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Original article

Effect of osmotic pretreatment and drying temperature on drying kinetics, antioxidant activity, and overall quality of taikor (*Garcinia pedunculata* Roxb.) slices

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ABSTRACT

Taikor (*Garcinia pedunculata* Roxb.) is an underutilized, however nutritious fruit, typically found in Bangladesh and northeast parts of India. Taikor slices (1 ± 0.25 cm thickness) were pretreated for 10 min in 10% sucrose, 10% fructose, and 2% brine solution. Three different temperatures, such as 45, 50, and 55 °C were used to perform the drying operation at 30% constant relative humidity (RH). The thin-layer dehydration characteristics of taikor slices were analyzed using the Newtonian, Page, and Henderson and Pabi's model. The changes in pH, total acidity, color, β-carotene, vitamin C, B vitamins, antioxidant activity, and microbial load calculation were done to compare the comprehensive quality of untreated and pre-treated dried taikor. After assessing the coefficient of determination (R^2) and root mean square error (RMSE) values, the Page model was obtained as the best-suited model. For this model, the R^2 and RMSE values were found to be approximately 1 and below 0.1094, respectively. Among the pretreatments, sucrose helped retain quality characteristics like ascorbic acid (115.25 ± 0.19 mg/100 g), antioxidant activity (33.25 ± 0.07%) more in the dried samples. The brine pretreated sample had minimum microbial growth. Fructose pretreated taikor samples dried at 45 °C exhibited maximum value of B vitamins (B_1 0.025 ± 0.002 mg/100 g, B_2 0.016 ± 0.002 mg/100 g, B_3 0.011 ± 0.001 mg/100 g), total phenolic content (15.78 ± 0.15 mg GAE/100 g), total flavonoid content (11.11 ± 0.08 mg QE/100 g). Overall, fructose pretreated sample dried at 55 °C was found to be the best method for preserving the maximum physical and chemical quality of dried *Garcinia pedunculata*.

1. Introduction

Garcinia pedunculata Roxb. is an underrated tropical fruit. It is typically grown in Bangladesh and the northern areas of India. In Bangladesh, this fruit is generally recognized as "taikor" in local areas and has several medicinal benefits. It is a large evergreen tree, whose trunk is fluted with small spreading branches, leaves are lanceolate, and the midrib is stout. The fruit is globose, with fleshy aril, 8–12 cm in diameter. The fruits (both ripe and green) are usually sliced first, then sun-dried and preserved (Deore et al., 2011).

Garcinia pedunculata is mainly used to prepare fish or meat curry. It is also used to treat many illnesses such as cough, asthma, catarrh, fever, bronchitis and, digestion. It is rich in protein, antioxidants, vitamins A, B, and C (Kagyung et al., 2010). *Garcinia pedunculata* is extremely perishable due to its high level of moisture. So, it needs to be preserved in order to use it after a certain period. Drying is a traditional and effective way to preserve foodstuffs, which is believed to be the standard and most economical way to maintain fruits. It does so by reducing the moisture level to a deficient level, which prevents microorganisms' productivity and suppresses a large portion of the degradation-mediated reactions (Sarkar et al., 2021; Yilbas et al., 2003). Sun drying is commonly used to dry taikor. However, sun drying takes plenty of space and time to minimize water movement. Sundried materials are at risk of fungi infestation and getting into physical contact with foreign materials (Fudholi et al., 2011). An alternative to sun drying is oven drying and hot air drying. The hot air-drying process offers

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many positive aspects like low equipment and operational costs, high material efficiency, etc. (Mariani et al., 2008). However, factors such as temperature, relative humidity, air velocity, water diffusivity, load density, product shape, and thickness can affect the drying of food by hot air (Hossain et al., 2021a; Zzaman et al., 2021; Marchi et al., 2015). Therefore, the concept experimental drying technique using mathematical modeling is essential to decide the correct drying state to preserve taikor without degrading its consistency.

Osmotic pretreatment aimed to enhance the drying kinetics, retain the nutritional and physical quality of products, and preserve volatile compounds (Sharma and Varma, 2014). Sugar and brine pretreatments reduce drying time and increase finished products' storage capability (Zzaman et al., 2021; Roy et al., 2021). They inactivate enzymatic and non-enzymatic browning reactions, lower energy consumption, and preserve both color and fragrance. They also eliminate surface and intercellular gases to avoid the production of oxidation, discoloration, softening, and off-flavor. As *Garcinia pedunculata* is one of the underutilized fruits, exploring its nutritional value and an appropriate preserving technique could be an area of research. However, very few research works were conducted to dry taikor using immersion pretreatments.

This research therefore designed to evaluate the drying characteristics of dried *Garcinia pedunculata* using various pretreatments and temperatures. Initially, three different immersion pretreatments viz. 10% sucrose, 10% fructose, and 2% sodium chloride (NaCl) were used. Based on prior studies, untreated and pretreated samples were then dried at three separate temperatures, for example, 45, 50, and 55 °C (Önal et al., 2019; Zzaman et al., 2021). It was expected that low temperature drying would help better retention of physicochemical and nutritional quality of Garcinia pedunculata. The alterations in physicochemical properties such as pH, total acidity, color, B vitamins, vitamin C, antioxidant activity, total phenolic content, and microbial load calculation were conducted in the dried samples, and the model that best suits the drying characteristics of taikor were also determined.

2. Materials and methods

2.1. Collection of raw materials

Fresh *Garcinia pedunculata* fruits were gathered from the Citrus Research Institute, Jaintiapur, Sylhet, Bangladesh. Visually blemished, diseased, damaged samples were removed to minimize biological variability. All of the samples were uniform in shape, diameter, and weight.

2.2. Pretreatments

The fresh fruits were washed with distilled water, and unnecessary parts, e.g. leaves, stalks, sepals, cores, etc., were removed. *Garcinia pedunculata* fruits were cut into 1 ± 0.25 cm thin slices using a sharp knife. Three types of pretreatments were applied at 27 ± 2 °C temperature before drying (Table 1). The cumulative samples were split into four fractions, the first of which was untreated. The solutions concentrations were chosen based on previous literature and trial experiments (Adiletta et al., 2018; Önal et al., 2019; Zzaman et al., 2021). The entire research design has been presented in Fig. 1.

Table 1
Different Pretreatment Methods.

No.	Methods	Pretreatment Process	Symbolization
1	Untreated	No treatment	UT
2	Sucrose Solution	Dipped into 10% Sucrose solution	ST
3	Fructose Solution	Dipped into 10% fructose solution	FT
4	Brine Solution	Dipped into 2% NaCl solution	BT

2.3. Drying method

Drying was conducted following the process described by Zzaman et al. (2021). The air temperature was the variable of the drying experiment. Three drying temperatures, such as 45, 50, and 55 °C, were applied. The constant air velocity (3 m/s) and relative humidity (30%) were maintained. Humidity Chamber (VS-811H-150, Korea) was used for all experiments. The drying data were recorded at the various interval. As moisture was removed very quickly in the initial hours, data were taken at 0.25 hr interval in the first hour of drying followed by 0.5 hr interval in the second hour. From the third to the twelfth hour, data were taken at 1 hr intervals. Then data were recorded every two hr until the equilibrium moisture content for each drying condition was achieved, measured by the constant mass of the product (Argyropoulos et al., 2012; Argyropoulos, and Müller, 2014).

2.4. Determination of moisture content

The method of AOAC, (2000) was used to evaluate the samples' moisture content. Sample (1.0 g) was carefully weighed and put into a washed and dried crucible of known weight. The dried sample was weighed by analytical balance (Shimadzu AY 220, Japan) in triplicate and positioned in a lab-scale oven dryer (Model-OF-21E, Korea) and dried for 24 h at 105 °C. After cooling down, the sample was reweighed. To calculate the percentage of moisture content, Eq. (1) was used.

$$MC\% = \frac{W_0}{W_i} \times 100 \quad (1)$$

where

W_0 = loss in weight (g) on drying
W_i = initial weight of the sample (g)

2.5. Drying kinetics

A single layer of *Garcinia pedunculata* slice was used to fill the perforated trays and put into the oven drier at 45, 50, and 55 °C with 30% relative humidity (RH). Weight loss of the dried *Garcinia pedunculata* slices was measured at different periods until drying was stopped when constant weight was reached and losing weight became negligible. For drawing the drying curve, the tests were mirrored thrice, and the mean moisture ratio on every measure for each pre-treatment was used.

