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Original Article

Essential oils from aromatic plants as an alternative for the preservation of processed meat

Aceites esenciales de plantas aromáticas como alternativa para la conservación de productos cárnicos procesados

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Abstract

Essential oils extracted from various parts of plants have been used since ancient times for medicinal, culinary, preservative, and aromatic purposes. In this study, an exhaustive literature review was conducted on the use of essential oils in the sausage industry. The PRISMA methodology was employed to gather information, resulting in a total of 15 technical documents and 17 specific documents on aromatic plant oils and their effects on meat products, following inclusion criteria and considering relevant keywords. In conclusion, the inclusion of essential oils in meat product manufacturing not only promotes preservation but also enhances their organoleptic characteristics and adds functionality to the final product. This study highlights the importance of essential oils as versatile and beneficial agents in the food industry, supporting their application in sausage production.

Keywords: Essential oils, Antimicrobials, Food preservation, Aromatic plants, Shelf life.

Resumen

Los aceites esenciales extraídos de diversas partes de las plantas han sido empleados desde tiempos ancestrales con fines medicinales, condimentarios, conservantes y aromatizantes. En este estudio, se llevó a cabo una exhaustiva revisión bibliográfica sobre el uso de aceites esenciales en la industria de embutidos. Se empleó la metodología PRISMA para recopilar la información, obteniendo un total de 15 documentos técnicos y 17 documentos específicos sobre aceites de plantas aromáticas y sus efectos en productos cárnicos, siguiendo criterios de inclusión y considerando palabras clave relevantes. En conclusión, la inclusión de aceites esenciales en la elaboración de productos cárnicos no solo favorece su conservación, sino que también mejora sus características organolépticas y añade funcionalidad al producto final. Este estudio destaca la importancia de los aceites esenciales como agentes versátiles y beneficiosos en la industria alimentaria, respaldando su aplicación en la producción de embutidos.

Palabras clave: Aceites esenciales, Antimicrobianos, Conservación de alimentos, Plantas aromáticas, Vida Útil.

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INTRODUCTION

The essential oils of aromatic plants have been the subject of extensive research not only due to their natural status but also for their recognized antimicrobial and antioxidant properties, which are utilized in food preservation[1]. un mercado ilegal [8].Additionally, they have been highlighted for their potential benefits in human nutrition and health. Currently, they are being extensively studied for their biological properties, including antitumor, analgesic, insecticidal, antidiabetic, and anti-inflammatory activities[2]. Of course, research also focuses on their antioxidant and antimicrobial properties, as well as their potential for direct application in foods or their incorporation into packaging and coatings to maintain product quality and extend shelf life[3].

Since ancient times, essential oils have been used for their potential as pesticides against a wide variety of agricultural pests, forming part of traditional practices. However, their application as antimicrobial and antioxidant agents is an emerging and recent trend, reflecting the growing interest in green consumerism[4] and in extending the shelf life of foods. The antimicrobial properties of active compounds found in plants and spices are supported by various research studies in clinical and food fields, demonstrating their effectiveness against pathogenic bacteria and fungi[5]. In fact, in recent times, there has been an increase in the use of these active compounds as proposed natural additives in the food industry[6]. Antimicrobial agents, including preservatives and certain organic acids, have traditionally been used in the industry to inhibit the growth of various microorganisms and thus extend the shelf life of a wide variety of foods on the shelves[7].

The exploration of essential oils and plant extracts unveils antibacterial, antifungal, and antiviral properties, suggesting their potential as sources of novel antimicrobial compounds. These compounds could serve as alternatives for both food preservation and the treatment of infectious diseases[8]. Food preservation, in broad terms, refers to a set of techniques aimed at extending the shelf life of food while preserving its quality characteristics, including color, texture, flavor, and especially nutritional value. This definition encompasses a wide range of preservation methods, from domestic cooking and short-term cold storage to industrial techniques such as freezing and dehydration, enabling longer and strictly controlled preservation periods[9].

