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History

Although thought to have originated in South America, pineapples were first discovered by Europeans in 1493 on the Caribbean island that came to be known as Guadalupe. When Columbus and other discoverers brought pineapples back to Europe, attempts were made to cultivate the sweet, prized fruit until it was realized that the fruit’s need for a tropical climate inhibited its ability to flourish in this region. By the end of the 16th century, Portuguese and Spanish explorers introduced pineapples into many of their Asian, African and South Pacific colonies, countries in which the pineapple is still being grown today.

Since pineapples are very perishable, and modes of transportation to bring them stateside from the Caribbean Islands were relatively slow centuries ago, fresh pineapples were a rarity that became coveted by the early American colonists. While glazed, sugar-coated pineapples were a luxurious treat, it was the fresh pineapple itself that became the sought after true symbol of prestige and social class. In fact, the pineapple, because of its rarity and expense, was such a status item in those times that all a party hostess had to do was to display the fruit as part of a decorative centrepiece, and she would be awarded more than just a modicum of social awe and recognition.

In the 18th century, pineapples began to be cultivated in Hawaii, the only state in the U.S. in which they are still grown. In addition to Hawaii, other countries that commercially grow pineapples include Thailand, the Philippines, China, Brazil and Mexico.

2.1 Introduction of Pineapple

Sen (1990) reported that 0.6 g acid was present in 100 g edible portion of pineapple fruit which contained 63 mg vitamin C. The pineapple fruits contained 13.0 % sugar and 0.05 g mineral matters.

Kumar (1992) reported that the fruit weight of the kew or Giant kew cultivar of pineapple varies from 1.6 to 3.0 kg. The fruit length varied from 20 to 25 cm and
diameter from 11.0 to 14.5 cm in the same variety. The content of pomace in the fruit of giant kew was lower (45 to 50 %) as compared to those of Queen (60-65 %) and Maritus (65 to 70%).

Gherandi et al. (1994) observed significant difference between the contents of sugars, organic acids, amino acids, metals and nitrates in the core and the flesh parts of pineapple fruits.

Cruck et al. (1994) reported that boiling is desirable in order to cause intimate mixing of fruit pulp and sugar and partially to concentrate the product by evaporation of excess moisture and also suggested the sheet test for examining the end point.

Lal and Pruthi (1995) reported that the ascorbic acid content kew or Giant kew and Maritus varieties of pineapple varied from 6.1 to 2.6 mg/100 g edible portion.

Ahmed and Bora (1998) revealed that there was no significant different in total soluble solid content in the fruits of cultivar kew harvested during difference months of the year.

Nokatoh (1999) found that summer fruits of pineapple had higher total soluble solids than winter fruits and also observed that the flesh and the peduncle portion were richest in total soluble solids, reported that summer fruits of pineapple had lower ash content than winter fruits.

Roy et al. (2000) reported that seven tropical fruits which are presently under utilized. These are aonla, jackfruit, pineapple, karonda kokum and phalsa. Medicinal and culinary uses are highlighted. It is concluded that a number of acceptable products can be prepared from these fruits.

Nazrul et al. (2004) reported that, Pineapples are being cultivated in this area in association with different kinds of trees and vegetables. Honey Queen is the most

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popular variety at the studied area. Farmers cultivate pineapples as ratoon crops and usually extend their garden by transplanting suckers in new sloping land. Fifty one percent of respondents who cultivate pineapple in association with trees pointed out the number of harvested fruits per hectare to be more than 2500. Fruit weight was also higher in the case of associated crops compared to that in sole cropping. All the farmers planted Gamari with pineapples followed by Jackfruit (82%), Olive (47%), Mango (46%), Jam (42%), Koori (38%), and some other tree species. Among all the vegetables, pumpkin has made the best association (i.e. 53%) with the pineapple. Benefit cost ratio (BCR) was found the highest (5.11 and 3.38) in the associated crop production.

Chand et al. (2007) reported that Pineapple (Ananus comosus) is non-climacteric fruit grown widely in Meghalaya. It is rich in vitamin C, magnesium calcium, potassium, iron and the protein digesting enzyme, bromelain. Kew and Queen are the two promising cultivars of pineapple In North East India. Kew variety is characterized by the big sized fruits (1.5-2.5 kg) which are oblong and tapering slightly towards the crown. The flesh is light yellow and very juicy when ripe. Queen variety fruits are of the weight 0.9-1.3 kg in general. The flesh is deep golden-yellow less juicy than Kew, crisp textured with a pleasant aroma and flavour. Pineapple plants flower 10-12 months after planting and fruits become ready 16-18 months after planting. In natural condition it is harvested during May-August. Fruits which mature in the winter are acidic. The fruits with crown can be kept for 10-15 days after harvesting.

Reinhardt and Rodriguez (2009) reported that Pineapple is a very well known fruit all over the world and within the tropical fruits it represents the largest processed volume, generating several kinds of products like canned and frozen pineapple (in slices and pieces) and juice (single strength and concentrate). Brazil is one of the largest growers of pineapple in the world, but is insignificant as industrial processor. The Asian producers focus on the total usage of pineapple, that is primarily fresh fruit combined with canning and juice production, where juice is basically a by-product. In South America, fresh fruit is also the main usage, but the canning industry is not well developed and juice is produced from the whole fruit. Pineapple juice concentrate is
applied to produce ready-to-drink pineapple juice or nectar and as main constituent in blends for multi fruit juices, nectars and juice drinks. The reason for that is that pineapple juice is considered as "cheap juice solids" compared to other fruit juice concentrates available, and as the concentrate is relatively neutral, it fits very well for blending with other tropical and exotic fruit juices of higher added value. Prices for juice concentrates on the international market are historically in the range of 1.000 to 1.300 US$/ton CFR Rotterdam, which means a huge challenge for efficiency in the whole industrial chain. Considering an annual world production of pineapple around 18 million t, we estimate that only roughly 1/3 is being industrially processed, mainly by canning (~30%) and to juice (4%), being 2/3 consumed as fresh fruit. To further promote pineapple for industrial processing and value addition, several factors are crucial: integration of grower and processing industry, fruit type versus application, product portfolio, processing technology, logistics, marketing and promotion, and long term planning.

Das et al. (2011) reported that Pineapple (Ananas comosus (L.) Merr.) is an important tropical fruit that shares about 50 per cent of global fruit market. Worldwide, 82 countries produce pineapple in economic quantities on about 950 thousand hectares and Brazil is the highest pineapple producing country in the world which shares about 14 per cent of world pineapple fruit production. Cultivation of pineapple is introduced in India only 4-5 decades ago and it has very little significance in terms of area coverage (about 1% of total fruit area) in the country. India, having about 84 thousand hectare under pineapple cultivation, shares about 8.42 per cent of world pineapple area and 6.5 per cent of pineapple production. This fruit is grown in states like Assam, Meghalaya, Tripura, Mizoram, Manipur, Nagaland, West Bengal, Kerala, Karnataka and Goa on a large scale. West Bengal is an important fruit growing region in the country. The state shares about 3.34 per cent of total fruit area and 4.27 per cent of total fruit production in the country. It contributes around 24 per cent of country's total pineapple production and North Bengal provides the major bulk of this. Uttar (North) Dinajpur and Darjeeling are two most important pineapple growing districts in the state and an Agri-Export Zone on pineapple is in operation in this zone to induce the farming folk towards
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the avocation. Time series analysis explores that growth and progress of pineapple cultivation in the country is not encouraging at all. Area under pineapple in the country is increasing non-significantly at 0.009 per cent per annum and its production is increasing (also non-significantly) at 0.017 per cent per annum. In contrast to the general trend, both area and production of pineapple in two most important pineapple growing districts in West Bengal are increasing at significant rate. But the progress is much below the expected level due to some inherent constraints which are analyzed.

Petronella (2011) reported that Pineapple is one of the most popular tropical fruit that is well known for its juicy sweet taste. This delicious fruit is also known as Pina, Nanas and Ananus. This fruit is rich in nutrition. It has a high content of vitamins, minerals, fibers and enzymes. This fruit is totally fat free and so help to maintain an ideal body weight and provide a balanced diet for those who want to be fit. Pineapples are a good source of vitamin-C and cholesterol free. This healthy nutritious fruit can be eaten raw as well as can be used in preparing various tasty recipes. The sodium content of the fruit is also very low. The micro nutrients content of this fruit helps to protect us from many diseases like cancer, stroke and other heart problems. Pineapple juice also helps to kill intestinal worms and helps to relieve intestinal disorders. The chemicals that this fruit contain stimulate the kidneys and aids in removing toxic elements in the body. An enzyme called bromelain that blocks the production of kinins which is formed during inflammation. This helps reducing swelling brought by arthritis, gout, sore throat and acute sinusitis. Surgical wounds or any wounds received due to injury can be healed fast by having pineapple juice.. In all, the pineapple fruit has many beneficial effects to our body. For the patients of tuberculosis, the juice of this fruit is found to be very helpful and effective to cure the disease by dissolving the mucus. Pineapples are also rich in manganese that is needed for your body to build bone and connective tissues. Pineapple also strengthens the bones of older people as well as the growth of bones in younger generation.
Table no 2.1

**Introduction to Food Rating System Chart**

U.S. Food and Drug Administration's "Reference Values for Nutrition Labeling."

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Amount</th>
<th>DV (%)</th>
<th>Nutrient Density</th>
<th>World's Healthiest Foods Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manganese</td>
<td>2.56 mg</td>
<td>128</td>
<td>30.3</td>
<td>Excellent</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>23.87 mg</td>
<td>39.8</td>
<td>9.4</td>
<td>Excellent</td>
</tr>
<tr>
<td>Vitamin B1 (thiamin)</td>
<td>0.14 mg</td>
<td>9.3</td>
<td>2.2</td>
<td>Good</td>
</tr>
<tr>
<td>Copper</td>
<td>0.17 mg</td>
<td>8.5</td>
<td>2</td>
<td>Good</td>
</tr>
<tr>
<td>Dietary fiber</td>
<td>1.86 g</td>
<td>7.4</td>
<td>1.8</td>
<td>Good</td>
</tr>
<tr>
<td>Vitamin B6 (pyridoxine)</td>
<td>0.13 mg</td>
<td>6.5</td>
<td>1.5</td>
<td>Good</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>World's Healthiest Foods Rating</th>
<th>Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>DV&gt;=75% OR Density&gt;=7.6 AND DV&gt;=10%</td>
</tr>
<tr>
<td>very good</td>
<td>DV&gt;=50% OR Density&gt;=3.4 AND DV&gt;=5%</td>
</tr>
<tr>
<td>Good</td>
<td>DV&gt;=25% OR Density&gt;=1.5 AND DV&gt;=2.5%</td>
</tr>
</tbody>
</table>

Pineapple Enzyme

Eapen (2007) reported that Pineapple is a digestive aid and a Natural Anti-Inflammatory fruit. A group of sulfur-containing proteolytic enzymes in pineapple aid digestion. Fresh pineapples are rich in bromelain. Bromelain has demonstrated significant anti-inflammatory effects, reducing swelling in inflammatory conditions such as acute sinusitis, sore throat, arthritis and gout, and speeding recovery from injuries and surgery. Pineapple should be eaten alone between meals. pineapple enzymes have been used with success to treat rheumatoid arthritis and to speed tissue repair as a result of injuries, diabetic ulcers and general surgery. Pineapple reduces blood clotting and helps remove plaque from arterial walls. Studies suggest that pineapple enzymes may improve circulation in those with narrowed arteries, such as angina sufferers.

