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Effect of pre-treatment, preparation techniques and pressing techniques for bottle gourd juice

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Abstract

The experiment was carried out to study the effect of pre-treatment, preparation techniques and pressing techniques on the physico-chemical, microbial and sensory quality of bottle gourd juice during six months of storage. For the preparation of bottle gourd juice, experiment was conducted with twelve treatment combinations comprising of three different factors with different levels of microwave pre-treatment (A₁- without pre-treatment, A₂- 30 seconds and A₃- 60 seconds), preparation technique (B₁- shredding and B₂- crushing) and pressing technique (C₁- complete pressing and C₂- single strength pressing). Each treatment in the experiment repeated trice using a completely randomized design with factorial concept. The results showed that bottle gourd slices treated with microwave for 60 seconds (A₃), shredded (B₁) and pressed at 0.25 kg/cm² (C₂) yielded the best bottle gourd juice with high ascorbic acid, antioxidant activity and overall acceptability. This juice can be stored for six months without significant quality changes. These developed technologies can be commercially adopted by the food processing industry for producing bottle gourd juice.

Keywords: Bottle gourd, extraction, juice, microwave, quality

1. Introduction

Bottle gourd (*Lagenaria siceraria* L.) is an important vegetable crop of tropical and subtropical regions of the world belonging to the family Cucurbitaceae. Bottle gourd has its origin in India and Africa. It is very popular in Indo-Pakistan subcontinent and cultivated throughout India almost all the year round and hence the fruits are always available in the market (Tomar *et al.*, 2007) [13]. It is commonly cultivated in India, Sri Lanka, Indonesia, Malaysia, China, etc. In India, it is widely cultivated in Bihar, Uttar Pradesh, Madhya Pradesh, Haryana, Punjab, Assam, etc., (Shivran *et al.*, 2023) [11]. The fruit is having high medicinal value of considerable importance. Bottle gourd is good source of Vitamin B and ascorbic acid. Bottle gourd is having cool effect on human body and easy to digest. It gives relief to patients suffering from urinary disorders, heart problems, insomnia and diabetes (Gopalan *et al.*, 2000) [4]. Bottle gourd is very useful to maintain cholesterol level in blood and reduces the impact of low blood pressure and heart diseases which are found most commonly among people. Enzymes commonly found to have deteriorative effects in bottle gourd are peroxides (PODs) and polyphenoloxidases (PPOs). Blanching is extremely necessary for inhibition of enzyme action before processing of fruits and vegetables and useful in determining the process parameters at different time-temperature combinations with maximum quality retention. Microwave blanching offers some advantages such as volumetric heating, low nutrient loss and high-quality products (Bingol *et al.*, 2014) [2]. The demands for vegetable and fruit juice are increasing in the present-day global market. Today consumers understand the relationship of how the intake of bioactive compounds can help in maintaining a good health and wellbeing (Silva *et al.*, 2020) [12]. Vegetable and fruit juice provide vital supplements into the daily nutrition requirements (Khandpur and Gogate, 2015) [6] as vegetables and fruits juice contains bioactive compounds like phenolics, alkaloids and terpenoids (Silva *et al.*, 2020) [12]. Bottle gourd juice has tremendous medicinal significance and the vegetable is not only a rich source of essential minerals, iron, protein and trace elements but also possess high fiber content and functional properties. It is a good source of vitamin B complex and a fair source of vitamin C (Shirwaikar and Sreenivasan, 1996) [10].

2. Materials and Methods

The present investigation was carried out during 2023-2024 at Centre of Excellence on Post Harvest Technology, ASPEE College of Horticulture, Navsari Agricultural University, Navsari. Total 12 treatment combinations were used for preparation of bottle gourd juice using three levels of microwave pre-treatment (Factor A), two levels of preparation technique (Factor B) and two levels of pressing techniques for juice (Factor C).

Factor A: Microwave pre-treatment

- A₁ - Without microwave pre-treatment
- A₂ - Microwave pre-treatment for 30 sec at 450 W
- A₃ - Microwave pre-treatment for 60 sec at 450 W

Factor B: Preparation technique

- B₁ - Shredding (3 mm shred size)
- B₂ - Crushing (8 mess/cm²)

Factor C: Pressing techniques for juice extraction

- C₁ - Complete pressing at 1 kg/cm² pressure
- C₂ - Pressing for single strength juice extraction at 0.25 kg/cm² pressure

Fresh bottle gourd fruits procured from the local market of Navsari, freshly prepared aonla juice was procured from Department of Post Harvest Technology and basil leaves

were procured from NAU farm. Fresh bottle gourd fruits were selected, sorted and washed to ensure the cleanliness of the raw material. Subsequently, the outer skin of the bottle gourd was peeled off then 5 cm thick slices were prepared followed by microwave pre-treatment. After microwave pre-treatment, slices were shredded / crushed followed by pressing using hydraulic press as per the treatment. Then 0.3% acidity was maintained by aonla juice and 12°B TSS was maintained by adding sugar. After that, juice was heat processed at 95±1 °C for 5 min with continue stirring. Then before the final stage of heating, 1% basil leaves extract was added. Heated juice was filled into 200 ml glass bottles by keeping 1.0-1.2 cm head space and sealed air tight by crown corking. Then juice was sterilized by keeping all bottles in hot water at 95±1 °C for 30 minutes followed by cooling, labelling and storage at ambient temperature.

