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COMPARISON OF THE EFFECTS OF NOVEL PROCESSING TECHNOLOGIES AND CONVENTIONAL PASTEURIZATION ON THE RETENTION OF BIOACTIVE COMPOUNDS OF FUNCTIONAL FIG (FICUS RACEMOSA) JUICE

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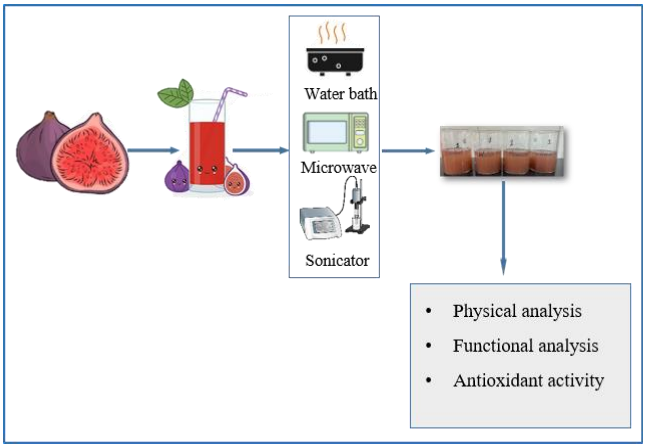
HIGHLIGHTS

- Non-thermal processing techniques aid in retaining the amount of bioactive compounds present in the juice.
- Novel processing techniques extend the shelf life of the food product.
- Instead of pasteurization, the food industry might use non-thermal food processing processes to preserve the shelf life and quality of fruit juice.
- Ultrasonic processing has shown potential as an alternative to more conventional heat treatments

GRAPHICAL ABSTRACT



ABSTRACT:

Background: Non-thermal processing improves food quality and safety while reducing nutrient losses. One of the technological innovations that are being frequently researched on a wide range of food products is ultra-sonication and microwave treatment, on the other hand, causes rapid heat transfer, preserving the functional properties of foods. **Methods**: The aim of this study was to evaluate the relative efficacy of ultrasonic and microwave technologies that have recently emerged on the market on selective qualitative characteristics of fig juice (phenolics, flavonoids, antioxidants, etc.) stored for 30 days with traditional thermal pasteurization. **Results**: These findings indicate that the pH and cloud value of all the treated samples decreases with storage time while TSS remains constant, especially in ultrasound and microwave-processed samples. The total amount of polyphenolic compounds and flavonoids decreased, and antioxidant activity followed a similar pattern after 30 days of storage, however ultrasound-treated sample showed greater retention of physical and functional compounds followed by antioxidants compared to other treatments. **Conclusions**: Juice processing industries might use ultrasound processing as an alternate method to conventional pasteurization due to their effectiveness in retaining the quality and nutritional characteristics. As a result, Ultrasonic treatment has a broad array of applications in preserving biologically active compounds and physicochemical characteristics while extending the storage stability of fig juice.

Keywords: Ultrasound, microwave, Pasteurization, Juice processing, Antioxidants, Total Phenols.

1. INTRODUCTION

With the growing demand for fresh foods, customer preferences are evolving. As a result, the fruit juice industry has focused its research on alternative processing technologies to manufacture foods with the fewest alterations induced by the technology. Ascorbic acid, phenolic compounds, flavonoids, antioxidants, and other phytochemicals found in fruits and vegetables serve a significant role in nourishing a healthy lifestyle [31]. Fruits and vegetables possess anti-aging characteristics, slowing down the process of aging and lowering the risk of diseases like arthritis, cancer, cataracts cardiovascular, and Alzheimer's disease [21]. Ficus is a genus comprising 800 species of woody shrubs, vines, and trees in the Moraceae family. Plants belongs to the genus Ficus are commonly referred to as fig trees, and the cluster fig (Ficus racemosa) is the most well-known species within this family. Throughout the world, Ficus has long been utilized in a wide range of indigenous medicine. The fig was highly valued because of its culinary value as well as its potential for therapeutic application [38].

