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Article

Assessment of Antimicrobial Effect Of Curcumin Extract And Sesame Oil Against Staphylococcus aureus in Mastitis Milk And Comparing With Antibiotics (Review)

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Abstract: This study aims to shed light on the role of the curcumin longa alcoholic extract and sesame oil in the inhibition of the pathogenicity of Staphylococcus aureus isolated from mastitis milk and compares their effectiveness with antibiotics. The frequent use of chemical drugs led to the failure of disease treatment because of their side effects and resistance to antibiotics, so they were directed to medicinal plants as therapeutic alternatives, and their role to inhibit pathogens and even eliminate them. S. aureus is one of the important bacteria for health and economics also it is the common bacteria, the main cause of clinical mastitis, as well as the most prominent cause of foodborne broad-spectrum food phages. In addition to the emergence of new serotypes resistant to antibiotics, especially methicillin and Vancomycin, the most important of these patterns are MRSA and VRSA. The information in this review is primarily focused on the physicochemical characteristics, chemical composition, and therapeutic applications of sesame oil, turmeric extract, and antibiotics concerning mastitis causes. The overall goal of this study was to compare the antimicrobial effects of sesame oil and turmeric (Curcuma longa) alcoholic extract on the growth of S. aureus to those of antibiotics.

Keywords: Antimicrobial Effect, Sesame Oil, Curcumin Extract, Mastitis, S. Aureus, Multi-Drug Resistant.

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1. Introduction

There have been documented worldwide epidemics of mastitis brought on by *S. aureus* and its enterotoxins, as well as staphylococcal food poisoning (SFP) (1, 2). The most prevalent and economically important infectious disease in animal science is bovine mastitis. Due to the decreased milk output and quality, there were significant financial losses as a result of higher treatment expenses, labor expenditures, and culling (3, 4). One of the most ubiquitous diseases in the dairy industry is mastitis. By lowering the quantity of cow's milk produced, it harms animal production. The removal of subpar milk, the killing of afflicted animals, and the expenditures of treatment all result in higher losses (5, 6).

Mastitis, an inflammation of the udder tissue of beef cattle or other ruminants caused by *S. aureus*, is a major concern in dairy cow production. It causes misery to the cow, and treating or replacing the afflicted cow is costly for the farmer. This bacterium causes chronic damage to the milk secretory cells in the udder tissue, resulting in altered milk composition and lowered milk supply (7, 8, 9). Once an udder quarter is contaminated with bacteria, it is extremely difficult to heal the quarter and eliminate the infection;

therefore, detecting infected quarters is critical to preventing pathogen transmission (10, 11). Furthermore, the emergence and dissemination of bacteria resistant to antibiotics as a consequence of mastitis therapy poses a risk to consumer health that affects the well-being of humans and animals alike (12, 13). There is a lot of interest in developing novel antimicrobial medications from medicinal plants because of the mounting evidence of bacteria that are resistant to multiple drugs (3, 14, 15).

2. Materials and Methods

This study employs a mixed-methods approach to analyze the relationship between technological innovation and the optimization of monetary cycles in Greece's economic recovery. Primary data were collected via structured surveys targeting key economic stakeholders, including policymakers, business leaders, and technologists. Secondary data analysis involved reviewing economic reports, technological indices, and monetary trends from reliable national and international databases.

A quantitative analysis was performed using econometric modeling to assess correlations between technological advancements and economic metrics such as GDP growth, employment rates, and fiscal balance. A qualitative component involved expert interviews to provide insights into challenges and strategic opportunities.

The findings are triangulated to ensure reliability and validity, contributing to a comprehensive understanding of how targeted innovations and monetary strategies can drive sustainable recovery. Statistical tools such as regression analysis and thematic coding were employed to interpret the data. The study's methodology aligns with its aim to propose actionable recommendations for Greece's economic resilience.

