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A Study on Development of Herbal Food Product- Bael (Aegle Marmelos) Fruit Toffee

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Abstract: *In India Aegle marmelos is commonly known as bael and belonging to Rutaceae family. This fruit have unlimited potential in its processed form. The present study was carried out with the objective to prepare toffee by incorporation of various herbs like cardamom and cinnamon and to assess the acceptability and nutritive value of the products prepared. The bael fruit toffees were prepared from bael pulp with sugar, ghee, milk powder, corn flour, citric acid and different proportion of cardamom and cinnamon (0.5g, 1.0g and 1.5g respectively). These samples of toffees were tested for chemical properties like moisture, total ash and acidity. All the seven products and data obtained during investigations were statistically analyzed by using analysis of variance techniques. Organoleptic properties were analyzed by 9 point hedonic scale. The mean score of toffees for color and appearance were 5.92, flavour - 6.4, texture – 6.19, taste – 6.43 and overall acceptability – 6.27. On the basis of findings toffee prepared with 0.5g cardamom was found the best in the case of color and appearance, texture, overall acceptability and 1.0g cinnamon powder in case of taste and flavor and the difference in the hardness was significantly different (P≤0.05).*

***Keywords*:** *Aegle marmelo, toffee, cardamom, cinnamon, sensory quality*

I. Introduction

India is second largest producer of fruits and vegetables in the world after China. The fruits and vegetables processing in India is highly decentralized, small scale industries accounting for 33%, organized 25 %, unorganized 42% and large number of units in cottage/house hold and small scale sector, having capacities of up to 250 tonnes/annum [1]. Due to absence of facilities and lack of knowledge for proper handling, distribution, marketing and storage of perishable fruits during certain parts of the year in different regions are wasted in large quantities. Furthermore, massive amounts of the perishable fruits and vegetables produced during a particular season result in a glut in the market and become scarce during other seasons. Quality of fruits in pre and post harvest influences the consumer acceptance. The changes that occur in various physical and chemical characters determine the quality and in turn the economic return to the producers and processors [2]. The hot season also showcases an indigenous fruit, which is not as popular but those who are aware of its existence love it with whole heart- the Bael and it is commonly known as Bengal quince, Indian quince, golden Apple, Holy fruit, Bel, Belua, Sriphal and Maredo in India [3, 4].

1.1 Different Names Of Bael Fruit

- Hindi – Bael. Beel, Sriphal
- Marathi – Bael
- Gujarati – Bili
- Bengali – Bilbam
- Telgu – Maredu, Bilbpandu
- Tamil – Bilbam
- Punjabi – Bil
- Sindhi – Katori
- Oria – Belo
- Pharasi – Beh Hindi, Bal
- Latin – Aegle Marmelos Corr

According to *Jauhari et al. 1969*, it can be processed into various delicious products like candy, squash, toffee, slab, pulp powder and nector from bael fruit [5].It works brilliantly as a marmalade or jam because of its sticky nature. The bael pulp is cooked in sugar and there is also a use of some spices such as cinnamon, star anise etc. to make it more flavourful. Bael fruit has very medicinal value and also has anti-fungal properties.The fruit is much used in India as a liver and cardiac tonic and when unripe, as a means of halting diarrhoea and dysentery and for effective treatment for hiccough, sore throat and disease of the gums [6]. Bael fruit has ability to combat constipation and it is have aromatic, cooling and laxative properties. Aegle marmelos has been used as herbal medicine for the management of diabetes mellitus in Ayurvedic, Unani and Siddha

systems of medicine in India [7]. Its medicinal properties have been described in the ancient medical treatise in sanskrit in Charaka Samhita [8].

1.2 Nutritional Value Of Aegle Marmelos

The fruit of a marmelos posses high nutritional value. It is used to make juice, jam, syrup, jelly, toffee and other products. The pulp is reported to contain water, sugar, protein, fiber, fat, calcium, phosphorus, potassium, Iron and vitamins (Vit A, Vit B, Vit C and Riboflavin). Aegle marmelos fruit pulp reported for the availability of steroids, terpenoids, flavonoids, phenolic compounds, lignin, fat and oil, inulin, protein, carbohydrates, alkaloids, cardiac glycosides and flavonoids [9]. Fruit is said to act as a tonic for heart and brain. Analysis of fruit gave the average value of moisture 61.5%. Its food value is 88 calories/100gm. Thus, it is richer than most of the reputed fruits like apple, guava and mango which have a calorific value of only 64, 59 and 36 respectively [10].

