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Review Article

Values of Essential Oils of Plant Origin on The Micro-Organisms During the Meat Storage

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Abstract

The Producers and the manufacturers have been challenged by the increasing demand for the safe and high-quality meat and meat products over the past few decades. Particularly, the recent demand for minimally the processed, the easily prepared, and the ready-to-eat meat products combined with the novel concepts of all-natural and clean-label has rapidly increased. These products may contain natural or organic ingredients without artificial preservatives that do not trigger the common food allergies or the sensitivities. The meat and the meat products are highly prone to microbial contamination since they are rich in essential nutrients and perishable. This is further accelerated by some intrinsic factors including pH and water activity of the fresh meat. In general, the freshest meat has a water activity value higher than 0.85, and its pH value falls within the favorable pH range for spoilage bacteria of the meat. Hence, deterioration in quality and potential public health issues is common if these products are not properly handled and preserved. The significant spoilage of the meat and the meat products occurs every year at different levels of the production chain including the preparation, the storage, and the distribution. Besides the lipid oxidation and the autolytic enzymatic spoilage, the microbial spoilage plays a significant role in this deterioration process leading to a substantial economic and environmental impact.

Key words: essential oils; safe; high quality; meat; meat products

Introduction

The microorganisms associated with the spoilage of the meat and the meat products including bacteria such as the Pseudomonas, the Acinetobacter, the Brochothrix thermosphacta, the Lactobacillus spp., the Enterobacter, etc., and the yeast and the mold cause the quality defects such as of flavor, off-odor, etc. Additionally, the foodborne diseases have emerged as important and growing public health and economic problems in many countries over the last few decades [1-6]. The foodborne diseases are not limited to a particular age group or the country. The foodborne diseases occur each year resulting in the illnesses, with hospitalizations and deaths, leading to high medical costs and productivity losses. In regarding to the meat and the meat products, several pathogenic microorganisms including the Salmonella spp., the *Campylobacter jejuni*, the Escherichia coli O157:H7, the *Listeria monocytogenes*, the Clostridium spp. and the *Aeromonas hydrophila* can result in the foodborne illnesses to the consumers if the products are not preserved and handled properly [7-12]. The vegetative cells of the microbes are destroyed with the thermal processing, but not the spores of the food pathogens such as the Bacillus spp. and Clostridium spp. They can survive and need much harsher conditions to be inactivated. With the absence of the competitive microflora, these spores can germinate and grow under favorable conditions caused by mishandling of the heat-treated products. Hence, it is vital to apply other hurdles such as low-temperature storage to avoid this problem (13-19). To extend the period of the refrigerated storage, which is the most common method used for preserving the fresh meat and the meat products, many synthetic additives have been used over the years. The synthetic additives have been accused for some carcinogenic and toxic properties. This increased the consumer concerns towards the healthier meat and the meat products and the demand for the natural food additives over the years, which led researchers to examine the natural alternatives to the synthetic food additives [137-143]. The meat and the meat products are highly subject to the microbial deterioration, which ultimately leads to the safety and the quality issues if the meat is not properly handled and preserved. Several plant-derived **Essential oils** can be effectively used in the meat and the meat products as natural alternatives to the synthetic food additives, particularly as the effective antimicrobial agents [144- 150]. The Phenolic compounds, such as the carvacrol, the eugenol, and the thymol, are mainly responsible for the antimicrobial activity of the **Essential oil**s to increase the permeability of cell membranes and leading to loss of the cellular constituents. These natural additives should improve the meat quality without leaving residues in the product or the environment [20-26].

The Microbial deterioration of the meat and the meat products

Depending on the preservation method used, the growth and the metabolism of the spoilage and the pathogenic microorganisms can cause rapid spoilage of the meat and the meat products and the serious foodborne intoxications. The Bacteria are generally considered as the principle agents responsible for these deteriorations and the health issues in addition to the molds and yeasts presents the major genera of bacteria, yeasts, and molds found in meat and meat products [27-33]. Main spoilage bacteria including the Pseudomonas, the Acinetobacter, the B. thermosphacta, the Moraxella, the Enterobacter, the Lactobacillus spp, the Leuconostoc spp, the Proteus spp. etc, the yeast