3. Results and Discussion

Causes of mastitis

Staphylococcus aureus (*S. aureus*) is a Gram-positive opportunistic pathogenic bacterium that can cause a range of zoonotic infections and toxin-related food poisoning. It is a significant potential pathogen that may cause acute and chronic disorders including mastitis, endocarditis, sepsis, bacteremia, and toxic shock syndrome. *S. aureus* has been linked to inducing mastitis in dairy cows, dermatitis and sepsis in pigs, septic arthritis, and subdermal abscesses in chickens (1, 16, 17). Mastitis is caused by different sources, including environmental and microbiological factors. This is generated by a variety of pathogenic microbes such as *S. aureus, S. agalactiae, S. dysgalactiae, S. uberis*, and *E. coli*, the most prevalent pathogens accounting for the majority of cases (3, 18, 19). Mastitis pathogen strains are variations in distribution among individual animals in a herd, host species, and nations. Controlling udder health is critical for dairy production, avoiding foodborne disease, and providing nutritious dairy products (3, 20).

Unsatisfactory mastitis can be either clinical or subclinical, and both cause a decline in the quantity and quality of milk produced. Though it is communicable, subclinical mastitis is the most harmful variety for stockholders because it affects milk ingredients 15–40 times more regularly than clinical mastitis, is difficult to diagnose, and has a long-lasting impact. Additionally, it is regarded to be a reservoir of bacteria that can transmit to other farm animals. (5, 21). The principal indicator of subclinical mastitis is a rise in the milk's somatic cell count (SCC) accompanied by the isolation of the causative bacteria (22).

Most recent research seems to agree that the amount of milk produced decreases linearly as SCC rises, with a cut-off point of about 250,000 cells/ml. Reduced milk production and the cost of culling and treatment are the primary expenses linked to mastitis (21). Streptococcus agalactiae, S. aureus, and a few other Streptococci are the main culprits behind subclinical mastitis. The most important infectious disease that affects milk yield in terms of quantity and quality is S. aureus mastitis (5). Secretory cells can be invaded by S. aureus and micro abscesses can develop. This form is subsequently discharged into milk after being concealed from the immune system (10).

Uses of Antibiotics (benefits and harmful)

Handling S. aureus infections with antibiotics is essential. Methicillin-resistant Staphylococcus aureus (MRSA) is one strain of S. aureus that has emerged as a result of the overuse of antibiotics, and it poses a major concern to both human and animal health (16, 23). Antibiotic residues entering the human food chain and the emergence of antibiotic-resistant bacterial strains are just two of the detrimental effects of often using parenteral and intra-mammary antibiotics to treat mastitis. Furthermore, antibiotic resistance is the root cause of the low success rate of intramural treatments (16, 24). Since antibiotics have been demonstrated to be successful in treating tiny dry ruminants with SCM, they are being given intramural more often on farms. The effectiveness of intramammary antibiotic therapy may be diminished by staphylococci that produce biofilms in the udder.

Antibiotic-resistant bacterial strains have emerged as a result of the extensive usage of antibiotics on dairy farms (25, 26). The bacteria identified from raw cow milk that exhibit antibiotic resistance in intramammary infections. The identification of various resistant strains in raw milk, particularly methicillin-resistant *S. aureus* (MRSA) and CNS (MRCNS) strains, is considerations as a problem of major concern due to their potential spread across the dairy food chain (25, 27). As a result of antibiotic abuse, S. aureus antibiotic resistance is progressively rising. This has led to outbreaks of foodborne diseases, particularly those caused by multidrug resistance (MDR) and MRSA, and this poses a challenge to public health security. Biofilm substrates not only help bacteria retain nutrients and water, but they also slow the rate of antibiotic penetration to the bacterial wall. Furthermore, S. aureus uses biofilm, a vital virulence factor that aids bacteria survival in hostile conditions. Therefore, it's critical to observe the progress of antibiotic resistance, virulence-associated SEs genes, and the formation of S. aureus biofilm rates in raw milk from handcrafted dairy retail stores (1, 28).

The first occurrence of MRSA was documented in 1961, each year since then, MRSA has become more augmentation. MRSA outbreaks were recorded in numerous countries throughout the 1980s, with significant morbidity and mortality rates. Meanwhile, MRSA was linked to more than 50% of nosocomial S. aureus cases in the majority of Asian nations. Although methicillin resistance has been decreasing in China since 2005, MRSA prevalence remains high (16, 29).