Table 1.Nutritional Value of Bael (Amount of Bael: 100gms) [11]

Nutrients	Amounts
Protein	1.8gm
Carbohydrates	
Total carbohydrates	31.8gm
Fat	
Total fat	0.3gm
Vitamins	
Riboflavin	1.19mg
Niacin	1.1mg
Thiamin	0.13mg
Vit A	55mg
Vit C	8-60mg
Minerals	
Calcium Phosphorus	85mg 50mg
Potassium	00mg

1.3 Cardamom

Small cardamom belongs to the family Zingiberaceae, order scitaminae and known as the "Queen of spices". It is a rich spice obtained from the seeds of a perennial plant, Elettaria Cardamomum Maton, locally known as "elaichi" [12]. Cardamom is an ancient spice and has longest influence in India, its birth place and it is considered a superior quality in the international market. The ancient Greeks and Romans also use it in food medicines and perfumes [12]. Cardamom founds in two forms "Green Cardamom" (*Elettaria Cardamom*) and "Black Cardamom" (*Amomum Subulatum*). Cardamom seeds have a pleasant aroma, slightly pungent taste and are rich in volatile oil that mainly includes phenolic and flavonoid components. The composition of cardamom oil has been studied by various researchers [13, 14] and the major compounds found were 1,8 cineole (20-60%) and a terpinyl acetate (20-55%). Cardamom has been used for the variety of conditions as an antivenom drug. Cardamom oil is effective as an antioxidant and can increase levels of glutathione [15], a natural antioxidant in body [16, 17]. Current research has implicated cardamom's potential therapeutic value as an inhibitor of human platelet aggregation [18]. Seeds of *E. cardamomum* posses anti-inflammatory, analgesic and antispasmodic. Powdered cardamom, posses antihypertensive activity. At a dose of 3g, it significantly decreases diastolic pressure. It enhances fibrinolysis and improves antioxidant status, without significantly altering blood lipids and fibrinogen level in hypertensive patients [19]. It possess gastro protective effect [20]. Cardamoms have Haematological and Lipid peroxidation activities [18]. Cardamom is used in promoting skin complexion, destroying itching and pustules [12]. It can also be used to ease cigarette addiction. Eating a few seeds of cardamom can safely be recommended to initially minimize the number of cigarettes being smoked and slowly the smoker may give up the chronic addiction to chain smoking [21]. In the present day stress-prone population cardamom is often used as cardiac stimulant [22]. Some of the components of cardamom posses mutagenicity and carcinogenicity [23].

1.4 Cinnamon

Cinnamon (*Cinnamomum verum*, synonym *C. zeylanicum*) is a small evergreen tree, 10-15 meters (32.8-49.2 feet) tall, belonging to the family Lauraceae, native to Sri Lanka and South India [24]. Cinnamon bark has been used as a spice in daily life not only for cooking but also in traditional and modern medicines with out any side effects. Cinnamon is not only the most important flavouring agents in the food and beverages industry but also have a medicinal property which plays a key role in the advancement of human health. "True" cinnamon (*Ceylon cinnamon*) is the dried bark of *Cinnamomum verum* and approximately 250 spices have been identified among the cinnamon genus. The most important constituents of cinnamon are cinnamaldehyde and

Trans cinnamaldehyde (cin), which are present in the essential oil, thus contributing to the fragrance and to the various biological activities observed with cinnamon [25]. Cinnamon also improves health of the colon, there by reducing the risk of colon cancer [26]. Cinnamon also increases the blood circulation in the uterus and advances tissue regeneration [27]. Its essential oil and other constituents also have important activities, including antimicrobial [28,29], antifungal [30], antioxidant [19, 11], and antidiabetic [31, 32]. Cinnamon has been used as anti-inflammatory [33, 34], antitermotic [34], insecticidal [35], antimycotic [35],[36], anticancer agent [37, 38], and anti-ulcer. Cinnamon has also been traditionally used as tooth powder and to treat toothaches, dental problems, oral microbiola and bad breath [39, 40]. Analgesic [41, 42] and Wound-healing [43] effect of its ethanol extract have been shown in laboratory rats. Also, no significant adverse effects of cinnamon have been found in human studies [44]. Considering the above mentioned evidence on the possible efficacy and safety of cinnamon extract, plus the lack of any human studies on its analgesic and healing effects, this study was conducted to determine the effect of a 10 day application of 2% cinnamon extract ointment on episiotomy wound. Cinnamon is found very safe in acute toxicity in animals and being used as spice for ages.

