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Accelerate storage validation for the production of thermally processed bottle gourd *(L. siceraria)* blended juice

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ABSTRACT

Experiments were carried out during year 2014 at FPTBE College, AAU, Anand to study the accelerated storage validation to produce thermally processed blended juice. Accelerated storage conditions were at 37°C for 10 days and 55°C for 7 days as per food safety and standards act 2006, rules and regulations (FSSRs), 2011. The total soluble solids of blended juice samples was above 5 ^{0}brix and found no significant (P>0.05) effect after the storages, though it was most stable. The significant decreased in ascorbic acid was noticed higher after 7 days storage at 55 ^{0}C and the maximum loss was 11.31 %. The total plate counts (cfu/ml) were found below food safety standards rules and decreased remarkably during storages. The yeasts and moulds count (cfu/ml) in the blended juice were increased significantly (P<0.05) after 37°C for 10 days storage and showed inverse relationship with the 55°C for 7 days storage. As per standards, the product was stable and microbiologically safe, hence; validated for commercial production as it satisfies require accelerated storage conditions.

Key words : Bottle gourd, blended juice, accelerated storage, total plate counts

Bottle gourd (*Langenaria siceraria*), a vigorous annual climbing vine with large leaves belongs to *Cucurbitaceae* family and known as Calabash, Doodhi, and Lauki in different parts of India (Deore *et al.*, 2009). India, Sri Lanka, South Africa, Indonesia and Malaysia are the major bottle gourd producing countries in the world. The bottle gourd is also known in other places as White flowered gourd, Trumpet gourd, Calebassier, Courage bouteille (French) Cojombro, Guiro amargo (Spanish), Upo, Talayag, Gucuzzi, Zucca melon (Philippines), Mokwa, Oo Lo Kwa (China) (Axtell and Fairman, 1992). Bottle gourd fruit contains almost 96% moisture but is rich in vitamins, minerals, antioxidants and dietary fibers. A 100 g of edible portion of the bottle gourd contains 12.0 mg ascorbic acid, 87.0 mg potassium, 12.0 mg calcium, 37.0 mg phosphorus and 0.3 mg niacin (Rumeza *et al.*, 2006; Sawate *et al.*, 2009). Bottle gourd contents 1.6% choline on a dry weight basis and is a precursor to acetylcholine, a chemical used to transfer nerve impulses (Thomas, 2008).

Bottle gourd has long been an important component of indigenous herbal medicine, particularly in Asia (Robinson and Decker-Walters, 2004) and traditionally used as a nutritive agent having cardioprotective, cardiotonic, general tonic, diuretic, aphrodisiac, antidote to certain poisons, alternative purgative, and cooling effects (Deshpande *et al.*, 2008). Bottle gourd plant is seasonal and hence supply of bottle gourd fruit is not uniform through the year. The bottle gourd fruit having higher edible index (94.17 %) and lower waste index (5.83 %) which proves its importance for processing (Sawate *et al.*, 2009). It is still underutilized fruit in spite of being one of the cheapest source of nutrients and potential source of natural antioxidants and hence, steps should be taken to preserve this perishable but nutritionally important fruit by extending the shelf-life in the processed form. Production of superior quality juice is one way to process the bottle gourd but bottle gourd juice in its pure form is difficult to preserve because of its lower acidity (0.17 %) and high concentration of spore forming bacteria (Kothadia, 2010). Acidification may convert low acid juice to an acidic juice and allow the use of milder thermal process conditions (James and Shen, 2011). To prepare such natural form of low acid juices, Bottle gourd juice can be blended with other acidic fruit juices namely Aonla *(Emblica officinalis Gaertn.)* and Lemon *(Citrus x limon)* with spice extracts like Ginger *(Zingiber officinale)*.

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Production of such juice is mostly done manually in the household or at cottage level, which is less hygienic with high chances of degradation within few hours. Different processing conditions are used with little knowledge of the effect of the treatment conditions on the physiochemical and microbiological quality on the final stored product. Therefore, this research work was conducted to determine the effect of accelerated storage on quality of thermally processed bottle gourd blended juice and its validation for production at commercial level.

