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Impact of Modified Atmosphere Packaging on Nutritive Values and Sensory Qualities of Fresh Maize (*Zea mays* L.) Under Tropical Ambient Storage Condition

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Abstract: Effect of film packaging on fresh yellow maize (*Zea mays* L.) on the cob after harvesting was tested. Proximate, mineral and sensory qualities of fresh maize samples subjected to passive modified atmosphere packaging (PMAP) and unpackaged samples at day 1, 2, 3 and 4 of storage at tropical ambient temperature (28±2°C) and 80% RH were carried out. The samples were compared with freshly harvested maize (FHM) which served as control. Results of proximate composition showed that the sample T1 (undehusked maize) maintained its moisture content at day 1 and 2 of storage and had the highest total sugar content when compared to other stored samples. Mineral composition showed higher contents of potassium, phosphorus, sodium and magnesium in control sample. Mineral content of T1 (undehusked maize) was not different significantly ($p<0.05$) from the control. T2 (dehusked maize) and PMAP samples had the lowest values due to their rate of deterioration at day 3 and 4 of storage. The sensory evaluation result showed the control sample to be the most preferred and followed by T1 in all the quality attributes (colour, taste, aroma and overall acceptability) evaluated. Due to the fast deterioration of fresh maize qualities after harvesting, it can therefore be concluded that PMAP had no impact in extending the storage life of fresh maize at ambient temperature.

Keywords: Ambient Temperature, Composition, Dehusked, Fresh Maize, Packaging, Postharvest

1. Introduction

Maize, *Zea mays* L., also referred to as corn is the most important cereal crop in the world after wheat and rice with regard to cultivated areas and total production. It is widely cultivated in the tropics [1] and a dietary staple for more than 200 million people in sub tropics and temperate regions of the world including Africa, America and Asia [2, 3]. It is cultivated both as rain-fed and under irrigation in the savannah agroecological zone of Nigeria, where its production has moved from that of subsistence cultivation to commercial cultivation [4]. Maize is an annual crop with a height range of 8-10 meters and it is characterized by an erect green stalk. General classes of maize include flint, pop, flour, dent, and sweet maize. The terms “common,” “normal,” or “typical” maize generally refer to dent and flint varieties. Depending on environmental, cultural, and genetic parameters, maize kernels can vary in colour (white, yellow, orange, red and black), quantity (300-1000 kernels per ear), weight (190-300 g per 1000 kernels), spatiality (12-16 kernels per row) and nutrient composition [2, 5].

Yellow dent maize which currently dominates the South Western part of Nigeria has a greater demand compare to white varieties. It is eaten as roasted and enjoy alongside with African pear or coconut and also in boiled form [6]. Its consumption is very high during every annual harvest season. Generally, maize is a rich source of carbohydrates, vitamins, proteins and minerals. It has a horny endosperm and more carotenoids (41.33-179.93%), which are the source of yellow colour in maize [7]. Sweetness and characteristic aroma which make up the sensory attributes are the most important indicators of shelf life from the consumer's point of view [8]. Fresh produce especially freshmaize has a very short shelf life and its nutritional composition undergoes significant changes immediately after harvesting as a result of metabolic reactions [9, 10]. Shelf life of agricultural commodities can be extended by several methods such as modified atmosphere storage, controlled atmosphere storage, chemical treatments and irradiation among others [11]. This study was therefore carried out to test theeffectiveness of modified atmosphere packaging on the postharvest nutritional and sensory qualities of freshly harvested yellow maize on the cob at ambient temperature storage.

2. Materials and Methods

2.1. Materials

Freshly harvested ears of open pollinated variety (SUWAN 1-SR) of normal yellow maize on the cob was obtained from the Research farm of the Federal University of Technology Akure (FUTA) and Low Density Polyethylene (LDPE) of two different gauges (25 and 30 µm) with 34 cm × 14.5 cm in area were used. Fresh maize were dehusked by hand and randomly selected for immediate analysis (control) while the remaining fresh maize were grouped into six lots: undehusked maize (T1), dehusked maize (T2), undehusked maize packaged with 25 µm LDPE (T3), dehusked maize packaged with 25 µm LDPE (T4), undehusked maize packaged with 30 µm LDPE (T5) and dehusked maize packaged with 30 µm LDPE (T6). All the PMAP samples were heat sealed using an impulse sealer (MEC, China). Samples were then transferred into a chamber set at 28±2°C and 80% RH maintained for 4 days.

