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Salmonella typhimurium ATCC 14028 inhibition with various extracts

Hülya Şen Arslan *, Sabire Yerlikaya

Karamanoğlu Mehmetbey University, Engineering Faculty, Food Engineering Department, Karaman, Turkey

Abstract

In this study, *Salmonella typhimurium* ATCC 14028 inhibition with ethanolic extracts of yarrow (EEY), lavender (EEL) and propolis (EEP) was investigated at 37 ºC. Samples were divided into seven groups. First group was control samples (has *Salmonella typhimurium* without EEY, EEL and EEP), the second group was inoculated with 70% ethanol (EA); the third, fourth and fifth group were inoculated with EEY 5%, EEL 5% and EEP 5% separately; the sixth group was inoculated with EEL after EEY and the seventh group was inoculated with EEY, EEL, EEP respectively. All treatments were incubated at 37ºC for 10 minutes. All samples reduced the count of pathogen in chicken broth compared with control samples. It was calculated 6.2 log cfu/mL pathogen in control samples. It was found that the samples inoculated with combination of extracts (EEY, EEL and EEP) were the most effective (3.7 log cfu/mL) and EA (5.92 log cfu/mL) is the less effective on the *S. typhimurium*. It has been seen EEP has shown the highest (5.35 log cfu/mL) inhibitory activity compared with EEY and EEL. The results of this study indicate that ethanolic extracts as a natural food preservative can be used to reduce *Salmonella typhimurium* ATCC 14028 in chicken broth.

Keywords: chicken, broth, pathogen

1. Introduction

Yarrow (*Achillea millefolium*) is a plant with a wide distribution in the northern hemisphere and Turkey. Some *Achilea* species have been found to have antispasmodic, anti-inflammatory, and antimicrobial properties. These pharmacological properties are believed to be due to the flavonoid and phenolic acid [1]. Lavender flowers carry 1-3% essential oil. 60-65% of lavender essential oil consists of monoterpene alcohols, of which 20-45% is linalool and 25-46% is linalyl acetate [2]. Lavender is known to have high antioxidant and antimicrobial properties. In the literature, antimicrobial properties have been found on the oils of these plants. Antioxidant and antimicrobial effects of propolis provide the opportunity to be used in the field of food technology. One of the most widely known and researched properties of propolis that contributes to the durability of food products is its antimicrobial activity. Many scientific studies have been carried out on the effect of propolis on various bacteria, fungi, viruses and other microorganisms [3].

Salmonella infections in poultry flocks can cause acute and chronic clinical diseases but have received greater international attention because of their role in foodborne outbreaks of human illness [4]. Wu et al. (2022) reported that pomegranate peels have the potential to be used Salmonella strains inhibition. Salaheen et al. (2016) found blackberry (*Rubus fruticosus*) and blueberry (*Vaccinium corymbosum*) pomace extracts have a green antimicrobial against enteric pathogen Salmonella. The study explored the antimicrobial activity of 10 different essential oils against *Salmonella* spp. in tahini and hydrated tahini [5-7]. The study evaluated the anti-bacterial and anti-inflammatory activities of lactic acid bacteria (LAB)-biotransformed mulberry fruit extract (MFE) against *Salmonella Typhimurium* [8]. Various plant extracts and propolis have an inhibitory effect on Salmonella [9-11].

* Corresponding author: *hsenarslan@kmu.edu.tr*

In this study, the inhibitory effects of ethanolic extract of yarrow (EEY), lavender (EEL) and propolis (EEP) on the survival *Salmonella typhimurium* ATCC 14028 in chicken broth was investigated.

2. Materials and Method

2.1. Materials

Propolis was collected from Pertek district of Tunceli. Yarrow and lavender used in the research were brought from an organic products company in Konya and brought to laboratory of Karamanoğlu Mehmetbey University, Department of Food Engineering under aseptic conditions.

2.2. Methods

Yarrow, lavender and propolis can be easily extracted by organic solvents, such as ethanol. For this reason, ethanol was chosen as organic solvent. Analyzes in the study were carried out in two parallel with two repetitions.

2.2.1. Ethanolic extracts

For 5% ethanolic yarrow and lavender extract; the extraction of plants was performed by the classic method. The dried plant materials were subjected to size reduction by a grinder. The dried plants (5%) were extracted with ethanol at 65 °C for 1 hour in agitation with water. The samples were filtered with coarse filter paper. All samples are stored at −18 °C until used [12].