Antibiotic misuse and abuse on farms have been a major factor in the growth of MRSA in food animals. This pathogen not only causes illnesses in animals but also puts people and animals at risk of infection through contaminated animal products, environmental pollution, and direct contact. Moreover, it has long been known that animals can harbor MRSA. There are records of MRSA infections and colonies in companion animals, domestic livestock, and wildlife (16, 30). MEC primarily mediates methicillin resistance. A gene that codes for the enzyme polypeptide penicillin-binding protein (PBP2a), which is responsible for creating crosslinks between the peptidoglycans found in bacterial cell walls. It is resistant to antibiotics because of its low affinity for β-lactams. Vancomycin has been widely utilized throughout the last few decades of the 20th century to combat MRSA. Vancomycin-resistant S. aureus strains have emerged as a result of antibiotic abuse (31, 32). MRSA strains have the mecA gene, which encodes a low-affinity penicillin-binding protein (PBP2), resulting in resistance to all β-lactam antibiotics (33).

Antimicrobial effect of Curcuma longa

Antimicrobial compounds are one of the most prevalent strategies for preserving and raising the durableness of foods. Growing levels of health issues have been connected to numerous food additives, with antibacterial and preservative compounds at the top of the list. Consumer desire for safe food is an important factor in obtaining natural, alternative, and dependable additives (23, 34). Curcuma longa is a plant from the ginger family that has been employed for millennia in India and China as an herb and traditional remedy to treat a variety of ailments (35).

Turmeric, scientifically known as Curcuma longa L., is a spice with a yellowish to brown color that is a member of the genus Curcuma and family Zingiberaceae. Worldwide, there are around 70-80 species of Curcuma (36). Since ancient times, food preparations included turmeric, a golden spice derived from the long-plant Rhizome of the Curcuma longa plant, to provide color, taste, and flavor. Additionally, turmeric, known as "Haridra" or "Haldi," contains moisture, protein, fat, minerals, and carbohydrates. Curry powder is linked to curcumin, a yellow pigment found in turmeric, an Indian spice (37,38).

Chemical constituents of Curcuma longa

Turmeric can produce volatile essential oil (EO) and non-volatile oleoresin, which are significant for a variety of uses, in addition to its flavoring, coloring, and preservation properties (36). The components of the essential oils may be affected by variations in the weather. The main constituents of a sample of C. longa essential oil that exhibited strong antibacterial and antioxidant properties included β-sesquiphellandrene, α-curcumene, and p-mentha-1,4-diene. Because of its various properties, which are typically ascribed to the components found in its rhizomes. Its essential oil typically includes dehydroturmerone, turmerone, and aromatic ketones, as well as a range of other volatile substances like sesquiterpenes and aliphatic or oxygenated mono (39). Among the chemical components of this spice, polyphenols, alkaloids, diterpenes, sesquiterpenes, triterpenoids, and sterols have been discovered in turmeric leaf extract (37, 40). A 5-8% essential oil including sesquiterpenes, zingiberene, α-phellandrene, cineol, sabinene, and borneol is produced by steaming the rhizomes. The main curcuminoid found in turmeric is curcumin. Desmethoxycurcumin and bisdemethoxycurcumin are the two other compounds. Curcumin, the compound that gives turmeric its color, is now known to have the most medicinal benefits. Curcumin is thought to comprise 2-5% of the substance of turmeric. Differentiuloylmethane (77%), desmethoxycurcumin (18%), and curcumin bisdesmethoxy (5%) are the curcumin formulations that are most widely available (37, 41). α-, β-, and ar-turmerone were discovered in another study; these compounds mostly exhibit antifungal and anti-mycotoxigenic qualities (40).

Therapeutic uses of curcuma longa

Curcumin, which comprises 2-5% of turmeric, is likely the most abundant component. The antibacterial, anti-cancer, anti-mutagenic, parricidal, insecticidal, and radioprotective effects of turmeric have been demonstrated. Several animal studies have exhibited the anti-inflammatory, neurological, diabetic, cancer, neurodegenerative, obese, depressed, and atherosclerotic properties of this spice (37, 42). Furthermore, Curcuma longa has been associated with the inhibition of inflammation, angiogenesis, tumor genesis, diabetes, diseases of the skin, liver, heart, and lungs, as well as chronic fatigue, depression, neuropathic pain, and loss of bone and muscle (43). the essential oil of Curcuma longa phytochemicals demonstrates desired biological properties by functioning as antibacterial, anti-inflammatory, antioxidant, antifungal, anti-diabetic agents, anticancer, neuroprotective, hepatoprotective, and anti-mutagenic.

