PRINT ISSN 1119-8362
Electronic ISSN 1119-8362

Full-text Available Online at
https://www.ajol.info/index.php/jasem
http://ww.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 25 (6) 1053-1058 June 2021

Antimicrobial Activity of *Zingiber Officinale* and *Allium Sativum* on some Drug Resistant Bacterial Isolates

[1*]EMMANUEL, SE; [2]EHINMITAN, EO; [1]BODUNDE RS; [1]JOSEPH, JC

*[*1]Department of Biosciences, Salem University, P.M.B. 1060, Lokoja, Kogi State, Nigeria*
[2]Department of Microbiology, Federal University of Agriculture Abeokuta, Nigeria
**Corresponding Author Email: emmysilver166@gmail.com*

ABSTRACT: Ginger and garlic are very important and useful spices and are used as therapeutic agent against many pathological infections. Increasing multi-drug resistance of pathogens forces researchers to find alternative compounds for treatment of infectious diseases. In this study, the antimicrobial potency of ginger and garlic were investigated against four clinical bacterial isolates. Three types of ginger and garlic extracts (aqueous extract, methanol extract and ethanol extract) were assayed separately against *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Salmonella typhi*. The antibacterial activity was determined by well diffusion method. The minimum inhibitory concentration (MIC) of different bacterial species varied from 1.5625mg/ml to 5.0mg/ml with ginger extracts having the lowest and garlic extracts having the highest respectively. All tested bacterial were most susceptible to the garlic aqueous extract and showed poor susceptibility to the ginger aqueous extract. However, ginger extracts from the mean zone of inhibition have higher antimicrobial activity when compared to garlic extracts with exception to garlic aqueous extract. This study encourages the use of spices especially ginger and garlic as alternative or supplementary medicine to reduce the burden of high cost, side effects and progressively increasing drug resistance of pathogens.

DOI: https://dx.doi.org/10.4314/jasem.v25i6.25

Dates: Received: 20 March 2021; Revised: 20 May 2021; Accepted: 04 June 2021

Keywords: Drug resistant bacteria, Antimicrobial Activity, *Zingiber Officinale, Allium Sativum,* Pathogens

Microbial pathogenicity and other infectious diseases have been controlled by use of commercially available antimicrobial drugs since many decades. Tremendous use of antibiotics has developed multiple drug resistance (MDR) in many bacterial pathogens. The increasing drug resistance is the main hindrance in successful treatment of infectious diseases and the control of microbial pathogenicity (Fu, *et al.*, 2007). Development of drug resistance in pathogens and increasing interest of consumers for safe food forces researchers to explore new antimicrobial agents (Erdogrul, 2002). This has given rise to a shift from the prescription of antibiotics to the use of medicinal plants and spices. It is estimated that there are about 250,000 to 500,000 species of plant on earth and relatively small percentage of them are used as food by both human and other animal species (Borris, 1996). These plants fall under the natural products which are a major source of new natural drugs and their use as an alternative medicine for treatment of various diseases has been increased in the last few decades (Vuorelaa, *et al.,* 2004; Ansari *et al.,* 2006). In comparison to the formulated drugs, the herbs and spices have fewer side effects. They are also inexpensive, show better patient tolerance and are readily available for low socioeconomic population (Adeshina *et al.*, 2011). In recent years, in view of their beneficial effects, use of spices or herbs is gradually increasing not only in developing countries but also in developed countries (Duman-Aydyn, 2008). The antimicrobial activity of spices and herbs is due to specific phytochemicals or essential oils (Avato *et al.*, 2000). The main factors that determine the antimicrobial activity are the type and composition of the spice, amount used, and type of microorganism, composition of the food, pH value and temperature of the environment (Sagdic, 2003). Several reports had been published that describe the antibacterial and antifungal properties of different herbs and spices. However, still there is little information about the exact mechanism of their antimicrobial action (Gur *et al.*, 2006; Yusha'u *et al.*, 2008; Belguith *et al.*, 2010; Yin *et al.*, 2002; Oskay *et al*, 2009). The use of medicinal plant and spices to treat diseases of varying etiology is part of the African tradition, but in spite of thousands of years of use, not many of these bioactive plants compounds have been exploited for clinical uses as antibiotics, though some alkaloid compounds like quinine and emetine have been developed as chemotherapeutic agents. Among those antibacterial foods that are becoming more common in western diet are green tea and ginger (Langner *et al.*, 2008;

