International Journal of Research and Publication
ISSUE 5 VOL. 3 (MAY 2024)

Comparative Study on the Antimicrobial Activity of Turmeric and Garlic extracts on Staphylococcus aureus and Salmonella typhi

Chukwu A.P. and Okpalaji V. O

Abstract

The aim of this study was to evaluate the antibacterial activity of aqeous and alcohol extracts of garlic and turmeric against Staphylococcus aureus and Salmonella typhi The antibacterial activities were investigated using the agar disc difussion. Garlic and turmeric extracts were used to determine the antibacterial activity against the test microorganisms at concentrations of 120mg/ml, 80mg/ml,

40mg/ml. Alcohol extracts of garlic at varying concentrations exhibited significant inhibitory efects against the test microorganisms , with a zone of inhibition Ranging from 7mm to 40mm against Salmonella typhi and 14mm to 20mm against Staphylococcus aureus . The aqueous extract demonstrated weak inhibitory activity against the test microorganisms. Conversely, the aqueous and alcohol extracts of turmeric exhibited no inhibitory effects against the test microoganisms, indicating bacterial resistance . This study has established that the extracts of Allium sativum have antibacterial activities against Salmonella typhi and Staphylococcus aureus.

Keywords: Antibacterial activity, Salmonella typhi, Staphylococcus aureus,garlic, turmeric, zone of inhibition.

INTRODUCTION

Spices have been indispensable components of cuisines since ancient times and are considered medicinal purposes for several centuries due to their extensive antimicrobial and antioxidant properties. The activity of herbs and spices are not only limited to boosting flavor, but also recognized for their preservative and

medicinal value (Panpatil et al., 2013). Garlic (Allium sativum), belongs to Alliaceace, comprises numerous discrete cloves whereas leaves and stems are sometimes eaten, particularly whole, immature and tender. It is claimed to help prevent heart disease including antherosclerosis, high cholesterol, high blood pressure and to improve the immune system as well as protection against cancer (Maryland , 2006). Garlic with its antibacterial properties are effective against acid-fast, gram-positive and gram-negative bacteria such as Salmonella , Escherichia coli, Pseudomonas, Proteus, Staphylococcus aureus, Klebsiella, Micrococcus, Bacillus subtilis,Clostridium,

Mycobacterium, and Helicobacter (Akeem et al., 2016).

In 1996, Reuter et al. described garlic as a plant with various biological properties like antimicrobial, anticancer, antioxidant, as well as different properties such as antiviral, antifungal, expectorant, antiseptic, anti-histamine (Hannan et al., 2001).

Turmeric (Curcuma longa) is a member of the ginger family Zingiberceace.rious sesquiterpenes and curcuminoids have been isolated from the rhizome of C. longa, attributing a wide array of biological activities, anti-inflammatory, wound healing, anticancer and antibacterial (Sandur et al., 2007). Uncontrolled use of chemical antimicrobial preservatives has been the inducing factor for the appearance of more and more microbial strains resistant to classic antimicrobial agents (Kiessling et al., 2002). Increasing use of chemicals and antimicrobials have created a situation leading to an ecological imbalance and enrichment of multiple multi-resistant pathogenic microorganisms.

Salmonella infection remains a major public health concern worldwide, contributing to the economic burden of both industrialized and underdeveloped countries through the costs associated with surveillance, prevention and treatment of disease (Crump et al., 2004). The major dissemination routes of the pathogens involve trade in animals and uncooked animal food products. The slaughtering process of food animals at abattoirs is considered one of the important sources of organ and carcass contamination with Salmonella (Gillespie et al., 2005).

Salmonella typhi is the etiological agent of typhoid fever, while paratyphoid fever is caused by S. paratyphi A, B and C. since the clinical symptoms of paratyphoid fever are indistinguishable from typhoid fever, the term ‘enteric fever ’ is used collectively for both fevers and both S. Typhi and S. paratyphi are referred to as typhoid salmonellosis (Connor and Schwartz, 2003).