The moisture ratio (MR) was calculated using the following formula (Eq. (2)) to test the samples, drying behavior:

$$\text{The moisture ratio, } MR = \frac{w_t - w_e}{w_0 - w_e} \quad (2)$$

where

w_t = moisture content at any moment
w_e = equilibrium moisture content
w_0 = initial moisture content, all expressed on a dry basis

The data were fitted with three semi theoretical thin layer models, i.e., Newtonian model, Page model, Henderson, and Pabis model (Table 2). SPSS 20 (Statistical Package for Social Science) software was used to estimate the models' parameters. The statistical features utilized to evaluate the model that better represent

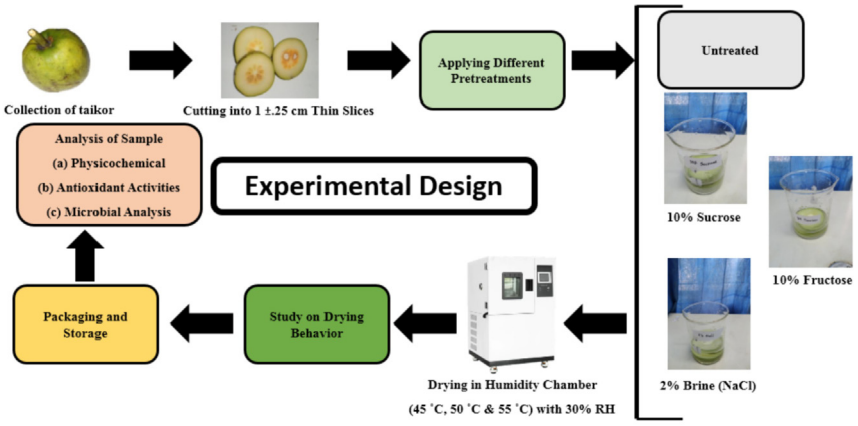

Fig. 1. Experimental design of the research work.

Table 2
Mathematical models applied to the drying curves.

Serial No.	Model name	Model equation
1	Henderson and Pabis	MR = aexp(−kt)
2	Page	MR = exp(ktn)
3	Newton	MR = exp(−kt)

Where, MR is the moisture ratio, k is the rate constant (min^{-1}), n and a are the model's constant.

the research data fitted with the lower root mean square error (RMSE) values and higher coefficient of variance R^2 value.

2.6. Fitting of mathematical model

The correlation coefficient (R^2) (Eq. (3)) and root mean square error (RMSE) (Eq. (4)) was the statistical parameters considered for the model assessment that best represented the difference in the moisture ratio values of *Garcinia pedunculata* during the drying process. The best-fit model considered as the model with the maximum R^2 value and the lowest RMSE value (Toğrul and Pehlivan, 2004).

$$R^2 = 1 - \frac{\sum_{i-1}^{n}\left(MR_{(exp,i)} - MR_{(pred,i)}\right)^2}{\sum_{i-1}^{n}\left(MR_{(exp,i)} - \overline{MR}\right)^2} \quad (3)$$

$$RMSE = \sqrt{\frac{\sum_{i-1}^{n}\left(MR_{(exp,i)} - MR_{(pred,i)}\right)^2}{N}} \quad (4)$$

where $MR_{(exp,i)}$ = experimental dimensionless moisture ratios, $MR_{(pred,i)}$ = predicted dimensionless moisture ratios, $\overline{MR}$ = average of all experimental moisture ratios, N = number of observations.

2.7. Determination of physicochemical properties

2.7.1. p^H and total acidity

The samples' pH was determined with a digital pH meter (MN 2211, USA). Total acidity was determined by the method of Patil et al., (2013). Sample (1.0 g) was poured in 20 mL distilled water and filtered. Two drops of Phenolphthalein were mixed with the filtered solution. 0.1 M NaOH (Sigma-Aldrich, USA) was used to titrate the mixture. For the estimation, the following Eq. (5) was used:

$$\text{Total acidity } (\%) = \frac{0.1\ M\ NaOH \times volume\ of\ NaOH\ (in\ litre) \times 0.064}{wt\ of\ the\ sample} \times 100 \quad (5)$$

2.7.2. Measurement of color

The surface color of fresh and dry *Garcinia pedunculata* were determined by a colorimeter (PCE-CSM4, UK). The values were presented by the Commission Internationale de l'éclairage (CIE) color, L* signifies lightness (black, L*=0; white, L*=100), a* (greenness, a*<0; redness, a*>0), and b* (yellowness, b*>0; blueness, b*<0). The changes in L*, a*, and b* factors of each treatment and drying circumstances concerning the color of the fresh Taikor slices were assessed by using the given formula (Eq. (6)):

$$\Delta E = \sqrt{(L_0^* - L^*)^2 + (a_0^* - a^*)^2 + (b_0^* - b^*)^2} \quad (6)$$

where L_0^*, a_0^* and b_0^* represents the fresh *Garcinia pedunculata* slices' reading and L*, a*, and b* represents the readings after the drying of samples.

The intensity of color was represented as the value of chroma factor, and the equation determined as Eq. (7)

$$\text{Chroma} = \sqrt{(a*^2 + b*^2)} \quad (7)$$

The hue angle, which is changed with the fruits maturity, were determined by using Eqs. (8a) and (8b) (Ramallo and Mascheroni, 2012):

$$Hue\ Angle = tan^{-1}\frac{b}{a},\ (when\ a > 0) \quad (8a)$$

$$Hue\ Angle = 180 + tan^{-1}\frac{b}{a},\ (when\ a < 0) \quad (8b)$$

2.8. Determination of bioactive compounds

2.8.1. Vitamin B

The spectrophotometric method described by (Fernandes et al., 2015), was used to determine the amount of B vitamins in fresh and dried taikor samples. About 0.5 g *Garcinia pedunculata* sample was homogenized with distilled water (10 mL) for 2 min. Sulfuric acid (H_2SO_4) 0.25 M (1 mL) was mixed, and the mixture (extract + Sulfuric acid 0.25 M) was moved to a water bath for 30 min at 70 °C. Then, after adding 0.5 M sodium hydroxide solution, the extraction mixture's pH was adjusted to 4.5 after it was cooled down by using an ice bath. After that, the samples were centrifuged (Gyrozen-Benchtop centrifuge, Model-416G, Korea) for 25 min at 4000 rpm and filtered using Whatman filter paper (No. 4). The vitamin B rich supernatant was collected. A UV–Vis spectrophotometer (Model-T60U, PG instruments limited, UK) was used to take the absorbance readings at 254 nm (B_1), 320 nm (B_2), and 265 nm (B_3). Standard thiamine hydrochloride (B_1), riboflavin (B_2), and nicotinamide (B_3) (Merck, Germany) were used to develop calibration curves.

2.8.2. β-Carotene

One g of fresh and dried sample was homogenized for 2 min with distilled water (10 mL) to determine the total carotenoids' value. Approximately 5 mL of hexane (Merck, Germany) was added to the mixture and stirred vigorously for 1 min, placed aside to rest for 5 min, and then stirred vigorously again for 1 min. The supernatant was acquired and assessed spectrophotometrically (Model-T60U, PG instruments limited, UK) at 452 nm for total carotenoids (Rodriguez-amaya, 2001). The outcomes were represented as mg/100 g utilizing calibration curves of β-carotene (Sigma-Aldrich, USA) as standard.