**Corresponding Author Email: emmysilver166@gmail.com*

Hoffman, 2007). The development of new antibiotics and plant based antimicrobial compounds are effective against the resistant organisms. Ginger (*Zingiber officinale*) a common substance found increasingly in the diets of the global population, have known antibacterial effects and are commonly used together in teas. Ginger has been valued for its antibacterial properties for thousands of years in Asian cultures (Weil, 2005). In South India, ginger is used in the production of a candy called Injimurappa meaning ginger candy in Tamil. Ginger compounds are active against a form of diarrhea which is a leading cause of infant death in developing countries. Ginger has been found effective in multiple studies for treating nausea caused by sea sickness, morning sickness and chemotherapy. Garlic has been in used since ancient times in India and China for a valuable effect on the heart and circulation, cardiovascular disease (Kris-Etherton, 2002; Yeh and Liu, 2001; Gardner *et al*., 2017), and regular use of garlic may help to prevent cancer, to treat malaria, and to raise immunity. Garlic has also been used to treat asthma, candidiasis, colds, diabetes, and antibacterial effect against food borne pathogens like *Salmonella*, *Shigella* and *Staphylococcus aureus* (Teferi and Hahn, 2002). Therapeutic use of garlic has been recognized as a potential medicinal value for thousands of years to different micro-organisms. Therefore, this study compares the antimicrobial activity level of ginger and garlic on selected clinical pathogens.

MATERIALS AND METHODS

Sample Collection: Garlic (*Allium sativum*) and ginger (*Zingiber officinale*) used in this study were collected from the international market and old market in Lokoja Local Government Area of Kogi State, Nigeria

Microbial Strains: Four different clinical isolates *Salmonella typhi, E. coli, Staphylococcus aureus,* and *Pseudomonas aeruginosa,* were obtained from Kogi State Specialist Hospital lokoja and Federal Medical Center, Lokoja, Kogi State respectively. The strains were maintained on nutrient agar slants. The aforementioned organisms cause the most common illness that re-occurring even after treatment with commercially available antibiotics.

Preparation of Extracts: Three types of extracts such as aqueous, ethanol and methanol extract from each garlic and ginger was prepared separately. The fresh garlic cloves and ginger rhizomes was washed, sliced and air-dried for two weeks. After drying, garlic and ginger slices was grinded to fine powder separately using electric blender. 10g powder of each garlic and ginger was soaked in 100 ml of distilled water, ethanol and methanol separately. The flasks were incubated at room temperature for 72 hours. The methanol and ethanol extracts were evaporated at 50°C while the aqueous extracts were evaporated at 80°C in rotary evaporator. The extract solutions were stored at 4°C.

Culture Preparation: The bacterial strains was inoculated in 10ml nutrient broth and allowed to grow overnight at 37°C separately before performing antimicrobial assay. The 50 µl of overnight culture of each bacterial strain was transferred separately into 10 ml of nutrient broth (pH 7.2) under sterile conditions and placed in shaking water bath at 37°C for 8 hours.

Antimicrobial Activity Testing Using Agar Well Diffusion Assay: The bacterial cultures were swabbed on the surface of sterile Muller Hinton agar plates using a sterile cotton swab. Agar wells were prepared with the help of sterilized cork borer with 10mm diameter according to Kirby-Bauer. (1996). Using a micropipette, 100ul of different concentrations of garlic extracts (100%, 75%, 50%, 25% and 10%) were added to the wells in the plate. The plates were incubated in an upright position at 37℃ for 24 hours. The diameter of inhibition zones were measured in mm and the results recorded. The inhibition zones with diameter less than 11 mm were considered as having no antibacterial activity. The same procedure was also performed for ginger extract respectively.

Determination of Minimum Inhibitory Concentration (MIC): The MIC was performed by micro dilution method using the National Committee for Clinical Laboratory Standards Guideline methods (NCCLS, 2000). The aqueous, ethanol and methanol extracts was diluted ranging from 100 to 10mg/ml, which was introduced into different test tube containing nutrient broth. The inoculums of microorganism were prepared using 24hours cultures and suspension was adjusted to 0.5McFarland standard turbidity. The MIC of each extract was taken as the lowest concentration that did not give any visible bacterial growth.