Pineapples are used to help cure bronquitis and throat infections. It is efficient in the treatment of arterioscleroses and anaemia. Pineapple is an excellent cerebral toner; it combats loss of memory, sadness and melancholy.

Joy (2010) reported that Bromelain is a complex mixture of substances that can be extracted from the stem and core fruit of the pineapple. Among dozens of components known to exist in this crude extract, the best studied components are a group of protein-digesting enzymes (called cysteine proteinases). Originally, researchers believed that these enzymes provided the key health benefits found in bromelain, a popular dietary supplement containing these pineapple extracts. In addition researchers believed that these benefits were primarily limited to help with digestion in the intestinal tract. However, further studies have shown that bromelain has a wide variety of health benefits, and that many of these benefits may not be related to the different enzymes found in this extract. Excessive inflammation, excessive coagulation of the blood, and certain types of tumor growth may all be reduced by therapeutic doses of bromelain when taken as a dietary supplement. Studies are not available, however, to show these same potential benefits in relationship to normal intake of pineapple within a normal meal plan. Bromelain extracts can be obtained from both the fruit core and stems of
pineapple. Potentially important chemical differences appear to exist between extracts obtained from the stem versus the fruit core. However, the practical relevance of these differences is not presently understood. Most of the laboratory research on bromelain has been conducted using stem-based extracts, however. Although healthcare practitioners have reported improved digestion in their patients with an increase in pineapple as their “fruit of choice” within a meal plan, there are no published studies that document specific changes in digestion following consumption of the fruit (versus supplementation with the purified extract. However, it is suspected that the fruit core will eventually turn out to show some unique health-supportive properties, including possible digestion-related and anti-inflammatory benefits.

**Milind and Goel (2010)** reported that Pineapple, a juicy and tasty fruit, belonging to family Bromeliaceae is scientifically known as Ananas cosmosus. The Pineapples are traditionally used as a blood purifier, to aid digestion, for gastro-intestinal disorders, diseases of the larynx and pharynx, as a mild antiseptic and to treat diabetes. There are no reports in literature pertaining to CNS actions of Ananas cosmosus fruit. In the light of above, the present study was undertaken to test the antidepressant potential of Ananas cosmosus fruit juice. Ananas cosmosus juice (ACJ) was administered at various concentrations ranging from 5% to 20% v/v to Swiss albino mice for 15 days and wistar rats for 8 successive days. The antidepressant activity was measured using forced swim test (FST), tail suspension test (TST) and reserpine induced hypothermia. The efficacy of Pineapple juice was compared with standard anti-depressant agents viz: fluoxetine (20 mg/kg) and imipramine (15mg/kg). The results showed that Pineapple juice significantly decreased immobility time in both FST and TST models. It also reversed the hypothermia induced by reserpine. The efficacy of Pineapple juice was found to be comparable to fluoxetine and imipramine. Prazosin, sulpiride baclofen and p-CPA antagonized the antidepressant effect of Pineapple juice in tail suspension test. Furthermore, Ananas cosmosus juice inhibited the monoamine oxidase MAO-A and MAO-B activity and reduced significantly malondialdehyde (MDA) levels. These findings reveal the anti-depressant potential of Pineapple.
Jams, jellies and marmalades

Jam is made using pulp from a single fruit or from a mixture of fruits. The combination of high acidity (pH around 3.0) and high sugar content (68-72%), prevents mould growth after opening the jar. Jellies are crystal-clear jams that are made using filtered juice instead of fruit pulp and marmalades are produced from clear citrus juices (lime, orange, grapefruit, lemon or orange) that have fine shreds of peel suspended in the gel. Ginger may also be used alone or mixed with the citrus fruits. The proportion of each fruit in a mixed fruit product is controlled by the Uganda Standard Specification for Jam (Fruit Preserves) and Jellies: US 31:1999. Citrus marmalades are controlled by US 32:1999.

2.2.1 Development of Pineapple Jam

Aniedu et al (2002) reported that This study looks into the possibility of developing a ginger-blended pineapple drink. To this effect, peeled pineapple and ginger were blended in the proportion of 50 g/50 g, 75 g/25 g, 83.5 g/16.5 g, 87.5 g/12.5 g and 90 g/10 g (fresh weight basis) to produce ginger blended pineapple drink, 'Pinegy' samples, designated as samples A, B, C, D, and E, respectively. Firstly, a trained 5-man panel of judges tested the products for colour, pineapple flavour, pungency and overall acceptability. From the results, samples C, D, and E were selected for further evaluation using 'Pinenaco', sample DA, as a control while samples DB, DC and DD were the earlier 'Pinegy' samples C, D, and E, respectively. The second evaluation was carried out with a trained 10-man panel drawn from the workers of the National Root Crops Research Institute, Umudike. Also, the proximate analysis of ginger-blended pineapple drink 'Pinegy' was carried out in order to determine their food quality. The result showed that the ginger-blended pineapple drink 'Pinegy' was richer than 'Pinenaco' in nutrient content. Also, the result of the sensory tests showed that in overall acceptability, sample DD was most acceptable followed by the control (sampled DA), although the whole samples were acceptable in various degrees. This therefore, shows that production of ginger-blended pineapple drink 'Pinegy' is possible. Also with locally
available raw materials and simple methods of preparation, 'Pinegy' production can serve as an employment for the youth and rural dwellers.

**Srivastava and Kumar (2006)** suggested that addition of sugar imparts sweetness, firm, texture and body to jam and suggested a method of preparation of Anola preserve and candy. The fruits were pricked, and then steeped in 2% salt solution for 24 hours to remove astringency. Then the fruits were washed in water, dipped in 2% alum solution for 24 hours. They again washed the fruit with water thoroughly. The fruits were blanched till softening and continued this process for the 3rd day. Added 200 gm sugar on the 4th day and then boiled for few minutes. Kept the product for 6 days in the airtight container on the 7th days. The fruits were removed from the syrup and kept them in shade from 2 days. Next day they were rolled in powdered sugar and dried in the shade.

**Singh (2007)** reported that an experiment entitled “effect of preservatives on nutritive value and shelf life of anola and guava mixed fruit jam. In this thesis three product of mixed fruit jam were prepared. Product 1 was prepared using 500 gm of guava, 500 anola, 1.25 kg of sugar, 2.5 gm of citric acid and essence 1 or 2 drops. Product 2 was prepared using 250 gm of guava 750 gm of anola, 1.25 kg of sugar, 2.5 gm of citric acid and essence 1 or 2 drops. Product 3 was prepared using 750 gm of guava 250 gm of anola, 1.25 kg of sugar, 2.5 gm of citric acid acid and essence 1 or 2 drops. Various physiochemical parameters of the stored jam were determined at 7 days intervals. On the basis physiochemical quality. Among all the products, product 3 should highest score for texture, Taste and Flavor. In product 3 the highest score for T.S.S was 75°-84° Brix during storage period. An optimum pH value (3.1) was observed in product 3, during storage period a maximum decrease in Ascorbic acid content was observed in product 3. On the basis of above results it is clear that product 3 is best product.

**Mathew et al. (2008)** reported that an experiment was conducted to study the changes in chemical, nutritional and microbial parameters of mixed cashew apple jam during storage. The cashew apples available at Madakkathara, India and the commonly
available fruits like mango, pineapple and apple were used for preparation of the following mixed jams: T1, cashew apple + mango (50:50); T2, cashew apple + pineapple (50:50); and T3, cashew apple + or-mango + pineapple + apple (50:50). Cashew apple alone was used as control. The prepared product was stored in well sterilized plain glass bottles under ambient and at low temperature (4±1 degrees C) conditions. Chemical constituents like acidity, tannin, reducing and total sugar and nutritional constituent (Vitamin C) of the mixed jam samples were analysed at the time of preparation and at bimonthly interval for a period of 6 months. Microbial evaluation of the samples was done from the time of preparation to six months of storage for surface total microflora. Vitamin C content of pure cashew apple jam was the highest (58.8 mg) at the time of preparation and also during the period of storage as compared to all the mixed jams. The mean vitamin C content of all mixed jam samples decreased during storage. In cashew apple + mango jam, vitamin C content slightly increased from 4th to 6th month after storage. Acidity of the jam samples decreased till 4th month of storage. When acidity of the jam samples were compared, acidity of cashew apple jam was always less compared to other mixed jams. Tannin content of the cashew apple jam was high throughout the period of storage. Cashew apple + mango jam had the lowest reducing sugar during all the months. At the time of preparation cashew apple + mango jam had 11.95% reducing sugar and it was 42.5% after six months of storage. Cashew apple + pineapple had the highest total sugar throughout the period of storage. When the effect of temperature on microbial count was analysed, yeast and fungal counts were always high under open storage condition compared to low temperature, as low temperature deactivated the microbial growth in jam samples. Results show that although the chemical parameters are not affected by keeping the jam samples under ambient storage temperature, it is better to keep them under low temperature condition to avoid microbial growth.

Yee et al. (2011) observed that cooking rate of pineapple bakery jam was investigated and the effect of cooking temperature, stirring speed and batch volume on rate constant was examined. The linear relationship between the logarithmic total soluble solids gain ratios of cooked jam and the cooking time showed that the cooking rate followed the
equation of first-order chemical reaction. In this present study, the cooking rates were increased with cooking temperature and stirring speed, but it decreased with increasing batch volume. The activation energy of cooking process was 42.49 kJ mol⁻¹. The recommended cooking temperature for cooking of pineapple bakery jam was 90 degrees C as the jam was burnt on the surface of the cooker and undesirable caramel flavour was resulted at cooking temperature of 100 degrees C. Present investigation of cooking rate constant will be useful in designing more efficient jam cookers with higher ratio of effective heating surface to batch volume of fruit pulp.

2.2.2 Physical, Chemical and Medicinal properties of Pineapple Jam

Pathak and Deen (1988) reported that Banarasi, Francis, Krishna, Chakaiya, Kanchan NA-6, NA-7, NA-9, NA-10, cultivars of Anola contain 826.4, 690, 783.8, 789.5, 711.4, 788.1, 767.2, 790.9, 881.8, and 720.5 mg/100 g of ascorbic acid respectively, decrease in Organoleptic quality of Anola jam, an increase in browning of Anola jam during storage, an increase in Acidity of candy of Anola was increased during storage of 8 months, Ascorbic acid content of Anola product decreased during storage period.

Burhamuddin (1993) noticed that jams prepared from pulp of Guava remained shelf stable under ambient temperature for 12 months.

