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Antibacterial activities of some plants used as condiments and spices in Nigeria

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ABSTRACT

The aim of this experiment was to determine the antibacterial actions of the extracts of garlic, ginger, onion, basil, sweet and hot peppers on some human pathogenic bacteria (*Klebsiella pneumoniae*, *Streptococcus faecalis*, *Corynebacterium diphtheriae*, *Pseudomonas aeruginosa* and *Escherichia coli*). Crude and filtered extracts of the plants were prepared by using water and tested on the pathogenic bacteria by agar diffusion method. All the spices and condiments showed varying antibacterial effects. Garlic was most effective; its extracts inhibited the growth of all the tested microbes with zones of inhibition ranging from 2 to 10 mm. Onion's extracts killed *Kl. pneumoniae*, *Strep. faecalis* and *E. coli*. The onion's crude extract bacteriostatically prevented *Coryne. diphtheriae* and *Ps. aeruginosa* from growing. It was observed that all the tested organisms except *Kl. pneumoniae* and *Strep. faecalis* did not grow in the presence of ginger. Also, filtered extract of the ginger did not inhibit the growth of the *E. coli*. Basil did not stop the growth of the organisms except *Strep. faecalis*. Extracts of sweet and hot peppers appeared inhibitory although crude extract of the former plant did not prevent the growth of *Kl. pneumoniae*. Boiled sweet pepper extract did not stop *Coryne. diphtheriae* from growing. Filtered extract of hot pepper killed *Coryne. diphtheriae* but did not show any zone of inhibition on other microorganisms.

Keywords: Nigerian condiments and spices, antibacterial effect.

INTRODUCTION

Allium sativum (Garlic) is commonly used as a condiment particularly in fish and meat preparations, and in various fruit and vegetable preserves. It has some medicinal properties including effectiveness for high blood pressure, rheumatic and muscular pain, and for giddiness and sore eyes. It is digestive and carminative, and it removes pain in the bowels. It heals intestinal and stomach ulcers. It is nature's best antiseptic for the alimentary canal. It is highly efficacious in torpid liver and dyspepsia. It is a good tonic for the lungs[1]. Onions are the most widely used out of the seven spices of the genus *Allium* for flavouring soups, stews, meat products, sausages, curries and other savoury foods. They are often used as vegetables either boiled, roasted or fried[2].

Ginger (*Zingiber officinale*) belongs to the family Zingiberaceae. The plant is used all over the world largely as a condiment to give aromatic hot taste to curries and various fruit and vegetable preserves. It contains an oleoresin (gingerin) and an essential oil which are responsible for its pungent taste and aromatic odour respectively. Medicinally, it is stomachic, digestive and carminative[1].

Capsicum species (Chillies) are branched shrubs. *C. annum* (red or sweet pepper) is a red pod-like berry fruit. The *C. frutescens* (hot pepper) is a biennial long fruit. The fruits of the former pepper are larger and flesher than those of the latter plant[3]. Chillies have wide applications all over the world. They are mainly used as condiments in raw, ripe and dried forms for flavouring and giving taste to stew, curries, chutney and vegetable dishes or

salads. Their cooked leaves are eaten. Fine powder of chilli is sold as cayenne pepper and the extracts have many pharmaceutical uses. They are pungent stimulants, stomachic and carminative. In small doses they help in the secretion of saliva and gastric juice, and also induce peristaltic movements[1,4]. Lowenfeld and Lowenfeld[5] reported that *C. annum* is used as liniment and for the treatment of diarrhoea, dropsy, toothache, relaxed throat, gout and as a l.iniment. The *C. frutescens* is used for culinary purposes and, as a powerful stimulant and external counter-irritant[6]. *Ocimum viride* (Basil) is another plant which is important in medicine. The leaves of basil are used to flavour sauces, stimulate appetite, digestive system and are made as infusions for headaches and coughs[4-5].

In this work we conducted a preliminary investigation into the antibacterial effects of some plants (garlic, onion, ginger, basil, hot and sweet pepper) commonly employed as spices and condiments in Nigeria.

