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EFFECT OF COOLING STRUCTURE ON THE WEIGHT AND NUTRITIONAL PARAMETERS OF ANJOU PEARS *(Pyrus communis)*

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Abstract
A study was conducted to study the effect of cooling structure on the weight and nutritional parameters of Anjou Pears. The structure consist of a cooling chamber made of aluminium and inserted inside a bigger galvanized steel interspaced with river bed sand of 7cm. the interspace soil is constantly wetted with water at room temperature. The other components attached are fan blade , 12 voltage battery and control switch. Freshly harvested but matured pears were used for the experiment the temperature and relative humidity were monitored on daily bases. The vitamin B and C of this produce were determined at interval for a period of 14days. The main result of vitamin B content was 2.40g/l, 2.31g/l, 2.10g/l, 2.00g/l and 1.88g/l for the 1st, 4th, 7th, 10th and 14th days in storage structure while that of ambient was 2.39g/l, 2.30g/l, 2.18g/l, 2.07g/l and 1.88g/l for the same storage period. Vitamin C mean result was 10.62g/l, 10.40g/l, 10.32g/l, 10.23g/l and 10.12g/l for storage structure and ambient was 10.60g/l, 10.38g/l, 10.21g/l and 10.11g/l for the same storage period. Also percentage moisture content mean was 68%, 66%, 64% 63% and 61% for storage structure and ambient was 63%, 60% 56%, 51% and 48%. The mean temperature in the storage structure and ambient were 24.93^{0}C and 31.14^{0}C respectively while the mean relative humidity in the ECS and ambient was 89.5% and 61.14% respectively. Also the average percentage weight loss of the stored pears in the ECS and ambient was 5.95% and 18.39% respectively.

Keywords: Nutritional, Vitamins, Anjou Pears, Storage, Structure

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1.INTRODUCTION

Some preservation methods for raw and processed fruits and vegetables include: storage in ventilated shed, storage at low temperatures, use of evaporative coolant system, waxing and chemical treatment (Olosunde, 2006). An aspect to consider when handling fruits and vegetables is the temperature and relative humidity of the storage environment. For fresh harvested produce, any method aimed at increasing the relative humidity of the storage environment (or decreasing the vapour pressure deficit (VPD) between the commodity and its environment) will slow the rate of water loss and other metabolic activities (Katsoulas *et al.*, 2001). This will slow both the respiratory processes and activities of micro-organisms (pathogens) which are the most destructive activity during storage of fruits and vegetables (Barre *et, al.*, 1988).

Fresh fruits and vegetables when harvested continue to undergo chemical changes which can cause deterioration of the product. This is why produce should be stored immediately after harvest as possible and at peak contains chemical compounds called enzymes and other damages. Enzymes in vegetables are inactivated by the blanching process. Blanching is the exposure of the vegetable to boiling water or steam for a period of time. Storage by evaporating cooling does not actually destroy the micro organism which may be present on fruits and vegetables. Why blanching destroy some micro-organisms and there is gradual decline in the number of these micro-organisms during storage in evaporative cooling structures, sufficient populations and still present to multiply in number and cause spoilage of the products when it thaws (Morris, 2009).

2. MATERIALS AND METHODS

2.1 Collection of Fresh Banana and Weight Determination

Seventy- five fresh samples of Anjou pears used for this study were obtained from Orchard Plantation in Kwara State, Nigeria. The samples were divided into two equal parts of 35 and stored inside the cooling structure and ambient. Five banana fingers were selected from each storage method and weighed every day using an electronic weighing balance. Weighing commenced from the first day of storage and continued throughout the 14 days experimental period.

2.2 Determination of Environmental Parameters

Temperature and relative humidity measurements were taken three times daily at 8.00am, 12: noon and 6.00pm using an instrument called EL-WIFI-TH. The sensitivity of the temperature and relative humidity data logger ranges -20°C to 60°C, 0% to 100% respectively. This is a digital instrument that gives accurate humidity and temperature measurements.