RESULTS AND DISCUSSION

The antimicrobial effect of ginger and garlic was evaluated by well diffusion method. The results as shown in table 1 indicated that the different extracts of the spices have broad spectrum antimicrobial activity with variable degree of sensitivity of tested bacterial isolates toward the extracts which is in accordance with Gull *et al*. (2012). The minimum inhibitory concentration (MIC) was determined by making the dilutions of different extracts of garlic and ginger ranging from 100 mg/ml to 1.5625 mg/ml. The MIC values of different ginger and garlic extracts are summarized in Figure 1. The results showed that MIC of different extracts of ginger and garlic against bacterial strains ranged from 1.5625mg/ml to 5.0 mg/ml respectively. The data in Figure 1 indicated that all tested strains were susceptible to ginger and garlic aqueous, methanol and ethanol extract. From all MIC values of different ginger extracts, lowest MIC values for *E. coli*, *S. typhi*, *S. aureus*, and *P. aeruginosa*, was 1.5625mg/ml, respectively. Aqueous and ethanol extract of ginger had lower MIC in comparison to the ginger methanol extract against tested bacterial strains (Figure 1). In the case of different garlic extracts, the lowest MIC value for *E. coli*, *P. aeruginosa*, *S. aureus*, and *S. typhi* (1.5625mg/ml) was observed with garlic aqueous extract. It is interesting to note that clinical isolates, both Gram negative and Gram positive bacteria were sensitive to all tested extracts of garlic and ginger but Gram positive bacteria were more sensitive compared to Gram negative bacteria as shown by the mean zone of inhibition in figure 2. This result is in accordance with the findings of Chandarana *et al.* (2005) and De-Souza *et al.* (2005).Table 2a and 2b shows the antimicrobial activity of ginger aqueous, methanol and ethanol extracts and garlic aqueous, methanol and ethanol extracts respectively at the different concentration ranging from 100 to 10mg/ml.

Table 1: The antimicrobial activities of aqueous, methanol and ethanol extracts of ginger and garlic on *Escherichia coli, Salmonella typhi, Staphylococcus aureus, Pseudomonas aeruginosa*.

Isolates	Ginger Aqueous Extract	Ginger Methanol Extract	Ginger Ethanol Extract	Garlic Aqueous Extract	Garlic Methanol Extract	Garlic Ethanol Extract
E. coli	++	++	++	++	++	++
S. typhi	++	++	++	++	++	++
S. aureus	++	++	++	++	++	++
P.aeruginosa	++	++	++	++	++	++

Key: ++ = Antimicrobial activities; -- = No antimicrobial activities

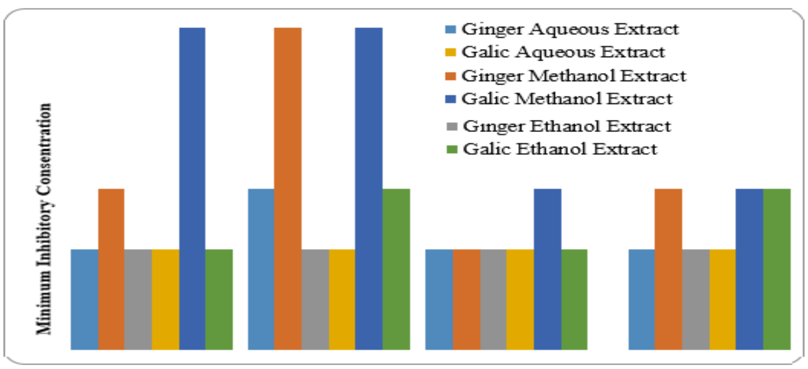

Fig 1: Shows the minimum inhibitory concentration (MIC) of aqueous, methanol and ethanol extracts of ginger and garlic against the organism tested. The MIC ranges from 1.5625to 5mg/ml for the tested organism. The lowest concentration that did not permit any visible growth when compared with the control was considered as the minimum inhibitory concentration.

