Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/cjm41f40

APPLICATION OF SUPERCRITICAL FLUID EXTRACTED VEGETABLE PEEL EXTRACTS AS NATURAL PRESERVATIVES IN JAMUN LEATHER

Wajeeha Nusrat[1*], Mahwash Aziz[1], Ambreen Basharat[2], Nimra Arshad[3], Noor ul Ain[3], Hafiza Bazlah Amjad[3], Yasmeen Bano[4], Farah Saeed[5]

[1*]Department of Food Science and Technology, Government College Women University, Faisalabad. Pakistan.
[2]Centre of Agricultural Biochemistry and Biotechnology (CABB), University of Agriculture Faisalabad, Pakistan.
[3]National Institute of Food Science and Technology, University of Agriculture Faisalabad, Pakistan.
[4]University of Agriculture Faisalabad Sub-Campus Burewala, Punjab, Pakistan.
[5]College of Earth and Environmental Sciences (CEES), University of the Punjab Lahore, Pakistan.

***Corresponding Author:** Wajeeha Nusrat
*Department of Food Science and Technology, Government College Women University, Faisalabad. Pakistan. Email: wajeehanusrat@gcwuf.edu.pk

Submitted 06-07-2024 Accepted 28-07-2024 Published 19-08-2024

Abstract

The processing of fruits and vegetables gives rise to several waste products, in the form of peels, seeds and pulps. These by-products are potential sources of health-promoting phytochemicals including phenolics, flavonoids, vitamins and minerals. There are several techniques employed in the extraction of bioactive compounds from vegetable peels; one of the green methods is the use of SFE (supercritical fluid extraction). SFE employs supercritical fluids like carbon dioxide (CO_2) as the solvent for the extraction process. Food industry is searching for natural preservatives to replace synthetic ones. Supercritical fluid extracts of vegetable peels (pumpkin, turnip, and potato) were used in this study to preserve jamun leather. Treatments included L_0 (leather having synthetic preservative), L_1 (leather having potato+pumpkin peel extract) and L_2 (leather having potato+pumpkin+turnip peel extract). At 0 day, the leather was examined for pH, titratable acidity and total soluble solids. Results of these analysis revealed that L_2 was better in preserving the quality of leather. L_2 also scored better in sensory evaluation for parameters like flavor, aroma, color and overall acceptability followed by L_1. The results revealed that vegetable peel extracts can be used as an efficient alternative to synthetic preservatives.

Keywords: Vegetable peels, supercritical fluid extraction, jamun leather, bioactive compounds

1. Introduction

Since fruit losses after harvest are becoming a significant problem, it is essential to turn these fruits into value-added food products. Jamun is among those fruits that unfortunately undergoes significant post-harvest losses due to improper storage. Jamun is a tropical, perishable and seasonal fruit with several therapeutic uses. This fruit has variable amounts of antioxidant components, sugars, phenolic compounds, vitamin C and minerals. Jamun fruit is mostly processed to make jam, jellies, vinegar and squash. Customers find jamun products appealing because of their eye-catching purple hue, which is a result of anthocyanin compounds. Additionally, the flavonoids in jamun serve as colorants and antioxidants. Harvesting season of most fruits is very short and are susceptible to deterioration even when kept at refrigerated storage in favorable conditions (Bukya and Madane, 2018).

Fruit leather also known as fruit slab or fruit bar is a dehydrated confectionery product prepared from fruits and is often consumed as dessert or snack. It has high carbohydrates and fiber content, low fat content and chewy texture. Being lightweight, it is easily packed and stored. As fruit leather is rich source of nutrients its consumption is a convenient and economic alternative for fresh fruits. Preparatory steps of fruit leather involve mixing of fruit pulp with pectin, citric acid and sugar in appropriate amounts. Then dehydration of this mixture is carried out to turn it into a leather like flexible sheet. Removal of moisture preserves leathers for a long time. Jackfruit, kiwifruit, berry, grape, apricot and mango leathers are easily available in the market (Diamante *et al*., 2014). The purpose of the present study is to assess the efficacy of SFE (supercritical fluid extracts) of vegetable peels (pumpkin, turnip, and potato) in jamun leather as natural preservatives.