Table 1: Treatment combinations used for preparation of bottle gourd juice

T ₁	A ₁ B ₁ C ₁	T ₇	A ₂ B ₂ C ₁
T ₂	A ₁ B ₁ C ₂	T ₈	A ₂ B ₂ C ₂
T ₃	A ₁ B ₂ C ₁	T ₉	A ₃ B ₁ C ₁
T ₄	A ₁ B ₂ C ₂	T ₁₀	A ₃ B ₁ C ₂
T ₅	A ₂ B ₁ C ₁	T ₁₁	A ₃ B ₂ C ₁
T ₆	A ₂ B ₁ C ₂	T ₁₂	A ₃ B ₂ C ₂

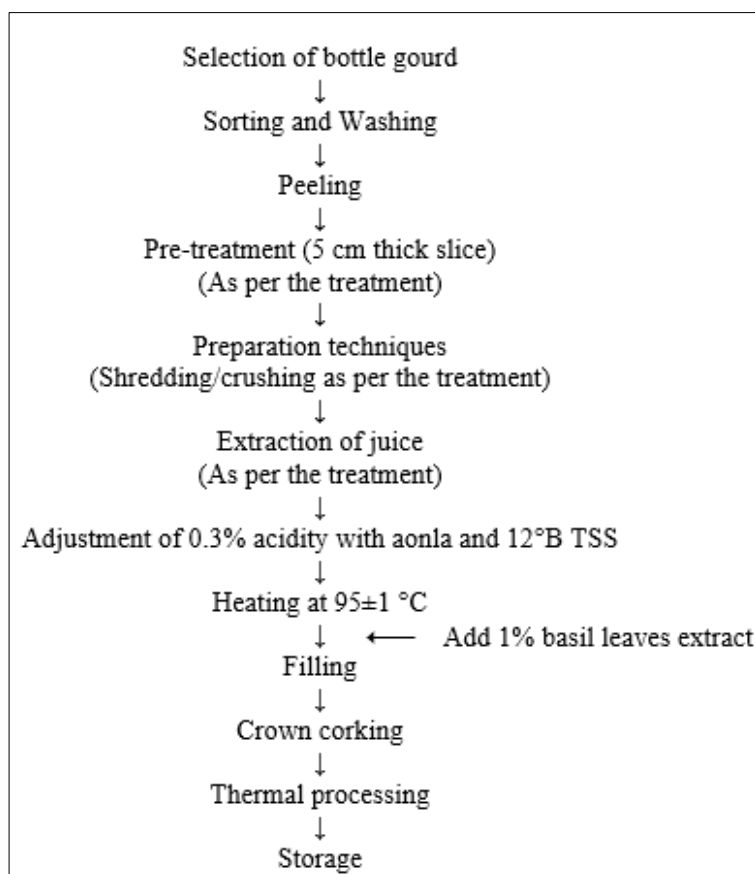


Fig 1: Principal steps for processing of bottle gourd juice

3. Results and Discussion

Juice yield

Data pertaining to effect of treatment combinations on juice yield of the bottle gourd juice has been presented in the Table 2. Data showed that maximum juice yield (60.61%) in juice when juice was extracted from crushed bottle gourds,

pre-treated with microwave for 60 seconds followed by complete pressing at 1 kg/cm² pressure and (A₃B₂C₁) and minimum juice yield (55.11%) in juice when juice was extracted from shredded bottle gourds without microwave pretreatment followed by single strength pressing at 0.25 kg/cm² pressure (A₁B₁C₁).

Table 2: Effect of treatment combinations on the juice yield (%) of bottle gourd juice

Microwave pre-treatment (A)	Preparation techniques (B)						Grand Mean (A)
	B1: Shredding			B2: Crushing			
	Pressing (C)			Pressing (C)			
	C1: Complete	C2: Single strength	Mean (A, B1)	C1: Complete	C2: Single strength	Mean (A, B2)	
A1: Control	55.43	54.79	55.11	59.25	58.75	59.00	57.05
A2: 30 sec.	59.22	57.90	58.56	59.64	58.79	59.21	58.89
A3: 60 sec.	59.27	58.70	58.98	60.61	59.33	59.97	59.48
Mean (B)	57.97	57.13	57.55	59.83	58.96	59.39	
Mean (C)	58.90	58.04					
	A	B	C	AxB	AxC	BxC	AxBxC
SEm±	0.18	0.14	0.14	0.25	0.25	0.20	0.35
CD at 5%	0.52	0.42	0.42	0.73	NS	NS	NS
CV%	1.05						

Total Soluble Solids

Data pertaining to effect of treatment combinations on TSS of the bottle gourd juice has been presented in the Table 3. Data showed that minimum decrease of TSS during six months from 12.10 to 11.15 °B in juice when juice was extracted from bottle gourds slices pre-treated with microwave for 60 seconds followed by shredding and single strength pressing at 0.25 kg/cm² pressure (A₃B₁C₂S₁ to A₃B₁C₂S₄).

