*Asian Journal of Agricultural and Horticultural Research*

*1(4): 1-7, 2018; Article no.AJAHR.41800*
*ISSN: 2581-4478*

# Effects of Storage Period on Nutritional Properties of Three Species of Fresh Pepper

**B. K. Akinyemi[1*], M. O. Obasi[2] and A. Faajir[3]**

*[1]Department of Biological Sciences (CEFTER), Benue State University, Makurdi, Benue State, Nigeria.*
*[2]Department of Crop Production, Federal University of Agriculture, Makurdi, Benue State, Nigeria.*
*[3]Department of Business Management, Benue State University, Makurdi, Benue State, Nigeria.*

***Authors' contributions***

*This work was carried out in collaboration between all authors. Authors MOO and AF are the supervisors and reviewers of the work. Author BKA performed laboratory experiments and wrote the manuscript. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/AJAHR/2018/41800
Editor(s):
(1) Magdalena Valsikova, Professor, Department of Vegetables Production, Faculty of Horticulture and Landscape Engineering, Slovak University of Agriculture (SUA), Nitra, Slovakia.
Reviewers:
(1) Mariana-Atena Poiana, Banat University of Agricultural Sciences and Veterinary, Romania.
(2) Venkata Satish Kuchi, Dr. YSR Horticultural University, India.
Complete Peer review History: http://prh.sdiarticle3.com/review-history/25067

***Original Research Article***

***Received 24th March 2018***
***Accepted 31st May 2018***
***Published 9th June 2018***

## ABSTRACT

Peppers are important sources of digestible carbohydrates, minerals and vitamins. These crops are highly perishable and high postharvest losses often result if handled poorly or stored in unfavorable conditions. This study is to assess how the period of storage actually affects the properties of the fresh pepper and to obtain the optimum period that they can be stored without losing their essential properties. An alternative non-refrigerated storage that can potentially maintain quality longer is the use of evaporative coolers. In this study, the effects of evaporative cooling system lower temperature (28.31±3.85°C, 83.84±9.33% RH) on the proximate analysis of pepper species (*Capsicum annuum, Capsicum genus* and *Capsicum chinense*) were evaluated. The evaporative cooler was stored under ambient condition (33.21±1.67°C, 68±3.78% RH). This experiment was carried out in Makurdi, Benue State Nigeria between November and December. The samples of three species of pepper used for this study were washed with distilled water and treated with 200ppm hydrochloride, allowed to drained and stored in basket wrapped with polythene and foam (evaporative cooler) for 21 days, during which tests carried out to quantify some nutritional

**Corresponding author: E-mail: akemfortco@gmail.com;*

parameters of moisture, ash, protein, lipid, carbohydrate and crude fiber contents were assessed, 7days interval. The sack wall of evaporative cooler was constantly wet with water. The study revealed that, there were continuous decrease in the quality parameters as the days increasing, such as moisture content dropped from 6.55 to 3.70 for *Capsicum annuum,* 5.58 to3.60 for *Capsicum genus* and 5.54 to 3.56 for *Capsicum chinense*. Ash content dropped from 4.38 to 2.40, 4.00 to 2.70 and 4.13 to 2.60 respectively. Carbohydrate content dropped from 63.22 to 43.98, 61.15 to 41.30 and 60.00 to 43.22 respectively. Protein content dropped from 11.33 to 8.30, 11.26 to 8.10 and 11.29 to 8.90 for respectively. Crude fiber content dropped from 2.10 to1.40, 2.08 to1.29 and 2.24 to 1.70 respectively. These findings we observed that, the three species of pepper contains large amount of nutrients; however, it was also suggested that fresh peppers should not exceed 14 days in storage, in other not to lose substantial part of the nutrients.

*Keywords: Evaporative cooler; pepper; storage; proximate analysis.*

## 1. INTRODUCTION

Fruits and vegetables constitute an important part of a healthy diet. They are an essential part of the agricultural produce, but their production volumes cannot be compared to that of grains [1]. They are sources of digestible food. Peppers contain carbohydrates, vitamins and minerals, they are mostly used for stew and soup ingredient in Nigeria [1]. Pepper is among the vegetables grown in Nigeria, at least five types of pepper grown in Nigeria [2]. Pepper species can be classified as sweet, mild or hot according to the amount of capsaicin present [3,4]. They contain antioxidant properties which are good source of vitamins A, C and phenol compounds [5,6]. They are recently the object of much attention due to possible links to prevent a certain type of cardiovascular diseases, atherosclerosis, hemorrhage, delaying of the ageing process, avoiding cholesterol, improving physical resistance and increasing appetite [7].