2.8.3. Ascorbic acid (Vitamin C)

A modification of the procedure proposed by Chemica et al., (2015) was implemented to measure the amount of vitamin C. Then 1.0 g sample was homogenized for 2 min with 10 mL 0.056 M sodium oxalate (Merck, India). Then, the mixture of extraction was put aside to rest for 5 min. A 0.5 mL aliquot of the extract was diluted with 0.056 M Sodium Oxalate and the volume was made to 5 mL. A UV–Vis spectrophotometer (Model-T60U, PG instruments limited, UK) was used to take the absorbance readings at 25 °C at 266 nm. Sodium oxalate of 0.056 M was used as blank. Calibration curve (y = 10.257x + 0.2889) was constructed utilizing L-ascorbic acid (Merck, Germany) as standard.

2.9. Determination of antioxidant properties

2.9.1. Determination of total phenolic content

A slight modification of the Folin-Ciocalteau assay stated by Rahman et al., (2016) was adopted to analyze the total phenolic content of the sample extract. One g of *Garcinia pedunculata* sample was mixed with 80% 10 mL acetone and put in the shaking incubator for 90 min. Then, it was centrifuged (416 G, Gyrozen, Korea) for 15 min at 3000 rpm and filtered with Whatman no.1 filter paper. This extract was then used for the determination of the polyphenol. The analysis was done by taking 20 μL of every extract and standard gallic acid (blank) (Merck, Germany) in separate test tubes and adding distilled water (1.58 mL), followed by of Folin-Ciocalteau reagent (100 μL) to each test tubes, mixed well, and sodium carbonate (300 μL) (Merck, India) was added after 8 min. Right after that, the test tubes containing the samples were vortexed and held in the dark at 40 °C for 30 min. A UV–Vis spectrophotometer (Model-T60U, PG instruments limited, UK) assessed the absorbance at 765 nm. Values were presented in mg equivalent gallic acid (GAE)/100 g. The standard equation obtained for total phenolic content was y = 0.0497x + 0.0197.

2.9.2. DPPH radical scavenging activity

Antioxidant potential was estimated by a slightly modified version of Bondet et al., (1997) by 2, 2 Diphenyl-1-picrylhydrazyl (DPPH) assay. One g of ground fruit slice was mixed with 80% methanol (Merck, Germany) and vortexed for 1 min. It was then centrifuged at 3000 rpm (416G, Gyrozen, Korea) for 15 min and filtered. This methanolic extract of taikor (100 μL) was mixed with DPPH (Merck, Germany) radical methanolic solution (1.4 mL, 10^{-4} M). After shaking it vigorously, the mixture was left to rest for 30 min in dark. Using a UV–Vis spectrophotometer (Model-T60U, PG instruments limited, UK), the absorbance was assessed against blank at 517 nm. The findings were presented as percentage of radical scavenging activity utilizing the following equation (Eq. (9)):

$$\text{DPPH radical scavenging activity } (\%) = \frac{Ao - As}{Ao} \times 100 \qquad (9)$$

where

A_0 = Absorbance of the control solution

A_s = Absorbance of the DPPH solution with sample extracts

2.9.3. Determination of total flavonoid content

The aluminum trichloride method was utilized to determine the flavonoid content (del Caro et al., 2004). Exactly 0.5 mL methanolic extract was mixed with 0.1 mL 10% aluminum trichloride (Merck, Germany), 1.5 mL 95% ethanol (Merck, Germany), 0.1 mL 1 M potassium-acetate (Sigma-Aldrich, USA), and 2.8 mL demineralized water. After allowing it to incubate for 40 min at 25 °C temperature, the UV–Vis spectrophotometer (Model-T60U, PG instruments limited, UK) was utilized to take the reading of the mixture at 415 nm against a de-ionized water blank. The results of the sample were presented as equivalent quercetin (mg QE/100 g). Quercetin (Merck, India) equivalent curve was utilized to calculate the total flavonoid content, and the standard equation was y = 0.004x + 0. 0236.

2.10. Microbial load determination

Microbial load analysis was conducted for the determination of fungal and bacterial loads. Mortin Rose Bengal agar (Oxoid, England) was implemented for fungal load calculation. Chloramphenicol was used in agar media to prevent bacterial growth. Standard plate count agar (HiMedia, India) was utilized for bacterial loading. Approximately 18 g agar was dissolved in 1l of saline (0.89% NaCl) water. The sample (1 g) was mixed in a test tube, where 9 mL of autoclaved saline had been placed earlier. The serial dilution process was adopted for the determination of fungal and bacterial loads. 1 mL of diluted solutions, extracted from different samples, were placed into each petri dish, where 20–25 mL of the prepared media had been placed earlier and allowed to cool for hardening. After inoculation, petri dishes were shifted to an incubator (Thermo Fisher Science Inc., Model-IGS60) and kept at 37 and 30 °C for bacteria and fungi, respectively. The incubated plates were examined for bacterial and fungal growth, after 24 and 72hrs, respectively. Finally, a digital colony counter (BEXCO 220 V) was utilized for colony counts (Zzaman et al., 2021).

2.11. Statistical analysis

All the results measured in the study were taken as triplicate and exhibited as mean ± standard deviation (SD). Well known statistical software SPSS (Version 20) was used for analysis. Analysis of Variance (ANOVA) and Duncan Multiple Range Test (DMRT) was performed to compare the means. The least significant differences were measured at $p < 0.05$.

3. Results

3.1. Drying behavior of Garcinia pedunculata

The impacts of drying temperature on the humidity ratio (MR) of the untreated sample (UT) over time has been shown in Fig. 2. It was found that the combination of different pre-treatments and temperatures resulted in different time for drying. It took approximately 720 mins to attain equilibrium moisture content at 55 °C. It also required about 1080, and 1200 mins to dry at 50, and 45 °C, respectively. Usually, fructose pre-treated samples resulted in faster drying than other samples.

The moisture content in untreated and treated dried samples has been presented in Table 3. A minimum of 12 h was required for samples dried at 55 °C to reach equilibrium moisture content. So, this drying time was used to compare the moisture content of other samples dried at 45 and 50 °C. It was found that pretreated fructose samples dried at 55 °C had the minimum moisture