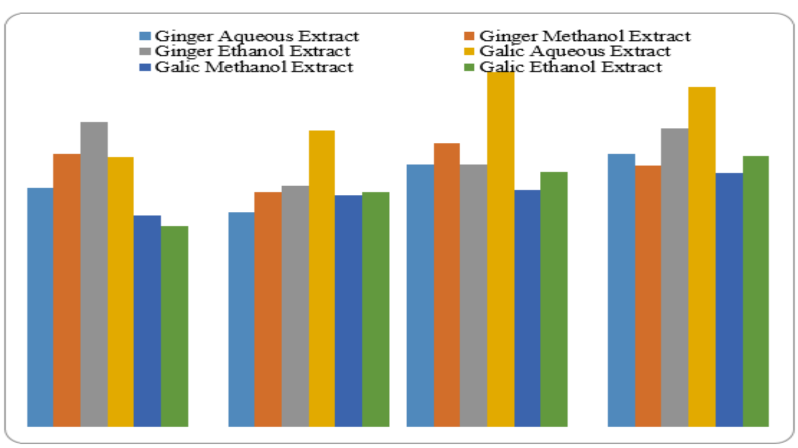

Fig 2: The Mean Diameter of Zone of Inhibition (mm) of the extracts of Ginger and Garlic.

Table 2a: Diameter of zone of inhibition (mm) of the different concentration of aqueous, methanol and ethanol extracts of ginger

Clinical isolates/ Conc.(mg/ml)	Ginger Aqueous Extract					Ginger Methanol Extract					Ginger Ethanol Extracts				
	100	75	50	25	10	100	75	50	25	10	100	75	50	25	10
E.coli	23.6±0.01	20.2±0.25	17.4±0.00	14.1±0.81	11.3±0.00	27.9±0.08	24.0±0.03	18.2±0.23	16.8±0.00	12.1±0.00	29.7±0.05	25.4±0.08	22.0±0.00	18.6±0.02	14.7±0.05
S. typhi	21.8±0.05	19.0±0.72	16.0±0.00	12.0±0.34	9.0±0.00	22.6±0.02	20.1±0.00	17.0±0.98	14.4±0.12	11.1±0.03	23.0±0.00	20.0±0.01	17.4±0.00	15.0±0.32	12.0±0.00
S. aureus	26.0±0.95	22.4±0.00	19.1±0.25	15.4±0,25	12.0±0.00	28.4±0.25	24.0±0.20	20.0±0.05	17.3±0.00	12.9±0.63	25.8±0.00	21.8±0.09	18.8±0.06	15.9±0.09	12.8±0.06
P. aeruginosa	26.1±0.24	23.0±0.00	19.9±0.78	17.0±0.00	13.0±0.21	26.6±0.09	21.9±0.09	18.6±0.00	15.5±0.22	11,9±0.39	29.0±0.00	26.0±0.05	20.7±0.02	17.9±0.25	14.6±0.08

Table 2b: Diameter of zone of inhibition (mm) of the different concentration of aqueous, methanol and ethanol extracts of garlic

Clinical isolates Conc. (mg/ml)	Garlic Aqueous Extract					Garlic Methanol Extract					Garlic Ethanol Extract				
	100	75	50	25	10	100	75	50	25	10	100	75	50	25	10
E.coli	27.5±0.71	23.0±0.00	20.1±0.05	15.0±0.65	12.0±0.00	22.4±0.25	19.0±0.00	15.0±0.01	12.3±0.07	8.0±0.00	20.9±0.05	18.0±0.75	15.0±0.00	11.0±0.05	7.9±0.75
S. typhi	30.9±0.05	26.0±0.05	21.0±0.00	16.6±0.25	12.9±0.00	24.7±0.05	20.8±0.04	17.2±0.09	13.0±0.00	8.2±0.05	24.5±0.00	20.0±0.00	17.4±0.25	13.0±0.00	10.0±0.01
S. aureus	37.5±0.00	32.0±0.00	26.8±0.75	19.0±0.00	13.0±0.00	22.5±0.75	20.0±0.00	18.2±0.02	14.0±0.06	11.0±00	25.2±0.00	21.9±0.79	18.0±0.00	15.2±o,45	12.2±0.24
P. aeruginosa	36.0±0.00	32.0±0.01	25.0±0.00	17.9±0.05	12.0±0.00	23.5±0.07	21.1±0.25	19.0±0.01	16.4±0.32	12.0±0.71	26.4±0.02	23.5±0.75	19.0±0.00	16.4±0.05	12.9±0.98

