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Effect of Packaging Materials on Shelf life of Mango Processed Food Products

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Abstract: *Proper packing, labeling and storage of mango processed food products play an important role to increase its shelf life and to attract the market and consumers. There are several raw mango processed food products available commercially in the markets under different brand names. Each mango processed product is packed with polythene/ tetra packs/LDPE bags/HDPE containers/plastic cans/glass jars, etc.Because of manual methods and unhygienic handling of mango fruits at various stages of processing the quality of the processed products are a matter of concern. The aim of this study is to find out the effect of different packaging materials on processed mango products and to analyze the quality parameters of selected mango processed products. Sensory evaluation was made to find out the characteristics of the fresh and stored food products such as its appearance, texture, flavor, taste and acceptability for storage period of nine months in different packaging materials.*

Keywords: *Raw mango, shelf life, packages, organoleptic, pickles.*

INTRODUCTION

Mango *(Mangiferaindica L.)* is one of the most important tropical fruits in the world India is the major mango growing country contributing nearly 47.00 per cent of the world's area in mango cultivation and 40.00 per cent of the World's production (Sekhar *et. al.* 2014). Mango fruit both in its immature and mature stages serve as raw material in the processing industries for making value added products like pickles, chutneys, candies, juice, dried powder (Amchur), beverages and jams. The ripe fruits besides being used for dessert, it is also used for preparing several value added products like pulp, canned slices, squashes, syrups, nectars, jams, jellies, fruit bars, soft drinks etc., are developed by constant research in India as well as in other parts of the world to satisfy the consumer's needs (Krishnaveni *et. al.* 2013). The mango processed food products demand in the domestic market increasing every year due to growing urbanization and changing lifestyle and spending pattern. There are several raw mango processed food products available commercially in the markets under different brand names. Each mango processed product is packed with polythene/ tetra packs/LDPE bags/HDPE containers/plastic cans/glass jars, etc.

METHODOLOGY

The objective of this study is to find out the effect of different packaging materials on processed mango products in Karnataka, Andra Pradesh and Tamil Nadu states of Southern India. Commercially available raw mango pickle samples of different brands which were prepared manually and mechanically (4 samples each) were procured from the retail outlets and local shops of selected citiesand subjected for organoleptic sensory evaluation, during the storage period at regular intervals at initial stage (0), three months, six months and nine months. All the samples collected were analyzed for estimation of various chemical quality parameters

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like pH, Acidity, Ascorbic acid, reducing sugars, non-reducing sugars, total sugars, phenolic substances, crude proteins, microbial contamination, shelf life and sensory analysis. The organoleptic sensory evaluation was carried out on manually and mechanically prepared mango processed products to study the shelf life of processed products scores were compared and analyzed statistically. The different parameters studied were as:

pH

The pH was measured using pH meter L1-120 manufactured by Elico India.

Acidity

The acidity of the samples was determined by titrating known weight of pickle samples against standard sodium hydroxide (0.01N) using methyl orange as indicator till orange red colour changes to yellow and expressed as per cent acidity.

Ascorbic Acid (mg/100g)

Acorbic acid was estimated by indicator method based on stoichiometric reduction of the dye 2,6-Dichlorophenol indophenol by ascorbic acid to colorless compound.

Reducing Sugars (per cent)

Five (5.0) gram of sample was boiled with 50mL distilled water, cooled, clarified by 2mL neutral lead acetate (45%) and allowed to stand for 10 minutes. Excess of lead was precipitated by using freshly prepared potassium oxalate solution (22%), filtered and suitable dilution was made. 5 mL of filtrate was taken, reducing sugar was estimated by Shaffer-somogyi micro method (Ranganna 2002).

Total Sugars (per cent)

A known quantity of filtrate was hydrolyzed by mixing with 5 ml of hydrochloric acid (1:1) and keeping over night for inversion. Then it was neutralized with sodium hydroxide using phenolphthalein as indicator and diluted suitably. An aliquot of 5 mL was taken; total sugar was estimated using shaffer-somogyi micro method (Ranganna 2002).

The per cent sugars were calculated using the formula:

$$\text{Total sugars \%} = \frac{\text{Amount of sugar present} \times \text{Dilution} \times 100}{\text{Aliquot taken for estimation} \times \text{Weight of sample}} \times 106$$

Non-reducing Sugars

Non-reducing sugar was estimated using formula:

Non reducing sugar (%)

= Total sugar (%) – Reducing sugar (%) g.