2. Materials and Methods

2.1 Standards and Chemical Reagents

Chemicals and standards, such as Foilin-Ciocalteu reagent, gallic acid, and DPPH were obtained from Sigma-Aldrich (Tokyo, Japan) and Merck (Darmstadt, Germany).

2.2 Formulation of Vegetable Peel Extracts

Vegetable peels were procured from local vegetable processing units in Faisalabad. Vegetable peel extracts were prepared by supercritical fluid extraction (SFE) method. SFE-CO_2 was carried out in a pilot-scale system (Supercritical Fluid Technologies, USA) according to method described by Santos et al. (2021). Eighty gram (80 g) of each peel powder was loaded into a 500 ml extraction vessel. The extraction conditions were set at 25 MPa pressure, 40°C temperature and 120 min duration based on preliminary optimization studies. The extract was collected in a glass vial from the separator at controlled conditions. The extracts were stored in refrigerator until testing.

2.3 Formulation of Jamun Leather

After deseeding the jamun fruit, the pulp was prepared in the pulper for leather preparation. Obtained jamun pulp was homogenized in lab homogenizer. Other ingredients were incorporated in mixture during homogenization. For drying purpose, 500g of pulp mixture was spread in the aluminium trays and placed in dryer set at 60°C temperature and 3.5m/s air velocity in dryer cabinet. Temperature of the oven was set almost an hour before placing pulp mixture in dryer. Trays were greased with vegetable oil to inhibit sticking of the leather in tray. For the first 2 hr, trays weight was observed after every 15 min then this duration was extended to 30 min for next 7-8 hours. After completion of drying process, trays containing leather were removed from dryer and leather was cut into required shapes. Butter paper was used for wrapping leather and it was then stored at room temperature in polyethylene bags.

2.4 Physicochemical Analysis of Jamun Leather

All leather treatments were evaluated for pH, titratable acidity and total soluble solids according to AOAC (2019) standard procedures.

2.5 Sensory Analysis

For sensory assessment nine-point Hedonic scale was used. Ten trained panelists were asked to evaluate color, texture, flavor and overall acceptability of puree samples as described by Moreira *et al.* (2019).

2.6 Statistical Analysis

Statistical analysis was applied to obtained data using a 2-factorial CRD (completely randomized design) and Tukey's test was used to compare means at 0.05 percent significant level by statistix software according to the method explained by Montgomery (2017).

3. Results and Discussion 3.1

pH of Jamun Leather

The pH level of jamun leather determine its quality, stability, and safety. Mean squares of pH showed significant variations within the treatments, during storage and non-significant variations in their interaction. The mean values regarding pH of treatments ranged from 3.37-3.44 (Table 1). The mean values regarding pH of leather during storage (0-120 days) were found to be 3.47-3.32. pH of Jamun leather decreased during storage. Maximum decrease in pH during storage was observed in L_0 while pH of treated samples didn't decrease rapidly.

Rahman *et al.* (2024) also reported a decreasing trend in pH of watermelon leather during storage of 9 months. Decrease in pH leads to acidity increase in the fruit leather. Reasons for this acidity increase include acids generation from sugars, hydrolysis of pectin, and degradation of ascorbic acid. Saranya *et al.* (2017) observed decrease in pH of papaya roll-ups manufactured using Ezidri dehydrator and cabinet dryer. The pH of roll-ups prepared in Ezidri dehydrator decreased from 4.74 to 4.54 during storage of 10 weeks. While the pH of roll-ups prepared in cabinet dryers exhibited decreased from 4.67 to 4.46.

Sreemathi *et al.* (2018) also reported similar decreasing trends in pH for papaya sapota bar during a storage period of 90 days. Results of Ankit *et al.* (2015) also support the results of present study as a decrease from 3.80 to 3.58 in pH of papaya leather was observed during storage of 90 days.