Table 2a shows that ginger ethanol extract exhibited the highest antimicrobial activity against *E. coli S. typhi* and *P. aeruginosa* while methanol extract exhibited highest antimicrobial activity against *S. aureus* at 100mg/ml. This shows that ginger ethanol extracts are more effective against all tested bacterial strains except *S. aureus*. *E. coli* and *P. aeruginosa* showed maximum susceptibility to the ginger ethanol extracts. The results of antimicrobial effect of ginger in this study is in accordance to the reports of Sebinoma *et al.* (2011); Gao and Zhang, (2010); Yu *et al.* (2009); Malu *et al.* (2008); and Akoachere *et al.* (2002). The antibacterial activities of the extracts were expected, perhaps due to the presence of compounds like flavonoids, gingerol and volatile oil which were dissolved in organic solvents. It is reported that flavonods and gingerol are the main component of ginger which attributes to its antibacterial activity (Malu *et al.*, 2008). The results obtained in this study corroborate with the report of Borris (1996), which explains that bioactive compounds of ginger rendering antimicrobial activity are volatile in nature and antimicrobial activity of ginger extract decreases upon storage. Apart from aqueous, methanol and ethanol were also used for extract preparation as De-Boer *et al.* (2005) has reported that bioactive compounds show better solubility in water miscible organic solvents.

Table 2b shows that garlic aqueous extract exhibited highest antimicrobial activity against all tested bacteria at concentration of 100mg/ml. The antimicrobial activity shown by garlic extracts in this study agrees with the findings of Belguith, *et al.* (2010); Yin *et al*. (2002); Bakht *et al.* (2011); Iwalokun *et al.* (2004) and O'Gara *et al*. (2000). Figure 2 shows the mean diameter of zone of inhibition (mm). From figure 2, it was observed that garlic aqueous had higher and more effective antimicrobial activity against the tested organisms with mean diameter zone of inhibition (mm) of 19.52±0.56, 21.48±0.32, 25.66±0.75, and 24.58±0.97 for *E. coli*, *S. typhi*, *S. aureus*, and *P. aeruginosa* respectively. This shows that garlic aqueous extract is more effective for the treatment of infections caused by *E. coli*, *S. typhi*, *S. aureus*, and *P. aeruginosa* as compared to ginger aqueous extract with mean diameter of zone of inhibition of 17.32±0.09, 15.56±0.22, 18.98±0.15 and 19.8±0.22 for *E. coli*, *S. typhi*, *S. aureus*, and *P. aeruginosa* respectively, while ginger methanol extract is more effective against the entire test organism with mean diameter of 19.8±0.25, 17.04±0.21, 20.52±0.45 and 18.9±0.99 for *E. coli, S. typhi*, *S. aureus*, and *P. aeruginosa* respectively compared to garlic methanol extract with mean diameter of zone of inhibition (mm) of 15.34±0.10, 16.78±0.30, 17.14±0.58 and 18.4±0.82 for *E. coli*, *S. typhi*, *S. aureus*, and *P. aeruginosa* respectively. Ginger ethanol extract is also effective against the entire tested organism with mean diameter of zone of inhibition (mm) of 22.08±0.65, 17.48±0.59, 19.02±0.50 and 21.64±0.40 for *E. coli*, *S. typhi*, *S. aureus*, and *P. aeruginosa* respectively when compared to garlic ethanol extract with mean diameter of zone of inhibition (mm) of 14.56±0.10, 16.98±0.81, 18.5±0.54 and 19.64±0.22 for *E. coli*, *S. typhi*, *S. aureus*, and *P. aeruginosa* respectively. Generally, it can be inferred that the ginger extracts have higher antimicrobial activity when compared to garlic extracts. The results obtained in this study showed the relatively higher therapeutic efficacy of plant materials (spices) being used as an alternative medicine.

Conclusion: The results obtained in this study showed an explanation for the relatively higher therapeutic efficacy of spices. Both garlic and ginger have antibacterial activity. Garlic and ginger have activity on both Gram positive and Gram negative bacteria. There are several advantages for the use of spices as dietary supplement or alternative medicine manifested by reduction the chance for developing antibiotic-resistant bacteria that resulted from the frequent use of antibiotic, besides decreasing the cost of treatment and also minimizes the development of adverse drug reactions.