Phenolic Substances Estimation (mg/100 g)

Sample of 0.25 g was ground with 10 ml of ethanol using pastel and mortar and centrifuged the homogenate at 10,000 rpm for 20 minutes. From the standard curve the concentration of phenol was calculated and expressed as mg phenol per 100g sample.

Crude Protein (mg/100g)

It was done by lowery method. Absorbance of solution was read at 660nm. From the standard curve, the concentration of proteins was calculated.

Microbial Contamination (CFU)

The samples prepared under manual and mechanized conditions were analysed for total bacteria and fungi by, standard serial dilution plate count method using nutrient Agar.

Shelflife (days)

A panel of 11 judges observed the samples prepared under manual and mechanized conditions by visual method at monthly interval throughout storage period like pH, Acidity, Ascorbic acid, reducing sugars, non-reducing sugars, total sugars, phenolic substances, crude proteins, microbial contamination, shelf life and sensory analysis.

RESULTS AND DISCUSSION

Proper packing, labeling and storage of mango processed food products play an important role to increase its shelf life and to attract the market and

consumers. The data in Table 1 indicates that different mango food products have different shelf life irrespective of their brand name. The shelf life of the products varies from product to product and brand to brand. We could see from the data that shelf-life of mango pickles vary from 6 to 12 months, mango chutney from 6 to 9 months and raw mango powder from 6 to 12 months. The shelf-life of Mango RTS drinks, Mango juice drink, Mango Jelly pud and Mango Ice candy vary from 3 to 6months. The shelf life of Mango squash,Mango fruit bar,Mango fruit strip vary from 6 to 9 months. The reason for variation of shelf-life may be due to the moisture content of the product at the time of packing and method of preservation/packing.

The data further reveals that different manufacturers use different types of packaging materials. It is seen that different mango processed food products have different types of packaging materials of the same brand. LDPE bags, HDPE containers, Plastic cans, Glass jars, Polyethylene terephalate (PET)/metallocene polyethylene (MPE) flexible packaging materials are used by the mango processing units in the study area.

The data in Table 2 indicates that, the chemical composition of various mango pickle samples prepared by manual and mechanized techniques. pHcontent of manually prepared pickle samples was in the range of 1.61 to 2.10 whereas pH content of mechanically prepared samples was ranging from 2.64 to 2.80. The corresponding increase in acidity could be responsible for decrease in pH.

Acidity of manually prepared samples was found in in the range of 2.57 to 2.71 per cent whereas the mechanically prepared samples were in the range of 2.18 to 2.25 per cent. The decrease in acidity percent values in mechanically prepared samples may be due tohydrolysis of polysaccharides and non-reducing sugars, where acid is hydrolysed converting them to hexose sugars or complexing in the presence of metal ions (Hussain 2004) and the degree of reduction in acidity is governed by concentration of sugar (Bhatia *et. al.* 1956).

The reducing sugar, non-reducing sugar and total sugar percent of manually prepared samples were found as 1.20 to 1.50, 0.50 to 0.60 and 1.70 to 2.10 respectively. Whereas the reducing sugar, non-reducing sugar and total sugar percent from mechanically prepared samples were found to be 2.35 to 2.50, 0.70 to 0.77 and 3.12 to 3.23 respectively. The change of sugars may be due to the addition of

Table 1
Storage life of commercially available different mango processed food products

Sl. No.	*Processed Products*	*Storage life (months)*	*Type of packing*
1.	Raw mango tender pickle	6 - 12	LDPE bags, HDPE containers, Plastic cans, Glass jars
2.	Ripe mango pickle	6 - 9	LDPE bags/HDPE/Glass jars/Plastic cans,
3.	Cut mango in brine	6 - 9	LDPE bags/HDPE/Glass jars
4.	Mango chutney	6 - 12	LDPE bags/HDPE/Glass jars/composite packages
5.	Raw mango candy	6 - 12	PET/MPE/composite packages
6.	Ripe mango candy	6 - 12	LDPE bags/HDPE/composite packages
7.	Mango RTS drink (1 lt)	3 - 6	Glass bottles/HDPE containers,
8.	Mango juice drink (1 lt)	3 - 6	Glass bottles/HDPE containers,
9.	Organa Fruit Drink Rich Pulpy (1 lt)	3 - 6	Glass bottles/HDPE containers,
10.	Mango fruit bar	6 - 9	Polyethylene terephalate(PET)/
11.	Mango fruit strip	6- 9	Polyethylene terephalate(PET)/
12.	Mango fruit bits	6 - 12	LDPE/PETE/Polypropylene
13.	Mango Jelly pud	3 - 6	LDPE/Flexible Plastic Packaging
14.	Dry mango powder	6 - 12	LDPE/Flexible Plastic Packaging
15.	Mango squash	6- 9	HDPE/Glass jars/composite packages
16.	Mango jam	6-12	HDPE/Glass jars/composite packages
17.	Mango ice candy	3-6	Poly ethylene/MPE