2.3 Percentage Weight Loss

The weights were taken with a digital top weighing balance of sensitivity 100g to 1000g (Ohaus valor 2000 Compact bench scale). Five samples were selected and labeled randomly from ECS and ambient storage condition. The produce was weighed at intervals of three days starting from the first day of storage till the end. Appendix show weight measurement in both conditions

The percentage loss in weight with respect to storage days was determined using the following relation:

$$w = w_1 - w_2 / w_1 \times 100 \ldots\ldots.1$$

where:
w_L is the loss in weight 1kg, w is the intiated weight of produce kg and
w_2 is the final weight of produce kg

2.4 Nutritional values

These were determined in the laboratory using AOAC (1995) nutritional guidelines. The nutritional values determined were vitamin A, vitatmin C were determined at intervals of three days.

2.5 Sensitivity Analysis

The effects of storage parameters on nutritional values of stored fruits were investigated using analysis of variance (ANOVA) at $P <= 0.05$

3. RESULTS AND DISCUSSIONS

3.1 Changes in Nutritional Value of Stored Pears

Table 1 shows the effect of storage conditions and storage days on nutritional composition and moisture content of stored pear and it can be inferred that depending on the storage condition, there exist variations in vitamin B content of the stored pears. Similarly, variations were also observed in vitamin C and moisture content of the stored pears in different storage conditions. The temperature and relative humidity of the ECS and Ambient as summarize on Table 1 also indicates variations which might be a function of the direct effect of the storage structure. These may imply that the nutritional qualities of stored pear fruits under these varied storage condition are not the same.

Table 1: Summary Statistics of the Measured Data

Storage Days		Ambient			ESC		
		Vitamin B (g/l)	Vitamin C (g/l)	Moisture Content (%)	Vitamin B (g/l)	Vitamin C (g/l)	Moisture Content (%)
1	Mean	2.39	10.60	63.00	2.40	10.62	68.00
	SD	0.00	0.00	0.00	0.00	0.00	0.00
4	Mean	2.30	10.38	60.00	2.31	10.40	66.00
	SD	0.00	0.00	0.00	0.00	0.00	0.00
7	Mean	2.18	10.30	56.00	2.10	10.32	64.00
	SD	0.00	0.00	0.00	0.00	0.00	0.00
10	Mean	2.07	10.21	51.00	2.00	10.23	63.00
	SD	0.00	0.00	0.00	0.00	0.00	0.00
14	Mean	1.95	10.11	48.00	1.88	10.12	61.00
	SD	0.00	0.00	0.00	0.00	0.00	0.00

The result of the effect of storage Condition, and storage days on vitamin B, C, % weight loss and moisture contents is presented on Table 2. The result of the test show that storage Condition and storage days had significant effect on vitamin B at 5% level of significance. This implies that vitamins B content of stored pear fruits differs significantly across the two storage conditions and days. Similarly, vitamin C, moisture content and % weight loss of the stored pear fruits were also significant across the two storage conditions and days. It can therefore be concluded that the variations observed in vitamin B, C and the moisture content were not due to chance occurrence alone but rather were due to the different storage Conditions and storage days used.

Table 2: Analysis of Variance Test for the Measured Nutritional Qualities

Source	Dependent Variable	Sum of Squares	Df	Mean Square	F	Sig.
SD	Vitamin B	0.914	4	0.228	435.086	0.000*
	Vitamin C	0.844	4	0.211	42220.000	0.000*
	Moisture Content	471.000	4	117.750	37.087	0.000*
	% Weight Loss	45.233	4	43.200	55.920	0.000*
SC	Vitamin B	0.012	1	0.012	22.857	0.000*
	Vitamin C	0.002	1	0.002	486.000	0.000*
	Moisture Content	580.800	1	580.800	182.929	0.000*
	% Weight Loss	46.233	4	45.200	58.920	0.000*
Error	Vitamin B	0.013	24	0.001		
	Vitamin C	0.000	24	0.000		
	Moisture Content	76.200	24	3.175		
	% Weight Loss	0.343	24	0.324		
Total	Vitamin B	0.939	29			
	Vitamin C	0.846	29			
	Moisture Content	1128.000	29			
	% Weight Loss	91.809	29			

*Significant at 5% level

3.2 Storability of the Pears Inside the Storage Structure

Table 3 shows the result obtained when Duncan New Multiple Range Test (NDMRT) was used to establish the storage ability of stored pears under different storage conditions and storage days.