MATERIALS AND METHODS

Pre-treatments and juicing

Tender bottle gourd fruits (cv. ABG-1) and fresh aonla fruits (cv. Anand-2) were procured from the Horticultural Farm, Anand Agricultural University, Anand. Matured lemon and ginger were procured from the local vegetable market, Anand, India. Procured raw fruits were thoroughly washed in the running tap water to remove surface adhering extraneous material, insecticides, pesticides, contaminations and the other microbial load. The bottle gourds were sliced and blanched to inactivate peroxidase enzymes prior to juicing (Gajera *et al.*, 2014). Aonla fruits were also blanched in boiling water before juicing. The juice from the blanched bottle gourd slices and aonla fruits was extracted using the same centrifugal juicer (Rama udyog, Jaipur, India) and strained through muslin cloth. For juice extraction from lemon, fruits were cut into two halves with the help of stainless steel knives and juice was extracted by squeezing manually and strained through muslin cloth. For juice extraction from ginger, cut slices were fed into domestic mixer cum grinder and strained through muslin cloth.

Product development

All the four juices prepared as above were blended using central composite design with response surface methodology. Design expert® 8.0.7.1 (Statease Inc., Minneapolis, USA) software; based on numerical technique was used for optimization of the blended juice. Optimized blended juice as obtained was hot filled in pre-sterilized 200 ml glass bottles and crown corked using hand operated sealing machine. Hot filled crown corked bottles were immediately subjected to thermal processing in hot water. The temperature and time of processing were over 80, 85, 90 and 95°C for 5, 10, 15, 20, 25 and 30 min. The process was carried out at atmospheric pressure by immersing bottles into the autoclave (Nova Instruments Pvt. Ltd., Ahmedabad).

Accelerated storage

Thermally processed at above temperatures and time, cooled bottles of blended juice was subjected for accelerated storage at 37 °C for 10 days and 55 °C for 7 days in incubator (Khera Instruments Pvt. Ltd., New Delhi) as per food safety standards regulations as described by Nijhawan (2012).

Proximate analysis

The total soluble solids was measured using pocket hand refractometer-PAL-1(ERMA, Japan) having measuring range 0-53 °Brix. The ascorbic acid content of blended juice was determined by visual titration method using 2, 6-dichlorophenol-indophenol while total plate counts, yeast and mold counts and coli form counts were carried out using standard procedures as described by Ranganna (2004). For the analysis, ascorbic acid standard (99%) were procured from SD Fine Chemicals Mumbai, India, and plate count agar, PDA and VRBA were procured from Hi-Media Laboratories Pvt. Ltd., Mumbai. For all assays, de-ionized distilled water was used.

Statistical analysis

The data obtained (mean ± standard deviation) after the accelerated storage experiments were analyzed by BASIC statistical software using 2-factors, 4- 6 levels CRD and results were analyzed by analysis of variance using $p < 0.05$.

RESULTS AND DISCUSSION

Effect on TSS

The TSS observed was in the range 5.37 to 5.23 °Brix across the treatments after accelerated storages with maximum variation 0.14 °Brix (Fig. 1). The TSS was significantly affected over the processed temperature (T) at 5% level of probability. The TSS of blended juice was most stable with increased over processed time (PT), though it was not significant. However, the interaction of both the parameters was found to be non-significant after the storage (Table 1). Non significant increase in total soluble solids in blended juice after accelerated storages was might be due to hydrolysis of polysaccharides into monosaccharide and oligosaccharides. The result was supported by Majumdar *et al.*, (2009); Jan *and Masih*, (2012) and Kausar *et al.*, (2012).