Table 2
Quality parameters of manual and mechanically prepared raw mango pickles

										Microbial Contamination	
Samples	*pH*	*Acidity (%)*	*Reducing Sugars (%)*	*Non Reducing sugars (%)*	*Total Sugars (%)*	*Ascorbic acid (mg/100g)*	*Phenolic Substances (mg/100g)*	*Crude Proteins (mg/100g)*	*Shelf life (days)*	*Fungi (CFU)*	*Bacteria (CFU)*
M1	1.97	2.64	1.20	0.50	1.70	77.0	4.95	0.40	210	$16x10^3$	36×10^4
M2	2.10	2.71	1.10	0.54	1.64	79.0	5.12	0.42	180	$18x10^3$	48×10^4
M3	1.61	2.57	1.50	0.60	2.10	78.5	5.20	0.45	180	$24x10^3$	52×10^4
Me1	2.80	2.13	2.35	0.77	3.12	77.0	5.92	0.58	365	0.0	22×10^4
Me2	2.64	2.25	2.45	0.70	3.15	75.8	5.65	0.55	300	0.0	30×10^4
Me3	2.70	2.18	2.50	0.73	3.23	76.2	5.50	0.54	330	0.0	20×10^4
CD (0.05%)	0.51	0.26	0.90	0.12	0.73	1.3	0.28	0.07	59	6.0	11
Sem ±	0.16	0.08	0.30	0.04	0.24	0.43	0.09	0.02	19.6	1.9	3.66

preservatives like potassium metabisulphite (Roy and Singh 1979 and Hussain 2004). The ascorbic acid of manually prepared pickle samples was 77.0 to 79.0 mg/100 g and the ascorbic acid of mechanically prepared samples was 75.8 to 77.0 mg/100 g. The increased value of ascorbic acid in manually prepared samples may be due to low pH in samples and similar results were obtained by Braverman (1963).

The crude protein values of manually prepared samples ranges from 0.40 to 0.45mg/100gm and the mechanically prepared samples was found in the range of 0.54 to 0.58 mg/100 g. The phenolic substances were found in the range of 4.95 to 5.20mg/100g in manually prepared samples while in the mechanically prepared samples it was 5.50 to 5.92 mg/100g. The poor quality of manually prepared samples may be due to manual cutting resulted in more injury to substrate cells of mango which in turn resulted in the release of more carbohydrates in to the medium and further fermentation of the cells leading to the more acid production. The shelf life of manually prepared pickle samples was in the range of 180 to 210 days, whereasthat of mechanically prepared samples was in the range of 300 to 365 days.

The microbiological analysis revealed that, the fungi load was in the range of 16×10^3 to 24×10^3 CFU in manually prepared samples. Whereas in the case of mechanically prepared samples the fungi load was not noticed. The bacteria load in manually prepared samples was in the range of 36×10^4 to 52×10^4 and that of mechanically prepared samples was in the range of 20×10^4 to 30×10^4 CFU.Increase in the moisture content during storage, might have increased the bacterial count and similar results have been reported by Hashmi *et. al.* (2007).

The bacteria load is not a big problem but the fungi load needs to be checked and the contamination of fungi load may be due to unhygienic conditions of manual processing of pickles prepared with bare hands in spices mixing, cutting of mangoes, manual packing etc,. It is clear from the data that mechanization of pickle making can produce quality product apart from saving of man-hour, time and cost of production.