The meat products industry, particularly chorizo, stands out as a favorite among consumers due to its favorable cost and organoleptic attributes[10]. Currently, this sector employs numerous additives and chemical preservatives in its formulations[11] due to their inhibitory capacity against the development of pathogens such as Clostridium botulinum[12]. Although the use of these preservatives has raised concerns regarding consumer health, their complete removal has proven to be unfeasible due to prevailing legislation in many countries that permits their use and facilitates their accessibility. Permissible limits have been established, supported by their role as barriers aimed at reducing or eliminating foodborne illnesses[13].

Essential oils, acknowledged for their ability to enhance the sensory characteristics of food, have been investigated for their potential in preserving a wide range of food products, including bakery items, meats, fish, fruits, and vegetables. It has been observed that their antimicrobial properties are linked to their ability to disrupt the permeability of microorganisms membranes[14]. This discovery, coupled with the warning issued by the World Health Organization in 2015 regarding the potential cancer risks associated with the consumption of processed meat products, underscores the viability of essential oils as an alternative for food preservation instead of the traditionally used nitrites and nitrates[15]. Essential oils (EOs) derived from plants emerge as a promising alternative in the realm of environmentally friendly preservatives[16] (Olmedilla and Jiménez, 2014). These natural products provide a similar antimicrobial action, reducing the risk of non-infectious diseases for consumers. EOs, recognized by the Food and Drug Administration (FDA) as generally recognized as safe (GRAS) substances, are employed for their antimicrobial, analgesic, anti-inflammatory, spasmolytic, and food preservation properties[17].

In recent decades, changes in food production techniques and the increasing interest in food safety have led to a demand for products with lower levels of synthetic additives and a reduced environmental impact[18]. Although chemical preservatives have been used for a long time to control microbial growth, their use is surrounded by controversies due to the side effects they present on human health[19]. In this context, essential oils extracted from aromatic plants have emerged as agents with significant antimicrobial and antioxidant potential. The use of these essential oils as natural preservatives aligns with the increasing consumer demand for safe, healthy, and nutritious food products. The efficacy of these compounds extends to the inhibition of pathogenic microorganisms, resulting in an extension of the shelf life of the foods and the preservation of their quality[20].

In contemporary times, businesses operate in a globalized context where competitiveness is evaluated considering factors beyond quality and productivity. These aspects gain additional importance in the realm of development and food security, implying that consumer acceptance of a food product is influenced by various elements, including color (as the first point of contact), aroma, taste, texture, cost, nutritional value, ease of preparation, and shelf life[21]. The visual presentation of a food product, along with its content, exerts a significant influence on consumer perception. In this context, the inherent characteristics of the product play a crucial role in encouraging improvement through the incorporation of additives[22]. The increasing consumer interest in food safety and quality represents

a significant phenomenon. Emerging trends in the food industry indicate a pronounced preference for natural preservatives, particularly antioxidants derived from plant extracts. This shift suggests a gradual decline in the market for synthetic antioxidants, paving the way for natural alternatives[23]. This paradigm shift is attributed to both growing consumer acceptance and regulatory requirements, as well as market entry facilitation[24].

The current consumer trend towards high-quality, natural, safe, minimally processed foods that can be prepared quickly poses a challenge for food preservation techniques. These techniques must focus on preserving perishable products without excessively compromising their original nutritional and sensory qualities[25]. The use conditions of preservatives are strictly regulated worldwide, establishing limits for both the quantity of a specific preservative and the total sum of preservatives. At authorized concentrations, food preservatives, in general, do not eliminate microorganisms but merely prevent their proliferation. Therefore, their utility is maximized in high-quality raw materials[26].

Foodborne diseases, or diseases transmitted through food or food poisoning (FTPs), exhibit a diverse array of symptoms resulting from the consumption of contaminated food or beverages. Despite significant advancements in food production technology and processing, these diseases persist as a notable cause of morbidity and mortality. The impact on public health is substantial, presenting a considerable global economic challenge[27]. The magnitude of this concern is further emphasized by the World Health Organization (WHO), which categorizes food safety as one of the most widespread health problems and a major cause of reduced economic productivity[28].

