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Development of Tomato Sauce Fortified with *Bael* and its Sensory and Chemical Evaluation

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Abstract: ***Bael fruit and Tomato have good medicinal and nutritional properties such as antidiabetic, antiulcer, antiseptic, antibacterial, anti-inflammatory, antioxidant and anticancer also, they are effective in treating stomach ailments, gastrointestinal problems, skin diseases, non-constipation, radiation injury, wound healing, burns, dysentery, and diarrhea and in the treatment of skin diseases, etc. Present study was designed to develop the nutritious and healthy food product. Bael enriched tomato sauce with various formulations and all were evaluated by sensory analysis. Materials required for it were Bael, Tomato, Garlic, Ginger, Cardamom, Sugar, salt. Three different samples A, B, and C with different proportions of ingredients such as tomato pulp 90,80,70.ml,Bael pulp 10,20,30ml, respectively for each sample, while the quantities of Ginger 2 gm ,Garlic 2 gm ,Cardamom 2 gm ,Sugar 17 gm, and salt 2 gm were kept constant for all three samples for 100 gm sauce. Sensory analysis was performed for each sample by using hedonic scale. Depending on the sensory evaluation we conclude that 'C' sample was the most acceptable sample for chemical analysis and commercial production. Further by the chemical analysis results we also conclude that Bael juice can be incorporated in the formulation of tomato sauce which in turn also helps in increasing its overall nutritive value.***

Keywords: *Bael*, Tomato, Sauce, Pulp, hedonic scale, Sensory analysis

1. Introduction

Sauces are generally thinner and contain more total solids (minimum 30%) than Ketchups (minimum 28%).Tomato, apple papaya, walnut, soybean, mushroom, etc., are used for making sauces, F.P.O. specifications.Sauces are of two kinds: 1) *Thin Sauces* of low viscosity consisting mainly of vinegar extract of flavoring materials like herbs and spices, and 2) *Thick sauces* that are highly viscous. Sauces are prepared from more or less the same ingredients and in the same manner as chutney, except that the fruit or vegetable pulp or juice used is sieved after cooking to give a smooth consistency to the final product. However, cooking takes longer because fine pulp or juice is used. Some sauces develop a characteristics flavour and aroma on storing in wooden barrels. High quality sauces are prepared by maceration of spices, herbs, fruits and vegetables in cold vinegar or by boiling them in vinegar. The usual commercial practice is to prepare cold or hot vinegar extracts of each kind of spice and fruit separately, and then blend these extracts suitably to obtain the sauces which are then matured. Thickening agents are also added to the sauce to prevent sedimentation of solid particles. Apple pulp is commonly used for this purpose in India but starch from potato, maize, arrowroot (cassava) and sago are also used.A fruit sauce should be cooked to such a consistency that it can be freely poured without the fresh tissues separating out in the bottle. The color of the sauce should be bright. Sauces usually thicken slightly on cooling. By using a funnel hot sauce is filled in bottles leaving a 2cm. head space at the top and the bottle are sealed or corked at once. The necks of the bottles, when cold, are dipped in paraffin wax for airtight sealing. It is advisable to pasteurize sauces after bottling since there is always a danger of fermentation, especially in tomato and mushroom based Sauces. Other sauces are more acidic and less likely to ferment but should be pasteurize all the same. For this the bottles are kept in boiling water for about in 30 min. [1].

