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Effects of Pickling and Sun-Drying On Nutritional Quality and Microbial Load of Red Pepper (Capsicum Frutescens)

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Abstract: ***Peppers are excellent sources of vitamin C, besides power-packed with vitamin C, they also provide vitamin B6, photochemical such as lycopene and beta-carotene. The study report means of preserving pepper that will help to maintain the nutritive value and reduce the microbial load. The main objective for this research was determine the effects of pickling (vinegar treatment) on the vitamin C and beta-carotene levels of red pepper, the effects of sun-drying on the vitamin C and beta-carotene levels of red pepper, the effects of pickling (vinegar treatment) and sun-drying on the microbial load (aerobic total plate count and total coli forms) of red pepper using Physic-chemical and microbial analysis to compare the microbial load and nutritional parameters of treated red pepper to the freshly harvested red pepper. The results of this study indicate effects of pickling (vinegar treatment) and sun-drying on the nutritional quality and microbial load of red pepper (Capsicum frutescent).***

Key words: Capsicum frutescent, Vitamin C, Beta-Carotene, Microbial Analysis, Red Pepper and Sun-Drying

I. INTRODUCTION

Vegetables make up a major portion of the diet of humans in many parts of the world and play a significant role in human nutrition, especially a sources of phytonutriceuticals: vitamins (C, A, B1, B6, B9, E), minerals, dietary fiber and photochemical (Quebedeaux and Eisa, 1990: Craig and Beck, 1999: Wargovich, 2000: Dias and Ryder, 2011).Peppers are excellent sources of vitamin C. besides power-packed with vitamin C, they also provide vitamin B6, photochemical such as lycopene and beta-carotene (the precursor for vitamin A), foliate, potassium and a lot of fiber (Amjad and Iqbal, 2010). The antioxidant substances such as B-carotene (pro vitamin A) and vitamin C contained in pepper confer protection against carcinogenic components and delay the aging process (Scala and Carpets, 2008).Red pepper is eaten raw and cooked vegetable and also used commonly in making paste, pickle and sauce. Red ground pepper made by drying and pulverizing is used as a spice and flavor ingredient in the food industry (Doymaz and Pala, 2002). Red pepper is one of the most widely used food colorants for culinary and industrial purposes. In Ghana, fresh pepper is used in almost all Ghanaian dishes; however, the shelf life of these peppers is very short, ranging from a period of days to week where firmness and flavor are lost. Some retailers keep the pepper in refrigerator only, but this practice is limited since some microorganisms are able to grow in very cold conditions and cause damage to the pepper. Some of the other practices such as blanching and drying tend to result in the huge loss of the essential vitamins in the pepper. There is therefore the need to explore or research into other means of preserving the pepper that will help to maintain the nutritive value and reduce the microbial load.This research is hoped to focus on investigation of the effects of pickling (vinegar treatment) and sun-drying on the nutritional quality and microbial load of red pepper (Capsicum frutescens).

II. MATERIALS AND METHODS

Fresh peppers were obtained from the University of Cape Coast Agriculture and Natural Sciences Farm. The pepper were sorted out to remove the anthracnose affected, over matured and damaged ones. Care was taken to select only fresh produce with no indications of chilling stress for the research.

A. Sample preparation for preservation study

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Upon arrival in the laboratory at the Department of Chemistry, University of Cape Coast, uniformly matured pepper fruits were selected and about 100g of fresh samples were aseptically weighed and immersed into the 6% vinegar solution for 20 minutes. About 100g of the fresh pepper that was immersed in the 6% vinegar solution was placed under the open sun whiles the other 100g of fresh pepper was immersed in 6% vinegar solution and was made to stand on the shelf. Observations of treated samples were compared with that of untreated samples.

B. Treatments

C = Control (fresh pepper with no treatment that is untreated fresh)
C_1 = untreated fresh pepper but dried (untreated dry)
B = treated fresh pepper with 6% vinegar (treated fresh)
B_1 = treated fresh pepper with 6% vinegar but dried (treated dry)

C. Physico-chemical and microbial analysis

Samples of pepper from each treatment were selected at random at an interval of 7 days for vitamin C, beta-carotene and microbial analysis during storage period. Vitamin C and beta-carotene were determined according to the method of the Association of Official Analytical Chemists (AOAC, 1995). Microbial load was determined by the APHA (American Public Health Association) (1992) standard analysis methods.

