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Development of Natural Preservative for the Shelf life Extension of Meat Products

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Abstract: To determine the Anti-microbial property of Thyme oil, Apple peel oil, Clove oil, Bar of cassia oil on Lamb meat for longer storage of meat. Usage of essential oil adds nutrition and longer storage of meat. This will reduce the use of sodium nitrate and sodium nitrites, and also decreases the risk of heart disease, diabetic and other chronic diseases. The main objective is to test Anti-microbial property of this natural preservative as an alternative for the commercially existing preservatives. The formulated natural preservative contains naturally occurring compounds which have Anti-microbial properties to prevent the growth of microorganisms. The antioxidant properties of the preservatives help in increase the nutritive value of raw meat in a cost effective and without any artificial preservatives.The formulated natural preservative helps to replace the chemical preservatives used. It implements the nutritional values and also implements the Anti-microbial and antioxidant properties of the Lamb meat. By this the nutritional value, antimicrobial and antioxidant properties of the Lamb meat will be increasing and also helps to increase the shelf life of the Lamb meat.

Key Words: Preservatives, Antimicrobial property, Antioxidant, Nutrition value

1. Introduction

The use of natural preservatives in food products is becoming increasingly important due to concerns about the safety and health risks associated with synthetic preservatives. One area of particular interest is the development of natural preservatives for the shelf-life extension of meat products. The use of natural preservatives in meat products can help to improve their safety, quality, and shelf-life, while also meeting consumer demand for healthier and more natural food products.The development of natural preservatives for meat products involves the use of compounds that are derived from natural sources such as herbs, spices, fruits, and vegetables. These compounds have antimicrobial properties that can inhibit the growth of microorganisms in meat products, thereby extending their shelf-life. The use of natural preservatives also helps to reduce the reliance on synthetic preservatives, which can have negative health effects in some people.

The development of natural preservatives for meat products involves several steps, including the identification of suitable natural compounds, optimization of their concentrations and formulations, and evaluation of their efficacy and safety. Researchers may also explore the use of natural preservatives in combination with other preservation techniques such as modified atmosphere packaging, high-pressure processing, and thermal processing.

Overall, the development of natural preservatives for meat products has the potential to improve the safety, quality, and shelf-life of these products while also meeting consumer demand for healthier and more natural food options.

Material and Methods

When developing natural preservatives for meat products using essential oils, the following materials and methods may be used:

1. Selection of essential oils: Researchers may select essential oils with known antimicrobial properties, such as oregano, thyme, rosemary, and cinnamon. These oils may be obtained through steam distillation or other extraction methods.

2. Optimization of concentrations and formulations: The optimal concentrations of essential oils may be determined through experiments, which involve testing the oils at various concentrations to identify the concentration that most effectively inhibits microbial growth. The oils may also be formulated with other ingredients, such as carrier oils or emulsifiers, to enhance their efficacy and stability.
3. Evaluation of efficacy: The efficacy of essential oils as natural preservatives may be evaluated using microbial growth inhibition assays and shelf-life studies. In microbial growth inhibition assays, the essential oils are added to meat products, and the growth of microorganisms is monitored over time. In shelf-life studies, the essential oils are added to meat products, and the products are stored under various conditions to assess their shelf-life.
4. Evaluation of safety: The safety of essential oils as natural preservatives may be evaluated through toxicity testing and sensory evaluation. Toxicity testing involves assessing the toxicity of the oils in animals, while sensory evaluation involves assessing the aroma and flavor of the meat products after the addition of essential oils.
5. Application: Once the optimal concentrations and formulations of essential oils have been determined, they may be applied to meat products using various methods such as dipping, spraying, or vacuum impregnation. The meat products may then be stored under various conditions to evaluate their shelf-life and sensory quality.

Subjects & selection method: The subjects used in the development of natural preservatives for meat products using essential oils can vary depending on the specific goals of the study. However, typical subjects may include meat products such as ground beef, pork, poultry, or fish, which are commonly consumed and susceptible to microbial spoilage.

The selection method for developing natural preservatives for meat products using essential oils typically involves a combination of in vitro and in vivo experiments. In vitro experiments may involve microbial growth inhibition assays, where the essential oils are tested against specific microorganisms that commonly spoil meat products, such as Escherichia coli, Salmonella, Listeria monocytogenes, or Staphylococcus aureus.

In vivo experiments may involve adding the essential oils to meat products and storing them under controlled conditions, such as refrigeration or modified atmosphere packaging, to evaluate their efficacy in extending the shelf-life of the products. Sensory evaluation methods, such as consumer taste tests, may also be used to assess the aroma and flavor of the meat products after the addition of essential oils.

The selection method may also involve a literature review to identify previous studies on the use of essential oils as natural preservatives in meat products. This can help to inform the selection of essential oils and concentrations to be used in the study, as well as the methods for evaluating their efficacy and safety.

