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Effect of Processing Parameters on Quality of Bottle Gourd (*Langenaria siceraria*) base Blend Juice

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Abstract: *Bottle gourd juice in its raw form is brown in colour, has off- flavour and unpleasant taste. Peroxides enzymes in bottle gourd were considered the most heat stable enzyme and it were used in the design of blanching process for juice extraction. Extracted bottle gourd juice was duly blended with Aonla (Indian gooseberry), Lemon and Ginger juices. The experiments were carried out at various temperatures and time to analyze the effects of processing parameters on the quality of blended juice. The significant effects (P<0.05) of processing temperature on pH and TSS in the blend juice was observed while, non-significant (P>0.05) interactions indicated the effects were non dependent. The ascorbic acid content in the blend juice was significantly decreased 42.36% at 95^{0}C for 30 min processing. The significant difference was observed in total plate counts and, yeast and mould counts (cfu/ml) in the blend juice. As per food safety and standards regulations (FSSRs), 2011, the best thermal process was found at 80^{0}C hot filled and processed at 80^{0}C for 30 min. At this temperature- time combination, 3.53 pH, 5.03 ^{o}Brix TSS, 39.94 mg/100 ml ascorbic acid, 25 cfu/ml total plate counts, 4 cfu/ml yeasts and moulds count, and nil coli form counts in the blend juice were obtained.*

Keywords: *Blend juice, Microbiological, Physicochemical, Thermal processing*

INTRODUCTION

India is the second largest vegetable producing country in the world next only to China with an estimated production of about 162.18 million metric tons from an area of 9.20 million hectares at an average yield of 17.62 metric tons per hectare [1]. Among various vegetables grown in India, bottle gourd (*Langenaria siceraria*) has a high place in human diet. Bottle gourd is a vigorous annual climbing vine with large leaves belongs to *Cucurbitaceae* family and locally known as Calabash, Doodhi, and Lauki in different parts of India [2]. Bottle gourd fruit contains about 96% moisture and is also a good source of vitamin B complex and choline along with fair amounts of vitamin C [3]. 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 [4, 5]. The bottle gourd fruit is a potential source of natural antioxidants [2].

Bottle gourd juice in its raw form is brown in colour, has off- flavour and unpleasant taste. The enzymes responsible for browning are peroxidase (POD) and poliphenoloxidase (PPO) [6]. The presence of residual endogenous enzymes in bottle gourd juice cause qualitative changes both textural and nutritional during the storage period. Bottle gourd juice in its raw form is difficult to preserve because of its lower acidity (0.17 %) and high concentration of spore forming bacteria [7]. Yeasts and molds can tolerate lower pH conditions than most bacteria [8]. Preservation of low acid juice for long term storage at ambient temperature, a high thermal processing temperature e" 121°C is also required. Acidification may convert low acid juice to an acidic juice and allow the use of milder thermal

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process conditions [9]. The most common acidifying agent for low acid juice is organic acid or citric acid. To prepare such natural form of low acid juices, it was blended with other acidic fruit juices such as aonla (Indian gooseberry) and lemon fruits to produce highly nutritive and stable blended juice.

Bottle gourd fruit is still underutilized in spite of being one of the cheapest source of nutrients and potential source of natural antioxidants and hence, steps was taken to preserve this perishable but nutritionally important fruit by extending the shelf-life in the processed form. Production of blend juice was one way to process the bottle gourd. Productions of such juices are mostly done manually in the household or at cottage level, thus making the process less hygienic with greater chances of degradation within few hours. Therefore, the objective of this work was to determine the thermal processing conditions for the bottle gourd base blend juice satisfying statistical, physicochemical and microbial criteria as per the required Food Safety Standards Regulations -2011 [10].

