Fruits are important part of human diet. They are commercially important and nutritionally indispensable food commodity (Prasanna et al., 2007). Man has kept these commodities in his diet to provide variety, taste, interest, aesthetic appeal and to meet certain nutritional requirements (Wills et al., 1996). Fruits are edible products of the perennial higher plants with high water content, soft texture, sweet, sour and semi-astringent flavors. Also because of their exotic flavor and taste, considerable attention is paid in different parts of the world.

The Fruit are consumed by man, mainly because of their organoleptic and chemical property. They play a vital role in human nutrition, by supplying the necessary growth factors essential for maintaining normal health. Fruits along with vegetables are termed as ‘Protective foods’ (Singh and Sharma, 2000). They are rich sources of vitamins (A, B complex and C) and minerals (calcium, iron and phosphorus) in diets to keep human health in goodsted (Tucker, 1993). Fruits are easily digestible and contain ample amounts of different organic acids and digestive enzymes. They are rich sources of roughage value in food, help in bowel movement, prevents constipation, natural fiber and an energy giving materials having high calorific value. Almost all fruits have some medicinal value in one way or the other. Physicians recommend fruits for the treatment of many ailments like scurvy, night blindness, asthma, fever, anemia, ulcers etc. (Peter, 2007). ‘An apple a day, keeps the doctor away’ is a well known phrase indicating significance of fruits in human diet.

The word fruit is derived from the Latin word “fructus” – to enjoy the produce (Coombe, 1976). In botanical terms, fruit is defined as “a ripened ovary” while in horticultural science it is described as “the plant product, which is edible on ripening” (Peter, 2007). Fruit has also been defined as “the tissues which support the ovules and whose development is dependent on the events occurring in the ovules” (Nitsch, 1952). The Botanical definition of a fruit is “the product of determinate growth from an angiosperm flower or inflorescence is too strict for the edible, fleshy fruits of commerce” (Wills, 1996). The Oxford English dictionary defines fruits as “the edible product of a plant or tree, consisting of seed and its envelope, especially the latter when juicy and pulpy”. The fruit has also been described as “a seed receptacle developed from a mature fertilized ovary” (Prasanna et al., 2007). A consumer defines fruit as “plant products with aromatic flavour that are either naturally sweet or normally sweetened before
eating” (Wills et al., 1996). “Fruit, a food, drink and medicine, neatly packed by nature in attractive, handy and easy to open containers”, is also a sensible definition indicating significance of fruits in human life (Peter, 2007). All the above stated definitions are more suited to the common usage of the term fruit. Also from the nomadic age to the present day civilized life, man has used fruits as food.

As fruits are living, biological entity, they are highly perishable once separated from the parent plant (Singh and Sharma, 2000). Constant attempts are made to find out better ways of preserving their freshness and extending their storage life. Various authorities have estimated that around 25–40 % of fruits and vegetables produced are lost after harvest (Kader, 2002). Hence, fruits and vegetables produced need to be protected from postharvest losses to safe guard grower’s investment and also to ensure demands of consumers and processors. A large amount of food reserves are wasted simply because of inadequate knowledge of their physiology as well as improper handling and storage facilities.

In recent years the production of fruits and vegetables has increased substantially with revolutionary advances in horticulture technology. The total production of fruits in the world is around 446 Million Tones (GOI, 2005). Crops belonging to around 180 plant families and thousands of genera are grown all over the world including temperate, tropical and subtropical species (Peter, 2007). Fruits contributing to the major share of world production include citrus fruits, grapes, banana, apple, mango, pineapple, pear, plum, papaya, date, strawberry, apricot, avocado and others (Table 1:1).

Recently, India has emerged as the 2nd largest producer of fruits in the world after China (Patel, 2004). Other major growers of fruits are Brazil, Australia, S.E. Asian countries, USA and S. African countries. The annual production of fruits in India is estimated as 45 Million Tones from an area of 4 million hectares contributing 9-10 % of the total world fruit production (GOI, 2005). Over the past decade, increase in area and production accounts for around 30 and 54 % respectively. Besides, India has also recorded a growth rate of 3.9 % with respect to fruit production in the past years and fruit processing sector has also increased by 20 % per annum (Peter, 2007). This progress is mainly due to the improvement like pre-cooling, cold storage and transport facilities.
### Table 1:1: Production of major fruits in India and World