The emergence of antimicrobial resistance in Salmonella strains is a serious health problem worldwide (Chiu et al., 2002). In the early 1960s, the first incidence of Salmonella resistance to a single antibiotic, namely chloramphenicol, was reported (Montville and Matthews 2008). Since then, the frequency of isolation of Salmonella strains with resistance towards one or more antimicrobial agents has increased in many countries, including the USA, the UK and Saudi Arabia (Yoke-Kqueen et al., 2008). Antimicrobial agents such as ampicillin, chloramphenicol and trimethoprim– sulfamethoxazole are used as the traditional first line treatments for Salmonella infections. Salmonella spp. resistant towards these agents are referred to as multi-drug resistant (MDR).

METHODS

Sample collection

The turmeric and garlic samples used for the study were purchased from Eke Oko market, Anambra state, Nigeria.

Collection of test organisms. The test organisms ; Staphylococcus aureus and Salmonella typhi were obtained from the Microbiology laboratory unit of Medical, Federal polytechnic Oko, Anambra state Nigeria.

Confirmation of the test organism

The test organism obtained were confirmed by gram stain and performing appropriate biochemical test.

Preparation of Extracts

The spices were dried fruits of turmeric, and fresh bulbs of garlic. The separable part (husk) of garlic was removed and the spices were washed with distilled water, air dried and ground finely in a laboratory blender. For preparation of extracts, 25g of ground and air- dried spice material was shaken with 100 ml of 96% (w/v) ethanol at room temperature with continuous stirring for 4 days. The collected extracts were concentrated using a rotary vacuum evaporator (Ika, Germany) and further the ethanol was evaporated to dryness using a vacuum oven at 40 ˚ C. The extracts were weighed and dissolved in alcohol to a concentration of 120mg/ ml 80mg/ml, 40mg/ml and stored at refrigeration temperature in sterile vials for further experiments.

Preparation of inoculums

Bacterial strains were grown on Salmonella-Shigella agar and Mannitol Salt agar. Bacterial inoculums were prepared from overnight grown cultures in peptone waterand the turbidity was adjusted equivalent to 0.5 McFarland units (approximately10^2 CFU/ml for bacteria inoculums turbidity was equivalent to 106 CFU/ ml). The microorganisms were inoculated into peptone water and incubated at 35 ± 2 ˚ C for1-2 hr.

Screening of Extract for Antimicrobial Activity

To assess the antimicrobial activity of Curcuma longa and Allium sativium extract, the agar well diffusion method was used . In this method , water and alcohol extracts served as the positive controls .This approach involves creating wells in an agar medium,into which the test substances (Curcuma longa and Allium sativium extract) are introduced. The remaining well which served as negative control had distilled water and alcohol.

Agar well diffusion method

Antimicrobial study was carried out using the agar well diffusion method. The petri-plates containing Mueller Hinton agar were spread with inoculums with a sterile glass spreader. Agar wells were prepared with the

help of sterilized cork borer with 6mm diameter. Using a micropipette, 100µl each, the three different concentrations (120mg/ml, 80mg/ml and 40mg/ml) of alcohol and distilled water extract of garlic and turmeric were introduced to different wells in the plates. The plates were incubated in an upright position for a period of 24hr at 37 degree Celsius.

Microorganisms showing a clear zone of more than 12 mm were considered to be inhibited.

RESULTS

Antimicrobial activity observed for the alcohol extract of *Allium sativium* against *Staphylococcus aureus* and *Salmonella typhi* was higher than that of the aqueous extract.The diameter for zone of inhibition for alcohol garlic extract ranged from 40mm to 20mm at various concentrations used.The aqueous extract of garlic had lower zone of inhibition of 10mm for both *Staphylococcus aureus* and *Salmonella typhi (*Table 1). The extract of tumeric for both alcohol and water showed no

antimicrobial activity against *Staphylocuccus aureus* and *Salmonella typhi* .

Table 1: Zone of Inhibition of Garlic Extract against *Salmonella Typhi*

Concentration/ mg	Aqueous Extract/mm	Ethanolic Extract/mm
120	10	40
80	8	36
40	3	7

Table 2: Zone of Inhibition of Garlic Extract against *Staphylococcus aureus*

Concentration/mg	Aqeous Extract/mm	Ethanolic Extract/mm
120	10	20
80	10	17
40	7	14

