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Antibacterial activity of Onions (*Allium cepa*) against *Staphylococcus aureus* and *Escherichia coli*

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Abstract

Onion (*Allium cepa*) is among the oldest cultivated plants, and is used for many things. Gram positive (*Staphylococcus aureus*) and Gram negative (*Escherichia coli*) was tested against *Allium cepa* extracts to determine the antibacterial activity. The antimicrobial effects of the aqueous extract against these bacteria species was carried out in vitro by using the agar well diffusion method. The extract was found to be effective at the concentration of 2000mg/ml against *Staphylococcus aureus* and *Escherichia coli* with the zone of inhibition of 4.5mm each respectively and was least effective at the concentration of 400mg/ml against *Staphylococcus aureus* and *Escherichia coli* with zone of inhibition of 3.5 and 2.5mm respectively. Minimum inhibitory concentration of 1000mg/ml was obtained for the aqueous extract on both bacteria. The results showed that the aqueous extract of onions had very minimal inhibitory effect on both tested bacteria.

Keywords: *Antibacterial, Onion, Staphylococcus aureus, Escherichia coli*

Introduction

Onion belongs to genus *Allium*, fam. *Amarillidaceae*. The species are cultivated at different altitudes in Europe, Asia, North America and Africa (Griffiths *et al.*, 2002; Yamaguchi, 1983). The increased interest in onion is due to the high health benefit to man (Griffiths *et al.*, 2002). Onion contains biologically active substances such as flavonoids, sulphur and seleno (Curcic *et al.*, 2012; Daglia, 2012; Slimestad *et al.*, 2007;

Arnault and Auger, 2006; Bonaccorsi *et al.*, 2005).

Onions have 25 active components, which are the worthiest substances that act as an anti-inflammatory, anti-thrombotic and anti-oxidants (Benitez *et al.*, 2011; Barrett *et al.*, 2000). The cell wall of onion is rich with uronic acid; glucose and smaller amount of arabinose, xylose, fructose and galactose (Ng *et al.*, 2000).

The antimicrobial effect of onion was first described by Louis Pasteur, the French researcher and physician (Agrawal *et al.*, 2010). Flavonoids in vitro had been an effective antimicrobial substance against wide array of microorganisms, such viruses and bacteria (Azu *et al.*, 2007). The antibacterial inhibitory action involves impeding the formation of microbial enzymes, adhesins and transport proteins (Mishra *et al.*, 2013). The phenolic acid compounds which is a flavonoid derivative prevented the development of bacteria such as *Bacillus cereus* and *Staphylococcus aureus* (Santas *et al.*, 2010).

Quercetin a component of flavonoids has shown great potential to inhibit the growth of *Staphylococcus aureus* (Kumar and Padey, 2013; Mishra *et al.*, 2011; Pandey *et al.*, 2010). Experiments have shown that kaempferol acts as an inhibitor against *Helicobacter pylori* (Calderon Montano *et al.*, 2011). Previous reports have shown that onion extracts exert bactericidal effects on *Streptococcus mutans*, *Streptococcus sobrinus*, *Porphyromonas gingivalis*, and *Prevotella intermedia* (Gram-

positive bacteria), considered as the bacteria responsible for dental carries and adult periodontitis. However, onion is not effective against Gram-negative bacteria (Griffiths *et al.*, 2002). This study aims at the determination of antibacterial activity of onion (*Allium cepa*)

Materials and Methods

Extraction of onion extract

The onion bulbs were washed and dried. Then weighed and blended to smooth form and the raw juice was extracted after standing in a clean glass container for 24 hours. It was extract and sieved using a sterile muslin cloth and was air-dried, stored below ambient temperature until required.

Antibacterial activity assay

The broth culture of the test organisms was inoculated on nutrient agar plates. Subsequently, wells of 8mm diameter were punched into the agar medium and filled with 0.02ml of the aqueous extract and allowed to diffuse at room temperature for 2 hours. The plates were then incubated at 37° for 24 hours. Wells containing the same volume of dimethyl sulfoxide served as negative control while Amoxil (0.3gml⁻¹) were used as the positive controls.

