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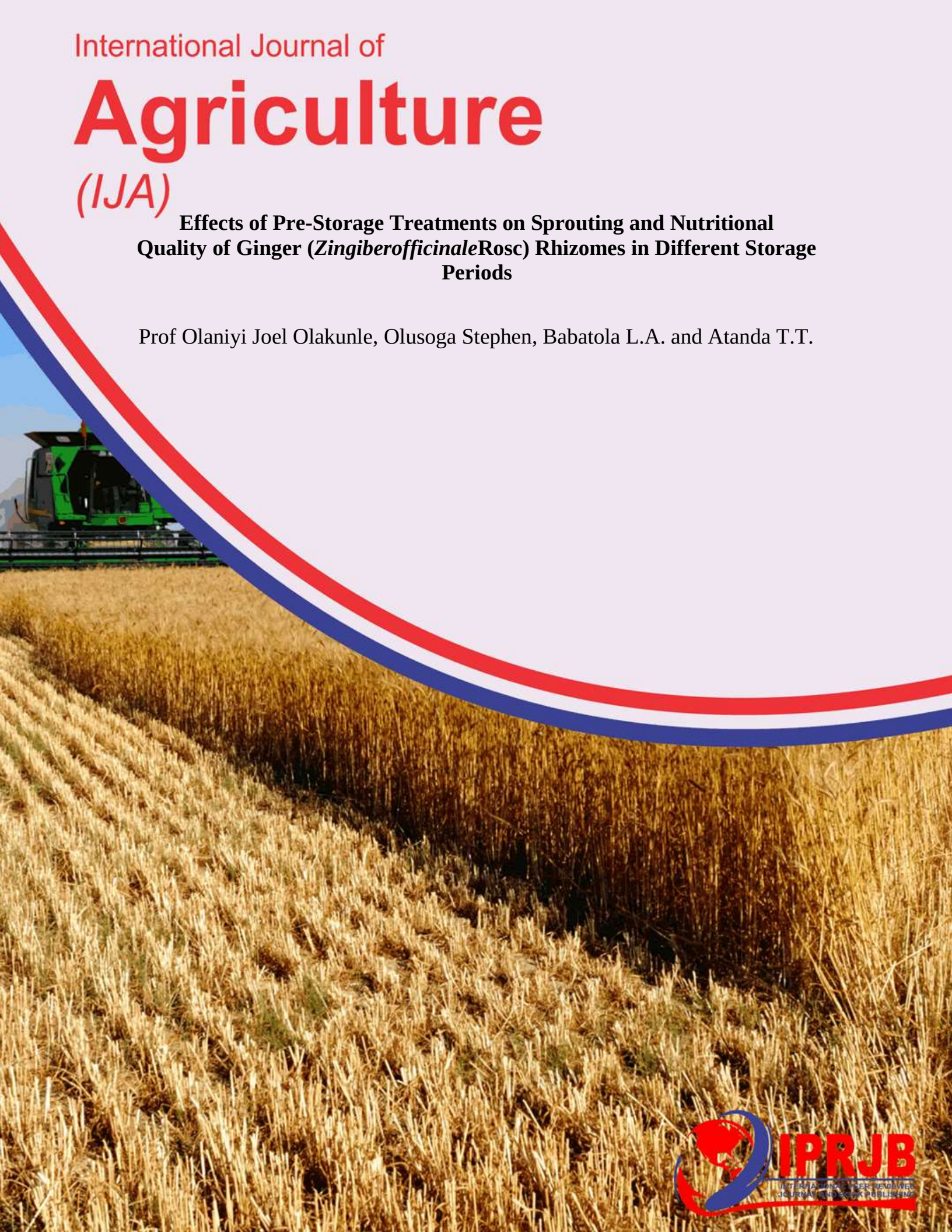

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Abstract

Purpose: Ginger rhizomes are highly susceptible to damage during postharvest storage due to soil borne pathogenic disorder. Experiments were conducted to evaluate the effects of prestorage treatments required for sprouting and maintaining the quality of ginger plant in different storage periods at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso.