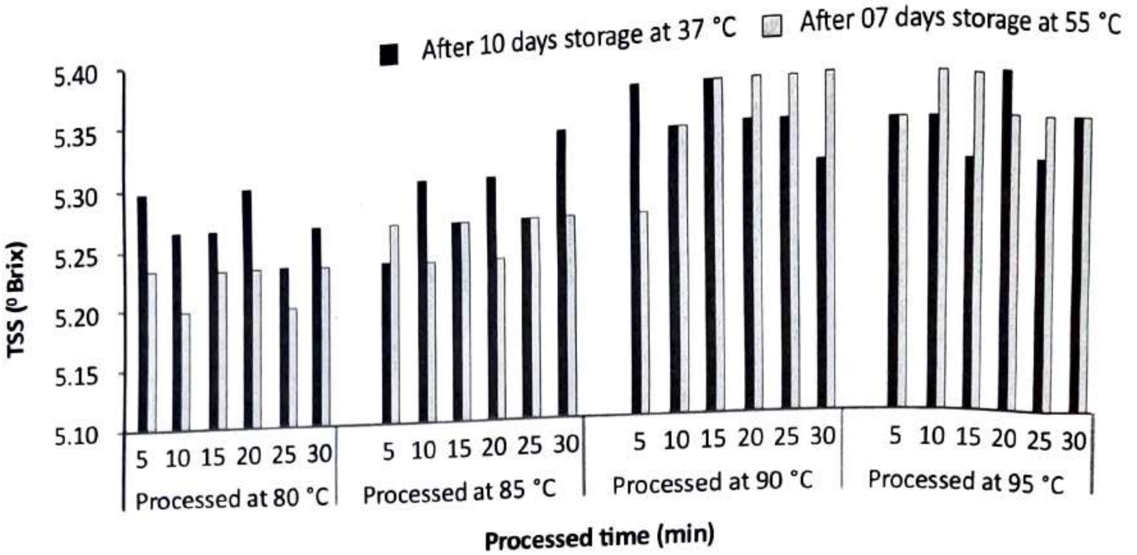

Fig. 1 Effect on total soluble solid of thermally processed blended juice after accelerated storage

Table 1 Statistically mean analyzed data showing the effect of thermally processed blended juice at varying processed time and temperatures on physicochemical and microbiological quality after accelerated storage

Treatment	TSS (⁰Brix)		Ascorbic acid (mg/100 ml)		Total plate count (cfu/ml)		Yeast & mould count (cfu/ml)	
	@	#	@	#	@	#	@	#
Processed time (PT)								
PT_1	5.3083	5.2750	34.0717	32.7967	18.2500	16.1667	2.5833	0.8333
PT_2	5.3083	5.2833	33.6642	31.8458	14.4167	12.9167	1.4167	0.5833
PT_3	5.3000	5.3083	32.4208	31.0775	7.6667	7.8333	0.9167	0.1667
PT_4	5.3250	5.2917	31.7742	30.3325	6.0000	5.1667	0.2500	0.0833
PT_5	5.2833	5.2917	30.3092	29.0683	3.5000	3.2500	0.0833	0.0000
PT_6	5.3083	5.3000	29.2867	28.1517	2.4167	2.0833	0.0000	0.0000
SEm ±	0.014	0.017	0.224	0.204	0.607	0.515	0.223	0.090
CD (P=0.05)	NS	NS	0.636	0.579	1.725	1.463	0.634	0.256
Processed temperature (T)								
T_1	5.2722	5.2222	35.1444	33.6200	15.7778	13.7222	3.5000	1.1111
T_2	5.2833	5.2556	33.5983	31.9883	10.3333	9.6667	0.0000	0.0000
T_3	5.3389	5.3444	30.4956	29.2978	5.5000	5.2222	0.0000	0.0000
T_4	5.3278	5.3444	28.4461	27.2756	3.2222	3.0000	0.0000	0.0000
SEm ±	0.011	0.014	0.183	0.166	0.495	0.420	0.182	0.073
CD (P=0.05)	0.033	0.039	0.519	0.473	1.408	2.013	0.518	0.209
Interaction (PT x T)								
SEm ±	0.028	0.034	0.447	0.407	1.213	1.735	0.446	0.180
CD (P=0.05)	NS	NS	1.272	1.158	3.449	1.195	1.268	0.512
CV %	0.92	1.11	2.43	2.31	24.13	22.57	88.32	112.25

PT_1=5 min, PT_2=10 min, PT_3=15 min, PT_4=20 min, PT_5=25 min and PT_6=30 min
T_1=80°C, T_2=85°C, T_3=90°C and T_4=95°C

@ Values after storage at 37⁰C for 10 days (mean ± std. deviation)
\# Values after storage at 55⁰C for 7 days (mean ± std. deviation)

Effect on ascorbic acid

The minimum ascorbic acid content of thermally processed blended juice was decreased to 6.44 % and the maximum 11.31 % after accelerated storage at 37 °C for 10 days and 55 °C for 7 days, respectively (Fig. 2). The significant ($P<0.05$) decreased in ascorbic acid was noticed higher at 55 °C temperature for 7 days. Processed time (PT) and temperature (T) increased indicated they were not governing independent (Table 1). Result confirmed that the low temperature long time storage of thermally processed blended juice exhibited a higher protective role of ascorbic acid than high temperature short time storage.