Shishoo et al. (1997) determined the vitamin C content of phyllanthus emblica and chyavanprash at traditional (Ayuervedi) herbal formation widely used on tonic anabolic, immunomodulatory and memory enhancer. Major ingredient (35%) was anola fruit which is a rich source of ascorbic acid. The specific and determination of vitamin C, during various states of the preparation of chyavanprash of its other products. The pericarp of larger fruits of anola was found to contain 2.915 mg vitamin c/g pulp while that of smaller fruits contain 2.775 mg vitamin (g/pulp).
Jawaheer et al. (2003) investigated the effects of storage of fresh fruit of guava and the processing into jam and juice followed by storage, on the ascorbic acid content of guava. Results showed that the average ascorbic acid content of two cultivars of guava ('Labourdonnais White' and Hawaiian) were 201.1± 0.70 mg/100 g and 95.4± 0.19 mg/100 g on a fresh weight basis, respectively. Postharvest storage of the fruits resulted in a loss of 28 percent of ascorbic acid for ‘Labourdonnais White’ (L. White’) and 25 percent for Hawaiian over six days. During the juice making process, the highest percentage of loss of ascorbic acid was due to peeling (6 percent) followed by exhausting (4.5 percent). Processing led to an overall decrease of 20.4 percent for juice and 62.5 percent for jam.

Singh et al.(2003) conducted a study to find out the techno-economic feasibility of processing of amla products like the preparation of amla pulp based products (jam, squash, sauce) and non pulp based candy and observed that was a loss of ascorbic acid in the products.

Rame and Mehta (2003) reported that T.S.S and pH of mango jam increased during storage period.

Agrawal and Chopra (2004) studied the changes which occurred in ascorbic acid and total phenols during storage in different amla products. They observed that the shreds registered greater loss in ascorbic acid followed by jam, candy and squash. However, the whole squash contained highest percentage of ascorbic acid.

Ahmad (2004) reported that T.S.S, pH of apple date jam increased and ascorbic acid, moisture, acidity decreased during period and also reported that 12/9 percent T.S.S, 1.14 percent acidity, 640.5 mg/100 gm vitamin C, 2.82 percent non reducing sugar in apple and 10.9 percent T.S.S, 0.99 percent acidity, 576.3 mg/100g vitamin C, 2.43 percent reducing sugar and 1.07 percent non reducing sugar in date.
**Dixit (2004)** reported that T.S.S, pH of karonda jam increased and ascorbic acid, acidity, moisture decreased during storage period.

**Siddiqui (2004)** reported that T.S.S, pH of pear jam increased and moisture, Ascorbic acid, Acidity decreased during 90 days of storage period also reported that there was loss in ascorbic acid content during preparation of jam as compared to fresh fruits.

**Ben-Erik (2005)** studied that guava are also processed into jam, jelly, guava paste and sherbet. Various drinks are prepared from the juice, obtained by boiling and straining. Pulp or puree made from ripe fruits cooked with water and sugar makes a delicious filling for tarts, pastries and pancakes. Nutritional value of the fruits indicates relatively low energy value (about 25 kcal per 100 g; the sugar content is 4-10%). They are also a good source of vitamin C (20-25 mg/100gm).

**Torralba et al. (2005)** reported that The acceptability and shelf life of processed pineapple (cv. Queen) products, such as pineapple crisps, jam and juice, in the Philippines were investigated. In addition, the acceptability of materials used for the packaging of these products was evaluated. The results showed that the individual attributes of colour, texture, flavour and odour did not predict the general acceptability of the processed products, suggesting that the products were generally acceptable to the evaluators. Microbiological analyses showed that the processed products were still acceptable and edible even after 3 months of storage at room temperature. The factors that influenced the acceptability of packaging materials were local food and drug agency label requirements, appearance, convenience, disposability and safety from physical and chemical contamination. Studies on processing techniques for larger volume production are suggested to further validate the acceptability of pineapple (cv. Queen) as raw material for processing.

**Patakh et al. (2007)** studied that nutritive value of different varities of amla and its preserved products such as jam, candy, syrup, pickle, chutney on the basis of chemical analysis. He stored amla product for 0,3,6,7,8 and 9 months and observed the change in
browning of amlas products during storage he also carried out an Organoleptic test for the acceptability of different products of amla during storage and found to increase the shelf life of amla.

**Shivhare et al. (2007)** reported that Jam is an intermediate moisture food containing fruit pulp, pectin, sugar and acid. The effect of sugar and pectin concentration, pH, shear rate and temperature on the time dependent rheological properties of pineapple jam was studied using a rheometer. Pineapple jam exhibited thixotropic behaviour. Shear stress of the pineapple jam at a particular time of shearing depended on the shear rate, temperature and composition. Weltman, Hahn, and Figoni and Shoemaker, models were applied to describe the time dependent flow properties of pineapple jam. Hahn model described adequately the rheological characteristics of pineapple jam.

**Goyal et al. (2008)** studied the perishable nature and importance of the fruits, their post harvest management with special reference to value addition is the need of present time. Amla (cv.NA-6) and ber (cv.Seb) were used for developing three sugar based value added products i.e. jam, preserve and squash. The products were assessed for their quality on the basis of sensory attributes, vitamin C retention and microbial load. The overall acceptability scores of the products ranged from 7.5 to 8.5 on nine point hedonic rating scale. Vitamin C retention was recorded as 149 to 210.87 mg/100g and 27.3 to 50.82 mg/100 g in the amla and ber products respectively.

**Uckiah et al. (2009)** determine the effects of processing pineapple fruits into different products and storage of the processed products on the ascorbic acid content. Design/methodology/approach - Pineapples (variety "Queen Victoria") were processed into juice, jam and sorbet. Vitamin C was analysed by the 2-6 dichloroindophenol titrimetric method and tests were performed during preparation and storage of the products. The pineapple juice was stored for nine days at 8 degrees C, whilst the jam and sorbet were kept for two months at 22-25 degrees C and -18 degrees C respectively. Findings - Fresh peeled pineapple fruit contains an average ascorbic acid content of 24.8 mg/100 g of fruit. During the juice making process, peeling led to the highest
percentage loss of vitamin C (41.8 per cent) followed by exhausting (23.7 per cent). Processing of pineapples into jam was revealed to be most destructive towards ascorbic acid (a loss of 46.8 per cent) as compared to juice making (38.5 per cent) and sorbet preparation (15.5 per cent). Storage of the three processed products in the specific conditions led to a significant decrease (p<0.05) in vitamin C content, and the highest rate of degradation was in pineapple juice (0.6 mg loss per day). Originality/value - This paper deals with the retention of vitamin C potency in pineapple products, which is important both to consumers concerned with maintaining good health, and to pineapple processors, who are interested in quality assurance, nutrient labelling and product storage.

Gyedu-Akoto et al. (2010) reported that Cashew tree gum is an exudate polysaccharide produced spontaneously or by deliberately inflicting wounds on the bark of the cashew (Anacardium occidentale L.) tree. Its physico-chemical and rheological properties have been found to be similar to those of gum Arabic which finds industrial applications as a thickening agent, emulsifier or stabilizer. This has led to the assessment of cashew gum as a gelling agent and stabilizer in pineapple jam and cashew juice. The optimum formulations for the production of pineapple jam and cashew juice drink with cashew gum were determined using response surface methodology. Significant regression models which explained the effects of cashew gum on the two products were determined. The coefficients of determination, R2 for all the response variables which were 0.7 or higher were used to generate contour and response surface plots. Based on the results, the possible combinations of ingredients for the production of jam with the desired sensory qualities were in the range 0.53-0.70, 0.05 and 0.25-0.42 for pineapple pulp, cashew gum and sugar, respectively. Cashew gum was found to be suitable as a clarifying agent rather than a stabilizer in cashew juice production with the optimum level being 0.3.

Kahate et al. (2010) reported that burfi is a popular khoa based confection and it’s contain considerable amount of milk solids. The manufacture of value added products by using seasonal fruit like pineapple. The present investigation shows that, the overall
acceptability of the pineapple pulp Burfi prepared with 15 per cent pineapple pulp in treatment T4 (93.53) was highest and superior. Treatment T4 was more acceptable than all treatments in flavor, body texture and colour and appearance. The chemical composition of Burfi was affected due to addition of pineapple pulp to the fat, protein, total solids, moisture and ash.

Roselli et al. (2010) reported that the demand of nutraceuticals for promoting health and preventing disease is rapidly growing. Various plants extracts have shown beneficial properties, including anti-inflammatory and immunomodulatory activities. This review reports an up-date of the anti-inflammatory properties and related mechanisms of action of different plant extracts belonging to culinary spices (garlic, rosemary, ginger and curcumin), fruits (pineapple and pomegranate) and beverages (green tea and citrus juice), representing traditional and/or common constituents of worldwide diets. These plant extracts have the ability to influence the immune response and counteract the inflammatory process, by inhibiting the inflammatory cytokines release, NF- kappa B activation, leucocyte adhesion, inflammatory mediators (PGE2, NO and COX-2) expression, while promoting the expression of anti-inflammatory cytokines. Thus, the plant extracts considered here represent an easy and safe way to satisfy the demand for health promoting food and prevent or ameliorate inflammatory disorders.

Vidhya et al. (2010) reported that wood apple is the cheap, highly nutritious, easily perishable and seasonally available fruit and it was decided to preserve for human consumption throughout the year. This study was planned to increase the shelf life of wood apple by preserving them as jam and fruit bar. Wood apple preserved products like jam and fruit bar were developed, stored and quality parameters were assessed for a periods of 90 days. Organoleptic evaluation shows storage stability was good in both jam and fruit Bar with respect to flavour and consistency. Nutritive analysis shows reduction in Vitamin C, Calcium and Phosphorous in both jam and fruit bar during 90th day of storage. The acidic content of the preserved products decreased in both Jam (2.5%) and Fruit bar (1.66%). No Significant change observed in TSS, pH, Pectin and Ash value for both Jam and Fruit Bar during storage. Total sugar increased up to 0.68%.
and 0.89% and reducing sugar increased to 2.59% and 1.53% in both jam and fruit bar respectively. The microbial load of both Jam and Fruit Bar was under the limit at the end of 90 days. Hence, the prepared Jam and fruit bar was safe and fit for consumption.

2.3.1 Development of Pineapple Jelly

Sombat et al. (1993) reported that pineapple (Annanas Comosus L.) with 14.6% sugar and 0.53% acidity were used in the study of pineapple candy processing, sugar, glucose, syrup, salts and citric acid were added at amount of 37.5%, 50%, 0.4% and 0.2% of squeezed pineapple respectively during the process of evaporation. The pineapple juice was concentrated to a half volume of original juice by rotary evaporator and then added back to the process for the flavour improvement. After 3-4 hours of evaporation the product contain 82% sugar, 0.87%, acidity 12.5 and 7/12 in munsell colour system and less than 10 colony gram of yeast and mould. The sensory test was done on the products for preference. The product flavour and texture were accepted by the consumer. The quantity of product did not change for 6 months stored.