Method: The rhizomes were treated with four different pre-storage treatments viz.,control, hydrated lime, Mancozeb, and 100ml of *Trichodermaharzianum* solution at different storage periods of one, two and three months. The experiment was arranged in a complete randomized designand laid out in a randomized complete block design with three replicates. Data were collected on percentage sprouting, plant height, number of leaves, leaf area and nutritional quality of ginger rhizomes. Data were subjected to analysis of variance using Statistical Analysis System Software (SAS, 2005). Differences among treatment means were compared using Least Significance Difference (LSD) at 5% probability level.

Results: The storage periods significantly ($P \leq 0.05$) influenced the percentage sprouting andgrowth parametersof ginger at various sampling period. Highest growth of 9.05cm was recorded from ginger plant stored for three months while the least value of 6.94cm was obtained from rhizomes stored for one month. The pre-storage treatments significantly ($P \leq 0.05$) influenced the percentage sprouting, weight loss and growth parameters of ginger at various sampling period. Highest percentage sprouting (94.3%) was recorded from rhizomes treated with 100 ml *Trichodermaharzianim* solution followed by rhizomes treated with hydrated lime (88.3 %) while lowest percentage sprouting (61.5 %) were recorded from control. Highest percentage weight loss of 46.3% was recorded from control followed by hydrated lime (35.58 %) while the lowest percentage weight loss of 33.93 % was recorded from 100 ml *Trichodermaharzianim* solution.

Conclusions: In conclusion, rhizomes treated with *Trichodermaharzianim* solution for a period of three months before planting produced better sprouting and enhanced the growth quality of ginger on the field.

Keywords: *Pre-Storage Treatment, Sprouting, Nutritional Quality, Ginger Rhizomes, Storage Periods*

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INTRODUCTION

Ginger (*Zingiberofficinale*Rosc) is an important spice crops throughout the world. It requires a tropical or subtropical climate and thrives well up to an altitude of 1500 m above MSL in the Himalayas, the optimum being 300-900 m (Archana *et al*., 2013). There are yellow ginger (Ug1) and black ginger (Ug2**)** varieties in Nigeria at present. (NRCRI, 2005). Ginger is used to prevent many ailments such as; asthma, fever and cough. It contains volatile oil, fixed oil, oleoresin, vitamins, starch, proteins and minerals (Sharma *et al*.,1991). From the time of harvesting (December to January) of rhizomes till subsequent planting season (May – June) the rhizomes are to be stored for about 3 -4 month in healthy and viable conditions (Thankamani *et al*.,2002). According to Karuppaiyan *et al*. (2008), harvested rhizomes are highly vulnerable to damage if proper care is not taken during postharvest storage due to soil borne pathogens or pest attack.

Chemical solutions are used to prevent soil borne pathogens or pest, and induce sprouting after sowing. Treatments of rhizomes with 5g of *Trichodermaharzianum* per kg rhizomes and 0.3% dithane M-45 had been reported to induce early sprouting and improves rhizomes quality (Shadap *et al*., 2014). However, there is need to improve the indigenous technology of prestorage treatments in order to obtain more viable and better performance ofginger rhizome. This study is todetermine the appropriatepre-storage treatments and storage periods required for improving the growth quality of ginger on the field.

MATERIALS AND METHODS

Laboratory and field experiments was carried out during December 2014 –May2015 at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso to determine the effects of pre-storage treatments and storage periods on sprouting and nutritional quality of ginger rhizomes. Fresh, healthy and uniform yellow ginger variety (Ug1) were obtained from Ladoke Akintola University of Technology, Ogbomoso. and used as test crop. The rhizomes were treated in four different pre-storage treatments and stored forthree storage periods. The pre-storage treatments are; Hydrated lime, Mancozeb,100ml of *Trichodermaharzianum* solution and Control. The storage periods are; one month, two months and three months. Each pre-storage treatment was used to treat 1kg of ginger rhizomes for 30minutes.The experimentswasarranged in a complete randomized designand laid out in a randomized complete block design with three replicates.