and the mold, the decompose meat and the meat products and develop the unpleasant quality characteristics when they grow in large numbers in these perishable products [34-40]. This can be attributed to the degradation of the proteins and the lipids present in the meat and the meat products resulting in the off-odors, the off-flavors, the discoloration, the texture defects, the slime and the gas productions, and the changes in pH. Although the spoilage microorganisms normally do not cause the illness, they can result in the gastrointestinal disturbances when consumed in the high concentrations [41-48]. However, the rate of the meat spoilage is affected by several factors including the hygiene, the storage temperature, and the acidity of the meat and the meat products. The growth of the spoilage bacteria is favored at a pH range of 5.5-7.0. The *Campylobacter jejuni*, *Salmonella serotype Typhimurium*, *Escherichia coli O157:H7*, other *Enterohemorrhagic E. coli (EHEC)*, *Listeria monocytogenes*, *Arcobacter butzleri*, *Mycobacterium avium subspp. paratuberculosis and Aeromonas hydrophila* are the most prevalent and serious emerging pathogens in the meat and the meat-derived products (49,50,51, 52, 53, 54,55 and 56). The color, the odor, the taste or the texture of the meat and the meat products are not often changed by these pathogenic bacteria. which are mainly responsible for the food poisoning and the food intoxications. The microbial deterioration of the meat and the meat products can be considered as one of the main limitations in the meat industry. The proper protective practices should be, therefore, applied for the meat and the meat products to produce the highest quality products possible [57-64]. The common preservation methods used against the microbial deterioration Due to the increasing demand for the precooked, the refrigerated, the ready-to-eat meat, and the meat products convenient for the modern and the busy lifestyles, the meat manufacturers must overcome many challenges, including the control of the microbial deterioration of these products [65-72]. Several factors such as the microbial growth, the color, and the lipid oxidation affect the shelf life and the consumer acceptance of the fresh meat and the meat products. Therefore, to produce the safest and the highest quality products possible, these factors must be controlled [73-79]. Several of the thermal and the non-thermal food preservation techniques have been used, alone or in combinations, to prevent or minimize the growth of spoilage and the pathogenic microorganisms in the meat and the meat products. The common physical and the chemical preservation techniques used to control the bacterial activity [80-87].

The mode of action of the Essential oils

The antimicrobial activity of a given **Essential oil** can be attributed to its major constituents as well as their interaction with the minor constituents present in oils. However, the antimicrobial activity of the **Essential oils** has been consistently linked to phenolic constituents such as the carvacrol, the eugenol, and the thymol. The presence of the hydroxyl groups in the phenolic compounds is very vital for their antimicrobial activity [88-95]. The antimicrobial activity of the **Essential oils** is not attributable to one specific mechanism. Several locations or mechanisms in the microbial cells are supposed to be the sites of action for the **Essential oil** constituents. In brief, **Essential oils** can degrade the cell wall, disturb the phospholipid bilayer of the cytoplasmic membrane, and damage the membrane proteins leading to increased permeability of the cell membrane and loss of cellular constituents [96-102]. The **Essential oils** can further disrupt the proton motive force, electron flow, and active transport, and coagulate the cell contents. The **Essential oils** can impair a variety of enzyme systems including the enzymes involved in the energy regulation and synthesis of structural components and inactivate or destroy genetic material, strengthening their antimicrobial activities [103-109].

Limitations and Future Perspectives

Although good antimicrobial activities were observed for many **Essential oils**, some limitations have 446 also been identified in the application of the **Essential oils** in the meat and the meat products. The interaction of some **Essential oils** with the food ingredients and structure may decrease their effectiveness [110-116]. The markedly reduced activity of the **Essential oils** may result in the food systems such as the meat and the meat products when compared to in vitro results. This may be attributed to the presence of fats, carbohydrates, proteins, and salts in such systems. For instance, the mint and the cilantro **Essential oils** were not effective against the *L. monocytogenes* in the products containing high levels of the fat, such as the pâté and a coating for the ham containing the canola oil [117-122]. It may be difficult to maintain the quality consistency because the composition of an individual **Essential oil** can vary due to several factors including the time of harvesting, variety, the part of the plant used, and method of extraction. The antimicrobial potency of the **Essential oil** constituents depends on pH, temperature, and level of microbial contamination [123-129]. Further, use of the **Essential oils** as the preservatives in the food has been limited as they are required in high concentrations in order to achieve the sufficient antimicrobial activity. The use of some **Essential oils** are mainly restricted to the spicy foods including the meat products that are associated with the herbs, spices, or seasonings since they affect the organoleptic quality of the food [130-136].

Conclusion

The application of the **Essential oils** is partially limited due to their intense aroma which may cause negative organoleptic effects. Novel technologies such as encapsulation of the **Essential oils** into the Nano emulsions and the use of the **Essential oils** as part of the hurdle technology (combined processes with MAP, nisin, EDTA, lysozyme etc.) to improve the microbial stability and the sensory quality of the meat and the meat products are being used in the meat industry; traditional methods of adding the **Essential oils** directly into the meat batter during manufacturing of the meat products.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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