Additionally, several properties of active food packaging materials have been studied previously (36, 39). These properties include insecticidal, mosquito repellent, pest resistant, herbicide, antibiotics against bacteria that cause eye infections, food emulsifiers, and preservatives. Because Curcuma longa has high levels of phenolic and flavonoid components, which provide strong antioxidant activity, it is used as medicine to treat a wide range of illnesses. Furthermore, the polyphenols that give plants their color also have anti-allergic and antioxidant qualities, which lowers the risk of allergies in people (37, 40). In addition, this spice has a long history of usage in folk medicine to treat a wide range of ailments, such as infectious diseases, gastrointestinal and gynecological issues, blood disorders, respiratory illnesses, hepatic disorders, coughs, and sore throats (37, 44).

Antimicrobial effect of sesame oil

Several African and Asian countries are native to the Pedaliaceae family, which includes sesame (Sesamum indicum L.). Sesame has been cultivated for around 4,300 years in Babylon and Assyria, making it one of the oldest crops in existence. The seed is employ as a condiment to produce halwa, which is eaten, and to emboss bread. Utilized also in the pharmaceutical and chemical industries (45). Sesame seeds (Sesamum indicum L.) are used to make sesame seed oil (SSO), an edible vegetable oil that is obtained through cold pressing and filtration. SSO can be made from both white- and black-hulled soybeans; black sesame contains less oil than white and brown sesame.

Generally, the cultivated seed of SSO has a higher oil content of approximately (50%) with greater oxidative stability when compared to the wild species (30%) and other vegetable oils (45, 46). Sesame is one of the most widely consumed foods, whether fresh or processed. It is also a vital component of many processed food items and nutraceutical industries because of its high oil and protein component, oxidation resistance, attractive color, good flavor, and high amounts of several macro- and micronutrients (45, 47).

Chemical constituents of sesame oil

Sesamolin, sesamin, and sesamol lignan fractions are only a few of the important ingredients in sesame seed oil that are recognized to play a key part in its oxidative stability and antioxidant activity (48). Additionally, SSO is a fantastic dietary source of vitamin E, a powerful antioxidant that promotes immunity, growth, and development as well as good skin. Niacin, a vitamin of the B complex family, is abundant in sesame seeds due to its high tocopherol, tocotrienol, sterol (omega-3 and omega-6), and essential fatty acid (EFA) content. Sesame's primary oil content ranges from 28% to 59%, while oil content from seed crops such as cotton (35–40%), rapeseed–canola (20–26%), sunflower (30%), and soybean (25%), is higher (45, 49).

Therapeutic uses of sesame oil

Sesame oil contains antibacterial and antifungal effects. Sesame oil is employed for recovery during massage by rubbing it on the skin to enhance energy flow and assist in purging the body of toxins. Furthermore, sesame oil may be utilized to alleviate anxiety and insomnia in addition to being an antimicrobial mouthwash. Premenstrual syndrome (PMS) can be remedied by putting oil on the abdomen. Sesame is reported to treat dysentery, headaches, ear discomfort, burns, and impotence (45, 50). Sesame is reputed for cure and sedation, and it has been used as medicine in China for millennia. Medical professionals utilize sesame seed oil to cure strep throat and staphylococcus germs. It is thought that sesame oil Alleviates disorders associated with arthritis, bursitis, tendinitis, colitis, gastroesophageal reflux disease (GERD), and irritable bowel syndrome. Sesamin protects the liver against oxidative destruction. Since ancient times, people have utilized oil to treat wounds. It has antibacterial and antifungal properties against common skin infections including Staphylococcus and Streptococcus, as well as athlete's foot fungus. It has anti-inflammatory and antiviral properties (51, 52).