Land was cleared using cutlasses and tilled thoroughly with hoe to bring the soil to fine tilt .Twelve beds were prepared on the field, each size of 1.2 m x 1.2 m with an inter-space of 0.5 m between beds.After one month interval of storage period,four samples of ginger rhizomes were taken from each pre-storage treatment and planted on each bed.Cultural practices such as mulching, watering, and weeding were carried out for proper crop establishment.Data were collected on percentage weight loss, sprouting date and number of sprouted plant per bed from each treatment combinations at one week interval.Early growth of ginger plant were determined by assessing the plant height, number of leaves and leaf area(using length x breadth x 0.6475).The sprouting percentage was calculated by the number of sprouted rhizomes divided by total number of rhizomes planted on each bed and multiplied with 100. Percentage Ca, Fe, Crude protein, Crude Fibre , moisture Content, fat and ash content was determined using the official method of analysis described by the Association of Official Chemist (AOAC,1990).Data collected were analyzed using Standard Analysis System (SAS, 2005) for analysis of variance (ANOVA). Difference

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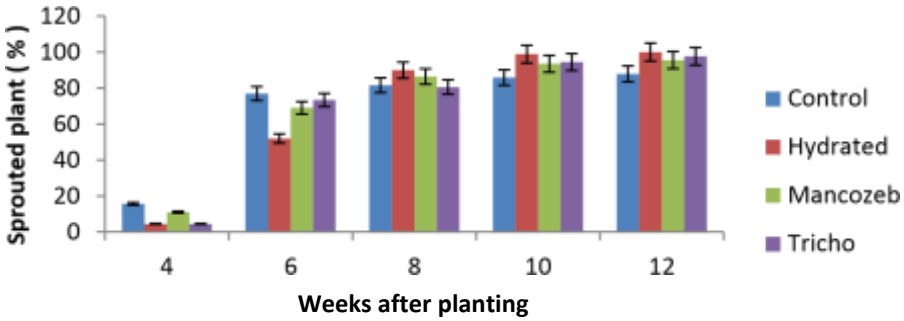
among treatments means were computed using least significance differences (LSD) at 0.05 probability level.

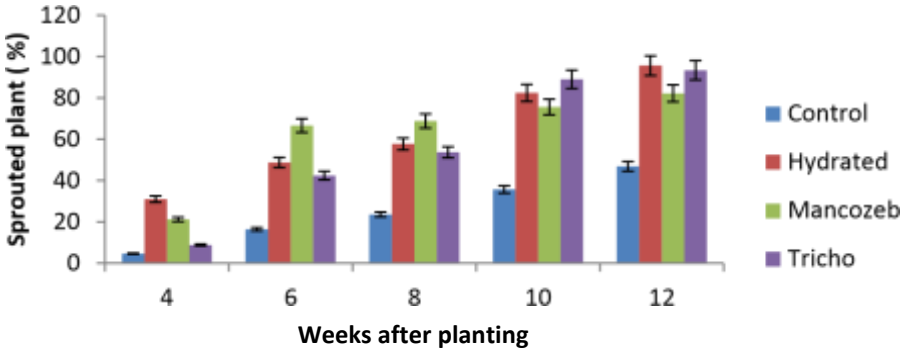
RESULTS AND DISCUSSION

The pre-storage treatment and storage periodsignificantly (P≤0.05) influenced the percentagesprouting of ginger plant at various sampling periods as shown in Figure 1. Highest percentage sprouting was recorded from ginger stored for one month while the least growth was obtained from rhizomes stored for three month irrespective of the pre-storage treatments. At one month after storage rhizomes treated with Hydrated lime gave the highest percentage sprouting of (100%) closely followed by rhizomes treated with *Trichodermaharzianum* solution (95.00%) while the control rhizomes recorded the least value of 87.87% at 12 WAP.