2.2. Methods

2.2.1. Proximate Analysis

Samples were taken on daily basis during storage for proximate composition using the recommended method of [12]. The moisture content of the various samples was determined on drying at 105°C in an oven until a constant weight was attained. The difference ininitial and final weights of the sample was expressed in percentage moisture. Micro-Kjeldahl method was employed to determine the total nitrogen and the crude protein was calculated based on nitrogen conversion factor of 6.25. Crude fat was extracted with petroleum ether using the Soxhlet method, crude fibre and ash contents (gravimetric) were determined. Total crude carbohydrate was estimated as follows: Total crude carbohydrates (%) = 100 – (%Ash + %Crude protein + %Crude lipid + %Crude fibre). Total sugar was determined using phenol-sulphuric acid method [13].

2.2.2. Mineral Analysis

The maize samples were ashed at 550°C. The ash was boiled with 10 ml of 20% HCl in a beaker and then filtered into a 100 ml standard flask. This was made up to the mark with deionized water and the minerals were determined from the resulting solution using the method described by [11]. Sodium (Na) and Potassium (K) were determined using the standard flame emission photometer. NaCl and KCl were used as the standards. Phosphorus was determined calorimetrically using the spectronic 20 (Gallenkamp, UK) with KH_2PO_4 as the standard. Calcium (Ca), Magnesium (Mg) and Iron (Fe) were determined using Atomic Absorption Spectrophotometer (AAS Model SP9). All values were expressed in mg/100g.

2.2.3. Sensory Evaluation

The stored packaged and unpackaged maize samples, and fresh maize samples harvested daily for comparison purpose (control) were boiled for 10 min and were coded before presenting to 20 member panelists (postgraduate students of FUTA) for evaluation. The sensory evaluation was conducted in a standard sensory laboratory where each of the panelists was positioned in a separate cubicle to avoid interferences. All indices were measured using a 9 point Hedonic scale from 1 to 9, where a score of 9 represents extremely like and a score of 1 represents extremely dislike [14].

2.2.4. Statistical Analysis

All experiments were done in triplicate. Data generated were analysed using SPSS version 20.0 software. One way analysis of variance (ANOVA) was employed to study the difference between means and where differences existed ($p<0.05$). Duncan's New Multiple Range Test was used to separate the means.

3. Results and Discussion

3.1. Changes in Chemical Composition (Proximate and Sugar Content) of Packaged and Unpackaged Fresh MaizeDuring Storage

The result of proximate composition of packaged and unpackaged fresh yellow maize on the cobs stored at ambient temperature (28±2°C) from day 1 to 4 is presented in Table 1. Moisture contents were in the range of 54.04-63.50% and 51.48-65.85% on day 1 and 2 of storage, respectively. Samples T1 (unpackaged undehusked maize) and T2 (unpackaged dehusked maize) were significantly ($p<0.05$) lowered than the control (61.13%) throughout the storage duration. Passive Modified Atmosphere (PMAP) samples (T3, T4, T5 and T6) had significantly ($p<0.05$) higher values than the control and the unpackaged samples (T1 and T2) on day 1 and 2 of storage. Moisture content for PMAP samples was not determined on day 3 and 4 due to the visible appearance of microbes. Moisture content is a very important factor not only in preharvest life of fresh maize but also during postharvest storage duration. Moisture content affects the appearance, textural characteristics and the chemical profile of fresh maize. In the present study, presence and absence of husks, packaging film with the interaction of storage duration and temperature had significant effects on moisture content of freshly harvested maize on the cob.