It also shows that vitamin B content of the pear fruits stored in ECS were slightly but significantly higher (about 0.04mm on the average) than the vitamin B content of pear fruits stored in Ambient condition in all the storage days of the storage experiment (i.e. day 4 through day 14). This implies that the ECS was able to preserve the vitamin B contents of the stored pear fruits above the ambient condition in all the storage days. It can be inferred from Table 3 also that, the vitamin C content of the pear fruits stored in ECS differs significantly from the vitamin C content of the fruit stored in ambient. Vitamin C content of the stored fruits was also statistically higher in ECS than in ambient in all the storage days considered. On the other hand, vitamin C content of the stored fruits also decreases significantly along the storage days irrespective of the storage medium. This si in line with the findings from Howard *et al* (1999) where he obtained 10% increase in beta-carotene content of carrots stored under refrigerated condition for 14-16 days. The increase in vitamins contents can also be attributed to cooling environment of the stored pears as reported by Padayatty *et al*., (2003) especially in the night where the increase in relative humidity added to the coolness of the evaporative cooling structure.

The moisture content of the stored pear fruits was also evaluated using the new Duncan multiple range test as presented on Table 3. The result shows that Moisture content of the stored pear fruits in ECS were significantly higher than the moisture content of the stored fruits in ambient condition irrespective of the storage days. The increase may be attributed to the absence of chilling/freezing injury as well as low temperature recorded in the evaporative cooling structure (Hardenburg *et al*., 1986). On the other hand, moisture content of stored pear fruits although was relatively stable in ECS than in ambient condition, generally decreases steadily along storage days. Figure 4 show the pictorial illustration of the result as inferred above. This result is graphically represented in Figures 1-3.

Table 3: Multiple Comparison using the New Duncan Multiple Range Test

	Vitamin B (g/l)		Vitamin C (g/l)		Moisture Content (%)		Weight Loss (%)	
Storage Days	Ambient	ECS	Ambient	ECS	Ambient	ECS	Ambient %	ECS%
1	2.39a	2.43a	10.60a	10.62a	63.00a	68.00a	0.00a	0.00a
4	2.30b	2.33b	10.38b	10.40b	60.00b	66.00b	6.08b	1.68b
7	2.18c	2.22c	10.30c	10.32c	56.00c	64.00c	15.44c	4.76c
10	2.07d	2.19d	10.21d	10.23d	51.00d	63.00c	21.84d	7.55d
14	1.95e	2.00e	10.11e	10.12e	48.00e	61.00d	30.21e	9.79e

Mean with the same alphabet are not significantly different from each other

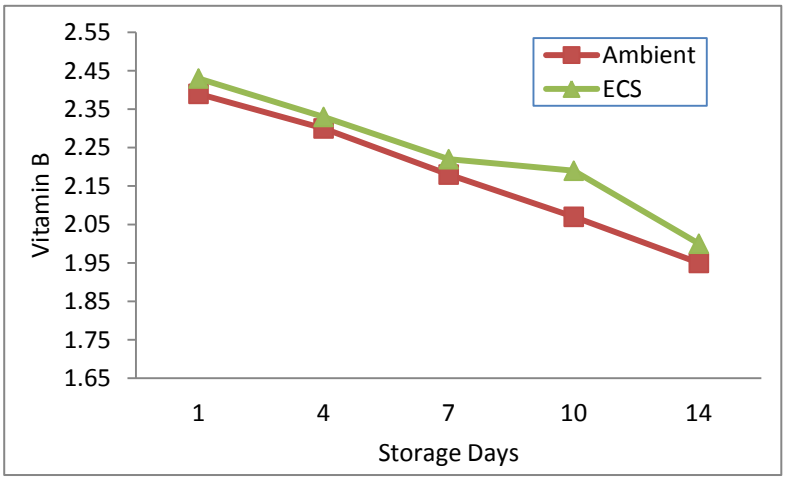

Figure 1: Relationship between Storage Days, Storage Condition and Vitamin B Content of Stored Pear Fruits