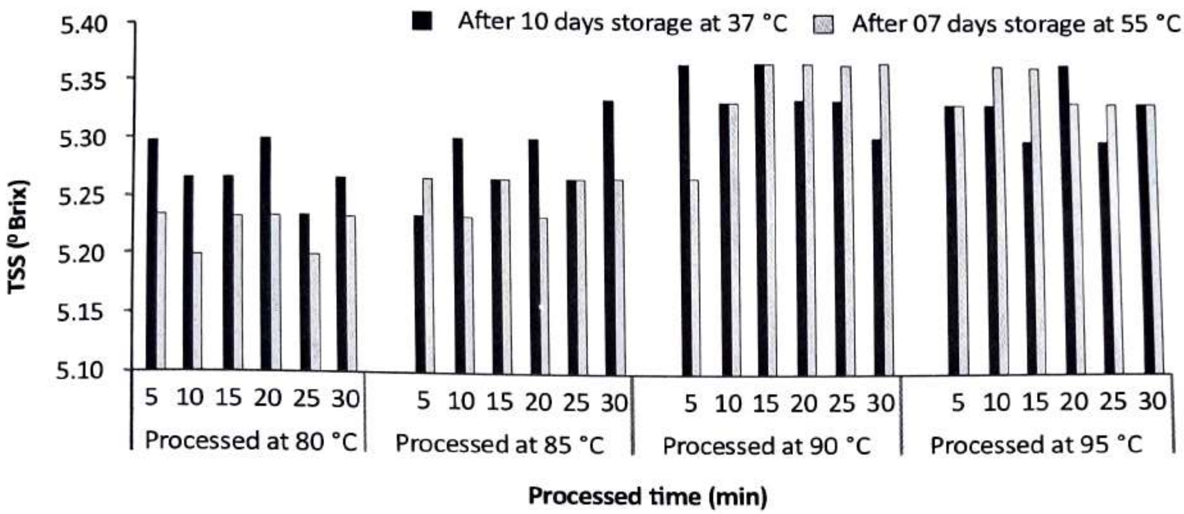

Fig. 2 Effect on ascorbic acid content of thermally processed blended juice after accelerated storage

Effect on total plate counts

maximum total plate counts in thermally processed blended juice was 31 and 28 cfu/ml after 37 °C for 10 days and 55 °C for 7 days, respectively (Fig. 3). The minimum total plate counts was nil after 37 °C for 10 days and 55 °C for 7 days in 30 min for 95 °C thermally processed blended juice. The total plate counts were decreased remarkably and had significant effect ($P<0.05$) after the storages (Table 1). However, decreased was higher in 55 °C for 7 days accelerated storage as compared to 37 °C for 10 days. This might be due to the inhibitory effect of thermophilic temperature of storage rather than masophilic towards the total plate counts of thermally processed acidic blended juice. The total plate counts were not grew which might be due to the acidic environment of the blended juice and stable TSS. The finding was in conformity with the results reported by Derossi *et al.*, (2011).

