CHAPTER I
General Introduction

Fruits are ripened reproductive body of a seed plant. Fruits, whether fresh or dried, have always shared a part of the staple diet of human beings (Nayak, 2012) and it was the first food items known to consume prehistorically by humans. Generally, fruits are important natural basic food and are excellent sources of anti-oxidants, vitamins, minerals, fibres and enzymes (Lamikanra et al., 2002). Fruits such as citrus and berries have the high sources of vitamin C (Hagg et al., 1995). Fruits, nuts and vegetables in the daily diet have been strongly associated with reduced risk of some diseases such as cancer, heart disease, stroke and other chronic diseases (Goldberg, 2003; Hyson, 2002; Prior and Cao, 2000). World Health Organization recommends the individuals to consume 400g of fruit and vegetables per day (WHO, 1990) and it encourages many individual through campaigns by government agencies of the countries. Since the availability of fruits is season and area based effective preservation method is required to store the quality of the fruit and to attain the availability throughout the year.

1.1 Emblica officinalis

1.1.1 Origin, Distribution and Other Names

Emblica officinalis has grown and recognized in India, earlier than 3500 years. Sushruta, the father of ancient medicine (1500 BC-1300 BC), mentioned about the effect of Emblica officinalis used in ayurvedic preparations. An ancient Indian mythological literatures such as Vedas, Shivpuran, Asandhpuran, Ramayana, Padma-puran, Charak Shanghita, Sushrut Shanghita, Kadambari, etc. are mentioned that it was considered as “Amrit Phal” (life giving fruit) (IPGRT, 2003). It can survive in various kinds of land
such as arid, semi-arid, salt affected, coastal and valleys. Amla is now becoming a crucial fruit of 21st century. It is one of the important native fruit of Indian subcontinent. It has been used as a source of nutrients, medicine and highly profitable for the farmers also. It is one of the oldest Indian fruits and considered as “Wonder fruit for health” because of its specific qualities. It has rich source of vitamin C next to Barbados cherry (*Malpighia glabra* L.). It is one of the three constituents of the famous ayurvedic preparation, triphala, which is prescribed in many digestive disorders (Chopra *et al.*, 1958). Triphala are used to strengthen the different tissues of the body, prevents ageing, promote health and immunity (Juss, 1977). The fruit *Emblica officinalis* Gaertn belongs to the family Euphorbiaceae, commonly known as amla. In Indian medicinal system amla is one of the popular herbs in ayurveda. Naturally farming trees of amla have been reported from India, Sri Lanka (Mac Millan, 1943), Java, West Indies, Trinidad (Webster, 1957), Hawaii, Florida (Barrett, 1956; Sturrock, 1959), Iran, Iraq (Hooper and Field, 1937), Cuba, Puerto Rico (Williams and Williams, 1951), Singapore, Southern Thailand, Pakistan, Malaya and China (Benthal, 1946) and Panama Canal regions. The major concentration of aonla cultivation is in Pratapgarh district of Uttar Pradesh. Aonla has spread over 50,000 ha area in the country with approximate production of 1, 75,000 tonnes (Pathak *et al.*, 2003).

In India, the amla fruit was first found in Varanasi (earlier known as Banaras) district of Uttar Pradesh started by Maharaja of Kashi. Banarasi variety of amla fruit is a master geno type, it was selected from Vindhyan hills. Authentic information regarding its cultivation dates back to 1881-82 in the Pratapgarh district of Uttar Pradesh. Pratapgarh town in Uttar Pradesh is known as amla city. The amla trees were introduced from Vanarasi and few from Gujarat. Those brought from Varanasi were named as Banarasi and those brought from Gujarat were known as Francis and later on as
Hathijhool (drooping branches). A seedling selection of Banarasi, with prolific bearing and flat fruits was named as Chakla and now it is known as Chakaiya. A high genetic diversity of amla exists in Northeastern region of India, especially in lower Maghalaya, Assam, Mizoram and Tripura (Yadav et al., 2001). In India, the most amla cultivars are Banarasi, Francis and Chakaiya (Scartezzini and Speroni, 2000). In addition other types of cultivars are Kanchan, Krishna, Narendra 9, Narendra 10, Narendra 6, Narendra 7 and BSR1 (Bavani Sakar).