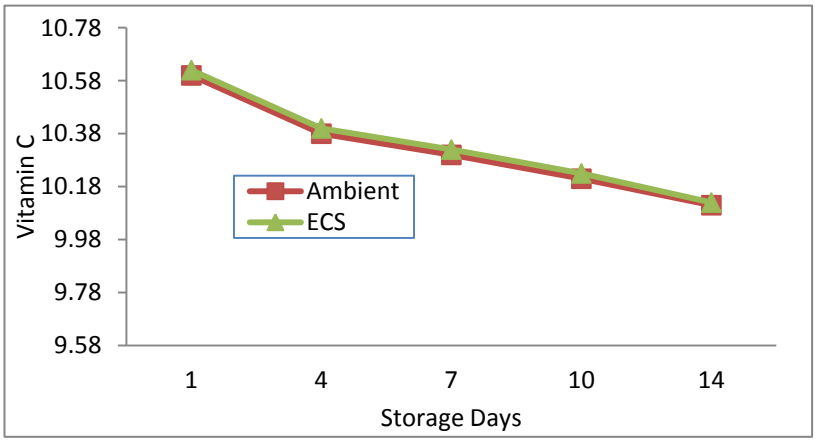

Figure 2: Relationship between Storage Days, Storage Condition and Vitamin C Content of Stored Pear Fruits.

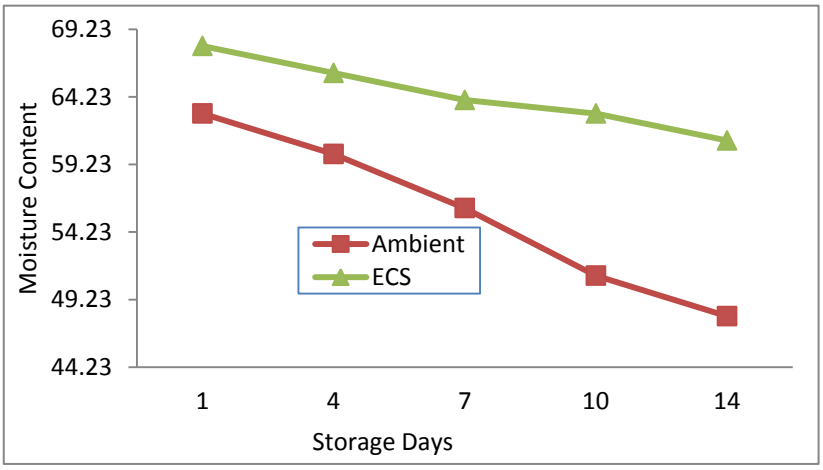

Figure 3: Relationship between Storage Days, Storage Condition and Moisture Content of Stored Pear Fruit

In general, it was observed that the vitamin B content of the stored fruit reduces progressively along the storage days. Figure 1 shows the graphical illustration of the relationship between vitamin B content of the stored pear fruits in the two storage system along the storage days. As earlier asserted, the vitamin B content of the stored pear fruits decreases progressively along the storage days irrespective of the storage medium. The decrease was however higher in ambient than in ECS. This is anticipated because the ECS was carefully constructed with materials such as aluminum known for its fruits and vegetables preservative ability and this result is in line with the report of Olusunde *et al., 2009*. Aluminum easily gain or loss heat, meaning that it is good for cold treatment.

The same trend was observed in both vitamin C and moisture content in ECS and ambient storage conditions which follows the same trend with the result of Olusunde *et al., 2009*.