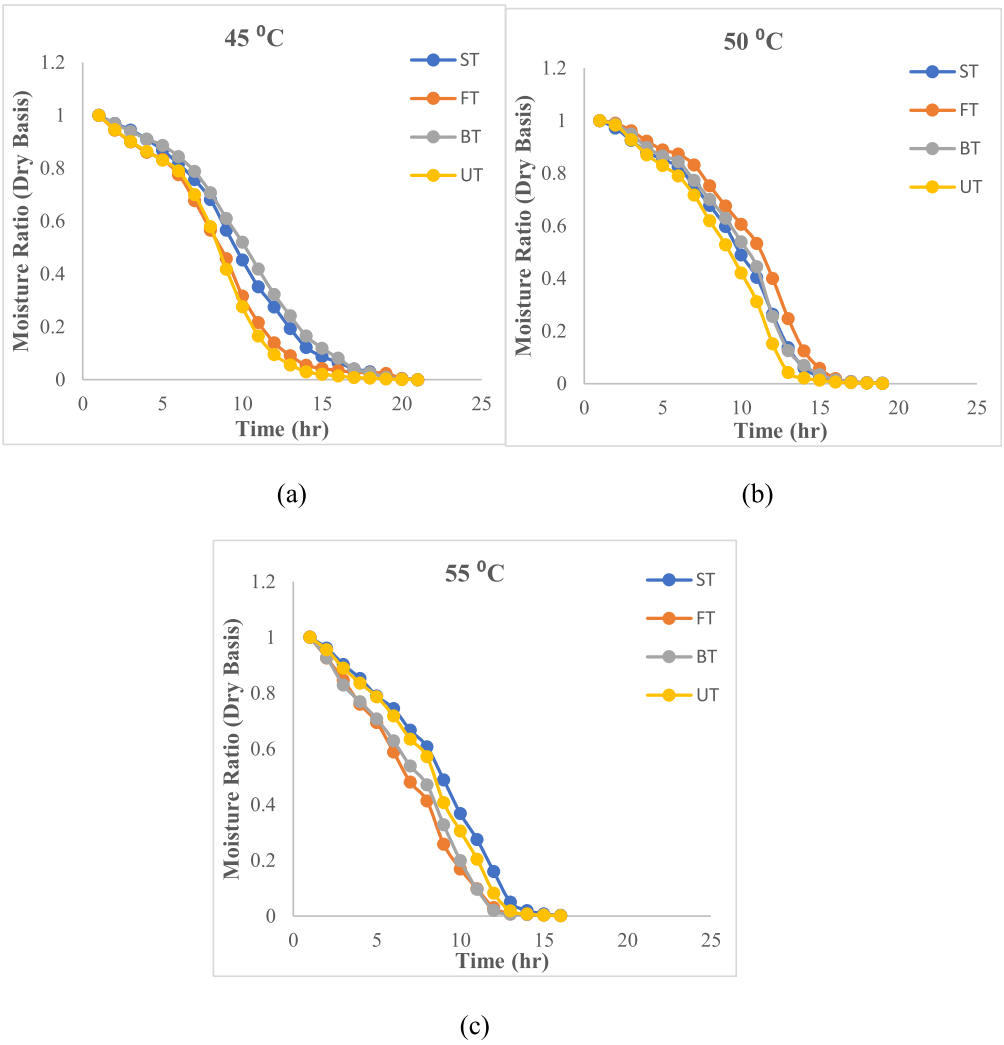

Fig. 2. Drying time-moisture ratio curve of sucrose, fructose, brine pretreated, and untreated *Garcinia pedunculata* slices at (a) 45 °C, (b) 50 °C, and (c) 55 °C temperatures (30% RH).

Table 3
Moisture content in untreated and pre-treated *Garcinia pedunculata* after drying for 12 h.

Drying Condition	45 °C				50 °C				55 °C			
	ST	FT	BT	UT	ST	FT	BT	UT	ST	FT	BT	UT
Moisture Content (%)	8.31 ± 0.22	7.65 ± 0.21	8.12 ± 0.19	7.99 ± 0.17	6.54 ± 0.15	5.79 ± 0.12	6.72 ± 0.15	6.91 ± 0.17	3.41 ± 0.09	3.07 ± 0.11	3.34 ± 0.14	3.46 ± 0.11

content (3.07 ± 0.11%) followed by brine pre-treated samples (3.34 ± 0.14%). As expected, samples dried at 45 °C had the maximum moisture content (8.31 ± 0.22% for ST).

3.2. Fitting of drying Model:

Besides the calculation of R^2 and RMSE summarized in Table 4, the fitting of the drying model is made out of visual comparisons between two factors- the experimental observations and the model predictions (Fig. 3). In different untreated and treated samples, the values of R^2 for the Newtonian, Page, and Henderson and Pabis model ranged from 0.6227 to 0.9738, −0.1582 to 0.9817, and 0.9618 to 0.9928, respectively. However, the RMSE values varied from 0.0866 to 0.3501, 0.0723 to 0.8373, and 0.0452 to 0.1094 for the Newtonian, Page, and Henderson and Pabis model, respectively. According to the specification of the maximum R^2 and the smallest RMSE, the Page model was found to be the best-suited model under all circumstances (temperature and treatment).

3.3. Drying model validation

Validation of the page model on various experimental data sets varying in temperature was done. The validation is a visual comparison between two factors which are the model prediction and the experimental observations (Fig. 3). The model predicts the experimental observation with the use of predicted parameter values very well in every case. In every observation, the R^2 value was close to 1, ensuring the model's validity and applicability by adjusting the temperature and relative humidity.

3.4. Effect of drying temperature on physicochemical properties

3.4.1. pH

The pH of the samples was observed between 1.91 ± 0.02 to 2.80 ± 0.04 (see Figure 4). The fresh *Garcinia pedunculata* sample contained a minimum amount of pH. With the rise of drying temperature, the samples' pH also increased, and the highest pH was

Table 4
Results of statistical analysis of the mathematical model for drying:

Temperature °C	Sample Name	R^2			RMSE		
		Newton	Herderson & Pabis	Page	Newton	Herderson & Pabis	Page
45 °C	ST	0.7856	0.6776	0.9635	0.2576	0.3159	0.1062
	FT	0.6227	−0.1582	0.9618	0.3501	0.8373	0.1050
	BT	0.7396	−0.0336	0.9628	0.2897	0.5770	0.1094
	UT	0.9489	0.4877	0.9715	0.1266	0.4011	0.0944
50 °C	ST	0.9062	0.7401	0.9913	0.1658	0.2759	0.0505
	FT	0.9738	0.9817	0.9928	0.0866	0.0723	0.0452
	BT	0.8768	0.6516	0.9852	0.1893	0.3183	0.0655
	UT	0.9140	0.8626	0.9879	0.1622	0.2049	0.0606
55 °C	ST	0.7943	−0.1433	0.9630	0.2470	0.5824	0.1047
	FT	0.9366	0.7453	0.9884	0.1286	0.2577	0.0549
	BT	0.9119	0.7812	0.9761	0.1533	0.2416	0.0797
	UT	0.8073	−0.1470	0.9693	0.2385	0.5819	0.0951