D. Determination of vitamin C

Preparation of the sample was carried out according to the method of the Association of Official Analytical Chemists (AOAC, 1995). 100ul of the filtrate was pipette into series of labeled tubes. The volume of the test tube was made to 1000ul by adding 900ul each of distilled water to each of the test tubes. This was followed by adding 250ul of bromine water to the content in the test tubes and the color formed was orange yellow. 150ul of 10% theorem solution was added to discharge the excess bromine water from orange yellow to colorless. 1ml of 2, 4-Dinitrophenyl Hydrazine (DNPH) reagent was added and incubated for 3 hours in a water bath at 37^0C. The content of the test tube was thoroughly mixed and incubated in a water bath at 37^0C for 3 hours. The solution in the test tube was allowed to cool and 7ml of 80% sulfuric acid was added to make up the volume to 11ml. This was done for all the samples analyzed. A blank was prepared in addition to the samples. Similarly, different concentrations of ascorbic acid solution were brominates and treated as above to obtain an orange-yellow color. The absorbance of the extract was measured using a spectrophotometer (UV mini1240) at a wavelength of 540nm. A cuvette containing the prepared blank solution was used to calibrate the spectrophotometer to the point zero. Samples of the extract were placed into a cuvette and readings were taken when the figure in the display window became steady. The spectrophotometer was blanked each time with the prepared blank solution before readings were taken. The operation was repeated two times for each sample and the average readings were recorded. The absorbance of the stock ascorbic acid solutions was also measured and a calibration curve prepared.

E. Determination of beta-carotene

Pigment extractionwas carried out according to the method of the Association of Official Analytical Chemists (AOAC, 1995). The absorbance of the extracts was measured using a spectrophotometer (UV mini1240) at a wavelength of 460nm. A cuvette containing pet-ether (blank) was used to calibrate the spectrophotometer to zero point. Samples of each extract were placed in cuvettes and readings were taken when the figure in the display window became steady. The operation was repeated 5-6 times for each sample and average readings were recorded. The concentration of bête-carotene was calculated using Bear-Lamberts Law, which states that the absorbance (A) is proportional to the concentration (C) of the pigment, as represented by the equation:

$A \propto L$ (if concentration (C) is constant).
$A = E \times C \times L$; => $C = A / E \times L$
Where: C = concentration of carotene
A= absorbance
E= extinction coefficient
L= thickness of cuvettes (path length) = 1cm
E of beta-carotene = 135700 $Lmol^{-1}$ cm^{-1} at 436nm (Walczak and Lantz, 2004)

F. Microbial assay

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1g of sub samples randomly taken were aseptically chopped into smaller pieces, aseptically weighed and diluted with 9ml of peptone water, and were vortexes (thoroughly mixed) for 5 minute. The homogenate from sample preparation in peptone water were used for the following procedures: Aerobic plate counts, and total coliforms by using APHA (American Public Health Association) standard analysis methods.

G. Aerobic plate count

Total viable count of all the pepper samples were determined by plate count as described by APHA using standard plate count agar medium.

Serial dilutions of the samples were made in peptone water; 0.1ml from each dilution (10^{-4} and 10^{-5}) was pour plated on the standard plate count agar medium in duplicates. The samples were mixed by rotating, and then the plates were inverted and incubated at 37^0C for 24 hours. After incubation, colonies were counted visually.

H. Total coliforms

Total coliform count of all pepper samples were determined by direct plate count as described in standard (APHA) using Eosin Methylene Blue Agar. Serial dilutions of the samples were made in 0.1% buffered peptone water; 0.1ml from each dilution (10^{-4} and 10^{-5}) was poured plated on Eosin Methylene Blue Agar medium in duplicates. The plates were incubated at 37^0C for 24-48 hours. After incubation, colonies were counted visually.