II. Material and Methods

The experiments were carried out in the laboratories of Institute of Food Technology (A Center of Excellence) of Bundelkhand University, Jhansi (UP) India in the year 2015 with a view to analyze the physico-chemical characteristics and sensory attributes of fresh fruit and its processed product. The details of material and experimental procedures during the course of the present investigation have been elaborated under the following heads:-

2.1 Collection Of Material

Bael, sugar, milk powder, ghee, corn flour, citric acid, cardamom, cinnamon and preservatives (KMS) were collect from the local market.

2.2 Selection Of The Method Of Preservation

Food preservation has an important role in the conservation and better utilization of fruits and vegetables. In order to avoid gult and utilize the surplus during the season, it is necessary to employ methods to extend storage life, for better distribution to preserve them for utilization in the off season both in large scale and home scale [45]. Fully matured with turn up of colour (light yellow colour) of bael fruit were used for processed product and washed with tap water as well as made into half horizontally. Opening a bael involves applying force to open the shell, then scooping out the sticky resinous orange flesh. There are several ways to extract bael's sticky resinous flesh, none of which are high tech. Hammer was used to gently pound the shell until it cracks the fruit. Each fruit has approximately 10-15 seeds. Removing these small, hairy (yet edible) seeds are advisable but not necessary. Scoop the flesh into a shallow bowl and squish the flesh with the spoon or fingertips. Manually remove the seeds once the flesh is pasty or by passing through 20 mesh stainless steel sieves and after that added 1 percent potassium meta-bisulphite (KMS) to the bael pulp. The prepared product or pulp was filled into sterilized glass beaker with the capacity of 500gm and closed air tight with aluminum foil and stored at room (25°C-37°C) and refrigerated (8°C-10°C) temperatures. *Roy and Singh (1972)* also stated the method of extraction of bael fruit pulp for making some other bael products [46].

Fig: 1. Preserved bael pulp

2.3 Preparation Of Fruit Toffee

Fruit toffee is a nutritional product, has chewy texture and is a good source of dietary fiber and natural sugar. A confection, bael fruit toffee is prepared by combining the pulp with sugar, ghee, milk powder, corn

flour and citric acid. Indian food technologists view the prospect for expanded bael fruit processing as highly promising. The process involved in fruit toffee preparation is shown in fig-2.

