

Studies on effect of drying temperature and storage time on vitamin-C retention capacity and moisture content of papaya-apple fruit leather

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ABSTRACT

In the present investigation a study was conducted to prepare fruit leathers from two different fruit pulps i.e. papaya and apple in various proportions. Further study was carried out in order to evaluate the vitamin C retention of prepared leathers at different temperatures such as 55°C, 65°C and 75°C. All fruit leathers were then analyzed for their organoleptic characteristics such as color, flavor, taste, appearance and overall acceptability during storage period. A study was also carried out to evaluate the moisture retention in storage of the prepared leathers in different packaging materials such as LDPE, HDPE, aluminum foil and PET jar. The results revealed that the fruit leathers dried at 65°C shown highest vitamin-C retention with better retention of sensory properties. All leathers remained unchanged during storage period but the leather stored in aluminum foil has shown a remarkable ranking as compared to others during storage period. LDPE package has shown greater moisture fluctuation, while aluminum foil shown significant moisture retention during storage. It was also observed during the study that all fruit leathers had identical color, flavor and appearance which cannot be compared with one another.

Key words: Apple, Fruits, Leather, Papaya, Sensory, Storage, Temperature, Vitamin C.

INTRODUCTION

Fruit leathers can be simply defined as dried sheets of fruit pulp that have a soft, rubbery texture and a sweet taste. The edible portion of fruit is pulped, pureed, mixed with different ingredients to improve its physicochemical and sensory characteristics. These are then heated, formed and dried on flat trays until cohesive fruit leather is obtained. Fruit leathers can be eaten as snack foods or added to a variety of food preparations (Raab and Oehler 1999). The papaya fruit is a rich source of vitamins and minerals. Papaya accounts the highest among fruits for vitamin C, vitamin A, riboflavin, folate, calcium, thiamine, iron, niacin, potassium and fiber (Gomez *et al.*, 2002). Papaya contains 64 mg ascorbic acid per 100g of fresh fruit, which is higher than oranges which has 37 mg/100g (Santiago-Silva *et al.*, 2011). Papaya fruit is highly appreciated world-wide for its flavour, nutritional qualities, digestive properties and serotonin content (Fernandes *et al.*, 2006).

Apples are one of the most consumed fruits worldwide and are consumed fresh or in processed forms such as jam, juice or dried (Masoud *et al.*, 2012). Apples contain over 84% water, a variety of vitamins (except vitamin B complex), minerals (K, Mg, Ca and Na), trace elements (Zn, Mn, Cu, Fe, B, F, Se and Mo) and have a high fiber

content (Juniper *et al.*, 2002). Due to the varied and well balanced composition of apples, they have the potential to prevent digestive cancers, colon and liver cancers, coronary heart disease, lung function disorder and asthma (Feliciano *et al.*, 2010).

Thus pertaining to the above discussion, a study was conducted to prepare fruit leathers from two different fruit pulps i.e. papaya and apple in different ratios. In the present investigation, the attempt was made to study the effect of drying temperature and storage time on vitamin C retention and moisture content of papaya-apple fruit leather.

MATERIALS AND METHODS

The present study was carried in the Agricultural Process Engineering Lab, Department of Agricultural Engineering, Maharashtra Institute of Technology, Aurangabad, Maharashtra. Materials used and methods adopted for the present investigations are presented under suitable headings.

Materials: Fresh papaya and apple fruits were obtained from the local market of the Aurangabad city. The packaging materials such as low density polyethylene, high density polyethylene, aluminum foil and PET jars were procured from local market of Aurangabad.

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Procedure: The procedure of manufacturing the papaya-apple fruit leather was followed as per process given in the (Fig. 1). Different proportions were made in order to standardize the formulations. The standard formula for making papaya-apple fruit leather has been given in (Table 1).

TABLE 1: Standard recipe for formulation of papaya-apple fruit leather

Ingredients	Treatments				
	C0	C1	C2	C3	C4
Papaya: Apple (Papaya)	100	90 : 10	80 : 20	70 : 30	60 : 40
Sugar	30	30	30	30	30
Acid (%)	1	1	1	1	1

