sausages. Saturated fatty acids were next, with palmitic acid as the main compound, with values ranging from 24 to 25 percent for common type and chicken sausages, respectively. Polyunsaturated fatty acids were present in lesser levels, with linoleic acid concentrations ranging from 10 % to 14 % chicken sausages. The poly-unsaturated fatty acid concentration of turkey and chicken sausages was higher than that of Chester and ordinary sausages, which had a low saturated fatty acid level (Pereira *et al*., 2000).

Chicken sausages are becoming more popular in Malaysia and all over the world. A study was conducted on the quality attributes of different brands of sausages. A total of 10 samples was analyzed for proximate, calcium, and magnesium. The results were analyzed the moisture, fat, and protein content in the range of 54.68-68.85%, 4.91-18.48%, 7.03-14.14%. The calcium and magnesium varied in every brand of sausages. The results concluded that the composition of each sausage is varied due to the different ingredients, different formulations during cooking, and different environmental condition in the manufacturing of each brand of sausages (Huda *et al.*, 2010).

To increase the storage period of chicken meat patties, a blender of oregano and thyme essential oils was inserted into edible film was tested. According to preliminary research, a 1.5 % (w / v) carrageenan solution as a biopolymer and a blend of 0.10 percent (v / v) oregano and 0.15 percent (v / v) thyme essential oil as an antibacterial were appropriate. Meat patties were coated in an eatable film containing the EOs listed above and packaged aerobically before being stored at (4 ± 1º C) for further research. Control samples had considerably higher pH and thiobarbituric reactive substance values than EOs treated items, according to the results of refrigerated storage. In comparison to control, treatment samples with EOs had much lower microbial counts and were judged to be well within permitted limits. In comparison to the control, all of the treated samples had less or equivalent flavor scores. It discovered that the stable life of chicken meat patties increased significantly during refrigeration storage and that the standard remained satisfactory at 30 days keeping duration. Essential oils of oregano, and thyme in the mixture (oregano, 0.10% thyme 0.15%). During refrigerated storage, oil-covered edible film extended the life of chicken meat patties by 5 days or maintained a good to very acceptable sensory score, except for flavor (Soni *et al*., 2018).

When (*Moringa oleifera*) leaves are used in chicken meat sausages, they contain antioxidant and antibacterial properties. Different concentrations of *M. oleiferaleaves* (MOL) inserted sausages (0.25% , 0.5 % , 0.75 % , and 1 %) were made. The value of TBARS and pH, microbiological data, sensory panel ratings, and color were all evaluated. When comparisons to 0.25 percent sausages with 0.5 percent, 0.75 percent, and 1 percent MOL had considerably reduced TBARS values. When comparison to 0.25 percent the two control samples, sausages with 0.5 percent, 0.75 percent, and 1 percent MOL had considerably lower pH values from the second to the fifth week of storage and significantly ($p<0.05$) lower TPC throughout the storage period. When comparing sausages with 0.25 percent and 0.5 percent to the control, the sensory panel found no differences in any sensory feature. The *Moringa oleifera* leaves are a great origin of vitamins B, protein, provitamin A, and C, minerals especially Fe, and critical amino acids like Meth, Cys, tryptophan, and lysine. The presence of ascorbic acid, phenolics, flavonoids, and carotene in leaves has been discovered as having strong phytochemicals and antibacterial action (Jayawardin *et al.*, 2015).

Clove oil has antibacterial properties against a variety of harmful bacteria. The anti-fungal preservation properties of meat items such as processed fish, processed poultry, processed pork, and processed beef were explored using clove oil microcapsule. An active fungicidal concentration of above 0.70 percent, showed good, antiseptic effects on various meat items. The effectiveness of clove oil microcapsules increased to 0.80 percent when the meat was cooked for 0.5 hours. Clove oil microcapsules demonstrated a high heat resistance and meat product inhibitory impact. Clove oil encapsulation, as a novel alternative, have practical applications as a preservative in meat items, particularly in dishes that required thermal heat processing. Clove oil after microencapsulation exhibited a high heat resistance and a high antibacterial impact on meat products has suggested that it might be developed as a unique and effective fungicide in the food industry (Wang *et al.*, 2018).