Data depicts that storage of bottle gourd juice resulted significant decrease in mean TSS (S) during six months storage from 12.00 to 10.58 °B (S₁ to S₄). The TSS values gradually decreased during storage. This might be due to the breakdown of sugars and the presence of some micro-pollutants which contribute to the reduction of total soluble solids. Similar observation was reported by Juli *et al.* (2023)^[5] for coconut drink. Ashuquallah (2021)^[1] reported opposite trends for TSS during storage in carrot juice.

Table 3: Effect of treatment combinations on the TSS (°B) of bottle gourd juice

TSS (°B)									
Storage Interval (S)	Microwave pretreatment (A)	Preparation techniques (B)						Grand Mean (S, AS)	Grand Mean (A)
		B1: Shredding			B2: Crushing				
		Pressing (C)			Pressing (C)				
		C1: Complete	C2: Single strength	Mean (B1, S, A)	C1: Complete	C2: Single strength	Mean (B2, S, A)		
S1: Initial	A1: Control	12.10	11.90	12.00	11.90	12.10	12.00	12.00	11.36
	A2: 30 sec.	12.00	12.00	12.00	12.10	11.90	12.00	12.00	11.46
	A3: 60 sec.	11.90	12.10	12.00	12.00	12.00	12.00	12.00	11.55
	Mean (BC of S1)	12.00	12.00	12.00	12.00	12.00	12.00	12.00	
S2: 2 Months	A1: Control	11.75	11.62	11.69	11.80	11.70	11.75	11.72	
	A2: 30 sec.	11.82	11.65	11.74	11.85	11.75	11.80	11.77	
	A3: 60 sec.	11.85	11.70	11.78	11.90	11.80	11.85	11.81	
	Mean (BC of S2)	11.81	11.66	11.73	11.85	11.75	11.80	11.77	
S3: 4 Months	A1: Control	11.30	11.20	11.25	11.30	11.30	11.30	11.28	
	A2: 30 sec.	11.40	11.30	11.35	11.50	11.50	11.50	11.43	
	A3: 60 sec.	11.55	11.35	11.45	11.65	11.50	11.58	11.51	
	Mean (BC of S3)	11.42	11.28	11.35	11.48	11.43	11.46	11.40	
S4: 6 Months	A1: Control	10.47	10.50	10.49	10.35	10.50	10.43	10.46	
	A2: 30 sec.	10.60	10.75	10.68	10.60	10.60	10.60	10.64	
	A3: 60 sec.	10.90	11.15	11.03	10.70	10.75	10.73	10.88	
	Mean (BC of S4)	10.66	10.80	10.73	10.55	10.62	10.58	10.66	
	Mean (B)	11.47	11.44	11.45	11.47	11.45	11.46	11.46	
	Mean (C)	11.47	11.44						
	SEm±	CD at 5%		SEm±	CD at 5%		SEm±	CD at 5%	
A	0.024	0.067	AxB	0.034	0.094	CxS	0.039	NS	
B	0.019	0.054	AxC	0.034	0.094	AxBxS	0.067	NS	
C	0.019	0.054	BxC	0.027	0.077	AxCxS	0.067	NS	
S	0.027	0.077	AxS	0.047	NS	BxCxS	0.055	NS	
AxBxC	0.047	0.133	BxS	0.039	NS	AxBxCxS	0.095	NS	
CV%	1.43								

Total sugars

Data pertaining to effect of treatment combinations on total sugars of the bottle gourd juice has been presented in the Table 4. Data showed that minimum decrease of total sugars during six months from 11.22 to 10.45% in juice when juice was extracted from bottle gourd slices pre-treated with microwave for 60 seconds followed by shredding and single

strength pressing at 0.25 kg/cm² pressure (A₃B₁C₂S₁ to A₃B₁C₂S₄).

Data depicts that storage (S) of bottle gourd juice resulted significant decrease in mean total sugars during six months storage from 11.24 to 10.43% (S₁ to S₄). The total sugars may be decreased due conversion into organic acids and utilization in non-enzymatic browning reaction. Ashuquallah

(2021) [1] also reported increase reducing, nonreducing and total sugars in carrot juice during storage. Similar

observation was reported by Juli *et al.* (2023) [5] for coconut drink.

Table 4: Effect of treatment combinations on the total sugars (%) of bottle gourd juice