MATERIALS AND METHODS

Bottle gourd (cv. ABG-1) and aonla fruits (cv. Anand-2) were procured at a Horticultural Farm, Anand Agricultural University, Anand. Matured lemon (*Citrus x limon*) and ginger rhizomes (*Zingiber officinale*) were procured at a local vegetable market (Anand, India). Procured materials were cleaned and washed with running tap water. The bottle gourds were sliced in 5 mm, blanched for 3.67 min in boiling water to inactivate peroxidase enzymes. [11]. Aonla fruits were blanched in boiling water for 6 min and juices were extracted by centrifugal juicer (Rama udyog, Jaipur, India). Lemons juice was extracted by squeezing. Ginger rhizomes were sliced and fed into mixer cum grinder for juicing. Final juices were strained through muslin cloth and prepared blend juice. The blend juice was hot filled at 80 °C in 200 ml pre-sterilized glass bottles, crown corked and were thermally processed into the autoclave (Nova Instruments Pvt. Ltd., Ahmedabad) at 80 to 95 ^{0}C for 0 to and 30 min. Blend juice pH was measured by using digital pH meter (Systronics India Limited, Ahmadabad, India**).** The total soluble solids was measured using pocket hand refractometer-PAL-1(ERMA, Japan) having measuring range 0-53 ^{0}Brix. The ascorbic acid content of blend juice was determined by visual titration method using 2, 6-dichlorophenol-indophenol [12]. Microbiological values of total plate counts, yeast and mold counts and coli form counts were carried out using standard procedures [12]. The data obtained during the thermal processing experiments were analyzed by BASIC statistical software.

RESULTS AND DISCUSSION

Effect of thermal processing on pH of blend juice

Maximum pH observed was 3.53 at 80 °C for 5 to 30 min processing and at 85 °C for 5 to 15 min processing. Minimum pH was 3.52 at 85 °C for 20 to 30 min and rest of the thermal process carried out at 90 and 95 °C. (Figure1). pH of blend juice was 3.51 and during thermal processing the variation was 0.02. A significant effect of processing temperature (T) on pH of blend juice ($P<0.05$) was noticed (Table 1). However, non-significant interaction indicated the active acidity in the juice remains very much unchanged and the effect was not dependent. Result supported by Li *et al* [13], studied changes in quality attributes of longan juice.

Effect of thermal processing on TSS of blend juice

The initial TSS of blend juice was 5.17 and maximum variation observed was 0.14 ^{0}Brix after thermal processing (Figure 2). The TSS was significantly affected over the processing temperature (T) and not significantly with increase in processing time (t) at 5 % level of probability. However, the interaction of both the parameters was found to be non-significant (Table 1).

Effect of thermal processing on ascorbic acid content of blend juice

The ascorbic acid content of bottle gourd blend juice was decreased 17.46 % at lower temperature at 80 °C for 5 min and 42.36 % at higher temperature at 95 °C for 30 min processing (Figure 3). The significant decreased in ascorbic acid was noticed as processing temperature (T) and time (t) increased indicated both the factor was not governed