Bael (*Aegle marmelos*),family Rutaceae, is also as Bale fruit tree, is a moderate sized, slender,aromatic tree, 6.0-7.5m in heightand 90to 120cm in girth, with a somewhat fluted bole of 3.0-4.5m growing wild throughout the deciduous forests of India, ascending to an altitude of 1200meter in the western Himalayas and also occurring in Andaman island[2]. Every part of *Bael* tree is utilized for various purposes. The wood is yellowish or grayish white, hard lustrous, aromatic when freshly cut. It takes a fine polish and is suitable for house building, part construction agricultural implements, carving pestles, tool handles, combs, etc., but the tree is too valuable to be felled for its timber [3][4].Physico-chemical studies have revealed that *Bael* fruit is rich in mineral and vitamin contents [5][6][7]. The life extract has preventing effects in isoprenaline (isoproterenol) -induced myocardial infarction in rats [8].*Bael* use as various therapeutic diseases, Cancer is one of the most dangerous diseases mainly because there is no complete treatment for it and also the treatments that are available for cuing the symptoms have lots of side effects, and are also not cost effective. Hence, search is going on to make available treatments of natural origin that will be cost effective and will show minimal side effects. *Bael* extract has been found successful in inhibition of *in vitro* proliferation of human tumor cell lines including Lecukenic K562, T-Lymphoid Jurat, Beta-Lymphoid Raji, and Erythro Leukemic HEL[9]. Diabetes has become a common disease around the world. When the body cannot produce ample of insulin, the blood glucose level increases. Antidiabetic aim at reducing the blood glucose level by inducing the production of a higher amount of insulin. *Bael* extract, when administered at a dose of 250 mg/kg of body weight, shows better result than glycenamide (antidiabetic drug). This antidiabetic effect may be due to the coumarins present in the fruit which induce the beta cells of 10 islets of Langerhans to produce insulin.

Aqueous extract of *Bael* seeds reduces blood glucose level in case of severe diabetic patients [10].

Tomato (*Lycopersiconesculentum*Mill.) is a major horticultural crop with an estimated globalproduction of over 120 million metric tons[11]. Tomato is the richest source of nutrients, dietary fibers antioxidant like lycopene and beta-caroteneand the compounds that protect cells from cancer [12].Apart from contributing nutritive elements, colour and flavour to the diet, tomatoes are also a valuable source of antioxidants, or chemo-protective compounds, and may thus be termed a "functional food"[13].The antioxidant potential of tomato is derived from a mixture of antioxidant biomolecules, including lycopene, ascorbic acid, phenolics, flavonoids and vitamin E, and is especially high in cherry tomatoes [14].Photochromehas also been implicated in the induction of lycopene accumulation [15].Fruit that are harvested at stages prior to full ripeness show an increase in lycopene content during postharvest ripening [16].Enzyme changes during ripening also determine the changes in the flavour and aroma constituents of the fruit [17].

1.1 Nutrition Benefit of Raw Material

Table 1: Nutritional value of Tomato/100gm

Principle	Amount
Energy	18 kcal
Carbohydrate	3.9 gm
Protein	0.9 gm
Total fat	0.2 gm
Vitamin-c	13 mg
Manganese	0.15 mg
Iron	0.3 mg

Source: USDA National Nutrient database

Table 2: Nutritional value of *Bael* /100gm [18][19][20]

Components	Value (%)
Water	64.2
Protein	1.8
Fat	0.2
Mineral	1.5
Fibre	2.2
Carbohydrate	30.6
Calcium	0.09
Phosphorus	0.05
Potassium	0.6
Iron	0.3
Vitamin A(IU)	186
Vitamin B_1	0.01
Nicotinic acid	0.9
Riboflavin	1.2
Vitamin C	0.01
Calorific value	129

2. Material and Method

2.1 Procurement of Raw Materials

Basic ingredients such as Tomato, *Bael*, Sugar, Garlic, Ginger, and Cardamomfor Sauce preparation were purchased from local market of Nashik. The present investigation was carried out in K. K. Wagh College of food technology, Nashik.