REFERENCE

Adeshina, GO; Jibo, S; Agu, VE and Ehinmidu, JO. (2011): Antibacterial activity of fresh juices of *Allium cepa* and *Zingiber officinale* against multidrug resistant bacteria. *Inter. J. Pharma. Biosci.* 2:289–295

Akoachere, JF; Ndip, RN; Chenwi, EB; Ndip, LM; Njock, TE; and Anong, DN; (2002). Antibacterial effect of *Zingiber officinale* and Garcinia kola on respiratory tract pathogens. *East Africa Med. J.* 79:588–592.

Ansari, MA; Ahmed, SP; Haider, S and Ansari, NL (2006). Nigella sativa: A nonconventional herbal option for the management of seasonal allergic rhinitis. *Pakistan J. Pharma.* 23:31–35.

Avato, P; Tursil, E; Vitali, C; Miccolis, V and Caddido, V (2000): Allyl sulfide constituents of garlic volatile oil as antimicrobial agents. *Phytomed*, 7:239–243.

Bakht, J; Tayyab, M; Ali, H; Islam, A and Shafi, M (2011). Effect of different solvent extracted sample of *Allium sativum* (Linn) on bacteria and fungi. *Afr. J. Biotech.* 10:5910–5915.

Belguith, H; Kthiri, F; Chati, A; Sofah, AA; Hamida, JB and Landoulsi, A (2010). Study of the effect of aqueous garlic extract (*Allium sativum*) on some *Salmonella serovars* isolates. *Emir J. Food Agric.* 22:189–206.

Belguith, H; Kthiri, F; Chati, A; Sofah, AA; Hamida, JBand Landoulsi, A (2010). Study of the effect of aqueous garlic extract (*Allium sativum*) on some *Salmonella serovars* isolates. *Emir J. Food Agric.* 22:189–206.

Borris, RP (1996). Ginger and Garlic: Nutural Product Research, perspective from a major pharmaceutical company. *J. Ethnopharmacol*, 51: 29-38

Chandarana, H; BAluja, S and Chanda, SV (2005).Comparison of Antibacterial Activities of Selected Species of Zingiberaceae Family and Some Synthetic Compounds. *Turkey J. Biology*, 29:83–97.

De-Boer, HJ; Kool, A; Mizirary, WR; Hedberg, I and Levenfors, J. (2005).Antifungal and antibacterial activity of some herbal remedies from Tanzania. *J. Ethanopharmacol*. 11: 231 -235

Deresse, D (2011). Antibacterial effect of garlic (*Allium sativum*) on *Staphylococcus aureus*: An in vitro study. *Afr. J. Biotechnol.* 10 (4). 666-669

De-Souza, EL; Stamford, TLM; Lima, EO; Trajano, VN and Filho, JMB; (2005). Antimicrobial Effectiveness of Spices: an Approach for Use in Food Conservation Systems. *Brazilian Arch Biol. Tech.,* 48:549–558.

Duman-Aydyn, B. (2008): Investigation of antibacterial effects of some medicinal plants and spices on food pathogens. *Kafkas. Univ Vet Fak. Derg*, 14:83–87.

Durairaj, S; Srinivasan, S and Lakshmanaperumalsamy, P (2009). In vitro Antibacterial Activity and Stability of Garlic Extract at Different pH and Temperature. *Elect. J. Biol.* 5(1): 5-10

Erdogrul, OT (2002): Antibacterial activities of some plant extracts used in folk medicine. *Pharm. Biol.,* 40:269–273.

Fu, YJ; Zu, YG; Chen, LY; Shi, XHG; Wang, Z; Sun, S; Efferth, T (2007).Antimicrobial Activity of clove and rosemary essential oils alone and in combination. *Phytother Res*, 21:989–999.

Gao, D; and Zhang, Y (2010).Comparative antibacterial activities of crude polysaccharides and flavonoids from *Zingiber officinale* and their extraction. *Asian J. Traditional Med.* 5:235–238.

Gardner, CD; Lawson, LD; Block, E (2017). Effect of raw garlic vs commercial garlic supplements on plasma lipid concentrations in adults with moderate hypercholesterolemia: a randomized clinical trial. *Arch. Intern. Med*. 167(4): 346-353

Gull, I; Saeed, M; Shaukat, H; Aslam, SM; Samra, ZQ; Atha, AM (2012).Inhibitory effect of *Allium sativum* and *Zingiber officinale* extracts on clinically important drug resistant pathogenic bacteria. *Annals of Clinical Microbio. Antimicrobials*, 11:8:1-6

Gur S; Turgut-Balik, D; Gur, N (2006). Antimicrobial activities and some fatty acids of turmeric, ginger root and linseed used in the treatment of infectious diseases. *World J. Agric. Sci.* 2:439–442.