MATERIAL AND METHODS

The spices and condiments used

Garlic (*Allium sativum*), onion (*A. cepa*), ginger (*Zingiber officinale*), sweet pepper (*Capsicum annum*), hot pepper (*C. frutescens*) and basil (*Ocimum viride*) were obtained from the Oba market in Akure, Ondo State, Nigeria. The human pathogenic bacterial strains used in this study were: *Klebsiella pneumoniae*, *Streptococcus faecalis*, *Corynebacterium diphtheriae*, *Pseudomonas aeruginosa* and *Escherichia coli*. They were obtained from Microbiology Laboratory of Federal University of Technology, Akure, Ondo State, Nigeria.

Preparation of extracts

Crude extracts of garlic, onion and ginger were made by slight modification of the method of Boboye and Dayo-Owoyemi[7]. Peeling and crushing of each (3 g) of the plants were carried out in 6 ml of cooled sterile distilled water with sterile mortar and pestle. Crude extracts of basil, sweet and hot peppers were prepared as stated above by using 15, 20 and 15 gm of each plant with 6, 6 and 12 ml of cooled sterile distilled water respectively. These extracts were screened separately through Whatman number 1 filter paper (Whatman Ltd., England) to obtain the filtered extracts.

In -vitro test

Each of the test microbes was cultured in nutrient broth at 37°C for 24 hours. An aliquot (0.1 ml) of the grown bacterium was inoculated into nutrient agar by pour plating after which a hole (10 mm in diameter) was bored into it and filled with 0.5 ml of each extract. Holes in the control

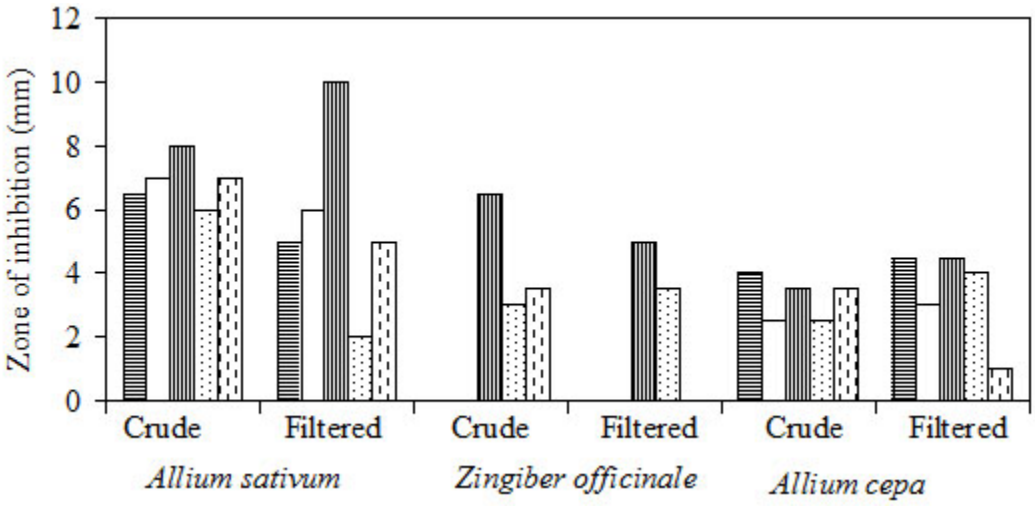


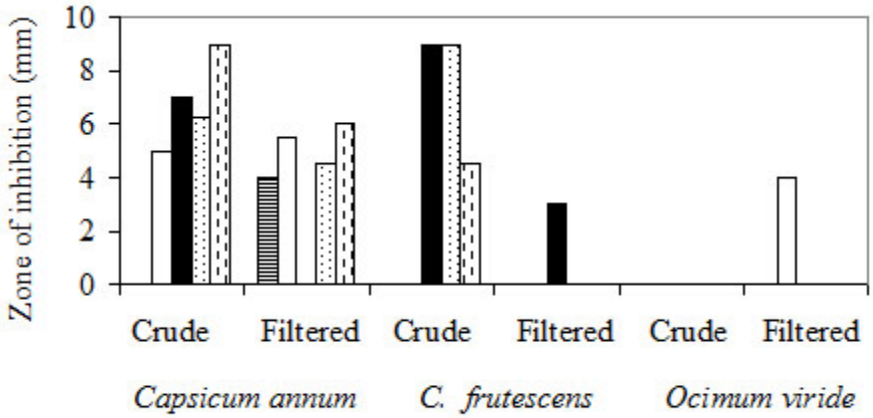
Fig. 1: Effect of *Allium sativum*, *Zingiber officinale* and *A. cepa* on some human pathogenic bacteria.

plates were filled with sterile distilled water. Another set of control was made with nutrient agar which contained each extract but lacked any of the microbes. The plates were incubated 37°C. Observation was made at 24 and 48 hours. Sensitivities of the microbes to the extracts were measured in mm as clear zone around the holes made in the agar.