Increase moisture content of PMAP samples as the storage duration progressed could be as a result of metabolic reactions during respiration. This probably encourages the proliferation of microbes. Ambient storage temperature had a great effect on dehusked maize which led to its dented appearance and shrinkage. The main reason for moisture loss is transpiration [8] and occurs primarily in the husks which in turn incur moisture loss from kernels and cobs in the form of water vapour [15, 16]. Ash (3.93%), crude protein (13.12%), crude fat (4.78%), crude fibre (5.43%) and carbohydrate (72.74%) were recorded for the control sample and thesewere similar to the finding of [17]. Significant differences ($p<0.05$) existed among the treatments. The carbohydrate content ranged from 72.23-73.07% and 71.57-73.86% on day 1 and 2 of storage, respectively. The highest content was recorded for dehusked maize samples (T2) on day 3 (75.22%) and 4 (77.72%) of storage. It was observed that T1 and T2 had higher carbohydrate contents than the control and PMAP samples. A decreasing trend in ash, crude protein, crude fat and crude fibre contents were noticed in all the treatments from day 1 to 4 of storage except T1 which was not significantly affected by the storage temperature.

Table 1. *Proximate composition of packaged and unpackaged fresh maize stored at 28±2°C.*

SD (day)	Sample code	Moisture content (%)*	Ash (%)	Crude protein (%)	Crude fat (%)	Crude fibre (%)	Carbohydrate(%)
0	FHM	61.13±1.32^{d}	3.93±0.02^{a}	13.12±0.59^{a}	4.78±0.13^{c}	5.43±0.34^{a}	72.74±1.75^{ef}
1	T1	58.40±1.70^{e}	3.92±0.28^{a}	13.04±0.34^{a}	4.74±0.14^{c}	5.38±0.20^{a}	72.92±0.60^{e}
	T2	54.04±0.82^{f}	3.86±0.19^{b}	13.10±0.34^{a}	4.65±0.06^{c}	5.32±0.38^{a}	73.07±0.52^{e}
	T3	62.40±1.10^{d}	3.61±0.11^{d}	12.34±0.17^{b}	6.40±0.29^{b}	5.23±0.57^{b}	72.42±0.80^{f}
	T4	61.10±0.51^{d}	3.66±0.13^{d}	12.52±0.37^{b}	6.31±0.35^{b}	5.28±0.22^{b}	72.23±0.19^{f}
	T5	63.50±0.60^{c}	3.72±0.08^{c}	12.25±0.23^{c}	6.50±0.26^{b}	5.21±0.52^{b}	72.31±0.41^{f}
	T6	63.20±0.12^{c}	3.64±0.19^{c}	12.30±0.16^{c}	6.43±0.28^{b}	5.24±0.38^{b}	72.39±0.56^{f}
2	T1	52.37±0.31^{f}	3.81±0.24^{b}	12.83±0.25^{b}	4.39±0.13^{c}	5.35±0.09^{a}	73.62±0.76^{d}
	T2	51.48±0.62^{f}	3.75±0.54^{c}	12.96±0.23^{b}	4.15±0.24^{e}	5.28±0.25^{b}	73.86±0.91^{d}
	T3	65.45±0.76^{a}	3.54±0.22^{e}	11.96±0.29^{d}	7.52±0.19^{a}	5.15±0.35^{c}	71.83±0.19^{g}
	T4	64.50±0.70^{b}	3.40±0.25^{f}	12.28±0.35^{c}	7.54±0.32^{a}	5.21±0.32^{b}	71.57±0.13^{g}
	T5	65.85±0.31^{a}	3.51±0.41^{e}	11.83±0.29^{d}	7.38±0.20^{a}	5.16±0.36^{c}	72.12±0.53^{g}
	T6	64.60±0.57^{b}	3.48±0.12^{f}	12.20±0.40^{c}	7.48±0.14^{a}	5.19±0.44^{c}	71.65±0.35^{g}
3	T1	49.45±0.36^{fg}	3.67±0.22^{d}	12.72±0.60^{b}	4.26±0.27^{d}	5.32±0.19^{a}	74.03±0.72^{c}
	T2	42.29±0.81^{h}	3.58±0.48^{e}	12.92±0.28^{b}	4.04±0.50^{e}	4.24±0.24^{d}	75.22±0.15^{b}
	T3	ND	ND	ND	ND	ND	ND
	T4	ND	ND	ND	ND	ND	ND
	T5	ND	ND	ND	ND	ND	ND
	T6	ND	ND	ND	ND	ND	ND
4	T1	46.64±0.63^{g}	3.54±0.28^{e}	10.52±0.31^{b}	4.01±0.40^{e}	4.21±0.22^{d}	77.63±0.30^{a}
	T2	41.61±0.40^{h}	3.43±0.18^{f}	10.84±0.28^{a}	3.94±0.32^{e}	4.16±0.30^{e}	77.72±0.15^{a}
	T3	ND	ND	ND	ND	ND	ND
	T4	ND	ND	ND	ND	ND	ND
	T5	ND	ND	ND	ND	ND	ND
	T6	ND	ND	ND	ND	ND	ND

