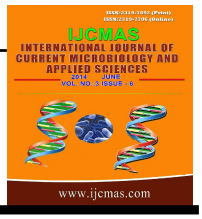
International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 3 Number 6 (2014) pp. 895-901**
http://www.ijcmas.com



Original Research Article

Microbial and Physicochemical Characteristics of Locally Produced Pineapple Juice Treated with Garlic and Ginger

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Keywords

Pineapple juice, garlic, ginger, bacteria, fungi, titratable acidity,

A B S T R A C T

Microbial and physicochemical characteristics of locally produced pineapple juice treated with garlic and ginger were investigated. Pineapple juice was produced by homogenizing the pulp portion of the pineapple fruit in a sterile blender. The juice obtained after filtration was treated with different quantities of garlic and ginger and their effects evaluated during the period of 21 days of storage. A ten-fold serial dilution of both treated and control juice samples were carried out for enumeration of bacteria and fungi on appropriate media. The titratable and pH of the samples were determined using standard methods. Different values of bacterial and fungal counts of both treated and control pineapple juices were obtained during the period of monitoring but the total viable bacterial count ranged from 3.8×10^4 to 4.4×10^8 cfu/ml while the fungal count ranged from 3.0×10^4 to 5.2×10^8 cfu/ml. Similarly, different values of physicochemical parameters of pineapple samples were obtained during the storage period. pH and titratable acidity values ranged from 1.10 to 4.81 and 0.020 to 0.522 respectively. Treatment of pineapple juice with garlic alone generally yielded reduced microbial count than treatment with ginger. Increase in quantity of ginger and garlic in pineapple juice resulted in more reduction in the microbial counts. Comparatively treatment of pineapple juice with 2g of garlic resulted in decreased microbial count than other treatments during the period of storage. The result of this study revealed that the treatment exhibited antimicrobial effect on the microbial load of pineapple juice especially with garlic. Therefore treatment of pineapple juice with ginger and garlic can help to extend the shelf life of the juice.

Introduction

Fruit juices are commonly consumed for their refreshing attribute, nutritive values and health benefits. Fruit juices are easy to process and may be prepared in the home. One of the many popular fruit juice products is the pineapple (*Ananas comosus*) juice.

Pineapple juice is widely consumed by both adult and children. Pineapple juice is a non-alcoholic drink and the demand continues to rise mainly due to increasing consumer awareness of its health benefits. Pineapple juice has a proximate composition of 81.2-

86.2% moisture, 13-19% total soluble solid of which sucrose, glucose, and fructose are the main components, 0.4% fibre and rich source of vitamin C (Dull, 2000). Lipids and nitrogenous compounds constitute about 0.2%. Pineapple juice has an estimated pH range of 3.7-4.5 and titratable acidity of less than 1.2 (Frazier *et al.*, 1995). Raw pineapple juice is an excellent source of calcium, potassium, magnesium and manganese. Pineapple juice if not refrigerated has a very short shelf life. The traditional method of preparation exposes the juice to microbial contamination through various means (Olubukola *et al*, 2011). Pineapple juice is normally dominated by the microbial genera of *Bacillus*, *Staphylococcus*, *Micrococcus*, *Aspergillus*, *Fusarium*, *Rhizopus* and *Penicillium*.

Therefore, there is the need to explore various preservative methods to extend the shelf life as well as reduce the microbial load. The use of some chemical preservatives such as sorbate and benzoate to improve the shelf life of drinks have been reported (Dougheri *et al*. 2007; Nwachukwu and Ezeigbo, 2013). But the use of chemical preservatives in food tends to have adverse effects on the health of consumers (Adesokan *et al*., 2010). Ginger (*Zingiber officinale*) and garlic (*Allium sativum*) are traditionally used as spices in food preparation (Kolapo *et al*., 2007). They also have both antioxidant and antimicrobial activities. Ginger was reported to have bacteriocidal effect against *Escherichia coli* and *Streptococcus* (Smith-Palmer *et al*., 1998). Garlic is widely used in medicine (Karrupiah and Rajaram, 2012).

