Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(11D):4128-4133 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2016.v04i11.053

Original Research Article

Antibacterial Effect of Onion

Mr. Ahmed M. Kabrah[1], Dr. Hani S. Faidah[2], Dr. Ahmad M Ashshi[1], Mrs. Safaa A. Turkistani[3]
[1]Department of Laboratory Medicine, Faculty of Applied Medical Sciences, Umm Al-Qura University Makkah, Saudi Arabia
[2]Department of Medical Microbiology, Faculty of Medicine, Umm Al-Qura University, Makkah, Saudi Arabia.
[3]PhD. Student Howard University, Department of Microbiology, Washington DC, United States of America

***Corresponding author**
Mr. Ahmed M. Kabrah
Email: amkabrah@uqu.edu.sa

Abstract: Onion (*Allium cepa*) is among the oldest cultivated plants, and is used for multiple purposes. In addition to its nutritional effects, the antioxidant and antimicrobial activities of onion has also been postulated, and continue to be extensively investigated. Therefore, this study was designed to investigate the possible antibacterial effects of three types of onions; red, green and white onion. Different concentration of each onion was prepared in water extraction form. Six types of bacteria were tested, and their selection was based upon their common involvement in causing infectious bacterial diseases among people who live in Saudi Arabia. These tested bacteria included *methicillin-resistant Staphylococcus aureus (MRSA), methicillin-sensitive Staphylococcus aureus* (MSSA), *Escherichia coli* (*E. coli*), *Pseudomonas aeruginosa* (*P. aeruginosa*), Klebsiella species (*Klebsiella Spp*.), and Salmonella species (*Salmonella Spp*.). The antibacterial effects of each onion water extraction against these 6 bacteria species were carried out in vitro by using filter paper method, different agar in media containing different concentration of onion extrat method, suspension method and pieces of onion method. The results showed that the three types of onions had inhibitory effects on the growth of all investigated bacteria; however, their antibacterial effects were varies according to onion type and its water extraction concentration as well as on the type of tested bacteria.
Keywords: onion, antibacterial, MRSA, MSSA, *E. coli Klebsiella Spp*., *P. aeruginosa*

INTRODUCTION

The first cultivated vegetable all over the centuries is the *Allium* family that is an amazing group that has over 500 species different in the shape, color and taste but they are close in their biochemical components [1]. The most common *Allium* family members are: *Allium* cepa (i.e., Onion), *Allium* stivum (i.e., Garlic), *Allium* Fistulosum, *Allium* Ampeloprasum, and *Allium* schoenoprasm [2].

Onion is the generic name of the *Allium* cepa family. It was cultivated 6000 years BC in the nail valley. It contains a lot of minerals and small number of vitamins. It is used as food as well as for medicinal purposes. As a medicine, it is better to use raw onions because by boiling it loses its efficacy [3].

The onions have different uses as culinary and therapeutic purposes. During World War II, Russian soldiers used the onions as antiseptic in the battle wounds. Recently, the onion still playing an important role in our diet and medicinal use [4].

Onions have 25 active components, like the sulphur which is the worthiest substance found in onion, it acts as an anti-inflammatory, thiosulfinates also can act as anti-thrombotic and superoxide-dismutase (SOD) which act as an anti-oxidants [5, 6]. The cell wall of the onion is rich with Uronic acid, glucose and smaller amount of arabinose, xylose, fructose and galactose which are found in the lower epidermis of the onion scale [2]. On the other hand, the chemical components can be classified into two groups: Alk(en)yl Cysteine

Sulphoxides(ACSOs) that gives the odour and taste of the onion when it's cleaved by allinase and two Flavonoid subgroups, anthocyanins that gives the red or the purple colour to the onion or the yellow colour which is obtained by the querctin that is mainly present as glycosides [6]. The querctin is a useful substance for people suffering from arthrosclerosis, it inhibits the vascular smooth muscle cell Ca^{++} influx isorham [7], netin-4-glucoside, xylose, mannose, organosulfur

compounds, allylsulfides, flavenols, cycloalliin and selenium can be present also in the Onion [8, 9].

The glutathione is also found in the onion to promote the metabolism ability of liver fat and improve the complexion and texture of the skin by inhibiting the formation of melanin. The mineral composition of onion includes as calcium, magnesium, sodium, potassium, selenium and phosphorus [6].