The quality and shelf-life of pepper depends on some biochemical reactions that take place after harvest. [1]. The main factors for the quality degradation of pepper during storage include poor external appearance, decay development, shriveling which is cause by water loss and its high sensitivity to chilling injury [8]. The most effective way of maintaining the quality and prolonging shelf life of fresh vegetables and fruits during storage period is temperature management. [9]. However, the high cost implication involve in using refrigeration and power source cannot be afford by most peasant farmers, retailers and wholesalers in developing countries [5,10]. They can only afford low cost method of cooling their perishable produce in storage [1]. There is need to understand the interactions among the many operations necessary for delivering pepper to consumers so as to be able to predict their impacts on produce quality [11]. Storage of pepper at ambient conditions is commonly practiced in Nigeria but their potential in maintaining produce quality is not well understood. Determining the best packaging material and storage temperature for pepper may assist the growers, dealers and consumers in maintaining the quality of the pepper Amajal et al. [12] reported result on effect of packaging material and different storage regimes on shelf life and biochemical composition of green hot pepper fruit. During the period of storage one of the major problems is what takes place in the nutritional quality parameters of the fresh pepper produce. [1]. Evaporative cooler is mostly used by rural and peasant farmers as postharvest treatment. It is a physical process wherein evaporation of a liquid cools an object in contact with it [5]. The evaporative cooler works on the principle of cooling resulting from the evaporation of water from the surface of the structures. The cooling obtained from this method also results in the high relative humidity of the air in the chamber from which the evaporation takes place relative to the ambient air [1]. To preserve vegetables, controlled storage conditions are essential [1]. It is cheaper than refrigeration cooling. Bautista et al. [13] explained that the heat that respired from the produce evaporates the water applied to its immediate environments. During windy period or when air movement is greater, the evaporation is faster compared to its surrounding and a lower temperature and a higher relative humidity is maintain in the storage chamber [5,14]. Studies have shown the efficiency of evaporative coolers as a good postharvest treatment for fresh crops. Awole et al. [15] conducted a study on the yield and two storage conditions (ambient and evaporative cooling) for hot peppers harvested mature green. After 16 days of storage, most pepper fruit stored at ambient condition were

unmarketable. The objective of this study is to assess the optimum storage period of fresh pepper without losing their essential properties [1].

## 2. MATERIALS AND METHODS

The samples of fresh peppers were obtained from University of Agriculture Makurdi, Experimental farm very early in the morning; the harvesting was done properly to avoid the rough handling. Forty fruits per sample uniformly-sized and unblemished-free peppers were sorted, washed in distilled water, and then surface-sterilized was done by dipping pepper in 200 ppm sodium hypochlorite for 5 min [5]. They were allowed to drain then stored in a basket wrapped with polythene and foam (evaporative cooler) *(28.31±3.85°C, 83.84±9.33% RH).* This experiment was carried out in Markurdi, Benue State Nigeria between November and December 2017. The sack wall of evaporative coolers was constantly wet with water. To get the initial nutritional qualities, some samples were immediately before storage assessed. The samples of the peppers parameter were taken every 7days intervals to assess nutritional qualities for 21 days.

The temperature and the relative humidity of the EC conditions were taken daily, using a digital data logger placed inside the EC [5].

### 2.1 Proximate Analysis

Association of Official Analytical chemist's method was used to determine the proximate composition of each sample [16].