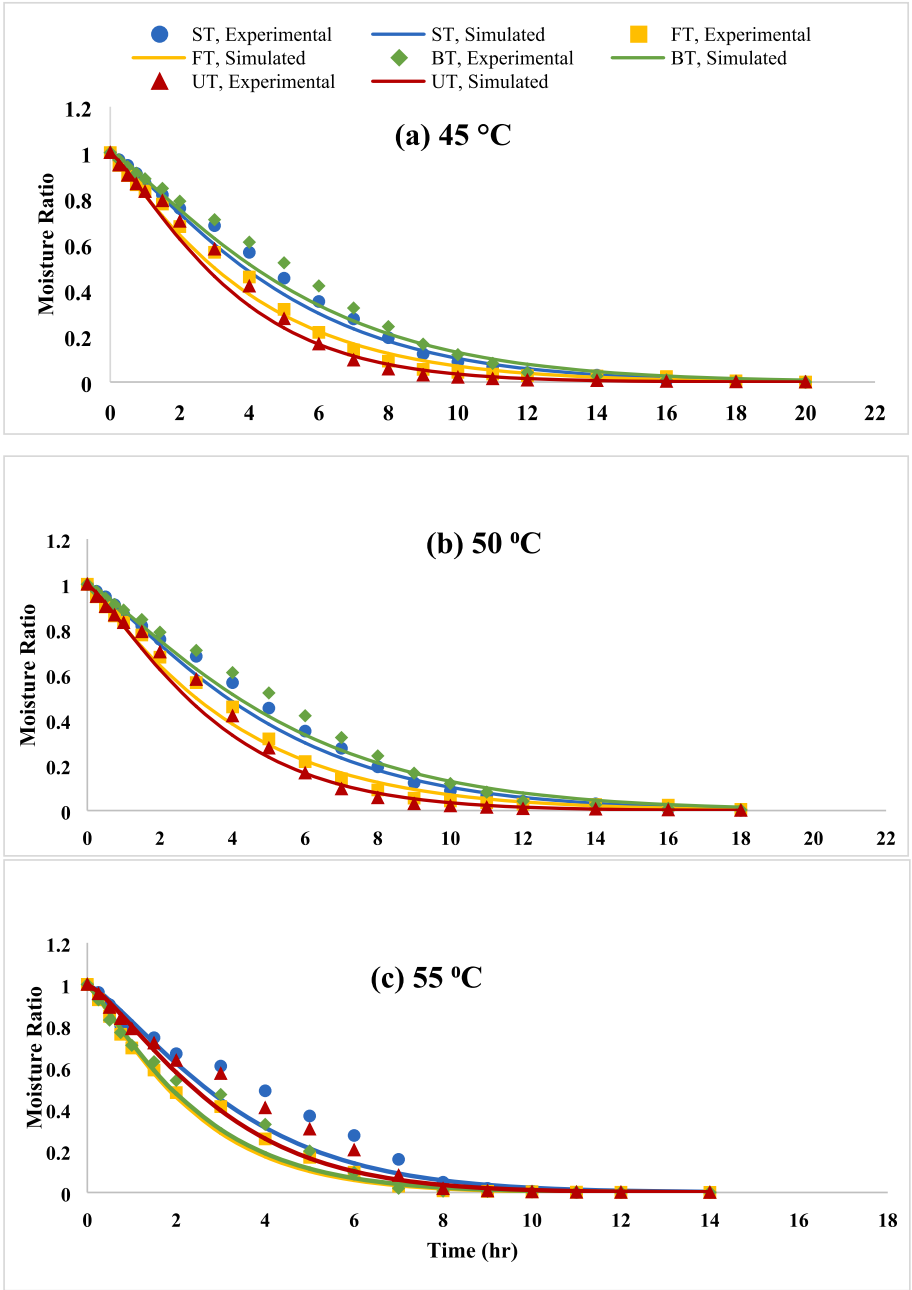

Fig. 3. Model validation results for moisture ratio (Dry Basis) of *Garcinia pedunculata*. Comparison between experimented moisture ratio and simulated moisture ratio at (a) 45, (b) 50, and (c) 55 ℃ drying temperature.

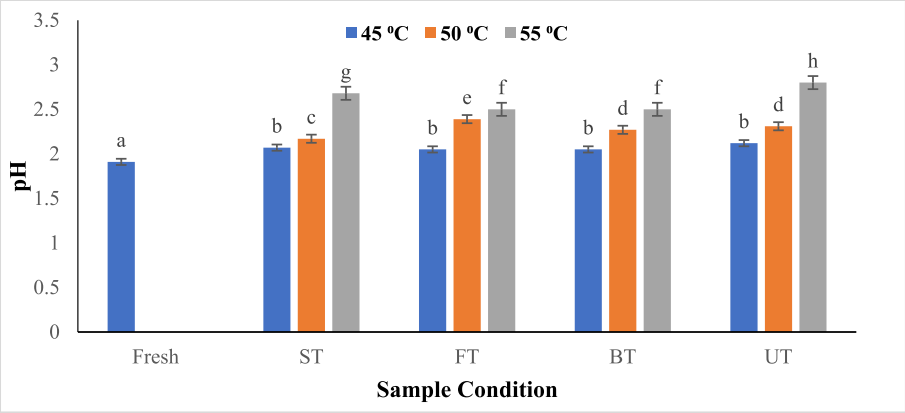

Fig. 4. Effect of drying temperature and pretreatment on the pH of the samples. Samples with different letters at the top differ significantly at $p < 0.05$.

observed in untreated samples dried at 55 °C. It was noticed that at lower temperature drying (45 °C), the pH had no significant difference.

3.4.2. Total acidity

The total acidity of *Garcinia pedunculata* was calculated in the scale of citric acid and it was found between 0.54 ± 0.04 to 1.05 ± 0.03%. The fresh taikor provided the highest amount of acidity as it had a lower pH value. The untreated sample dried at 55 °C contained a lower amount of total acidity. Total acidity was decreased with the rise in the dehydration temperature (see Figure 5).

3.4.3. Changes in color

The color values of all samples have been presented in Table 5. Color has been considered as the significant quality parameters of a dried food product. The lightness/darkness (L*) of the sample ranges from 34.81 ± 0.20 to 20.37 ± 0.15. The surface color of the fresh sample provided the highest value (34.81 ± 0.20) of L. The lower value of L* indicates the darkness and the higher value indicates the lightness. Here, with the increase of drying temperature, dried products become darker and provided lower L* values. Lightness value was also lower in the untreated samples than pretreated by sucrose, fructose and brine solution. Greenness/redness index a* and blueness/yellowness index b* of the samples increases with drying temperature, and the highest value of a* and b* was noted in untreated samples dried at 55 ℃. The chroma value was increased slightly during drying. The hue angle is another important color parameter, which changes with the maturity and ripening of the fruits. In this study, the hue angle was found below 90 and slightly reduced with temperature, which referred that yellow color reduced in the dried products and red color increased. In present study, ΔE increased with the increasing drying temperature. The changes in color (ΔE) were also greater in untreated samples in contrast with pretreated samples.

3.5. Effect of drying temperature on bioactive compounds

3.5.1. Effect on B vitamins

Vitamin B contents in *Garcinia pedunculata* samples such as thiamine hydrochloride (Vitamin B_1), riboflavin (Vitamin B_2), nicotinamide (Vitamin B_3) is shown in Table 6. The fresh sample's value of the vitamin B_1, B_2, and B_3 were 0.031 ± 0.002, 0.021 ± 0.001, and 0.013 ± 0.001 mg/100 g dry matter (DM), respectively. The amount of Vitamin B_1 in the dried taikor samples ranged from 0.012 ± 0.001–0.027 ± 0.001 mg/100 g DM. In this study, vitamin B_2 was found to reduce with higher drying temperatures and immersion pretreatments. The vitamin B_3 was ranged from 0.005 ± 0.001 to 0.012 ± 0.001 mg/100 g DM.

3.5.2. Effect on β-Carotene and ascorbic acid (Vitamin C)

It was found that the fresh sample of *Garcinia pedunculata* had the maximum amount of β-carotene with a value of 45.18 ± 0.16 (mg/100 g DM). The highest value of β-carotene has been found for the samples pretreated with fructose. The drying temperature of 45, 50 and 55 °C had more equivalent value of β-carotene and the lower loss (approximately 30.89%, 39.03%, and 47.97%, respec-

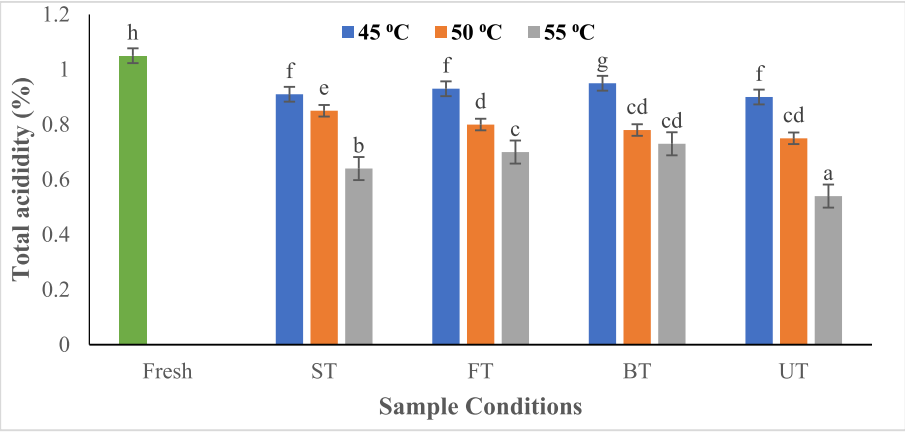

Fig. 5. Effect of drying temperature and pretreatment on the total acidity of the samples. Samples with different letters at the top differ significantly at $p < 0.05$.

Table 5
Color Parameters of fresh, untreated, and pre-treated dried *Garcinia pedunculata* slices.