This study therefore is to determine the effect of ginger and garlic on the physicochemical parameter, microbial load and shell-life of locally produced pineapple juice

Materials and Methods

Source of Samples

The garlic bulbs, ginger rhizomes and fresh ripe mature pineapple fruits were purchased from market in Umuahia, Nigeria. The samples were separately placed in sterile polyethylene bags and transported to the laboratory for analyses.

Production of Pineapple Juice

The pineapple fruits were washed and rinsed thoroughly with potable water. The fruits were peeled with sterile stainless knife. The pineapple fruits were cut into small pieces with a sterile knife and homogenized in a clean electric blender. The extracted juice was filtered by passing through a sterile muslin cloth into a clean transparent plastic bowl (Akinosun, 2010).

Pineapple
↓
Sorting
↓
Washing (with clean water)
↓
Peeling (using sterile stainless knife)
↓
Cutting (using sterile stainless knife)
↓
Extraction (using juice blender)
↓
Filtering (using muslin cloth)
↓
Pineapple juice

Fig.1 Flow chart for the production of pineapple juice
(Source: Akinosun, 2010).

Treatment of pineapple juice with ginger and garlic

The ginger rhizomes and garlic bulbs were washed with potable water repeatedly. Their outer covering was peeled off with a sterile knife and then sliced into cutlets and dried using a hot air oven at 65^{o}C for 48 h. Using a sterile electric blender, the dried ginger or garlic bulb was pulverized into powder. Exactly 1g of ginger powder was added into 200 ml of pineapple juice and 1g of garlic powder was added into another 200 ml of the pineapple juice. Similarly, 2g of the ginger powder was added into another 200 ml of the pineapple juice and 2g of garlic powder was added into another 200 ml of the pineapple juice so as to obtain two different concentrations for ginger-pineapple juice and garlic-pineapple juice.

Determination of the combined effect of mixed ginger and garlic on pineapple juice

Exactly 0.5g of ginger powder was added to 0.5g of garlic powder and 1g of ginger powder was added to 1g of garlic powder to obtain a mixture of 1g and 2g respectively of ginger-garlic powder. The 1 g mixture of ginger-garlic was added to 200 ml of pineapple juice while the 2g mixture of ginger-garlic was added into another 200 ml.

Storage of Samples

The pineapple juice samples containing different concentrations of ginger or garlic and mixed ginger-garlic were stored at ambient temperature (28^{o}C ±2^{o}C) for 21 days. The control sample was 200 ml of the pineapple juice without any treatment.

Enumeration and Isolation of Microorganisms

A ten-fold serial dilution of each of the samples was carried out. Spread plate technique was employed by inoculating 0.1ml of the appropriate dilutions on plate count agar plate (Cheesbrough, 2000) for enumeration of bacteria and on potato dextrose agar for fungal count. The agar plates were incubated at 30^{o}C for 24-48h for bacterial count and at 26^{o}C for 3-5 days for fungal count. Each sample was inoculated in duplicate agar plates and the mean values of bacterial and fungal counts were recorded as colony forming unit per ml (cfu/ml). The yeast and mould colonies were characterized based on their cell or colonial morphological features (Cheesbrough, 2000). Bacterial isolates were identified following Gram reaction, spore staining, motility test and biochemical tests (indole, methyl red, Voges Proskauer, citrate,catalase, coagulase, oxidase, urease, sugar fermentation).

Physicochemical Analysis

Titratable acidity and pH of the samples were determined using standard methods (AOAC, 2000).

Results and Discussion

Table 1 shows the effect of ginger and garlic on the total viable bacterial counts of pineapple juice during storage. The total viable bacterial counts ranged from 3.8 × 10^{8} - 4.4 × 10^{8} cfu/ml. Higher bacterial counts were observed in control samples than the treated pineapple juice during the period of monitoring. The pineapple juice treated with 2g of garlic generally showed decreased bacterial count than other treatment. Table 2 shows the effects of ginger and garlic on the total viable fungal counts of pineapple juice during storage. The total viable fungal counts ranged from 3.0 × 10^{8} - 5.2 × 10^{8} cfu/ml.