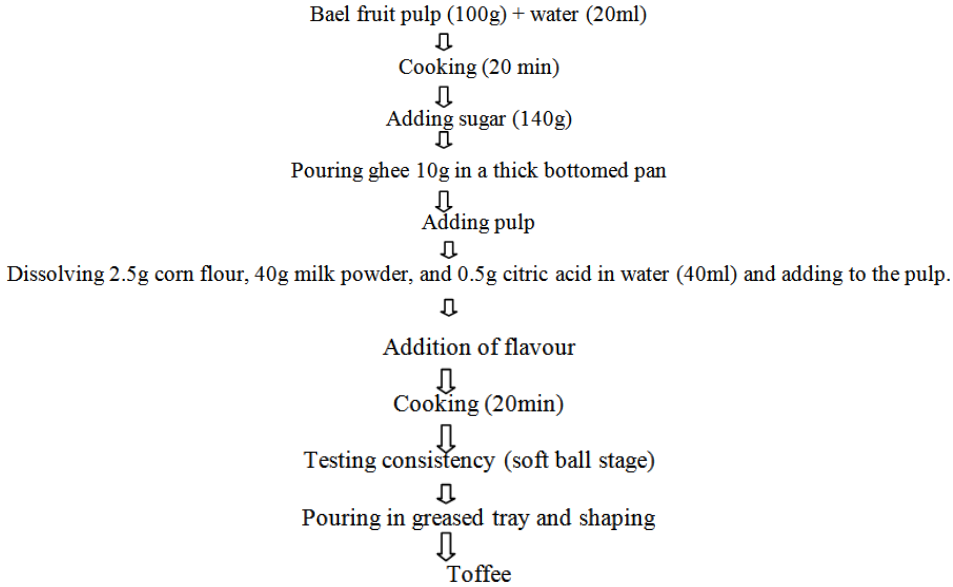


Fig: 2. Flow diagram for the preparation of bael fruit toffee

III. Experimental Design Layouts

The levels of ingredients were selected based on basic trials by keeping the pulp quantity constant as 100g. The independent variables considered were: cardamom quantity (0.5g-1.5g) and cinnamon quantity (0.5g-1.5g). A two variables (three levels of each variables), 3 level factorial design was used to understand the changes on the texture, taste, colour, flavour, overall acceptability, moisture and ash content of the prepared fruit toffee.

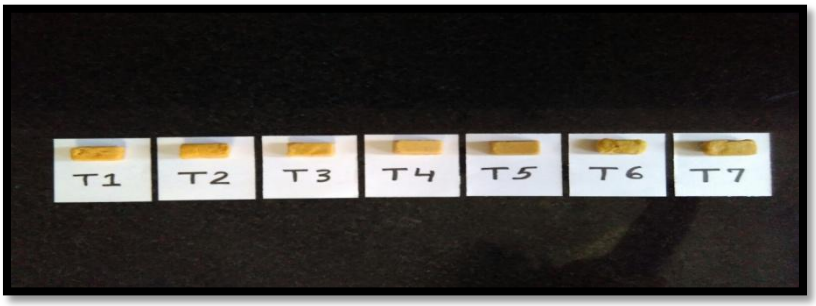


Fig: .3 Bael fruit toffees

Table 2. Details of treatments were as follow

Samples	Cardamom (gm)	Cinnamon (gm)	Ranking for further study
Sample101	-	-	T1
Sample 102	0.5	-	T2
Sample 103	-	0.5	T3
Sample 104	1.0	-	T4
Sample 105	-	1.0	T5
Sample 106	1.5	-	T6
Sample 107	-	1.5	T7

3.1 Physico-Chemical Analysis Of Bael Fruit Toffee

The physico-chemical analysis of bael fruit toffee was done using the following procedures.

3.1.1 Texture Profile Analysis

Hardness of fruit toffee was measured by stable Micro- system Texture Analyzer (model TAXT2i). A compression plate was used in conjunction with a texture analyzer [47]. Pre-test speed was set to 2 mm/s, a test speed of 2 mm/s, post-test speed of 5 mm/s and distance of 7mm. The absolute peak force was considered as the hardness of the bael fruit toffee.

3.1.2 Moisture

This was determined by I.S.I. 1984 [48]. Ten gram sample was taken in a previously dried and tare moisture dish and kept in an oven maintained at 60°C ± 1 and after drying cooled in a dessicator and weighed. The process of heating, cooling and weighing was repeated until the difference between two successive weighing is less than 1 mg. The loss in weight was used to calculate percent moisture as follows:

$$\text{Moisture percent by weight} = \frac{100(\text{M1} - \text{M2})}{\text{M1} - \text{M}}$$

Where, M 1 = weight in gm of dish with material before drying
M 2 = weight in gm of dish with the dried material
M = weight in gm of empty dish

3.1.3 Ash

AOAC (1984) procedures were followed for ash determination. Sample of 5 gram taken in a silica dish was ignited on heater and later shifted to a muffle furnace until clean ash was obtained. The temperature of furnace as raised to 400°C ± 15°C. The weight of residue was noted and the percent ash was determined as follows:

$$\% \text{ Total ash} = \frac{100(W3 - W1)}{(W2 - W1)}$$

Where, W1 = Weight of empty dish,
W2= Weight of dish containing sample,
W3 =Weight of dish containing ash

3.1.4 Titrable Acidity

To obtain the sample in the suitable form, the following procedures are employed: Dissolve a known weight of the sample in boiling water and mix thoroughly or heat on steam bath to dissolve, if necessary. Cool and make up a known volume. Take aliquots for determination. If insoluble material is present, filter before taking aliquots.