Refrigeration and freezing are two of the most extensively used storage conditions. Foods that are refrigerated have a shorter shelf life than frozen foods, although they do not significantly change the structure of the product after minor processing [6]. Processing methods and conditions are one of the most important factors impacting the shelf life of fruit goods in various processing procedures. In recent years, people have paid more attention to nonthermal studies like ultrasonication and high hydrostatic pressure [36]. The thermal processing technique has been used in the production of fruit juice, to prevent contamination and extend storage stability, but it can result in heat-sensitive nutrient depletion [32]. In recent years, nonthermal technologies like ultrasonication and high hydrostatic pressure have been studied. The ultrasound technique is a revolutionary food processing technique that has effectively increased health-related components and other quality characteristics of fruit juices due to decreased energy usage, environmental friendliness, and fast processing time [25]. Sonication treatment substantially increases, DPPH free radical scavenging activity, phenolic and flavonoid compounds [29].

Ultrasonication of fruit and vegetable juices such as apples and carrots Abid et al.,[3] has been shown to improve antioxidant qualities, quality parameters, and microbial inactivation [18]. Microwaves are a type of electromagnetic wave that have a frequency range of 300 MHz to 300 GHz and a wavelength range of 1 mm to 1 m. Microwave frequencies of 915 MHz and 2.45 GHz are useful for a variety of applications including analytical procedures, the pharmaceutical industry, and manufacturing purposes [28].

Consumers can obtain high-quality fruit products that are easy to eat and require minimal heat treatment, however unit procedures like homogenization and filtration cause cellular integrity loss due to alterations in enzyme activity [14]. Quality parameters in various fruit commodities differ slightly depending on factors including pH, phytochemicals, structure, or matrix [12]. In recent years, several novel technologies such as ultrasonic and microwave processing have demonstrated their ability to produce quality products based on shelf-life security and functional quality. Consumers will benefit from high-quality, safe goods, and promote utilization. As a result, keeping in view the importance of fig juice and the rising prevalence of healthier foods, this research aimed to develop fig juice with greater nutritional contents that required minimal processing and did not contain artificial preservatives. The purpose of this study is to compare the ideal storage life of fig-based beverages processed with pasteurization to those processed with microwave or ultrasound.

2. MATERIAL AND METHODOLOGY

2.1 Product development

The fig fruit of similar size was harvested from Kangra Himachal Pradesh, India in the month of June. Before extracting the juice, the fruits were washed with tap water. The fruit pulp was homogenized separately for 5 minutes (6000rpm) in a household juicer (Borosil primus II), then the juice was trained in a flask employing watt man paper to collect clear juice. After that, the juice samples were mixed with a sucrose solution [35]. The samples of juice were then kept at 4°C for further evaluation. Juice samples were processed on the same day of the preparation.

2.2 Processing methods of fig juice

After the preparation of fig juice, different samples of juice were treated in three different ways to compare with untreated juice thermostatic water bath at 90°C was used to pasteurize 100mL of fresh juice for 10 minutes before being immediately switched to cold water to reach a temperature of 20°C. Microwave treatment was performed for 1.5 minutes at 900W:50Hz with power and frequency (SAMSUNG: MC28H5025VK/TL, Malaysia). The sonication was conducted by (150 vT Ultrasonic Homogenizer, Biologics, Inc. USA) with a frequency of 20kHz for 90 minutes at a regulated temperature of 30 ±5°C, the fruit juice was continuously sonicated with an ultrasonic probe held 25mm in the juice [35]. The same samples of juice were then refrigerated at 4 °Celsius for further analysis.

2.3 Storage study

The samples of processed juice were all placed in falcon tubes and stored in a refrigerator at a temperature of 4 degrees Celsius for 10, 20, and 30 days to test the persistence and sustainability of bioactive components in produced fig juice post-treatments.

