

Effect of different packaging materials and storage conditions on physico-chemical characteristics of guava (var. Allahabadi)

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Abstract: The present study was conducted to evaluate the effect of different packaging/wrapping materials viz. tissue papers, newspapers and plastic bags at room temperature 24°C (±2°C) and fridge temperature 16°C (±2°C) on shelf life and physico-chemical characteristics of Guava fruit. The highest fruit weight (241 g) at green mature and yellow stage (242 g) was observed in fruits wrapped with tissue papers at room temperature, at fridge temperature maximum fruit weight (244.20) was recorded at green stage under newspapers after 4 days of storage. Maximum moisture percentage (87.51) was observed in yellow fruits with plastic bags after 8 days of storage at room temperature followed by green fruits (87.63) at fridge temperature. Maximum TSS % (13.20) was observed at fridge temperature in green mature stage after 4 days of storage under newspapers followed by room temperature (12.23) in yellow fruits after 8 days of storage under tissue papers. Fruits wrapped in tissue wrappers were more acidic (3.3) at room temperature than fruits at fridge temperature (3.6). Fruits at room temperature had the maximum specific gravity of fruit and juice under tissue papers followed by fridge temperature. So, tissue papers proved better as wrapping materials for guava at room temperature and at fridge temperature.

Key words: Tissue papers, newspapers, plastic bags, room temperature, fridge temperature.

Introduction

The Guava, *Psidium guajava* belongs to family myrtaceae is the most important, highly prolific, delicious and nutritious fruit of tropical and sub-tropical regions of Indo-Pak sub-continent. The fruit is an excellent source of vitamin C containing 2 – 5 times more than oranges and 10 times more than tomatoes. It is a good source of calcium, phosphorus and iron. However, being a fruit of perishable nature it is most difficult to store for long periods (Sanjay, 2000).

Investigations have shown that maximum physiological loss in weight (13.37%), maximum increase in TSS% fruits resulted when wrapped in newspaper at room temperature. However minimum PLW (2.91%) was observed in fruits wrapped in HDPE (Kumar *et al.*, 2003). Highest moisture content (83.90%), fruit weight (310g), diameter (23.22 cm), Total soluble solids (12.20%), acidity (0.38%), total sugars (7.40%) were observed in Guava variety Kazi (Biswas, 1999). Guava fruits at green stage packed in cryovac PD-900 and stored at 8°C (85-90% RH) for 49 days had lower weight loss and best retention of ascorbic acid. (Yamashita and Benassi, 2000). However, best physico-chemical characteristics and marketability quality for up to 16 days were observed when fruit was harvested at mature green stage and wrapped in transparent polyethylene bags stored at refrigerated at 10°C (Gonzaga *et al.* 1999). Guava fruits harvested green had the highest acidity and lowest TSS values. (Azzolini *et al.* 2004). Pereira *et al.* (2003) found that fruits packed in polyethylene terephthalate (PET) trays and stored at 5°C had the lowest weight loss microbial spoilage and best physico chemical characteristics. Packing fruits in rigid or flexible packaging retained freshness. The highest retention of green colour (20%) was observed in the polythene laminated with aluminum foil packaging (Mandhyan, 1999). Keeping in views the importance and perish ability nature of guava, an attempt has been made in the present study to evaluate the effect of different packing materials on shelf life and physico-chemical characteristics of guava.

Materials and Methods

Ten year old Guava trees Cv. Allahabad safeda, growing in a private commercial orchard near Tando jam were selected for present investigation to evaluate the effect of

three treatments; tissue paper, newspaper and plastic bags on shelf life, fruit weight TSS%, moisture%, specific gravity of fruit, specific gravity of juice, juice%, and pH at room temperature 20°C – 22°C and fridge temperature 16°C. Each treatment was replicated three times. First general reading was noted then fruits were individually wrapped in tissue paper, newspaper and plastic bags packed in a corrugated paper box in a single layer. Observations on fruit physico-chemical parameters were recorded at 4, 8 and 12 day internals.