III. RESULTS AND DISCUSSION

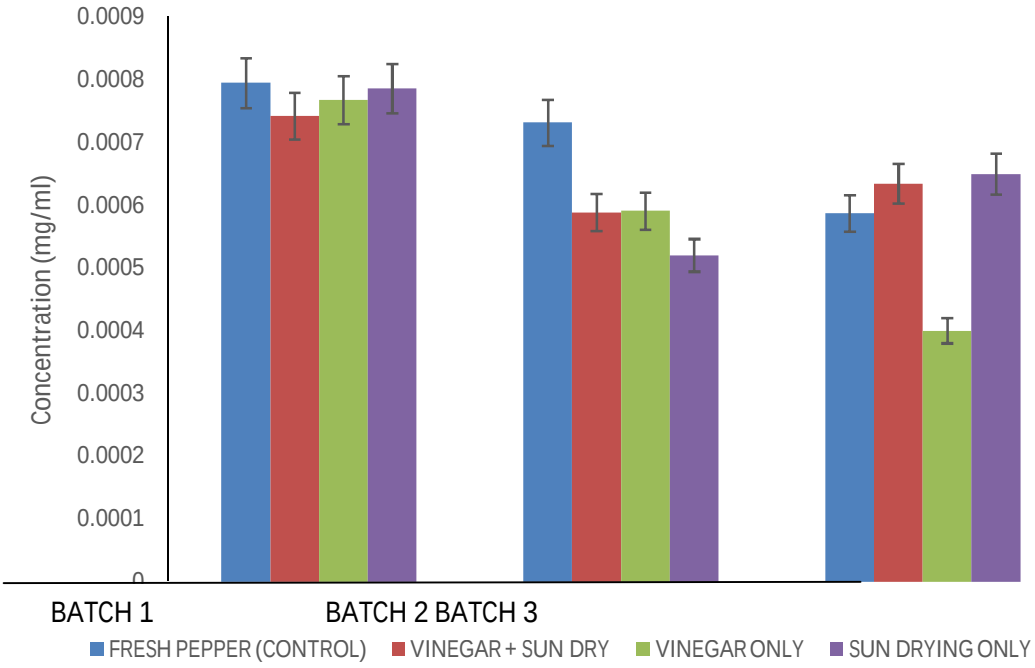

Fig.1:Beta carotene contents of red pepper under different treatments (vinegar & sun drying) for three sampling batches.

Beta carotene contents in the various pepper samples decreased generally throughout the three sampling batches which lasted for a period of three (3) weeks. The fresh pepper (control) in batch 1 recorded the highest beta carotene content followed by the samples treated with sun drying only. Samples treated with vinegar + sun drying the least amount of beta carotene content. Generally, the amount of beta carotene content in all the treated samples (vinegar + sun drying, vinegar only & sun drying only) did not decrease much comparing to the fresh pepper (control) in batch 1. The fresh pepper (control) recorded the highest amount beta carotene in batch 2 followed by samples treated with vinegar only and samples treated with sun drying only recorded amount of beta carotene. Also samples treated with sun drying only recorded the highest amount of beta carotene content in batch 3 followed by fresh pepper (control) samples and samples treated with vinegar only recorded the least amount of beta carotene