2.4 Determination of Physicochemical attributes

The digital pH meter was used to determine the pH of the treated juice (Systronics digital pH meter MK-VI). The total soluble solids (TSS) of all juice samples were estimated using a Hand refractometer (ERMA-Hand refractometer, Tokyo). The method described by Tiwari et al., [37] was adopted to investigate the value of the cloud of processed juice samples. An aliquot of 1ml of each of the treated juice samples was centrifuged for 10 minutes at 3000rpm at 20°C. The absorbance of the cloud value was measured using a Spectrophotometer (Thermo Scientific™ GENESYS™ 180 UV-Visible Spectrophotometer) at 660nm with distilled water used as a blank.

2.5 Functional analysis

The extraction of phenolic content followed the steps laid out by Nadeem et al., [25]. In a falcon tube, 1000 µl of the sample of juice was dissolved in 80 percent methanol to generate a final amount of 10ml. The formed mixture was centrifuged after being vortexed for 20 seconds (4000 rpm for 10min). To get clear juice, the resultant mixture was passed through the Whatman filter paper. As a result, the extracted juice was separated and kept at 4°C until further use. The total phenols were estimated spectrophotometrically adopting the method by Canan et al.,[8]. A 0.5ml of the sample was obtained after dilution for testing. Gallic acid was used to provide a reference standard for the calibration curve. The total phenolic content of the beverage was determined in mg of gallic acid equivalent (GAE/100ml). The content of the total flavonoid of fig juice was determined using the methodology of Liu et al., [20]. The sample extract (25µl), and distilled water was used to prepare the mixture in a falcon tube with $AlCl_3$ and sodium acetate. The results were represented as mg per 100ml of the sample using quercetin as a standard.

2.6 Antioxidant activity

The method of Yi et al., [40] was utilized to determine the DPPH radical-scavenging activity of fig juice. 25 µL of juice sample was mixed in 1000 µL of 0.1 mM DPPH solution in methanol, and the mixture was vortexed for 20 seconds., and left in the dark for 30 minutes before being measured using a spectrophotometer at 517 nm. The preparation of the control (ethanol) sample followed a similar pattern. Absorbance was calculated in the prepared samples. The percentage DPPH was calculated as follows

$$\%\mathrm{DPPH} = \left(\mathrm{A_c} - \frac{\mathrm{A_s}}{\mathrm{A_c}}\right) \mathrm{x}100\%$$

Where '$A_{c'}$ is absorbance of the control and 'A_S' is absorbance of sample.

In the (FRAP) assay, a 6 µL sample of juice was mixed with 187 µL of FRAP reagent in falcon tubes. After giving it a quick 10-second spin in a vortex, the combination was let to rest at room temperature for the next 6 minutes. The absorbance of the supernatant juice sample was measured at 593 nm using a spectrophotometer (Thermo ScientificTM GENESYSTM 180 UV-Visible Spectrophotometer) and compared to that of the control (80 percent (v/v) methanol).

In the ABTS radical activity, mix thoroughly 10 µL of fig juice with 300 µL with an aqueous solution of ABTS. After that, deionized water was added to dilute the solution. Juice samples were left in an incubator for 6 minutes at room temperature. Using a spectrophotometer (Thermo Scientific™ GENESYS™ 180 UV-Visible Spectrophotometer), the transmittance of juice samples was measured at 734nm and compared to that of a control (80 percent (v/v) methanol). The measurements are in µmol Trolox/L of juice [35].

2.7 Statistical analysis

The findings have been presented as the average of nearly three independent sample standard deviation determinations (SD). Using IBMSPSS statistical software, ANOVA with the least significant difference ($p \leq 0.05$) was used to evaluate the magnitude of the difference among both treatment methods and storage time.

3. RESULTS AND DISCUSSION

Processing of food and food products and storage environment have affected the nutritional value and chemical components of plant foods. Untreated and processed fig juice maintained in the refrigerator for up to 30 days has been presented and discussed. The nutritional value and chemical composition of food products are affected by processing and storage conditions. Comparative analysis of various novel processing methods like pasteurization, ultrasound, and microwave was presented and discussed in terms of the retention of Physico-chemical characteristics and functional components during the storage of 30 days of fig juice.

