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SANITIZING EFFECT OF ACETIC ACID (VINEGAR) ON SOME SLICED FRUITS ANDVEGETABLES IN KABUGA KANO, NIGERIA

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ABSTRACT
Fruits and vegetables promote good health but can harbor a wide range of microbial contaminants. To assess the sanitizing effect of vinegar on some sliced fruits and vegetables, 16 samples of sliced fruits and vegetables were purchased from a vendor at Kabuga Gwale local government Kano. Samples were analyzed to study the density of the microorganisms by standard plate count (SPC). The samples were treated with 5%, 10% and 15% acetic acid concentration and exposure time of 0, 5, and 15mins on the microbial load of the sampled fruits and vegetables, and the effectiveness of the treatments in reducing microbial population determined. The untreated samples had a mean log_{10} count of 5.19 (Bacteria) and 5.08 (fungi). However samples treated with 5%, 10%, and 15% respectively had log count reduction values of 0.22,0.47 and 0.75 for bacteria while for fungi, 0.90,0.40 and 0.93 .This study shows that acetic acid can be used as an effective sanitizer for fruits and vegetables.
Key words: Acetic acid, microorganisms, fruits, vegetables, Kano.

INTRODUCTION

Fruits and vegetables are an extraordinary dietary source of micro and macro nutrients, vitamins and fibre for humans and are thus vital for health (Kalia *et al.*, 2006). Fruits and vegetables are widely exposed to microbial contamination through contact with soil, water and also by handling, at point of harvest or during post-harvest processing. They therefore harbor a diverse range of microorganisms including plant and human pathogens (Carmo *et al.,* 2008).

Over the last few years, there has been a significant increase in the consumption of sliced/ready-to-eat fruits in Nigeria, because they are cheap, convenient and easily accessible (Ofor *et al.,* 2009).

Acetic acid (vinegar) may be defined as a condiment made from various sugary and starchy materials by alcoholic and subsequent acetic fermentation. Vinegar is a liquid substance consisting mainly of acetic acid and water, the acetic acid being produced through the fermentation of ethanol by acetic acid bacteria (Cruess, 2005).Vinegar" meaning "sour wine," can be made from almost any fermentable carbohydrate source, including wine, molasses, dates, sorghum, apples, pears, grapes, berries, melons, coconut, honey, beer, maple syrup, potatoes, beets, malt, grains, and whey. Initially, yeasts ferment the natural food sugars to alcohol. Acetic acid bacteria (Acetobacter) convert the alcohol to acetic acid (Parish *et al.,* 2003). Vinegar has long been used as a food preservative and condiment. Vinegar has antimicrobial properties which makes it useful for a number of applications (Rutala *et al.,* 2003). Most food-borne bacterial pathogens cannot survive for long periods of time or grow at pH of less than 4.5 (Parish *et al,.* 2003). Thus, vinegar having a pH of 3, has shown to have bacteriostatic and bactericidal effect on microbes (Entani *et al.*, 1998). The antimicrobial effect of vinegar is dependent on the concentration, the type of microorganism, the strain, and the contact time (Beuchat *et al.,* 2003). The research aimed at investigating the sanitizing effect of vinegar on some sliced fruits and vegetables.

MATERIALS AND METHODS

A total of 16 samples comprising of vegetables; Cabbage (*Brassica oleracea*), Cucumber (*Cucumis sativus*), and fresh sliced fruits; Water Melon (*Citrullus lanatus)*, pawpaw (*Carica papaya*) were collected in duplicate from two road side vendors at Kabuga in Gwale local government Area of Kano state. Three different concentrations of 5%, 10% and 15% (v/v) acetic acid were prepared. Twenty five grams (25g) of sample was macerated in 225ml of sterile physiological saline. Fivefold serial dilution of the afore mentioned sample was carried out. One ml of sample was drawn from each dilution and dispensed into 9ml of 5% acetic acid this resulted in 10^{-1} dilution, subsequent dilutions were carried out to obtain 10^{-2}, 10^{-3}, 10^{-4} and 10^{-5} dilutions.

Immediately, 1 ml of the serially diluted tubes above was plated into sterile petri- dish at the initial time of dilution (0 hour). The same procedure was maintained after 5, and 15min. of exposure time.
The same procedure was repeated for 10% and 15% concentrations of acetic acid. All samples were placed on Nutrient agar and Potato Dextrose Agar for bacterial and fungal enumeration respectively. Sample plating was achieved using the pour plating method according to Parish *et al.*, (2003).

RESULTS

The results for the log count of aerobic mesophilic bacteria and coliform counts of various samples without treatment are presented in Table 1. Samples analyzed include Cucumber, Water melon, Cabbage and Pawpaw. The untreated vegetables and fruits had a mean aerobic mesophilic log count of log $_{10}$ 5.25 for bacteria log $_{10}$ 5.26 for Fungi.

Table 1. Aerobic mesophilic bacterial and fungal count and coliform counts of samples without treatment (pre-treatment).