In addition, it helps to relieve stress, decrease cholesterol and body detoxify. Sesame seeds have high magnesium concentration can benefit persons suffering from respiratory difficulties, also zinc and calcium in Sesame seeds can be an effective weapon for combating osteoporosis. Sesame seeds include sesamol, an essential antioxidant and anti-inflammatory substance that has been shown to help against heart disease and atherosclerosis. Sesame oil has substantially higher polyunsaturated lipids, including omega-3 fatty acids. These healthy fats assist in saving your heart from destruction, decrease blood pressure, and may even lower your chance of developing type 2 diabetes. In the East, sesame is considered a nutritious food that promotes increased energy and delays the aging process (53). Compounds found in sesame oil have a variety of physiological effects, including anti-inflammatory and estrogenic properties, as well as lowering blood cholesterol and arachidonic acid levels. Sesame oil inhibits the formation of malignant melanoma in vitro and the propagation of human colon cancer cells. Sesame oil helps to neutralize oxygen radicals beneath the surface. It penetrates the skin fast and enters the bloodstream via capillaries. Furthermore, Sesame seed contains myristic acid, which has the property to prevent cancer. Sesame oil is utilized as an intramuscular solvent with nutritional, demulcent, and emollient qualities. It has also been employed as a laxative. Chinese medicine treats toothaches and gum problems. Sesame oil has recently been widely utilized to remedy nasal mucosa dryness caused by dry winter weather (54).

Foodborne pathogens in milk

S. aureus infection is a dangerous infection with significant morbidity and mortality, and it frequently leads to metastatic diseases like infective endocarditis, which have a detrimental influence on patient outcomes. The primary cause of staphylococcus in cow milk, accounting for roughly 30% of cases, is a subpar husbandry state. Traditionally, the pathogen's sensitivity to penicillin has played a significant role in determining the choice of therapy for *S. aureus* infections. Nonetheless, the majority of *S. aureus* strains are resistant to penicillin (40, 55).

Since the 1940s, the revolution in medical therapy, particularly for bacterial infections, has significantly in decreased the prevalence of microorganism infections. Unfortunately, this advancement has coincided with the emergence of drug-resistant microbes. This places significant limits on the medical therapy choices for many bacterial illnesses. Drug-resistant microorganisms are becoming increasingly widespread today. To treat this alarming challenge, new active compounds against targets must be identified as soon as possible. (56).

Potential natural chemical compounds with a multitude of therapeutic applications have been linked to a wide range of medicinal properties, including biological targets and interactions. Many physiologically active compounds may be extracted from spice extracts and used to develop novel medicines. It implies that common spices found in our kitchens might, in a few ways, help safeguard us against illness. This study focuses on the necessity of using specific antibiotics to kill or inhibit the growth of *S. aureus* using Curcuma longa alcoholic extract and sesame oil (40, 55). Unsanitary conditions during the milking process are the cause of the high contamination rate. Many factors affected the quality of the milk, including the following: the pollution rate increased with the number of pregnancies, age, and volume of milk produced by the cow, as well as the thickness of the bedding; the rate of milk pollution increased when milking took place outside of a milking parlor and when it was carried out by machine; and greater rates of staphylococci infections were discovered in the milk of lactating cows (52, 56).

This review has established the importance of Curcuma longa extracts and sesame oil inefficiently inhibiting the development of all bacteria compared to antibiotics. Curcuma longa is used as a medication to cure several ailments because of its chemical contents, which include polyphenols, alkaloids, diterpenes, sesquiterpenes, triterpenoids, and sterols. It also has a high phenolic and flavonoid content, which gives strong antioxidant action. Furthermore, sesame seed oil has a high concentration of essential components such as sesamin, sesamolin, and sesamol lignan fractions, as well as sterols, tocopherols, and tocotrienols, all of which contribute to its oxidative stability and anti-oxidative activity (51, 53). All of the chemicals in this review exhibit antibacterial properties, assessment of phytomedicinal items like Curcuma longa and Sesame seed oil must be encouraging.

4. Conclusion

Milk contamination rates were extremely high owing to loss of health control in milk, which causes several diseases that affect humans, via tainted milk that lacks health conditions. Drug-resistant bacteria are becoming increasingly frequent as a result of antibiotic abuse and misuse on farms, which has greatly contributed to MRSA's widespread dispersion among food animals. This study revealed that natural curcumin longa and sesame oil extracts may be employed as possible antibacterial agents against *S.*

aureus, which causes mastitis and food poisoning compared to antibiotics. The current study demonstrated the significance of the comprehensive pharmacological activity of turmeric extracts and sesame oil in the medical industry, as well as their potential use in the development of innovative medications to treat various ailments.

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