Chockchai (1994) developed the technology for pineapple core glaze in order to get the best texture acceptable for the consumer. The main problem is a great deal of fibre in pineapple core, because it makes readily tough texture after processing. Heat and pressure decreased tough fibre in pineapple core glaze. The pineapple core glaze which boiled under pressure (ISlb/in²) for 15 minute gave a good quality product. Five percent glucose syrup was the best method to protect crystallization of sugar, which provided tenderness, good colour and least fibre.

Siddahapa and Tandon (1994) reported that the proportion of sugar of fruit varies from jam to jam. He also reported that most common ratio of sugar to fruit is half pound per pound. But sweet fruit of low acidity normally requires less than equal weight of sugar. He also further reported in case of Anola jelly of best texture the sugar should be equal to half of the fruit and also reported that selected large sized fruits washed and pricked and place in 2% brine solution on subsequent days until the find concentration
reached 8 % salt solution for a week. The fruits were then blanched in 2 % alum solution until they were soft.

Dhawan and Gupta (1996) studied the comparison of guava hybrids with commercial cultivars for making jelly. The acidity of jelly was decreased as the period of storage increased. Through a linear relationship was found but the acidity decreased at higher rate during storage. The decreased in acidity might be due to formation of sulphurous acids and free fatty acids, during storage moisture content also decreased in guava jelly. Tarr and Buker (1996) found that 70 % sugar in finished product gave jelly of good texture.

Acosta et al. (2008) studied that Response surface methodology (Box-Behnken design) was used to evaluate and model effects of three factors (sweetener, low methoxyl (LM) pectin and calcium content) at three levels each, on the overall acceptability of a tropical mixed fruit (pineapple, banana and passion fruit) jelly, determined by 100 consumers. Results showed that the model fit was significant (p=0.014) and there was satisfactory correlation between actual and fitted values (R2=0.940 and adjusted R2=0.832). The model presented no significant lack of fit (p=0.253). Calcium level had a significant effect on overall acceptability, but LM pectin and sweetener levels did not. The statistical model was used to optimise the factors' levels for highest acceptability, to obtain a jelly that provided less than 12 calories per serving, allowing the product to be labelled as "low calorie".

2.3.2 Physical, Chemical and Medicinal properties of Pineapple Jelly

Uddin and Mahfuz (1991) reported that apple was analysed for total soluble solids, total sugar, acidity, ascorbic acid, ash, content and pH. Jelly, butter jam preserves and candies were prepared from apples. These products were analysed for proximate composition.
Olsen (1994) reported that with greater Hydrogen ion concentration jelly strength increase up to 3.0.

Scott and Janith (1994) reported that total soluble solids of date jelly showed a slight increase up to six months of storage at room temperature.

Dhawan and Gupta (1996) reported that the ascorbic acid content of guava jelly decreased markedly to 30% to 40% during 90 days of storage period. However ascorbic acid content was comparatively less during the first month of storage (8.33) but the loss were much more amounting to 12.54% and 13.25% in second and third month of storage period. The decrease in ascorbic acid content might be due to oxidation.

Drazya and Jechna (1996) studied the quantity of pectin preparation in relation to extraction of pH. They found that the increase in the acidity extraction. The degree of etherification polymerization and gelatin capacity decreases steadily, yield in terms of gelatine capacity showed no clear trends.

Rahman et al. (1997) reported that Organoleptic score for jamun jelly and beverage decrease gradually after 4 months of storage and also reported that Organoleptic quality of jamun jelly decreased sharply during storage. However addition of SO$_2$ (1000-1500 ppm) improved the Organoleptic quality for up to 6 month. But higher dose (2000 ppm) of SO$_2$ masked the flavour of jelly.

Beom et al. (1998) stated that intake of carrot-pineapple juice as potent antioxidants, appear to be associated with better health. It is not only preventing vitamin A and vitamin C efficiency but also cancer and other diet related human diseases. It has greater cytotoxic effect against cancer cell and reducing the enzymes, that promote the conversion pre carcinogens to carcinogens. It may also enhance the immune system, project against stroke, high blood pressure, osteoporosis, heart disease, bronchial asthma and urinary tract infections.
Oziezak (1998) reported that Texture, flavour and other physical qualities of Anola jelly increase up to smooth and thereafter they show decrease and also reported that volatile flavouring compounds are loosed during processing.

Vait et al. (1998) reported that Apple jelly shows a reduction in Ascorbic acid during storage.

Sims et al. (1999) reported that Carrot pineapple juice is a relatively good source of beta-carotene. Consumers like it because of its convenience, colour, aromatic compounds and refreshing characteristics.

Yousif and Agrandi (1999) reported that total soluble solids of date jelly showed a slight increase up to six months of storage at room temperature.

Chinprahast et al. (2002) reported that mixed vegetable and fruit high fibre jelly drink was prepared from carrot (Daucus carota) and pineapple (Ananas comosus) juice and pumpkin puree. Firstly, the effects of varying proportions of carrot and pineapple juice were investigated. An increase in the amount of carrot juice resulted in significantly (P<=0.05) higher pH, "a" and "b" values, but lower total soluble solids (TSS), % titratable acidity and "L" values. Cloud stability of the mixed juices was also altered significantly with increasing time especially for those samples with higher quantities of carrot juice. Differences in some sensory characteristics of the mixed juices were also observed and it was evident that the most suitable proportion of carrot:pineapple juice was 3:7. Subsequently, this ratio was used to verify the influences of added pumpkin puree, as a source for dietary fibre, on properties of the jelly drink. It was obvious that the product added with higher content of pumpkin had significantly (P<=0.05) higher viscosity but lower "L" (more darkness) and lower "b" (less yellowness) values. Alteration of sensory traits of the product was apparent when different amounts of pumpkin were added. However, when all the physical and sensory characteristics were taken into account, the most suitable proportion of pumpkin was selected at 20% for the development of this kind of product.
Madhav et al. (2002) reported that in this study, the different fruit wastes selected for pectin extraction and preparation of jelly were rinds of jackfruit, nutmeg, passion fruit and mangosteen; peels of pummelo, mango, pineapple, citrus, and banana; and cocoa pod husk. The quality of the jellies prepared was evaluated visually (setting property, consistency, syneresis, crystallization, cloudiness, colour) and organoleptically (appearance, transparency, colour, consistency, taste, aroma, flavour, acceptability as bread-spread), then compared with that of guava jelly. Corrective treatments were applied to the jellies with defects and whose quality did not reach the standard of guava jelly. Some of the jelly defects noticed include syrupy consistency (pineapple peel, cocoa pod husk and mangosteen rind jellies), cloudiness (banana peel jelly), bitter taste (pummelo and lime peel jellies), firm consistency (pummelo peel and passion fruit rind jellies), and syneresis (cocoa pod husk and mangosteen rind jellies). Application of the corrective treatments, such as blending with pectin of other fruit wastes at the ratio of 1:1, reduction of extraction time, and boiling the chopped peel in sodium chloride or hydroxide, resulted in quality improvement for the jellies.

Prasad (2003) reported that T.S.S, pH, pectin of guava jelly increased and ascorbic acid decreased during 6 month of storage period and also reported that dymethylation in pectin can be controlled at low temperature of about 50°C and at a pH of 1.5.

Deka et al. (2005) reported that mango-pineapple spiced beverages were prepared from 'Dashehari' mango and 'Kew' pineapple. Fifteen per cent blended juices (85:15) were used for preparation of ready-to-serve (RTS) beverages having 10 degrees Brix, 0.2% acidity and 0.006% cardamom spice drops. The RTS beverages stored in white and amber coloured bottles for 6 months under 3 different storage environment viz., ambient temperature (12.5-36 degrees C), cool chamber (10-29.6 degrees C) and low temperature (4+or-1 degrees C) showed a gradual decrease in sensory quality, acidity, ascorbic acid and tannins. Retention of ascorbic acid was more in beverages stored in amber coloured bottles under low temperature. An increasing trend was found in total soluble solids, reducing sugars, total sugars and NEB. The hunter colour values 'L and a'
got decreased over 6 months. The major volatile flavouring compound found in mango-
pineapple spiced beverage was Terpenyl acetate that got decreased during storage.

Srivastava et al. (2006) reported that final jelly should contain at least 0.5 % - 0.75 %
acidity, it should not contain more than 1 % acidity, because at larger quantities of acids
synthesis is likely to occur.

Singh et al. (2007) reported that jelly prepared from sardar guava, Allahabad safeda and
Banarasi Surekha cultivars of guava Organoleptic quality of guava RTS was acceptable
upto 3 months of storage at room temperature, an increase in acidity of guava RTS and
nectar during storage of 4 months, reduction in ascorbic acid content during storage of
guava beverage, browning of RTS and nectar of guava fruit increased continuously
during storage, Organoleptic quality of anola jam decrease during storage and
acceptable quality was maintained upto 6 months of storage, ascorbic acid content of
anola intermediate moisture food reduced, from 40-68 mg/100 g in six months of
storage.

Singh et al. (2007) reported that in this study guava and pineapple juice ratio was
standardized for the preparation of RTS and nectar beverages. Different ratios of guava
and pineapple juices were blended and the quality of the processed product was studied
up to 120 days of storage beverage. The RTS score prepared from 70% guava and 30%
pineapple juice had highest acceptability with 82% score initially and 48% marks after
four month of storage at ambient temperature. Similarly, nectar scored 80.2% marks
initially but 56% marks after 4 months at ambient storage. The total soluble solids and
total sugars, reducing sugars increased continuously during the storage period of 120
days, while ascorbic acid and non-reducing sugars decreased during storage. The
decrease in organoleptic acceptability was due to the changes in the composition of
these parameters. However, RTS and nectar beverages were acceptable up to 120 days
of storage period.
**Hossen et al. (2009)** studied that the jelly from composite of first and second extractions juice was found better than other jellies as per chemical composition and sensory evaluation. The chemical composition of first extraction juice was found as moisture content 95.5 percent, ash 0.35 percent, acidity 0.091, vitamin C 55.47 mg/100g, total sugar 3.00, TSS 3.5 and pH 3.46. The analysis of chemical composition of guava jelly prepared from composite of first and second extraction juice was found moisture 21.53 percent, ash 0.28 percent, TSS 67 percent, total sugar 64 percent, acidity 0.7 percent, and pH 3.10. On the basis of sensory evaluation the guava jellies prepared from different extractions of juice considering, smell and taste, colour, texture and overall acceptability the jelly prepared from composite of first and second extractions of juice was more acceptable than others. Storage study was conducted on the jellies for nine months at room temperature (20-30°C) and relative humidity 80 to 85 percent.