Different letters denote significant difference ($p<0.05$) within each column. % * = % wet basis, SD=Storage Duration, FHM= Freshly Harvested Maize, T1=Undehusked maize, T2=Dehusked maize, T3=Undehusked maize packaged with 25 µm gauge LPDE, T4= Dehusked maize packaged with 25 µm gauge LDPE, T5= Undehusked maize packaged with 30 µm gauge LDPE, T6= Dehusked maize packaged with 30 µm gauge LDPE, ND= Not Determined due to observations of microbial growth. Values are means±SD of three determinations.

Deterioration observed in PMAP samples on day 3 and 4 of storage might be attributed to heat generated by the respiration of fresh maize inside the packaging material at storage. The total sugar content of packaged and unpackaged fresh maize is shown in Table 2. The major quality characteristic of fresh maize is sugar content and therefore kernel sweetness [18]. Sweetness of fresh maize is the most important flavour-related factor. Total sugar content ranged from 11.64-22.64 mg/g and 10.57-20.78 mg/g on day 1 and 2 of storage, respectively. Control sample had the highest value of 61.82 mg/g and was found to be lower than the result of [9] who studied sugar content of *Zea mays* var. *rugosa* and this may be as a result of environmental factors or genetic variation. Significant ($p<0.05$) reduction in sugar contents were noticed in all the treatments from day 2 to 4 of storage. PMAP samples were not determined on day 3 and 4 due to observations of microbial growth.

Table 2. *Total sugar content (mg/g) of packaged and unpackaged fresh maize stored at 28±2°C.*

	Storage duration (day)				
SC	0	1	2	3	4
T1	(61.82^{a})	22.64^{b}	20.78^{bc}	16.02^{d}	14.18^{de}
T2	(61.82^{a})	19.24^{c}	18.95^{c}	12.50^{e}	11.78^{f}
T3	(61.82^{a})	12.88^{e}	10.57^{f}	ND	ND
T4	(61.82^{a})	15.76^{d}	12.75^{e}	ND	ND
T5	(61.82^{a})	11.64^{f}	10.72^{f}	ND	ND
T6	(61.82^{a})	13.84^{e}	12.24^{e}	ND	ND

Different letters denote significant difference ($p<0.05$) within each row. SC=Sample Code, T1=Undehusked maize, T2=Dehusked maize, T3=Undehusked maize packaged with 25 µm gauge LPDE, T4= Dehusked maize packaged with 25 µm gauge LDPE, T5= Undehusked maize packaged with 30 µm gauge LDPE, T6= Dehusked maize packaged with 30 µm gauge LDPE, ND= Not Determined due to observations of microbial growth. Values in parenthesis are for day 0 (freshly harvested maize) only. Values are means of three determinations.

Undehusked maize had higher sugar content compared to unpackaged dehusked maize and PMAP samples. This could be as a result of cooling effect of husk and this is in agreement with previous studies of [19] and [20].