3.1 Effect of storage on Physico-chemical parameters

Physicochemical parameters are crucial in preserving beverage quality. It is vital to investigate the Physico-chemical conditions under which these characteristics can be kept at their best for improving the sensory attributes of developed products. The stability of bioactive metabolites in fruit juice is directly related to pH stability. The pH of fig juice reported a significant increase ($p \leq 0.05$) as the storage time increased Table 1. The increase in pH might be due to the acid hydrolysis of polysaccharides into disaccharides, such as starch into glucose, sucrose, fructose, etc. The rise in pH caused by these reactions makes things sweeter while making them less sour [33]. This data is consistent with that of Rabie et al.,[30], found that the pH of freshly prepared, conventional pasteurized beverage of Physalis decreased considerably after storage for the first three weeks, then rose in the fourth week. During a 30-day storage period, microwave processing showed an increase in pH value. This finding is comparable to that of Igual et al.,[15], discovered an increase in grapefruit juice pH after 60 days of storage. Similarly, it has been reported that a high-powered ultrasonic treatment has been shown to raise the pH range of strawberry juice over time [4]. The pH range of the prepared fig juice did not change noticeably following any of the processing treatments after being kept for a period of thirty days. As a result, it's been determined that thermal pasteurization, ultrasound, and microwave treatments all exhibit a similar pattern of pH stability throughout storage.

The percentage of total soluble solids (TSS) for both freshly prepared and pasteurized juice decreases ($p>0.05$) as storage duration increases Table 1. The findings are consistent with those of Khandpur & Gogate, [19], who discovered that the level of TSS in fruit juices decreased after thermal pasteurization. In contrast, Igual et al., [15] coined that the amount of total soluble solids in microwave-treated samples remained constant over a 30-days storage period. Math & Nayani, [23] found that heating in a microwave had a similar impact on the dependability of TSS in various juice combinations that had been stored for six months. The content of total soluble solids is also retained during storage due to ultrasound processing. The sustainability of TSS in ultrasonic lemon juice has also been observed by Berichter & Meuser, [17]. According to Yurdugül & Kırmusaoğlu, [42], TSS levels in ultrasound-treated peach juice do not vary considerably after storage. The effects of preservation on total soluble solids of ultrasonicated, microwave-processed, and pasteurized samples of juice reveal that innovative processing technologies (microwave and ultrasound) are highly effective in sustaining TSS levels over some amount of time. After ultrasonic treatments, there were no significant variations in acidity, pH, and total soluble solids.

The cloud value decreased significantly ($p>0.05$) in thermal pasteurization processing as storage time increased from 0 to 30 days as shown in Table 1. In the pasteurization of watermelon juice, the reduction in cloud stability during storage was also investigated by Liu et al., [20]. In contrast, the cloud value in samples that were processed using a microwave has decreased substantially from 0.091 to 0.067 over time. In Kava juice, a similar effect of decreasing cloud value was observed during microwave processing [2].

Samples that had been ultrasonically processed showed a declining trend of cloud value with increasing storage days. Tiwari et al., [37] also observed that the cloud value of ultrasonically treated beverages from orange reduces during the storage period. Similar outcomes were observed when apple juice was ultrasonically treated for four months of storage [13]. The inactivation of undesired enzymes in juices could be the reason for cloud value loss in processed samples of juice during storage days [9]. As the storage time increases, the amount of cloud value in all three processing procedures was significantly reduced. As a result, storage days make fruit juices cloudier by reducing their clarity.

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Table 1- Physicochemical parameters in untreated and treated fig juice at different storage days.