In recent years, there has been a growth in the consumption of meat and its products, particularly sausages. However, during manufacture, the product is prone to microbe contamination, reducing its shelf life. Essential oils have been recognized for their taste and preservative properties, and the use of these anti microbe agents as natural chemicals in food prevention had shown effect. The least inhibitory concentration of EO was first measured in vitro. The sausage was produced and maintained at 4°C before being inoculated with specific bacteria. EO was added at concentrations of 0.3, 1.0, and 1.5 percent v/w. The most likely number method (MPN) was used after 0, 5, and 24 hours. The harm caused by these essential oils on pathogens morphology and the structure was examined using transmission electron microscopy. Only the 1.5 percent concentration of *L. monocytogenes* was successful in decreasing the bacteria. After 5 hours of testing, 0.3 percent of *O. Vulgare* essential oils were able to lower the of *Salmonella* by 2 logs. After 5 hrs, *O. basilicum* essential oil did not affect *Salmonella*, but after 24 hrs, it had dropped by 2 log. The findings supported the use of essential oil in the control of food-borne diseases (Barbosa *et al*., 2015).

During a 50 days refrigerated storage period, the storage durability of low-fat chicken sausages manufactured using fresh boneless breast chicken meat and 0%, 2 %, and 5% added beef meat fat was tested. Heat-processed samples were cooled, vacuum packaged, and stored at 4 °C after reaching a final internal temperature of 74°C. At the end of the investigation, the formulations had good heat thermal stability, with processing yields ranging from 94 to 97 percent and cooking losses of less than 9.7%. For all of the examined samples, water activity declined somewhat during the first 28 days of storage and the remained same after that, whereas pH and color parameters remained the same. During the storage of the samples, no coliforms or sulfite-reducing Clostridium were found. After 50 days of storage at 4ºC.The predominate microflora was psychrotrophic lactic acid bacteria, with levels of less than 7 log. Independent of the extra fat formulated low-fat chicken sausages had acceptable sensory scores. Able to obtain extra lean items with excellent stability and quality qualities (Andres *et al*., 2006).

After being packaged in a gas-tight plastic tray with top film the quality of Ready-to-eat (RTE) ginseng chicken porridge was heated in a retort with an F-value of 4.0. Various quality changes were studied throughout a 28 week storage period at 25°C. Microbes were not discovered during the storage period. At 25°C, the ginseng chicken porridge might last for at least 24 weeks. Consumers today desire recipes made with nutritious ingredients that are also quick and easy to prepare. Different types of rice porridges including varied components are accepting popularity in Asian markets in this area. With this in mind, ginseng chicken porridge, a traditional Korean nutritious dish, was made and packaged in a gas-tight multilayer plastic film, then sterilized. Tests revealed that the product may be kept at 25°C for up to 24 weeks and still be marketable. When served at room temperature, ginseng chicken porridge did not appear to be a microbial threat (Jang and Lee, 2012).

The effects of chitosan coatings, both with and without clove oil, on the quality and safety of cooked pork sausages stored at (4 ± 2°C) were examined. Cooked pig sausages were treated in three ways untreated, coating with 2% chitosan, and coating with a mixture of 2% chitosan and 1.5 percent clove oil. Over 25 days of storage, several microbial, physicals, chemicals, and sensory aspects were examined. The CS + CO treatment slowed these alterations the most. Under refrigerated storage, the shelf life for control, CS, and CS + CO treated samples were 14 days, 20 days respectively, based on sensory performance and microbiological quality. Experiments showed that using chitosan and clove oil together prevented microbiological growth, slowed lipid oxidation, and increased the shelf life of cooked pig sausages (Lekjing, 2016).