**Pons et al. (2009)** reported that the test was aimed to develop and evaluate the sensory characteristics of in goat milk yogurt with semi fluid pineapple jelly to give greater value to these products abundant in the state of Lara. We evaluated the proportion of peptina to make pineapple jelly, using a completely randomized design with four treatments (0, 0.05, 0.1, 0.15% peptina/pineapple pulp) and 8 replicates. We determined the pH, acidity, soluble solids and viscosity. After adding starter cultures of to acid to milk goats was placed the mixture over pineapple jelly and incubated. Then they evaluated the product acceptance through sensory analysis (colour, odour, taste, texture, sweetness and appearance) compared with a commercial product (cow’s milk yogurt with pineapple jelly) using untrained panellists. As a result it was found pH from 4.00 to 4.30, soluble solids content of 64.90 to 65.90 degrees Brix and acidity from 0.84 to 0.99% in the proportion of peptina used. Was selected the addition of 0.15% pectin by the higher viscosity present in the pineapple jelly. In the sensory evaluation in the yogurts were found that the panellists showed acceptance by the colour, odour, taste and texture, so it is concluded that the goat milk yogurt with pineapple jelly can be used in marketing of fermented milk products.
Licodiedoff et al. (2010) evaluated that pineapple jelly is intended to analyze the occurrence of syneresis by univariate and multivariate analysis. The jelly of the pineapple presents low concentration pectin, therefore, it was added high methoxyl pectin in the following concentrations: 0.50%, 0.75% and 1.00% corresponding to slow, medium and fast speed of gel formation process. In this study it was checked the pH, acidity, brix and the syneresis of jelly. The highest concentration of pectin in the jelly showed a decrease in the release of the water, syneresis. This result showed that the percentage of 1.00% of pectin in jelly is necessary to form the gel and to obtain a suitable texture.

Danyluk et al. 2011 reported that presence of Alicyclobacillus in fruit juices and concentrates poses a serious problem for the juice industry. This study was undertaken to determine the (i) prevalence, concentration, and species of Alicyclobacillus in tropical and subtropical concentrates; (ii) efficacy of aqueous chlorine dioxide in reducing Alicyclobacillus spp. spores on tropical and subtropical fruit surfaces; and (iii) fate of and off-flavor production by Alicyclobacillus acidoterrestris in mango and pineapple juices. One hundred and eighty tropical and subtropical juice concentrates were screened for the presence and concentration of Alicyclobacillus spp. If found, the species of Alicyclobacillus was determined by 16S rDNA sequencing and analysis with NCI BLAST. Of these samples, 6.1% were positive for Alicyclobacillus, and nine A. acidoterrestris strains and two Alicyclobacillus acidocaldarius strains were identified. A five-strain cocktail of Alicyclobacillus spp. was inoculated onto the surface of fruits (grapefruit, guava, limes, mangoes, oranges and pineapple), which were then washed with 0, 50, or 100 ppm aqueous chlorine dioxide. Significant reductions due to chlorine dioxide were only seen on citrus fruits. A five-strain cocktail of A. acidoterrestris was inoculated into mango and pineapple juices. Microbial populations were enumerated over a 16-day period. Aroma compounds in the juice were analyzed by GC-olfactometry (GC-O) and confirmed using GC-MS. GC-O of mango juice identified previously reported medicinal/antiseptic compounds. GC-O of pineapple juice revealed an unexpected "cheese" off-aroma associated with 2-methylbutyric acid and 3-methylbutyric acid.
Phimpharian et al. (2011) reported the effects of glucose syrup (2%, 4%, and 6%) and pectin (0.5%, 1.0%, and 1.5%) concentrations on physicochemical characteristics and sensory acceptability of machine-formed pineapple leather snack were investigated. Changes in glucose syrup and pectin concentrations significantly affected velocity of forming and total soluble solids content of pineapple paste, but did not affect thickness of pineapple leathers. Increasing pectin concentrations generally increased redness (a*) and yellowness (b*), and hardness (tensile force and work) while decreased moisture content and aw of pineapple leathers. Two most acceptable pineapple leathers were prepared with 6% glucose syrup and 0.5-1.0% pectin. Increasing pectin concentration from 1.0% to 1.5% negatively affected toughness acceptability, which was attributed to reduced moisture and aw, and increased tensile force and work. The optimum formulation range consisted of 3.5-6.0% glucose syrup and 0.5-1.0% pectin, yielding products with acceptability scores of 6.7-7.3 (on a 9-point hedonic scale) for appearance, sourness, sweetness, overall-taste, toughness and overall-liking.

2.4 Introduction of Pineapple Cheese

Barbaste et al. (2000) reported that fruit cheese was prepared from mature, ripe papayas (Carica papaya var. Red Lady) and from puree blends of papaya + pineapple. The effects of varying pH, pectin levels and sucrose to invert syrup were investigated on gel set of the fruit cheese. A pH of 3.1, 1% pectin and processed to 80 degrees Brix were required for a good gel set papaya cheese. For the blended fruit cheese, the ratio of papaya:pineapple was 2:1 with 2% pectin and processed to 77-80 degrees Brix. Sensory evaluation indicated a significant preference for the blended fruit cheese and significant changes in sensory attributes of the fruit cheeses stored for 10 weeks at 4-5 degrees C.

Fruit ‘cheeses’
Fruit cheeses are pulps that are boiled until they have a final sugar content of 75-85%. When they cool, they set as a solid block and can be cut into bars or cubes to eat directly as confectionery, or they can be used in small pieces in bakery product.
2.4.1 Development of Pineapple Cheese

Raphaelides and Ambatizotizodis (1996) reported that butter texture prepared by using cinnamon syrups of 50 ml and 60 ml was markedly affected by the composition of syrup. The consistency of butter ranged from very firm when 100% cinnamon was used and three weeks aging was needed for stabilization. The analysis showed that butter could be classified and textural attributes.

Taniwaki et al. (2001) reported the efficacy of three culture media, dichloran rose bengal chloramphenicol (DRBC), dichloran 18% glycerol agar (DG18), and potato dextrose agar (PDA) supplemented with two antibiotics, were compared with the Simplate and Petrifilm techniques for mould and yeast enumeration. The following foods were analyzed: corn meal, wheat flour, cassava flour, bread crumbs, whole meal, sliced bread, ground groundnuts, mozzarella cheese, grated parmesan cheese, cheese rolls, orange juice, pineapple pulp, pineapple cake, and mushroom in conserve. Correlation coefficients of DRBC versus PDA and DG18 for recovering total mold and yeast counts from the composite of 14 foods indicated that the three media were generally equivalent. Correlation coefficients for Petrifilm versus culture media were acceptable, although not as good as between culture media. Correlation coefficients of Simplate versus DRBC, DG18, PDA, and Petrifilm for recovering total yeasts and moulds from a composite of 11 foods demonstrated that there was no equivalence between the counts obtained by Simplate and other culture media and Petrifilm, with significant differences observed for the most foods analyzed.

Kamble et al. (2010) reported that burfi is a popular khoa based confection and it’s contain considerable amount of milk solids. The manufacture of value added products by using seasonal fruit like pineapple. The present investigation shows that, the overall acceptability of the pineapple pulp Burfi prepared with 15 per cent pineapple pulp in treatment T4 (93.53) was highest and superior. Treatment T4 was more acceptable than all treatments in flavor, body texture and colour and appearance. The chemical
composition of Burfi was affected due to addition of pineapple pulp to the fat, protein, total solids, moisture and ash.

**Xenthain (2001)** concluded in his studies that apple butter with addition of cinnamon syrup showed more consistency in total soluble solids than butter with clove syrup.

**Prabhaker et al. (2007)** studied different ratios of guava and pineapple juices were blended and the quality of the processed products was studied up to 120 days of storage beverage. The RTS prepared from 70% guava and 30% pineapple juice had highest acceptability with 82% score initially and 48% marks after four months of storage at ambient temperature. The decrease in Organoleptic acceptability was due to the changes in the composition of these parameters.

**Prajapati et al. (2010)** reported that prepared value added dried Indian gooseberry (amla) shreds were using amla fruits of cv. ‘NA-7’. Two blanching methods (hot water and potassium metabisulphite (KMS) at 0.1% and two drying methods (solar and hot air oven drying) were tried for the production of amla shreds. Common salt, black salt and ginger juice were mixed for enhancing sensory quality of the product. The best product was obtained with KMS blanching and drying in solar dryer with added common salt at 3%. The most acceptable product had ascorbic acid content 298.3 mg/100 g, tannin 2.4%, acidity 2.6%, reducing sugar 3.0%, non reducing sugar 21.0% and total sugar 24.0%. The recovery was 8.0-8.5%.

### 2.4.2 Physical, Chemical and Medicinal properties of Pineapple Cheese

**Barbaste et al. (2000)** reported that A fruit cheese was prepared from mature, ripe papayas (Carica papaya var. Red Lady) and from puree blends of papaya + pineapple. The effects of varying pH, pectin levels and sucrose to invert syrup were investigated on gel set of the fruit cheese. A pH of 3.1, 1% pectin and processed to 80 degrees Brix were required for a good gel set papaya cheese. For the blended fruit cheese, the ratio of papaya:pineapple was 2:1 with 2% pectin and processed to 77-80 degrees Brix. Sensory
evaluation indicated a significant preference for the blended fruit cheese and significant changes in sensory attributes of the fruit cheeses stored for 10 weeks at 4-5 degrees C.

Vijayanand et al. (2000) found that guava cheese bars packed in polythene bags retained their sensory textural properties for about 3 months of storage at room temperature.

Ranganna (2001) described that sensory quality is a combination of different senses of perception coming choosing and eating a food. Appearance which can be judged by the eye. Ex: colour, size, shape, uniformity and absence of defects are of first importance.

Sandhu et al. (2001) studied that guava cultivators differ in their suitability for cheese preparation. Surkha cultivars from India were found to produce better quality cheese than the Allahabad Safeda cultivars.

Braimwell and Badrie (2002) reported that T.S.S, pH, and pectin of Banana cheese increased and ascorbic acid decreased during storage period.

Suresha et al. (2003) reported that in an attempt to utilize cheese whey permeate for edible purposes, a flavoured beverage was formulated by the addition of sugar, citric acid, colour and flavour. The beverage containing 10.0% sugar and 0.1% citric acid was adjudged best compared to other combinations. The flavour level of 0.40, 0.30 and 0.35 ml/litre were optimum for pineapple, mango and orange flavours, respectively, along with 0.30 ml/litre of their respective colour (lemon yellow for pineapple, saffron for mango and orange red for orange). The beverage prepared with pineapple flavour was adjudged as the best, followed by mango and orange. Carbonation remarkably improved the sensory characteristics of the flavoured beverages. The non-carbonated beverages had a shelf life of about 15 days at 4 degrees C. Carbonated beverages had a shelf life of more than 30 days at similar storage conditions.
Belewu et al. (2005) reported that the effect of biological extracts on the storage qualities of West African soft cheese was evaluated in a completely randomized design model within a 15-day period. The control and the treated cheeses were stored under ambient temperature and assessed for the pH, titrable acidity, moisture content and crude protein. The pH and titrable acidity rose (P<0.05) with ginger extract preservant. The crude protein and moisture content were increased (P<0.05) by preservation. The ginger extract was found to be the most effective method of reducing microbial load, followed closely by the garlic extract. The ginger extract treatment extended the shelf life of cheese for 15 days. Treatment of West African soft cheese with ginger extract may not markedly alter the nutritional quality but appeared promising as it has a preservative property.

