Potency of Unripe and Ripe Express Extracts of Long Pepper (*Capsicum frutescens var. baccatum*) Against Some Common Pathogens

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ABSTRACT

Purpose: This study assessed the comparative activity of express extracts of *Capsicum frutescens* var. *baccatum* against some bacterial pathogens such as *Escherichia coli, Staphylococcus aureus, Bacillus subtilis* and *Pseudomonas aerugionsa*. **Materials and Methods:** The ripe and unripe *Capsicum frutescens* var. *baccatum* was obtained from a smallholder farmer in Ndemili, Delta State, Nigeria. The peppers were macerated using pestle and mortar and the extract was obtained through filter-pressing using a double muslin cloth. The extracts were tested for sensitivity using agar well diffusion techniques. **Results:** The various zone of inhibition for *Escherichia coli, Pseudomonas aerugionsa, Staphylococcus aureus, Bacillus subtilis* and *Pseudomonas aeruginosa* were 11.11, 13.00, 12.67, and 10.00 mm, respectively for unripe express extract and 10.33, 11.33, 12.00, and 9.67 mm, respectively for ripe express extracts. In comparison, the unripe pepper had a higher zone of inhibition compared to the ripe extract, though not significantly different at $p>0.05$ for each of the isolates. **Conclusion:** The inhibition by the unripe and ripe express extracts of *Capsicum frutescens* var. *baccatum* is an indication that they are potential broad-spectrum antibiotics.

Key Words: *Antibacterial, Capsicum frutescens, Express extracts, Medicinal Plants, Zone of inhibition*

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INTRODUCTION

Pepper is used as spice and medicine in several parts of the world. Peppers are used as spices to enhance desired aroma, color and flavor. Pepper belongs to the genus *Capsicum* and family Solanaceae. It has several nutritional characteristics including Vitamins A, C, and Carotene (which enhance proper growth and functioning of some essential organs in humans), minerals (which aid the body to withstand stress, cold and stimulate mucous that protects intestinal lining from an ulcer). The pepper also contains some important essential trace metals such as iron, manganese, lead, cobalt, chromium, zinc and copper. These trace metals play an essential role in metabolic and physiological functions in the body at a certain concentration [1-8].

The sharp taste of *Capsicum* peppers is due to the mixture of seven related alkaloids of which capsaicin is the most

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predominant. Capsaicinoid alkaloid (which has biological and therapeutic characteristics) is responsible for the pungency smell. Furthermore, pepper has been widely reported to contain bioactive ingredients including flavonoids, tannins, alkaloids and saponins [1].

Several species of *Capsicum* have been documented in the literature. But the major species include *Capsicum annuum, Capsicum chinense, Capsicum baccatum, Capsicum frutescens* and *Capsicum pubescens.* These major species have many taxonomic varieties. Based on morphological characteristics, *C. pubescens* and *C. baccatum* are quite, while *Capsicum annuum, Capsicum chinense* and *Capsicum frutescens* show evidence of similar development based on fruit morphological characteristics. Such complexities are formed among *Capsicum annuum*, *Capsicum chinense* and *Capsicum frutescens* due to overlapping in their morphological characteristics (such as color, calyx and pedicels) [9, 10].

Different *Capsicum* cultivars are known to have pharmacological properties. Some of the varieties of pepper have been studied while some others are yet to be documented in the literature. For instance, *Capsicum annum* which is known to contain capsaicin and capsaicinoids have been reported to have analgesic, antiangiogenic, antiparasitic, antiplatelet, anti-arthritic, antioxidant, antiviral, antifungal, antineoplastic, hypoglycemic, gastroprotective, and larvicidal activities through scientific processes. In different regions of the world, they also have different medicinal uses. For instance, *Capsicum annum* is used for the treatment of dyspepsia, flatulence, constipation, arthritis, menstrual cramps, gangrene, and catarrhal affliction as in colds, cough, asthma and urinary catarrh among Siddha, Ayurveda, Unani and Allopathy [11]. In some regions in Nigeria, some species of pepper are used to treat the wound.

In Nigeria, some varieties of *Capsicum frutescens* are available in local markets. Some of them include *Capsicum frutescens* var. *maxima*, *Capsicum frutescens* var. *minima*, *Capsicum frutescens* var. *chacoense*, *Capsicum frutescens* var. *baccatum* and *Capsicum frutescens* var. *finger*. The antibacterial activities of these varieties of *Capsicum frutescens* have been ascertained using water, ethanol and acetone [1]. Therefore, the current study assesses the antibacterial effectiveness of ripe and unripe express extracts of *Capsicum frutescens* var. *baccatum*.

