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Development and standardization of solar dehydrated pineapple-pomegranate fruit rolls

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Abstract

Solar Dehydration Technology is an emerging technology in the food processing sector. Pineapples are loaded with vitamins and minerals including vitamin A, vitamin C, calcium, phosphorus, and potassium. It is also rich in fiber and calories. On top of it all, this fruit is low in fat and cholesterol. Pomegranate juice (PJ) shows potent 17 antioxidant and anti-atherosclerotic properties attributed to its high content of 18 polyphenols. The most abundant of the polyphenols is punicalagin. Excellent flavour, nutritive value and medicinal properties of pomegranate fruit indicates its good potentiality for processing into value added products having extended shelf life. Therefore in this study, solar dehydration technology was used to develop a value added product using fresh pineapple pulp and pomegranate juice. With this objective, the study was conducted to develop solar dried pineapple-pomegranate fruit rolls, with 16 sunny hours of drying time with a yield of 40%, and 13% moisture content in the product. The fruit rolls were packed. Physico-chemical characteristics and nutritional parameters along with microbiological quality at accelerated storage conditions were studied.

Keywords: Pineapple, pomegranate, solar dehydration, antioxidants, sensory properties

1. Introduction

Many processing techniques can be employed to preserve fruits. Drying and dehydration is one of the most important operations that are widely practiced because of considerable saving in packaging, storage and transportation. Solar dryers are cabinet type which operates on the principle of natural convective airflow in drying chamber. In these dryers, the ambient air enters through the inlet holes in the bottom of the cabinet and the moisturized hot air exhausts through the ventilators located at the top of the cabinet. The solar radiation is incident through transparent glass and this causes the temperature of air inside the cabinet to be higher than ambient air.

Drying is a technique of conservation that consists of the elimination of large amount of water present in a food by the application of heat under controlled conditions, with the objective to diminish the chemical, enzymatic and microbiological activities that are responsible for the deterioration of foods (Barnabas *et al.*, 2010) ^[19].

The aim of the study is to enhance the shelf-life of pomegranate and pineapple by processing it into a value added fruit roll using solar drying technology and thereby increase the shelf-life of the product.

2. Materials and Methods

Collection of Raw Materials

Pineapple and pomegranate fruits, sugar, pectin, potassium metabisulphite and citric acid were procured from the local market, Hyderabad. The chemicals required for analysis of physicochemical characteristics of developed products were procured from Hi-media laboratory Mumbai.

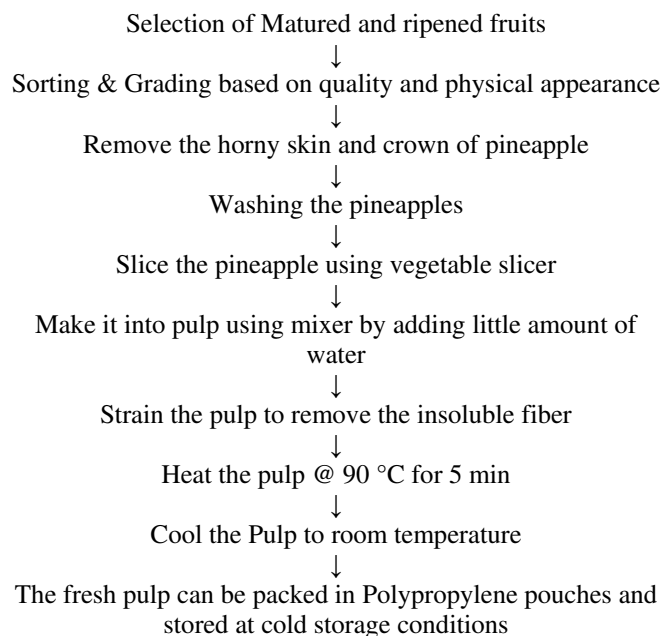
Development of fruit rolls using pineapple and pomegranate fruit

The pomegranate fruit could be considered a functional food because it has valuable compounds in different parts of the fruit that display functional and medicinal effects. These can act as antioxidant (Çam and others 2009) ^[17], as antitumoral (Hamad and Al-Momene 2009) ^[18] or anti hepatotoxic (Celik and others 2009) ^[17] agents, and improve cardiovascular health.