2.2 Various formulations designed for preparation of sauce from Tomato and Bael juice blend:

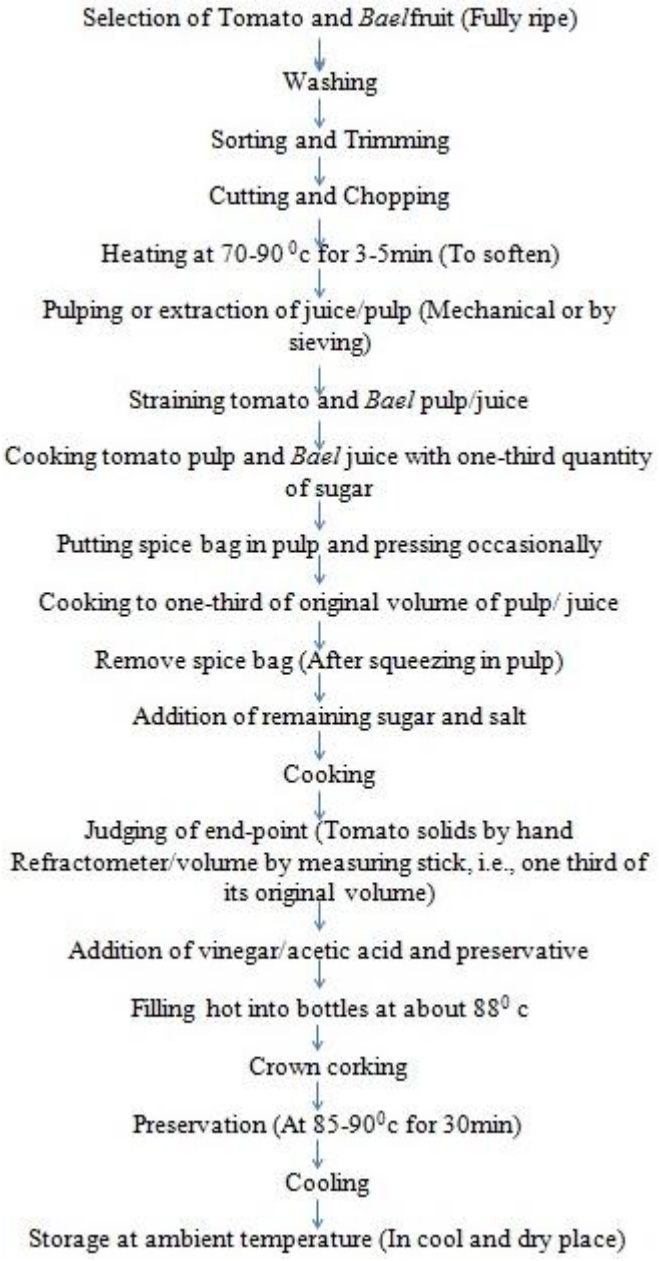
The blended Sauce having 30% T.S.S. (Total Soluble Solids) and 0.9 % acidity, with following blending ratios was prepared and further evaluated by sensory analysis.
Sample A) 90% Tomato juice + 10% *Bael* juice
Sample B) 80% Tomato juice+ 20% *Bael* Juice
Sample C) 70% Tomato juice+ 30% *Bael* juice

2.3. Preparation of *Bael* enriched tomatosauce:

Step 1: First fully ripped Tomatoes and unripe*Bael*fruitswere selected.
Step2: Tomato and*Bael*were washed with tap water and boiledat 70-90^0 for 5 min.
Step 3: Soft skin was removed by hand or knife and all tomatoeswere crushed by hydraulic press
Step 4: juice was removed by colander or drainer. And tomato juice was filtered by using muslin cloth.
Step 5: Cover of all *Bael* fruits were broken andpulp was removed by using spoon and finally *Bael*juice was extractedby using colander or drainer and filtered through muslin cloth.
Step 6:As per designed formulationsdifferent ratios of tomato pulp and *Bael* pulp were mixed.
Step 7: This mixture was kept for cooking with one third quantity of sugar. During cooking Spice bag was kept in the blend and frequently pressed.
Step 8: Remaining sugar and salt were added till reached up to 28^0 brix.
Step 9: Finally vinegar or acetic acid was added as a preservative.
Step 10: hot sauce up to 88^{0}c was filled in the bottles and allowed for cooling at room temp. Further proper packaging was done and stored at ambient temperature.

Flow Chart

Flow-sheet of *Bael* enriched tomato sauce [1]



3. Sensory Evaluation

The best blended Sauce was selected by sensory evaluation which was conducted on 9 point Hedonic Scale for different sensory attributes like appearance color, flavor and over all acceptability by a panel of 20 semi- trained members having experience of sensory evaluation of fruits and vegetable products

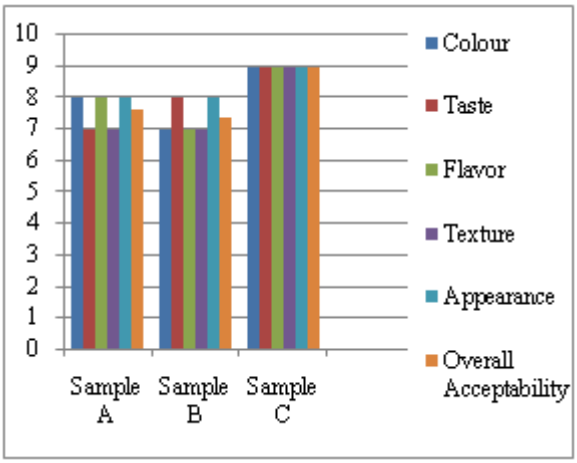
3.1. Nutritional Evaluation by Chemical Analysis

Nutritional evaluation of Sauce made from the Tomato and *Bael* blend was done for parameters like moisture, ash, fat and protein,theirdetermination was done according to AOAC 2000 methods. Protein content was obtained by using conversion factor of 6.25, Dietary fibre was determined by (IS: 11062).