The fruit of *Emblica officinalis* consists of nearly pedicelless, fruits depressed, round globose indented at the base. A capsular (drupaceous) berry with fleshy exocarp, smooth to obscurely 6 lobed, initially light green becoming dull greenish yellow or rarely brick red as it matures, hard 2-5cm in diameter. The fruit skin was thin, tunas or semi-translucent, fleshy juicy, crisp, stone containing 6 small seeds, the edible part of the fruit is mesocarp and the endocarp forms the hard stone, which encages the seed. The previous name of Amla fruit is *Phyllathus Emblica* L., it was assigned by the botanist Linneaus with reference to a specific character of this plant. Phyllanthus comes from the Greek words Phyllon means leaf and anthos means flower. Emblica word comes from Sankrit name of Amlika it means corruption. In Sanskrit, *Emblica* has different synonyms, such as Dhatriphala (nurse fruit), Amritaphala (fruit of immortality) and Amalaki (pure, clean) all of these names shows important of this plant (IGPRI, 2003).

There has been a growing interest in pigment components of fruits and vegetables, which may promote human health or lower the risk for disease. All parts of *Emblica officinalis* tree (fruit, leave, bark, seed and roots) have their own benefits (Dharmananda, 2003). *Emblica officinalis* fruit has different names in different languages. They are English - Indian Goose berry, Emblic myrobalan, Tamil - Nelli, Sanskrit - Aamalaki,
1.1.2 Antioxidant and Nutritional Properties

The edible fruit tissue contains three fold protein concentration and 160 fold ascorbic acid content compared to that of apple. Nutritive value of amla contains protein 500mg, energy 58kcal, vitamin A 151IU, carotene 9mg, vitamin C 600mg, calcium 50mg, iron 1.2mg, phosphorus 20mg, fibre 3.4g and different type of antioxidants, poly phenolic compounds are present in amla fruit. It contain high amount of vitamin C (Gopalan et al., 1991). Traditionally, the fruit is useful as an astringent, cardiac tonic, diuretic, laxative, liver tonic, diuretic, cooling (Zhang et al., 2000, Peryanayagam et al., 2004). The fruit contains a wide range of phenolic compounds, such as tannins, phyllembelic acid, phylemblin, rutin, curcuminoides and emblicol (Kim et al., 2005). Antioxidants may serve as the reducing agent for oxidative damage in humans and it will induce the free radical form (Pourmorad et al., 2006). The assay such as 2,2- diphenyl-1-picrylhydrazyl (DPPH) and oxygen radical absorption capacity (ORAC) are more indirect because they measure the inhibition of reactive species (free radicals) generated in the reaction mixture and the results largely depend on the type of reactive species used. Traditionally, deep coloured fruits, vegetables or foods are recognized as more healthy to human body, especially in the oriental countries. Emblica officinalis includes minerals such as phosphorous, calcium, iron and vitamins such as thiamine, niacin and riboflavin, respectively. Fruits contains rich amount of tannins present in leaves and barks. Root part of fruits having ellagic acid as well as lupeol, bark part contains leucodelphinidin. Fruit seeds contains 16% of fixed oils, which is a brownish yellow in colour and also contains different fatty acids such as palmitic (3.0%) linolenic (8.8%), linoleic (44.0%), stearic (2.15%), oleic (28.4%), and myristic (1.0%) acids (Thakur et al., 1989). The fruit of
*Emblica officinalis* used to making jellies, jams, pickles and other important products also.

### 1.1.3 Medicinal Properties

In the recent decades there has been developed growth in the field of herbal medicine and herbal plants, this extracted drugs are benefiting the developing as well as developed countries, because this herbal medicine and herbal plant drugs are not harmful or no side effects on human beings (Grover *et al*., 2002). In World Health organization (WHO) estimated that 80% of the people depend on the medicinal plants for their therapeutic purposes. In India more than 2000 medicinal plants preparation were used. India has a very rich source of traditional medicinal plants and traditional treatment system (Pareek, 1988 and Mukhopadhaya, 1998). The powdered seeds are useful to treat asthma, bronchitis and biliousness (HMRC, 2002).