Masatcioglu et al. (2005) studied to determine the cumulative effects of flavourings (chili pepper, thyme [Thymus vulgaris], mint [Mentha], cumin [Cuminum cyminum], nutmeg, allspice, clove, cinnamon, black pepper, salt and hot red pepper paste), storage conditions and storage time on the survival of Staphylococcus aureus in Surk cheese, and to monitor the associated chemical changes. Surk cheese, a traditional Turkish cheese, was produced by heating diluted non fat yoghurt and adding flavourings to the resultant acid-heat curd. The cheese was later inoculated with S. aureus, shaped conically and stored aerobically for mould growth and anaerobically in olive oil for 30 days at room temperature. The moisture content of aerobically stored cheese decreased over time and led to increases in total solids, salt, salt-in-moisture and ash content during ripening (P<0.05). The presence or absence of the flavourings had no significant effect, whereas storage conditions and storage duration decreased the survival of S. aureus (P<0.05).

Kumar (2006) reported that TSS, pH of pineapple candy increased and Ascorbic acid decreased during storage period.

Mendi et al. (2009) studied to evaluated the nutritional merits of ginger-spiced cheese in terms of body weight gain and feed utilization, blood lipid profile and implantation of
micro-organisms in the gastrointestinal tract of consumers. Four groups of male Wistar rats of 9 per group housed 3 per cage were fed for four weeks. Three of the groups were supplemented with ginger-spiced cheese of 0, 1.0 and 1.5 g ginger powder/100 g of milled curd while the control group did not receive any cheese supplement. The rats were weighed before the start of cheese supplementation and thereafter, every week. The rats were sacrificed and blood was collected and triglycerides, total cholesterol, HDL and LDL cholesterol were determined. There was the enumeration of total bacterial colonies, yeasts and moulds and Lactobacilli colonies from the intestinal contents of the rats. Results showed that body weight gain and feed efficiency ratio were significantly (p<0.05) lowest for the control group while group C (1.5 g ginger powder/100 g of milled cheese curd) was significantly (p<0.05) highest. LDL cholesterol was significantly (p<0.05) highest for the control group D (22.7 mg/dl) compared to the other groups (A, 15.6 mg/dl; B, 15.5 mg/dl; C, 17.3 mg/dl). LDL/HDL ratio was significantly (p<0.05) highest for group D,(6.6) and lowest for group A (2.6) that consumed cheese containing 1.0 g ginger powder/100 g of milled curd. The best counts of yeasts and moulds were in group B (plain cheese), Lactobacilli in group C and least bacterial colony counts in group D. Incorporating ginger into cheese during manufacture improved significantly on some nutritional aspects. Cheese should not always be considered as a predisposing food to developing coronary heart diseases.

Pierro et al. (2011) reported the use of plant coagulants in cheese production is known since ancient times. Many plant extracts, such as the cardoon (Cynara cardunculus L.) fig (Ficus carica L.) papaya (Carica papaya) and pineapple (Ananas comosus), have milk-clotting activity. Despite the limitations deriving from their use in cheese-making (bitter taste and texture defects), recently there is a growing interest in vegetable coagulants as an alternative to traditional calf rennet. Moreover, current food trends, due to dietary (vegetarian) and religion restrictions (Islam and Judaism) are pushing towards the use of these plant extracts. Therefore, they are the new frontier of dairy products, although further studies are required on the subject.
2.5 Herbs

Caragay (1992) reported that several commonly used herbs have been identified by the US National Cancer Institute as possessing cancer-preventive properties. These herbs include members of the Allium sp. (e.g., garlic); members of the Labiatae family (e.g., oregano, rosemary, and thyme); members of the Zingiberaceae family (e.g., turmeric and ginger) and members of the Umbelliferae family (e.g., cumin).

Fisher (1992) stated that herbs and spices are an important part of the human diet. Not only do they enhance the taste and flavour of foods, they also increase their shelf life by being both antimicrobial and anti-oxidant. Herbs and spices also exhibit a wide range of physiological and pharmacological properties.

Bandyopadhyay (2006) reported that herbal products are gradually gaining popularity in the world market due to the presence of natural antioxidants and functionally active ingredients.

Christine and John (2008) reported that herbs and spices have enjoyed a rich tradition of use for their flavour enhancement characteristics and for their medicinal properties. The culinary herbs and spices are full of minor dietary constituents with multiple anticancer characteristics on the antimicrobial, antioxidant, and antitumorigenic properties, their ability to influence carcinogen bioactivation and likely anticancer contributions and presently intriguing possibilities for health promotion.

Kochhar (2008) reported that herbs and spices, as plant products, can add substantial variety to the nutrients and bioactive available in the diet. Herbs have been widely used as culinary herbs and have been known as medicinal plants in traditional medicines. Dietary spices influence various systems in the body such as gastrointestinal, cardiovascular, reproduction and nervous system resulting in diverse metabolic and physiologic importance.
2.5.1 Mint

Bose and Soin (1994) stated different action of mint that therapeutic action analgesic, anti-inflammatory, antiulcer. Production calcium present in mint influx into muscles cells causing inhibition of isolated contraction dissolve gall stone and elimination heart burn.

Ganesh and Mahjeshwar (2002) stated that mint extract provide protection against the radiation induced sickness and mortality and the optimum protective dose of 10g/kg is safe from the point of drug induced toxicity

Arabshahi and Ansa (2004) reported that medicinal plants like mint (menthe spicata), drumstic (Moringa oleifera), and Mulberry (Moros indica), are rich sources of natural antioxidants, vitamin C, iron, carotenoids and phenolic compounds.

Hasler et al. (2005) reported that certain phytochemicals from herbs or herbal extracts (such as turmeric, basil and mint) have been shown to inhibit one or more of the stages of cancer process in animal model and in vitro studies.

Liu and Zhang (2005) studies the chemical constituents of menthe haplocalyx. The chemical constituents were isolated and purified with column chromatography and the structures were elucidated by spectral analysis. Results shows that the nine compounds were obtained and identified as emodin (I), chrysophanol (II), physcione (II), benzoic acid (IV), trans-cinnamic acid (V), beta-sistosterol (VI), aloe-emodin (VII), ursolic acid (VIII) and daucosterol (IX). Compounds I,II,III,V,VII were first isolated from M. Haplocalyx.

Ye LanRong et al. (2006) studies the mentha (mint) is a genus of about 25 species (and many hundreds of varieties) of flowering plants in the family Lamiaceae (mint family). The word “mint” descends from the Latin word menthe, which is rooted in the Greek word minthe, mentioned in Greek mythology as Minthe, a nymph who was transformed
into a mint plant. There are different types of mint including Mentha aquatica — water mint or marsh mint; Mentha arvensis — corn mint, wild mint, Japanese peppermint, field mint or pudina; Mentha asiatica — asian mint; Mentha australis — Australian mint; Mentha citrata — bergamot mint; Mentha crispata — wrinkled-leaf mint; Mentha diemenica — slender mint; Mentha laxiflora forest mint; Mentha longifolia or Mentha sylvestris — horse mint; Mentha piperita — peppermint; Mentha requienii — Corsican mint; Mentha sachalinensis — Garden mint; Mentha spicata — M. cordifolia, spearmint, curly mint; Mentha suaveolens — apple mint, pineapple mint, and Mentha vagans — gray mint. Mint leaves are used in teas, beverages, jellies, syrups, candies, and ice creams. In Middle Eastern cuisine mint is used in lamb dishes. In British cuisine, mint sauce is popular with lamb. Mint is a necessary ingredient in Touareg tea, a popular tea in northern African and Arab countries. The plant is commonly used as a herbal agent in the treatment of loss of appetite, common cold, bronchitis, sinusitis, fever, nausea and vomiting, and indigestion. Peppermint plants have been used as a herbal medicine for the same conditions, and others. Mentha arvensis is known to possess abortifacient properties in folk medicine (Casey and Satyavati) and is commonly used as a folk remedy for pregnancy termination.

Zhi et al. (2006) studied systematically the involatile constituents of Mentha haplocalyx. The chemical components were isolated and purified by silica gel column chromatography and recrystallization. The chemical structures were elucidated on the basis of physic-chemical properties and spectral data. Results show that eight compounds were isolated and identified as: acacetin(I), tilianine(II), linarin(III), n-butyl-beta-D-fructophyranoside (IV), ursolic acid (V), oleanolic acid (VI), betasitosterol (VII), daucosterol(VIII). The compounds I approximately V were obtained from this plant for the first time.

Arabshahi et al. (2007) studied the three plant foods, namely, drumstick leaves (Moringa oleifera), mint leaves (Mentha spicata) and carrot tuber (Daucus carota) which were extracted with ethanol and analyzed for their antioxidant activity. The antioxidant activity of extracts was evaluated according to the amount of malonaldehyde (MDA)
formed by the FeSO$_4$ induced oxidation of linoleic acid and a high PUFA oil (sunflower oil) at 37°C in Trizma-buffer (pH 7.4). At a concentration of 1.5 mg/ml of linoleic acid, the extracts from drumstick and carrot had a higher antioxidant activity (83% and 80%) than α-tocopherol (72%). In sunflower oil, the extracts from drumstick leaves and mint leaves were found to exhibit a similar activity (46% and 44%). The extract from drumstick exhibited the highest antioxidant activity in both lipid systems. In addition, the stability of extracts of pH (4 and 9) and temperature (100°C, 15 min) was investigated. The antioxidant activity of the extracts from mint leaves and carrot was higher at pH 9 than pH 4, while that of drumstick extract remained the same under both pH conditions. The extract from carrot was more heat-stable than other extracts. The three extracts stored in the dark at 5 and 25°C after a 15 day period did not show any significant change ($p \leq 0.05$) in their antioxidant activity. These data indicate that selected plant extracts are potential sources of dietary antioxidants.

Simonne et al. (2010) reported that mints and other raw fresh herbs are widely used for flavouring as well as garnish in a variety of dishes without further cooking. However, mint is one considered as one of the high-risk herbs when it comes to microbial contamination. It was shown that low-dose irradiation (1.0 to 2.0 KGy) appears to be a promising method for improving the microbiological quality of fresh mint without compromising its visual and color attributes. This method may be applied to many popular fresh culinary herbs that are commonly used as garnishes in Asian cuisine.

2.5.2 Basil

Kothari (2005) reported that basil is used as flavouring agent in jellies, packed foods, non alcoholic beverages, chewing gums, candy pudding and ice-cream. It also protects them from bacterial contamination and preserves them for long.

Prakash and Gupta (2005) worked on therapeutic and pharmacological used of tulsi and suggested that it posses antifertility, antimicrobial, hepto-protective, cardio-protective, antispasmodic, analgesic, adaptogenic and diaphoretic action.
Bandyopadhyay et al. (2006) reported that herbal products are gradually gaining popularity in the world market due to the presence of natural antioxidants. They used tulsi for the preparation of various traditional herbal sweets like sandesh, chamcham.