Table 1: Effect of vegetable peels extract on pH of jamun leather

Treatments	Storage (days)					Means
	0	30	60	90	120	
L_0	3.46±0.07	3.43±1.03	3.39±1.93	3.32±1.04	3.26±1.04	**3.37**
L_1	3.47±1.04	3.44±0.06	3.41±0.08	3.37±1.10	3.32±0.14	**3.40**
L_2	3.49±0.09	3.47±1.09	3.45±0.07	3.42±0.07	3.38±1.03	**3.44**
Means	**3.47**	**3.44**	**3.41**	**3.37**	**3.32**	

L_0=jamun leather with synthetic preservative, L_1= jamun leather with 50% potato+50%pumpkin peel extract L_2= jamun leather with 33.3%potato+33.3%pumpkin+33.3%turnip peel extract

3.2 Titratable Acidity

Titratable acidity (TA) in jamun leather ensures preservation of natural flavor, texture and color while also inhibit microbial growth. Mean squares of acidity showed significant variations within the treatments, during storage and in their interaction. The mean values regarding TA of treatments ranged from 0.49-0.55%. The mean values regarding TA of leather during storage (0-120 days) were found to be 0.46-0.60% (Table 2). During storage TA values of leather increased and maximum increase was shown by P_0 (synthetic preservative), The increase in TA was less significant in extract treated samples.

Suradkar *et al.* (2021) studied physicochemical parameters of jamun bars stored for a duration of 180 days. Bars were stored at ambient and refrigerated temperature and an increase in acidity was found in both types of storage. However, bars stored at ambient temperature exhibited a rapid increase in acidity as compared to the bars stored at refrigerated temperature. The acidity of freshly formulated bars was measured to be 1.72 percent. While the acidity increased to 1.87 and 1.90 at 180th day for refrigerated and ambient storage respectively. One possible explanation for this acidity increase could be the production of acids by breakdown of polysaccharides, uronic acid and pectic substances. During storage the concentration of acids having weak ionization increase along with their salts contributing to rise in acidity. During storage the concentration of acids having weak ionization increase along with their salts contributing to rise in acidity.

Table 2: Effect of vegetable peels extract on TA of jamun leather

Treatments	Storage (days)					Means
	0	30	60	90	120	
L_0	0.47±0.04	0.50±1.02	0.54±1.00	0.59±1.04	0.66±1.05	**0.55**
L_1	0.46±1.05	0.48±0.08	0.51±1.05	0.55±1.03	0.60±1.02	**0.52**
L_2	0.44±1.07	0.46±1.01	0.48±0.09	0.52±1.01	0.56±0.07	**0.49**
Means	**0.46**	**0.49**	**0.51**	**0.55**	**0.60**	

L_0=jamun leather with synthetic preservative, L_1= jamun leather with 50% potato+50%pumpkin peel extract L_2= jamun leather with 33.3%potato+33.3%pumpkin+33.3%turnip peel extract

3.3 Total Soluble Solids

Total soluble solids (TSS) are important for jamun leather as they help to determine the concentration of the leather, which is necessary to maintain its taste, color, and aroma. Mean squares of TSS showed significant variations within the treatments, during storage and in their interaction. The mean values regarding TSS of treatments ranged from 50.06-50.33 ^{o}Brix. The mean values regarding TSS of leather during storage (0-120 days) were found to be 50.33-49.91 ^{o}Brix (Table 3). TSS of jamun leather decreased during storage.

The results of present study are in line with Vagadia *et al.* (2016) who prepared fruit bars from banana and papaya pulp at different concentrations and reported a decrease in TSS during storage. This decrease in TSS was observed in all treatments at storage intervals of 0, 3 and 6 months. The TSS of the treatment having 100% papaya pulp and 0% banana pulp was calculated as 84.83% at 0 day that reduced to 82.40% at 90th day of storage.
Metabolic processes particularly oxidative metabolism affects the changes in TSS in the fruit leather. Long-term storage can cause changes in moisture content, which can affect the product's pore space leading to an increase or decrease in total soluble solids because of water absorption (Rahman *et al.* 2024).