Onion represented a rich source of antimicrobial agents, the French researcher and physician (Louis Pasteur) first described the antibacterial effect of onion and garlic juices [10]. Flavonoids founded in vitro had been an effective antimicrobial substance against wide array of microorganisms, such viruses and bacteria [11]. The antiviral Function of flavonoids has been demonstrated with the *HIV virus*, and also with a herpes simplex virus (HSV-1), The phenolic acid compounds which is a flavonoid derivatives prevented the development of bacteria such as *Bacillus cereus, Staphylococcus aureus, Micrococcus luteus, Listeria monocytogenes* and all microorganisms typically associated with the deterioration of foods by inhibiting of DNA gyrase [12]. Querectin derived products such 2-(3,4-dihydroxyphenyl)-4,6-dihydroxy-2-methoxybenzofuran-3-one presented had an activity against Helicobacter pylori strains and 3-(quercetin-8-yl)-2,3-epoxyflavanone showed antibacterial activity against MRSA and H. pylori strains at the same time which increased susceptibility of MRSA to beta-lactams [13].

There were also observed that raw onion had activity only on *Pseudomonas aeruginosa* and *salmone*lla but no effect on *Staphylococcus aureus, Escherichia coli and Bacillus subtilis.* In contrast the hot water extracts of onion did not inhibit the growth *Pseudomonas aeruginosa* neither *Salmonella* this might be due to the destruction of phinolic compounds by heat from the hot water [14]. Onion extract had different inhibition levels against *S. aureus* and *S.enteritidis*. In the dose response study, the inhibition zone increased with increasing concentration of extracts. Low concentrations inhibited weakly the development of bacteria; however *S.enteritidis* was more sensitive than *S. aureus* at high concentrations Otherwise *S.aureus* is less sensitive than *S.enteritidis* which was more inhibited at the same concentration [5]. On the other hand, the onion extract had also an antifungal effect on *Aspergillus niger,* Penicillium cyclopium and less inhibition of *Fusarium oxysporum* due to thiosulfunides. Researchers reported that allicin found in the Allium was effective against Candida, Cryptococcus, Trichophyton, Epidermophyton and Microsporum [14]. The minimum inhibitory concentration is affected by the incubation time, inoculum size, pH and type of medium. There is an inverse increase relationship between the inoculum size and susceptibility; they also observed that the allicin had an antifungal activity which was strong in Sabouraud glucose agar medium with a pH of 5.6 than on the same medium with a pH of 6.0 or higher [14].

Antifungal activity of aqueous extracts prepared from onion was also active against *Malassezia furfur, Candida albicans, Yeasts and other Candida* species and reduced the production of aflatoxin production by *Asparguillus flavus* and *Asparguillus parasiticus* [15]. Moreover, the Allicin had an antibacterial activity that effect on *Staphylococcus epidermidis* [16]. and methicillin-resistant Staphylococcus aureus (*MRSA*) [17]. In addition, the onion had and inhibitory effect on the main bacteria causing dental caries such Streptococcus mutans and Streptococcus sobrinus, and those causing adult periodontitis such Porphyromonas gingivalis and Prevotella intermedia [18]. Zwiebelane A which present in onion play an important role in enhancing the potential fungicidal activity of polymyxin B [19].

Aim of the study

This study was designed to investigate the possible antibacterial effects of three types of onions; red, green and white onion. Different concentration of each onion was prepared in water extraction form.

Material and Methods:

Onions

Three types of onions (Allium cepa), green onion (var. Blanc), yellow (var. Jaune 'Espagne) and red (var. Rouge Amposta), were selected for this investigation.

Preparation of different types of Onion's Extract:

An equal weight about 1Kg of each type of onion was individually peeled and cut into small pieces, then crushed by the domestic blender. Finally, it was filtered by the domestic filter to obtain a final yield of onion extract ready for antimicrobial testing.

Selected Bacterial Strains

The targeting bacteria were selected based upon their involvement in causing common bacterial infections in humans. In this regard, following 6 bacterial species were tested:

- M*ethicillin-resistant Staphylococcus aureus (MRSA).*
- Methicillin-sensitive *Staphylococcus aureus* (MSSA).
- *Escherichia coli* (*E. coli*).
- *Pseudomonas aeruginosa* (*P. aeruginosa*).
- *Klebsiella species* (*Klebsiella Spp*.).
- *Salmonella species* (*Salmonella Spp*.)