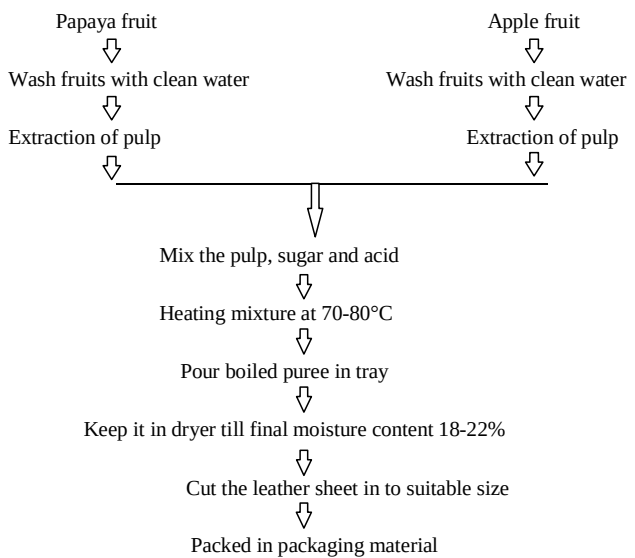


FIG.1: Flow sheet for preparation of papaya-apple fruit leather

Effect of different temperatures on vitamin C: In order to study the effect of different temperature conditions on vitamin C retention of the fruit leather, the various ranges of the temperatures used for drying of the fruit puree are given in (Table 2), such as $55^{\circ}\pm 5^{\circ}\text{C}$ for 14-16 hrs, $65^{\circ}\pm 5^{\circ}\text{C}$ for 10-12 hrs and $75^{\circ}\pm 5^{\circ}\text{C}$ for 8-10 hrs. After drying these fruit leathers at different temperatures, the same leathers were subjected for the analysis of ascorbic acid by AOAC methods.

TABLE 2: Different time-temperature combination for drying of fruit leather

Temperature	Time
$55^{\circ}\pm 5^{\circ}\text{C}$	14-16 Hrs
$65^{\circ}\pm 5^{\circ}\text{C}$	10-12 Hrs
$75^{\circ}\pm 5^{\circ}\text{C}$	8-10 Hrs

Organoleptic evaluation of leather: Fruit Leather was evaluated for sensory characteristics like color, taste, flavor, mouth feel and overall acceptability at room temperature

using departmental semi trained panel members on 9- point hedonic rating.

Storage stability of leathers under different packaging materials: The study was carried on storage of mix fruit leather in various packaging materials for 90 days. The various packaging materials used were LDPE, HDPE, aluminum foil pouch and PET jar at ambient temperature and product was regularly evaluated at 15 days interval.

Effect of storage on moisture content: During storage period the fruit leathers packed in different packaging materials were also analyzed to study the effect of storage on moisture content of the product. The samples packed in four different packaging materials were evaluated for moisture content at 15 days interval for the period of 90 days.

Effect of storage on vitamin-C retention capacity: Study was also carried out to investigate the effect of storage on the vitamin C retention of the product. The samples packed in four different packaging materials were evaluated for vitamin C content at 15 days interval for the period of 90 days.

RESULTS AND DISCUSSION

Standardization of papaya-apple mix fruit leather: After standardization of sugar-acid ratio the efforts were made to prepare papaya-apple mix fruit leather. The apple pulp was admixed with papaya pulp at 10, 20, 30, and 40 percent and evaluated for sensory analysis by trained panel members. Sincere efforts were made to prepare mix fruit leather using papaya and apple pulp at various levels ranging from 10:90 to 40:60. The results are presented in (Table 3). The highly acceptable and desirable products with respects to color, taste, flavour, mouth feel and overall acceptability can be obtained with combination of 30 percent apple pulp and 70 percent papaya pulp. The product scored maximum score (8.1) for color, taste, flavor and overall acceptability. However, it is interesting to note that higher level of apple pulp in papaya pulp is not that acceptable since the excessive apple pulp affects all the parameters such as color, flavor, taste, mouth feel and overall acceptability.

TABLE 3: Effect of different formulations on sensory quality attributes of papaya-apple leather

Sample No.	Color	Appearance	Flavor	Taste	Overall Acceptability
S ₀	7.6	7.3	7.3	7.2	7.4
S ₁	7.7	6.9	6.7	7.4	7.3
S ₂	7.6	7.4	7.0	7.2	7.5
S ₃	8.6	7.7	7.9	9.0	8.1
S ₄	7.5	7.4	7.3	7.3	7.3

Where,
S₀-apple 0 % : papaya 100 %
S₁-apple 10 % : papaya 90 %
S₂-apple 20 % : papaya 80 %
S₃-apple 30 % : papaya 70 %
S₄-apple 40 % : papaya 60 %

With increase in the level of apple pulp in mixture reduced the color, flavor and taste score this may due to addition of higher level of apple pulp proportionately decrease papaya pulp level in the mixture. This directly affect in reducing the appealing yellowish red color of the product and increase in dull color of the product. Not only this, the higher apple pulp in the mixture increases the breaking of leather texture in final leather and thus lower the overall acceptability of the products.

Hence higher level of apple pulp in papaya pulp is not that desirable from overall acceptability point of view. The best desirable ratio of apple papaya is 30:70. This ratio is recommended for the preparation of apple papaya mix fruit leather. In the apple papaya or papaya apple both cases the ratio of mixture is acceptable.

The results in present investigation with respect to mix fruit leather are in close agreement with the finding of Rozina Naaz *et al.*, (2013) in Date-Tamarind fruit leather. Malanganie, (2001) noted mix fruit leather prepared from lawulu-pineapple ratio as 1:2, 1:1 and 2:1 in development of jam and fruit leather using lawulu and pineapple.