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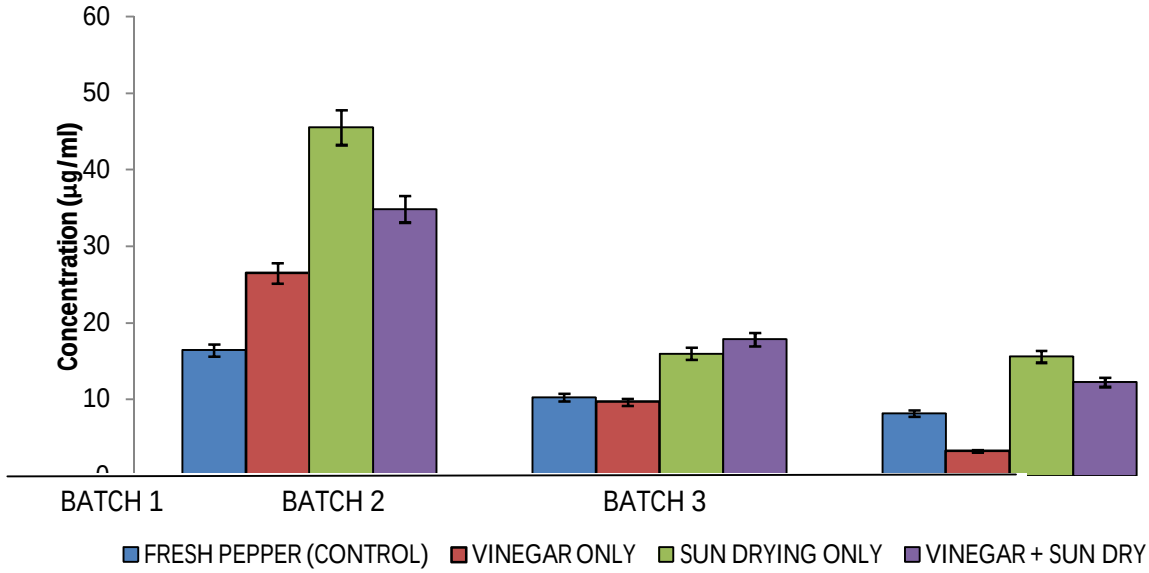

Fig.2: Vitamin C contents of red pepper under different treatments (vinegar & sun drying) for three sampling batches

Vitamin C contents in the various pepper samples decreased generally throughout the three sampling batches which lasted for a period of three (3) weeks. The samples treated with sun drying only in batch 1 recorded the highest vitamin C content followed by samples treated with vinegar + sun drying. Fresh pepper (control) recorded the least amount of vitamin C content. Generally, the amount of vitamin C content in all the samples (vinegar + sun drying, vinegar only, sun drying only& fresh pepper (control)) decreasedappreciably throughout the three sampling batches. Samples treated with vinegar + sun drying recorded the highest amount ofvitamin C content in batch 2 followed by samples treated with sun drying only and samples treated with vinegar only recorded the least amount of vitamin C content. Also samples treated with sun drying only recorded the highest amount of vitamin C content in batch 3 followed by samples treated with vinegar + sun drying and samples treated with vinegar only recorded the least amount of vitamin C.

Batch	Treated pepper sample	Microbial loads ((cfu/g) *10^2)		
		Total variable count	Total coliform count	Faecal coliforms
1	Vinegar + Sun Dry	23.95		0.000.00
	Vinegar Only	0.000.000.00		
	Sun Drying Only	28.95	7.20	4.80
	Fresh pepper (Control)	97.4011.6011.10		
2	Vinegar + Sun Dry	0.000.00		0.00
	Vinegar Only	255 .0030.00		24.00
	Sun Drying Only	65.00	0.00	0.00
	Fresh pepper (Control)	389.50 25.00		7.50

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3	Vinegar +Sun Dry	345.100.000.00		
	Vinegar Only	0.000.000.00		
	Sun Dying Only	425.0012.10	9.00	
	Fresh pepper (Control)	513.0012.00	9.70	

Table 1: Microbiological Profiles of red Pepper under different treatments (Vinegar and Sun Drying) for three sampling batches

Fresh pepper (control) samples in batches 1& 2 recorded the highest microbial loads with respect to total viable count (TVC), total coli form count (TCC) & faecal coli form count (FCC) followed by samples treated with sun drying. Samples treated with vinegar only and vinegar + sun drying recorded no count in microbial load (TVC, TCC & FCC) in batches 1 and 2 respectively. In batch 3 the highest count of microbial load was recorded in the fresh pepper (control) sample with respect to TVC, TCC & FCC followed by samples treated with sun drying only and samples treated with vinegar only recorded no count.

IV. CONCLUSION

The study provides foundation for minimizing post-harvest losses by using appropriate storage methods. The research found that, essential nutrients (vitamin C and beta-carotene) were favorably maintained in all the treated samples (vinegar only, sun drying only and vinegar + sun drying). However, the treatment did not have any significant effect on the nutritional quality (vitamin C and beta-carotene) and microbial load (total viable count, total coliform count and faecal coliform count).