Within this context, the overarching issue emerges as a global concern affecting a vast number of individuals worldwide. As perishability is inherent to many food products, ensuring their quality throughout the stages of preparation, storage, and distribution becomes imperative to meet desired shelf-life standards[29]. Shelf life, defined as the duration during which a food product maintains its desired sensory, chemical, physical, microbiological, and functional characteristics under recommended storage conditions, assumes fundamental importance. Consequently, any additive demonstrating the capability to extend or preserve the shelf life of a food product is deemed a preservative[30]. Addressing these challenges is critical for enhancing global food safety, public health, and economic productivity. Based on this historical context, the primary objective was established: to identify essential oils from aromatic plants as an alternative for preserving processed meat products.

METHODOLOGY

The research was conducted by applying the guidelines of the PRISMA methodology (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (Page, 2021), which allow for the proper identification, selection, evaluation, and systematization of studies for a comprehensive approach to the topic.

Information retrieval was performed in the following recognized databases: Scopus, Science Direct, and Springer Link, in relation to the study topic. Using these platforms provided access to a large number of scientific articles, research, and publications, ensuring that the information is up-to-date.

Additionally, research questions and search criteria were established as follows: Table 1

Research questions posed:

(a) What studies exist regarding the use of essential oils from aromatic plants in processed meats?

(b) What effects and uses of essential oils from aromatic plants exist in the area of processed meats?

On the other hand, the search criteria were as follows: The keywords used in the bibliographic search are presented below in Table 2:

Tabla 1. Inclucion and Exlusion Criteria

Inclusion	Exclusion
Articles and documents published between 2010-2023	Articles prior to the year 2009
Bibliographic sources in Spanish and English	Languages other than Spanish and English
Related to essential oils topic	Sources not directly related to plant essential oils
Articles published in scientific journals	Grey literature (theses and unofficial documents)
Open access sources	No access to full text

Tabla 2. Keywords and Synonyms

Key words	Synonym
Decomposition	Desintegration
Documentary film	based
Product	Plant aromatic
Effect	consequence

Study Selection Procedure

The initial phase aimed at achieving the research objective involved conducting searches in the databases: Scopus, Science Direct, and Springer Link. Subsequently, the selection and data extraction process comprised four phases: initially, a preliminary review of the results in each database was conducted using the following search string: essential oils, uses as food preservatives, effects on meat products.

For the third phase, the identified works were reviewed, and those deemed potential research based on their title or abstract were included. From these articles, the full version of the work with its respective citation was obtained for subsequent analysis and evaluation, while studies that met at least one exclusion criterion were discarded.

RESULTS AND DISCUSSION

Next, the data collection and selection diagram under the PRISMA methodology is presented (see Fig. 1).

The shelf life is the maximum period for which meat can be stored without a significant decline in nutritional quality, sensory appeal, and safety, ultimately leading to consumer rejection[31]. In this context, physicochemical, sensory, and microbiological attributes become crucial. Particularly, meat color plays a pivotal role in shaping consumer perceptions of quality and appearance, thereby influencing their product choices[32]. The results of the bibliographic search for the characteristics of essential oils are presented in Table 3.

After conducting the identification of essential oils from aromatic plants and their uses in the industry, the results obtained are detailed in Table 4.

In the analysis of the essential oils obtained from the species T. moroderi, T. piperella, S. chamaecyparissus, and S. angustifolia, numerous compounds contributing to the complexity of their chemical profile were identified. The essential oil of T. moroderi revealed the presence of 51 different compounds, collectively representing 92% of the total oil composition. The major components