MATERIALS AND METHODS

Samples procurement, preparations and extraction

The sample of ripe and unripe *Capsicum frutescens* var. *baccatum* was obtained from a smallholder farmer in Ndemili, Delta State, Nigeria. The peppers were macerated using pestle and mortar and the extract was obtained through filter-pressing using a double muslin cloth.

Dilution of the extracts

The previously described dilution process was carried out. The raw extracts were considered as 100% concentration and then diluted into 95%, 90% and 85% of the original volume by sterile water [7, 12-15].

Sources and Preparation of organisms

The four bacterial isolates (*Staphylococcus aureus*, *E. coli*, *Pseudomonas aeruginosa* and *Bacillus subtilis*) used for the study were obtained from Microbiology Units, Federal Medical Centre, Yenagoa, Bayelsa State, Nigeria. The purity and characteristics of the isolates were determined by using the scheme [16]. Each of the isolates were inoculated into sterile peptone water and after 24 hours of incubation at room temperature, they were used for the sensitivity assessment.

Antimicrobial screening of the extracts

The sensitivity assessment was carried out using agar well diffusion techniques as previously described [7, 17-19]. Nutrient agar was prepared according to the manufacturer's instruction, autoclaved and dispensed into sterile Petri dish. When the agar was solidified, about 0.2 ml of the incubated isolates was spread over the solidified agar plates. Triplicate wells of 6 mm diameter were made on the agar plates. Then, after 0.3 ml of each of the concentration of the extracts were dispensed into the agar wells. The plates were labelled accordingly and then for 24 hours at room temperature. The resultant zones of inhibition were measured using meter rule.

Statistical analysis

SPSS software version 20 was used for the statistical analysis. The data obtained were expressed as Mean ± standard deviation. Test of significant at P=0.05 was carried out using one-way analysis of variance between the isolates, and t-test was used to compare zone of inhibition between the ripe and unripe express extracts. Where significant variation occurred for the one-way analysis of variance, the means were separated using Duncan statistics at P=0.05.

RESULTS

Table 1 presents the zone of inhibition at a different concentration of express extracts of *Capsicum frutescens* var. *baccatum* unripe fruits. Various zones of inhibition exhibited by *E. coli*, *Staphylococcus aureus*, *Bacillus subtilis* and *Pseudomonas aeruginosa* were 11.00, 13.00, 12.67, and 10.00 mm, respectively for 100% concentration; 9.33, 10.67, 7.33, and 7.33 mm, respectively for 95% concentration; and 7.33, 8.00, 4.67, and 0.00 mm, respectively for 90% concentration. Statistically, there was no significant difference (*P*>0.05) in most of the isolates for each of the concentrations except for 95% concentration that showed significant variation between *E. coli*, *Staphylococcus aureus* and *Bacillus subtilis*.

Table 1: Zone of inhibition (mm) of extracts of *Capsicum frutescens* var. *baccatum* unripe fruits.

Isolates	100%	95%	90%
E.coli	11.00±1.00a	9.33±0.58b	7.33±0.58a
Staphylococcus aureus	13.00±1.00a	10.67±0.58c	8.00±1.00a
Bacillus subtilis	12.67±2.52a	7.33±0.58a	4.67±4.04a
Pseudomonas aeruginosa	10.00±1.00a	7.33±0.58a	0.00±0.00a

Mean ± standard deviation (*n*=3); Different letters along the column indicate significant variations (*P*<0.05) according to Duncan statistics.

The zone of inhibition at a different concentration of extracts of *Capsicum frutescens* var. *baccatum* ripe fruits are presented in Table 2. The zone of inhibition for *E. coli*, *Staphylococcus aureus*, *Bacillus subtilis* and *Pseudomonas aeruginosa* were 10.33, 11.33, 12.00 and 9.67 mm, respectively for 100% concentration; 8.00, 9.00, 8.67 and 7.33 mm, respectively for 95% concentration; and 7.67, 4.67, 7.67 and 4.67 mm, respectively for 90% concentration. There was no significant variation (*P*>0.05) at 90% concentration. For the 95% concentration no significant variation between the isolates was observed in most of the isolates for each of the concentrations except for *Pseudomonas aeruginosa*, while at 100% concentration significant variations exist between some of the isolates.

