POSTHARVEST DETERIORATION AND NUTRIENT DEFICIENCY OF FRUITS SOLD IN OWERRI MUNICIPAL MARKETS: CHALLENGES TO NUTRITION AND HEALTH.

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Abstract
Ripe and over-ripe fruits of Pineapple (*Ananas comosus* L. Merr.); Banana (*Musa acuminata*) and Avocado pear (*Persea* sp.) were collected from markets in Owerri Municipality, Imo State, Nigeria. These samples were analyzed in the laboratory for pathogens associated with them and also their nutrient status, vis-a viz their crude fibre, ash and ascorbic acid contents. The array of microorganisms found to be associated with the ripe and over-ripe fruits were as follows: Banana (ripe and over-ripe) – *Fusarium solani*; Pineapple (ripe) – *Aspergillus niger*; (over-ripe) – *Fusarium moniliforme*, *A. niger*, *Phoma* spp. and Avocado pear (ripe) – *Fusarium oxysporum*, *F. solani*; (over-ripe) – *Fusarium oxysporum*, *Aspergillus niger* and *F. Solani.*On analysis using Genstat (2005), mean values of ripe and over ripe fruits were 0.736% and 0.493% respectively for ash content; 6.407 and 4.626 mg/100ml respectively for ascorbic acid content and 1.047 % and 0.883 % respectively, for crude fibre content. The stage of maturity and the fruit type had significant effects at P = 0.05% on the ash, crude fibre and ascorbic acid contents of the different fruits. The sale and consumption of fruits even at the overripe stage poses serious challenges to the nutrition and health of consumers, most of whom consume these fruits, at the advanced stage of ripeness, out of ignorance. The deterioration in nutrient value, alongside the array of pathogenic contaminants, poses a risk to human safety. Food safety regimens which are affordable and practicable are suggested.
Keywords: ripe and over-ripe fruits, pathogens, nutrient deficiency, food safety.

Introduction: The physiological development of fruits involves four stages namely: growth, maturation, ripening and senescence.According to Aini and Mohamad-Roff (2005), harvesting horticultural produce at the stage, size and at peak maturity is a must if the shelf life of the produce must be enhanced; especially as fruit crops are also attacked by a wide range of microorganisms in the post harvest phase (Snowdon, 1990; Ogawa and English, 1991). Packing sanitation can also be singled out as a factor that can influence senescence and decay. Snowdon (1990) stated that fruits are mostly attacked by a wide range of microorganisms, mostly fungi in the postharvest phase, and are responsible for the early senescence and rotting of fruits. Microorganisms occur in both the ripe and over ripe fruits principally because of sanitary reasons, but the disease severity rate on the two stages vary. Studies on marketing of fruits in municipal markets (Ofor, 1999) has revealed that these fruits are generally purchased and consumed even at the over ripe stages due to poor enlightenment (about the health implications) and economic reasons (traders sell the over ripe fruits at lower prices).This study was carried out to identify the microorganisms associated with fruits at different stages of ripeness; their nutrient quality and recommendations were made based on the health implications of the various nutrient deficiencies.

Materials and Methods: Ripe and overripe fruits of Banana, pineapple and avocado pear were collected from the Owerri Municipal Market, stored in sterile Ziploc packs and taken to the laboratory for analysis. Isolates were obtained from the pure cultures of samples and identified using Barnett and Hunter (1998).
Proximate analyses were also carried out on the various samples to establish their nutrient status – the crude fibre and ash content in the fruits were determined using methods in A.O.A.C. (1990); while percentage crude fibre and ash content was calculated using the formula:

I. % Crude Fibre = $\frac{\text{Weight of Crude Fibre}}{\text{Weight of fresh samples}} \times \frac{100}{1}$

II. % Ash = $\frac{\text{Weightof Ash}}{\text{Weight of fresh samples}} \times \frac{100}{1}$

The ascorbic acid content was determined using the method described in Egan *et al.*, (1981) and expressed as mg Ascorbic acid/100g sample. The results were analyzed using analysis of variance on Genstat (2005).

Results and Discussion: The samples yielded an array of microorganisms shown in Table 1 below. The results show that the pathogens isolated from the fruits are mainly Fusarium, Aspergillus and Phoma species. Among these organisms, Aspergillus spp.is known to play a role in three clinical settings in man, namely; opportunistic infections, allergic states and/or toxicoses. According to Ho and Yuen (2000), immuno-suppression has been reported to be the precursor to the development of opportunistic infections, with the development of the condition known as *Aspergillosis*. Various organs may be affected and conditions ranging from Meningitis, Pulmor-aspergillosis, Osteomyelitis, Cutaneous Aspergillosisand HepatosplenicAspergillosis may develop (Dening, 1998). According to Glimp and Bayer (1983), Aspergillosis spp. may also be local colonizers in previously developed lung cancer due to Tuberculosis, Sarcoidosis, Bronchiectasis, Spondgylitis or Neoplasm, presenting a distinct clinical condition, called Aspergilloma. Aspergillosis may also occur in the kidney (Halpern *et al.*, 1992).