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Production (Million Tones)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>India</td>
<td>World</td>
</tr>
<tr>
<td>Banana</td>
<td>13.304</td>
<td>64</td>
</tr>
<tr>
<td>Grapes</td>
<td>1.250</td>
<td>68</td>
</tr>
<tr>
<td>Mango</td>
<td>12.733</td>
<td>25</td>
</tr>
<tr>
<td>Papaya</td>
<td>2.150</td>
<td>5</td>
</tr>
<tr>
<td>Pineapple</td>
<td>1.172</td>
<td>17</td>
</tr>
<tr>
<td>Others</td>
<td>14.594</td>
<td>267</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45.203</strong></td>
<td><strong>446</strong></td>
</tr>
</tbody>
</table>

Source: Ministry of Commerce and Industries, Data Sheet 2005, Govt. of India

Though there is a tremendous increase in fruit production, it is estimated that about 25-40 % of the fruits produced are lost due to spoilage at various post harvest stages (Kader, 2002). India, besides being one of the largest producer of fruits, exports less than 1 % of its total fruit production, which indicates very poor exploitation of its potential in terms of earning foreign exchange (Peter, 2007).

In India, due to the varied agro-climatic conditions and diversified soil types, it is now possible to grow wide range of tropical, subtropical, temperate and arid zone fruit crops in the country (Peter, 2007). Considering the wide range of fruit types, they can be broadly classified into pome (apple, pear, quince etc.), drupe/stone (mango, peach, plums, cherry etc.), berry (strawberry, tomato), nut (walnut, pecan), hesperidium (citrus fruits), synconium (fig), sorosis (mulberry), coenocarp (jackfruit) and syncarp (custard apple) (Singh and Sharma, 2000). It is perhaps not surprising that with the availability of wide range of fruit types, they also differ to a certain extent in their respective metabolisms. However, the central biochemical pathways involved are common to all fruit and indeed vary often to other plant tissues (Tucker, 1993). Hence, it has been necessary to have a complete understanding regarding the behavior of these fresh produce at physiological, biochemical, cellular and molecular levels.

In recent times the physiology of fresh fruits and vegetables has become an important subdivision of both plant physiology and horticulture. The increased attention towards postharvest horticulture has mainly been due to the realization of the faulty handling practices after harvest. To prevent large loss of product it requires large inputs
in form of labour, material and capital. In order to increase the effectiveness of conservation measures, more must be known about the nature and cause of losses. Hence more information is required regarding the physiology of individual fruits (Singh and Sharma, 2000).

Understanding the life of fruit is by no means complete when it has reached maturity. Mature fruits undergo yet another developmental transition involving coordinated changes in a number of catabolic and anabolic reactions that results in ripening. As a developmental process, the term ripening is misleading in that it implies only the deteriorative aspects of the process resulting in spoilage and loss. But, currently ripening is characterized as the final phase of fruit development reflecting harmonious change in a number of biochemical pathways. Changes that takes place during ripening includes higher rate of respiration, increased ethylene production, carotenoid synthesis, chlorophyll degradation, production of cell wall hydrolytic enzymes etc (Raghavan, 2000). These changes suggest that rather than being a deteriorative process, ripening of fruit involves a series of differentiation events.

The visible changes that occur during the growth and ripening are the result of histo-architectural and histo-chemical changes. These changes in the underlying tissues are due to changes in the morphological phenomenon of differentiation and development of tissues and organs. Hence, the morpho-histogenic events of fruits in conjunction with the associated physiological and biochemical changes reveal the bewildering mechanisms of growth and development of fruit. Although all other facets of ripening have been extensively investigated, the structural/histological changes have received very little attention (Nagaraja, 1987). Thus, a comprehensive knowledge is required to understand the various biochemical changes occurring within the fruits in relation with the cellular and tissue levels. Thus, the study of histo-architecture and histo-chemistry of fruits could help in determining the exact sites of occurrences of various biochemical events. These in deed would help, in understanding the biochemistry and physiology associated with the development, in determine the maturity indices and in turn helpful in increasing the shelf life of these perishable commodities.
The high postharvest losses demand an instant need to supply bulk of fresh fruits and vegetables to the burgeoning population. This demand can only be fulfilled by either using the technology to prevent the deterioration of fruits after harvest and/or to introduce underutilized fruits for their commercial utilization. Also due to the ever increasing population and escalating urbanization, highly productive agricultural land is being used for urban development. These in turn creates extreme pressure on the remaining agricultural land. These difficulties have become more acute due to the over-dependency of humans on fewer plant species. Hence, diversifying production and/or consumption of a broader range of plant species including those currently identified as 'underutilized', can therefore contribute significantly to improve health and nutrition, income generation and maintain ecological sustainability (ICUC, 2006).