The cinnamon essential oil and grape seed extract act as a natural preservative when used individually or in combination in Lyoner-type meat sausages at 4±8ºC during the storage interval of 40 days. The control and treatment samples were analyzed for physicochemical, lipid oxidation, microbiological count, and sensory characteristics. The results showed that combined use of cinnamon essential oil and grape seed extract higher TBARS value (2.91-3.28) the microbial count of treatment samples were less than the control sample microbial count at 10 days of storage interval. The best antibacterial activity of *C. perferinges* was observed in treatment samples with cinnamon essential oils than the control samples. The treatment sample with CEO+GSE score the highest sensory score it is concluded that a combination of these two natural preservatives CEO+GSE was preferred to achieve their synergistic effect in Lyoner-type sausages on the fresh meat and meat products the combination of these two preservatives extend the shelf life of sausages (Aminzare *et al.*, 2015).

Clove oil can be used as a natural preservative in muscle meals by evaluating how it affects the storage quality of fiber-rich chevon cutlets. Chevon cutlets with an optimum quantity of barley flour(4%) treated with and without clove oil (100 ppm) were packaged aerobically in low-density polyethylene pouches alongside control (chevon cutlets without barley flour and clove oil) and stored for 15 days at (4±1°C). Physicochemical, microbiological, and sensory factors were examined in the products. With increasing days of storage, the TBARS value, total plate count, psychrophilic count, and yeast and mold count all showed a significant upward trend, whereas pH and other sensory parameters decrease significantly with the increase of storage interval. During the storage period, no coliforms were found. For several metrics such as TBARS value, total plate count, psychrophilic count, and yeast and mold count, products containing clove oil exhibited significantly lower values than control samples (Sing *et al*., 2014).

However, clove essential oil is effective against the food-borne pathogen more likely to *L. monocytogenesis*. Here is the problem of using the spices in food like carbohydrate, protein, and fat because it reduces the antibacterial activity of spices when used within it. The other problem is consumer acceptance because of the strong flavor of these spices.

When these spices are used in the excess amount it reduces the food-borne pathogen but the product is not acceptable by the consumer. Spices like clove and cinnamon should be used in less quantity with other preservatives to reduce bacterial growth such as salt, acid, and sugar (Hoque, 2008).

Cinnamon essential oil (0 percent, 0.1 percent, and 0.5 percent, v / w) was added to minced beef, cased, and stored at 4° C to see how it affected the microbiological and physicochemical characteristics of fresh Italian style sausage. When compared to the control, CEO treatments had fewer thiobarbituric acid reactive substances at 4, 6, 8, and 10 days, with 0.5 percent CEO having a stronger effect than 0.1 percent CEO. Cinnamon essential oil extended the color shelf life of fresh sausage by blocking lipid oxidation and preventing the formation of TVB-N and biogenic amines by lowering microbial populations during storage. According to this study, the CEO could be used in the food business to extend the life of beef products. The addition of the CEO suppressed the TBARS value to improve the color of pork sausage during storage, according to this investigation (Zhang *et al.*, 2018).

The impact of incorporating oregano (0.25 percent v/v) and thyme (0.25 percent v/v) essential oils to a Tunisian dry fermented poultry meat sausage on microbiological, biochemical, and sensory features was examined. The antibacterial effect of oregano, and thyme essential oils increase the sanitary quality and safety of dry fermented sausages by lowering the numbers of coliforms, and *S. aureus.* The addition of essential oils during the fermenting of sausages did not affect proteolysis ($P > 0.05$). In terms of lipolysis and lipid oxidation, the incorporation of oregano and thyme essential oils reduced thiobarbituric acid levels significantly during the last two weeks of fermenting, although lipid breakdown was unaffected. In the end, the sensory qualities of sausages were unaffected by the addition of EOs. The use of oregano and thyme essential oils in the preparation of dry sausages appears to be a viable option because they had no negative impact on sensory characteristics and had beneficial effects on the stability oxidative Additionally, the use of essential oils may be beneficial in maintaining the hygienic quality of sausages by inhibiting spoilage and harmful microbes, allowing for better sausage preservation and, as a result, increased shelf life (El Adab *et al*., 2016).