Total sugars (%)									
Storage Interval (S)	Microwave pretreatment (A)	Preparation techniques (B)						Grand Mean (S, AS)	Grand Mean (A)
		B1: Shredding			B2: Crushing				
		Pressing (C)			Pressing (C)				
		C1: Complete	C2: Single strength	Mean (B ₁ , S, A)	C1: Complete	C2: Single strength	Mean (B ₂ , S, A)		
S ₁ : Initial	A ₁ : Control	11.13	11.11	11.12	11.25	11.19	11.22	11.17	10.77
	A ₂ : 30 sec.	11.23	11.17	11.20	11.31	11.28	11.30	11.25	10.85
	A ₃ : 60 sec.	11.27	11.22	11.25	11.40	11.34	11.37	11.31	10.92
	Mean (BC of S ₁)	11.21	11.17	11.19	11.32	11.27	11.30	11.24	
S ₂ : 2 Months	A ₁ : Control	10.91	10.89	10.90	11.02	10.96	10.99	10.95	
	A ₂ : 30 sec.	11.00	10.94	10.97	11.09	11.06	11.08	11.02	
	A ₃ : 60 sec.	11.06	11.00	11.03	11.18	11.12	11.15	11.09	
	Mean (BC of S ₂)	10.99	10.94	10.97	11.10	11.05	11.07	11.02	
S ₃ : 4 Months	A ₁ : Control	10.58	10.56	10.57	10.69	10.64	10.67	10.62	
	A ₂ : 30 sec.	10.68	10.62	10.65	10.77	10.74	10.76	10.70	
	A ₃ : 60 sec.	10.74	10.68	10.71	10.85	10.80	10.83	10.77	
	Mean (BC of S ₃)	10.67	10.62	10.64	10.77	10.73	10.75	10.70	
S ₄ : 6 Months	A ₁ : Control	10.30	10.28	10.29	10.41	10.37	10.39	10.34	
	A ₂ : 30 sec.	10.41	10.35	10.38	10.50	10.47	10.49	10.43	
	A ₃ : 60 sec.	10.48	10.45	10.47	10.59	10.55	10.57	10.52	
	Mean (BC of S ₄)	10.40	10.36	10.38	10.50	10.46	10.48	10.43	
	Mean (B)	10.82	10.77	10.79	10.92	10.88	10.90	10.85	
	Mean (C)	10.87	10.82						
	SEm±	CD at 5%		SEm±	CD at 5%		SEm±	CD at 5%	
A	0.012	NS	AxB	0.017	0.048	CxS	0.020	NS	
B	0.010	NS	AxC	0.017	0.048	AxBxS	0.034	NS	
C	0.010	NS	BxC	0.014	NS	AxCxS	0.034	NS	
S	0.014	0.039	AxS	0.024	NS	BxCxS	0.028	NS	
AxBxC	0.024	0.068	BxS	0.020	NS	AxBxCxS	0.048	NS	
CV%				0.74					

Acidity

Data pertaining to effect of treatment combinations on acidity of the bottle gourd juice has been presented in the Table 5. Data showed that minimum increase of acidity during six months from 0.300 to 0.351% in juice when juice was extracted bottle gourd slices pre-treated with

microwave for 60 seconds followed by shredding and single strength pressing at 0.25 kg/cm² pressure (A₃B₁C₂S₁ to A₃B₁C₂S₄).

Data depicts that storage of bottle gourd juice resulted increase in mean acidity (S) during six months storage from 0.300 to 0.364% (S₁ to S₄).

Table 5: Effect of treatment combinations on the acidity (%) of bottle gourd juice

Acidity (%)									
Storage Interval (S)	Microwave pretreatment (A)	Preparation techniques (B)						Grand Mean (S, AS)	Grand Mean (A)
		B1: Shredding			B2: Crushing				
		Pressing (C)			Pressing (C)				
		C1: Complete	C2: Single strength	Mean (B ₁ , S, A)	C1: Complete	C2: Single strength	Mean (B ₂ , S, A)		
S ₁ : Initial	A ₁ : Control	0.299	0.300	0.300	0.300	0.301	0.301	0.300	0.338
	A ₂ : 30 sec.	0.300	0.299	0.300	0.300	0.299	0.300	0.300	0.332
	A ₃ : 60 sec.	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.329
	Mean (BC of S ₁)	0.300	0.300	0.300	0.300	0.300	0.300	0.300	
S ₂ : 2 Months	A ₁ : Control	0.326	0.324	0.325	0.330	0.327	0.329	0.327	
	A ₂ : 30 sec.	0.324	0.322	0.323	0.328	0.323	0.326	0.324	
	A ₃ : 60 sec.	0.320	0.318	0.319	0.323	0.317	0.320	0.320	
	Mean (BC of S ₂)	0.323	0.321	0.322	0.327	0.322	0.325	0.324	
S ₃ : 4 Months	A ₁ : Control	0.353	0.343	0.348	0.355	0.353	0.354	0.351	
	A ₂ : 30 sec.	0.342	0.340	0.341	0.349	0.340	0.345	0.343	
	A ₃ : 60 sec.	0.340	0.338	0.339	0.345	0.333	0.339	0.339	
	Mean (BC of S ₃)	0.345	0.340	0.343	0.350	0.342	0.346	0.344	
S ₄ : 6 Months	A ₁ : Control	0.371	0.373	0.372	0.375	0.374	0.375	0.373	
	A ₂ : 30 sec.	0.362	0.364	0.363	0.363	0.362	0.363	0.363	
	A ₃ : 60 sec.	0.360	0.351	0.356	0.358	0.355	0.357	0.356	
	Mean (BC of S ₄)	0.364	0.363	0.364	0.365	0.364	0.365	0.364	
	Mean (B)	0.333	0.331	0.332	0.336	0.332	0.334		

	Mean (C)	0.334	0.332						
	SEm±	CD at 5%		SEm±	CD at 5%		SEm±	CD at 5%	
A	0.002	0.006	AxB	0.003	0.008	CxS	0.003	NS	
B	0.002	0.005	AxC	0.003	0.008	AxBxS	0.006	NS	
C	0.002	0.005	BxC	0.002	NS	AxCxS	0.006	NS	
S	0.002	NS	AxS	0.004	NS	BxCxS	0.005	NS	
AxBxC	0.004	0.011	BxS	0.003	NS	AxBxCxS	0.008	NS	
CV%	4.16								

pH
 Data pertaining to effect of treatment combinations on pH of the bottle gourd juice has been presented in the Table 6. Data showed that minimum decrease of pH during six months from 4.668 to 4.615 in juice when juice was extracted from bottle gourd slices pre-treated with microwave for 60 seconds followed by shredding and single strength pressing at 0.25 kg/cm² pressure (A₃B₁C₂S₁ to A₃B₁C₂S₄). Data depicts that storage(S) of bottle gourd juice resulted decrease in mean pH during six months storage from 4.668 to 4.604 (S₁ to S₄).