Parameters	Storage(days)	Processing methods			
		C	CP	MW	US
pH	0	4.76 ± 0.284^{a}	4.71 ± 0.252^{ab}	4.75 ± 0.015^{a}	4.74 ± 0.020^{a}
	10	4.78 ± 0.066^{abcd}	4.73 ± 0.043^{abc}	4.76 ± 0.105^{ab}	4.74 ± 0.010^{ab}
	20	4.82 ± 0.132^{bcd}	4.76 ± 0.011^{abcd}	4.78 ± 0.049^{abc}	4.76 ± 0.020^{abc}
	30	4.83 ± 0.151^{d}	4.79 ± 0.028^{cd}	4.79 ± 0.068^{abc}	4.77 ± 0.030^{abc}
TSS	0	13.63 ± 0.152^{ab}	13.23 ± 0.152^{efgh}	13.73 ± 0.115^{ab}	13.83±0.577a
	10	13.36 ± 0.152^{cdef}	13.10 ± 0.100^{hi}	13.56 ± 0.152^{bc}	13.53 ± 0.057^{bcd}
	20	13 ± 0.200^{i}	12.96 ± 0.15^{i}	13.4 ± 0.200^{cde}	13.33 ± 0.152^{defg}
	30	12.66 ± 0.115^{j}	12.73 ± 0.115^{j}	13.13 ± 0.577^{ghi}	13.16 ± 0.577^{fghi}
C.V	0	0.091 ± 0.002^{ab}	0.091 ± 0.001^{ab}	0.085 ± 0.003^{c}	0.094 ± 0.002^{a}
	10	0.083 ± 0.001^{cde}	0.086 ± 0.002^{cd}	0.084 ± 0.002^{cd}	0.093 ± 0.002^{a}
	20	0.072 ± 0.002^{h}	0.079 ± 0.003^{efg}	0.080 ± 0.001^{defa}	0.092 ± 0.001^{a}
	30	0.067 ± 0.003^{i}	0.076 ± 0.001^{gh}	0.077 ± 0.002^{fg}	0.087 ± 0.003^{bc}

C control, P pasteurized samples microwave processed samples, US ultrasound processed samples. TSS total soluble solids, C.V cloud value.

*Means that do not share a letter are significantly different

3.2 Effect of storage on functional characteristics

3.2.1 Total Phenolic content

The effects of treatments of fig juice on total phenolics and flavonoid content are shown in Table 2. The total phenolics of fig juice varied significantly ($p>0.05$) according to the processing method and the storage time interval. During the 30-day duration, there was a considerable loss of TPC. Mgaya-Kilima et al., [24] studied the loss of total phenolic content after storage in pasteurized guava, papaya blend, and mango juice. According to the investigation of microwave-processed samples, TPC decreases significantly after storage. After two months of storage, microwave-processed grapefruit juice samples showed a similar decrease in TPC [15]. TPC retention was found to be higher in ultrasound-sterilized black mulberry juice than in microwave or thermally processed juice after the storage of 8 days [18]. Similarly, Martínez-Flores et al.,[22] discovered the total phenolic content, the ultrasound-treated carrot juice had considerably greater total phenolics than pasteurized juice at the same extract concentration. The increment in the total phenolics might be the result of cavitation, which causes cell wall rupture in the added juice due to abrupt pressure fluctuations generated by implosions of bubbles, which may liberate the bound form of these phenols and make them more accessible in the liquid [5]. The effects of ultrasonication and pasteurization on the total phenol content of fig beverage held for four weeks were explored by Yildiz,[41], and the results showed that ultrasound-treated samples had the highest TPC. Therefore, TPC levels are affected by fruit species, processing conditions, analytical methods, and preservation. In our study, TPC levels gradually decreased in all treated samples. However, during storage, ultrasonic processing produced a higher TPC value than other approaches.