3.2. Changes in Mineral Content of Packaged andUnpackaged Fresh Maize on Cobs During Storage

The results of selected mineral composition of packaged and unpackaged fresh maize are presented in Table 3. Higher contents of potassium (801.98 mg/100g), phosphorus (159.77 mg/100g), sodium (158.42 mg/100g) and magnesium (124.95 mg/100g) were observed in the control sample. This was significantly ($p<0.05$) higher than the stored samples and it shows that fresh maize is a good source of mineral. Mineral is very essential to the maintenance of human health by supporting healthy immune system, DNA synthesis, wound healing, healthy growth and development of body during adolescence, childhood and pregnancy [21, 22]. However, the value for undehusked maize sample (T1) was significantly similar to the control throughout the storage duration. The least mineral found in control sample were calcium, iron and zinc and further decrease in all the treatment as the storage duration progressed. Significant ($p<0.05$) differences were noticed among the stored samples from day 1 to 4 of storage. Potassium content ranged from 766.34 (T5)-786.00 mg/100g (T1) on day 1 and 648.51 (T5)-767.33 mg/100g (T1) on day 2 of storage. Higher values 3705.58 mg/100g and 692.06 mg/100g were recorded for T1 on day 3 and 4, respectively. A significant ($p<0.05$) decreasing trends in the mineral contents as storage duration progressed were observed. This result is in accordance with the findings of [23] on storage of plantain at ambient temperature. PMAP samples were not determined on day 3 and 4 of storage as a result of the growth of microorganisms.

Table 3. *Mineral content (mg/100g) of packaged and unpackaged fresh maize stored at 28±2°C.*

SD (day)	Sample code	Na	Ca	K	Fe	Zn	Mg	P
0	FHM	158.42 ± 2.29^{a}	29.70 ± 1.50^{a}	801.98 ± 3.14^{a}	1.78 ± 0.23^{a}	1.98 ± 0.03^{a}	124.95 ± 1.17^{a}	159.77 ± 1.17^{a}
1	T1	152.32 ± 1.78^{ab}	29.41 ± 0.80^{a}	786.00 ± 2.49^{a}	1.74 ± 0.11^{a}	1.86 ± 0.13^{b}	123.69 ± 3.37^{a}	154.25 ± 2.97^{a}
	T2	145.00 ± 1.45^{b}	27.70 ± 0.55^{b}	783.92 ± 2.08^{a}	1.71 ± 0.24^{a}	1.81 ± 0.18^{b}	122.71 ± 2.40^{a}	148.52 ± 1.73^{b}
	T3	138.67 ± 2.23^{c}	25.00 ± 0.39^{cd}	781.04 ± 3.37^{a}	1.56 ± 0.48^{c}	1.72 ± 0.20^{c}	119.80 ± 1.61^{c}	136.50 ± 2.60^{c}
	T4	142.16 ± 1.05^{b}	26.50 ± 0.71^{c}	784.98 ± 2.14^{a}	1.59 ± 0.05^{c}	1.70 ± 0.12^{c}	120.00 ± 2.51^{bc}	140.30 ± 2.14^{b}
	T5	122.55 ± 1.10^{d}	20.00 ± 1.13^{e}	766.34 ± 4.17^{b}	1.52 ± 0.20^{c}	1.59 ± 0.29^{d}	117.00 ± 2.31^{c}	131.65 ± 3.25^{c}
	T6	132.00 ± 1.55^{c}	24.70 ± 0.46^{d}	771.29 ± 3.71^{b}	1.51 ± 0.19^{c}	1.68 ± 0.12^{c}	118.00 ± 1.80^{c}	135.00 ± 2.65^{c}
2	T1	150.86 ± 2.75^{ab}	26.63 ± 1.51^{c}	767.33 ± 1.79^{b}	1.69 ± 0.15^{b}	1.70 ± 0.01^{c}	122.69 ± 3.26^{a}	151.20 ± 2.04^{a}
	T2	140.56 ± 1.68^{b}	25.72 ± 0.20^{cd}	756.47 ± 4.63^{c}	1.65 ± 0.27^{b}	1.68 ± 0.24^{c}	120.00 ± 1.49^{bc}	135.00 ± 1.76^{c}
	T3	128.71 ± 1.54^{cd}	19.92 ± 1.49^{e}	710.78 ± 2.43^{d}	1.49 ± 0.58^{cd}	1.34 ± 0.20^{e}	116.83 ± 1.68^{c}	123.76 ± 2.85^{d}
	T4	113.76 ± 1.48^{f}	21.86 ± 3.71^{d}	745.76 ± 5.24^{c}	1.46 ± 0.15^{d}	1.35 ± 0.29^{e}	118.87 ± 2.68^{c}	130.76 ± 3.65^{c}
	T5	118.71 ± 1.84^{e}	19.72 ± 1.11^{e}	648.51 ± 5.41^{e}	1.43 ± 0.03^{d}	1.30 ± 0.30^{e}	112.00 ± 1.11^{d}	128.52 ± 3.27^{c}
	T6	112.00 ± 2.41^{f}	19.80 ± 0.31^{e}	705.88 ± 3.22^{d}	1.48 ± 0.15^{cd}	1.34 ± 0.50^{e}	113.73 ± 2.47^{d}	123.66 ± 3.41^{c}
3	T1	142.00 ± 2.25^{b}	25.86 ± 1.71^{cd}	705.58 ± 4.83^{d}	1.60 ± 0.22^{b}	1.60 ± 0.38^{c}	118.57 ± 3.64^{c}	145.00 ± 3.56^{b}
	T2	134.16 ± 1.62^{c}	24.34 ± 1.21^{d}	691.61 ± 6.59^{d}	1.62 ± 0.32^{b}	1.38 ± 0.06^{e}	113.80 ± 3.39^{d}	121.00 ± 3.78^{c}
	T3	ND	ND	ND	ND	ND	ND	ND
	T4	ND	ND	ND	ND	ND	ND	ND
	T5	ND	ND	ND	ND	ND	ND	ND
	T6	ND	ND	ND	ND	ND	ND	ND
4	T1	129.06 ± 2.65^{cd}	23.21 ± 1.22^{d}	692.06 ± 4.14^{d}	1.54 ± 0.26^{c}	1.56 ± 0.26^{c}	112.47 ± 2.66^{d}	142.31 ± 2.41^{b}
	T2	131.01 ± 1.55^{c}	21.22 ± 1.30^{d}	676.85 ± 5.42^{e}	1.43 ± 0.52^{d}	1.32 ± 0.06^{e}	109.21 ± 3.67^{d}	116.30 ± 3.26^{d}
	T3	ND	ND	ND	ND	ND	ND	ND
	T4	ND	ND	ND	ND	ND	ND	ND
	T5	ND	ND	ND	ND	ND	ND	ND
	T6	ND	ND	ND	ND	ND	ND	ND