Table 6: Effect of treatment combinations on the pH of bottle gourd juice

pH									
Storage Interval (S)	Microwave pretreatment (A)	Preparation techniques (B)						Grand Mean (S, AS)	Grand Mean (A)
		B ₁ : Shredding			B ₂ : Crushing				
		Pressing (C)			Pressing (C)				
		C ₁ : Complete	C ₂ : Single strength	Mean (B ₁ , S, A)	C ₁ : Complete	C ₂ : Single strength	Mean (B ₂ , S, A)		
S ₁ : Initial	A ₁ : Control	4.667	4.668	4.668	4.667	4.669	4.668	4.668	4.636
	A ₂ : 30 sec.	4.668	4.667	4.668	4.668	4.667	4.668	4.668	4.638
	A ₃ : 60 sec.	4.668	4.668	4.668	4.668	4.668	4.668	4.668	4.641
	Mean (BC of S ₁)	4.668	4.668	4.668	4.668	4.668	4.668	4.668	
S ₂ : 2 Months	A ₁ : Control	4.645	4.642	4.644	4.651	4.651	4.651	4.647	
	A ₂ : 30 sec.	4.648	4.651	4.650	4.648	4.655	4.652	4.651	
	A ₃ : 60 sec.	4.651	4.655	4.653	4.655	4.655	4.655	4.654	
	Mean (BC of S ₂)	4.648	4.649	4.649	4.651	4.654	4.653	4.651	
S ₃ : 4 Months	A ₁ : Control	4.625	4.621	4.623	4.630	4.630	4.630	4.627	
	A ₂ : 30 sec.	4.627	4.630	4.629	4.627	4.634	4.631	4.630	
	A ₃ : 60 sec.	4.630	4.634	4.632	4.634	4.634	4.634	4.633	
	Mean (BC of S ₃)	4.627	4.628	4.628	4.630	4.633	4.632	4.630	
S ₄ : 6 Months	A ₁ : Control	4.606	4.596	4.601	4.594	4.601	4.598	4.599	
	A ₂ : 30 sec.	4.600	4.610	4.605	4.603	4.607	4.605	4.605	
	A ₃ : 60 sec.	4.603	4.615	4.609	4.605	4.610	4.608	4.608	
	Mean (BC of S ₄)	4.603	4.607	4.605	4.601	4.606	4.604	4.604	
	Mean (B)	4.637	4.638	4.637	4.638	4.640	4.639	4.638	
	Mean (C)	4.637	4.639						
	SEm±	CD at 5%		SEm±	CD at 5%		SEm±	CD at 5%	
A	0.003	NS	AxB	0.004	NS	CxS	0.004	NS	
B	0.002	NS	AxC	0.004	0.010	AxBxS	0.007	NS	
C	0.002	NS	BxC	0.003	NS	AxCxS	0.007	NS	
S	0.003	NS	AxS	0.005	NS	BxCxS	0.006	NS	
AxBxC	0.005	0.015	BxS	0.004	NS	AxBxCxS	0.010	NS	
CV%	0.39								

Ascorbic acid
 Data pertaining to effect of treatment combinations on ascorbic acid of the bottle gourd juice has been presented in the Table 7. Data showed that minimum decrease of ascorbic acid during six months from 30.90 to 26.74 mg/100g in juice when juice was extracted from bottle gourd slices with microwave for 60 seconds followed by shredding and single strength pressing at 0.25 kg/cm² pressure (A₁B₁C₂S₁ to A₁B₁C₂S₄). Data depicts that storage (S) of bottle gourd juice resulted significant decrease in mean ascorbic acid during six months storage from 31.18 to 24.59 (S₁ to S₄). The ascorbic values gradually decreased during storage. This might be due enzymatic and non-enzymatic reaction. Similar observation was reported by Gajera (2017) [3] for bottle gourd juice and Malik *et al.* (2022) [7] for lemon cordial.

Table 7: Effect of treatment combinations on the ascorbic acid (mg/100ml) of bottle gourd juice