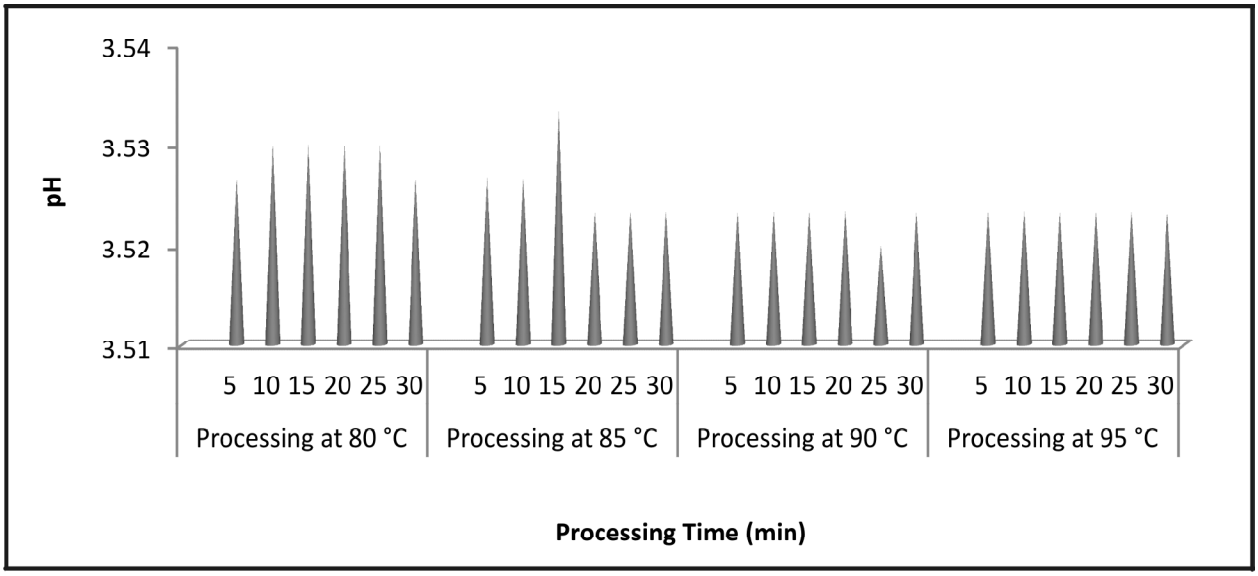

Figure 1: Effect of thermal processing on pH of blend juice

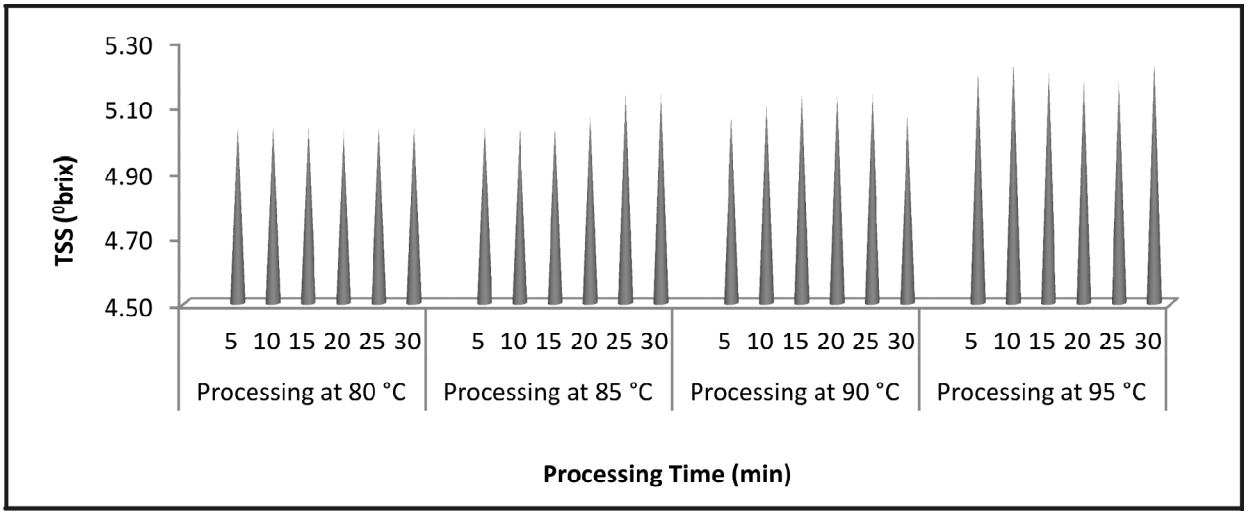

Figure 2: Effect of thermal processing on TSS of blend juice

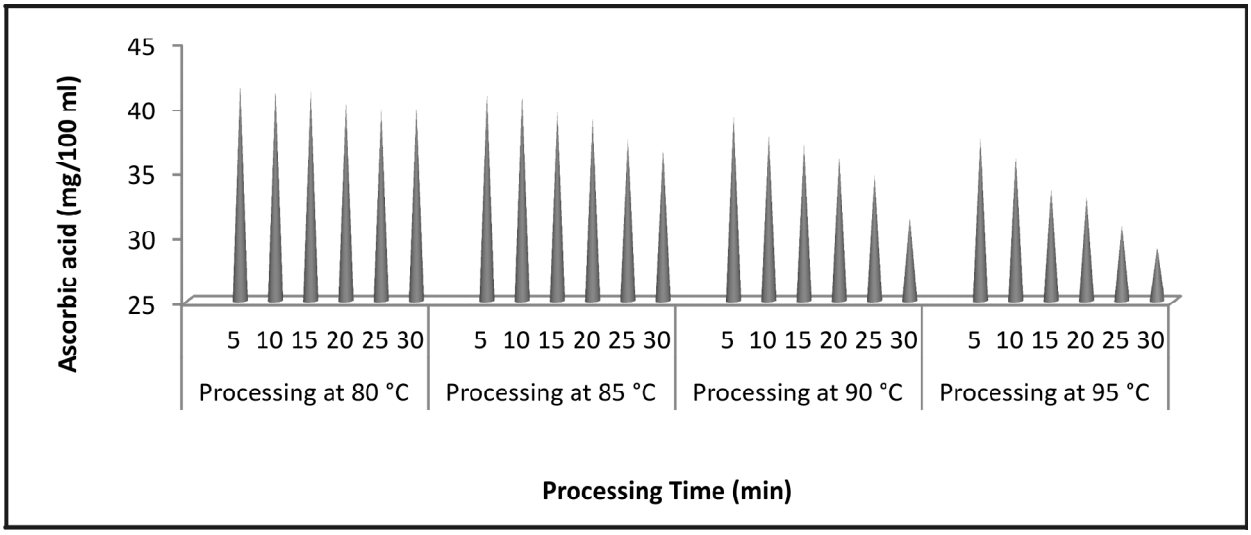

Figure 3: Effect of thermal processing on ascorbic acid content of juice

independently (Table 1). Result revealed that the low temperature long time (LTLT) processing exhibited a higher protective role of ascorbic acid in the blend juice than high temperature short time (HTST) but prolonging processing time increased the ascorbic acid losses more than the elevation of the processing temperatures.