Table.1 Effect of ginger and garlic on the total viable bacterial counts (cfu/ml) of pineapple juice during storage

Storage (days)	PJ + GG 1g	PJ + GG 2g	PJ + GL 1g	PJ + GL 2g	PJ + GG + GL 0.5g each	PJ + GG + GL 1g each	Control
0	4.8×10^4	4.7×10^4	4.3×10^4	3.8×10^4	4.6×10^4	4.2×10^4	5.2×10^4
3	5.9×10^4	5.0×10^4	4.9×10^4	4.4×10^4	5.2×10^4	4.7×10^4	6.2×10^4
6	6.2×10^4	5.3×10^4	5.2×10^4	4.7×10^4	5.5×10^4	5.0×10^4	6.5×10^4
9	2.7×10^5	2.4×10^5	2.3×10^5	1.8×10^5	2.5×10^5	2.1×10^5	5.0×10^5
12	2.8×10^5	2.5×10^5	2.3×10^5	1.8×10^5	2.6×10^5	2.2×10^5	7.0×10^5
15	3.0×10^5	2.8×10^5	2.5×10^5	1.9×10^5	2.8×10^5	2.4×10^5	7.3×10^6
18	2.2×10^6	2.1×10^6	1.9×10^6	1.7×10^6	2.0×10^6	1.8×10^6	2.4×10^7
21	5.2×10^6	5.1×10^6	4.7×10^6	4.5×10^6	4.8×10^6	4.6×10^6	4.4×10^8

Values are mean of two determinations

Key: Control = contain neither garlic nor ginger; PJ = Pineapple Juice; GG = Ginger; GL = Garlic;

Table.2 Effect of ginger and garlic on the Total fungal counts (cfu/ml) of pineapple juice during storage

Storage (days)	PJ + GG 1g	PJ + GG 2g	PJ + GL 1g	PJ + GL 2g	PJ + GG + GL 0.5g each	PJ + GG + GL 1g each	Control
0	4.0×10^4	3.9×10^4	3.4×10^4	3.0×10^4	3.7×10^4	3.3×10^4	4.4×10^4
3	4.5×10^4	4.3×10^4	3.9×10^4	3.4×10^4	4.1×10^4	3.7×10^4	5.8×10^4
6	5.2×10^4	5.0×10^4	4.6×10^4	4.1×10^4	4.8×10^4	4.4×10^4	7.5×10^4
9	2.4×10^5	2.0×10^5	1.6×10^5	1.1×10^5	1.9×10^5	1.3×10^5	4.8×10^5
12	2.5×10^5	2.1×10^5	1.6×10^5	1.1×10^5	2.0×10^5	1.4×10^5	2.6×10^6
15	2.4×10^6	2.0×10^6	1.7×10^6	1.5×10^6	1.9×10^6	1.6×10^6	2.2×10^7
18	3.6×10^6	3.5×10^6	3.0×10^6	2.8×10^6	3.1×10^6	2.9×10^6	2.9×10^7
21	5.4×10^6	5.2×10^6	4.8×10^6	4.5×10^6	5.0×10^6	4.3×10^6	5.2×10^8

Values are mean of two determinations

Key : Control = contain neither garlic nor ginger; PJ = Pineapple Juice; GG = Ginger; GL = Garlic

Table.3 Effect of ginger and garlic on the pH of pineapple juice during storage

Storage (days)	PJ + GG 1g	PJ + GG 2g	PJ + GL 1g	PJ + GL 2g	PJ + GG + GL 0.5g each	PJ + GG + GL 1g each	Control
0	4.60	4.68	4.73	4.81	4.70	4.75	4.50
3	4.42	4.46	4.51	4.58	4.49	4.54	4.00
6	4.02	4.06	4.11	4.17	4.07	4.13	3.20
9	3.51	3.54	3.60	3.68	3.56	3.62	2.80
12	3.01	3.04	3.10	3.18	3.06	3.12	2.20
15	2.80	2.83	2.89	2.97	2.85	2.91	2.00
18	2.24	2.28	2.32	2.37	2.28	2.33	1.80
21	2.10	2.14	2.18	2.20	2.14	2.16	1.10