In vitro Assessment of Antibacterial Effects of different Onion extract preparations

Using filter paper method

Different concentrations of each isolated onion extract were prepared as follow: 50 ml/L (5%), 100 ml/L (10%), 200 ml/L (20%), 400ml/L (40%), 500 ml/L (50%), and 1000 ml (100%). The filter paper method was used to determine the sensitivity of the bacterial species to these different concentrations per the inhibition zone. Each bacterial species of the above mentioned 6 types were suspended in normal saline and inoculated in Mueller Hinton agar. Filter papers contained the above-mentioned onions extract, were individually placed in each inoculated plate and then incubated for an overnight. The results were read next day.

Onion Pieces Method

In this method, we used Muller Hilton media that were used in lab of King Abdul Aziz University Hospital, the bacteria species of the above mentioned 6 types were individually inoculated in these media. The three types of onions were individually cut.

RESULTS

Antibacterial effects of onions on Filter Paper Method:

As shown in Table 1, the prepared **green onion** didn't affect the growth of *Pseudomonas, E. coli,* and *Salmonella* at any tested concentration. On the other hand, it produced bactericidal effect of *MRSA, MSSA,* and *Klebsiella* in a concentration dependent manner.

As shown in Table 2, the prepared **red onion** didn't affect the growth of *MRSA, E. coli* and *Salmonella* at any tested concentration. On the other hand, it produced bactericidal effect of *Pseudomonas, MSSA, and Klebsiella* in a concentration dependent manner.

As shown in Tables 3 the prepared **white onion** produced inhibitory effect on the growth of all tested bacteria but at various bactericidal effects depended on its used concentration and the type of tested bacteria.

Table 1: Showing results of filter paper method with Green onion

Bacteria	50ml\L	100ml\L	200ml\L	400 ml\L	500 ml\L	1000 ml\L
MRSA	No	No	10 mm*	12mm	14 mm	20 mm
MSSA	No	No	7mm	9mm	10 mm	12mm
E.coli	No	No	No	No	No	No
Klebsiella	No	No	8mm	9mm	11 mm	15 mm
Pseudomonas	No	No	No	No	No	No
Salmonella	No	No	No	No	No	No

* It is the diameter of the inhibitory zone.

Table 2: Showing results of filter paper method with Red onion

Bacteria	50ml\L	100ml\L	200ml\L	400 ml\L	500 ml\L	1000ml\L
MRSA	**No**	**No**	**No**	**No**	**No**	**No**
MSSA	3mm*	4mm	4mm	5mm	6mm	7mm
E.coli	**No**	**No**	**No**	**No**	**No**	**No**
Klebsiella	3mm	6mm	8mm	9mm	10mm	13mm
Pseudomonas	No	No	No	6mm	8mm	15mm
Salmonella	**No**	**No**	**No**	**No**	**No**	**No**

* It is the diameter of the inhibitory zone.

Table-3: Showing results of filter paper method with White onion

Bacteria	50ml\L	100ml\L	200ml\L	400 ml\L	500 ml\L	1000ml\L
MRSA	No	No	No	6mm*	9mm	12mm
MSSA	No	4mm	6mm	9mm	10mm	11mm
E.coli	No	8mm	12mm	15mm	25mm	40mm
Klebsiella	No	No	No	No	11mm	16mm
Pseudomonas	3mm	6mm	8mm	9mm	10mm	12mm
Salmonella	4mm	5mm	7mm	10mm	12mm	15mm

* It is the diameter of the inhibitory zone.

Antibacterial Effects of onion Pieces Method

The piece of green onion killed *MRSA* and Salmonella but not MSSA, *Escherichia coli, Klebsiella, and Pseudomonas (Table 4).* The piece of white onion affected *MRSA* and *E. coli* but not MSSA, Salmonella, *Klebsiella, and Pseudomonas(Table 5)* Finally, The piece of red onion failed to inhibit the growth of Salmonella *and Klebsiella* but inhibited *MRSA, MSSA,* E.coli and *Pseudomonas* (Table 6).

Table 4: Showing the results of pieces method – Green onion-

Bacteria	**Zone of inhibitory growth**
MRSA	23mm*
MSSA	**No**
E.coli	**No**
Klebsiella	**No**
Pseudomonas	**No**
Salmonella	19mm

* It is the diameter of the inhibitory zone

Table 5: Showing the results of pieces method – White onion

Bacteria	Zone of inhibitory growth
MRSA	22mm*
MSSA	No
E. coli	19mm
Klebsiella	No
Pseudomonas	No
Salmonella	No

* It is the diameter of the inhibitory zone.