### 2.2 Moisture Content

Moisture content of the samples were determined by the use of thermal drying. Sample of 1.0g was weighed in triplicate, washed, dried and weighed crucible. This was oven-dried at 105°C for three hours to complete dryness. The samples were reweighed after cooling in desiccators [17]. The percentage of moisture content was calculated using the formular:

$$MC\ (\%) = \frac{W_{\circ}}{Wi} \times 100$$

Where Wo = loss in weight (g) on drying
Wi = initial weight of sample (g)

### 2.3 Ash Content

The method used to determine ash content was ignition. Thoroughly washed crucibles and pre-heated in a muffle furnace at 500°C were used. The dried sample of 1.0 g used in moisture determination were weighed in triplicate, pre-heated, allowed to cool, weighed crucible and then reweighed. The crucible was covered tidily; the number was noted and then placed in a cold muffle furnace. The temperature was allowed to rise to 500°C and it took three hours for the ashing process. Then crucible was removed from the furnace, placed in desiccators to cool and reweighed [17]. The ash content percentage was calculated using the formula:

$$Ash\ (\%) = \frac{Ma}{Ms} \times 100$$

Where, Ma = Mass of ash (g)
Ms = Mass of sample used (g)

### 2.4 Crude Protein

In determining crude protein, total organic nitrogen was first determined using the macro-Kjeldhal method. This involved digestion, distillation and titration. The sample of 1.0 g was weighed in triplicate and placed in digestion flasks. Few granules of anti-bumps and about 3.0 g of copper catalyst mixture (96% anhydrous sodium sulphate, 3.5% copper sulphate and 0.5% selenium dioxide) were put together in each of the flasks. Digestion commenced when 20 $cm^3$ concentrated of sulphuric acids were added to each flask and heated on a heating mantle. Digestion was continued until a clear solution was observed and it was allowed to cool, filtered and then distilled water was added to make up 100 $cm^3$ [17]. Exactly 20 $cm^3$ of the diluted digest was pipette into round-bottomed flasks and used in the distillation step.

### 2.5 Crude Lipid

Soxhlet type of the direct solvent extraction method was used to determined crude lipid content. Petroleum ether (boiling range 40°C - 60°C) was used as the solvent. A dried sample of 3.0 g was weighed in triplicate and secured in soxhlet extraction thimble. The thimble was then put into 20 $cm^3$ capacity soxhlet extractor. A Round-bottomed flask of 100 $cm^3$ was washed, oven-dried, weighed and approximately 60 $cm^3$ of the 40-60°C boiling range petroleum ether added to it. The flask was then placed on the

heating mantle and connected to the extractor (with condenser). The condenser and heating mantle were then activated and extraction carried on for four hours. At the end of the extraction, the solvent was evaporated and the flask oven dried (at 60°C). The flask was then cooled and reweighed [17]. Crude lipid percentage was calculated using the formula:

$$CL\ (\%) = \frac{Mex}{Ms} \times 100$$

Where, Mex = mass of extract (g)
Ms = Mass of sample used (g)

## 2.6 Carbohydrate Content

Total carbohydrate content was estimated by addition of the percentages of all the other proximate components and was subtracted from 100 *i.e* total carbohydrate (%) = 100 – (% moisture + % crude protein + % crude lipid + % ash) [17].

## 2.7 Statistical Analysis

The results are presented with their means, coefficient of variation, standard deviation and standard error.

## 3. RESULTS AND DISCUSSION

The results of the proximate composition of *C. annuum* are shown in Table 1, that of *C. genus* are shown in Table 2 and *C chinense* shown in Table 3.

**Table 1. Proximate composition of *Capsicum annuum* stored in evaporative cooler**

| Composition (%) | Day 1 | Day 7 | Day 14 | Day 21 |
|---|---|---|---|---|
| Moisture | 6.55 ± 0.11$^{c}$ | 6.37 ± 0.01$^{a}$ | 5.70 ± 0.15$^{b}$ | 3.70 ± 0.12$^{a}$ |
| Ash | 4.38 ± 0.10$^{b}$ | 4.30 ± 0.13$^{b}$ | 4.25 ± 0.10$^{b}$ | 2.40 ± 0.15$^{a}$ |
| Crude protein | 11.33 ± 0.01$^{a}$ | 11.28 ± 0.01$^{c}$ | 11.10 ± 0.13$^{b}$ | 8.30 ± 0.15$^{b}$ |
| Crude fat | 12.72 ± 0.01$^{c}$ | 11.65 ± 0.13$^{b}$ | 12.50 ± 0.10$^{a}$ | 9.50 ± 0.15b$^{b}$ |
| Carbohydrate | 63.22 ± 0.01$^{a}$ | 62.15 ± 0.01$^{b}$ | 61.94 ± 0.01$^{b}$ | 43.98 ± 0.15$^{c}$ |
| Crude fibre | 2.10 ± 0.01$^{b}$ | 2.05 ± 0.13$^{a}$ | 2.01 ± 0.01$^{b}$ | 1.40 ± 0.15$^{a}$ |