The observations recorded were: weight of fruit (g), total soluble solids (TSS %), moisture percentage, pH, juice % (ml), specific gravity of fruit and specific gravity of juice. For average weight of fruit ten fruits were randomly selected and weighted by using electronic balance and average there of per fruit was calculated in grams. TSS% was determined by hand refracto meter moisture % was carried out in triplicate and then average value was recorded through the method recommended by AOAC (1970) through the formula:

$$\frac{\text{Fresh Weight} - \text{Dry Weight}}{\text{Fresh Weight}} \times 100$$

pH was determined by extracting pure juice and putting pH meter in juice then values were recorded in triplicate and there of average value were observed. Specific gravity of juice was determined by Picnometer through the following formula:

$$\text{Sp. Gr. Of juice} = \frac{\text{Density of substance}}{\text{Density of Standard}}$$

Specific gravity of fruit was determined by water displacement method. Finally the data was collected and subjected to statistical analysis.

Results and Discussion

The results of analysis show a highly significant difference among the treatments.

Fruit Weight: The date regarding to fruit weight (Table-1) shows highly significant difference among all the treatments at room temperature and fridge temperature. Guava fruits of green stage wrapped in tissue wrappers had the highest fruit weight (241g) at room temperature. After four days of storage, while at fridge temperature newspaper wrappers proved better and had the highest fruit weight (244g). After 8 days of storage tissue

wrappers had the fruit weight of 222.63g at room temperature while at fridge temperature fruit weight became 239.80g in the newspaper wrappers. However the highest weight (242.40g) of yellow fruits was observed under tissue wrapper on the 4th day of storage and 218.80g on the 8th days of storage at room temperature, no yellow fruits were observed in the fridge till 8th day. However fruits were taken from the fridge and placed at room temperature afterwards then on 12th day at room temperature maximum fruit weight (211.90g) was recorded under tissue paper, wrappers followed by newspapers wrappers. The minimum fruit weight loss at room temperature was recorded under tissue paper

wrappers due to its moisture absorbing capacity which created suitable micro-climate surrounds the fruits due to which its shelf life increased and all the fruits remained in an edible condition. In fridge temperature newspaper wrappers proved better for enhancing fruits shelf life. It may be due to its thickness which absorbed more moisture and controlled the temperature of fruits. These results are in coincide with result of Kumar, *et al* (2003) and Gutierrez-alonso, *et al.* (2002) who found that, all polyethylene bags with green mature stage were effective in controlling physiological loss and decay loss and increased the shelf life of guava.

Table 1. Effect of different packaging materials and conditions on fruit weight (g) of guava

Conditions	Stage of Fruit maturity	Days of Storage	Treatment			F- Value	Remarks
			T1	T2	T3		
Room Temperature	Green	4	241.00 a	203.00 b	167.00 c	25.04	**
		8	222.63 a	185.00 b	0.00 d	9.62	**
	Yellow	4	242.40 a	197.60 b	163.20 c	31.45	**
		8	218.80 a	191.70 b	165.05 c	11.53	**
Fridge Temperature	Green	4	225.80 b	244.20 a	178.0 b	8.09	**
	Green	8	221.90 a	239.80 a	175.05 b	7.70	NS
	Yellow	12	211.90 a	210.80 a	178.05 b	2.60	NS

T₁ = Tissue paper; T₂ = News paper and T₃ = Plastic bag

Table 2. Effect of different packaging materials and conditions on moisture % of guava fruit

Condition	Stage of Fruit maturity	Days of Storage	Treatment			F-Value	Remarks
			T1	T2	T3		
Room temperature	Green	4	83.66 b	82.28 c	84.98 a	175.11	**
		8	84.43 a	82.85 b	0.00 b	52.85	**
	Yellow	4	84.95 a	83.75 a	84.95 a	2.25	NS
		8	82.63 c	84.13 b	87.51 a	102.86	**
Fridge temperature	Green	4	79.73 a	79.70 a	79.65 a	0.04	NS
	Green	8	82.53 b	84.10 b	87.63 a	9.79	**
	Yellow	12	83.18 b	82.35 b	87.40 a	43.04	**

Table 3. Effect of different packaging materials and conditions on TSS % of guava fruit

