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Effect of Spoilage on the Antimicrobial Potential and Phytochemical Components of Ginger and Garlic

Osaro-Matthew R. C.*
Department of Microbiology, Michael Okpara Universiy of Agriculture, Umudike, Nigeria
Email: mensahuche@yahoo.com

Itaman V. O.
Department of Microbiology, Michael Okpara Universiy of Agriculture, Umudike, Nigeria

Kogonye J.
Department of Microbiology, Michael Okpara Universiy of Agriculture, Umudike, Nigeria

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Abstract

This study evaluated the effect of microbial spoilage on the phytochemical component and antimicrobial potential of Garlic (*Alliums Sativum*) and Ginger (*Zingiber offinale*). The antimicrobial activities of both spoilt and un-spoilt Ginger and Garlic were assessed by measuring the inhibition zone diameter using agar well diffusion method. The result showed that both spoilt and un-spoilt samples were active against all test organisms with ethanolic extract of un-spoilt Garlic showing the highest activity against *Staphylococcus* sp. and *Aspergillus* sp with mean inhibition zone diameter (21.00mm and 21.50mm) respectively. Similarly the ethanolic extract of un-spoilt Ginger exhibited greatest activity against *Staphylococcus* sp. and *Aspergillus* sp with mean inhibition zone diameter (20.00Smm and 20.00mm) respectively. The preliminary phytochemical screening of the samples revealed the absence of saponin in spoilt samples of both Ginger and Garlic while phenol and flavonoid became more prominent in the both spoilt samples. This study confirms that microbial degradation of some plant extracts does not affect the antimicrobial potential and suggest usage of these products even if spoilage is noticed.

Keywords: Antimicrobial potential; Phytochemistry; *Alliums sativum*, *Zingiber offinale*; Microbial spoilage.

1. Introduction

Plant and plant products such as fruit and vegetable preparations, spices and its extracts have been of use in preservation of food for centuries [1]. Spices are indigenous aromatic plant used to improve organoleptic properties of food. Examples of spices include bulbs (Garlic, Onion), fruits (pepper, chilies), leaves (mint, coriander), rhizomes (ginger, tumeric) and other parts of plant [2]. Spices are also being used as antimicrobial agent for the management and control of food borne pathogens and food spoilage organisms [3].

Garlic (*Alliums Sativum*) is a commonly used spice for enhancing taste of food. It is an edible bulb of family Liliaceae. The aromatic sulphur based compounds present in it contributes to its odor and taste characteristics [4]. Also present in garlic is allicin, a volatile molecule which gives garlic its unique odor and the antimicrobial activity of garlic have been attributed to this volatile molecule [4].

Ginger which is a spice and also a herb (*Zingiber offinale*) belongs to the family Zingerbaracease. It is a tuberous rhizome, a perennial plant [5]. *Zingiber offinale* has been known for its medicinal properties for a long time. Its anti-inflammatory and antimicrobial properties have been exploited in the management of some health conditions such as colds, rheumatism, headache and tumor. *Zingiber offinale* is used as raw materials in most pharmaceutical and cosmetics industries and also as flavoring material in food industries [6].

The antimicrobial effects of ginger and garlic have been reported by several researchers [4, 7, 8] but the ability of microorganisms to breakdown and utilize active ingredient of most food items becomes of concern since plant products and metabolites can be destroyed by spoilage organisms thereby making them less potent [9]. Therefore, the aim of this study is to determine the effect of spoilage on the antimicrobial activities and phytochemical components of ginger and garlic.

2. Materials and Methods

2.1. Sample Collection and Preparation

The test samples ginger and garlic (Unspoilt and spoilt) were obtained from the research programme National Root Crop Research Umudike (NRCRI). The ginger and garlic (rhizome and bulbs) were peeled and cut into slices and were oven dried at 65° C. The dried samples were ground into powdered form and used for further analysis.

*Corresponding Author

2.2. Extraction

The method of Srinivasan, *et al*. [10], was adopted for the extraction. The powdered form of the samples 50g each was soaked in 500ml of 95% ethanol (ethanolic extract) and 500ml distilled water (aqueous extract) for 24hrs. The slurry obtained was shaken vigorously and filtered through Whatman filter paper (No.1). The filtrate was evaporated to dryness over a water bath at 60^{o}C and the extracts from each sample in the different solvent were stored in the fridge for analysis. And to make stock solutions of 500mg/ml, 10mls of water was added to 5000mg of extract.

2.3. Antimicrobial Activity Assay

The antimicrobial activity test was done using Agar well diffusion test method [11]. The test organisms were aseptically inoculated onto sterile Muller Hinton Agar plate by spread plate technique. 6mm size wells were made using a well sterilized cork borer and with the aid of micropipette 50µl of the extract were carefully dispensed into the wells. The plates were incubated at appropriate temperature 37^{o}C for bacteria and room temperature (25^{o}C) for 2 – 5 days for fungi. The antimicrobial activity was assayed by measuring the diameter of the inhibition zone formed around the wells [11].