One month



Two months



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Three months

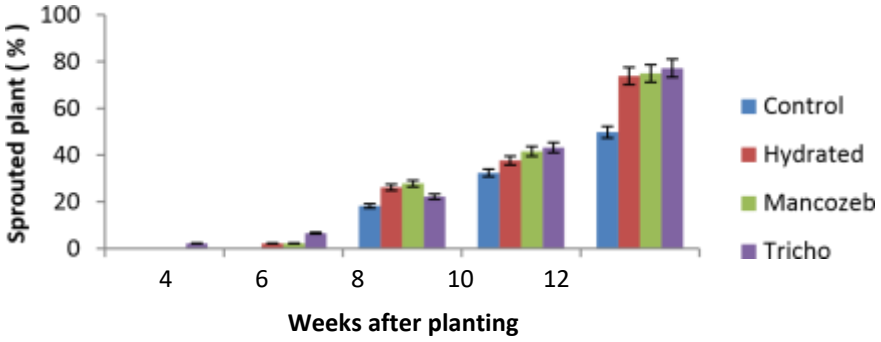

Figure 1: Effects of pre-storage treatments on the percentage sprouting of ginger rhizomes at different storage periods

At two months after storage rhizomes treated with Hydrated lime gave the highest percentage sprouting of 95.6% closely followed by rhizomes treated with *Trichoderma harzianum* solution (93.00%) while the control rhizomes recorded the least value of 46.87% at 12 WAP. At three months after storage rhizomes treated with *Trichodermaharzianum* solution gave the highest percentage sprouting of 95.6% followed by rhizomes treated with Mancozeb (74.93%) while the control rhizomes recorded the least value of 49.8% at 12 WAP.This was in accordance with Shadap *et al*., (2014) who reported that ginger rhizomes treated with *Trichodermaharzianum* (5g/kg) gave highest percentage sprouting when used as pre-storage treatment which might be due to the favorable effects of the bio-control agent on sprouting.

The pre-storage treatmentand storage period significantly (P≤0.05) influenced the growth parameters of ginger plant at various sampling periods (Table 1). Highest plant height was recorded from ginger stored for three months while the least value was obtained from rhizomes stored for one month irrespective of the pre-storage treatments. This was in accordance with Shadap *et al*., (2014) who reported that rhizomes stored under healthy condition for 90 days prior to subsequent planting season prevent rhizomes rot and improved viability of ginger rhizomes. At one and two months after storage the highest height 8.63 cm and 10.4cm of ginger plant were recorded from rhizomes treated with *Trichodermaharzianum*at 12 WAP. At three months' storage rhizomes treated with 100 *Trichodermaharzianim* solution recorded the highest sprouted height (9.05cm) followed by control (8.95 cm) while rhizomes treated with hydrated lime recorded the least value (7.71cm) at 12 WAP.

At one month after storage the highest number of leaves (5.0 and 8.63) for ginger plant was recorded from rhizomes treated with *Trichodermaharzianum*at 10 and12 WAP. At two months after storage the highest number of leaves (10.4) for ginger plant was recorded from rhizomes treated with *Trichodermaharzianum* at 12 WAP. At three months storage rhizomes treated with mancozeb recorded the highest number of leaves (8.63 cm) followed by rhizomes treated with 100

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ml of *Trichodermaharzianim* solution (10.25 cm) while control recorded the least value (8.33 cm) at 12 WAP.

At one month after storage the highest leaf area for ginger plant (36.31cm^2 and 41.21cm^2) were recorded from rhizomes treated with *Trichodermaharzianum*at (10 and 12 WAP). At two months after storage the highest leaf area for ginger plant (28.58 cm^2 and 43.09 cm^2) were recorded from rhizomes treated with Mancozeb at (10 and 12WAP). At three months storage rhizomes treated with hydrated lime and stored for three months recorded the highest leaf area (62.23 cm^2) followed by rhizomes treated with 100 ml of Trichodermaharzianim solution (61.96 cm^2) while control recorded the least value (49.56 cm^2) at 12 WAP.