RESULTS

All the extracts showed inhibitory effects on the pathogenic microbes to varying degrees. Zones of inhibition formed by ginger and onion were lesser in diameter than that of garlic. *A. sativum* was the most effective. Its extract affected the growth of all the organisms with zones of inhibition ranging from 6 to 8 mm and 2 to 10 mm when crude and filtered extracts were used respectively Fig. 1. Ginger did not stop the growth of *Kl.pneumoniae* and *Strep. faecalis* but that of *Coryne. diphtheriae*, *Ps. aeruginosa* and *E. coli* although *E. coli* was not killed by filtered ginger extract. Crude and filtered extracts of onion were inhibitory against all the microorganisms. They formed largest zone with *Kl. pneumoniae*. After 24 hours of incubation, *Coryne. diphtheriae* and *P. aeruginosa* resumed growth in the presence of the crude onion's extract while all the pathogens except *E. coli* were active when the filtered extract was used.

Crude extract of sweet pepper (*C. annum*) killed all the microbes except *Kl. pneumoniae* Fig. 2. Crude extract of *C. frutescens* (hot pepper) did not prevent the growth of *Kl. pneumoniae* and *Strep. faecalis* but killed other pathogens. Filtered extract of the hot pepper was ineffective against all the microbes safe *Coryne. diphtheriae* which zone of inhibition was 4 mm. Besides *Strep. faecalis*, all the microorganisms were resistant to the action of basil.



=, Klebsiella pneumoniae; , Streptococcus faecalis; |, Corynebacterium diptheriae, :, Pseudomonas aeruginosa and ¦, Escherichia coli.

Fig. 2. Effect of *Capsicum annum*, *C. frutescens* and *Ocimum viride* on some human pathogenic bacteria.

DISCUSSION

All the plants have antibacterial effect on the tested human pathogenic microbes at various levels. Similar results were reported by Zohri *et al*.[8] who showed that onion was effective against some Gram negative bacteria and one Gram positive bacterium (*Kl. pneumoniae*).

Garlic, ginger, basil, hot and sweet peppers were bacteriocidal in activity. Crude extract of onion inhibited the growth of *Kl. pneumoniae*, *Strep. faecalis* and *E. coli* by killing the cells. Bacteriocidal effect of antimicrobial agent is indicated by irreversible inhibition of the growth of the organisms[9]. The onion's (crude) extract's inhibitory action on *Coryne. diphtheriae* and *P. aeruginosa* and its filtered

extract antagonistic effect on *Kl. pneumoniae*, *Strep. faecalis*, *Coryne. diphtheriae* and *Ps. aeruginosa* was reversible, an indication of bacteriostatic activity at the concentrations at which it was used in this study. This suggests that the concentrations at which the onion extracts were used in this work were lower than their minimum inhibitory concentrations for the respective microbes. Increase in concentrations of the extracts may completely destroy the organisms[10].

Higher effectiveness of the crude than the filtered extracts of the individual plants was due to possible removal of active ingredients of the plants during filteration. However, the higher activity recorded for filtered than crude extracts of onion implies that some constituents of the plant which hindered or reduced its activeness were removed during filteration.

Inhibitory effects of these plants were chiefly caused by the active principles in them. Garlic antimicrobial action could be due to allicin and/or sulphurous compounds like diallyl sulfide and allyl mercaptan[11-12]. Ginger's volatile oil which is made up of zingiberene and non-volatile oleresin (gingerin)[13] may be responsible for the plant's antibacterial effect. Onion's antimicrobial effect is related to its organic sulphur compounds, mostly n-propyl disulphide content[2]. Capsicin contained in the skin, placenta and seeds of the chilli fruit is the active principle responsible for the pungency.

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