"Underutilized species" are the one, which are poorly addressed by researchers and conservation efforts. Underutilized species are only different from other (major) crops because their economic potentials have been poorly addressed and are confined to mostly traditional/local usage only. These underutilized species have never commanded great attention from the National and International agencies/centers dealing with improvement, use and conservation. The core argument that is being sustained in favor of their promotion today is that such species are indeed being cultivated and used in small areas or harvested directly from the wild but are not commercialized. Indigenous communities use these underutilized species as a source of food, feed, shelter and medicine. Thus, these underutilized fruits needs to be acknowledged, employed and explored for today’s and future generations (Padulosi, 1998).

A large number of underutilized edible fruits exist in tropic and sub tropics of the world. Many of such fruit species are identified, domesticated and are being utilized for various purposes, but their full potential has not been exploited (Peter, 2007). These plants produces edible fruits, which are known to have great potential, but are not at all being grown and utilized by people other than in a much localized manner. Such under and un-utilized fruits are needed to be evaluated for understanding their nutritive value, potential uses for other purposes, for possibilities of commercial cultivation in suitable areas and change in marketing (ICUC, 2006). Practice and techniques employed for utilizing these fruits by local people, where these plant species are seen at present can be scientifically and systematically refined for commercial exploitation.
In India broad spectrum of agro climatic conditions and diversity in people’s preference for taste offer great chances to identify right fruit for its commercial cultivation. In this context, significance of under and un-utilized fruits for exploiting potentials become clearer. Identification and introduction of such plant species in different regions, methods of present utilization, nutritive value, pomological significance, specific climatic and cultural requirements for successful growth of fruit species proves to be an upcoming area of research (Peter, 2007).

Wide range of underutilized fruits are grown in India, but full potential of these fruits are not exploited, which leads to limited scope for marketing of the processed goods outside the region. Only traditional processing methods are obtained, also seasonal availability of fruits, non suitable methods of storage and lack of information regarding the nutritional value limits the use of these underutilized fruits (Peter, 2007). The potential of underutilized fruits is also hampered by lack of awareness in society, as well as by lack of relevant capacity within the research community. The current scenario emphasizes the need to improve resource mobilization. Development of underutilized plant species research and development includes urgent work to collect baseline information and formulate meaningful indicators to guide future action (ICUC, 2006).

The underutilized plant species of economic importance are the key to sustainable agriculture in most of the developing countries facing resource constraints as well as rapid depletion of natural resources due to ever-increasing population pressure. Poverty at both rural and urban levels leads to various health and nutritional problems respectively. This can be improved upon through wider cultivation and inclusion of underutilized crops in our food habit. These underutilized plants can help to make diets more balanced and hence can play an important role in combating silent hunger (Swaminathan, 1999). Moreover, neglected and underutilized crops are essential to the livelihoods of millions of poor farmers throughout the world, they are part of the (threatened) biological assets of the rural poor. These crops could also help in poverty alleviation by providing income generating opportunities to farmers by linking the development of these crops to market opportunities. But many of these crops are in danger of loss through competition resulting from the introduction of higher value commodities into the farming system.
Leading international research organizations such as the Consultative Group on International Agricultural Research (CGIAR) are among those taking a keen interest in strengthening the work on these underutilized species (Swaminathan, 1999). Several international agencies, such as the Overseas Development Agency (ODA), International Plant Genetic Resources Institute (IPGRI), United States Agency for International Development (USAID), and International Centre for Underutilized Crops (ICUC) also encouraged research on these underused species in order to broaden the range of plant species under cultivation.

Hence, diversifying production and consumption of underutilized fruits can therefore contribute significantly to improve health, income generations and ecological sustainability. In nutshell, use of underutilized fruits has a vital role in imparting nutritional security to people. The father of green revolution, Dr. M.S. Swaminathan has also rightly stated that “Fruits and vegetables are the food of the future” (Peter, 2007).

In view of these opinions and observations, the present investigation has been undertaken to understand certain physiological and histo-architectural changes associated with the growth and development of some underutilized fruits with the following set of objectives:

- Elucidation of certain physiological changes associated with the histo-architectural features during growth and ripening of selected fruits.
- To determine the maturity indices for ensuring nutritional quality and adequate postharvest shelf-life before harvesting the underutilized fruits.
- Screening of antibacterial activity of the selected underutilized fruits.