3.2.2 Total Flavonoid content

The total flavonoid concentration of fig juice (TFC) showed highly significant changes ($p>0.05$) throughout production and duration of storage (Table 2). With time, the total flavonoid content of a thermally pasteurized prepared fig juice decreased. Petruzzi et al., [27] discovered that after 4 days in the refrigerator, a thermally pasteurized blend of juices (grapefruit. pumpkin, carrot, celery orange) had a reduction in total flavonoid content. However, microwave-treated juice samples did not exhibit a significant decline in TFC over the storage period. Sonication improved the overall flavonoid concentration of all juice samples, which was followed by microwave treatment [34]. Ordóñez-Santos et al., [26] observed that in the juice of Cape gooseberry, ultrasonic treatments resulted in considerable increases in total flavonoids. Igual et al., [16], discovered that flavonoids were retained in microwave-processed samples of orange juice after two months of refrigerated storage. TFC in formulated fig juice is likewise reduced by ultrasound processing over a 30-day storage period. Nadeem et al., [25] investigated the influence of ultrasound on grape carrot juice blend on storage. TFC present in the ultrasonication processed juice blend decreases after 90 days in the refrigerator, according to the authors. During the storage duration, there was a decrease in TFC in all processed samples. In comparison with control and traditional pasteurization processing, overall flavonoid content loss is less evident in juices that have been treated with microwave and ultrasonication. Cheng et al., [10] stated that the novel processing technologies like microwave and ultrasound restricted the degradation of phenolic and flavonoid compounds. Juice processed with novel processing technologies has a stronger potential to maintain its quality than traditional pasteurization.

Table 2- Bioactive compounds in untreated and treated fig juice at different storage days

Parameters	Storage(days)	Processing method			
		C	CP	MW	US
TPC	0	314.82 ± 1.333^{e}	312.17 ± 0.085^{ef}	326.62 ± 5.16^{d}	384.42 ± 0.122^{a}
	10	312.09 ± 1.98^{ef}	305.17 ± 4.30^{gh}	325.64 ± 0.09^{d}	381.23 ± 0.985^{ab}
	20	307.41 ± 0.92^{fg}	301.65 ± 3.84^{hi}	323.56 ± 3.75^{d}	376.41 ± 2.22^{bc}
	30	301.77 ± 1.54^{hi}	297.98 ± 2.74^{i}	323.75 ± 7.52^{d}	374.71 ± 1.270^{c}
TFC	0	20.85 ± 0.542^{ef}	20.52 ± 0.376^{fg}	21.36 ± 0.229^{de}	23.83 ± 0.187^{a}
	10	19.15 ± 0.655^{h}	$19.340 \pm .250^{h}$	20.88 ± 0.036^{def}	23.08 ± 0.660^{b}
	20	17.73 ± 0.768^{i}	18.11 ± 0.475^{i}	20.1 ± 0.058^{g}	22.32 ± 0.124^{c}
	30	16.67 ± 0.628^{j}	15.98 ± 0.148^{k}	19.22 ± 0.151^{h}	21.48 ± 0.063^{d}

C control, P pasteurized samples, MW microwave processed samples, US ultrasound processed samples, TPC total phenolic content, and TFC total flavonoid content.

*Means that do not share a letter are significantly different

3.2.3 Antioxidant activity

Three distinct antioxidant studies, including ABTS, DPPH, and FRAP were used to examine the antioxidant potential of prepared fig juices at varied storage time intervals. The DPPH, FRAP, and ABTS values of prepared juice indicated significant differences between storage time intervals specified in the study (Table 3). The antioxidant activity of pasteurized fig-juice declines substantially after 30 days of storage, according to DPPH, FRAP, and ABTS evaluation. Pasteurized baobab juice's antioxidant value decreased similarly with storage [36]. In comparison with untreated kiwi juice and ultrasound-treated juice possess more antioxidant activity [39]. The implications of both traditional and microwave pasteurization on the major biologically active compounds in fruit juice as well as their retention for over two months in refrigerated and frozen storage were investigated. When compared to fresh or conventional pasteurized juices, microwave-processed juices better retained total phenols and maintained the amount of antioxidants and vitamin C [15]. Pasteurization lowers the antioxidant activity of papaya, roselle, guava, and mango (juice blend) during storage, according to Mgaya-Kilima et al., [24]. When compared to the first day of assessment, the antioxidant content of sonicated apple juice samples decreased significantly after 7 days of refrigerated storage [7]. Similarly, as storage time increased, microwave processing resulted in decreased antioxidant activity in the formulated beverage. In contrast to conventional treatment, which significantly reduces the antioxidant activity of grapefruit juice, microwave treatment preserved these compounds [15]. The antioxidant potential of blackberry juice was examined using the FRAP assay; the results show that the FRAP value increased with longer microwave and ultrasound time [15]. In the ABTS, FRAP, and DPPH assays, the quantity of antioxidant activity in ultrasonically treated beverage decreased over storage time. However, according to del Socorro Cruz-Cansino et al., [11], a comparable effect of ultrasound led to a slight decrease in antioxidant activity in the ABTS and DPPH assays and FRAP assay on purple cactus pear juice throughout a 28-day storage period.