Sample	AMBC (cfu/g)	AFC (cfu/g)	MPN index per 100ml
Cucumber[A]	5.47	5.15	150
Cucumber[B]	5.31	5.00	150
Water melon[A]	5.46	5.00	28
Water melon[B]	5.38	4.60	460
Cabbage[A]	5.24	5.16	240
Cabbage[B]	3.97	4.99	460
Pawpaw[A]	5.41	5.42	1,100
Pawpaw[B]	5.26	5.32	460
Mean	**5.19**	**5.08**	

Key:
AMBC = Aerobic mesophilic bacterial count
AFC = Aerobic fungal count.
A = Vendor 1 B = Vendor 2

The results for the aerobic mesophilic bacteria log count reduction of samples treated with different concentrations of acetic acid at different exposure time are presented in Table.2. In which samples treated with 5% acetic acid had mean aerobic mesophilic bacterial $\log_{10}$ count reduction of; 0.14, 0.22, 0.31 after 0min, 5min. and 15 min. exposure time respectively.
And samples treated with 10% acetic acid had mean aerobic mesophilic bacterial $\log_{10}$ count reduction of 0.32,0.44,0.63, after 0min, 5min. and 15min. exposure time respectively.
Samples treated with 15% acetic acid had the aerobic mesophilic bacterial $\log_{10}$ count reduction of 0.35, 0.63, 1.28 ,after 0min, 5min. and 15min. exposure time respectively.

The results for fungal log count reduction of samples treated with different concentrations of acetic acid, under different exposure time are presented in Table 3. Samples treated with 5% acetic acid had mean fungal log count reduction of 0.14, 0.26, 0.38 after 0min. 5min. and 15min. of exposure time respectively.
While samples treated with 10% acetic acid had the mean fungal log count reduction of 0.28, 0.38, and 0.55 after 0 min, 5 min. and 15 min of exposure time respectively.
Samples treated with 15% acetic acid had mean fungal log count reduction of 0.46, 0.75, and 1.62 after 0 min, 5 min. and 15 min. of exposure time respectively.

Table 2; Bacterial log_{10} count reduction after treatment (post treatment):

	Acetic acid conc. (%v/v)	0 min (cfu/g)	5 minute (cfu/g)	15 minute (cfu/g)
	5.00	0.15	0.30	0.32
Cucmber [A]	10.00	0.18	0.29	0.34
	15.00	0.19	0.31	0.46
	5.00	0.08	0.15	0.25
Cucumber [B]	10.00	0.10	0.27	0.35
	15.00	0.29	0.49	1.31
	5.00	0.03	0.09	0.14
Water melon [A]	10.00	0.14	0.22	0.36
	15.00	0.19	0.48	1.46
	5.00	0.08	0.04	0.04
Water melon [B]	10.00	0.01	0.02	0.23
	15.00	0.06	0.23	1.38
	5.00	0.34	0.47	0.74
Cabbage [A]	10.00	1.43	1.76	2.24
	15.00	1.14	1.94	2.42
	5.00	0.17	0.27	0.44
Cabbage [B]	10.00	0.33	0.41	0.46
	15.00	0.39	0.77	1.38
	5.00	0.11	0.18	0.20
Paw-paw [A]	10.00	0.17	0.23	0.68
	15.00	0.23	0.35	0.56
	5.00	0.18	0.26	0.34
Paw-paw [B]	10.00	0.22	0.31	0.41
	15.00	0.31	0.48	1.26

Key: A= Vendor 1, B = Vendor 2.

Table 3; Aerobic Fungal log_{10} count after treatment (post treatment):

	Acetic acid conc. (%v/v)	0 hour (cfu/g)	5 minute (cfu/g)	15 minute (cfu/g)
	5.00	0.29	0.36	0.49
Cucumber [A]	10.00	0.48	0.62	0.84
	15.00	0.72	1.09	1.75
	5.00	0.15	0.20	0.25
Cucumber [B]	10.00	0.23	0.28	0.38
	15.00	0.26	0.57	2.00
	5.00	0.28	0.38	0.46
Water melon [A]	10.00	0.40	0.49	0.62
	15.00	0.50	0.80	1.46
	5.00	0.19	0.60	0.86
Water melon [B]	10.00	0.41	0.62	0.95
	15.00	0.79	1.20	2.00
	5.00	0.06	0.22	0.31
Cabbage [A]	10.00	0.33	0.46	0.65
	15.00	0.83	1.56	2.16
	5.00	0.10	0.18	0.32
Cabbage [B]	10.00	0.14	0.27	0.42
	15.00	0.16	0.33	1.59
	5.00	0.03	0.08	0.14
Pawpaw [A]	10.00	0.14	0.19	0.25
	15.00	0.25	0.23	0.57
	5.00	0.04	0.09	0.21
Pawpaw [B]	10.00	0.09	0.14	0.28
	15.00	0.14	0.19	1.39

Key: A = Vendor 1, B = Vendor 2.

DISCUSSION

Treatment with different concentrations of acetic acid (5%, 10%, and 15%) at holding times of 5, 10 and 15mins brought about a considerable decrease in microbial population. A significant decrease in bacterial and fungal population was recorded with increase in concentration and holding time at P<0.5 (using two way Anova). This implies that microbial inhibition increases with increase in acetic acid concentration. According to Parish *et al.*, (2003), efficacy of treatment depends on Physiology of target microorganism, characteristic of produce surface, exposure time and concentration of sanitizer. The results of this research are in line with the findings of Amoah *et al.,* (2009); Akbas and Olmez (2007) which demonstrated that dipping lettuce in 0.5% lactic and citric acid for 2mins was effective in reducing the microbial population, prior to consumption.

CONCLUSION

In conclusion this study indicates that fruits and vegetables can harbour microorganisms and acetic acid can be used as an effective sanitizer to reduce the microbial population.

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