*Values are mean ± SD of 3 replicates. a-c Test values along the same row carrying different superscripts for each parameter are significantly different (p < 0.05). [18]*

**Table 2. Proximate composition of *Capsicum genus* stored in evaporative cooler**

| Composition (%) | Day 1 | Day 7 | Day 14 | Day 21 |
|---|---|---|---|---|
| Moisture | 5.58 ± 0.11$^{a}$ | 5.27 ± 0.01$^{a}$ | 4.40 ± 0.15$^{b}$ | 3.60 ± 0.15$^{b}$ |
| Ash | 4.20 ± 0.10$^{b}$ | 4.17 ± 0.13$^{a}$ | 4.13 ± 0.10$^{b}$ | 2.70 ± 0.15$^{b}$ |
| Crude protein | 11.26 ± 0.01$^{a}$ | 11.21 ± 0.01$^{c}$ | 11.18 ± 0.13$^{b}$ | 8.10 ± 0.15$^{b}$ |
| Crude fat | 11.68 ± 0.01$^{c}$ | 11.55 ± 0.13$^{b}$ | 11.20 ± 0.10$^{a}$ | 9.30 ± 0.15$^{b}$ |
| Carbohydrate | 61.15 ± 0.01$^{a}$ | 59.35 ± 0.02$^{b}$ | 57.24 ± 0.01$^{c}$ | 41.30 ± 0.15$^{b}$ |
| Crude fibre | 2.08 ± 0.01$^{b}$ | 2.05 ± 0.13$^{a}$ | 2.01 ± 0.01$^{b}$ | 1.29 ± 0.15$^{b}$ |

*Values are mean ± SD of 3 replicates. a-c Test values along the same row carrying different superscripts for each parameter are significantly different (p < 0.05). [18]*

**Table 3. Proximate composition of *Capsicum chinense* stored in evaporative cooler**

| Composition (%) | Day 1 | Day 7 | Day 14 | Day 21 |
|---|---|---|---|---|
| Moisture | 5.54 ± 0.11$^{c}$ | 5.37 ± 0.01$^{a}$ | 4.22 ± 0.15$^{b}$ | 3.56 ± 0.15$^{b}$ |
| Ash | 4.13 ± 0.10$^{b}$ | 4.09 ± 0.13$^{a}$ | 4.05 ± 0.12$^{b}$ | 2.50 ± 0.05$^{b}$ |
| Crude protein | 11.29 ± 0.01$^{a}$ | 11.18 ± 0.01$^{c}$ | 11.10 ± 0.3$^{b}$ | 8.90 ± 0.15$^{b}$ |
| Crude fat | 11.72 ± 0.01$^{c}$ | 11.65 ± 0.13$^{b}$ | 11.50 ± 0.10$^{a}$ | 8.70 ± 0.10$^{b}$ |
| Carbohydrate | 60.00 ± 0.01$^{a}$ | 59.15 ± 0.01$^{b}$ | 54.94 ± 0.02$^{c}$ | 43.72 ± 0.15$^{b}$ |
| Crude fibre | 2.24 ± 0.01$^{b}$ | 2.15 ± 0.13$^{a}$ | 2.11 ± 0.01$^{b}$ | 1.70 ± 0.15$^{b}$ |

*Values are mean ± SD of 3 replicates. a-c Test values along the same row carrying different superscripts for each parameter are significantly different (p < 0.05). [18]*

### 3.1 Moisture Content

The moisture content of *C. annuum* obtained in the day 1 was 6.55 that of *C. genus* were 5.58 and 5.54 for *C. chinense*. In all the tables the moisture content of the stored products reduced from the initial value to 5.70 after been stored for 14 day for C *annuum*, 4.40 for *C. genus* while that of *C chinense* was 4.22. The reduction in moisture content related well to the change in relative humidity [1]. The pepper retained moisture because of the relative humidity within the inner chamber.