Effect of thermal processing on microbiological quality of blend juice

Total plate counts in bottle gourd blend juice was found to be 122, 102, 79, 31 and 25, 17, 13, 4 cfu/ml at 80, 85, 90 and 95 °C for 5 and 30 min processing, respectively (Figure 4). Similarly, yeasts and moulds count in blend juice was found to be 9, 3, 0, 0 and 4, 0, 0, 0 cfu/ml (Figure 5). At the time of hot filled at 80 °C, the total plate counts and yeasts and moulds count in bottle gourd blend juice was 129 and 11cfu/ml, respectively which was higher than minimal thermally processed blend juice (Figure 4 and 5). The total plate counts decreased remarkably and significantly ($P<0.05$) as processing temperature (T) and time (t) increased. Yeasts and moulds count was absent in blend juice processed at e" 90 °C and their interaction was highly significant (Table 1). The coli form counts in blend juice at the time of hot filled at 80 °C was nil cfu/ml and was absent during the entire thermal process.

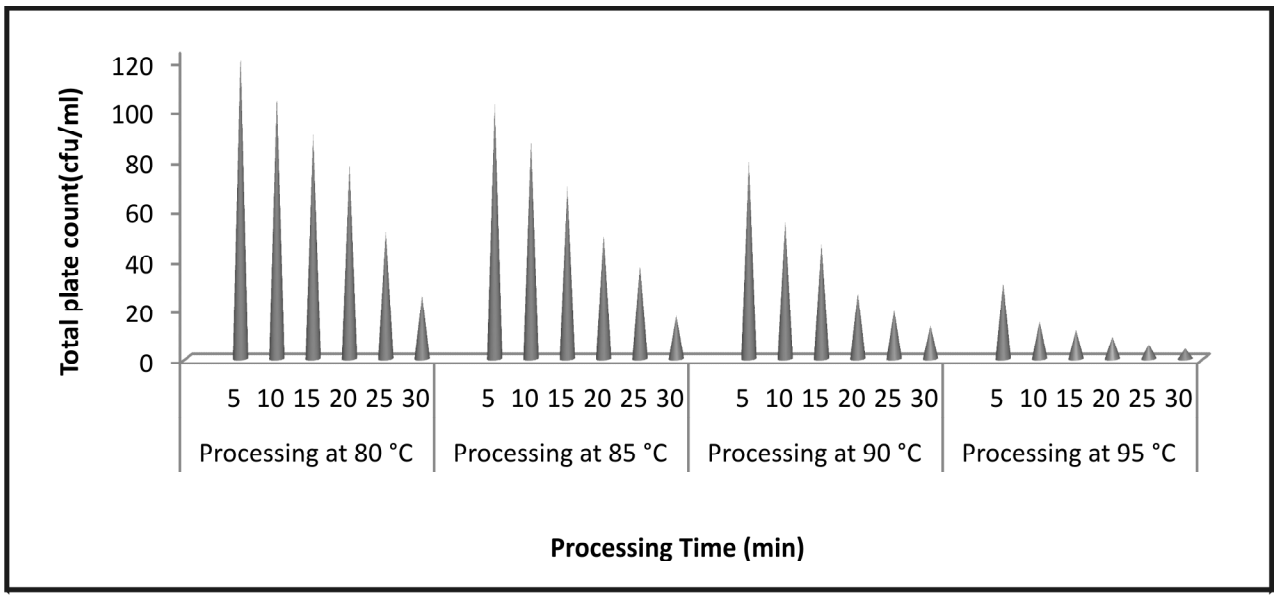

Figure 4: Effect of thermal processing on total plate count of blend juice

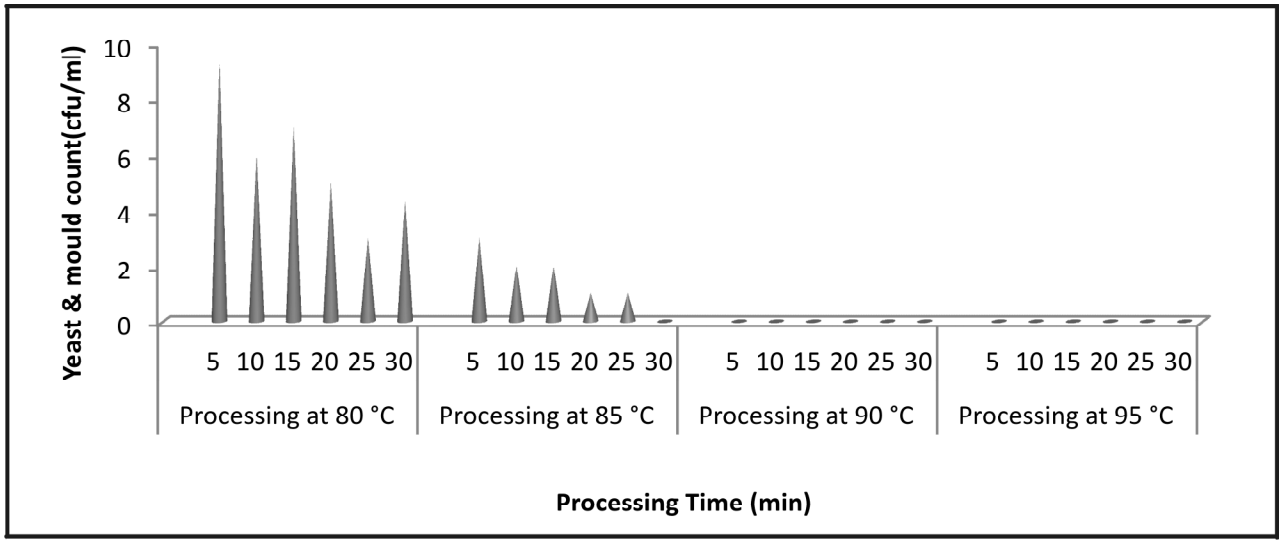

Figure 5: Effect of thermal processing on yeast & mould count of juice

Table 1
Effect of thermal processing on physicochemical and microbiological quality of the bottle gourd blend juice

Treatment	*pH*	*TSS (^{0}Brix)*	*Ascorbic acid (mg/100 ml)*	*Total plate counts (cfu/ml)*	*Yeast & mould counts (cfu/ml)*
Processing temperature, T (°C)					
80	3.5289	5.0333	40.7083	78.8333	5.6111