Table1: Effects of pre-storage treatments on the plant height (cm) of ginger at different storage periods

	STORAGE PERIOD					
	ONE MONTH		TWO MONTHS		THREE MONTHS	
	WEEKS AFTER PLANTING					
Pre—storage Treatments	10	12	10	12	10	12
Control	3.45	6.91	6.20	7.95	8.13	8.95
Hydrated lime	3.93	8.06	5.95	6.95	6.75	7.71
Mancozeb	4.18	8.25	7.83	9.26	5.75	8.17
Trichoderma	5.59	8.35	5.86	7.37	4.40	9.05
LSD (0.05)	0.50	0.32	0.45	0.51	0.53	00.19

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Table 2: Effects of pre-storage treatments on the number of leaves of ginger plant at different storage periods

	STORAGE PERIOD					
	ONE MONTH		TWO MONTHS		THREE MONTHS	
WEEKS AFTER PLANTING						
Pre-Storage Treatments						
Control	**4.1**	**5.13**	**6.03**	**9.47**	**8.25**	**8.33**
Hydrated lime	**4.4**	**6.81**	**6.03**	**8.8**	**8.41**	**9.05**
Mancozeb	**4.04**	**7.7**	**6.1**	**8.36**	**9.15**	**10.6**
Trichoderma	**5.0**	**8.63**	**7.3**	**10.4**	**9.00**	**10.25**
LSD	**0.45**	**0.52**	**0.5**	**0.55**	**0.49**	**0.51**

Table 3: Effects of pre-storage treatments on the leaf area (cm^2) of ginger at different storage periods

	STORAGE PERIOD					
	ONE MONTH		TWO MONTHS		THREE MONTHS	
WEEKS AFTER PLANTING						
Pre-storage Treatments	**10**	**12**	**10**	**12**	**10**	**12**
Control	25.90	39.29	28.49	49.56	39.62	49.56
Hydrated lime	27.69	34.60	28.47	62.22	44.17	62.23
Mancozeb	28.39	33.89	28.58	43.09	39.04	43.10
Trichoderma	36.31	41.27	28.48	42.22	47.28	61.96
LSD(0.05)	0.63	1.00	0.15	0.70	1.52	0.71

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The pre-storage treatment and storage period significantly (P≤0.05) influenced the percentage weight loss and retained the nutritional quality of ginger rhizomes at various sampling periods as shown in Figure 2, 3. Highest percentage weight loss was recorded from ginger stored for three months while the least percentage weight loss was obtained from rhizomes stored for one month irrespective of the storage methods. This was in line with Bahri and Rashidi (2009) who reported that weight or water loss significantly increased with increased in storage period. At one month storage period percentage weight loss was minimum for rhizomes treated with 100 ml of Trichodermaharzianim solution (13.15 %) followed by mancozeb (15.59%) while percentage weight loss recorded the least for control (23.75%). At two months storage period percentage weight loss was minimum for rhizomes treated with 100 ml of *Trichodermaharzianim* solution (24.46 %) followed by hydrated lime (25.89%) while percentage weight loss recorded the least for control (35.72%). At three months storage period percentage weight loss was minimum for rhizomes treated with 100 ml of *Trichodermaharzianim* solution (24.46 %) followed by hydrated lime (35.58%) while percentage weight loss recorded the least for control (45.30%).