### 3.2 Ash Content

The results of ash content shown that as the storage period increases there was a gradual decrease in ash quality [1]. The initial values of the ash content recorded on the day 1 were 4.38 for *C. annuum,* 4.00 for *C. genus* and 4.13 for *C. chinense*. After 14 days of storage, the values were reduced to 4.25 for *C. annuum*, 4.13 for *C. genus* and 4.05 for *C. chinense*. Ash content of pepper is usually low, this is as a result of low inorganic mineral content in pepper [17,19]. The ash content ranging between 4.13 in *C. chinense* to 4.38 for *C. annuum*, Tchiegang and Mbougueng reported a range higher than 2 to 9 [20]. This difference in value may be due to the difference in the origin and species of the samples [18].

### 3.3 Protein Content

The protein content results shown that *C. annuum, C. genus and C. chinense* gave 11.33, 11.26 and 11.29 respectively. On day 14, these results 11.10, 11.18 and 11.10 were obtained for *C. annuum, C. genus* and *C. chinense* respectively. This observation in protein content shows a similar trend as observed in ash content that is protein content of the samples decreases as the days increases, Cheema and Karmarkar observed a lower value [21]. This difference may be probably due to diversity in species and environmental conditions [1].

### 3.4 Lipid Content

The lipid content result shown that *C. annuum, C. genus and C. chinense* were generally low, this agree with the findings of many researcher that pepper are poor source of lipid [22]. Though, pepper may not be classified as an oil seed, but the small oil extracted could be use as an essential oil. [18,23]. The results dropped from 12.72 to11.50, 11.68 to11.20 and 11.72 to 11.50 respectively, within day1 to day 14 of storage. The result also has shown decrease in value of lipid content as the storage period increase [1].

### 3.5 Carbohydrate Content

The result of carbohydrate content shown that *C. annuum, C. genus and C. chinense* gave 63, 61.15 and 60.00 respectively, in day1 and day 14 of storage, the carbohydrate content of *C. annuum, C. genus and C. chinense* gave 61.94, 57.24 and 54.94 respectively. Although, the high valve of carbohydrate shown in pepper but it cannot be regarded as carbohydrate sources when compared to tubers and cereals which are spread all over the world [24,17].

The results obtained in this study were good indications that shown the relevance in this area, especially the use of evaporative cooler for storage system for fresh peppers [1]. The results also serve as a guide, to know how long pepper can be stored without losing the essential part of the nutrients, even though their appearance make look fresh. Though physical appearance is one of the major quality parameters used to measure if fruits and vegetables are good but nutritional quality cannot be compromised.

## 4. CONCLUSION

These samples of pepper species; *C. annuum, C. genus and C. chinense* used in this work have generated important information on nutrition properties as they change with storage time. It can be concluded that these qualities generally change with time [1]. The study revealed that there were continuous decreases in the quality parameters such as moisture, ash, protein, carbohydrate, lipid and crude fiber content. From these results, it can be generally concluded that for the consumer to get the best-required nutrients from their products, they should not store fresh pepper beyond two weeks as evaporated coolers storage system is concerned. However, preservation of fruits and vegetables in the rural areas can be more effective in Nigeria with some careful modifications in the evaporative cooler storage system [1].