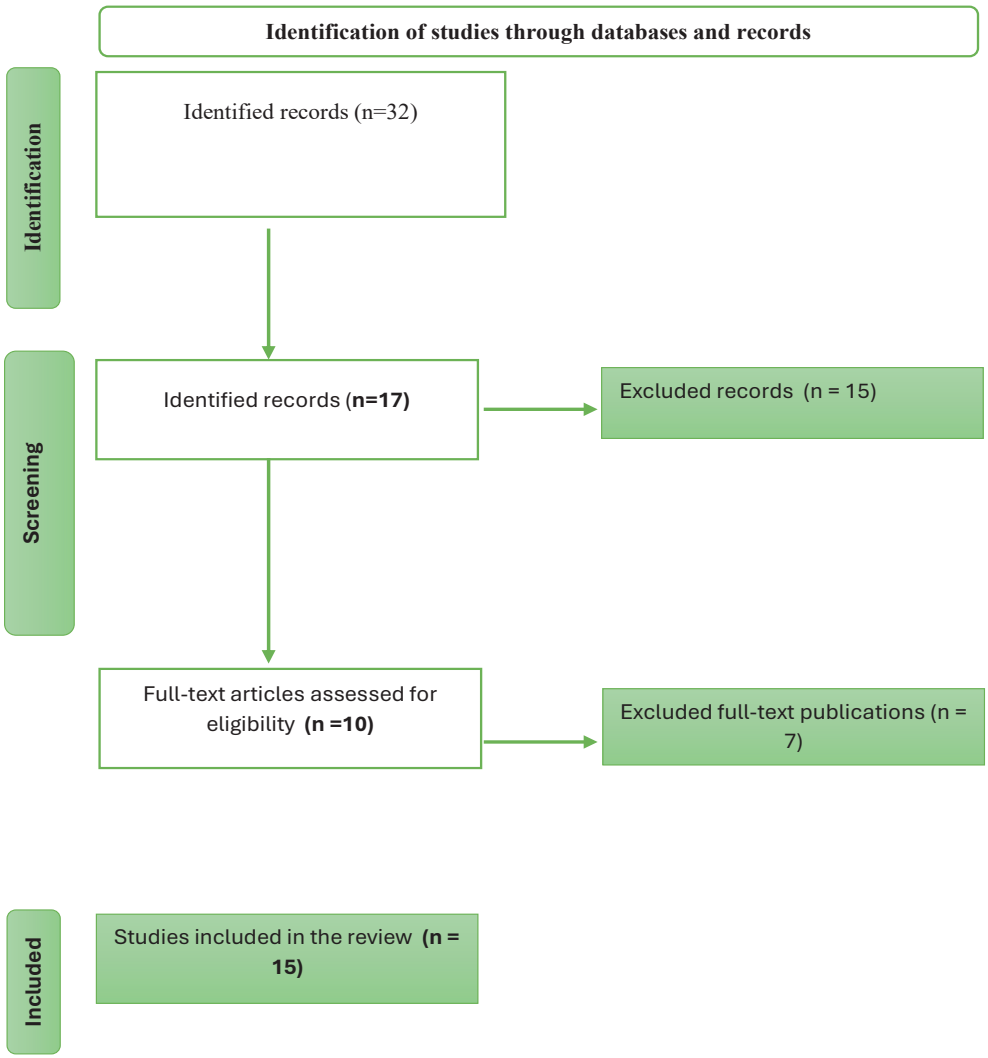

Fig. 1. Flowchart of search and information selection

Source: Own elaboration based on the PRISMA methodology

Tabla 3. Characteristics of plant essential oils

Characteristics of essential oils
Essential oils have been recognized and employed in the meat industry for their antimicrobial and antioxidant properties, playing a crucial role in food preservation[33].
They are also used as synthetic preservatives to prevent the decomposition and deterioration of food products[34].
Plant oils are composed of more than seventy components, with terpenes, monoterpenes, sesquiterpenes, hydrocarbons, alcohols, and ketones being the most prominent among them[35].
Essential oils and oleoresins extracted from various plants are widely used in the food industry due to their medicinal properties[36].
Previous studies have demonstrated that essential oils have antimicrobial activity against various strains, such as Listeria innocua, Staphylococcus aureus, Bacillus subtilis, Yersinia enterocolitica, Salmonella Enteritidis, Salmonella Typhimurium, Proteus mirabilis, Escherichia coli, and Klebsiella oxytoca [37].
The application of essential oils in meat products, such as salami, hamburgers, and sausages, has become common. This practice enables a more effective balancing of aromas, ensuring optimal sensory acceptance by consumers, especially in products with distinctive aromatic characteristics[38].
The preservative function of essential oils is based on their composition, particularly the presence of eugenol-type compounds or cinnamic aldehyde, which exhibit antimicrobial properties[39].
These natural essential substances have been used since ancient times as flavorings and preservatives, encompassing a broad spectrum of activities, from pharmacological and anti-inflammatory effects to antioxidant properties in foods[40].
They enhance flavor and the need to reduce salt and fatty seasonings to improve digestion and metabolism in the human body [41].
They prevent the onset of physiological and metabolic disorders [42].
The antimicrobial activity of essential oils shows greater efficacy against Gram-positive bacteria compared to Gram-negative ones[43].
The presence of lipophilic ends in the lipoteichoic acids of the cell membrane of Gram-positive bacteria may facilitate the penetration of hydrophobic compounds from essential oils in processed meat products [44].
In the food industry, organoleptic impact plays a significant role, with foods commonly associated with herbs, spices, or condiments being the least prone to this phenomenon[45]
The use of essential oils emerges as a strategy to confer distinctive aromatic profiles, impart specific flavors, and contribute to the overall improvement of the sensory quality of meat products[46]