LSD 5%

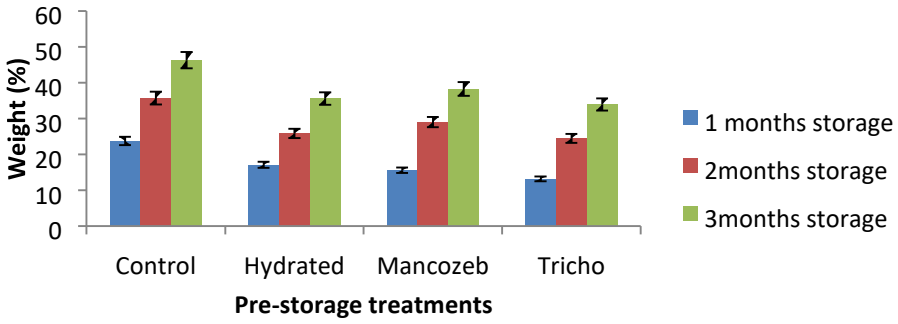

FIGURE 2: Effects of pre-storage treatments on the percentage weight loss of ginger rhizomes at different storage periods

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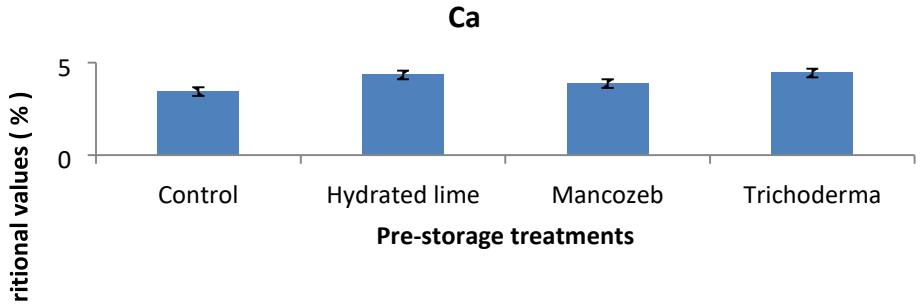
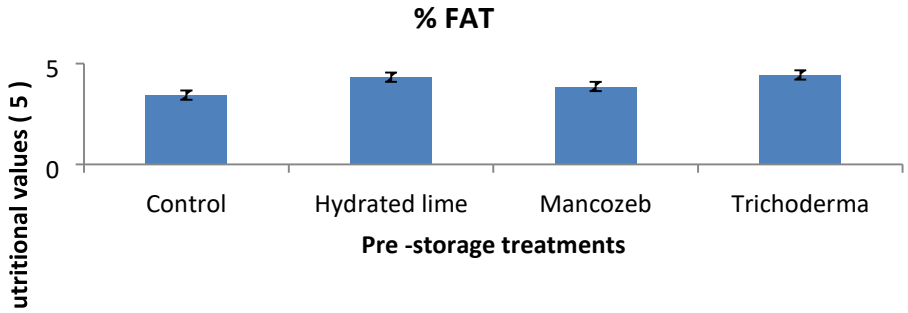
One month

LSD 5%



Two months

LSD 5%



Three months

LSD 5%

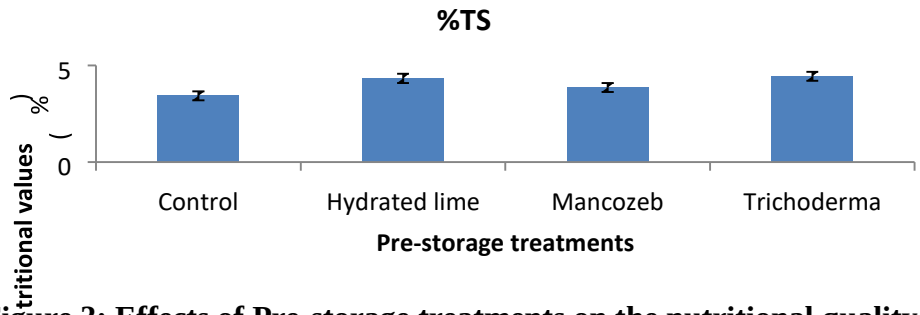


Figure 3: Effects of Pre-storage treatments on the nutritional quality of ginger rhizomes at different storage period

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