Values are mean of two determinations

Key: Control = contain neither garlic nor ginger; PJ = Pineapple Juice; GG = Ginger; GL = Garlic

Table.4 Effect of Ginger and Garlic on the Total Titratable Acidity of Pineapple juice during storage

Storage (days)	PJ + GG 1g	PJ + GG 2g	PJ + GL 1g	PJ + GL 2g	PJ + GG + GL 0.5g each	PJ + GG + GL 1g each	Control
0	0.032	0.030	0.025	0.020	0.028	0.023	0.036
3	0.053	0.050	0.045	0.035	0.049	0.090	0.088
6	0.083	0.078	0.069	0.061	0.077	0.121	0.099
9	0.106	0.102	0.100	0.095	0.102	0.199	0.120
12	0.122	0.116	0.111	0.106	0.118	0.111	0.131
15	0.133	0.127	0.123	0.115	0.128	0.121	0.233
18	0.257	0.241	0.238	0.233	0.256	0.230	0.334
21	0.348	0.340	0.334	0.334	0.342	0.332	0.522

Values are mean of two determinations

Key: Control = contain neither garlic nor ginger; PJ = Pineapple Juice; GG = Ginger; GL = Garlic

Table.3 shows the effect of ginger and garlic on the pH of pineapple juice during storage. The pH values ranged from 1.10 - 4.81. The pH of the treated pineapple juice and the untreated or control decreased steadily during the period of storage. Table 4 shows the effects of ginger and garlic on total titratable acidity of pineapple juice during storage. The total titratable values ranged from 0.020 - 0.522.

The microbial quality and physicochemical characteristics of locally produced pineapple juice treated with garlic and ginger were investigated. Untreated control sample showed remarkably high microbial load during the period of storage and this may possibly be a major cause of spoilage commonly experienced by the producers of this product. It is evident from this study that the treated samples had lower microbial load when compared with the control sample. Ginger and garlic may have antimicrobial effect which helped to reduce the microbial load of the treated pineapple juice (Smith-Palmer *et al*, 1998; Ayo *et al*., 2003; Omoya and Akharaiyi, 2012).

Though the treatment of pineapple juice with ginger and garlic separately generally showed low microbial load, the combination of the two (garlic and ginger) showed relatively lower count. This could be due to synergistic effect of garlic and ginger treatment against the microorganisms in the pineapple juice. However the magnitude of effectiveness of ginger and garlic treatment on the microbial load of the pineapple juice differed with the concentrations. A decrease in the microbial count was observed with increase in the concentration of garlic or ginger. Generally the effects of ginger or garlic on the microbial load of pineapple juice decreased with storage time and this could be due to microbial degradation.

There was a decrease in pH of all the pineapple juices especially the untreated control during storage period. The reason for this may be attributed to greater microbial activities since the decrease was observed more in the untreated control sample. On the other hand the titratable acidity increased with storage days with the untreated control pineapple juice producing higher titratable acidity than the treated samples. The changes in pH and total titratable acidity of the treated and untreated pineapple juices during storage period could be due to fermentation process by microorganisms.

The different treatments of pineapple juices with garlic or ginger have shown the potential to extend the shelf-life of pineapple juice especially the treatment with garlic alone at 2 gram in 200ml which recorded lower microbial count . Therefore, the treatment of pineapple juice with garlic or ginger or both is recommended as preservatives for pineapple juice. However, practice of good hygiene during the preparation of any fruit juice should be adopted to avoid microbial contamination of public health significance.

S. pneumonia and *S. aureus* were the most frequent gram positive pathogens from throat, whereas gram negative pathogens including *Klebsiellaspp. P. aeruginosa* were the leading pathogens from throat site. A study has reported *S. pneumonia* is not representing the most common gram positive pathogen infecting throat but *S. aureus* (Tahiri and Mustafa, 2008). On the other hand, our study was identical with a study has shown *P. aeruginosa and Klebsiella spp*. were the most frequently

pathogens isolated from respiratory tract (Hadadi*et al*., 2008 and Khalili *et al*., 2012).

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