For 5% ethanolic propolis extract, 5 g of propolis was dissolved in 95 mL of ethanol. Dissolution was carried out in a closed container in a light-free environment for one week. The solution was shaken twice a day, and the solution obtained at the end of the period was filtered through Whatman no: 1 filter paper and placed in sterile bottles and stored at +4 °C until used for analysis [13].

2.2.2. Salmonella typhimurium ATCC 14028 inhibition

Salmonella typhimurium was used in the study. Bacterial strains from stock cultures were activated in Nutrient Broth (Merck, Darmstadt, Germany) at 37 °C for 24 h. Chicken broth is inoculated with activated pathogen. Then samples were divided into seven groups. First group was the control samples (has *Salmonella typhimurium* without ethanolic extracts), the second group was inoculated with 70% ethanol (EA); the third, fourth and fifth group were inoculated with 5% EEY, 5% EEL and 5% EEP separately; the sixth group was inoculated with EEL after EEY and the seventh group was inoculated with EEY, EEL, EEP respectively. All treatments were incubated at 37ºC for 10 minutes, separately. After incubation, Brilliant-green Phenol-red Lactose Sucrose (BPLS) agar was used for *Salmonella typhimurium*. Samples were inoculated by spreading plate method, then they were incubated for 24 hours at 37 ºC.

2.2.3. Statistical analysis

The results were analyzed statistically using SPSS 22 (IBM Corp., Armonk, New York, USA) program. Sample means were compared using One Way ANOVA and were evaluated with Tukey test from Post Hoc Test.

3. Results and discussion

The effects of different concentration of ethanolic extracts on *Salmonella typhimurium* inhibition were statistically significant ($p<0.05$). Figure 1 shows the results of the Tukey Test for *Salmonella typhimurium* inhibition values.

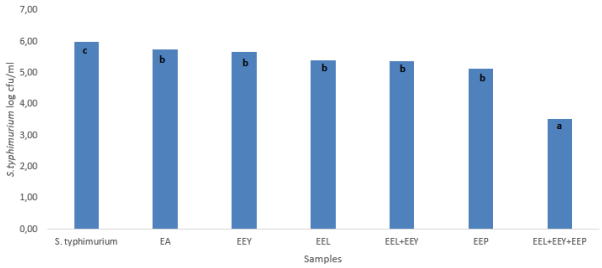

Figure 1. Inhibitory effect of different extracts on *Salmonella typhimurium* (EA: ethanol; EEY: ethanolic extract of yarrow; EEL: ethanolic extract of lavender; EEP: ethanolic extract of propolis)

As seen in Figure 1, all extracts significantly reduced *Salmonella typhimurium* numbers in chicken broth compared to ethanol and control samples ($p<0.05$).

Pathogen was detected as 6.2 log cfu/mL in the control sample. Ethanol has the least antimicrobial activity on Salmonella (5.92 log cfu/mL). The most effective inhibition on the pathogen was the combination of EEL, EEY and EEP (3.7 log cfu/mL). EEL (5.41 log cfu/mL) has more inhibitory effect than EEY (5.67 log cfu/mL). In inhibition, EEP (5.35 log cfu/mL) alone is more

effective than the combination of EEL and EEY. The use of propolis and plant extracts is a good strategy to combat Salmonella, the most dangerous microorganism in chicken and chicken products.

Kazemi (2015) reported, yarrow has antimicrobial effect on many bacteria. *Salmonella typhimurium* is one of them [14]. In a study by Mangena and Muyima (1999), lavender essential oil was found to be effective on 41 different types of microorganisms [15]. In the study conducted by Aksoy and Dığrak (2006), propolis was antimicrobial against Gram (+) and Gram (-) bacteria; it has also been determined that it has antifungal activity against yeasts [16].

4. Conclusions

Conscious food consumption increases proportionally as the conscious consumer increases. For this reason, the demand for safe food is constantly increasing. Pathogens are undesirable microorganisms in foods. One of the basic conditions in producing safe food is to destroy pathogenic microorganisms in foods. It is preferred to use natural foodstuffs pathogen inhibitory substances. For this purpose, yarrow, known as a powerful antimicrobial agent, was used in this study.

According to this study, it is seen that the inhibitory effect of yarrow, lavender and propolis extracts on *Salmonella typhimurium*. The high initial *Salmonella typhimurium* of chicken broth decreased the inhibitory power of EEL, EEY and EEP combinations. It is known that EEP is more effective on pathogenic bacteria than EEY and EEL. The results of this study indicate that EEY, EEL and EEP as a natural food preservative may be used to effectively reduce *Salmonella typhimurium* ATCC 14028 in chicken broth.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

Disclosure statement: No potential conflict of interest was reported by the authors.

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