Table 2: Zone of inhibition (mm) of an extract of *Capsicum frutescens* var. *baccatum* ripe fruits

Isolates	100%	95%	90%
E.coli	10.33±0.58ab	8.00±0.00ab	7.67±0.58a
Staphylococcus aureus	11.33±0.58bc	9.00±0.00b	4.67±4.04a
Bacillussubtilis	12.00±1.00c	8.67±1.15b	7.67±0.58a
Pseudomonas aeruginosa	9.67±0.58a	7.33±0.58a	4.67±4.04a

Mean ± standard deviation (*n*=3); Different letters along the column indicate significant variations (*P*<0.05) according to Duncan statistics

Table 3 presents the **c**omparative zones of Inhibition (in mm) of unripe and ripe fruit extracts of *Capsicum frutescens* var. *baccatum*. The zone of inhibition for *Escherichia coli, Pseudomonas aerugionsa, Staphylococcus aureus, Bacillus subtilis* and *Pseudomonas aeruginosa were* 11.11, 13.00, 12.67 and 10.00 mm, respectively for unripe express extract and 10.33, 11.33, 12.00 and 9.67 mm, respectively for ripe express extracts. In the comparison, the unripe pepper had a higher zone of inhibition compared to the ripe extract, though not significantly different (*P*>0.05) for each of the isolates.

Table 3: Comparative zones of Inhibition (in mm) of unripe and ripe fruit extracts of *Capsicum frutescens* var. *baccatum*

Isolates	Unripe	Ripe	t-value	p-value
E. coli	11.00±1.00	10.33±0.58	1.000	0.374
Staphylococcus aureus	13.00±1.00	11.33±0.58	0.250	0.067
Bacillus subtilis	12.67±2.52	12.00±1.00	0.426	0.692
Pseudomonas aeruginosa	10.00±1.00	9.67±0.58	0.500	0.649

Data is expressed as mean ± Standard deviation

DISCUSSION

Between the various isolates, not much significant variation exists, but apparent difference occurs. Authors have attributed zone of inhibition between isolates and plant extract to the environmental factors (pH of the medium, temperature, water activity, oxygen and nutrient availability, choice of solvent, source of the organisms, biochemistry, physiology, metabolism and adaptation strategies of the microbes, plant species, biochemistry, age and parts, concentration of the plant extract, and method and period of extraction) [1, 14, 15, 18-26]. The apparent difference that occurred between the unripe and ripe content could be due to the moisture content of the pepper. The zone of inhibition values of each of these bacterium reported in this study had some similarity with the previous works on alligator pepper [12], wonderful and bitter kola [13], lemongrass [27], ginger and lemongrass [7], nutmeg [14], bitter leaf and scent leaf [15], pawpaw [24] and cashew [25]. Due to these effects, authors have attributed the pharmacological characteristics of a plant to the presence of bioactive/phytochemical ingredients in their tissue parts [18, 19, 21, 22]. These peppers, *Capsicum frutescens* var. *baccatum* have been reported to contain phytochemicals such as flavonoids, tannins, alkaloids and saponins [1]. Alkaloids have the tendency to wade off pest including microbes [28]. Flavonoids have been reported to possess antioxidant, antimicrobial and antitumor characteristics [1, 29] also reported that saponin and alkaloids in pepper could also account for its antibacterial activities. Thus, the ability of both unripe and ripe *Capsicum frutescens* var. *baccatum* to inhibit gram-positive and negative organisms suggests that both can be used as broad-spectrum antibiotics development.

CONCLUSION

Plants have emerged as an alternative to many synthetic drugs due to the presence of many active ingredients they possess. In human history, plants have been widely used for the treatment of various kinds of diseases, especially in many developing nations. Peppers are used as spices in the human diet and are also used as active ingredients for some traditional medicine. This study assessed the antibacterial activities of unripe and ripe express extracts of *Capsicum frutescens* var. *baccatum.* The study found that both unripe and ripe have the antibacterial activity against the bacteria under study (*Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis* and *Pseudomonas aerugionsa*). Though the unripe extract had an apparent higher zone of inhibition which was not significant at $P>0.05$ for all the bacterium under study. The activities of these peppers to inhibit both gram positive and gram negative bacteria suggest they could be used as broad-spectrum antibiotics.

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