Table 3: Effect of vegetable peels extract on TSS of jamun leather

Treatments	Storage (days)					Means
	0	30	60	90	120	
L_0	50.20±1.04	50.17±0.07	50.13±0.05	50.06±0.07	49.74±0.04	**50.06**
L_1	50.35±0.05	50.33±0.08	50.30±1.02	50.21±1.04	49.94±0.07	**50.22**
L_2	50.44±0.06	50.42±1.09	50.39±1.14	50.33±0.03	50.07±1.06	**50.33**
Means	**50.33**	**50.30**	**50.27**	**50.20**	**49.91**	

L_0=jamun leather with synthetic preservative, L_1= jamun leather with 50% potato+50%pumpkin peel extract L_2= jamun leather with 33.3%potato+33.3%pumpkin+33.3%turnip peel extract

3.4 Sensory Analysis of Jamun Leather

The 9-point Hedonic scale method—9 being "like extremely" and 1 being "dislike"—was used to test the formulated leather samples (L_0, L_1, L_2) for sensory evaluation. Figure 1, 2, 3, and 4 demonstrate the sensory scores of all leather samples. L_2 was declared best in terms of color, texture, flavor and overall acceptability followed by L_1. Present study revealed that natural extracts have no negative impact on sensory attributes of food products.

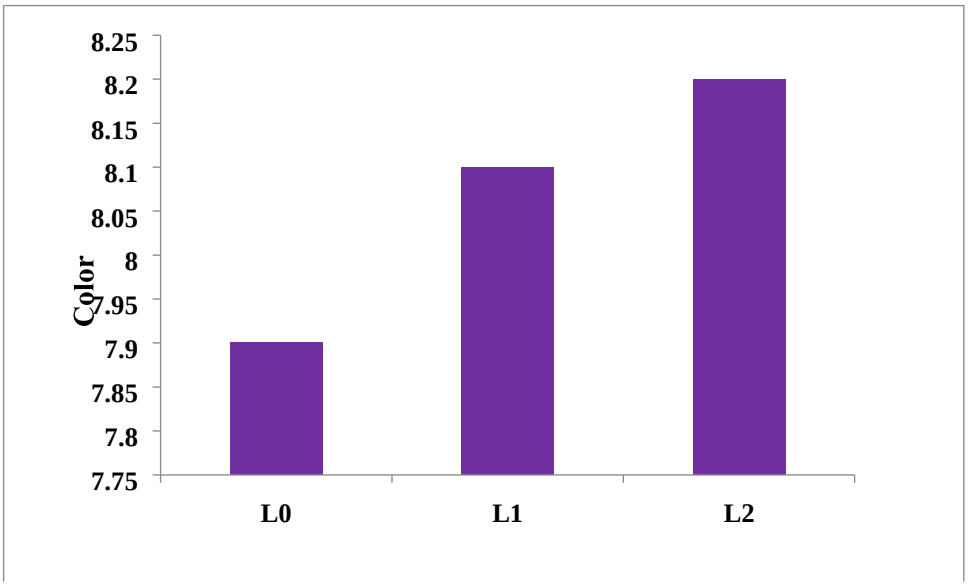

Figure 1. Color of jamun leather preserved with natural and synthetic preservative