Ascorbic acid (mg/100 ml)									
Storage Interval (S)	Microwave pretreatment (A)	Preparation techniques (B)						Grand Mean (S, AS)	Grand Mean (A)
		B1: Shredding			B2: Crushing				
		Pressing (C)			Pressing (C)				
		C1: Complete	C2: Single strength	Mean (B1, S, A)	C1: Complete	C2: Single strength	Mean (B2, S, A)		
S1: Initial	A1: Control	30.03	29.61	29.82	31.90	31.22	31.56	30.69	26.94
	A2: 30 sec.	30.85	30.50	30.68	32.27	31.42	31.85	31.26	27.97
	A3: 60 sec.	31.17	30.90	31.04	32.50	31.73	32.12	31.58	28.72
	Mean (BC of S1)	30.68	30.34	30.51	32.22	31.46	31.84	31.18	
S2: 2 Months	A1: Control	27.37	28.24	27.81	28.01	29.51	28.76	28.28	
	A2: 30 sec.	28.43	29.10	28.77	28.12	30.11	29.12	28.94	
	A3: 60 sec.	29.88	30.03	29.96	28.67	30.77	29.72	29.84	
	Mean (BC of S2)	28.56	29.12	28.84	28.27	30.13	29.20	29.02	
S3: 4 Months	A1: Control	26.05	26.02	26.04	25.31	25.32	25.32	25.68	
	A2: 30 sec.	26.56	26.78	26.67	26.49	26.82	26.66	26.66	
	A3: 60 sec.	27.97	28.92	28.45	27.07	27.45	27.26	27.85	
	Mean (BC of S3)	26.86	27.24	27.05	26.29	26.53	26.41	26.73	
S4: 6 Months	A1: Control	23.89	24.33	24.11	22.00	22.23	22.12	23.11	
	A2: 30 sec.	24.76	25.93	25.35	24.54	24.87	24.71	25.03	
	A3: 60 sec.	25.46	26.74	26.10	24.92	25.41	25.17	25.63	
	Mean (BC of S4)	24.70	25.67	25.19	23.82	24.17	24.00	24.59	
	Mean (B)	27.70	28.09	27.90	27.65	28.07	27.86	27.88	
	Mean (C)	27.68	28.08						
	SEm±	CD at 5%		SEm±	CD at 5%		SEm±	CD at 5%	
A	0.141	0.397	AxB	0.200	NS	CxS	0.231	NS	
B	0.115	0.324	AxC	0.200	NS	AxBxS	0.400	NS	
C	0.115	0.324	BxC	0.163	0.459	AxCxS	0.400	NS	
S	0.163	0.459	AxS	0.283	NS	BxCxS	0.326	NS	
AxBxC	0.283	NS	BxS	0.231	NS	AxBxCxS	0.565	NS	
CV%				3.50					

Antioxidant activity

Data pertaining to effect of treatment combinations on antioxidant activity of the bottle gourd juice has been presented in the Table 8. Data showed that minimum decrease of antioxidant activity during six months from 80.34 to 76.03% in juice when juice was extracted from bottle gourd slices pre-treated with microwave for 60

seconds followed by shredding and single strength pressing at 0.25 kg/cm² pressure (A₃B₁C₂S₁ to A₃B₁C₂S₄). Data depicts that storage of bottle gourd juice resulted decrease in mean antioxidant activity (S) during six months storage from 79.24 to 73.24% (S₁ to S₄). The antioxidant activity values gradually decreased during storage.

Table 8: Effect of treatment combinations on the antioxidant activity (%) of bottle gourd juice

Antioxidant activity (%)									
Storage Interval (S)	Microwave pretreatment (A)	Preparation techniques (B)						Grand Mean (S, AS)	Grand Mean (A)
		B1: Shredding			B2: Crushing				
		Pressing (C)			Pressing (C)				
		C1: Complete	C2: Single strength	Mean (B1, S, A)	C1: Complete	C2: Single strength	Mean (B2, S, A)		
S1: Initial	A1: Control	78.27	77.45	77.86	78.84	78.69	78.77	78.31	75.45
	A2: 30 sec.	78.64	78.12	78.38	79.35	79.02	79.19	78.78	76.14
	A3: 60 sec.	80.73	80.34	80.54	80.89	80.58	80.74	80.64	78.11
	Mean (BC of S1)	79.21	78.64	78.93	79.69	79.43	79.56	79.24	
S2: 2 Months	A1: Control	76.00	76.71	76.36	75.87	76.23	76.05	76.20	
	A2: 30 sec.	76.79	77.13	76.96	76.65	77.11	76.88	76.92	
	A3: 60 sec.	79.00	79.03	79.02	79.00	79.08	79.04	79.03	
	Mean (BC of S2)	77.26	77.62	77.44	77.17	77.47	77.32	77.38	
S3: 4 Months	A1: Control	74.74	75.07	74.91	75.97	76.79	76.38	75.64	
	A2: 30 sec.	74.00	75.88	74.94	76.32	77.00	76.66	75.80	
	A3: 60 sec.	76.97	77.50	77.24	78.11	78.34	78.23	77.73	
	Mean (BC of S3)	75.24	76.15	75.69	76.80	77.38	77.09	76.39	
S4: 6 Months	A1: Control	70.69	72.32	71.51	70.56	73.00	71.78	71.64	
	A2: 30 sec.	72.12	74.77	73.45	71.84	73.43	72.64	73.04	
	A3: 60 sec.	75.00	76.03	75.52	74.05	75.04	74.55	75.03	
	Mean (BC of S4)	72.60	74.37	73.49	72.15	73.82	72.99	73.24	
	Mean (B)	76.08	76.70	76.39	76.45	77.03	76.74	76.56	
	Mean (C)	76.27	76.86						

	SEm±	CD at 5%		SEm±	CD at 5%		SEm±	CD at 5%	
A	0.354	0.996	AxB	0.501	NS	CxS	0.578	NS	
B	0.289	0.813	AxC	0.501	NS	AxBxS	1.002	NS	
C	0.289	NS	BxC	0.409	NS	AxCxS	1.002	NS	
S	0.409	NS	AxS	0.708	NS	BxCxS	0.818	NS	
AxBxC	0.708	NS	BxS	0.578	NS	AxBxCxS	1.417	NS	
CV%	3.19								

Calcium

Data pertaining to effect of treatment combinations on calcium content in bottle gourd juice has been presented in the Table 9. Data showed that minimum decrease of calcium during six months from 241.33 to 238.50 ppm in juice when juice was extracted from bottle gourd slices pre-treated with microwave for 60 seconds followed by shredding and single strength pressing at 0.25 kg/cm² (A₃B₁C₂S₁ to A₃B₁C₂S₄).