Haslar et al. (2006) investigated that certain phytochemical from herb and herbal extract have been shown to inhibit one or more of the stages of the cancer process in animal model and in vitro studies i.e. inhibition growth and metastases (mint, basil, turmeric).

Chand and Anonymous (2007) reported that traditionally basil leaves has a wide range of applications in curing several health hazards like cough, cold, insect bites, fever, respiratory disorders, kidney stones and heart disease.

Chowdhary et al. (2008) developed different types of herbal yoghurts by mixing standardized milk with pretreated herbs, namely tulsi leaf (ocimum sanctum), pudina leaf (Mentha arvensis) and coriander leaf (coriandrum sativum), with leaves separately and a 1:1(v/v) mixture of the strains of lactic starter cultures- Lactobacillus acidophilus (NCIM 2903) and Lactobacillus plantarum (NCIM 2083)- followed by incubation at 40°C for 6 hr. The β-galactosidase enzymatic activity of the above enzymatic activity compared with the control yoghurt (without any herbs). Among all herbal yoghurts, tulsi yoghurt had the maximum β- galactosidase activity.

Mondal et al. (2009) reported that medicinal properties of Tulsi (Ocimum sanctum Linn ) are known for thousand years to various civilizations of the world . This medicinal herb is considered as a sacred plant by the Hindus in the Indian subcontinent . Scientific explorations of traditional belief of medicinal properties of Tulsi have got momentum mostly after the middle of the 20 th century . In the present review, efforts have been made to sum up different aspects of scientific studies on this medicinal plant. Scientific evidences are available on various medicinal aspects i.e. ant imicrobial, adaptogenic, anti-diabetic, hepato-protective, anti-inflammatory, anti-carcinogenic, radio-protective, immunomodulatory, neuro-protective, cardio-protective , mosquito
repellent etc. to name a few. Most of these evidences are based on in-vitro, experimental and a few human studies.

2.5.3 Ginger

Kumar et al. (1997) reported that ginger (zingiber officinable) an indigenous plant is an important spice crop of the world. It is valued in medicine as a carminative and stimulant of the gastro intestinal tract. It is used for the manufacture of oil, oleoresin soft drink, non-alcoholic beverages and vitaminised effervescent soft drinks. One hundred gram of edible portion of ginger contained 80.9 g moisture, 2.3 g protein, 0.9 g fat, 2.4 g fibre, 12.3 g minerals, 12.3 g carbohydrate, 20 mg calcium, 60 mg phosphorus, 2.6 mg iron, 0.06 mg thiamine, 0.03 mg riboflavin, 0.6 mg niacin and 6 mg vitamin C.

Ackermann (2001) reported that ginger (family Zingiberaceae) has many therapeutic attributes such as antimicrobial, antithrombotic, anti-inflammatory and anticancer activity. It has also demonstrated to be antimutagenic, inducers of detoxification and preventers of DNA damage in vitro.

Pruthi (2001) stated that ginger is one of the oldest spices of the world. Vamica and India produces the best quality of ginger. Ginger has pleasant aroma and flavour pungent and slightly bitter taste due to the antiseptic compound present in it. Ginger is a carminative, stimulant and given in dyspepsia and flatulent colic.

Ambujeba et al. (2003) reported that ginger, turmeric and Siamese ginger extracts use as natural food preservatives.

Govindranjan et al. (2005) reported that fresh ginger contains 80.9 percent moisture, 2.3 percent protein, 0.9 percent fat, 1.2 percent minerals, 2.4 percent fibre and 12.3 percent carbohydrates. The minerals present in ginger are iron, calcium and phosphorus. It also contain vitamin such as thiamine, riboflavin, niacin and vitamin C. The
composition varies with the type variety, agronomic condition, curing methods, drying and storage conditions.

**Grzanna et al. (2005)** reported that ginger (*Zingiber officinale*) is commonly used as a cooking spice throughout the world. The rhizome of ginger has long been used in Ayurvedic and traditional Chinese medicine to treat a wide range of ailments including gastrointestinal disorders, mainly nausea and vomiting associated with motion sickness and pregnancy, abdominal spasm, as well as respiratory and rheumatic disorders. As a home remedy, ginger is widely used for dyspepsia, flatulence, abdominal discomfort and nausea. It has been recommended by herbalists for use as a carminative (an agent that reduces flatulence and expels gas from the intestines), diaphoretic (an agent that produces or increases perspiration), antispasmodic, expectorant, peripheral circulatory stimulant, and astringent (an agent that causes shrinkage of mucous membranes or exposed tissues and that is often used internally to check discharge of blood serum or mucous secretions). Ginger has a reputation for its anti-inflammatory properties. In traditional medicine, ginger has been used to treat a wide array of ailments including sore throats, stomach aches, diarrhoea, toothache, gingivitis, arthritis (inflammation of the joints), bronchitis (an acute inflammation of the air passages within the lungs), muscle pains, sprains, constipation dermatitis, hypertension, dementia, fever, infectious diseases, helminthiasis, stroke, constipation, diabetes and asthmatic respiratory disorders.

**Venkatesh et al. (2005)** reported that ginger contains very potent anti-inflammatory compounds called gingerols. These substances are believed to explain why so many people with osteoarthritis or rheumatoid arthritis experience reductions in their pain levels and improvements in their mobility when they consume ginger regularly. In two clinical studies involving patients who responded to conventional drugs and those who didn’t physicians found that 75 percent of arthritis patients and 100 percentages of patients with muscular discomfort experienced relief of pain and swelling.
**Steward et al. (2006)** found that the active component of the ginger is reported to stimulate digestion, absorption, relieve constipation and flatulence by increasing muscular activity in the digestive tract.

**Chen et al. (2007)** reported that ginger (Zingiber officinale) contains active constituents such as sesquiterpenoids, Zingiberene, β-phelladrene, cineol, gingerol, gingerdiol, potassium, magnesium and copper. It is a worthy natural remedy against inflammation, food poisoning, vomiting, cold, skin inflammations, nausea, cramps, motion sickness and may also decrease pain from arthritis. Zingerone is likely to be the active constituent against enterotoxigenic Escherichia coli heat-labile enterotoxin-induced diarrhoea.

**Sashikumar (2009)** reported that among the spices, ginger is one commodity having excellent scope for product diversification. Many value added products from ginger like ginger beer, ginger wine, ginger candy, ginger cookies, ginger flakes, ginger brine, salted ginger etc. are now there in the superstores.

**Warrier et al. (2009)** reported that in Ayurveda, ginger has been recommended for use as carminative, diaphoretic, antispasmodic, expectorant, peripheral circulatory stimulant, astringent, appetite stimulate, anti-inflammatory agent, diuretic and digestive aid.

### 2.5.4 Cardamom

**Jamal et al. (2006)** reported that cardamom, the fruits of Elettaria cardamomum Maton. ingiberaceae commonly known as “Heel khurd” is used in Unani system of medicine to treat gastrointestinal disorders. A crude methanolic extract (TM), essential oil (EO), petroleum ether soluble (PS) and insoluble (PI) fractions of methanolic extract, were studied in rats at doses of 100–500, 12.5–50, 12.5–150 and 450 mg/kg, respectively for their ability to inhibit the gastric lesions induced by aspirin, ethanol and pylorlous ligature. In addition their effects on all mucus and gastric acid output were recorded. All fractions (TM, EO, PS, PI) significantly inhibited gastric lesions induced by ethanol and aspirin but not those induced by pylorus ligation. TM proved to be active reducing
lesions by about 70% in the EtOH-induced ulcer model at 500 mg/kg. The PS fraction reduced the lesions by 50% at 50 and 100 mg/kg (no dose response was observed) with similar effect than the PI fraction at 450 mg/kg. In the aspirin-induced gastric ulcer, the best gastroprotective effect was found in the PS fraction, which inhibited lesions by nearly 100% at 12.5 mg/kg. In our experimental conditions, the PS extract at doses ≥12.5 mg/kg proved to be more active than ranitidine at 50 mg/kg.

Nooman et al. (2007) reported the methanolic crude extracts of some commonly used medicinal plants were screened for their free radical scavenging properties using ascorbic acid as standard antioxidant. Free radical scavenging activity was evaluated using 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical. The overall antioxidant activity of green tea (Camellia sinensis Linn.) was the strongest, followed in descending order by black tea (Camellia sinensis Linn.), Eugenia caryophyllus (Spreng.) Bullock and Harrison, Piper cubeba Linn., Zingiber officinale Roscoe and Piper nigrum Linn. Trigonella foenum graecum Linn. and Elettaria cardamomum (Linn.) Maton showed weak free radical scavenging activity with the DPPH method. All the methanolic extracts exhibited antioxidant activity significantly. The IC50 of the methanolic extracts ranged between 6.7 ± 0.1 and 681.5 ± 8.4 µg/ml and that of ascorbic acid was 8.9 ± 0.1 µg/ml. The study reveals that the consumption of these spices would exert several beneficial effects by virtue of their antioxidant activity.

Ajaykumar Kunnunakkara et al. (2009) reported that medically, cardamom is used for flatulent indigestion and to stimulate the appetite in people with anorexia. Moreover, in Ayurvedic medicine it is used as a carminative, diuretic, stomachic and digestive, and for cough, colds and cardiac stimulation. Cardamom has been used in traditional medicine against kidney and urinary disorders, and as a gastrointestinal protective. Cardamom oil has reported anti-inflammatory and antibacterial uses. In India, green cardamom (A. subulatum) is broadly used to treat infections of the teeth and gums, to prevent and treat throat trouble, congestion of the lungs and pulmonary tuberculosis, asthma, heart disease, inflammation of the eyelids and digestive disorders. When mixed with neem and camphor, cardamom is used as a nasal preparation to treat colds. An
infusion of cardamom can be used as a gargle to relieve sore throats, which has led to its use in cough sweets. Cardamom is also reportedly used as an antidote for both snake and scorpion venom and for food poisoning. In traditional Chinese medicine it is used to treat stomachache, constipation, dysentery, and other digestion problems. Cardamom pods, fried and mixed with mastic and milk, are used for bladder problems. The seeds are popularly believed to be an aphrodisiac.

Mishra et al. (2010) reported the antimicrobial activity and to determine the Minimum Inhibitory Concentration (MIC) of various spice extract on some bacterial and fungal strains. The antimicrobial activity of alcoholic and aqueous extracts of asafoetida, ginger, cinnamon and cardamom extract was tested against B. subtilis, S. aureus, E. coli, P. aeruginosa, C. albicans & P. chrysogenum by agar well diffusion method. The crude extract showed a broad spectrum of antimicrobial activity by inhibiting both the groups of bacteria and fungus. Agar well diffusion assay for antimicrobial activity yielded the inhibitory zone of 16 to 34 mm diameter for asafoetida, 12 to 18mm diameter for cinnamon, 15 to 35mm diameter for ginger and 13 to 21 mm for cardamom extracts. The MIC value ranged between 12.5 mg/ml to 3.125 mg/ml with an exception of cinnamon alcohol extract against E. coli for which the calculated MIC was 25mg/ml.