Condition	Stage of Fruit maturity	Days of Storage	Treatment			F-Value	Remarks
			T1	T2	T3		
Room temperature	Green	4	11.36 a	11.33 a	11.18 a	2.03	NS
		8	11.96 a	11.15 b	0.00 d	111.96	**
	Yellow	4	11.31 b	12.08 a	11.28 b	40.96	**
		8	12.23 a	11.73 b	10.23 c	227.5	**
Fridge temperature	Green	4	11.26 c	13.20 a	12.38 c	137.21	**
	Green	8	12.23 a	12.21 a	10.38 b	130.1	**
	Yellow	12	10.15 b	12.21 a	10.15 b	517.46	**

Table 4. Effect of different packaging materials and conditions on pH of guava fruit

Condition	Stage of Fruit maturity	Days of Storage	Treatment			F-Value	Remarks
			T1	T2	T3		
Room temperature	Green	4	4.1 b	4.5 a	4.6 a	11.26	**
		8	3.3 a	3.4 a	0.0 c	0.98	NS
	Yellow	4	4.8 a	4.7 a	4.7 a	0.48	NS
		8	5.0 a	3.9 b	4.0 b	38.26	**
Fridge temperature	Green	4	4.1 a	4.3 a	3.6 a	0.72	NS
	Green	8	3.7 a	3.7 a	3.6 a	0.46	NS
	Yellow	12	3.6 ab	3.5 b	3.8 a	3.06	NS

Table 5. Effect of different packaging materials and conditions on specific gravity of guava juice

Condition	Stage of Fruit maturity	Days of Storage	Treatment			F-Value	Remarks
			T1	T2	T3		
Room temperature	Green	4	1.20 a	1.39 a	1.27 a	1.46	NS
		8	1.24 a	1.20 a	0.00 b	0.75	NS
	Yellow	4	0.96 a	0.95 a	0.69 a	0.13	NS
		8	0.97 b	0.96 b	1.11 a	6.93	NS
Fridge temperature	Green	4	1.174 b	1.212 b	1.475 a	7.35	NS
	Green	8	1.104 a	1.062 a	1.208 a	0.98	NS
	Yellow	12	0.983 a	0.942 a	0.948 a	0.92	NS

Table 6. Effect of different packaging materials and conditions on specific gravity of guava fruit

Condition	Stage of Fruit maturity	Days of Storage	Treatment			F-Value	Remarks
			T1	T2	T3		
Room temperature	Green	4	1.227 a	0.885 a	0.847 a	1.31	NS
		8	1.126 a	1.040 a	0.00 b	0.19	NS
	Yellow	4	1.258 a	1.107 a	0.900 a	0.58	NS
		8	0.951 a	0.918 a	0.975 a	0.10	NS
Fridge temperature	Green	4	1.244 a	1.214 a	0.952 a	2.29	NS
	Green	8	1.246 a	0.978 a	0.899 a	1.42	NS
	Yellow	12	1.836 a	0.862 a	0.601 a	1.00	NS

Moisture percentage: The data regarding moisture percentage (Table-2) of guava shows highly significant difference among all the treatments at room temperature and fridge temperature, as it is clear from the results that after 4 days of storage with green stage of maturity maximum moisture percentage (84.98) was observed with treatment-3, plastic bags under room temperature conditions while under fridge temperature the results are non-significant among all the treatments. After 8 days of storage maximum moisture% was observed under tissue papers at room temperature (84.43%) and 87.63% with plastic bags at fridge temperature, it may be because of the more moisture retention in the plastic bags which increased moisture percentage of the fruit. Yellow fruits after 4 and 8 days of storage had the maximum moisture% of 84.95 and 84.13 with tissue paper, newspaper and plastic bags respectively, at room temperature, as storage period increased moisture% also increased specially with plastic bags as compare to tissue papers and newspapers which highly absorbed the moisture of fruit.

At fridge temperature yellow fruits after 12 days of storage had the maximum (87.40) moisture% within the fruits wrapped in plastic bags followed by newspaper and tissue papers. These results are in accordance with the results of Biswas, (1999), Yamashita and Benassi (2000) and Singh *et al.* (2003).