Effect of Different Packaging Materials on Mango Pickles During Storage Period

The results presented in Table 3 and Figure 1 shows the storage of mango pickles for nine months in different packaging materials.The fresh samples were procured from retail outlets in the study area and subjected for organoleptic sensory evaluation, during the storage period at regular intervals at intial stage (0), three months, six months and nine months. The sensory scores were compared between the four different packaging materials *viz.*, Low Density Polyethylene (LDPE) bag, High Density Polyethylene (HDPE) containers/pouches,

Table 3
Organoleptic evaluation scores of raw mango pickles stored in different packing materials

Days of Storage	Appearance				Colour				Texture				Taste				Flavour				Overall Acceptability			
	LD	HD	PC	GL	LD	HD	PC	GL	LD	HD	PC	GL	LD	HD	PC	GL	LD	HD	PC	GL	LD	HD	PC	GL
0 Day	4.4	4.4	4.4	4.4	4.6	4.6	4.6	4.6	4.4	4.4	4.4	4.4	4.5	4.5	4.5	4.5	4.3	4.3	4.3	4.3	4.44	4.44	4.44	4.44
3 Month	4.0	4.2	4.2	4.2	4.2	4.2	4.3	4.3	4.0	4.0	4.1	4.2	4.0	4.1	4.3	4.4	3.7	3.9	3.9	4.0	3.98	3.72	4.16	4.22
6 Month	3.5	3.7	3.8	4.0	3.6	3.6	3.7	3.8	3.4	3.4	3.5	3.9	3.2	3.4	3.5	3.7	3.2	3.4	3.5	3.8	3.38	3.5	3.6	3.84
9 Month	2.8	2.9	3.0	3.5	3.1	3.2	3.4	3.6	2.7	2.9	3.0	3.6	2.8	2.9	3.3	3.6	2.7	2.9	3.0	3.3	2.82	2.96	3.14	3.52
Mean	3.6	3.8	3.85	4.02	3.87	3.9	4.0	4.07	3.62	3.67	3.75	4.02	3.62	3.72	3.9	4.05	3.47	3.62	3.67	3.85	3.65	3.65	3.83	4.0
F-value	0.10				0.05				0.12				0.13				0.09				0.10			
CD at 5%	0.31				0.17				0.36				0.41				0.29				0.30			

LD = LDPE bag, HD = HDPE containers, PC = Plastic can, GL = Glass jar

Plastic Can (PC) and Glass Jar (GL). The evaluated sensory scores were analysedstastically and the attributes were compared for their level of significance.

Almost all the attributes in mango pickles found to have significantly different between the characters such as colour, appearance, taste, texture, flavour and overall acceptability. The slight rancidity was found in the pickle samples stored after six and nine months in LDPE bags.

The samples packed in HDPE containers are also fair but off-flavour was noticed after nine months of storage. In plastic can/containers the mango pickle samples were fair but the sample was soft and mashy in texture. Though there was no significant difference between packaging materials, the product stored in glasses were found to be good compared to other three packages even after nine months of storage. Among the different packaging materials used, it was observed that the pickle samples kept in glass jar after 6 months of storage scored highest as compared to all other packaging material.

Organoleptic Evaluation of Mango Pickle Products Prepared by Manual and Mechanized Techniques

A panel of 11 judges evaluated the samples of mango pickles prepared by manual and mechanized techniques for its quality attributes like appearance, colour, Texture, taste and overall acceptability with five point hedonic scales.

The data from the Table 4 shows that, the mechanically prepared samples scored maximum of 22 points indicating very good condition by sensory analysis. Whereas among the three manually prepared samples, manually prepared sample M1 got the total score of 15 adjudged as good, followed by manually prepared samples M2 and M3 with total scores of 14 and 13 respectively adjudged as fair as shown in Figure 2.

CONCLUSION

It is evident from the study that adding ingredients play an important role in making ripe and raw mango products to define its nutritional value, shelf

