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REGULAR ARTICLE

EFFECT OF STORAGE ON THE NUTRIENT COMPOSITION AND THE MYCOBIOTA OF SUNDRIED WATER MELON SEEDS (*Citrullus lanatus)*

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ABSTRACT

The nutrient composition and the mycobiota of *Citrullus lanatus* (water melon) seeds were investigated during twenty weeks storage. Six fungi were isolated namely *Aspergillus niger, Aspergillus flavus, Fusarium* sp., *Mucor* sp., *Neurospora* sp. and *Penicillium* sp. The fungal count was found to increase as the storage time increased. The proximate (in %) analysis were found to decrease as the storage time increased. The fat content was found to decrease from 38.98 in the freshly shelled water melon seeds to 35.44 in the stored seeds. The ash content decreased from 3.23 to 2.92 in the stored water melon seeds while the fibre content decreased from 9.60 to 5.44 in the stored seeds. The mineral composition (in $mg.100g^{-1}$) also decreased during the storage. The sodium content decreased from 1.78 to 1.66, calcium from 0.80 to 0.34, magnesium from 6.75 to 6.30, zinc from 0.49 to 0.34, iron from 1.32 to 1.00, copper from 0.06 to 0.02 and manganese was not detected.

Keywords: Mycobiota, water melon, proximate, minerals, nutrient composition

INTRODUCTION

Water melon belongs to the genus *Citrullus* and family *Cucurbitaceae* **(Huxley, 1992)**. The *Cucurbitaceae* is a medium sized plant family, primarily found in the warmer regions of the world. It is recognizable by its pinnatifid leaves and prolific fruit, up to 100 melons on a single vine. The water melon fruit, loosely considered a type of melon, possesses a smooth exterior rind (green and yellow) and a juicy, sweet, usually red, yellow or orange interior flesh (**Jeffrey, 2005**). Moreover, they are used as a domestic remedy for urinary tract infection, hepatic congestion, catarrh, worm remedy, abnormal blood pressure **(Deible and Swanson, 2001; Amadi *et al.*, 2003)**.

Water melon is rich in minerals, protein, vitamins, carbohydrate and fibre **(Duke and Ayensu, 1985; Tarek and Khaled, 2001)**. However, storage conditions have effect on the proximate and chemical composition of the stored water melon because of the growth of some spoilage fungi that strife in such conditions **(Abaka and Norman, 2000).** The fungi that invade stored product are generally grouped into two categories namely field fungi which attack developing and matured seeds in the field and storage fungi which are predominantly species of *Aspergillus* and *Penicillium* which attack the stored products **(Fagbohun *et al.*, 2010)**.

The conditions of the stored product determine the extent of invasion of the stored product. The environmental factors that aid the development of fungi in stored products include moisture content **(Amusa *et al.*, 2002)**, temperature **(Abaka and Norman, 2000)**, aeration **(Burell, 1974)**, pH **(Aderiye, 2004)**, relative humidity **(Kuku, 1979)**. However, the effect of this storage fungi on stored products include deterioration and spoilage of stored products **(Abaka and Norman, 2000; Ekundayo and Idzi, 2005)**, reduction of market value **(Muller, 1991)** and production of chemical substances that are toxic **(Richard and Wallace, 2001)**. The preventive measures that can be employed for the growth of the storage fungi are biological control **(Aderiye, 2004)**, chemical control and physical control **(Rice, 2002)**.

However, the aims and objectives of this study were to study the effect of storage on the nutrient composition and the mycobiota of sundried water melon seeds.

MATERIAL AND METHODS

Collection of Samples

Ten seeds of *Citrullus lanatus* were collected from Oja-oba, the main market in Ado Ekiti, Ekiti State, Nigeria. The seeds were shelled and sun dried for one week. The samples were stored for six months in an insect free container, labeled and kept in the laboratory at 28^{o}C. The seeds were examined for changes in the mycobiota and nutrients composition after each month of storage.

Isolation of Fungi from the Stored Sun Dried Melon

Direct Plating

From the sun dried water melon seeds, 10 seeds were examined randomly for external mouldness. They washed with sterile distilled water. Using a sterile dissecting forceps, the surface of the stored dried water melon seeds was scrapped and was plated aseptically on Potato Dextrose Agar (PDA) plate and incubated at 28^{o}C for 7 days as described by **Amusa (2001)** and **Arotupin and Akinyosoye (2001)**. The pure cultures obtained were examined under the microscope for fruiting bodies, hyphae to determine the fungi present.