Hence, the study was conducted to utilize the functional properties of pomegranate fruit using solar dehydration technology. The product developed can be considered as a functional food.

Flow Chart

Preparation of pineapple fruit pulp



Procedure to prepare concentrated pomegranate fruit juice

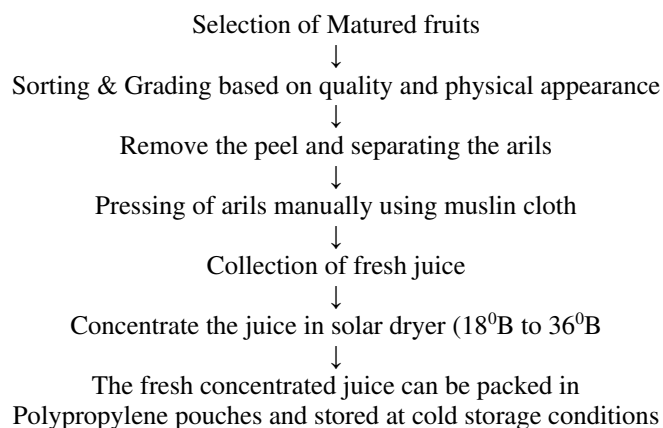
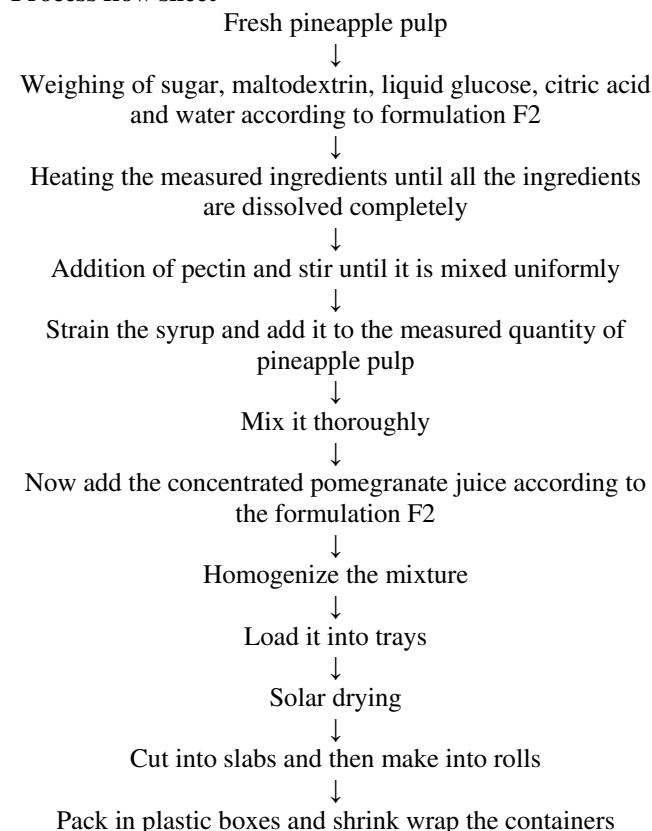


Table 1: Formulations of fruit rolls

S. No	Ingredients	Quantity (%)	
		F1	F2
1.	Pineapple pulp	69.5	69.5
2.	Pomegranate juice	30	20
3.	Sugar	23	24
4.	Maltodextrin	5	8
5.	Liquid glucose	5	5
6.	Pectin	1.0	1.1
7.	Citric acid	0.2	0.4
8.	Potassium Metabisulphite	0.02	0.02
9.	Water	5.3	5.3

Different formulations (F1, F2) have been developed and based on organoleptic properties, formulation F2 has been standardized

Process flow sheet



Similarly, the load for 2nd layer was prepared and loaded into trays i.e., onto the 1st layer (after drying of 1st layer).

Physico chemical properties of pineapple and pomegranate fruit rolls

Knowledge of the physico-chemical properties of food is fundamental in analysing the characteristics of food during its processing. The study of these food properties and their responses to process conditions are necessary because they influence the treatment received during the processing and also because they are good indicators of other properties and qualities of food. In the present investigation certain physico-chemical properties of the developed product were analysed to ensure the quality of the products.