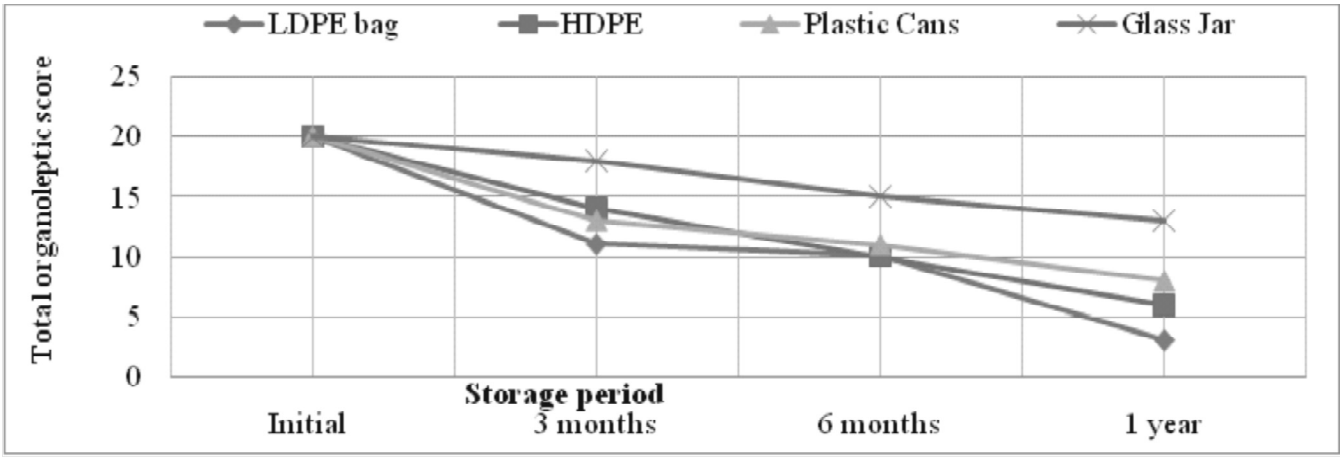

Figure 1: Effect of different packaging materials on mango pickles during storage period

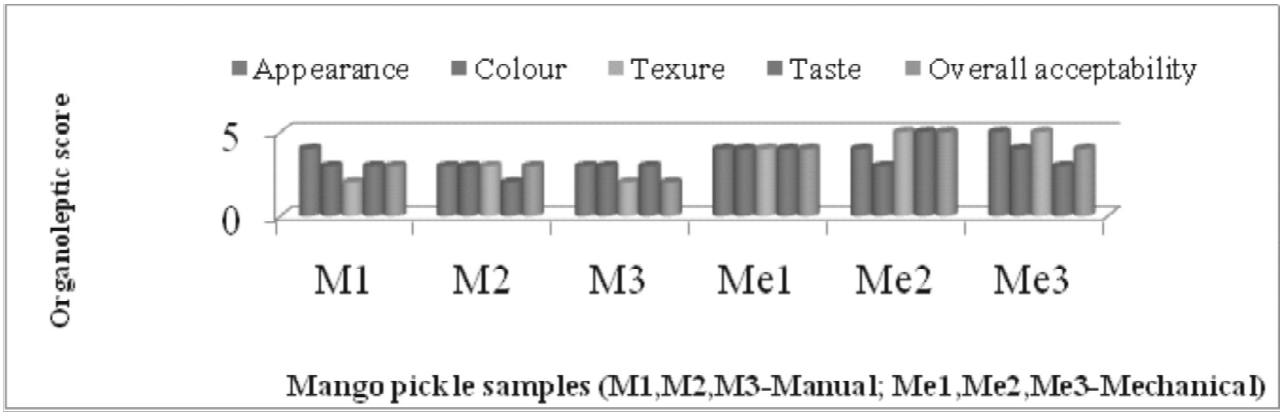

Figure 2: Organoleptic evaluation of manually and mechanically processed mango pickles

Table 4
Organoleptic evaluation of manually and mechanically prepared raw mango pickles

Samples	*Appearance*	*Colour*	*Texture*	*Taste*	*Overall Acceptability*	*Total Score*
M1	4.0	3.0	2.0	3.0	3.0	15.0
M2	3.0	3.0	3.0	2.0	3.0	14.0
M3	3.0	3.0	2.0	3.0	2.0	13.0
Me1	4.0	4.0	4.0	4.0	4.0	20.0
Me2	4.0	3.0	5.0	5.0	5.0	22.0
Me3	5.0	4.0	5.0	3.0	4.0	21.0

Very good : > 25, Good : 20-24, Fair : 15-19, Poor : 10-14, Very poor : 5-9

M1, M2, M3 = Manually prepared samples Me1, Me2, Me3 = Mechanically prepared samples

life of the product, product quality, flavour, taste and appearance. Proper packing, labelling and storage of mango processed food products are important to increase their, shelf life and to attract the market and consumers. Among the different packaging materials used, it was observed that the pickle samples kept in glass jar after 6 months of storage scored highest as compared to all other packaging material. The mango processed food products maintains shelf life for 3-12 months depending upon the type of product, moisture content and manually or mechanically prepared. The shelf life of pickles made manually cut slices/ cubes was 180 to 210 days, whereas the pickles made of mechanically cut slices/cubes can be preserved 300 to 365 days.

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