Table 6. Showing the results of pieces method – Red onion-

Bacteria	**Zone of inhibitory growth**
MRSA	22mm*
MSSA	16mm
E.coli	21mm
Klebsiella	No
Pseudomonas	12mm
Salmonella	No

* It is the diameter of the inhibitory zone

DISCUSSION

Indent this study was designed to investigate the possible antibacterial effects of three types of onions; red, green and white Onion. Six types of bacteria were tested, and their selection was based upon their common involvement in causing infectious bacterial diseases among people who live in Saudi Arabia.

These tested bacteria were *methicillin-resistant Staphylococcus aureus (MRSA),* methicillin-sensitive Staphylococcus aureus (MSSA), *Escherichia coli* (*E. coli*), *Pseudomonas aeruginosa* (*P. aeruginosa*), Klebsiella species (*Klebsiella Spp.*), and Salmonella species (*Salmonella Spp*.)

Onion (*Allium cepa* L.), garlic (*Allium sativum* L.) are among the oldest cultivated plants, and are used for multiple purposes. With the increasing interest into the utilization of natural biological active compounds and the development of specific alternative medical therapy we designed this study to investigate the possible antibacterial effects of different kinds of most commonly consumed onions. Among these numerous and abundant naturally occurring compounds, *Allium* extract has been considered a natural preservative or food additive, and can be used as additional methods of controlling pathogens. In addition to their nutritional effects, the antibacterial and antifungal activities against a variety of Gram-negative and Gram-positive were, and continue to be extensively investigated. Onion extract is effective *in vitro* against many bacteria species including *Bacillus subtilis*, *Salmonella*, and *E. coli*. Similarly, this inhibiting effect was also noted on *Staphylococcus aureus* and results showed a complete inhibition of all strains tested at a concentration of 6.5 mg/ ml. Also, the antifungal effect of onion has been reported. *Fistulosin*, an antifungal compound isolated from roots of Welsh onion exhibited marked antifungal activities against several fungal species particularly

P.roqueforti and *A.oryzae* which showed high sensitivity. The antibacterial effects of the tested onions were documented in this study. The results showed that the most bacteria affected with white onion were *MRSA*, which showed growth reduction in the three methods, filter paper, pieces of onion and onion extract in agar but no effect in suspension method.

Methicillin sensitive Staphylo aureus (MSSA) growth reduction in filter paper and onion extract in agar methods but not pieces of onion nor suspension methods, the white onion has affected the *Escherichia coli (E.Coli)* in filter paper and pieces of onion methods but not onion extract in agar nor suspension methods. *Klebsiella*, *Pseudomonas* and *Salmonella* had showed an effect only in filter paper method. The Green onion had different effects with different methods, the growth of *MRSA* had been reduced in filter paper and onion extract in agar methods but not pieces of onion nor suspension methods, then *Pseudomonas*, which had been effected in onion extract in agar method but not filter paper nor pieces of onion and suspension method, *Salmonella* were reduced only in pieces of onion and agar method. The green onion had the same effect on *MSSA* and *Klebsiella* only in filter paper method. At least the *E. coli* showed reduction only in suspension method.

The most bacteria affected with red onion were *MSSA* and *Pseudomonas* which showed a reduction in filter paper, pieces and onion extract in agar methods but not suspension method. *MRSA* and *E. coli* showed a reduction only in two methods, pieces of onion and onion extract in agar method for *MRSA* than pieces of onion and suspension methods for *E. coli*. The two least affected bacteria were *Klebsiella* and *Salmonella* that showed a growth reduction only in filter paper and agar method respectively.

CONCLUSION

The results of this preliminary study concluded that:

- Extracts of three onions used have shown antibacterial activity against the organisms tested.
- The degree of antibacterial activity was associated with the type of onions and concentration of their extracts.
- Generally, onion extracts in concentrations of 50% and above have shown considerable antibacterial activity
- Further evaluation using standardized techniques will provide more comprehensive information about antibacterial activities of onions against common bacterial pathogens.