Sample Condition		L*	a*	b*	Chroma	Hue angle	ΔE
Fresh		34.81 ± 0.20^{j}	2.36 ± 0.11^{b}	14.3 ± 0.19^{a}	17.36 ± 3.6^{b}	88.77 ± 3.40^{k}	–
Drying at 45 °C	ST	28.11 ± 0.13^{h}	4.37 ± 0.07^{e}	19.59 ± 0.10^{d}	20.17 ± 0.15^{f}	71.45 ± 0.10^{d}	8.77 ± 0.01^{c}
	FT	28.36 ± 0.19^{h}	4.43 ± 0.20^{de}	18.44 ± 0.20^{e}	18.98 ± 0.17^{d}	76.6 ± 0.18^{e}	7.93 ± 0.04^{b}
	BT	30.89 ± 0.10^{i}	1.26 ± 0.02^{a}	18.25 ± 0.15^{c}	18.56 ± 0.07^{c}	79.88 ± 0.07^{g}	5.71 ± 0.04^{a}
	UT	23.64 ± 0.04^{d}	3 ± 0.15^{cd}	15.32 ± 0.1^{b}	15.8 ± 0.06^{a}	79.14 ± 0.09^{f}	11.23 ± 0.15^{d}
Drying at 50 °C	ST	26.36 ± 0.05^{g}	4.81 ± 0.05^{e}	22.88 ± 0.07^{g}	23.07 ± 0.05^{i}	83.05 ± 0.09^{i}	12.29 ± 0.01^{e}
	FT	21.07 ± 0.07^{b}	4.66 ± 0.10^{de}	19.48 ± 0.07^{d}	19.66 ± 0.09^{e}	82.33 ± 0.08^{h}	14.86 ± 0.08^{f}
	BT	25.16 ± 0.14^{f}	1.98 ± 0.13^{b}	20.59 ± 0.08^{e}	20.66 ± 0.10^{g}	84.67 ± 0.21^{j}	11.53 ± 0.01^{d}
	UT	21.88 ± 0.09^{c}	3.29 ± 0.04^{d}	24.32 ± 0.02^{h}	24.53 ± 0.20^{k}	82.31 ± 0.28^{h}	16.38 ± 0.03^{g}
Drying at 55 °C	ST	24.65 ± 0.22^{e}	5.65 ± 0.20^{g}	24.76 ± 0.19^{i}	23.68 ± 0.19^{j}	45.45 ± 0.16^{a}	14.95 ± 0.01^{f}
	FT	20.55 ± 0.18^{a}	5.11 ± 0.22^{f}	20.81 ± 0.19^{e}	19.83 ± 0.12^{e}	49.66 ± 0.19^{b}	16.02 ± 0.04^{g}
	BT	20.37 ± 0.15^{a}	2.84 ± 0.12^{c}	21.27 ± 0.16^{f}	21.98 ± 0.15^{h}	61.67 ± 0.19^{c}	16.04 ± 0.04^{g}
	UT	20.64 ± 0.24^{a}	6.23 ± 0.07^{h}	27.96 ± 0.15^{j}	29.36 ± 0.2^{l}	84.97 ± 0.21^{j}	20.06 ± 0.06^{h}

All the values in the table are mean ± SD of three independent determinations. Samples with different superscript letters differ significantly $p < 0.05$.

Table 6
Vitamin B_1, B_2, B_3, β-Carotene, and Vitamin C content of different *Garcinia pedunculata* samples.

Sample condition		Bioactive compounds				
		Vitamin B_1 (mg/100 g)	Vitamin B_2 (mg/100 g)	Vitamin B_3 (mg/100 g)	β-Carotene (mg/100 g)	Vitamin C (mg/100 g)
T(℃)	Fresh	0.031 ± 0.002^{f}	0.021 ± 0.001^{f}	0.013 ± 0.001^{e}	45.18 ± 0.16 ^{g}	142.62 ± 0.14 ^{l}
45 °C	ST	0.018 ± 0.001^{bc}	0.004 ± 0.001^{b}	0.007 ± 0.001^{b}	26.81 ± 0.076^{f}	115.25 ± 0.19^{k}
	FT	0.025 ± 0.002^{d}	0.016 ± 0.002^{e}	0.011 ± 0.001^{d}	31.22 ± 0.018^{g}	104.45 ± 0.22^{h}
	BT	0.022 ± 0.001^{cd}	0.008 ± 0.001^{c}	0.011 ± 0.001^{d}	26.27 ± 0.02^{e}	97.46 ± 0.23^{c}
	UT	0.027 ± 0.001^{e}	0.008 ± 0.001^{c}	0.012 ± 0.001^{d}	22.39 ± 0.79^{c}	105.20 ± 0.17^{i}
50 °C	ST	0.018 ± 0.001^{bc}	0.004 ± 0.001^{b}	0.006 ± 0.001^{b}	23.68 ± 0.04^{de}	107.22 ± 0.12^{j}
	FT	0.023 ± 0.001^{cd}	0.012 ± 0.002^{d}	0.012 ± 0.001^{e}	27.55 ± 0.02^{f}	103.92 ± 0.07^{g}
	BT	0.022 ± 0.002^{cd}	0.007 ± 0.001^{c}	0.009 ± 0.002^{c}	23.33 ± 0.03^{d}	91.72 ± 0.07^{b}
	UT	0.020 ± 0.001^{ab}	0.007 ± 0.001^{c}	0.010 ± 0.001^{cd}	21.49 ± 0.01^{b}	99.45 ± 0.18^{d}
55 °C	ST	0.012 ± 0.001^{a}	0.003 ± 0.001^{a}	0.005 ± 0.001^{a}	19.65 ± 0.04^{ab}	101.91 ± 0.21^{f}
	FT	0.019 ± 0.001^{c}	0.007 ± 0.001^{c}	0.009 ± 0.001^{c}	23.51 ± 0.02^{de}	99.76 ± 0.15^{e}
	BT	0.018 ± 0.001^{bc}	0.007 ± 0.001^{c}	0.008 ± 0.001^{b}	19.28 ± 0.07^{ab}	87.68 ± 0.03^{a}
	UT	0.017 ± 0.001^{ab}	0.007 ± 0.001^{c}	0.009 ± 0.001^{c}	17.82 ± 0.08^{a}	97.27 ± 0.02^{c}

All the values in the table are mean ± SD of three independent determinations. Samples with different superscript letters differ significantly $p < 0.05$.

tively) of the dried samples pretreated by fructose. The highest ascorbic acid value (142.62 ± 0.14 mg/100 g DM) was found in a fresh sample. It was decreased (ranging from 87.63 ± 0.03 to 115. 25 ± 0.19 DM) for both untreated and treated samples with the increased drying temperatures from 45 to 55 °C. The highest vitamin C reduction (38.56%) was observed in brine treated *Garcinia pedunculata* dried at 55 °C for 17 hrs, although a reduction of 19.22% was found after drying at 45 °C (for 22 hrs) for sucrose treated sample.

3.6. Effect of drying temperature on antioxidant properties

3.6.1. Total phenolic content (TPC)

The highest value of TPC (19.45 ± 0.20 mg GAE/100gDM) was found in the fresh sample; it was reduced (10.33 ± 0.20 to 15.78 ± 0.14 mg GAE/100gDM) for both of the treated and untreated sample due to the increase of drying temperature from 45 to 55 °C (Fig. 6). The highest loss (47%) was observed in untreated *Garcinia pedunculata* dried at 55 °C for 16hrs, whereas for FT sample, about 19% loss was observed after drying for 22 h at 45 °C.

3.6.2. DPPH radical scavenging activity

The DPPH radical scavenging activity of various temperatures and pretreated samples were evaluated. According to Fig. 6, DPPH free radical scavenging activity reduced dramatically in contrast with the fresh sample due to the drying time and temperature. The highest reduction was measured in the untreated sample (69.56%) dried at 45 °C (dried for 22 h), whereas it was 47.21% at 55 °C (dried for 16 h).

3.6.3. Total flavonoid content (TFC)

Fig. 6 shows that the total flavonoid content of various pretreated samples dried at different temperatures. The highest TFC 18.30 mgQE/100 g DM was found in a fresh sample. After drying, the maximum amount of TFC 11.09 mgQE/100 g DM was observed in the fructose pretreated sample dried at 45 °C. Again, the minimum value was obtained at 55 °C temperature dried sucrose pretreated sample (4.85 mgQE/100 g DM). Overall, TFC decreased as drying temperature increased.

3.7. Microbial load

The total bacterial and fungal count of fresh, and dried *Garcinia pedunculata* samples are shown in Table 7. The value of the bacterial count of the fresh taikor sample was $2.45 \times 10^5 \pm 0.2$ CFU/g, and the fungal count was $3.5 \times 10^5 \pm 1.3$ CFU/g. Treated and untreated samples' microbial load changed after drying treatment. Pre-treated samples contained the lower microbial count. The minimum microbial load was found at different temperatures in brine pretreated samples. Comparatively, brine treated samples showed lower microbial count than the untreated sample.