The impact of clove extract (0.25 percent, 0.5 percent, 1 percent, and 2 percent) on the quality deterioration and oxidative stability of Chinese-style sausage stored for 21 days at 4°C were investigated. The incorporation of clove extract into sausages greatly reduced the generation of protein carbonyls while also slowing the growth of TBARS. Moreover, the incorporation of clove extract assists in decreased thiol group content in sausages. When compared to the control, sausages modified with clove extract showed lower L* values. Similarly, texture deterioration was delayed in sausage with additional clove extract during refrigerated storage when compared to the control. Furthermore, adding clove extract to sausages showed no negative effects on their sensory characteristics. These findings revealed that clove extract could prevent sausages from oxidation and quality degradation throughout 21 days of refrigerated storage (Zhang *et al.*, 2017).

Cloves and cinnamon extracts were tested and found to have anti bactericidal activity against the test organisms. Clove and cinnamon essential oils demonstrated antibacterial action after being heated to 100°C for 30 minutes, indicating that the high temperature did not affect their activity. Within one day of exposure, the EO of cloves eliminated all *Listeria monocytogenes* cells in ground chicken flesh to undetectable levels. Cinnamon essential oil, on the other hand, reduced *Listeria monocytogenes* in just one day. Hence, clove essential oil may be effective in the control of *L. monocytogenes* in ground chicken meat. Although, there are some drawbacks to utilizing spices like clove or cinnamon in reduced antibacterial activity when spices are added to the protein, carbohydrate, or fat-containing foods, and the strong flavor. If more amounts of spices are added to the products to suppress food-borne diseases, the flavor may not be acceptable to some customer groups. Spices, in combination with preservatives such as salt, acid, and sugar, as well as processing and storage conditions, can help control bacteria in food (Hoque, 2008).

Lipid oxidation, color stability, sensory characteristics, PH, water activity, and chemical composition of Loyner type sausage at 4 degrees centigrade for 40 days with the effect of *Cinnamomum zeylanicum* which is essential oil at 0.02 % and 0.04 % concentrations. By adding essential oil, protein content, fat and ash were not affected but as compared to *Cinnamomum zeylanicum* essential oil (CZEO) incorporated samples, moisture contents of control were higher. CZEO addition increased the total color but decreased lightness and white index (WI) significantly at 0 and 40 days. Yellowness and redness significantly increased at the initial stage of storage but decreased during the later stage of storage. There was no difference in PH values among CZEO containing sample and control samples. Lipid oxidation was retarded by the CZEO at the end of storage. They found higher sensory characteristics in CZEO samples rather than in control. Their results pointed out that the chemical stability of Loyner type sausage can be increased by adding CZEO which acts as a natural additive (Aminzare *et al.*, 2018)

An experiment was set to check the sensory and microbial attributes of chicken sausage by the optimization of several essential oils. They found the swabbing method best for the incorporation of essential oils in chicken sausage. In fresh chicken sausage, they optimized cassia oil and thyme oil. They optimized essential oil at 0.025 and 0.125 % in the first phase of the study. Blends of essential oils were optimized (B_1, B_2, B_3) at 0.025 % based on total plate count and sensory attributes in the second phase of the study. B4 was optimized at 0.125 % in chicken sausage for incorporation. They ended their result by recommending blend-1 and cassia oil out of four essential oils to use in emulsion base and fresh chicken sausage (Sharma *et al.*, 2019).

The quality of vacuum-packed fresh checked sausage by the use of different essential oils that act as bio-preservatives. They checked antimicrobial activity by screening 15 essential oils. Desired results were obtained only from 9 essential oils. They observe sensory evaluation from thyme oil, cassia oil, clove oil holy basil oil. Incorporated sausage was stored at -18 degrees for 45 days. EO-treated products showed the least increased oxidation as clove had significantly higher TBARS and PH values. Treated products showed higher DPPH activity and total phenolics as compared to control. They observed low microbial count in treatment products while cassia and control showed this behavior at the end of storage. Their results indicated the acceptance of frozen chicken sausage at the end of storage and for 45 days (Sharma *et al.*, 2017b).