Minimum inhibitory concentration

Mueller Hinton agar plates were prepared to contain 4000, 2000, 1000 and 500mg/ml of the extracts. In to 100ml of sterile tryptic soya agar which was maintained at 45°C was added 1ml of the prepared bacterial culture to give a final concentration of 10⁷ cells/ml in the medium. The culture was thoroughly mixed and the plates were poured, allowed to solidify and placed in a refrigerator for 10minutes. Holes were then punched into the agar to create wells, into which measured volume of 100µl of the different concentrations of aqueous extracts was placed and incubated at 37°C for 24 hours (Chessbrough, 2000).

Results

An inhibitory zone of 4.5mm, 3.0mm each, 2.0mm, 2.5mm was observed for *Escherichia coli* and 4.5mm each, 4.0mm, 3.0mm, 3.5mm for *Staphylococcus aureus* at the concentration of 2000mg/ml, 1600mg/ml, 1200mg/ml, 800mg/ml and 400mg/ml respectively (table 1). A minimum inhibitory concentration (MIC) of 1000mg/ml of the extracts was observed for both *Escherichia coli* and *Staphylococcus aureus*. At 500mg/ml, there was no inhibition, except from 1000mg/ml to the maximum concentration of 4000mg/ml (table 2).

Table 1: Zones of inhibition of the aqueous extracts of onion (*Allium cepa*)

Concentration (mg/ml)	Zones/diameter of inhibitions (mm)	
	<i>Escherichia coli</i>	<i>Staphylococcus aureus</i>
2000	4.5	4.5
1600	3.0	4.5
1200	3.0	4.0
800	2.0	3.0
400	2.5	3.5
Positive control	9.0	Nil
Negative control	11.5	Nil

Table 2: Minimum inhibitory concentration (MIC) of aqueous extracts of onion (*Allium cepa*)

Concentration (mg/ml)	<i>Escherichia coli</i>	<i>Staphylococcus aureus</i>
Concentration (mg/ml)	<i>Escherichia coli</i>	<i>Staphylococcus aureus</i>
4000	-	-
2000	-	-
1000	-	-
500	+	+

Discussion

The antibacterial activity of the aqueous extracts exhibits a very minimal activity at all concentration used. The aqueous extracts at the 2000mg/ml was observed to have higher inhibition zone than other concentrations below 1600mg/ml. Bakt *et al.* (2013) stated that aqueous, butanol and ethanol extracts of *Allium cepa* were ineffective to control the growth of *Staphylococcus aureus* at any concentration and that the antibacterial effects of onion extract is much lower when compared to the effect of synthetic antibiotics. This may be attributed to the inability of water to extract the most active components of *Allium cepa* responsible for the antimicrobial activities.

Onion extract is effective invitro against many bacteria species including *Bacillus subtilis*, *Salmonella sp.* and *Escherichia coli* as earlier reported by Kabra *et al.* (2016). However, in this study, the aqueous extracts of onion have a minimum inhibitory effect invitro on Gram-negative (*Escherichia coli*) and Gram-positive (*Staphylococcus aureus*). This may probably be due to the use of water as extraction solution in our study.

The antibacterial activity of onion extracts has been attributed to the presence of flavonoids and polyphenols as stated by Hendrich (2006); Adeshina *et al.* (2007). Although, Bakt *et al.* (2013) in their study reported that petroleum ether, ethyl acetate and chloroform extracts of *Allium cepa* inhibited the growth of *Staphylococcus aureus* at both lower and higher

concentration; this is In contrast to our findings because only aqueous extracts of *Allium cepa* was use in this study which partly agree with another study that fresh *Allium cepa* extracts of butanol, ethanol and water were ineffective in the inhibition of *Staphylococcus aureus* at any concentration. Nonetheless, the activity of the *Allium cepa* extracts in sterile distilled water against the bacterial strains of *Escherichia coli* and *Staphylococcus aureus* in this study is consistent with other previous works (Induja and Geetha 2018; Elaweel, 2013).

Conclusion

This study has shown that aqueous extracts of *Allium cepa* has minimum antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*. It is necessary therefore, to carry out further study using organic extracts such as alcohol, ether or any other solvent that has capacity for extraction of organic components.

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