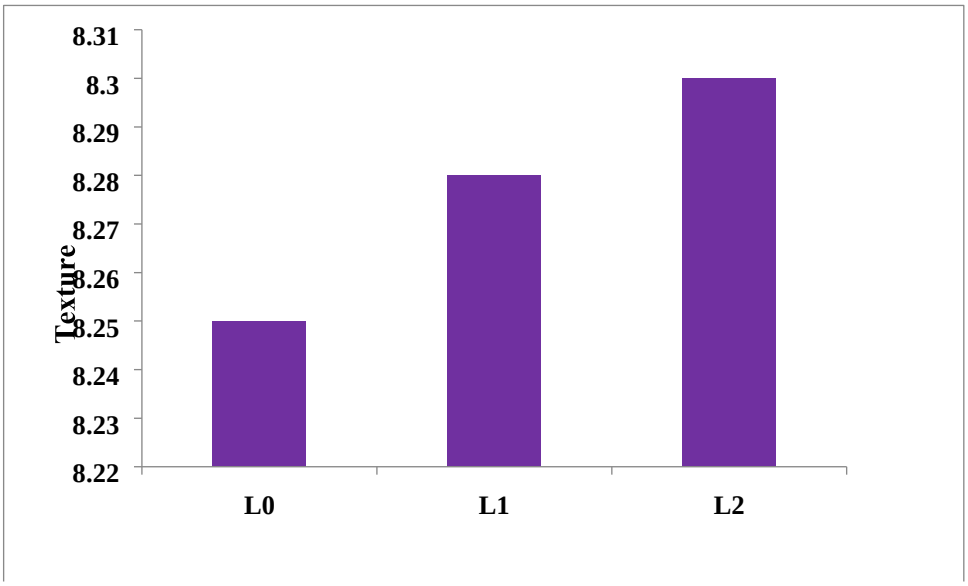

Figure 2. Texture of jamun leather preserved with natural and synthetic preservative

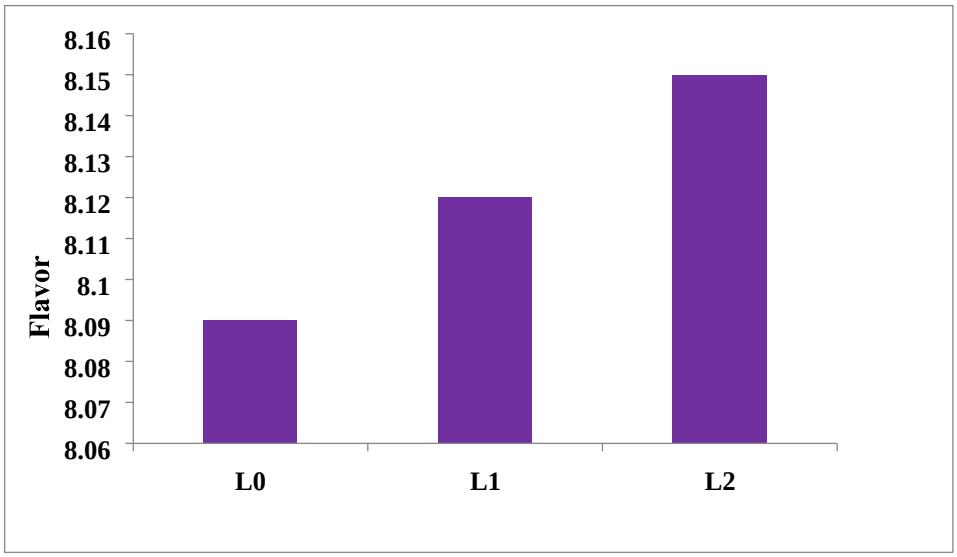

Figure 3. Flavor of jamun leather preserved with natural and synthetic preservative