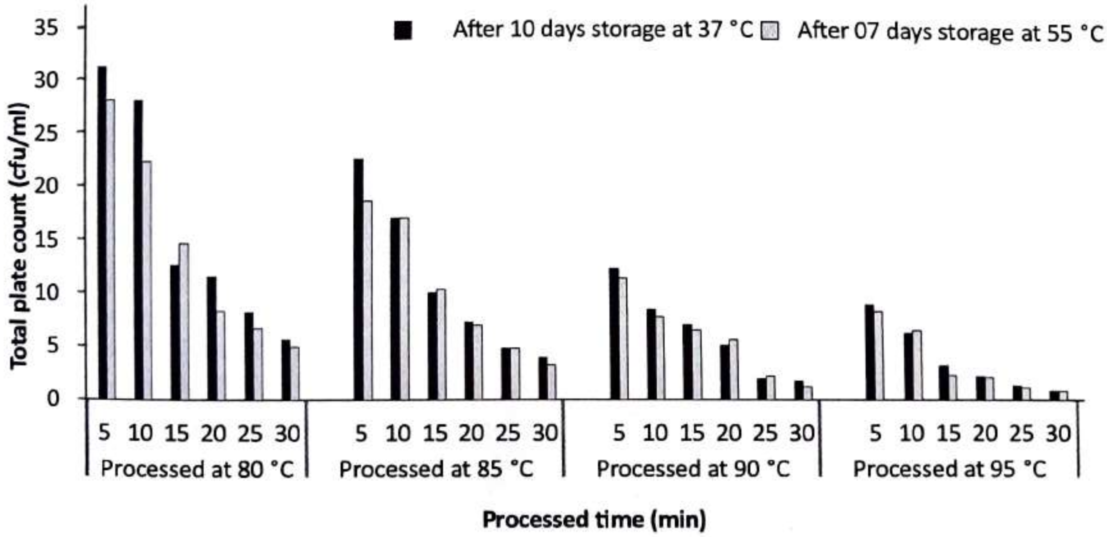

Fig. 3 Effect on total plate counts of thermally processed blended juice after accelerated storage

Effect on yeast and mould counts

The maximum yeast and mould counts were 10 and 3 cfu/ml, respectively after 37 °C for 10 days and 55 °C for 7 days accelerated storage in 5 min for 80 °C thermally processed blended juice (Fig. 4). The yeast and mould counts increased remarkably and significantly (P<0.05) after both the storages (Table 1). However, yeast and mould counts were absent after accelerated storage in thermally processed blended juice at 25 min for 80 °C and 5 to 30 min for 85 to 95°C. Result revealed that the yeasts and moulds can tolerate masophilic temperature rather than thermophilic temperature in the lower acidic environment of blended juice. The coli form counts (cfu/ml) was nil after both the storages.

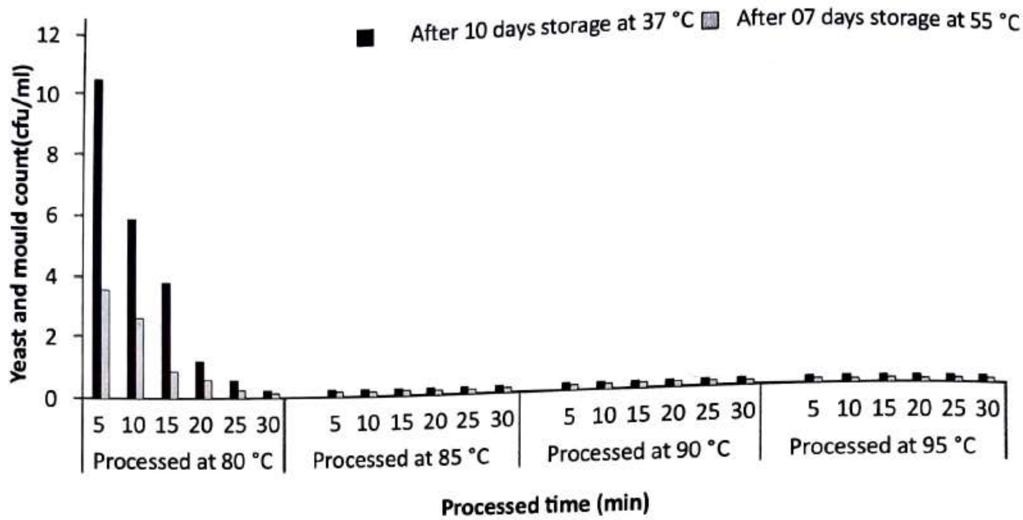

Fig. 4 Effect on yeast and mould counts of thermally processed blended juice after accelerated storage

CONCLUSION

After the accelerated storage, thermally processed blended juice TSS was above 5.0 °Brix and remained most stable. The total plate counts also were not more than 50cfu/ml after the storages as per food safety and standards act 2006, rules and regulations (FSSRs), 2011. The minimum and the maximum loss of ascorbic acid in blended juice was 6.44 and 11.31 % after accelerated storage at 37 °C for 10 and 55 °C for 7 days, respectively. The product was validated for commercial production, as it was stable and microbiologically safe after accelerated storages.

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