A study was conducted on the replacement of chicken skin which is mostly used in chicken sausages. Poultry fat which is generated from abdominal and gizzard are used in the replacement of chicken skin. The effect of this partial replacement of fat was seen on the quality properties of sausages such as proximate, microbial, color, lipid profile, and sensory properties. (40% and 50%) partial replacement shows lower moisture content and a high-fat profile. 40/% and 50% substitute sausages show similar texture and microbial quality as control. 50% level shows the difference in color and sensory properties. The results concluded that chicken fat can be successfully added in the replacement of chicken skin in sausages (Pena-Saldarriaga *et al.*, 2020).

The shelf life of emulsion type cooked sausage by the combination of natural antimicrobials (nisin, ethylenediaminetetraacetate cinnamon, essential oil) at 10 degrees for 45 days under vacuum packing. They observed sensory characteristics, objective color, pH, LAB count, and total count at days 1, 14, 28, 35and 42 of storage. They found the increased shelf life of sausage for 7 and 14 days by the use of CEO treatment and nisin. As compared to control, self-life was not effectively extended by N+C and N+E+C treatments for more than 7 to 14 days. Total bacteria and LAB growth were inhibited ineffectively by EDTA alone. E+C and N+E increased shelf life from 14 to 35 days. the study indicated that shelf life can be extended significantly by the natural antimicrobial combination (Khorsandi *et al.*, 2019).

A study to get the microbial file, physiochemical, sensory quality, and volatile composition of dry fermented sausage with the contribution of chitosan rosemary and chitosan thyme essential oils during 3 months of storage at 4 degrees. Against fungal growth, they investigated the effect of chitosan enriched with thyme, chitosan, potassium sorbate, and rosemary essential oils. For control acetic acid and distilled water were used. Gram catalase, Cocci, *Enterobacteriaceae*, and yeast count were low and fungal growth was inhibited by C, CT, PS, and CR. CR and CT showed lower values for TABRS and they identified a total of 44 and 65 volatile compounds in sausage. At the end of storage, there were acceptable sensory attributes in sausage coated with CR, CT, and C. intense fungal growth acetic acid and distilled water were rejected. Their study showed chitosan enriched with thyme and rosemary as an alternative against chemicals (Demirok Soncu *et al.*, 2020).

The quality of turkey sausage by the effect of essential oils and leaves of rosemary. They found that color parameters and sausage texture were not significantly affected by the addition of essential oils. A significant increase in chewiness and hardness of sausage and a decrease in lightness were observed at the high level of rosemary leaves as compared to the control one. Depending on the concentration, turkey sausage score and aroma were increased by rosemary leaves and essential oils. As compared to control, TBRS and plate counts were significantly reduced by rosemary leaves. Due to this chemical use will be reduced which is badly used by the consumer, it also increases the sensory properties of products (Jridi *et al.*, 2015).

A study to check the quality of fresh chicken sausage by antimicrobial and anti-oxidant activity effect of essential oil. Cassia oil, thyme oil, clove oil, and holy basil oil were optimized by several preliminary trials. They used 0.25%, 0.125%, 0.25% and 0.125% in sausage. At refrigerator temperature 4 for 20 days, detailed storage and quality evaluation were carried. Significant higher TABRS and lower DPPH activity were revealed in control rather than treatments. They observed significantly lower values of TABRS and higher values of DPPH activity, total phenolic in clove oil followed by cassia, holy basil, and thyme oil. They found cassia oil having better anti-microbial characteristics than clove oil at 0.25% while thyme products are better than holy basil at 0.125%. Their results showed that refrigerated fresh and aerobically packed sausage had longer shelf life 2-3 than control (Sharma *et al.*, 2017a).