Table 3- Antioxidant activity in untreated and treated fig beverages at different storage days

Parameters	Storage(days)	Processing method			
		C	CP	MW	US
%DPPH	0	45.41 ± 0.113^{fgh}	46.25 ± 0.162^{bcdef}	47.4 ± 0.327^{bc}	50.03 ± 1.162^{a}
	10	44.83 ± 0.630^{fgh}	45.85 ± 0.312^{cdef}	47.15 ± 0.145^{bcd}	47.57 ± 0.746^{b}
	20	43.11 ± 1.257^{ij}	43.29 ± 1.463^{hi}	45.73 ± 0.916^{cdef}	46.82 ± 1.90^{bcde}
	30	41.44 ± 0.787^{j}	42.85 ± 0.875^{ij}	43.84 ± 1.680^{ghi}	45.63 ± 1.110^{def}
FRAP	0	235.43 ± 0.780^{e}	225.37 ± 2.06^{f}	254.23 ± 3.47^{b}	273.21 ± 1.10^{a}
	10	228 ± 2.20^{f}	215.35 ± 1.269^{g}	244.64 ± 1.531^{c}	266.00 ± 2.03^{bc}
	20	219.19 ± 2.92^{h}	203.38 ± 1.83^{h}	238.91 ± 2.00^{e}	257.82 ± 4.68^{d}
	30	196.97 ± 3.55^{i}	193.64 ± 5.47^{i}	236.99 ± 1.39^{f}	252.53 ± 3.12^{e}
ABTS	0	412.50 ± 3.97^{g}	401.57 ± 5.01^{h}	435.40 ± 1.059^{de}	442.69 ± 2.35^{b}
	10	400.66 ± 5.92^{h}	392.91 ± 3.15^{ij}	427.21 ± 2.49^{f}	432.07 ± 4.59^{c}
	20	385.51 ± 2.92^{i}	384.18 ± 2.38^{k}	413.89 ± 1.97^{g}	421.28 ± 1.014^{d}
	30	354.19 ± 2.07^{j}	370.25 ± 1.86^{a}	402.68 ± 1.344^{g}	415.28 ± 1.014^{e}

C control, P pasteurized samples, MW microwave processed samples, US ultrasound treated samples, DPPH; FRAP; ABTS antioxidant assays.

*Means that do not share a letter are significantly different

4. CONCLUSION

The goal of the study was to find out how sonication and microwave treatment affect the physical, chemical, and functional properties of fig fruit juice after it has been stored for one month. According to the current study, ultrasound and microwave treatment resulted in significant juice with beneficial functional and nutritional parameter stability during storage. Both microwave and ultrasound are found to have a significant impact on the quality of functional fig juice. When compared to pasteurization, both microwave and ultrasound treatment preserved the quality of juice, but ultrasonically processed samples were far better compared in retaining the quality and consistency, as they exhibit higher biologically active compounds, primarily antioxidant activity, and total phenolic content during the storage period. As a result, ultrasound, a non-thermal technique, has shown to be a potential replacement for conventional thermal processing. The utilization of microwave processing and ultrasonication of fig fruit juice without artificial additives could be applied on a commercial level with enhanced quality attributes and storage stability throughout storage, according to the findings of this study. The present study implied that ultrasound as a simple and economical technique could be used to enhance the retention and stability of the nutritional quality of fig juice.

Conflict of interest: No conflict of interest reported.

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