In the organoleptic realm, it is imperative to consider the appropriate dosage of essential oils, as an excessive amount can have a negative impact on the final taste of the product [47].

Table 4 Identification of essential oils used in the meat industry.

Essential Oil	Effect	Uses in the meat industry.
Thymus vulgaris (Thime)	Antimicrobial effect, extends the shelf life of sausages	Thymol and carvacrol exhibit antibacterial activity against both gram-positive and gram-negative bacteria in the production of fresh and fermented[48].
Rosmarinus officinalis (Rosemary)	Antimicrobial activity in sausages used as a preservative. Antioxidante.	The presence of components such as lactone rings, flavonoids, and/or coumarins in rosemary allows for its utilization in meat marination, yielding favorable outcomes[49].
Origanum vulgare (Oregano)	Antioxidant and antimicrobial capacity against Salmonella, Escherichia coli, Staphylococcus	Oregano does not exhibit toxic effects when consumed in its natural state, as long as appropriate doses are observed, and its consumption is limited to a prudent period [50]. Under these technical parameters, considering its inclusion in the formulation of meat products as a fundamental component is viable, Microwave-assisted hydrodistillation[51].
Ocimum basilicum (Basil)	Antifungal and antispasmodic	The mucilage derived from basil seeds can be classified as a hydrocolloid with functions as a thickener, stabilizer, fat substitute, texturizer, surfactant, and emulsifier. This versatility justifies its application in the meat industry, particularly in the production of raw and fermented sausages [52].
Mentha spicatab (Peppermint)	Antimicrobial and antioxidant activity.	A concentration of 67% cavrone in the extract serves as an antimicrobial agent, eliminating the need to add synthetic elements to raw and cooked meat products [53].
Lavandula (Lavender)	Stimulant, antimicrobial and preservative	The inclusion of lavender in meat products produces subtle and highly volatile aromas[54].
Petroselinum crispum (Parsley)	Diuretic, rich in vitamin C and minerals, especially iron and calcium.	The high concentration of phenolic compounds enables the reduction of soluble radicals during the processing of meat products[55].
Coriandrum sativum (Cilantro)	Antioxidant and antimicrobial.	Cilantro in meat products allows for the inhibition of the growth and sporulation of Clostridium perfringens in food [56].
Cuminum cyminum (Cumin)	Antioxidant	Incorporation of cumin into food products will have the benefits of a flavorant and nutraceutical at the same time [57].
Pimpinella anisum (Aniseed)	Aroma, antiseptic property.	Anise in meat products serves as a flavoring agent, antioxidant, anti-spoilage agent, and preservative, providing a distinctive touch of freshness[58].