85	3.5261	5.0722	39.1239	60.5556	1.2778
90	3.5228	5.1056	36.0439	39.8889	0.0000
95	3.5233	5.2056	33.3794	12.5000	0.0000
SEm ±	0.001	0.014	0.130	1.325	0.124
CD (P=0.05)	0.004	0.040	0.368	3.766	0.353
Processing time, t (min)					
05	3.5250	5.0833	39.8833	83.5833	3.0000
10	3.5258	5.1000	39.0475	65.7500	2.0000
15	3.5275	5.1000	37.8658	54.2500	2.0833
20	3.5250	5.1083	37.1092	40.7500	1.4167
25	3.5342	5.1167	35.6825	28.5000	0.8333
30	3.5242	5.1167	34.2950	14.8333	1.0000
SEm ±	0.002	0.017	0.159	1.623	0.152
CD (P=0.05)	NS	NS	0.451	4.613	0.432
Interaction (T x t)					
SEm ±	0.003	0.035	0.317	3.245	0.304
CD (P=0.05)	NS	NS	0.902	9.225	0.865
CV, %	0.17	1.18	1.47	11.72	30.6

CONCLUSIONS

Thermal processing of bottle gourd blend juice at various time and temperatures were considered to optimize the process as per FSSRs (2011). The thermal process was optimized on the basis of no changes in pH and the total plate counts were not more than 50cfu/ml along with the maximum retention of quality (ascorbic acid and TSS) in thermally processed blend juice. Based on these process parameters, the best thermal process was found at 80^{0}C hot filled and processed at 80^{0}C for 30 min. At this temperature- time combination, 3.53 pH, 5.03 ^{o}Brix TSS, 39.94 mg/100 ml ascorbic acid, 25 cfu/ml total plate counts, 4 cfu/ml yeasts and moulds count, and nil coli form counts in the blend juice were obtained satisfying statistical, physicochemical and microbial criteria as per the required Food Safety and Standards Regulations.

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