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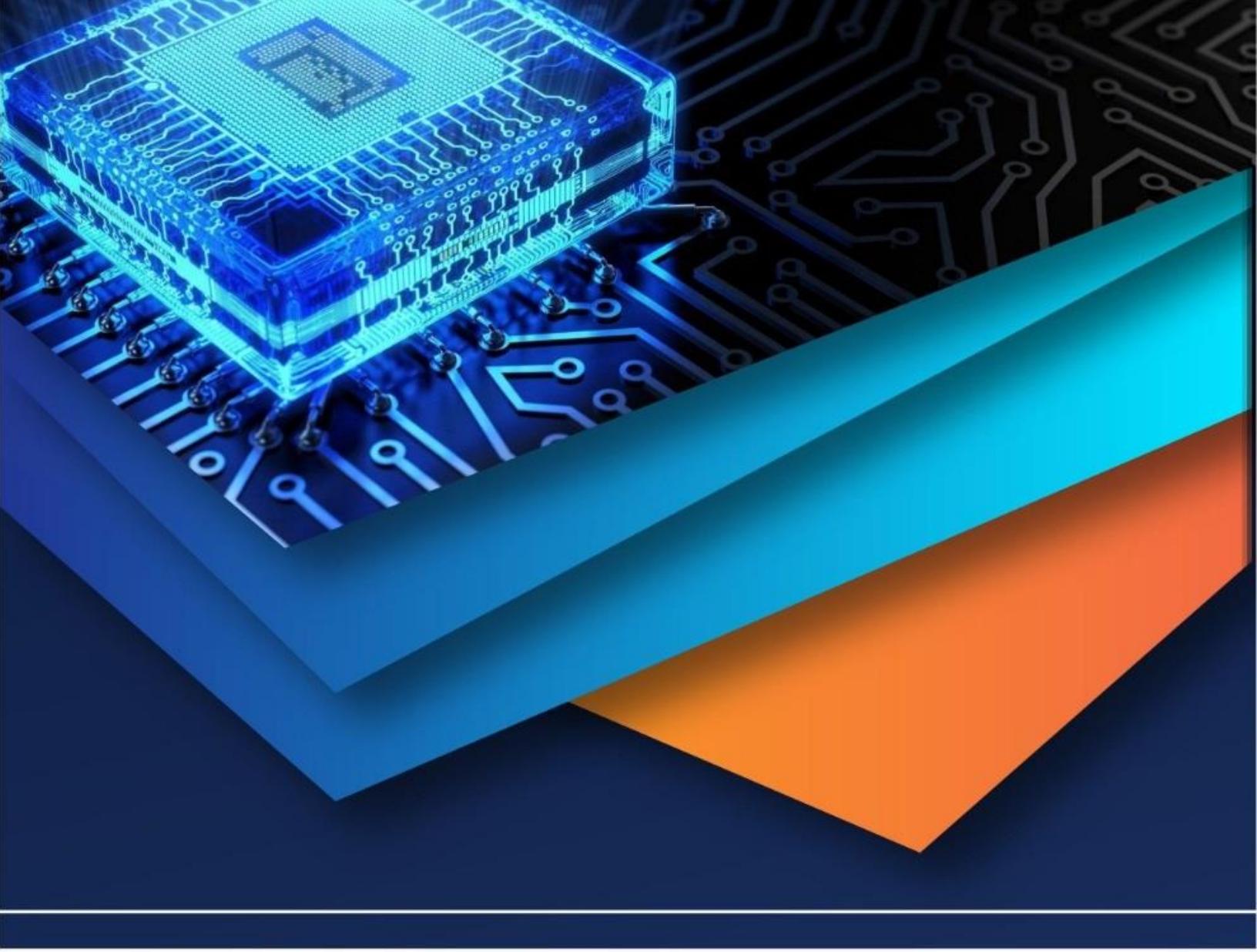

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