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES


1. Peter AI, John JM, Mohammed A. Effect of Storage Period on some Nutrtional Properties of Orange and Tomato. 2010; AU J.J.13(3).
2. Nwokem CD, Agbaji EB, Kagbu JA, Ekanem EJ. Determination of Capsaicin Content and Pungency Level of Five Different Peppers Grown in Nigeria. New York Science Journal. 2010;3(9):17-21.
3. Available:www.gemiuskitchen.com./recipe Review by ggsisco 2009.
4. Famurewa JAO, Oluwamukomi MO, Adenuga AL. Dehydration osmosised red bell pepper (*Capsicum annuum*). Research Journal of Biological Sciences. 2006; 1(1-4):36-39.
5. Emma RB, Roelene S, Ana Maria CM, Joseph A. Shelf Life of two Sweet Pepper (*Capsicum annuum*) cultivars stored at ambient and evaporative cooling conditions. South Western Journal of Horticulture, Biology and Environment. 2017;8(1):1-15.
6. Shotorbani NM, Jamei R, Heidari R. Antioxidant activities of two sweet pepper *Capsicum annuum* L. varieties phenolic extracts and the effects of thermal treatment. Avicenna Journal of Phytomedicine. 2013;3(1):25-34.
7. Marin A, Ferreres F, Tomas-Barberan GILM. Characterization and quantitation of antioxidant constituents of sweet pepper (*Capsicum annum* L.). Journal of Agriculture. Food Chem. 2008;52:3861-3369.
8. Shehata SA, Ibrahim MIA, El-Mogy MM, El-Gawad KFA. Effect of hot water dips and modified atmosphere packaging on extending the shelf life of bell pepper fruits. Wulfenia Journal. 2013;20(3):315-328.
9. Leon JJ, Elias JL, Huez Lopez MA, Garcia Lopez AM, Ortiz RS, Escoboza Garcia LF. Postharvest quality and shelf life of green pepper (*Capsicum annuum* L.) grown under open-field and greenhouse conditions. IDESIA (Chile). 2013;3(4):35-41.s.
10. Zhiwen Chem. Challenge in the spectroxchemical analysis of complex materials. B.Sc, Nankai University; 2008.
11. Basediya AM, Samuel DVK, Beera V. Evaporative cooling system for storage of fruits and vegetables – a review. Journal of Food Science Technology. 2013;50(3): 429-442.
12. Amjad M, Iqbal J, Iqbal Q, Nawaz A, Ahmad T, Rees D. Effect of packaging material and different storage regimes on shelf life and biochemical composition of green hot pepper fruits. Acta Hortic. 2010; 876:227-234.
13. Bautista OK, Flor NB, Yaptenco KF. Alternatives to refrigerated transport and storage. In: Bautista, O.K., Esguerra, E.B. (eds.), Postharvest Technology for Southeast Asian Perishable Crops. (University of the Philippines Los Baños and Department of Agriculture-Bureau of Agricultural Research. Shelf life of two sweet pepper cultivars 15. 2007;300-308.
14. Dadhich SM, Dadhich H, Verma RC. Comparative study on storage of fruits and vegetables in evaporative cool chamber and in ambient. International Journal of Food Engineering. 2008;4(1):1–11.
15. Awole S, Woldetsadik K, Workneh TS. Yield and storability of green fruits from hot pepper cultivars (*Capsicum* spp.). African Journal of Biotechnology. 2011;10(56): 12662-12670.
16. AOAC. Official Methods of Analysis, 18th edn. Association of Official Analytical Chemists, Arlington, VA; 2006.
17. Nuhu AH, Gwanzo YS, Kabuk JB. Proximate analysis of Ginger, Scotch bonnet pepper, Garlic Bell pepper and Onion (spices) samples.
18. Gloria AO, Oyelola BO, Adenike TO, Anthony JA. Comparative analysis of chemical composition of three spices – *Alium sativa* L. *Zingiber officinale* Rose and capsicum frutescens L.commonly comsumed on Nigeria. 2010;9(41):6927-6931.
19. Oloyede OI. Chemical profile of Unripe Pulp of Carica Papaya. Pak. J. Nutr. 2005; 4(6):379-381.
20. Tchiegang C, Mbougueng D. Composition chimique des epics utilisees dans la preparation du na'a poh et du kul de l'ouest cameroun. Tropicultura. 2005; 23(4):193-200.
21. Cheema GS, Karmarkar DV. Cold storage of fruits and vegetables. Imp. Counc. Agr. Res. India, Misc. Bull. 1939; 23.
22. Gloria A, Oyedola B, Adenike T, Anthony J. Comparative analysis of the chemical composition of three spices. Journal of Korean society of Food Science and Nutrition. 2010;37(8):1090-1095.

23. Okwu DE, Nnamdi FU. Evaluation of the chemical composition of Dacryodes Edulis and Raphia Hookeri Mann and Wendl exudates used in herbal medicine in South Eastern Nigeria. Afr. J. Trad. Comp. Alt. Med. 2008;5(2):194-200.

24. Jayakody L, Hoover R, Liu Q, Weber E. "Studies on Tuber and Root Starches. I. Structure and Physiochemical Properties of Innala (*Solenostemon rotundifolus*); 2005.



*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*http://prh.sdiarticle3.com/review-history/25067*