4. Results

Table 3: Average of Sensory analyses Data

Samples	Sensory Attributes					
	Color	Appearance	Texture	Flavour	Taste	Overall Acceptability
A	8.0	8.0	7.0	8.0	8.0	7.8
B	7.0	8.0	7.0	7.0	8.0	7.4
C	9.0	9.0	9.0	9.0	9.0	9.0



Graph 1: Sensory analysis Chart of Bael enrich tomato sauce

Chemical Analysis

The data obtained for chemical properties such as TSS, acidity, moisture content, Ash Content, protein, fat for the sample "C" were recorded for fresh sample (Table.4)

Table 4: Chemical analysis for 100 gmssample:

Chemical attribute	Values
TSS(^{0}B)	30^{0}Brix
Protein (g) %	0.13
pH	5.30
Ash content %	0.31
Acidity (%)	0.96
Fat (g)%	0.1

5. Discussion

5.1 Sensory Analysis

The Tomato and Bael fruit juice were blended in various ratios that are 90:10, 80:20 and 70:30. The experimental Sauce prepared using Tomato and Bael fruit was evaluated by sensory analysis. Mean scores obtained for the various proportions by sensory analysis are given in Table 2:The sensory attributes „Colour and Appearance" of the Sauce made from Tomato and Bael for 70:30 proportion i.e. for C treatmentnoted highest mean score 9.0 where as treatment „A" and „B" were not much acceptable by colour and appearance point of view. The average scores forattribute „texture"were noted to be maximum for treatment „C" followed by „B" and „A" treatments. Similarly mean score for another sensory attribute „Taste" noted highest again for treatment „C".For sample „A"average score obtained for sensory attribute „Taste"was noted to be minimum and highest for sample „C" while for sensory attribute „Flavor"Minimum average score observed to treatment „B"

and highest for sample „C". The sample „A" and „B" were almost unacceptable because of decreasing concentrationof *Bael* juice.Following remarks were obtained by the panelist for all three test samples: Sample „C'obtained „Liked extremely" remark, while Sample „A" received „Liked very much" and „B"got "Like Moderately" remarks respectively.Though Bael juiceisarichsource of nutrients but it has not been accepted due to its poor taste and flavor. Blending tomato and Bael is good options to improve the utilization of Bael. Similar kind of research was done by (Mishra and Chopra, 2006) was prepared a mixfruit jam from *Bael* and mango in this final optimized jam had 45%mixed pulp ,70%T.S.S. and 0.5%acidity based on organoleptic characteristic[21]. Thus over all acceptability of sample „A" and „B" was good but sample „C" received highest hedonic scale score by all the panelist, therefore it wasselected for chemical analysis and large scale production.

5.2 Chemical Analysis

Furthertest Sample „C" has wasselected for chemical analysis. Following chemical parameters for 100gms of sample were evaluated: Initially TSS was measured by refractometry method and it was noted to be 30 ^{0} brix. Similarly Protein estimation for sample C was carried out by micro Kjeldhal method and it was observed to be 0.13% .pH was also noted be acidic i.e. 5.30, while acidity of sample C was estimated by titrimetric method and it was observed to be 0.96 %.Finally ash content and fat content in the sample C were determined by using muffle furnaces and Soxhlet apparatus and they were noted to be 0.31 % and 0.1 % respectively. Thus results of chemical analysis have revealed the safe and nutritional characteristics of the innovative food product.

6. Conclusion

Depending on the sensory evaluation we conclude that „C" sample was the most acceptable sample for chemical analysis and commercial production. Further by the chemical analysis results we also conclude that*Bael*juice can be incorporated in the formulation of tomato sauce which in turn also helps to increase its overall nutritive value.

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