Dilution Plate Method

This method was used to determine the type of fungi present in the stored sun dried water melon seeds. However, 1g of the sample was grinded with 10ml of sterile distilled water. This was shaken thoroughly and 1ml of suspension was pipetted into a sterile test tube containing 9ml of distilled water. This was thoroughly mixed together. The sample was serially diluted and 1ml each of aliquots of 10^{-5} and 10^{-6} were added to molten PDA plates. The plates were swirled gently to obtain thorough mixing and were allowed to solidify and incubated at 28^{o}C for 7 days. The fungal colonies were counted every 24 hours.

Washing Method

This was carried out by weighing 1 g of the sundried water melon seeds into 10 ml of sterile distilled water in a beaker. This was shaken thoroughly and drops of suspension of contaminated water were introduced into Ppetri dishes containing Potato Dextrose Agar. This was evenly spread on the agar plate with aid of a sterile glass spreader. The plates were incubated at 28^{o}C for 7 days and were observe for visible fungi growth.

Identification of mycobiota

The associated fungi were identified by their cultural and morphological features **(Alexopoulous *et al.*, 1996; Burnet, 1975; Dungan, 2006)**. The isolates were examined under bright daylight for the colour of the culture and further examination was carried out.

Proximate analysis

The proximate analysis of the samples for moisture, ash, fibre and fat were done by the method of **AOAC (2005)**. The nitrogen was determined by micro-Kjeldahl method as described by **Pearson (2002)** the percentage Nitrogen was converted to crude protein by multiplying 6.25. All determinations were performed in triplicates.

Mineral analysis

The minerals of the samples were analyzed using the solution obtained by dry ashing the sample at 550°C and dissolving it in HCl (25ml) and 5% Lanthanum chloride (2ml), boiling, filtering and making up to standard volume with deionized water. Mn, Cu, Co, Zn, Fe, Mg, Na, and Ca were determined with a Buck Atomic Absorption Spectrometer (Buck Scientific, Model 200A/200, Inc. East Norwalk, Connecticut, U.S.A). Sodium was measured with a Corning 405 flame photometer (Corning Halstead, Essex, UK, Model 405) **(AOAC, 2005)**. The detection limits had previously been determine using the methods of **Techtron (1975)** as Mn 0.01, Cu 0.005, Co 0.05, Zn 0.005, Fe 0.02, Mg 0.002, Ca 0.04, Na 0.001 ppm (all for aqueous solutions).

The optimum analytical range was 0.5 to 10 absorbance units with coefficient of variation of 0.05 to 0.40% phosphovanado-molybdate method using a Spectronic 20

colorimeter (Galenkamp, London, UK) **(AOAC, 2005)**. All chemicals were BDH analytical grade.

RESULTS AND DISCUSSION

A total of six fungi were isolated from stored sundried water melon seeds and were identified based on their cultural and morphological characteristics. The fungi include *Aspergillus niger, Aspergillus flavus, Fusarium* sp., *Mucor* sp., *Neurospora* sp. and *Penicillium* sp. The summary of the fungi isolated from stored sundried water melon seed using various methods are shown on Table 1. In addition, results of the proximate and mineral analysis are shown on Tables 2 and 3 respectively.

In this study, there was an increase in the numbers of fungi isolated as the study progressed. Three fungi *Aspergillus niger*, *Aspergillus flavus* and *Mucor* sp. were isolated at the first week of the study while others joined the number as the study progressed. This result is in agreement with the findings of **Fagbohun and Lawal (2011)** who reported the isolation of *Aspergillus glaucaus, Aspergillus flavus* and *Aspergillus niger* from sundried soybean stored for twenty weeks. The metabolic activities of isolated fungi in the stored products may cause decay of agricultural produce thereby reducing their market and nutritional value **(Amusa *et al.*, 2002)**. The fungi isolated using washing method are those capable of growing in the seeds. The fungi isolated by any of the three methods used could therefore be field or storage fungi.

Table 1 A summary of fungi isolated from stored sun dried water melon seeds using various methods

Fungal sp.	Weeks of storage and method of isolation					
	0	4	8	12	16	20
	ABC	ABC	ABC	ABC	ABC	ABC
Aspergillus niger	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Aspergillus flavus	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Fusarium sp.	- - +	+ - +	+ + +	+ + +	+ - +	+ + +
Mucor sp.	+ + +	+ - +	+ + +	+ + +	+ + +	+ + +
Neurospora sp.	- - -	+ - +	+ - +	+-+	+ + +	+ + +
Penicillium sp	- - -	- - -	- - +	+-+	+ + +	+ + +

Legend: A = Direct Plating Method, B = Dilution method, C = Washing method

Moreover, the fungi isolated in this study could be from the air, soil, storage house and or improper handling of the products. The penicillia are as common and as cosmopolitan as the aspergilla. They are so called green molds and blue molds which so frequently find on *Citrus* and other fruits, on jellies and preserves and on other foodstuffs that have become contaminated with their spores **(Rice, 2002)**.