1. *Colorless or slightly colored solution*: Dilute an aliquot of the sample prepared as above with the recently boiled distilled water. Titrate with 0.1N NaoH using a few drops of 1% phenolphthalein solution as indicator. Note the titre value. Calculated the results as percent anhydrous citric acid [49].

$$\% \text{ Total acid} = \frac{Titre \times Normality\ of\ alkali \times Volume\ made\ up \times Equivalent\ wt.of\ acid \times 100}{Volume\ of\ sample\ taken\ for\ estimation \times Wt.of\ sample\ taken \times 1000}$$

3.2 Organoleptic Analysis Of Products

Sensory evaluation offers the opportunity to obtain a complete analysis of the various properties of food as perceived by human sense. Sensory evaluation is an important and best method for evaluating new developed which provide quality measure and production control. The sensory evaluation was done using a score card developed [50].

Following 9 point hedonic scale

Like Extremely	9
Like Very Much	8
Like Moderately	7
Like Slightly	6
Neither like nor dislike	5
Dislike Slightly	4
Dislike Moderately	3
Dislike Very Much	2
Dislike Extremely	1

IV. Results and discussions

The present investigation was envisaged to develop highly nutritious bael fruit toffee. The toffees were analyzed for physico-chemical characteristics, sensory attributes and textural properties. The results of present investigation are discussed in three sections:

- Effect of flavour ingredient on quality of fruit toffee.
- Effect of flavour ingredient on sensory characteristics.
- Effect on textural characteristics of the bael fruit toffees.

Table 3. Proximate composition of bael fruit toffee

Treatments	Moisture (%)	Ash (%)	Acidity (%)
T1	8.8	8.2	0.35
T2	13.5	9.6	0.37
T3	11.2	6	0.38
T4	10.5	6.2	0.40
T5	9.7	9.2	0.39
T6	13.7	8.2	0.41
T7	9.8	8.4	0.40
Mean	11.03	7.97	0.39
S.D	1.91	1.38	0.02
S.E±	0.72	0.52	0.01

4.1 Chemical Composition Of Toffees

Moisture The moisture content of bael fruit toffees were ranged from 8.8 to 13.7%. From the results presented in Table 3 it is revealed that the moisture content in T6 is maximums as compared to other sample. However, the moisture content is minimum in control sample (T1). The result showed that every sample has higher amount of moisture than control sample. After control sample bael fruit toffee in combination with 1 g cinnamon (T5) was found best on the basis of its sensory attributes and it contains 9.7% moisture. The selected product was evaluated for various physico-chemical parameters.

Ash The ash value is a measure of the amount of added minerals. Natural ash content is due to the minerals like calcium, phosphorus and iron. Ash content of the food stuff represents inorganic residue remaining after destruction of organic matter. From the result presented in Table 3, it is revealed that the T2 contain maximum ash content and there is minor difference between ash content of T2 (9.6) and T5 (9.2). However, the ash content is minimum in T3 (6.0). Difference in ash content between the samples is due to the mineral content present in cardamom and cinnamon. It has also been observed that in bael fruit toffee with cardamom-0.5g, cinnamon-1.0g and 1.5g amount there was increase ash as compared to control sample while decrease in cinnamon-0.5g, cardamom-1.0g and 1.5g amount.

Titrable Acidity The acidity value is a measure of stability and shelf life of toffee. It is due to the organic acid in fruits and those which are added while making toffee. Titrable acidity studied to ensure physico-chemical changes during preparation. The titrable acidity of bael fruit toffee ranged from 0.35 to 0.41%. The control sample (T1) had acidity 0.35, while the treatments T2, T3, T4, T5, T6 and T7 had 0.37, 0.38, 0.40, 0.39, 0.41 and 0.40% respectively**.**

4.2 Statistical Analysis

The product bael fruit toffees were freshly prepared and organoleptically evaluated by a panel of judges selected from Institute of Food Technology, Bundelkhand University, Jhansi. The products were judged for the quality such as colour, flavour, taste, texture and overall acceptability with the help of 9 point hedonic scale [50]. The data obtained from the sensory evaluation was statistically analyzed by using analysis of variance techniques (SPSS) to evaluate the significance at $p<0.05$. Differences were considered significant when $P<0.05$.