Kumar (2010) reported that cardamom, a perennial herb indigenous to the Indian sub continent, contains a wide variety of bioactive compounds. In vitro studies showed that cardamom inhibited platelet aggregation. Cardamom is called queen of spices because of very pleasant aroma and good test. In India, it is used for many conditions, including asthma, bronchitis, kidney stones, anorexia, and general debility, as well as for disorders of the urinary tract. It is also used for digestive upsets, soothing a spastic colon, and relieving flatulence and constipation. It is effective to counter bad breath; and, when taken with garlic, it helps to reduce the strong smell of garlic.

Padmakumari et al. (2010) reported the relative levels of antioxidant activity, total flavonoid content, total phenolic content and reducing power of different organic and aqueous extracts with hexane sequentially extracted, dichloromethane, ethyl acetate,
methanol and water of four different varieties of cardamom viz. Mysore, Malabar, Vazhukka and Guatemala have been studied. Ethyl acetate extract of all varieties showed greater activity. Based on the results Malabar variety was identified as the best source of antioxidant compounds. Chemical analysis of the samples was carried out to calculate the percentage amount of components present in the sample. The data given are in the normal range reported for the varieties. Chemical compositions of the essential oil of seed powder of these varieties were studied by GC and GC-MS. The main constituents identified were terpinyl acetate ranging between 61.65 % - 68.19 % followed by cineol (7.23 % - 11.76 %).

www.tajagroproducts.com (2011)

* Cardamom oils are used for messages in Ayurveda massage parlor. It eases muscle tension and gradually gives a whole physical relief. The volatile oils extracts from cardamom is used for improving metabolism. It is used in the cure of halitosis.
* Cardamom is used for digestive disorders frequently. It helps to relieves gas and heartburn.
* Cardamom reduces the air and water elements, increases appetite and soothes the mucous membrane. Ground cardamom seed mixed with ginger, coriander and cloves is an effective medicinal solution for indigestion.
* The aromatic cardamom acts as breath freshener too. A few seeds chewed for a brief time can outfight bad breath. It has the power to kill the germs which causes the bad breath.
* It also cures some genitor-urinary infections. The powdered cardamom seeds mixed with a tablespoon of banana leaf and amla juice acts as an excellent diuretic treatment for cystitis, nephritis [inflammation of kidney], burning micturation and scanty urination.
* It’s a fighter against oral infections. Daily gargle of an infusion of cardamom and cinnamon protects one from the Flu and bacterial infections like throat infections. The same medicinal mixture can cure pharyngitis too.
* Cardamom powder mixed tea is a delicious drink which cures physical depression. It may help relieve nausea and vomiting. It can help detoxify against excessive caffeine. It
is effective in fighting pulmonary disease with copious phlegm. Cardamom tea helps to cure headache caused by indigestion

* The herb is using for treating in sexual dysfunctions like impotency. A pinch of cardamom seeds powder boiled in milk and sweetened with honey is useful in case of premature ejaculation. However, excessive use of cardamom at times may lead to impotency.

* Cardamom also helps in cleansing the body as it has detoxifying properties. It can be helpful in prevention of spasms or convulsions. People use cardamom in foods as a flavoring agent. It helps to remove toxins too.

2.5.5 Clove

Kalemba and Kunicka (2003) reported that syzygium aromaticum (Clove) (Syn-Eugenia caryophyllus Eugenia caryophyllata, Eugenia aromatica, Caryophyllus aromaticum) Essential oils of clove possess antimicrobial properties. Clove oil was effective against E. coli, L monocytogenes, S. enterica (Friedman et al., 2002). The antibacterial activity of clove against two gram-negative bacteria, such as Pseudomonas fluorescens and Serratia liquefaciens, and four gram-positive bacteria, such as Brochothrix thermosphacta, Carnobacterium piscicola, Lactobacillus curvatus, and Lactobacillus, involved in meat spoilage was found effective. The 1/100 dilution of clove oils inhibited the bacterial growth of five of the six tested bacteria mentioned above. A relationship between the inhibitory effect of essential oils and the presence of eugenol and cinnamaldehyde was found (Ouattara et al., 1997). A crude methanol extract of S. aromaticum exhibited growth-inhibitory activity against gram-negative anaerobic pathogens, including Porphyromonas gingivalis and Prevotella intermedia. The chromatographic analysis of clove isolated eight active compounds identified as 5,7-dihydroxy-2-methylchromone 8-C-beta-D-glucopyranoside, biflorin, kaempferol, rhamnocitrin, myricetin, gallic acid, ellagic acid, and oleanolic acid. The flavones, kaempferol and myricetin, active compounds from clove, demonstrated potent growth-inhibitory activity against the periodontal pathogens Porphyromous gingivalis and Porphyromous intermedia (Cai and Wu, 1996).
Nazrul et al. (2005) reported that clove extracts (petroleum ether, chloroform and ethanol extracts) were tested in vitro for their antibacterial activity against forty isolates of pathogenic bacteria including clinically resistant (resistant to ampicillin and nalidixic acid) strains of twenty five Shigella and four. Vibrio. All of the isolates except Pseudomonas aeruginosa showed promising sensitivity to the extracts.

Kunnumakkara et al. (2009) reported that cloves (Syzygium aromaticum, or Eugenia aromaticum or Eugenia caryophyllata) are the aromatic dried flower buds of a tree in the Myrtaceae family. Cloves are native to Indonesia and are used as a spice in cuisine all over the world. The name derives from the French “clou,” (meaning “nail”) as the buds vaguely resemble small irregular nails in shape. The spice is used in Ayurveda, Chinese medicine and Western herbalism and dentistry, where the essential oil is used as an anodyne (painkiller) for dental emergencies It has been reported as analgesic, anesthetic, antibacterial, antiparasitic, antidotal, antioxidant, antiperspirant, antiseptic, carminative, deodorant, digestive, rubefacient, stimulant, stomachic, tonic and vermifugal. Cloves are used as a carminative to increase hydrochloric acid in the stomach and to improve peristalsis. Cloves are also said to be a natural antihelmintic. The essential oil is used in aromatherapy, especially for digestive problems. Topical application of this spice over the stomach or abdomen will warm the digestive tract. In Chinese medicine cloves are considered acrid, warm and aromatic, entering the kidney, spleen and stomach meridians, and are notable in their ability to warm the middle, direct stomach qi (energy flow) downward, treat hiccough and fortify the kidney. Because the herb is so warming, it is contraindicated in any persons with fire symptoms. As such it is used in formulas for impotence or clear vaginal discharge, for morning sickness together with ginseng and patchouli, and for vomiting and diarrhoea due to spleen and stomach coldness. Clove oil is used in various skin disorders like acne and pimples, to treat severe burns and skin irritations, and to reduce the sensitiveness of the skin. Cloves are used for the treatment of dog and cat ear problems in British Columbia, Canada. The essential oil extracted from cloves is used as an ointment to relieve pain and promote healing in herbal medicine. Cloves are also employed as a fragrance in flavouring industries.
Kumar (2010) reported that clove tree is an evergreen which grows to a height ranging from 8–12 m. It has a major use as a local anesthetic for dental fillings. At one time, dentists routinely used cotton swabs saturated with clove oil to relieve the pain of a tooth. The essential oil extracted from clove by steam distillation has numerous uses, including as a preservative on microscope slides, a topical anesthetic, a flavouring in gargles and mouthwash, and as a mild germicidal in toothpastes, perfumes, and aftershaves. It is believed to be a good stimulant for the mind, improving memory. Its antispasmodic action eases coughs and, when applied topically, relieves muscle spasms. Alyaa et al. (2011) reported that Clove has a long traditional in use as a popular mouthwash, breath freshener and food flavoring, in addition to its medical benefits. The purpose of this study was to test the effect of water extract of clove on the micro hardness of artificially initiated carious lesion of the outer enamel surface compared with sodium fluoride and de-ionized water. Thirty-one teeth of upper first premolars extracted from 11-14 year old patients, referred from Orthodontic Department, College of Dentistry, Baghdad University. They were randomly divided to four study groups and one control group. After production of initial carious like lesion of outer enamel surface, the teeth were immersed, for four minutes of selected agents which were water clove extract (1%, 5% and 10%), sodium fluoride 0.05% and de-ionized water. Then each tooth was rinsed and storage with de-ionized water. This procedure was repeated daily for one week. Teeth were subjected to Vicker’s micro hardness and microscopic examination before and after the pH cycle and following the treatment with the selected solutions. water clove extract and sodium fluoride were successful in elevation of the micro hardness values of demineralised enamel surface, this was statistically highly significant for clove extract at (1%, 5% and 10%), and sodium fluoride 0.05%, while the microscopic examination of enamel ground section under light microscope revealed that zone of remineralisation in enamel was seen after treatment with all concentrations (1%.5% and 10%) of water clove extract, and sodium fluoride, but it revealed more with 0.05% sodium fluoride and 5% clove extract concentration. The three concentrations of water clove extract were effective in remineralisation of the outer enamel surface; which was reflected by increase in enamel micro hardness values.
**www.anniesremedy.com (2011)** Clove oil has come to the rescue of many who could not get a timely dentist appointment. Keeping a bottle of clove oil on hand is a very wise idea, you can use the antibacterial power of clove to treat colds, viruses, dental abscesses, ear pain and gum disease. Clove oil can also be added to massage oils for muscle soreness, abdominal pain, and arthritis.

**www.wikipedia.org/wiki/Clove (2012)** Cloves are used in Indian Ayurvedic medicine, Chinese medicine, and western herbalism and dentistry where the essential oil is used as an anodyne (painkiller) for dental emergencies. Cloves are used as a carminative, to increase hydrochloric acid in the stomach and to improve peristalsis. Cloves are also said to be a natural anthelmintic. The essential oil is used in aromatherapy when stimulation and warming are needed, especially for digestive problems. Topical application over the stomach or abdomen are said to warm the digestive tract. Clove oil, applied to a cavity in a decayed tooth, also relieves toothache. It also helps to decrease infection in the teeth due to its antiseptic properties. In Chinese medicine cloves or ding xiang are considered acrid warm and aromatic, entering the kidney, spleen and stomach meridians, and are notable in their ability to warm the middle, direct stomach qi downward, to treat hiccough and to fortify the kidney yang. Because the herb is so warming it is contraindicated in any persons with fire symptoms and according to classical sources should not be used for anything except cold from yang deficiency. As such it is used in formulas for impotence or clear vaginal discharge from yang deficiency, for morning sickness together with ginseng and patchouli, or for vomiting and diarrhoea due to spleen and stomach coldness. This would translate to hypochlorhydria. Clove oil is used in various skin disorders like acne, pimples etc. It is also used in severe burns, skin irritations and to reduce the sensitivity of skin. Cloves may be used internally as a tea and topically as an oil for hypotonic muscles, including for multiple sclerosis. This is also found in Tibetan medicine. Some recommend avoiding more than occasional use of cloves internally in the presence of pitta inflammation such as is found in acute flares of autoimmune diseases. In West Africa, the Yorubas use cloves infused in water as a treatment for stomach upsets, vomiting and diarrhoea.