Effect of different temperatures on vitamin-C: Vitamin-C content was obtained after studying the effect of different temperature conditions on vitamin C retention of the fruit leather. The various ranges of the temperatures used for drying of the fruit leather puree and different percentage of vitamin C retained have been given in (Table 4).

Hence it can be concluded from (Table 4) that the vitamin C content in the freshly prepared apple papaya puree was 31.23 mg/100gm and it has been reduced significantly in the leathers which were dried at higher temperatures. The puree processed at different temperatures such as 55°C, 65°C and 75°C had vitamin C content as 23.42 mg/100gm, 21.86 mg/100gm and 17.18 mg/100gm respectively.

TABLE 4: Percent Vitamin-C retained after drying at different temperatures

Temperature	Vitamin C (mg/100gm)
55°C	23.42
65°C	21.86
75°C	17.18

This change in vitamin C content can be related to the irreversible oxidization of vitamin C during drying of the fruit leather. The reduction in thermo sensitive vitamin C can also be attributed to the length of time required for dehydration. The results in present investigation with respect to vitamin C content in dried papaya are in close agreement with the finding of Sadegh Rigi *et al.*, (2014) in effect of

temperature on drying kinetics, antioxidant capacity and vitamin C content of papaya.

Effect on moisture content during storage period: The study was carried out to evaluate the effect on moisture content during storage of fruit leather in various packaging materials for 90 days. The various packaging materials used were LDPE, HDPE, aluminum foil pouch and PET jar at ambient temperature and product was regularly evaluated at 15 days interval. The results are presented in (Table 5).

From (Table 5) it can be concluded that there was a significant change in the moisture content of the fruit leather packed in LDPE package followed by HDPE, PET Jar and aluminum foil.

TABLE 5 : Effect on moisture content during storage period:

Days	Moisture Percent			
	S ₁	S ₂	S ₃	S ₄
0	22.24	19.60	19.65	20.00
15	21.92	19.60	19.65	20.00
30	21.35	19.52	19.65	20.00
45	20.70	19.41	19.65	19.65
60	19.92	19.30	19.65	19.62
75	18.87	19.15	19.60	19.58
90	17.60	18.90	19.60	19.55

S₁- LDPE S₃-Aluminum foil
S₂-HDPE S₄-PET Jar

Since aluminum foil has greater moisture barrier properties, therefore the fruit leather packed in this foil shown higher moisture retention during its storage period than fruit leathers packed in other packages.

Effect on vitamin C during storage period: The study was also carried to investigate the effect on vitamin C retention of the fruit leather during storage in various packaging materials for 90 days. The various packaging materials used were LDPE, HDPE, aluminum foil pouch and PET jar at ambient temperature and product was regularly evaluated at 15 days interval. The results are presented in (Table 6).

TABLE 6 : Effect on acidity during storage period:

Days	Vitamin-C (mg/100gm)			
	S ₁	S ₂	S ₃	S ₄
0	21.53	21.53	21.53	21.53
15	21.50	21.53	21.53	21.53
30	20.49	20.85	21.53	21.53
45	19.54	19.88	21.53	20.89
60	18.53	18.86	20.98	19.96
75	17.49	17.85	20.87	19.05
90	16.45	16.83	20.42	18.25

S₁- LDPE S₃-Aluminum foil
S₂-HDPE S₄-PET Jar

From (Table 6) it can be concluded that there was no drastic variation in the vitamin C content of the fruit leather packed in all types of packages such as LDPE, HDPE, PET Jar and aluminum foil for the period of 90 days storage. Fruit leather packed in aluminum foil had a greater stability than other packages since it hadn't allowed any ambient condition to interfere the ultimate composition of the fruit leather. Therefore it had not allowed the vitamin C content of the fruit leather to get fluctuated within that specified storage period.

Microbial analysis of fruit leather during storage: Results from (Table7) indicated that the type of packaging materials and time of storage both significantly affected the microbial growth during storage. From the results, AF seemed to be the finest material to inhibit the growth of the mesophilic bacteria, mould and yeast.

It also had been observed that leather packed in LDPE has shown maximum microbial growth from initial 19.13 Cf/g to 117.9 Cf/g. PET jar and HDPE had shown

TABLE 7 : Microbial growth rate during storage period:

Days	Total molds and yeast (cfu/g)			
	S ₁	S ₂	S ₃	S ₄
0	19.13	19.13	19.13	19.13
30	56.7	40.7	33.5	41.7
60	83.7	63.3	54.4	70.0
90	117.9	103.2	69.6	103.1
S ₁ - LDPE		S ₃ -Alluminium foil		
S ₂ -HDPE		S ₄ -PET Jar		

nearly similar range of microbial growth that is 103.2 Cf/g and 103.1 Cf/g at the end of 90 days storage period. From above results it can be concluded that AF has greater barrier properties than other packaging materials used for the packaging of leather.

HDPE and PET jar exhibits similar packaging characteristics so far the microbial growth during storage period is concerned, whereas LDPE shown poor packaging characteristics as compared to all the other packaging materials used for the packaging.

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