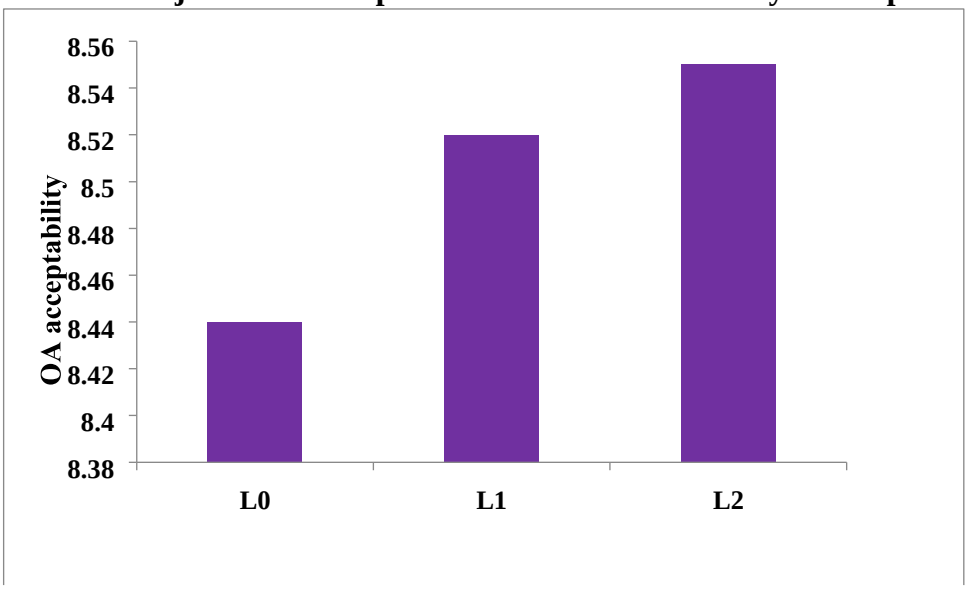

Figure 4. Overall acceptability of jamun leather preserved with natural and synthetic preservative

4. Conclusion

Results obtained from present research encouraged the extraction of bio-active compounds from peel extracts through supercritical fluid extraction technique. This extraction technique recognized as GRAS, yielded bio-active compounds from peels without generation of any toxic residues. The addition of these phytochemical rich extracts in jamun leather maintained pH, acidity and total soluble solids. Peel extracts imparted all these beneficial effects without compromising on sensory attributes like color, texture flavor and overall acceptability. So, use of natural extracts for maintaining quality of food products is a good option as consumers now a day demand for use of natural additives in processed fruit products.

References

1. Ankit, S., J. Singh, N. Chauhan, V. Kumar and K. Dinesh. 2015. Effect of different citric acid levels and packaging materials on quality of sugar based papaya leather. South Asian Journal Food Technology Environment. 1(1): 75-78.

2. AOAC (Association of Official Analytical Chemists). 2019. Official Methods of Analysis, 21st Ed. Washington, DC, USA.
3. Bukya, A. and L. P. Madane. 2018. Preaparation and standardization of jamun jam (Syzygium cumini) it's chemical and storage studies. World Journal of Pharmacy and Pharmacological Science. 7: 876-885.
4. Diamante, L. M., X. Bai and J. Busch. 2014. Fruit leathers: method of preparation and effect of different conditions on qualities. International Journal of Food Science. 2014(1): 139890.
5. Montogmery, D. C. 2013. Design and analysis of experiments, 7th Ed. John Wiley and Sons., Inc. Honkon, NJ, USA: 1-656p.
6. Moreira, M. C. N. D., G. L. D. Almeida, E. E. N. Carvalho, J. A. D. Garcia, A. M. Nachtigall and B. M. V. Boas. 2019. Quality parameters, antioxidant activity, and sensory acceptability of mixed jams of rose petals and apple. Journal of Food Processing and Preservation. 43(12): 14272.
7. Rahman, M. M., M. R. Akon and M. F. Hasan. 2014. Production and evaluation of the physicochemical and sensory attributes of watermelon fruit leather and sauce. Journal of Patuakhali Science and Technology. 13(2): 13-26.
8. Saranya, V., K. U. Devi, J. Suneetha and K. B. Suneetha, 2017. Development and shelf life study of papaya fruit rollups. Journal of Pharmacognosy and Phytochemistry. 6(6): 1420-1424.
9. Sreemathi, M. R. Sankaranarayanan B. Balasubramanyan. 2008. Sapota-Papaya bar. Madras Agricultural Journal. 95(6): 170-173.
10. Suradkar, N., V. Pawar, H. Deshpande, V. Mane, J. Ughade and A. Ghorband. 2021. Storage stability of jamun fruit bar with respect to different temperature and packaging material. Pharma Innovation. 4(10): 1172-1176.
11. Vagadia, P., A. Senapati, R. Tank, J. Mayani and B. Koyani. 2016. Evaluation of Physicochemical and organoleptic quality of Papaya Cv. Taiwan and Banana Cv. Grand naine based mixed fruit bar during storage. International Journal of Agriculture, Environment and Biotechnology. 9(4): 541-544.