Table 4. Mean Sensory Evaluation values and TPA values for developed bael fruit toffees

Treatments	*Colour*	*Flavour*	*Taste*	*Texture*	*Overall acceptability*	*Hardness*
T1	*7.75±0.79*	*6.90±1.29*	*6.90±1.35*	*6.65±1.25*	*7.04±0.88*	*6434.0±10.99*
T2	*7.00±1.41*	*6.35±0.94*	*6.30±0.95*	*6.75±0.79*	*6.60±0.69*	*5190.8±12.90*
T3	*6.40±0.81*	*6.75±1.18*	*6.35±1.45*	*6.45±0.96*	*6.48±0.84*	*4338.8±12.80*
T4	*6.25±1.18*	*5.75±1.14*	*6.25±0.86*	*6.10±1.20*	*6.08±0.68*	*3796.8±12.21*
T5	*5.45±1.26*	*6.90±1.10*	*7.15±1.16*	*6.40±1.60*	*6.47±0.88*	*3200.8±12.66*
T6	*4.40±1.71*	*6.65±1.42*	*6.30±1.77*	*5.80±1.40*	*5.78±1.20*	*2107.0±16.45*
T7	*4.20±1.69*	*5.50±1.35*	*5.70±1.60*	*5.20±2.04*	*5.17±1.34*	*1423.5±16.13*
F Ratio	*10.022**	*2.177***	*1.119***	*1.570***	*3.440**	*4.887**

Note: Results are mean ± SD of sensory analysis score cards and the three determinants of TPA.
*The mean difference is significant at the 0.05 (5%) level. ** Non-significant at 5%.

Colour and appearance It is evident from Table 4 and Fig 4 that the highest score for colour was scored by T2 (7.0) after control sample (T1) followed by T4, T3, T5, T6 and T7. In ANOVA Table (in SPSS) the p-value of colour (0.000) is much smaller than our chosen alpha level of .05, so we can conclude, once again, that the observed difference between the samples is statistically significant.

Flavour Flavour score for bael fruit toffee ranged from 5.5 to 6.9. There was non-significant difference in the scores for flavour. The flavour of T1 was as good as T5 and both treatments scored maximum (6.9), while treatment T7 scored minimum (5.5). The increase in score of flavour might be due to 1gm cinnamon in toffees. *Taste* The score for taste was 6.9, 6.3, 6.35, 6.25, 7.15, 6.3 and 5.7 for treatment T1, T2, T3, T4, T5, T6 and T7

respectively (Table 4). The amount of 1gm cinnamon in toffee might be responsible for giving good taste score to the toffee. ANOVA table of taste shows non-significant difference between all the seven treatments.

Texture The score for texture of bael fruit toffees were in the range 5.2 to 6.75. The best texture found in the toffee treated with 0.5gm cardamom scored maximum (6.75), while T7 scored minimum (5.2). It can conclude that there was non-significant difference ($p \leq 0.05$) between the seven treatments of toffee regarding texture.

Overall acceptability The data presented in Table 4 shows that toffee score highest overall acceptability of 7.04. The highest value of overall acceptability for toffee may be due to it sweet and sour taste which can easily be related to its Vit C content which aids to its sourness. There were significant differences among the treatments for overall acceptability (Table 4). The bael fruit toffee Overall acceptability score was observed maximum for treatment T2 (6.6) and minimum for the treatment T7 (5.17).

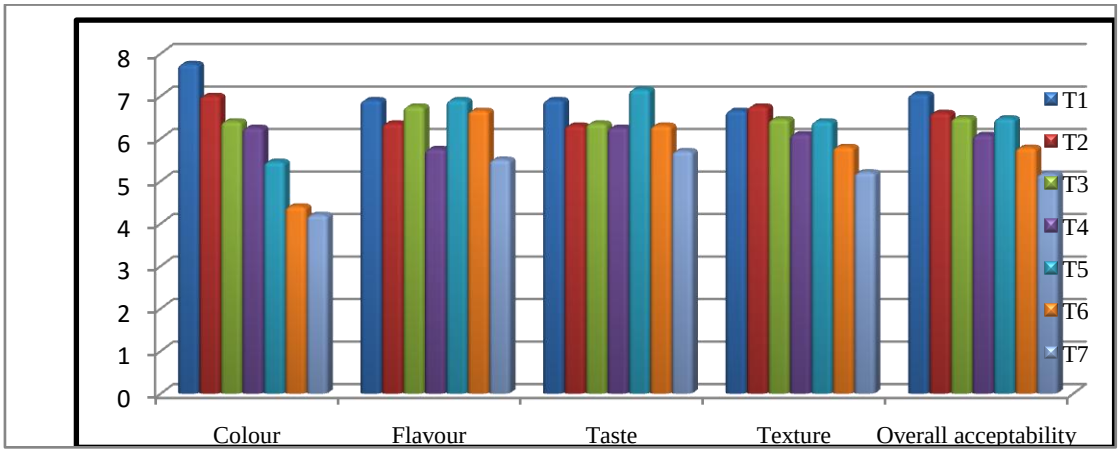


Fig: 4. Response of the treatments on physiological characters of bael fruit toffee