Physicochemical properties of developed products

Dry a petri dish beside its lid in an oven for 30 minutes at 95 °C. Cool to room temperature in a desiccator for about 45 minutes and weigh the dish lid to the nearest 0.1 mg (M1). Transfer the homogenized representative sample into the dish and record the weight with lid to the nearest 0.1 mg (M2). Place the dish beside its lid into the oven without draught, at ordinary pressure. Dry the whole for 5 hours at 105±2 °C. Then place the lid onto the let cool to room temperature in a desiccator for 45 minutes. Weigh the closed dish to nearest 0.1mg (M3). Calculation:

% Moisture Content:

$$[(M2-M3) / (M2-M1)] \times 100$$

M1 = Mass in grams of the empty dish

M2 = Mass in grams of the empty dish + the test portion

M3 = Mass in grams of the empty dish + the test portion after drying.

Titration acidity

It was estimated using the method of S Ranganna, “Handbook of Analysis and Quality Control for Fruits and Vegetable Products”.

Total Soluble Solids

Weigh about 2 g of sample and macerate it by adding 10ml of distilled water. Smear on the hand refractometer and note down the reading of the soluble solids present in it in terms of °Brix. The total soluble solids present in the sample can be calculated using the following formula:

% TSS = [(volume made up + weight of sample) * refractometer reading] / (weight of sample).

Reducing Sugars and Total Sugars

They are estimated using the method of S Ranganna, “Handbook of Analysis and Quality Control for Fruits and Vegetable Products”

Nutritive analysis of pineapple and pomegranate fruit rolls

Nutritional profile was done by using the standard methods available.

Estimation of ascorbic acid

The method of Ranganna, (1986) [21] was followed for the estimation of ascorbic acid. Five grams of sample was extracted with 3% metaphosphoric acid. The sample was filtered and 5 ml filtrate was taken for estimation against standard dye to a pink colour. Dye was standardized taking 5 ml ascorbic acid standard (100 mg/100 ml in 3% metaphosphoric acid) in a conical flask and mixed with 5 ml 3% meta phosphoric acid and titrated against the dye to a faint pink colour which persists for 15 sec and the dye factor was determined using the formula

Dye factor = 0.5/titre value

10 g of sample was weighed and macerated with 3% metaphosphoric acid. Volume was made up to 100ml with metaphosphoric acid and filtered. 10ml of the extract was titrated against the dye in the burette to a faint pink color which persisted for 15 sec.

Ascorbic acid content (mg/100g) =

(Titre value × dye factor × volume made up × 100) / (Aliquot taken for estimation × weight of sample taken for estimation).

Total Carotenoids

It was estimated using the method of Arya *et al.*, 1979 [20].

Total Phenols & Total Flavonoids

They were estimated using the method of Singleton & Rossi, 1965 [21].

Sensory evaluation

Deep-fried meatballs were subjected to sensory analysis using 55 semi-trained panel members with 9-point hedonic scale. Sensory attributes evaluated were appearance, flavour, texture, taste, juiciness and overall acceptability (Diaz *et al.* 2022; Mian *et al.* 2017) [22, 23].

Results and discussions

Much attention has been given to the quality of dehydrated products. Drying methods and physicochemical changes that occur during dehydration seem to affect colour, texture, density, porosity and sorption characteristics of dehydrated product (Abbot, 1999; Gabas *et al.*, 1999; Lewicki and Lukaszub, 2000; Krokida *et al.*, 2000; Telis *et al.*, 2000) [25-29]. Solar dehydration is one of the easiest and cost effective technologies which can be profitably multiplied at the rural level increasing employment and per capita income.