Different letters denote ($p<0.05$) significant difference within each column, FHM= Freshly Harvested Maize, SD = Storage Duration, T1= Undehusked maize, T2= Dehusked maize, T3=Undehusked maize packaged with 25 µm gauge LDPE, T4 = Dehusked maize packaged with 25 µm gauge LDPE, T5= Undehusked maize packaged with 30 µm gauge LDPE, T6 = Dehusked maize packaged with 30 µm gauge LDPE, ND= Not Determined due to observations of microbial growth. Values are means±SD of three determinations.

3.3. Sensory Qualities of Packaged and Unpackaged Fresh Maize on Cobs During Storage

Presented in Table 4 are data on the sensory evaluation of boiled packaged and unpackaged storedmaize samples and freshly harvested maize on cobs. The sensory attributes of control sample in term of colour, taste, aroma and overall acceptability were significantly ($p<0.05$) higher that the stored samples. However, unpackaged undehusked maize (T1) was preferred most and rated 5.85, 5.12, 4.86 and 3.25 for colour, taste, aroma and overall acceptability, respectively, on day 1 of storage. Decreases in panelists' scores were observed as the storage duration progressed. This showed that boiled stored fresh maize may be affected by temperature and duration of storage. This phenomenon suggests that the stored fresh maize on the cob lost sugar over the storage duration at different temperature conditions. The finding is in agreement with the result of [8] who also experience decrease in rated scores as the storage duration progressed. Taste, aroma and overall acceptability of the packaged samples were not evaluated on day 4 of storage due to the observations of microbial growth.