Essential Oil	Effect	Uses in the meat industry.
Carum carvi (Caraway sedes)	Expectant	The antiallergic and antimicrobial capability in meat products allows inhibiting the presence of bacteria such as Staphylococcus aureus and Escherichia coli [59].
Anethum graveolens (Dill)	Toner, flavoring, antispasmodic and diuretic.	The content of tannins, phellandrene, cymene, pinene, carvone, flavonoids, and beta-carotenes has the ability to enhance the flavor in raw meat products [60].
Foeniculum vulgare (Fennel)	Energizing, flavoring and stimulating	The polyphenolic content of this plant component initiates a preservative action on organoleptic properties [61].
Anthriscus cerefolium (Perifollo)	antibacterial, fungicide, antiseptic, antispasmodic	The antioxidant content of this plant allows for the inhibition of fat oxidation in cured sausages [62]. (Burri, 2020)
Piper carpunya (Guaviduca)	Flavoring, antioxidant, antimicrobial	The addition of this extract to raw products extends their shelf life due to its inhibitory action[63].
Zingiber officinale (Jenjibre)	Antioxidant, antimicrobial	The addition of ginger essential oil to processed meats enables us to reduce the use of nitrites and nitrates, which are synthetic chemical compounds that can lead to diseases such as cancer[64].
Eugenia caryophyllata (Clove)	Preservatives and antibacterial agents	Inhibits the peroxidation of linoleic acid in processed meat products [65].

were camphor (26.74%), 1,8-cineole (24.99%), and myrcene (5.63%). In the case of the essential oil of T. piperella, 48 compounds were identified, constituting 90.5% of the total oil components. The major components in this essential oil were carvacrol (31.92%), para-cymene (16.18%), and γ-terpinene (10.11%). Regarding the essential oil of S. chamaecyparissus, 58 components were identified, representing 90.1% of the total components, with artemisia ketone (27.19%) as the major component, followed by dihydro-aromadendrene (18.21%) and β-phellandrene (7.49%). On the other hand, the essential oil of S. angustifolia presented the identification of 77 compounds, covering 94.6% of the total oil components. The major component in this case was α-pinene (12.71%), followed by β-phellandrene (11.97%), and 1,8-cineole (7.41%). It is important to note that there is a significant variability in the composition of essential oils, even among those belonging to the same genus and species, as supported by scientific literature. This variability can be attributed to various factors, including the climatic and environmental conditions of the collection site, the season of the year in which the collection was made, geographical location, water availability, altitude above sea level, the presence of diseases caused by fungi and insects, the plant part used, as well as post-harvest drying and storage processes, and the method used for essential oil extraction[65]. These factors significantly contribute to the chemical and functional diversity of essential oils, which should be considered when interpreting and applying their properties in different contexts.

CONCLUSIONS

A thorough review of technical documents was conducted using the SALSA method across 30 sources, of which 83,86 % provided specific information on the effects of components from the plant species in question. The significant influence of essential oils in the production of various meat products was emphasized, with a more frequent application in the preparation of salami, burgers, sausages, chorizo, among others.

The effects generated by essential oils in meat products encompass a diverse spectrum of properties. Their antimicrobial, antioxidant, and preservative capabilities stand out, contributing to extending the shelf life and maintaining food quality. Additionally, antifungal, antispasmodic, stimulating, and diuretic activities have been observed, expanding the potential applications and benefits of these compounds in the food industry. Their flavoring function also plays a crucial role in enhancing the sensory acceptance of meat products. These findings consolidate the versatility and multifaceted potential of essential oils in improving the quality and safety of meat products.

The literature review allowed us to understand the fundamental characteristics of essential oils from aromatic plants regarding the preservation of raw and processed meats in the industry, enabling their availability for use and the reduction of synthetic elements that are causing health issues related to the digestive system. The phytochemical properties of these oils have enabled the creation of functionality in processed products.

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Conflicts of Interest

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