3.3 Effect of Storage Structure on the Weight Loss of Stored Pears

The weight loss of stored pear fruits was measured at consecutive intervals during the storage period. Table 3 also shows that weight loss increases along storage days and this loss in weight differs significantly from day to day. The ECS was seen to have preserved the weight of the stored pear more significantly than the ambient condition. The lower weight loss recorded in evaporative cooling structure may be attributed to slower rate of respiration of the stored pears as well as higher relative humidity recorded in the structure which is in line with the finding of Bhowmik and Pan, 1992). This is also in line with the findings from Dadhich *et al*., 2008. With more weight preserved in ECS, it can be concluded without lost of generality that nutritious qualities of the stored pear are retained. Therefore the ECS can be said to be more advantageous in the preservation of pear fruits than the ambient condition. Figure 5 shows the graphical illustration of the % weight loss during the storage days in the two storage system.

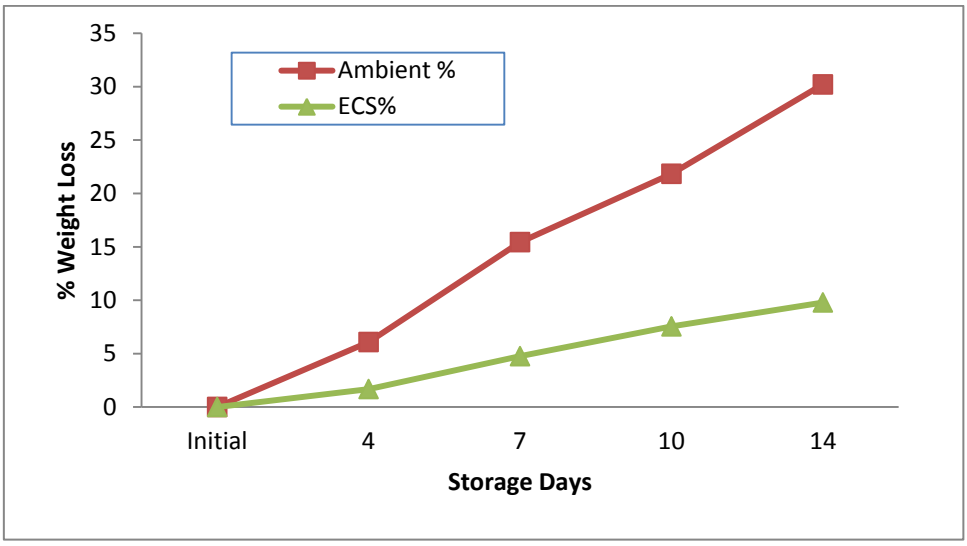

Figure 4: Relationship between Storage Days, Storage Condition and % Weight Loss of Stored Pear Fruits.

4. CONCLUSIONS

It can be concluded at the end of the thesis report that:

Vitamin B and C content of the stored fruits in the two conditions (ECS and ambient) have relatively the same mean irrespective of the storage days. It was also seen from the storage days that as day go by there was decrease in content of vitamin B and C. The average vitamin B content for ambient stored pears are 2.39(g/l), 2.30(g/l), 2.18(g/l), 2.07(g/l) and 1.95(g/l) while that of ECS are 2.40(g/l), 2.31(g/l), 2.10(g/l), 2.00(g/l) and 1.88(g/l). The average vitamin C contents for ambient were 10.60(g/l), 10.38(g/l), 10.30(g/l), 10.21(g/l) and 10.11(g/l) while that of ECS were 10.62(g/l), 10.40(g/l), 10.32(g/l), 10.23(g/l), and 10.12(g/l).

It can also be concluded that the discrepancies or variations observed in moisture content was not due to chance occurrence but rather different storage condition and storage days used. The average moisture content of the pears stored in the ECS are 68%,66%,64%,63% and 61% and ambient storage condition were 63%,60%,56%,51% and 48%.

Analysis should be carried out on the effect of microbial growth (if any) on fruits stored in ECS.

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