Table 4. *Sensory evaluation of packaged and unpackaged boiled fresh maize stored at 28± 2°C.*

Sensory attribute	SD (day)	FHM	Storage treatments T1	T2	T3	T4	T5	T6
Colour	1	8.22 ± 0.34^{a}	5.85 ± 0.17^{b}	5.11 ± 0.28^{e}	5.35 ± 0.35^{c}	5.10 ± 0.30^{e}	5.21 ± 0.52^{d}	4.96 ± 0.62^{e}
	2	8.61 ± 0.22^{a}	5.61 ± 0.40^{b}	4.11 ± 0.43^{f}	3.22 ± 0.40^{g}	3.07 ± 0.52^{h}	3.18 ± 0.36^{h}	2.95 ± 0.54^{h}
	4	7.95 ± 0.28^{a}	4.85 ± 0.31^{e}	3.42 ± 0.52^{g}	1.30 ± 0.05^{j}	1.12 ± 0.05^{k}	1.26 ± 0.05^{j}	1.15 ± 0.05^{k}
Taste	1	8.82 ± 0.61^{a}	5.12 ± 0.72^{b}	3.84 ± 0.39^{c}	3.66 ± 0.48^{c}	3.46 ± 0.55^{d}	3.36 ± 0.63^{d}	3.51 ± 0.44^{c}
	2	8.65 ± 0.61^{a}	3.04 ± 0.31^{e}	2.23 ± 0.29^{f}	1.86 ± 0.41^{g}	2.12 ± 0.61^{f}	1.21 ± 0.24^{h}	1.53 ± 0.48^{g}
	4	8.87 ± 0.61^{a}	1.47 ± 0.54^{g}	1.33 ± 0.21^{h}	ND	ND	ND	ND
Aroma	1	8.58 ± 0.51^{a}	4.86 ± 0.62^{b}	3.81 ± 0.55^{c}	3.20 ± 0.23^{e}	3.41 ± 0.55^{d}	3.16 ± 0.26^{e}	3.18 ± 0.27^{e}
	2	8.61 ± 0.51^{a}	2.11 ± 0.63^{e}	1.65 ± 0.33^{f}	1.45 ± 0.71^{f}	1.55 ± 0.28^{f}	1.12 ± 0.49^{g}	1.24 ± 0.25^{fg}
	4	8.72 ± 0.51^{a}	1.28 ± 0.00^{fg}	1.20 ± 0.04^{g}	ND	ND	ND	ND
Overall acceptability	1	8.31 ± 0.44^{a}	3.25 ± 0.57^{b}	3.05 ± 0.57^{c}	2.21 ± 0.33^{e}	2.46 ± 0.36^{d}	1.98 ± 0.27^{ef}	2.14 ± 0.27^{e}
	2	8.27 ± 0.44^{a}	3.14 ± 0.51^{c}	2.72 ± 0.41^{d}	1.63 ± 0.38^{f}	1.80 ± 0.36^{f}	1.20 ± 0.32^{g}	1.57 ± 0.38^{f}
	4	8.48 ± 0.44^{a}	2.45 ± 0.14^{d}	2.42 ± 0.13^{d}	ND	ND	ND	ND

Different letters denote significant ($p<0.05$) difference within each row. SD=Storage Duration, FHM= Freshly Harvested Maize, T1= Undehusked maize, T2= Dehusked maize, T3=Undehusked maize packaged with 25 µm gauge LDPE, T4= Dehusked maize packaged with 25 µm gauge LDPE, T5=Undehusked maize packaged with 30 µm gauge LDPE, T6= Dehusked maize packaged with 30 µm gauge LDPE. ND= Not Determined due to observations of microbial growth. Values are means±SD of three determinations.

4. Conclusions

This research work was designed to reduce the postharvest loss in freshly harvested maize on the cob thereby increase the shelf life through appropriate storage conditions. Nutritionally, it can therefore be concluded that freshly harvested maize is a good source of carbohydrate (sugar) and minerals. The most abundant mineral in the fresh maize were potassium followed by phosphorus, sodium and magnesium. However, gradual decreases in nutrients were observed as the storage duration progressed. The results of this study showed that the tropical ambient temperature had significant effect on unpackaged undehusked and dehusked maize samples during storage while passive modified atmosphere packaging samples were greatly affected at this temperature.

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