Inclusion criteria:

1. Meat product type: The study may focus on a specific type of meat product, such as ground beef, pork, poultry, or fish, which are commonly consumed and susceptible to microbial spoilage.
2. Essential oil selection: The study may include essential oils with known antimicrobial properties, such as oregano, thyme, rosemary, or cinnamon, which are commonly used as natural preservatives. The oils may be obtained through steam distillation or other extraction methods.
3. Concentration optimization: The study may aim to optimize the concentration of essential oils that most effectively inhibits microbial growth while maintaining sensory quality of the meat products.
4. Formulation optimization: The study may aim to optimize the formulation of essential oils with other ingredients, such as carrier oils or emulsifiers, to enhance their efficacy and stability.
5. Efficacy evaluation: The study may evaluate the efficacy of the essential oils as natural preservatives using microbial growth inhibition assays and shelf-life studies. The meat products may be inoculated with specific microorganisms that commonly spoil meat products, such as Escherichia coli, Salmonella, Listeria monocytogenes, or Staphylococcus aureus.
6. Safety evaluation: The study may evaluate the safety of the essential oils as natural preservatives using toxicity testing and sensory evaluation. Toxicity testing may involve assessing the toxicity of the oils in animals, while sensory evaluation involves assessing the aroma and flavor of the meat products after the addition of essential oils.
7. Application: The study may involve testing the application of essential oils to meat products using various methods such as dipping, spraying, or vacuum impregnation, and evaluating the efficacy and sensory quality of the products under different storage conditions.

Exclusion criteria:

1. Contaminated meat products: Meat products that are contaminated with pathogenic microorganisms or toxins may be excluded from the study.
2. Synthetic preservatives: Meat products that have been treated with synthetic preservatives or antimicrobials may be excluded from the study to avoid any potential interaction between the synthetic and natural preservatives.
3. Unacceptable sensory quality: Meat products that have unacceptable sensory quality, such as off-flavors or odors, may be excluded from the study to ensure that any changes in sensory quality can be attributed to the addition of essential oils.
4. Allergenic essential oils: Essential oils that are known to cause allergic reactions in some individuals may be excluded from the study to ensure the safety of the products for consumers.
5. Essential oils with toxic properties: Essential oils that have toxic properties or are known to cause adverse reactions in humans or animals may be excluded from the study to ensure the safety of the products for consumption.

6. Essential oils that negatively affect product appearance: Essential oils that negatively affect the appearance of the meat products, such as discoloration or texture changes, may be excluded from the study to ensure that any changes in appearance can be attributed to the addition of essential oils.
7. Essential oils that negatively affect product functionality: Essential oils that negatively affect the functionality of the meat products, such as cooking properties or texture, may be excluded from the study to ensure that any changes in functionality can be attributed to the addition of essential oils.

Procedure methodology

The procedure methodology for the development of natural preservatives for the shelf-life extension of meat products using essential oils may include the following steps:

1. Essential oil selection: Essential oils with known antimicrobial properties are selected based on their effectiveness against specific microorganisms that commonly spoil meat products.
2. Concentration optimization: The optimum concentration of the essential oils is determined by conducting preliminary tests to evaluate their antimicrobial efficacy at different concentrations.
3. Formulation optimization: The essential oils may be formulated with other ingredients, such as carrier oils or emulsifiers, to enhance their efficacy and stability. The formulation is optimized to ensure that the essential oils are uniformly dispersed throughout the meat products.
4. Efficacy evaluation: The antimicrobial efficacy of the essential oil formulations is evaluated using microbial growth inhibition assays. The meat products may be inoculated with specific microorganisms that commonly spoil meat products, such as Escherichia coli, Salmonella, Listeria monocytogenes, or Staphylococcus aureus. The meat products are then treated with the essential oil formulations and evaluated for microbial growth inhibition over time.
5. Shelf-life studies: The shelf-life of the meat products treated with the essential oil formulations is evaluated under different storage conditions, such as refrigerated or frozen storage. The meat products are evaluated for changes in microbial growth, sensory quality, and other quality parameters over time.
6. Safety evaluation: The safety of the essential oil formulations is evaluated using toxicity testing and sensory evaluation. Toxicity testing may involve assessing the toxicity of the formulations in animals, while sensory evaluation involves assessing the aroma and flavor of the meat products after the addition of essential oils.
7. Application testing: The essential oil formulations may be tested for their application to meat products using various methods such as dipping, spraying, or vacuum impregnation. The efficacy and sensory quality of the products are evaluated under different storage conditions.
8. Optimization: Based on the results of the efficacy and safety evaluations, the essential oil formulations are optimized for their efficacy, safety, and sensory quality.
9. Scale-up: The optimized essential oil formulations are then scaled up for commercial production and further testing to ensure their effectiveness and safety under large-scale production conditions.

Overall, the development of natural preservatives for the shelf-life extension of meat products using essential oils requires a thorough evaluation of the essential oils' antimicrobial efficacy, safety, and sensory quality, as well as their formulation, application, and storage conditions.

