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Research Article

Antimicrobial activity of fruit wine against food borne pathogens

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Abstract

Wines produced from grapes have been found to possess bactericidal properties on a number of pathogens *in vitro*, suggesting possible health benefits that may be derived from microbiological safety. This study investigated the bactericidal effects in wines made from fruits other than grape. As some study demonstrated that the foodborne pathogens *Escherichia coli* O157:H7, *Listeria monocytogenes*, *Salmonella typhimurium*, *Shigella dysenteriae*, and *Staphylococcus aureus* were treated with fruit wine solutions at varying concentrations for 24 h using blackberry, cherry, peach, and red raspberry wine, and enumerated using a pour plate assay. At 40% fruit wine concentration, numbers of all pathogens tested were significantly reduced compared to a 0% wine solution control ($P \leq 0.05$). Increasing wine concentrations above 40% showed a greater effect. The bactericidal effect of wine extracts with ethanol removed was also tested, and a significant reduction in number for the pathogens was observed at 60% concentration compared to a control. Correlation strength of the following factors to antibacterial activity of the fruit wines at 40% concentration was in the order of titratable acidity, alcohol content, pH, free sulfite concentration, anthocyanin content, total phenolic content, and tannin content. Scanning and transmission electron microscopic examinations of *E. coli* O157:H7 and *S.* Typhimurium after treatment with peach and cherry wine revealed differences in cellular morphology, specifically reduction in cell size, holes in the cell wall and membrane disruption that appeared to have caused leakage of intracellular contents.

Keywords: Wines, foodborne pathogens Correlation strength,. antibacterial activity

Introduction

The food industry is always looking to find ways to add value to food, known as value added processing. Value added processing is simply the processing of an item resulting in a finished product having a value exceeding the cost of processing. The perishability of fresh fruits makes it a good candidate for processing, especially for processing methods that extend its shelf life. Though a variety of processing methods are currently used to make products like dried fruit, frozen fruit, canned fruit, fruit juice, jams and preserves, oils (for example, orange or lemon seed oil), and flavorings, the alcoholic fermentation of fruit offers a potential way to dramatically increase the value. Historically, fermentation was a cheap and efficient way to preserve perishable raw materials. Today, fermentation is partly responsible for the greatest utilization of a single fruit product in the United States in terms of U.S. dollars. In 2008, grapes had the highest value of production for any fruit reported by the USDA (2009), with a total value of $3.3 billion. That year, apples had a value of $2.2 billion, oranges a value of $2.2 billion, and strawberries a value of $1.9 billion. In addition to grape production value, total U.S. wine sales in 2005 were estimated at $23.8 billion (MFK, 2007). Despite the value wine can potentially bring to a fruit, wine made from fruits other than grapes is not produced in great quantity in the U.S. compared to that made from grapes. In 2010, 677.3 million gallons of still wine was produced from grapes, while only 19.3 million gallons of other

special natural wines, which fruit wine is in the category of, was produced (DOT 2011). This constitutes less than 3% of the market, and is a valuable opportunity open to fruit processors.

While the value added to grapes through wine production is a great benefit, protection against pathogenic bacteria may potentially be another. Food safety is an important concern to public health in the United States, with microbial contamination by pathogenic bacteria being the main cause of recalls. In 2010, there were 2.3 million pounds of beef recalled in the U.S. due to 11 recalls concerning *E. coli* O157:H7 (Flynn 2010). The largest recall in 2010 was due to *Salmonella* found on eggs, with over 500 million eggs coming from two farms (Doell, 2010). Despite recalls such as these, it is estimated that 1 in 6 people in the U.S. (roughly 48 million) will get sick each year from foodborne illness; approximately 128,000 people will be hospitalized from it; and 3,000 people will die (CDC, 2010).

Previous research has found wines made from grapes to have a bactericidal effect on a variety of pathogens *in vitro*, including *E. coli* O157:H7 and other virulent strains (Boban and others 2010), *Listeria monocytogenes* (Møretrø and Daeschel, 2004), *Salmonella* Typhimurium, *Salmonella* Enteritidis (Boban et al.,2010), *Staphylococcus aureus* (Møretrø and Daeschel, 2004), *Campylobacter jejuni* (Gañan et al.,2009), *Helicobacter pylori* (Daroch et al., 2001), *Streptococcus pyogenes* (Chinnam et al., 2010), *Shigella sonnei*, *Vibrio parahaemolyticus* (Liu et al., 2006). Although the effect of grape wines has been studied on a variety of pathogenic bacteria, information about the bactericidal effect of fruit wines on pathogens is lacking. The goal of this thesis was to expand upon previous findings from red and white wines, and investigate the bactericidal properties of fruit wines.

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