4. Discussion

The increase in temperature resulting faster rate of drying was anticipated as expressed in the literature (Garau et al., 2007). Vega-Gálvez et al., (2009) stated that an increase in temperature from 45 to 55 °C was the reason for reducing drying time from 560 to

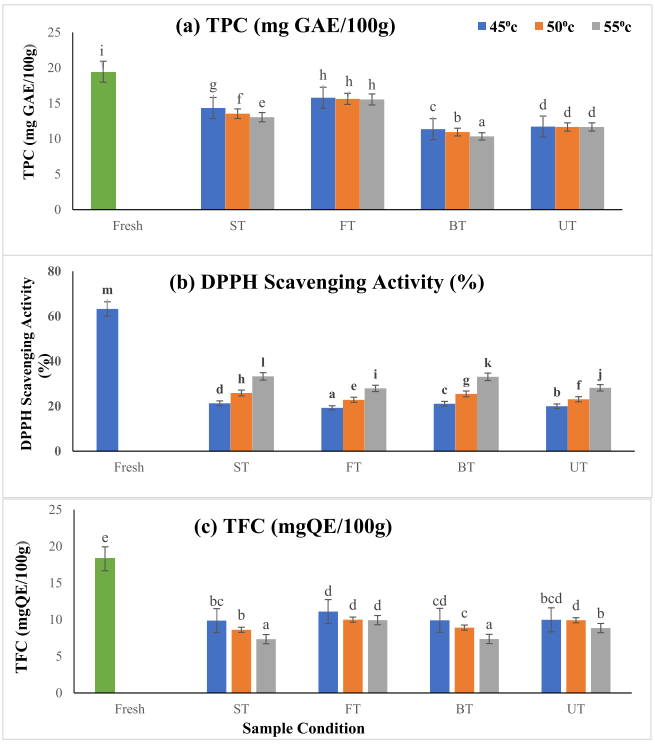

Fig. 6. (a) Total phenolic content (mgGAE/100 g), (b) DPPH radical scavenging activity (%), and (c) Total flavonoid content (mgQE/100 g) of different pretreated samples dried at various temperatures. Samples with different letters at the top of the bar differ significantly at $p < 0.05$.

Table 7
Microbial Load of different pretreated *Garcinia pedunculata* samples.

Sample condition		Microbial load	
		Bacterial count CFU/g	Fungal count CFU/g
Temperature (°C)	Fresh	$2.45 \times 10^5 \pm 0.2^{j}$	$3.5 \times 10^5 \pm 1.3^{g}$
45 °C	ST	$4.18 \times 10^4 \pm 0.2^{f}$	$17 \times 10^3 \pm 5.1^{e}$
	FT	$4.22 \times 10^4 \pm 0.1^{g}$	$8 \times 10^3 \pm 2.3^{c}$
	BT	$1.96 \times 10^4 \pm 0.1^{c}$	$2 \times 10^2 \pm 1.6^{a}$
	UT	$5.34 \times 10^5 \pm 0.2^{k}$	$4 \times 10^3 \pm 1.42^{b}$
50 °C	ST	$2.07 \times 10^4 \pm 0.2^{d}$	$9 \times 10^3 \pm 2.45^{d}$
	FT	$3.11 \times 10^4 \pm 0.1^{e}$	$3 \times 10^3 \pm 1.37^{b}$
	BT	$1.83 \times 10^4 \pm 0.04^{b}$	0
	UT	$5.31 \times 10^4 \pm 0.2^{i}$	$1 \times 10^4 \pm 0.59^{f}$
55 °C	ST	$1.95 \times 10^4 \pm 0.2^{c}$	$3 \times 10^3 \pm 1.28^{b}$
	FT	$2.03 \times 10^4 \pm 0.2^{d}$	$3 \times 10^3 \pm 1.22^{b}$
	BT	$1.64 \times 10^4 \pm 0.3^{a}$	0
	UT	$5.23 \times 10^4 \pm 0.1^{h}$	0

All the values in the table are mean ± SD of three independent determinations. Samples with different superscript letters differ significantly $p < 0.05$.

360 min. The increase of temperature is responsible for escalating the driving force for dehydration; the evaporation of water into air increases with the driving force and hence increases the drying rate (Fudholi et al., 2011). This result was also comparable with a number of researches such as red chili (Gupta et al., 2002), figs (de Souza Matias et al., 2019), lemon balm (Argyropoulos, and Müller, 2014), etc.

In terms of pretreated samples (Fig. 2), changes were found for pretreated samples to reach an equilibrium moisture content at a shorter time than UT. Osmotic pretreatment solutions, such as sucrose, fructose, and brine are widely used to rupture the cell of food content, making the food content easier to release moisture content from the inner particle during further drying treatment and reduces the drying time (Falade et al., 2007). Junqueira et al., (2016) exposed sweet potato to a different osmotic solution (sucrose, sorbitol, and fructose) for 180 min and found the reduction of drying time for sucrose (400 s), sorbitol (500 s), and fructose solution (600 s) compared to untreated samples (1500 s). Nowicka et al., (2015) also found a similar trend for sour cherry fruit, which was exposed for 180 min in osmotic pre-treatment. However, based on of the findings of this study, no measurable changes were found; it may be due to the short pre-treatment period.

Different fruit samples have different safe moisture content based on their inner ingredient. Dried fruits rich in sugar usually have a higher safe moisture level. *Garcinia pedunculata* fruit has low sugar content, so it should dry to comparatively lower moisture content as reflected by its lower equilibrium moisture content during drying. Afolabi (2014) and Fellows (2009) suggested that about 15–20% moisture is safe for various dried fruits. Alur and Venugopal (1999) considered 18–25% moisture content as 'alarm water' for dehydrated fruits. The moisture content of dried taikor in the present study is much lower than the standard levels. Some research works have already been done to determine the effect of the operating parameters on model outcome prediction (da Silva et al., 2014; Singh et al., 2015). One of the essential characteristics of the drying model is the drying rate constant, which decides the process efficiency and suitability. The rate constant depends on several variables from the process, such as the temperature and humidity, material's properties, the surface area to volume ratio of its shape, and velocity of moisture being carried away from or towards the material, etc. (Arsanjani et al., 2012). During this study, taikor was cut into small pieces, it was not always possible to maintain uniform size and shape, but a constant air velocity was applied. Temperature and RH were used as state variables and the drying process is perfectly described.

The pH and acidity of *Gracinia pendunculata* changed slightly with the drying temperature. The pH of the dried sample increased, whereas total acidity decreased with the increasing drying temperature. At lower temperatures, the disruption in the cell wall structure is very low, which might cause lower changes in the pH of different samples (Zzaman et al., 2021). Rapisarda et al., (2001) also found analogous results in the case of total acidity of orange and pineapple.

Color is an important parameter for dried food as drying changes the color of food from the fresh one. In this study, the lightness value was decreased with the increasing drying temperature. The surface color of the fresh sample showed the highest L^* value (34.81 ± 0.20), which was reduced to 20.37 ± 0.15 for brine treated samples dried at 55 °C. Non-enzymatic browning at higher drying temperature was the reason behind this (Ramallo and Mascheroni, 2012). The greenness/redness index a^* and blueness/yellowness index b^* of the samples increases with drying temperature, and the highest value of a^* and b^* was observed in untreated samples dried at 55 °C. This result is almost identical to the results obtained by Zzaman et al., (2021) for pineapple. The chroma value indicates the purity of the color. The higher chroma value indicates the intensity and purity of the dried foods' color. Usually, higher drying temperatures exhibited higher chroma values, which means that higher drying temperatures required lower drying time and hence, protected the purity of the color. The value of ΔE indicates total color change of the dried product. The samples with low color change values (ΔE) are considered the best for aesthetic appeal. The untreated samples dried at a higher temperature usually exhibited higher color changes. Sucrose pretreated samples showed the minimum color changes in contrast with untreated samples. The changes in color properties of a dried food depends on several physicochemical alterations during the drying process. The thermal treatment causes degradation of pigments; hence

the color changes occur in dried fruit, in particular, the brown pigments are produced by non-enzymatic reactions, enzymatic reactions and the degradation of carotenoids (Maillard reaction) (Kammoun Bejar et al., 2011). During the processing of foods with thermal treatments, the color change is hypothesized to occur by different processes, like degradation of pigment, ascorbic acid oxidation, and Maillard reaction (Aliha et al., 2013).