REFERENCES

1. Amagase H, Petesch BL, Matsuura H, Kasuga S, Itakura Y. Intake of garlic and its bioactive components. The Journal of nutrition. 2001 Mar 1;131(3):955S-62S.
2. Ng A, Parker ML, Parr AJ, Saunders PK, Smith AC, Waldron KW. Physicochemical characteristics of onion (Allium cepa L.) tissues. Journal of agricultural and food chemistry. 2000 Nov 20;48(11):5612-7.
3. Elisabetsky E. Sociopolitical, economical and ethical issues in medicinal plant research. Journal of Ethnopharmacology. 1991 Apr 30;32(1):235-9.
4. Mulrow C, Lawrence V, Ackermann R, Ramirez GG, Morbidoni L, Aguilar C, Arterburn J, Block E, Chiquette E, Gardener C, Harris M. Garlic: Effects on Cardiovascular Risks and Disease, Protective Effects Against Cancer, and Clinical Adverse Effects: Summary.
5. Bora KS, Sharmab A. PHCOG REV.: Review Article Phytoconstituents and Therapeutic Potential of Allium cepa Linn.–A Review.
6. Barrett B, Marchand L, Scheder J, Appelbaum D, Chapman M, Jacobs C, Westergaard R, Clair NS. Bridging the gap between conventional and alternative medicine. Journal of Family Practice. 2000 Mar 1;49(3):234-.
7. Nemeth K, Piskula MK. Food content, processing, absorption and metabolism of onion flavonoids. Critical reviews in food science and nutrition. 2007 Apr 26;47(4):397-409.
8. Lee SU, Lee JH, Choi SH, Lee JS, Ohnisi-Kameyama M, Kozukue N, Levin CE, Friedman M. Flavonoid content in fresh, home-processed, and light-exposed onions and in dehydrated commercial onion products. Journal of Agricultural and Food Chemistry. 2008 Aug 30;56(18):8541-8.
9. Arnault I, Auger J. Seleno-compounds in garlic and onion. Journal of Chromatography A. 2006 Apr 21;1112(1):23-30.
10. Agrawal H, Ranjan S, Kishore G, Bhatt JP, Gupta S. In vitro antibacterial activity of Allium humile. Academic Arena. 2010;2:83-6.
11. Azu NC, Onyeagba RA, Nworie O, Kalu J. Antibacterial activity of Allium cepa (Onions) and Zingiber officinale (Ginger) on Staphylococcus aureus and *Pseudomonas aeruginosa* isolated from high vaginal swab. Internet J Trop Med. 2007;3(2):110-5.
12. Santas J, Almajano MP, Carbó R. Antimicrobial and antioxidant activity of crude onion (Allium cepa, L.) extracts. International journal of food science & technology. 2010 Feb 1;45(2):403-9.

13. Ramos FA, Takaishi Y, Shirotori M, Kawaguchi Y, Tsuchiya K, Shibata H, Higuti T, Tadokoro T, Takeuchi M. Antibacterial and antioxidant activities of quercetin oxidation products from yellow onion (Allium cepa) skin. Journal of agricultural and food chemistry. 2006 May 17;54(10):3551-7.
14. Benkeblia N, Lanzotti V. Allium thiosulfinates: chemistry, biological properties and their potential utilization in food preservation. Food. 2007;1(2):193-201.
15. Zohri AN, Abdel-Gawad K, Saber S. Antibacterial, antidermatophytic and antitoxigenic activities of onion (Allium cepa L.) oil. Microbiological research. 1995 May 31;150(2):167-72.
16. Pérez-Giraldo C, Cruz-Villalón G, Sánchez-Silos R, Martínez-Rubio R, Blanco MT, Gómez-García AC. In vitro activity of allicin against Staphylococcus epidermidis and influence of subinhibitory concentrations on biofilm formation. Journal of applied microbiology. 2003 Oct 1;95(4):709-11.
17. Cutler RR, Wilson P. Antibacterial activity of a new, stable, aqueous extract of allicin against methicillin-resistant Staphylococcus aureus. British journal of biomedical science. 2004 Jan 1;61(2):71-4.
18. Kim JH. Anti-bacterial action of onion (Allium cepa L.) extracts against oral pathogenic bacteria. The Journal of Nihon University School of Dentistry. 1997;39(3):136-41.
19. Borjihan B, Ogita A, Fujita KI, Doe M, Tanaka T. The cyclic organosulfur compound zwiebelane A from onion (Allium cepa) functions as an enhancer of polymyxin B in fungal vacuole disruption. Planta medica. 2010 Nov;76(16):1864-6.