TSS: The results pertaining to TSS show (Table-3) non-significant difference among the treatments at room temperature maximum increase in TSS after 4 days or storage was recorded at under tissue wrappers (11.36obrix) followed by newspapers (11.33) of green mature stage of guava, after 8 days of storage maximum TSS (11.96) was observed under tissue wrappers at green mature stage. Yellow fruits had the maximum TSS (12.23obrix) was observed under newspapers after 8 days of storage at room temperature followed by storage after 4 days (12.08obrix).

At fridge temperature maximum TSS% (13.20) was recorded under newspaper after 4 days of storage followed by tissue wrappers (12.23obrix) after 8 days of storage, while yellow fruits of fridge after 12 days of storage had the maximum TSS% of 12.21obrix under wrappers. Results at fridge temperature were highly significant among treatment. These results are in accorded with the results of Yamashita and Benassi (2000), Azzolini, *et al.* (2004) and Singh *et al.* (2003).

pH: Result pertaining to pH (Table-4) of guava show non-significant differences among all the treatments at room temperature and fridge temperature except yellow stage of maturity after 8 days of storage which had the maximum pH of 5.0 under tissue wrappers while the minimum acidity (3.3) was observed under tissue wrappers after 8 days of storage at green mature stage. It may be due to more absorption of moisture and thickness of tissue wrappers which may have caused more acidic fruit at green state and increase in pH at yellow stage under tissue wrappers may be due to increase in sugar content of fruit as it begins to ripe. At fridge temperature maximum pH (4.3) was recorded under newspaper at green stage of the fruit after 4 days of storage while minimum pH (3.5) was recorded at yellow stage after 12 days of storage it may be due to sudden change in atmosphere from fridge temperature to room temperature which caused the fruit acidic in nature. However, overall the results were non-significant among all the treatments at fridge temperature, similar result have been observed by Kumar *et al.* (2003) and Mandhyan (1999).

Specific gravity of Juice: The data regarding specific gravity of Juice show non-significant differences among all the treatments at room temperature and fridge temperature (Table-5). The maximum mean value (1.3⁰) or specific gravity of Juice with green stage of maturity was observed under newspaper at room temperature and 1.47 was recorded under plastic bags at fridge temperature after 4 days of storage, while, after 8 days of storage maximum

mean value 1.24 was observed under tissue wrappers at room temperature and 1.208 was recorded under plastic at fridge temperature. It may be due to more preservation of moisture within the fruits under plastic bags and decrease of surrounding temperature in the fruit. However yellow fruits after 4 days of storage showed non-significant differences among all the treatments, after 8 days of storage maximum mean value (1.11) was recorded under plastic bags at room temperature, no yellow fruits were observed after 4 and 8 days of storage at fridge temperature, but after 12 days at room temperature yellow fruits had non-significant mean value among all the treatments, but the spgra. Of juice reduced as the time period increased which indicate loss of juice from the fruit. These results are in resemblance with the results of Azzolini *et al.* (2004) and Yamashita and Benassi (2000).

Specific gravity of Fruit: The Results of analysis pertaining to specific gravity of fruit shows non-significant difference among all the treatments at room temperature and fridge temperature, days of storage had also no effect on this parameter (Table-6). However, the maximum specific gravity of 1.244 & 1.246 was recorded in fridge under tissue papers after 4 days and 8 days storage at green stage of maturity as compare to room temperature (1.227) respectively yellow fruits had the maximum specific gravity of 0.96 and 1.11 after 4 and 4 days of storage at room temperature respectively under plastic bags. However yellow fruits of fridge temperature after 12 days of storage had the maximum specific gravity of 1.836 under tissue wrappers. These results are in accordance with the results of Jitender *et al.* (2003), Mandhyan, (1999), Singh *et al.* (2003) and Gutierrez *et al.* (2002). It can be concluded from this experiment that tissue wrappers proved best of all the packaging materials at room temperature and fridge temperature followed by news papers. Tissue papers improved various physico-chemical characteristics of guava at room temperature and fridge temperature. These packaging materials are low cost, easily available and economically feasible materials.

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