Drying Data

The drying data is tabulated as follows:

Table 2: Drying data for pineapple-pomegranate fruit rolls

S. No	Name of the Product	Drying conditions				Finished product	
		Loading capacity (kg/m ²)	Ambient temp (°C)	Cabinet temp (°C)	Time (hrs)	Moisture Content (%)	Yield (%)
1.	Solar dehydrated Pineapple-Pomegranate Fruit Rolls	7	30	55	16	12	40

Physico Chemical Parameters

The different physico-chemical parameters were carried out and the study includes estimation of moisture content, acidity, brix, sugar content as well as browning index. The result

states that the sugar content in solar dehydrated pineapple-pomegranate fruit rolls was around 66%. All the data is tabulated in table -6.2 and the results are as follows:

Table 3: Study on physico chemical parameters of solar dehydrated pineapple-pomegranate fruit rolls

S. No	Parameters	F2
1	Moisture content (%)	13.20 ± 0.20
2	Total soluble solids (%)	73.71 ± 0.41
3	Acidity (%)	0.12 ± 0.24
4	Ash content (%)	0.70 ± 0.34
5	Acid insoluble ash content (%)	0.36 ± 0.41
6	Reducing sugar (%)	28.54 ± 0.12
7	Total sugars (%)	53.54 ± 0.24
8	Browning index	0.356 ± 0.24

Values are expressed as mean ± SD (N=3)

Nutritional Parameters

Pineapple is a good source of potassium, manganese, fiber and vitamin A and C. Pomegranate is a good source

of vitamins, especially vitamin A, C, and E, as well as folic acid. The nutritional parameters which were analysed include vitamin c, carotenoids, phenols, flavonoids, crude fiber,

sodium, potassium, calcium, iron ^[24]. The results indicated that many of the nutrients can be retained with less energy consumption. The final product was acceptable in terms of nutritive value also and the results are tabulated as follows:

Table 4: Study on nutritional parameters of solar dehydrated pineapple-pomegranate fruit rolls

S. No.	Parameters	Value
1	Vitamin C (mg/100 g)	47.20
2	Phenols (µg/g)	1887.50
3	Flavonoids (µg/ g)	17.46
4	Crude fiber (g/100 g)	1.22
5	Sodium (mg/100 g)	0.47
6	Potassium (mg/100 g)	3.19
7	Calcium (mg/100 g)	37.03
8	Iron (mg/100 g)	01.09

Microbial Assay

Measured volume of different dilutions of samples is plated on suitable nutrient media, such as nutrient agar or yeast extract agar plates and the number of colonies counted. The total viable count per milliliter or gram is calculated. The results are tabulated as follows:

Table 5: Microbial parameters of solar dehydrated pineapple-pomegranate fruit rolls

S. No	Microbial parameters	Value
1	Total plate count	Nil
2	Yeast and mould	Nil
3	<i>E. coli</i>	Nil

Sensory Evaluation

Sensory evaluation is done to know the acceptability of the product. This sensory evaluation helps in ensuring the quality of the product. Mean scores of sensory evaluation are presented in the table. The results revealed that solar dehydrated custard apple rolls were acceptable in terms of colour, appearance and taste.

Table 6: Sensory properties of solar dehydrated pineapple-pomegranate fruit rolls

S. No	Parameters	Score
1	Color	8.6
2	Appearance	8.7
3	Taste	8.1
4	Texture	7.9
5	Flavor	8.2
6	Overall acceptability	8.4

Conclusion

From the above study on dehydration of pineapple-pomegranate fruit rolls using dehydration methods like solar dehydration, it can be concluded that all the physicochemical parameters (moisture, pH, brix, total soluble solids, browning index, reducing sugars and total sugars) were maintained and there was negligible chances of loss in the product.

As the process of development of pineapple-pomegranate roll is by solar drying, the nutritive value of the fruit retains and can be stored for long time.

Based on the microbial analysis, there were no colonies found in solar dehydrated pineapple-pomegranate rolls. Sensory evaluation of the rolls was done as per the 9 points Hedonic scale reading (colour, flavor, texture, appearance, taste). The

results of the sensory evaluation revealed that pineapple-pomegranate rolls were more appealing than other rolls in terms of all parameters rated on 9-point Hedonic scale.

Thus it can be concluded that solar dehydrated pineapple-pomegranate fruit rolls are best in terms of nutritional, physicochemical, microbial and sensory parameters.

The storage conditions and shelf life of the product must be studied in order to regulate the uniformity of the product and also the stability of the product.

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