Statistical analysis

The statistical analysis for the development of natural preservatives for the shelf-life extension of meat products using essential oils may vary depending on the specific goals and design of the study. Some common statistical analyses that may be performed include:

1. Descriptive statistics: Descriptive statistics, such as mean, standard deviation, and range, may be used to describe the characteristics of the samples, such as the microbial load, sensory quality, and other quality parameters.
2. Analysis of variance (ANOVA): ANOVA may be used to determine whether there are significant differences between the treatment groups, such as the meat products treated with essential oils versus those without.
3. Tukey's post-hoc test: Tukey's post-hoc test may be used to compare the means of different treatment groups and identify which treatment groups are significantly different from each other.
4. Regression analysis: Regression analysis may be used to determine the relationship between the concentration of essential oils and their antimicrobial efficacy or sensory quality.
5. Survival analysis: Survival analysis may be used to evaluate the shelf-life of the meat products and determine the time at which a certain proportion of the products reach a specific endpoint, such as microbial growth or sensory deterioration.
6. Principal component analysis (PCA): PCA may be used to identify the most important variables that contribute to the sensory quality or microbial growth of the meat products and to evaluate the relationships between these variables.

The specific statistical analyses used will depend on the study design, sample size, and data collected, and the results of the analyses will be used to draw conclusions about the efficacy and safety of the essential oil formulations for the shelf-life extension of meat products.

2. Result

- Antimicrobial efficacy: The essential oils haveshown significant antimicrobial activity against specific microorganisms that commonly spoil meat products. The concentration of the essential oils required to inhibit the growth of these microorganisms is optimized.

- Shelf-life extension: The meat products treated with essential oil formulations have a significantly longer shelf-life compared to untreated products. The shelf-life extension varies depending on the specific formulation, concentration, and storage conditions.
- Quality parameters: The sensory quality of the meat products is evaluated using various parameters such as color, texture, odor, and taste. The essential oil formulations show some impact on the sensory quality, but the impact is optimized to minimize any negative effects.
- Safety: The essential oil formulations are evaluated for their safety, including their potential toxicity to humans and their potential impact on the nutritional quality of the meat products.
- Application methods: Different application methods are evaluated to determine the most effective and practical way to apply the essential oil formulations to the meat products.

- *After 72 hours the plate is observed for the growth of microorganism.*
- *Growth of E.coli was not found.*

Overall, the results of the study will provide valuable information about the potential of natural preservatives using essential oils for the shelf-life extension of meat products, as well as the specific formulation and application methods that are most effective and safe for commercial production.

3. Discussion

The development of natural preservatives for the shelf-life extension of meat products using essential oils is a promising area of research, as it offers an alternative to synthetic preservatives that can have negative health effects and contribute to the development of antimicrobial resistance. In this discussion, we will explore some key points related to this topic.

1. Antimicrobial efficacy: Essential oils are known for their antimicrobial properties, which can be attributed to their active components, such as terpenes, phenols, and aldehydes. These active components can damage the cell membrane and inhibit the growth of microorganisms. The antimicrobial efficacy of the essential oils can be optimized by selecting the most effective combination of active components and determining the optimal concentration for meat preservation.
2. Shelf-life extension: The use of essential oils as natural preservatives for meat products can help to extend their shelf-life by inhibiting the growth of spoilage and pathogenic microorganisms. The shelf-life extension may vary depending on the specific formulation and storage conditions. For example, essential oils with high volatility may be more effective in vacuum-packed products compared to air-packaged products.
3. Quality parameters: The sensory quality of meat products can be affected by the use of essential oils as natural preservatives. However, by optimizing the formulation and concentration of the essential oils, the negative impact on sensory quality can be minimized. Additionally, the use of essential oils can also have positive effects on the sensory quality of the meat products, such as improving flavour and aroma.
4. Safety: The safety of essential oils as natural preservatives for meat products is a critical consideration. While essential oils are generally recognized as safe (GRAS) by the U.S. Food and Drug Administration (FDA), their potential toxicity to humans and potential impact on the nutritional quality of meat products need to be evaluated. It is also important to consider the potential for allergic reactions to the essential oils.
5. Application methods: The application method of essential oils to meat products can affect their efficacy and safety. Different application methods, such as immersion, spray, or incorporation into packaging materials, can be evaluated to determine the most effective and practical method for commercial production.

In conclusion, the development of natural preservatives for the shelf-life extension of meat products using essential oils has the potential to offer a safe and effective alternative to synthetic preservatives. By optimizing the formulation and concentration of the essential oils, their impact on the sensory quality of the meat products can be minimized, and their safety can be ensured. However, further research is needed to fully evaluate the potential of essential oils as natural preservatives for meat products and to identify the most effective and practical application methods for commercial production.

4. Conclusion

The development of natural preservatives using essential oils presents a promising avenue for the food industry to reduce the use of synthetic preservatives while also extending the shelf-life of meat products. The use of essential oils can provide antimicrobial benefits, and their safety can be ensured through careful formulation and concentration optimization. However, further research is needed to fully evaluate the potential of essential oils as natural preservatives for meat products and to identify the most effective and practical application methods for commercial production. By continuing to

explore and develop natural preservatives, we can provide consumers with safer and more sustainable food options while also reducing the environmental impact of the food industry.

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