Data depicts that storage of bottle gourd juice resulted significant decrease in mean calcium content (S) during six months storage from 242.75 to 236.43 ppm (S₁ to S₄). The decrease in calcium content in bottle gourd juice during storage can be attributed due to several factors related to chemical stability and physical changes over time. Similar observations were recorded by Math *et al.* (2014)^[8] in vegetable blended juice and Juli *et al.* (2023)^[5] in coconut drink.

Table 9: Effect of treatment combinations on the calcium (ppm) of bottle gourd juice

Calcium (ppm)									
Storage Interval (S)	Microwave pretreatment (A)	Preparation techniques (B)						Grand Mean (S, AS)	Grand Mean (A)
		B1: Shredding			B2: Crushing				
		Pressing (C)			Pressing (C)				
		C1: Complete	C2: Single strength	Mean (B ₁ , S, A)	C1: Complete	C2: Single strength	Mean (B ₂ , S, A)		
S ₁ : Initial	A ₁ : Control	240.67	248.00	244.34	245.67	251.33	248.50	246.42	242.25
	A ₂ : 30 sec.	237.00	244.00	240.50	241.67	247.00	244.34	242.42	239.54
	A ₃ : 60 sec.	235.33	241.33	238.33	237.67	243.33	240.50	239.42	237.09
	Mean (BC of S ₁)	237.67	244.44	241.06	241.67	247.22	244.45	242.75	
S ₂ : 2 Months	A ₁ : Control	237.00	246.00	241.50	242.67	248.00	245.34	243.42	
	A ₂ : 30 sec.	234.67	243.00	238.84	240.00	245.00	242.50	240.67	
	A ₃ : 60 sec.	233.33	240.00	236.67	236.33	241.67	239.00	237.83	
	Mean (BC of S ₂)	235.00	243.00	239.00	239.67	244.89	242.28	240.64	
S ₃ : 4 Months	A ₁ : Control	234.67	243.67	239.17	240.33	246.00	243.17	241.17	
	A ₂ : 30 sec.	232.00	241.00	236.50	238.00	243.33	240.67	238.58	
	A ₃ : 60 sec.	230.67	239.67	235.17	235.00	240.00	237.50	236.34	
	Mean (BC of S ₃)	232.45	241.45	236.95	237.78	243.11	240.44	238.70	
S ₄ : 6 Months	A ₁ : Control	232.33	240.00	236.17	236.00	243.67	239.84	238.00	
	A ₂ : 30 sec.	230.00	239.67	234.84	235.33	241.00	238.17	236.50	
	A ₃ : 60 sec.	229.33	238.50	233.92	231.67	239.67	235.67	234.79	
	Mean (BC of S ₄)	230.55	239.39	234.97	234.33	241.45	237.89	236.43	
	Mean (B)	233.92	242.07	237.99	238.36	244.17	241.26	239.63	
	Mean (C)	236.14	243.12						
	SEm±	CD at 5%		SEm±	CD at 5%		SEm±	CD at 5%	
A	1.150	3.234	AxB	1.627	NS	CxS	1.879	NS	
B	0.939	NS	AxC	1.627	NS	AxBxS	3.254	NS	
C	0.939	NS	BxC	1.328	NS	AxCxS	3.254	NS	
S	1.328	3.735	AxS	2.301	NS	BxCxS	2.657	NS	
AxBxC	2.301	NS	BxS	1.879	NS	AxBxCxS	4.602	NS	
CV%	3.33								

Overall acceptability

Data pertaining to effect of treatment combinations on overall acceptability score (9-point hedonic scale) of the bottle gourd juice has been presented in the Table 10. Data showed that minimum decrease of overall acceptability during six months from 8.29 to 7.99 in juice when juice was extracted from bottle gourd slices pre-treated with microwave for 60 seconds followed by shredding and single strength pressing at 0.25 kg/cm² pressure (A₃B₁C₂S₁ to A₃B₁C₂S₄).

Data depicts that storage of bottle gourd juice resulted decrease in mean overall acceptability score (S) during six months storage from 8.17 to 7.57 (S₁ to S₄). The overall acceptability of bottle gourd juice decreases it might be due to degradation of flavor, color changes and nutrient loss during storage. Ashuqullah (2021)^[1] reported that overall acceptability score decreases during storage in carrot juice. Rayman and Baysal (2011)^[9] in carrot juice, Zang and Zang (2014) in apple juice reported same variations for overall acceptability.