Table 3: Zone of Inhibition of Tumeric Extract against *Salmonella Typhi*

Concentration/mg	Aqeous extract	Ethanolic Extract

120	-	-
80	-	-
40	-	-

Table 4: Zone of Inhibition of Tumeric Extract against *Staphylococcus aureus*

Concentration/mg	Aqeous Extract/mm	Ethanolic Extract/mm
120	-	-
80	-	-
40	-	-

Discussion

In the present study, alcohol extract of Allium sativium showed maximum antibacterial activities against Salmonella typhi and Staphylococcus aureus (Table 1) .A study by Shobana et al. (2009) revealed that alcohol extract of Allium sativum has the highest inhibitory activity against all test bacteria. Allicin has been found to be an active ingredient in garlic and it works as an antimicrobial agent by inhibiting DNA and protein synthesis completely as a primary target (Shobana et al., 2009; Rahiman et al., 2011). Lipid is a part of Staphylococcus aureus membrane, which helps the easy penetration of allicin into the membrane and consequently influences the RNA (Deresse, 2010). The aqueous extract of garlic exhibited a zone of inhibition of 10 mm for Salmonella typhi and Staphylococcus aureus .The water used to prepare the garlic extract could have prevented the liberation of the active ingredient (Allicin), thus affected the result of this study.

Alcohol and aqueous extract of Curcuma longa did not show any inhibitory effect at various concentrations against the test microorganism . The turmeric used for this study could have had low quality and quantity of curcuminoids and chemical components, thus was not able to inhibit the growth of the test microorganisms. The pre-extraction drying process used for this study could have affected the amount of bioactive and phytochemical content of turmeric .These bioactive substances are usually degraded due to high temperature ,high oxygen content , and exposure to radiation (Nguyen et al . 2015).

The alcohol used for the preparation of the turmeric extract could have had impurities which could have affected the result of this study. Also the strains of the test microorganisms used could have been resistant to the aqueous and alcohol turmeric .

The findings of this study is not in accordance with Shahida et al ., (2023) whose work concluded that ethanol extract of Curcuma longa exhibited significant antibacterial actions, while the aqueous extract showed weaker activities.But in accordance with (Bandna, 2013) who concluded that garlic possesses good antibacterial activity against Escherichia coli, Salmonella typhi and Staphylococcus aureus.

Conclusion

This study has shown that the alcohol extracts of Allium sativum have strong antibacterial activity against the test microorganisms which are known human pathogens. It is concluded that the antimicrobial effect of alcohol extract of Garlic was stronger than the aqueous extract and that turmeric has no antibacterial activity against Salmonella typhi and Staphylococcus aureus. This study revealed that garlic may serve as an alternative to synthetic drugs based on the observed antimicrobial properties . It can also be used as a natural antibacterial agent especially when used as a spice in food.

The results obtained from this study reveal that different extracts of Garlic (Allium sativum) have a significant amount of antibacterial activity. However, depending on which solvent is used for the extraction, the antibacterial activities vary. More solvent is therefore recommended to be used for the extraction of garlic to effectively determine the solvent that is most suitable for the extraction of garlic and turmeric.

References

Akeem, K., Adeniyi, B. and James, A. (2016). Effects of spices on growth and survival of Escherichia coli 0157 and Salmonella enterica serovar enteridis in broth model systems and mayonnaise. Food control. 13:399-404

Bandna , C. (2013) . Antibacterial effect of garlic (Allium sativum) and ginger (Zingiber oficinale) against Staphylococcus aureus , Salmonella typhi, Escherichia coli and Bacillus cereus. Journal of Microbiology and Biotechnology and Food sciences .2(4) 2481-2491.

Chiu, C.H., Wu, T.L., Su, L.H., Chu, C., Chia, J.H., Kuo, A.J., Chien, M.S., Lin, T.Y. (2002). The emergence in Taiwan of fluoroquinolone resistance in Salmonella enterica serotype choleraesuis. The New England Journal of Medicine. 346:413–419.

Connor, B.A. and Schwartz, E. (2005). Typhoid and paratyphoid fever in travellers. The Lancet Infectious Diseases. 5:623–628.

Crump, J.A., Luby, S.P. and Mintz, E.D.(2004). The global burden of typhoid fever. Bulletin of the World Health Organization. 82:346–353.

Deresse D. Antibacterial effect of garlic (Allium sativum) on Staphylococcus aureus : An in vitro study.Asian J Med Sci. 2010;2(2):62-5.