The texture analysis was done with the help of stable micron system texture analyzer TAXT2i. It is above device used to study various mechanical forces applied during the experiment. It used to study many parameters such as hardness, crispiness, sponginess, firmness, etc. by using different kind of probes. The texture analyzer measures the desired force and plots a graphical image which can be easily available to the users for the further analysis.

The hardness value is the peak force of the first compression of the product. The cutting probe was used for the evaluation of requirement of force to cut the product. During the test the probe distance was fixed at 7 mm, pre-test speed of 2mm/sec and load cell of 50 kg to complete test. On the basis of Table 4 it can be concluded that treatment T1 had maximum hardness (6434.0) and minimum in T7 (1423.5). In the present study we observed that all the treatments had less hardness than control sample that is T1. All these data were analyzed by one-way ANOVA (Analysis of Variance) and it was found that the hardness was significantly different at 5% level of significance (Table 4).

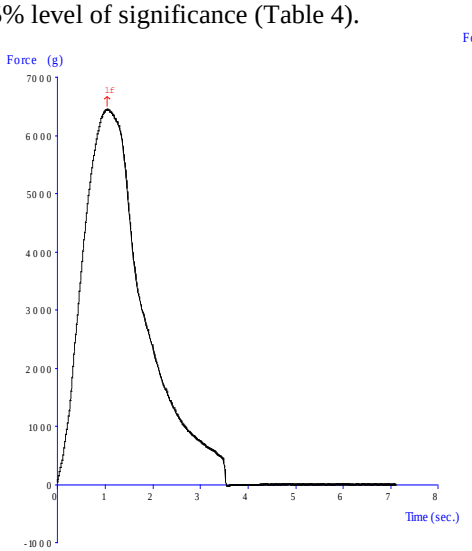
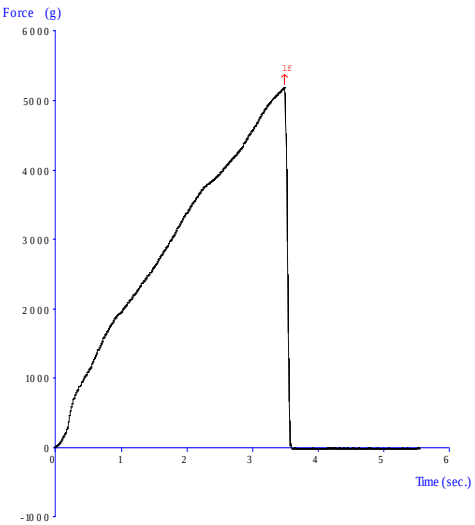


Fig: a



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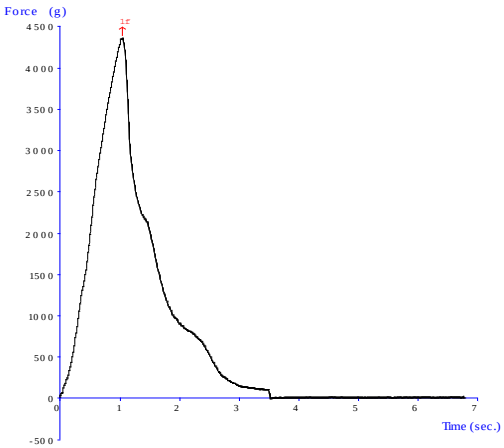

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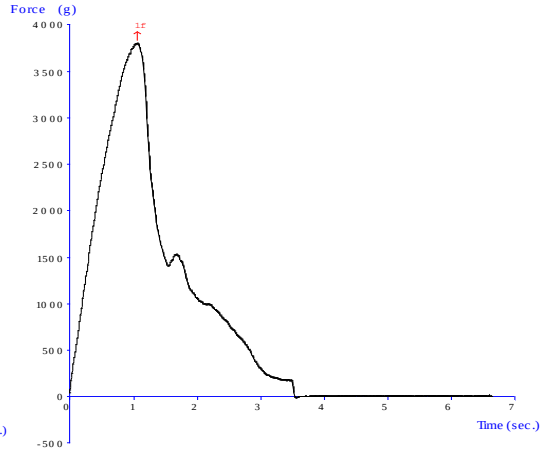