2.4. Qualitative Analysis and Quantitative Determination of the Phytochemicals

Qualitative and quantitative analysis was carried out to ascertain the presence of the different phytochemicals (Tannin, alkaloid, flavonoid, phenol and saponin) in ginger and garlic (unspoilt and spoilt) adopting the methods of [12, 13].

3. Results

The result of the antimicrobial assay is represented in (Table 1) which shows that both the spoilt and unspoilt giner and garlic had activity against the test organisms, with the ethanolic extracts of both samples showing more activity.

In Table 2 is presented is qualitative phytochemical component of ginger and garlic extracts (unspoilt and spoilt), from the table it can be seen that saponin was absent in the both spoilt samples.

Represented in Table 3 the result of the quantitative assay of phytochemical component of ginger and garlic (Unspoilt and Spoilt) with Phenol the most abundant component in both spoilt and unspoilt ginger and garlic, with the highest percentage obtained in spoilt garlic (0.91%) while the least present component was saponin with the highest value of obtained in unspoilt ginger (0.18%).

Table-1. Antimicrobial Screening of extracts (aqueous and ethanol) of ginger and garlic (Spoilt and Unspoilt)

Samples	***Bacillus* sp (mm)**	***Pseudomonas* sp (mm)**	***Staphylococcus* sp (mm)**	***Aspergillus* sp (mm)**	***Penicillium* sp (mm)**
Unspoilt ginger Aqueous	8.00	12.40	15.00	16.60	14.0
Unspoilt garlic Aqueous	15.00	14.00	17.10	16.50	16.00
Spoilt ginger Aqueous	6.40	8.00	12.00	10.00	9.60
Spoilt garlic Aqueous	10.5	10.00	12.00	10.00	9.70
Unspoilt ginger Ethanol	14.80	17.00	20.00	20.00	18.80
Unspoilt garlic Ethanol	12.00	12.00	21.00	21.50	11.00
Spoilt ginger Ethanol	11.00	13.60	14.20	17.00	13.00
Spoilt garlic Ethanol	8.00	9.50	13.00	15.00	15.30

Values shows means of triplicate analysis

Table-2. Qualitative phytochemical component of ginger and garlic extracts (unspoilt and spoilt)

Samples	**Tannin**	**Alkaloid**	**Flavonoid**	**Phenol**	**Saponin**
Unspoilt ginger	+	+	+	+	+
spoilt ginger	+	+	+	+	-
Unspoilt garlic	+	+	+	+	+
spoilt garlic	+	+	+	+	-

Table-3. Quantitative Screening of Photochemical component of ginger and garlic (Unspoilt and Spoilt)

Samples	Tannin (%)	Alkaloid (%)	Flavonoid (%)	Phenol (%)	Saponin (%)
Spoilt Ginger	0.39	0.47	0.69	0.76	0.00
UN Spoilt Ginger	0.50	0.35	0.37	0.56	0.18
spoilt garlic	0.21	0.65	0.57	0.91	0.00
unSpoilt Garlic	0.27	0.43	0.41	0.75	0.13

Values shows means of triplicate analysis

4. Discussion

This research work exploited the antimicrobial and phytochemical properties of spoilt and unspoilt ginger and garlic. Aqueous and ethanolic extracts of the samples showed activity against both fungi and bacteria used as test organisms. The highest antibacterial activity was against *Staphylococcus* spp. (21.00mm) while the highest antifungal activity was against *Aspergillus* spp. (21.50mm), this is in agreement with the report of some researchers [4, 7].

The result showed that the un-spoilt ginger and garlic exhibited more activity than the spoilt ones which could be attributed to the slight changes that occurred in the phytochemical properties.

The ethanol extract had higher zone of inhibition than the aqueous extract of both ginger and garlic. This could be as a result of ethanol being an organic solvent known for its extraction ability which is in concordance with the work of [14].

This result of antimicrobial effect of ginger in this study are in accordance with most of the reports published regarding ginger antimicrobial activity [7, 14, 15].

The result of the preliminary qualitative analysis of the samples revealed the presence of alkaloid, flavonoid, saponin and phenol which affirms the pharmacological properties of ginger an garlic. this result is in accordance with the result of Huzaifa, *et al.* [16] and that of Nzekwe and Ugwoke [6].

In this study, the quantitative screening of phytochemical component of spoilt ginger and garlic demonstrated abundant of phenol and flavonoid while tannin was absent, this could be attributed to microbial degradation of glycosides into glycon and simple sugars this is in agreement with the work of Ejele and Nwokonkwo [9] and Ejele, *et al.* [17].

5. Conclusion

This result suggest that microorganisms responsible for spoilage probably destroy the saponin to produce aglycin and simple sugar to form their food nutrients. The presence of flavonoid, phenol, and increase tannin and phenol in the spoilt extracts confirmed that the polyphenolic glycoside were probably involved, although the spoilage did not affect the antimicrobial activity of the spices

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