After drying, the quantity of B vitamins was reduced. The level of vitamin B_1, B_2, and B_3 in fresh *Gracinia pendunculata* were 0.03 1 ± 0.002, 0.021 ± 0.001, and 0.013 ± 0.001 mg/100 g dry matter (DM), respectively. The maximum retention of vitamin B_1 in the dried samples (0.027 ± 0.001 mg/100 g DM) was shown by UT samples dried at 45 °C, whereas the lowest vitamin B_1 was found in ST samples dried at 55 °C. This trend was almost similar for vitamin B_2, which was found to reduce with higher drying temperatures and immersion pretreatments. Vitamin B_3 showed comparatively lower changes in contrast with vitamin B_1 and B_2. The loss of vitamin B_1, B_2, B_3 occurred during the pretreatment process. As these are water-soluble nutrients, leaching out occurs during the immersion pretreatments, which causes loss of water-soluble vitamin B group in the pretreated dried samples. According to Francesco et al. (1989) among the vitamin B compounds, Vitamin B_1 is the most susceptible to change because of heat and the dependence on temperature of the constants among various foods and model systems. Temperature and light must be kept into consideration when researching the stabilization of vitamin B_2, while processing due to the release of this vitamin during digestion is an incredibly energy-consuming mechanism (Fernandes et al., 2015; Sheraz et al., 2014). It was found that vitamin B_3 tends to be unchanged by ambient oxygen, heat, and light in dry and neutral aqueous solution. It is chemically connected to nucleotides and may be biologically inaccessible in raw foods by as much as 70% (Fernandes et al., 2015). It is relatively stable with temperature change. The present study's results suggest that the changes in vitamin B_3 with drying temperatures were relatively low in contrast with other B vitamins.

Both β-carotene and vitamin C content in dried samples were influenced by drying temperature and pretreatment. The lower drying temperatures had resulted in marginally less degradation of β-carotene in the samples. The maximum retention of β-carotene was found for the samples pretreated with fructose (31. 22 ± 0.018 mg/100 g DM) and dried at 45 °C, whereas the lowest value (17.82 ± 0.08 mg/100 g DM) was found for untreated samples dried at 55 °C. As β-carotene is not water soluble, it retained for all these pre-treatments of the *Gracinia pendunculata* samples. Fernandes et al., (2015) found a reduction in β-carotene content in ultrasound-assisted dried apple. Vitamin C is another heat and light-sensitive vitamin. It is easily dissolved in water and can be lost due to moisture depletion at high temperatures (Rodríguez et al., 2017). It is also very prone to leaching loss. As in this study, immersion pretreatment and heat treatment were conducted to dry taikor, the decrease in vitamin C after drying was estimated. A decline in vitamin C with the increase in temperature was observed. The maximum level of ascorbic acid (142.62 ± 0.14 m g/100 g DM) was found in fresh *Gracinia pendunculata*. The highest vitamin C retention (a reduction of 19.22%) was found after drying at 45 °C for sucrose treated sample. In contrast, the maximum loss of vitamin C (a reduction of 38.56%) was observed in brine treated sample dried at 55 °C. Similar findings were observed on pears (Djendoubi Mrad et al., 2012); potato (Mclaughlin and Magee, 1998). Among the pretreated samples, sucrose pretreated samples showed a lot of retentive impact on ascorbic acid degradation during drying, as sucrose has the capacity to preserve ascorbic acid (Aktas et al., 2013).

The high temperature increased the evaporation rate, and the higher evaporation rate can damage the products' cell, which was responsible for increasing the polyphenol enzyme activity (Whitesides et al., 2001). Hossain et al. (2020a, 2021b) observed the decrease of phenolic content with the increase of temperature in moringa leaves and legumes, respectively. Another probable reason for the decrease of TPC could be the effect of pretreatment. Previous studies reported that osmotic pretreatment effectively retained the bioactive food compounds due to the water removal process at low temperatures (NS et al., 2017). Here in this study, fructose treated sample also shown a lower loss of TPC. Unlike TPC, the maximum DPPH free radical scavenging activity was for the ST sample (33%) dried at 55 °C for both treated and untreated. Mphahlele et al. (2016) also found that the TPC of pomegranate peel was decreased when the processing temperature was increased from 40 to 50 °C. Hossain and Hossain (2021) found that the TPC of Burmese grape's pulp and seed increased until a certain temperature. The formation of new antioxidant compounds resulting from drying probably triggered the increase in antioxidant capacity (Albanese et al., 2013). The Maillard reaction products also increase antioxidant potential after drying, which can be produced due to thermal treatment and typically demonstrate excellent antioxidant properties (Kamiloglu and Capanoglu, 2014). However, *Gracinia pendunculata* samples were exposed for a long time at low temperatures. Aktas et al., (2013) stated that extended drying times and low processing temperature might cause a decrease in antioxidant capacity. However, among all the samples, sucrose pretreated samples showed the highest DPPH scavenging activity because sucrose can retain phenolics, which have antioxidant activity (Aktas et al., 2013). Flavonoids are vulnerable to heat, and it gets weakened with increased drying temperature. Increased drying temperatures also cause cell wall disruption, which releases oxidative and hydrolytic enzymes that can degrade flavonoid content (Rodríguez et al., 2017). Changes in flavonoid structure affected the extract's antioxidant activities during heating treatment (Ghanem Romdhane et al., 2015; Hossain et al., 2020b).

Salt promotes antimicrobial activity and inhibits microbial growth (Molyneux, 2003). It is stated that when the product contains 10–12% moisture, microorganisms cannot survive there due to a lack of free water (Bourdoux et al., 2016). That is why dried *Garcinia pedunculata* contained a lower microbial load. The guideline of Indian microbiological standards stated that the satisfactory level of plate count of dehydrated fruits is 4×10^4 CFU/g and the accepted level is lower than 1×10^5 CFU/g. Again, the accepted value of the fungal load is below 10^5 in dried fruits and vegetable products (FSSAI, 2018). The majority of the collection of dried samples maintained this accepted value (Zzaman et al., 2021).

This study found that sucrose treated *Garcinia pedunculata* dried at 45 °C gave the best retention value of vitamin C, color component, whereas DPPH scavenging activity was highest at 55 °C. Again, fructose treated taikor dried at 45 °C provided the best retention value of B vitamins, β-Carotene, TPC, and TFC. Brine treated samples dried at 55 °C, on the other hand, provided a lower microbial load (both fungal and bacterial). Considering all the physical and chemical parameters, it can be concluded that drying at 55 °C using fructose pretreatment might be the best method for the drying of *Garcinia pedunculata* slices.

5. Conclusion

Drying is the primary method of preserving *Garcinia pedunculata*. The pretreated dried samples were analyzed to observe the changes in different parameters. Changes in pH, total acidity, color, vitamin B_1, B_2, and B_3, loss of β-carotene, reduction of vitamin C, loss of TPC, TFC, antioxidant activity, microbial load were analyzed for the consistency of untreated and treated dried taikor slices. The Page model provided a robust statistical fit for drying *Garcinia*

pedunculata. Brine solution provides a lower microbial load in the dried samples. The sucrose and fructose solution help to protect nutritional quality in the dried taikor. Lower temperature drying with fructose solution protects maximum chemical properties. This study may help future researchers develop a better method for processing and storing *Garcinia pedunculata*, and other underutilize fruits and vegetables. Optimization of drying air temperature by considering variables like pretreatments, relative humidity, and drying time constant could be a subject of concern for future research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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