A study to evaluate the enhancement of shelf life of emulsion base chicken sausage with the effect of natural anti-oxidant, antimicrobial agents, essential oils as bio-preservatives. B_1, B_2, B_3, and B_4 (blends of four essential oils) at levels of 0.25 and B_4 at 0.125 % used. At temperature 4, four treatments were stored and packed aerobically. Significantly higher TBARS and PH values and lower DPPH and phenolic content were found in B_2 that indicated its better oxidative stability. They observed a lower microbial count in B_2 and a higher sensory score in B_4 than B_2. They ended up their result by concluding that chicken sausage shelf life can be enhanced by 13-14, 16-17, 10-11and 6-7 days by blends B_1, B_2, and B_3 (Sharma *et al.*, 2020).

32 Essential Oils (EOs) were tested for antibacterial activity against four pathogenic bacteria (*E. coli*, *L. monocytogenes*, *S. aureus*, and *S. Typhimurium*) and one spoilage microbe (*P. aeruginosa*). Antibacterial activity in the solid, vapor, and liquid phases was assessed accordingly. In comparison to other EOs, Ajowan, Red Bergamot, Red thyme, Summer savory, Chinese cinnamon, and Cinnamon bark showed a greater inhibitory zone (20 to 40) in the solid phase against five target microorganisms. *S. aureus* was suppressed by more than 60 mm when Red thyme, Red bergamot, Ajowan, and Summer savory were used. Red bergamot and Chinese cinnamon and were the only EOs that inhibited all target bacteria in the vapor phase, depending on the target bacteria. Combined Chinese cinnamon and Cinnamon bark essential oils showed additive antibacterial activity against all microorganisms in the checkerboard method. The greatest organoleptically acceptable EO level was 0.05 percent in a sensory evaluation of mixed Chinese cinnamon and Cinnamon bark EOs used in cooked minced beef (Ghabria *et al.*, 2016).

An experiment was set to determine the bio preservative and probiotics effect of lactic acid bacteria on dry fermented sausages. The LAB act as an antimicrobial count in dry sausages by producing antimicrobial peptides and low molecular mass compounds. These LAB bacteria contribute to the safety and quality of dry fermented sausages because bacteria act as probiotics and also contribute to the fermentation process of dry sausages. However, these probiotics reduce the *L. monocytogenesis* and *E. coli* bacteria in dry sausages derived from raw meat. These bacteria are also useful in the small intestine of humans because they can survive in the gastrointestinal tract of a human. Although the use of probiotics is increasing in the food industry to naturally preserve the food rather than using synthetic preservatives to ensure the safety and quality of the product (Tyopponen *et al.*, 2003).

The influence of chicken breast and animal fat type on the microstructural and macroscopic parameters of cooked sausages. The emulsion stability of sausages made with the most saturated pig back fat was remarkably reduced, and a greater proportion of the total fluid was fat, whereas the opposite was true for sausages made with the more unsaturated pork back fat. Fat globules at the microstructural level were most likely to be related. Sausages made with the most saturated hog fat had a somewhat lower cooking loss. Regardless of the meat type or temperature, the fat type had a significant impact on the hardness of the cooked sausages. As a result, it can be assumed that slight changes in fatty acid content between different pig back fats had a significant impact on the microstructural and macroscopic features of cooked sausages, but meat type (muscle fiber type) and the temperature had only a minor impact (Glorieux *et al*., 2019).

The purpose of this study was to see how varying concentrations of pumpkin affected the quality features of common chicken sausages. The pumpkin was used to replace lean meat in the recipe at three different levels 6, 12, and 18 percent. The items were tested for physicochemical and sensory characteristics. With increasing degrees of pumpkin incorporation, the pH, emulsion stability, cooking yield, crude protein, ether extract, and ash content of the products decreased significantly although the moisture and crude fiber content increased significantly. The best level of integration was found to be 12 percent based on numerous metrics. During the storage period, no coliforms were found. Fiber-enriched chicken sausages may thus be successfully stored at fridge temperature (4 ± 1°C) for 14 days without substantial quality loss (Zargar *et al.*, 2014).

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