Hoffman, T (2007).Antimicrobial activity of some medicinal plants from India. *Hawaii Med. J*. 66: 326-327.

Iwalokun, BA; Ogunledun, A; Ogbolu, DO; Bamiro, SB; Jimi-Omojola, J (2004). In Vitro antimicrobial properties of aqueous garlic extract against multidrug-resistant bacteria and *Candida* species from Nigeria. *J Med Food*, 7:327–333.

Kirby-Bauer, A (1996): Antimicrobial sensitivity testing by agar diffusion method. *J. Clin. Pathol,* 44:493.

Kris-Etherton, PM (2002). Bioactive compounds in foods: Their role in the prevention of cardiovascular disease and cancer. *Journal of American Med*icine 113: 71s-88s.

Langner, E; Griefenberg, S; Gruenwald, J (2008): Antimicrobial activity of Ginger (*Zingniber officinalist*) in vitro. Adu. *Their*. 25: 44.

Malu, SP; Obochi, GO; Tawo, EN; Nyong, BE (2008) Antibacterial activity and medicinal properties of ginger (*Zingiber officinale*).*Global J Pure Appl. Sci*, 15:365–368.

NCCLS. (2000). Performance Standards for Antimicrobial Disk and Dilution Susceptibility Tests for Bacteria Isolated from Animals; Approved Standard, Second Edition. NCCLS document M31-A2. NCCLS, 940 West Valley Road, Suite 1400, Wayne, Pennsylvania 19087-1898, USA.

O'Gara, EA; Hill, DJ; Maslin, D.J (2000).Activities of garlic oil, garlic powder, and their dially constituents against Helicobacter pylori. *Appl. Environ. Microbiol*, 66:2269–2273.

Oskay M; Oskay, D; Kalyoncu, F (2009). Activity of some plant extracts against multi drug resistant human pathogens. *Iranian J Pharmacol. Res*. 8:293–300.

Sagdic, O (2003): Sensitivity of four pathogenic bacteria to Turkish thyme and wild marjoram hydrosols. *Lebensm Wiss Technol*. 36:467–473.

Sebiomo, A; Awofodu, AD; Awosanya, AO; Awotona, FE; Ajayi, AJ (2011).Comparative studies of antibacterial effect of some antibiotics and ginger (*Zingiber officinale*) on two pathogenic bacteria. .*J. Microbiol Antimicro*. 3:18–22.

Teferi, G; Hahn, HJ (2002).Treatment of malaria in Ethiopia folk medicine. *Trop. Doc*. 32: 206-207.

Vuorelaa, P; Leinonenb, M; Saikkuc, P; Tammelaa, P; Rauhad, JP; Wennberge, T; Vuorela, H. (2004): Natural products in the process of finding new drug candidates. *Curr Med Chem*, 11:1375–1389.

Weil, A. (2005). Antimicrobial activity of ginger against different microorganisms: New York, pp. 300-308.

White, B. (2007). Antimicrobial activity of ginger against different microorganisms: *Physician*, 75: 1689-1691.

Yeh, YY; Liu, L. (2001). Cholesterol lowering effect of garlic extracts and organosulfur compounds: Human and Animal studies. *J. Nutr*. 131: 989s-993s.

Yin, MC; Chang, HC and Tsao, SM (2002).Inhibitory Effects of aqueous garlic extract, garlic oil and four diallylsulphides against four enteric pathogens. *J Food Drug Anal*, 10:120–126.

Yu, J; Yun, CH; Gao, ZJ; Zhao, XF; Xiao, CN; Fang, MF; Zheng, XH (2009). Study on antimicrobial of ginger extracting components. *Nat Prod Res Dev*, 21:459–461.

Yusha'u, M; Garba, L; Shamsuddeen, U (2008). In vitro inhibitory activity of garlic and ginger extracts on some respiratory tract isolates of gram-negative organisms. *Int. J. Biomed Hlth. Sci.* 4:57–60