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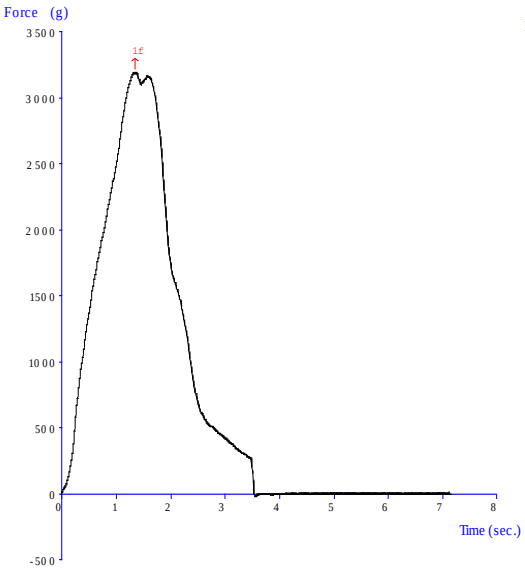

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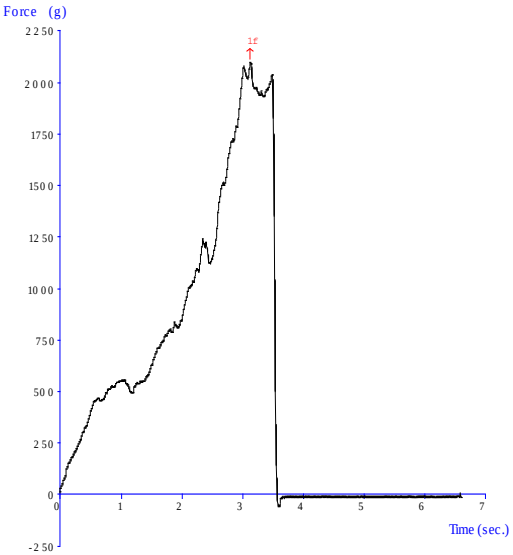

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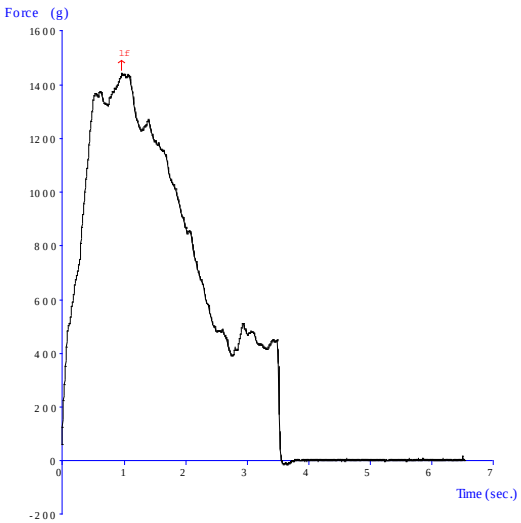

Fig: g

Fig: 5.(a,b,c,d,e,f,g) shows the cutting force of the sample T1, T2, T3, T4, T5, T6 and T7 respectively.

V. Conclusion

Bael fruit has a lot of potential to be processed for value addition. Its flavour is acceptable by almost all classes of people as a refreshing drink in the summer. Toffee is one of the most acceptable products largely consumed by children. The confectionary products due to its varied taste and flavour have a wide acceptance in children throughout the world. The different levels of ingredients for preparation of bael fruit toffees showed that all these variables markedly affect texture, taste, flavour, and overall acceptability score and moisture, ash, acidity of the prepared fruit toffees. The bael fruit toffees prepared from cardamom and cinnamon at different proportion were found almost similar with respect to proximate composition. However, the treatment T2 had highest scores for all sensory quality attributes except flavour than the rest of the treatments. On the basis of flavour, treatment T5 was found best. Instead of having high nutritional properties bael is still being used only by unorganized sector and is not being given much emphasis for its commercial utilization in term of value added products. The above developed product may be a good use of therapeutic values of bael fruit in combination with cardamom and cinnamon.

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