Deurenberg, R.H. and Stobberingh, E.E. (2013). "The evolution of Staphylococcus aureus". Infection, Genetics and Evolution. 8 (6): 747–63.

Gillespie, I.A., O'Brien, S.J., Adak, G.K., Ward, L.R. and Smith, H.R. (2005). Foodborne general outbreaks of Salmonella Enteritidis phage type 4 infection, England and Wales, 1992–2002: where are the risks? Epidemiology and Infection. 133: 759–801.

Hannah, G., Morbissen, R. and Fresan, E. (2001). In: Koch HP, Lawson LD, eds. Garlic: the science and therapeutic application of Allium sativum L and related species (2nd edn). Baltimore Williams and Wilkins. Pp1-24.

Kiessling, C.R.,Cutting, J.H., Loftis, M., Kiessling, W.M., Datta, A.R. and Sofos, J.N.(2002). Antimicrobial resistance of food-related Salmonella isolates. Journal ofFood protection 65(4): 603-608.

Maryland, D. (2006). Inhibition of growth of Entamoeba histolytica by Allicin, the active principle of garlic extracts (Allium sativum). Journal of Infectious Diseases. 156:243-244.

Masalha, M., Borovok, I., Schreiber, R., Aharonowitz, Y. and Cohen, G. (2011). "Analysis of transcription of the Staphylococcus aureus aerobic class Ib and anaerobic class III ribonucleotide reductase genes in response to oxygen". Journal of Bacteriology. 183 (24): 7260–7272.

Montville, T.J. and Matthews, K.R. (2008). Food microbiology: an introduction. 2nd ed. Washington, USA: ASM Press.

Nguyen,V.,Van Vuong, Q., Bowyer, M., Van Altena, I.& Scarlett, C. 2015 . Effects of different drying methods on bioactive compound yield and antioxidant capacity of phyllanthus Amarus . Drying Technology 33(8): 1006- 1017.

Panpatil,V.V., Tattari, S., Kota, N., Nimgulkar, C. and Polasa, K. (2013). In vitro evaluation on antioxidant and antimicrobial activity of spice extracts of ginger , turmeric and garlic . Journal of pharmacognosy and phytochemistry 3:143-148.

Rahiman, A.- Parvez, A. K. - Islam, R. - Khan, M. H. 2011. Antibacterial activity of natural spices on multiple drug resistant Eschericha coli isolated from drinking water, Bangladesh . In Annals of Clinical Microbiology , vol 10,

2011, p. 1-4.

Sand ur ,S.K., Manoj, K.P., Bokyung ,S., Pornngarm, K., Vladimir, B. and B harar, B.A (2007) Curcumin,

dimetoxycurcumin and turmerones differentially regulate anti-inflammatory and antiproliferative responses through

ROSindependent mechanism 28:1765-1773.

Schlecht, L.M., Peters, B.M., Krom, B.P ., Freiberg, J.A ., Hansch , G.M., Filler, S.G., Jabra-Rizk, M.A and Shiirtliff , M.E. (January 2015). "Systemic Staphylococcus aureus infection mediated by Candida albicans hyphal

invasion of mucosal tissue ". Microbiology. 161 (pt 1): 168-181.

Shahida, S., Iqra, S., Yasir, N., Fouzia, T., and Samiya, R., (2023) Study of antibacterial properties of turmeric extract against Salmonella typhi and Staphylococcus aureus . Journal of Phytopharmacological communications.

003.002.0431

Shobana, A. V. (2009). A meta-analysis of the effect of garlic on blood pressure.

Journal of Hypertens. 12:463-468.

Shobana , S. - Vidhya , V.G - Ramya, M.2009. Antibacterial activity of garlic varieties (ophioscordon and Sativum) on enteric pathogens . In Current Research Journal of Biological Science , vol 1, 2009, p. 123-126.

Taylor, Tracey A, and Chandrashe khar G %J Statpearls Unakal. 2021.

"Staphylococcus aureus . "

Yoke- Kqueen, C., Learn-Han, L., Noorzaleha, A.S., Son, R., Sabrina S., Jiun-Horng, S. and Chai-Hoon, K. (2008). Characterization of multiple

antimicrobial-resistant Salmonella enterica Subsp. enterica isolated from