Table 10: Effect of treatment combinations on the overall acceptability score (9-point hedonic scale) of bottle gourd juice

Overall acceptability score									
Storage Interval (S)	Microwave pretreatment (A)	Preparation techniques (B)						Grand Mean	Grand Mean
		B1: Shredding			B2: Crushing				
		Pressing (C)			Pressing (C)				
		C1: Complete	C2: Single strength	Mean	C1: Complete	C2: Single strength	Mean		
S1: Initial	A1: Control	8.24	8.13	8.06	8.06	8.12	8.09	8.08	7.77
	A2: 30 sec.	8.27	8.14	8.08	8.11	8.30	8.21	8.14	7.87
	A3: 60 sec.	8.42	8.29	8.23	8.19	8.46	8.33	8.28	8.05
	Mean	8.31	8.19	8.13	8.12	8.30	8.21	8.17	
S2: 2 Months	A1: Control	8.10	8.01	7.93	7.80	8.00	7.90	7.92	
	A2: 30 sec.	8.11	8.02	7.94	7.83	8.18	8.01	7.97	
	A3: 60 sec.	8.29	8.15	8.10	7.94	8.31	8.13	8.11	
	Mean	8.17	8.06	7.99	7.86	8.16	8.01	8.00	
S3: 4 Months	A1: Control	7.94	7.86	7.78	7.62	7.75	7.69	7.73	
	A2: 30 sec.	8.01	7.90	7.83	7.66	7.86	7.76	7.80	
	A3: 60 sec.	8.23	8.09	8.04	7.84	8.15	8.00	8.02	
	Mean	8.06	7.95	7.88	7.71	7.92	7.81	7.85	
S4: 6 Months	A1: Control	7.50	7.57	7.41	7.02	7.65	7.34	7.37	
	A2: 30 sec.	7.76	7.71	7.61	7.32	7.67	7.50	7.55	
	A3: 60 sec.	7.97	7.99	7.86	7.42	7.97	7.70	7.78	
	Mean	7.74	7.75	7.63	7.25	7.76	7.51	7.57	
	Mean	8.07	7.99	7.91	7.74	8.04	7.88	7.90	
	Mean	7.90	8.01						
	SEm±	CD at 5%		SEm±	CD at 5%		SEm±	CD at 5%	
A	0.028	0.080	AxB	0.040	NS	CxS	0.046	NS	
B	0.023	NS	AxC	0.040	0.113	AxBxS	0.080	0.226	
C	0.023	NS	BxC	0.033	NS	AxCxS	0.080	NS	
S	0.033	0.092	AxS	0.057	NS	BxCxS	0.066	NS	
AxBxC	0.057	0.160	BxS	0.046	NS	AxBxCxS	0.114	0.319	
CV%				2.64					

Total plate count

Data pertaining to total plate count of the bottle gourd juice prepared using different microwave pre-treatment, preparation technique and pressing technique were free from microbial contamination up to 4 months of storage but detect TPC during 6 months of storage (Table 11). Thus, juice samples were safe for consumption up to 6 months of

storage in juice when juice was extracted from crushed bottle gourds, pre-treated with microwave for 60 seconds followed by complete pressing at 1 kg/cm² pressure (A₃B₂C₁S₄) having minimum TPC (CFU/ml). Similar observations recorded by Gajera *et al.* (2018) [3] for bottle gourd juice and Ashuqullah (2021) [1] for carrot juice.

Table 11: Effect of treatment combinations on the total plate count (x 10² CFU/ml) of bottle gourd juice

Storage Interval (S)	Microwave pre-treatment (A)	Preparation techniques (B)					
		B1: Shredding			B2: Crushing		
		Pressing (C)			Pressing (C)		
		C1: Complete	C2: Single strength	Mean	C1: Complete	C2: Single strength	Mean
S1: Initial	A1: Control	-	-	-	-	-	-
	A2: 30 sec.	-	-	-	-	-	-
	A3: 60 sec.	-	-	-	-	-	-
	Mean	-	-	-	-	-	-
S2: 2 Months	A1: Control	-	-	-	-	-	-
	A2: 30 sec.	-	-	-	-	-	-
	A3: 60 sec.	-	-	-	-	-	-
	Mean	-	-	-	-	-	-
S3: 4 Months	A1: Control	-	-	-	-	-	-
	A2: 30 sec.	-	-	-	-	-	-
	A3: 60 sec.	-	-	-	-	-	-
	Mean	-	-	-	-	-	-
S4: 6 Months	A1: Control	0.85	0.87	0.86	0.83	0.88	0.86
	A2: 30 sec.	0.48	0.54	0.51	0.47	0.55	0.51
	A3: 60 sec.	0.27	0.21	0.24	0.22	0.26	0.24
	Mean	0.53	0.54	0.54	0.51	0.56	

4. Conclusion

From the foregoing discussion, it can be concluded that bottle gourd juice can be prepared by bottle gourd slices by giving microwave pre-treatment for 60 seconds, shredding of slices followed by single strength pressing at 0.25 kg/m² pressure for juice extraction. Then aonla juice and sugar must be added to maintain 0.3% acidity and 12°B TSS. This is followed by heating, addition of 0.1% basil leaves extract, filling into glass bottles (1.0-1.2 cm head space) and heat processing at 95±1°C for 30 minutes. The bottle gourd juice prepared using this process can be successfully stored for six months in glass bottles without significant changes in physico-chemical, sensory and microbial quality at ambient temperature.

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