Table 1: Microorganisms Isolated from Ripe and Overripe Fruits Sold in Owerri Municipal Market

Fruit Type	Fruit Status	Microorganisms Isolated
Banana	Ripe	*Fusarium solani*
	Over ripe	*F. solani*
Pineapple	Ripe	*Aspergillus niger*
	Over ripe	*Fusarium moniliforme, A. flavus and Phoma* spp.
Avocado pear	Ripe	*Fusarium oxysporum* and *F. solani*
	Over ripe	*F. oxysporum, A. niger* and *F. solani*

The result of the proximate analysis, as presented in Table 2, shows that there is a decrease in the nutrient status of the over ripe fruits compared to the ripe ones. Variations in the ash content of the various fruits were significant ($p<0.01$). Banana was shown to have the highest ash content of 0.758%; followed by Pineapple (0.587%) and Avocado pear (0.499%). The interaction of fruit type and stage of maturity was however, not significant. Ofor (1999) observed that the percentage ash and fibre content of infected tomato fruits were found to decrease generally with increasing days of storage. The importance of minerals and fibre in the overall health of a human cannot be over-emphasized. Though minerals are required in small quantities, a diet containing high fibre content is shown to reduce susceptibility to disease (FAO, 1989). According to Willcox *et al*. (2004), the negative impact of reactive oxygen species and other free radicals promote oxidative stress in humans, which has been related to cardiovascular disease, cancer, and other chronic disease that account for a major portion of deaths today.

The crude fibre content of the fruits also recorded a decrease as they moved from the ripe to over ripe stage. However, ripe Avocado pear recorded significantly ($p<0.01$) highest Crude fibre value of 2.43% while the least was recorded for over-ripe bananas (0.137%). According to FAO (1989), once the fruit is severed from the tree, the only available fuel for this degradation process is its stored reserves.

There were significant variations in the Ascorbic Acid content of the various fruits under study. The table further reveals that there is a downward trend in the AA content as the fruits move from ripe to over-ripe, with ripe and over-ripefruits recording 6.407 and 4.626mg/100g respectively. Ripe pineapple recorded significantly ($p<0.01$) highest AA content of 6.423 mg/100g while over-ripe banana recorded the least (3.583 mg/100g). Aworh *et al*. (1983) observed reduced ascorbic acid content in damaged but marketable tomato fruits in comparison with damaged fruits. This agrees with the report of Oladiran and Iwu (1992) who observed a decline in ascorbic acid content of tomato fruits inoculated with *Fusarium equiseti*, *F. chlamydosporium*, *Geotrichum candidum*, *Acremomium recifei*, *Aspergillus flavus* and *A. niger*. Similar decrease in ascorbic acid content was also exhibited by tomato fruits inoculated with *Rhizopus stolonifer* and *Nematospora coryli*, with increasing days of incubation (Ofor, 1999).According to Phan (1987), fresh fruits and vegetables exhibited an increased respiratory rate when in storage. This increase brings about a sharp decrease in the soluble sugar content, both reducing and non-reducing, usually the non-reducing, as they serve as the immediate reserve for the reducing sugars which are preferred metabolites for respiration.

Table 2: Effect of Stage of Maturity on the Nutrient Content of Avocado Pear, Banana and Pineapple

A – Ash Content (%)

	Stage of Maturity		
Fruit Type	**Ripe**	**Over-Ripe**	**Mean**
Avocado pear	0.610	0.387	0.499
Banana	0.863	0.653	0.758
Pineapple	0.733	0.440	0.587
Mean	0.736	0.493	
L.S.D. $_{(5\%)}$ Stage of Maturity (SM)	– 0.038		
" Fruit Type	– 0.046		
" Interaction (SM/Fruits)	– 0.066 ns		

B – Ascorbic Acid Content (AAC mg/100ml)

	Stage of Maturity		
Fruit Type	**Ripe**	**Over-Ripe**	**Mean**
Avocado pear	6.397	5.540	4.992
Banana	6.400	3.583	0.758
Pineapple	6.423	4.753	5.588
Mean	6.407	4.626	
L.S.D. $_{(5\%)}$ Stage of Maturity (SM)	– 0.167		
" Fruit Type	– 0.205		
" Interaction (SM/Fruits)	– 0.289		

C – Crude Fibre (%)

	Stage of Maturity		
Fruit Type	**Ripe**	**Over-Ripe**	**Mean**
Avocado pear	2.430	2.190	2.310
Banana	0.237	0.137	0.187
Pineapple	0.473	0.323	0.398
Mean	1.047	0.883	
L.S.D. $_{(5\%)}$ Stage of Maturity (SM)	– 0.0297		
" Fruit Type	– 0.0242		
" Interaction (SM/Fruits)	– 0.0419		

Conclusion

The sanitary conditions under which most fruits are handled in the postharvest environment leave much to be desired. The display conditions (mostly on the ground), portends an open invitation to an array of microorganisms. These organisms in turn deplete the nutrients that ought to be available to the consumers. The fact that the over-ripe fruits had significantly decreased amounts of nutrients (ash, fibre and ascorbic acid contents) means that these fruits should preferably be consumed before they enter the over-ripe stage. Also, the human health risks which the array of microorganisms found in association with these fruits are likely to cause makes it imperative to consume wholesome fruits, devoid of these pathogens. Strict sanitary policies which promote food safety and extension of the shelf life of fresh horticultural produce should be put in place by the appropriate authorities and measures for strict compliance and implementation by farmers and traders (small and large scale) should be adhered to.

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