Some of the fungi associated with stored products are capable of producing toxin metabolites or chemicals that are detrimental to the health of consumers. However, consumption of handful amount of these chemicals in the stored products can cause illness or death **(Anon, 1993; Mirocha *et al.*, 2003)**. Based on the concern of the hazard to livestock and man, concerted effort is now being directed at finding very cheap and reliable methods of minimizing aflatoxin formation in stored products **(Bankole and Adebanjo, 2003)**.

Table 2 A summary of the results of proximate analysis of sun dried water melon seeds during storage (in %)

Weeks of storage	Ash	MC	CP	Fat	Fibre	CHO
Freshly prepared	3.23	3.86	43.61	38.98	9.60	6.16
4 weeks	3.64	3.13	43.04	36.76	9.48	3.96
8 weeks	2.92	10.02	43.12	35.21	5.42	4.19
12 weeks	2.87	8.14	44.79	34.65	5.37	3.33
16 weeks	3.23	5.44	44.75	37.92	7.40	1.27
20 weeks	2.92	7.89	42.17	35.44	5.44	0.70

Legend: MC = Moisture Content, CP = Crude Protein, CHO = Carbohydrate

The results of the proximate analysis (in %) are shown of Table 2. It was found that the freshly shelled water melon seed had ash content of 3.23, moisture content (mc) of 3.86, crude protein (CP) of 43.61, fat of 38.98, fibre content (FC) of 9.60 and carbohydrate (CHO) of 6.16. However, after six months of storage the ash, crude protein, fat, fibre and carbohydrate decreased to 2.92, 42.17, 35.44, 5.44 and 0.70 respectively.

In contrast, **Fagbohun and Lawal (2011)** reported the increase of ash content from 5.07 to 6.44 and crude protein from 40.94 to 42.33 in sundried soybean stored for twenty weeks. The moisture content also increased to 7.89 %, this may be due to the degrading activity of the fungi.

The proximate analysis of stored shelled water melon seeds revealed that there was a decrease in the nutritive value of the stored melon seeds compared to the freshly shelled water

melon seeds. This is due to fungal activity that caused changes during storage of the product. Nutrients are lost because of changes in CHO, protein, lipids and vitamins **(Abaka and Norman, 2000)**.

The mineral analysis of the melon seeds during storage (in mg/100mg) are shown on Table 3. It was found that Na (1.78), K (2.51), Ca (0.80), Mg (6.75), Zn (0.49), Fe (1.32) and Cu (0.06) in the freshly shelled water melon seeds decreased to 1.66, 2.34, 0.34, 6.30,0.34 1.00, 0.02 respectively at twentieth week of storage. This is in agreement with the findings of **Ekundayo and Idzi (2005)** who reported the decrease in the minerals content of melon seeds after two weeks of storage. However, this is in contrast to the findings of **Fagbohun and Lawal (2011)** who reported an increase in the minerals of sundried soybean stored for twenty weeks.

Table 3 A summary of the results of the mineral analysis of sun dried water melon seeds during storage (in $mg.100g^{-1}$)

Storage in weeks	Na	K	Ca	Mg	Zn	Fe	Cu	Mn
Freshly prepared	1.78	2.51	0.80	6.75	0.49	1.32	0.06	ND
4	1.77	2.49	0.74	6.69	0.53	1.32	0.05	ND
8	1.73	2.42	0.50	6.61	0.47	1.26	0.05	ND
12	1.65	2.40	0.43	6.42	0.42	1.19	0.03	ND
16	1.70	2.41	0.35	6.54	0.41	1.17	0.03	ND
20	1.66	2.34	0.34	6.30	0.34	1.00	0.02	ND

CONCLUSION

Water melon seed is of great importance to mankind. It contain high amount of calcium, phosphorus, magnesium, potassium, zinc and iron. These nutrients are required in major or minor quantities for the physic-chemical reactions that occur daily which contribute to good health and fitness in human beings. Water melon seed oil also contain high amount of unsaturated fatty acid which has been discovered to be effective against high blood pressure, hypertension and obesity. However, adequate and proper care of the fruits and its seeds during processing and storage will ensure the conservation of its usefulness.

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