Recently, amla extract has been tested for various pharmacological activities. The fruit extract was reported to have hypolipidaemic (Anila and Vijayalakshmi, 2002), antidiabetic (Sabu and Kuttan, 2002) anti-inflammatory activities (Asmawi *et al*., 1993) and inhibit retroviruses such as HIV-1 (El-Mekkawy *et al*.,1995), tumour development (Jose *et al*., 2001), gastric ulcer (Bandyopadhyay *et al*., 2000), diarrhea and jaundice (Deokar, 1998), antiulcerogenic (Sairam *et al*., 2002), antivenom capacity (Alam and Gomes, 2003) and anti diabetic activities (Parminder *et al*., 2012). The pulp of the fruit is smeared on the head to alleviate headache and dizziness (Perry, 1980). The fruit have the group of therapeutic effects including the anti carcinogenesis and anti mutagenic (Jeena *et al*., 1996), induction of apoptosis (Rajesh Kumar *et al*., 2003) anti-ageing substances (Ozyurt *et al*., 2004). All parts of the plant are used for medicinal uses; especially the fruit has been used in Ayurvedic preparations (Thakur, 1985).
1.2 Preservation Technologies

Naturally food may be contaminated during the stage of production and consumption. Contamination may be occurred by microbes and that causes a food borne diseases. Drying was most likely one of the first techniques developed. In early stage food preservation techniques are Heating, fermentation, salting and smoking etc. Recent techniques such as salting, heat pasteurization, canning, freezing, refrigeration, ultrahigh hydrostatic pressure, electrical conductivity heating, pulsed electrical fields and crop-protecting chemicals.

1.2.1 Drying

Drying is one of the oldest techniques used to limit the decomposition of food products, and they were dried using the sunlight. But in the Middle Ages, were built in areas that didn't have enough sunlight to dry things. A fire would be built inside the building to provide the heat to dry the various vegetables, fruits and herbs (Nummer, 2014).

1.2.2 Refrigeration

Refrigeration of vegetables can arrest the growth of certain pathogen and spoilage microorganisms but will not eliminate them. It is generally recognized that maintaining foods at 5°C is sufficient to prevent the growth of most common food-borne pathogens. Some growing psychrotrophic pathogens such as Clostridium botulinum Yersinia enterocolitica, Listeria monocytogene and E.coli are able to multiply slowly in refrigerated foods (FAO, 2008).

1.2.3 Freezing

Freezing is commonly used in commercial process of foods but mostly in domestic purpose for preserving prepared food.
1.2.4 Salting

Salting in the food contents removes the water content through the process of osmosis. For an example in the commercial process meat has been stored by salting or sugaring or a combination of sugar and salt. *Clostridium botulinum* produce pink colourization in meat followed by spoilage this can be effectively controlled by nitrates and nitrites.

1.2.5 Sugaring

Sugaring of food will removes water from the microbe by the process of plasmolysis followed by dehydration of the microbial cells leads to death and prevention of microbial growth. Sugaring is mostly used in preservation of syrup with fruit such as apples, pears, peaches, apricots, plums or in crystallized form where the preserved material is cooked in sugar to the point of crystallisation and the resultant product is then stored dry. This method is used for the skins of citrus fruit (candied peel), angelica and ginger.

1.2.6 Smoking

Exposure of food items to smoke from burning plants will lengthen the shelf life of food items. It is one of the ancient method developed after the people starts to cook. Smoke deposits a number of pyrolysis products onto the food, including the phenols syringol, guaiacol, catechol (Msagati, 2012). For cooking and flavoring the fruits and vegetables like paprika, cheeses, spices, and ingredients for making drinks such as malt and tea leaves are also smoke.

1.2.7 Pickling

Food items can be stored in edible anti microbial liquid such process is called as pickling. Traditionally there are two types of pickling chemical pickling and fermentation
pickling. In chemical pickling agents like brine (high in salt), vinegar, alcohol and vegetable oil, especially olive oil but also many other oils are used to inhibit or kill bacteria and other microorganisms. In some cases, fold itself can produce some preservatives it can be activated by fermentation process. Ex. lactic acid.

1.2.8 Irradiation Technology

The ionizing radiation such as gamma-rays, X-rays and electron beam are permitted to irradiate the food materials (IFT, 2003). Most of the work on ionizing radiation has focused mainly on food-safety (Smith and Pillai, 2004) and food-quality issues (Sendra et al., 1996). Food irradiation is the highly advanced method to treat the food by ionizing radiation. Food irradiation has a specific merits, includes one of the important method of food preservation. It is applied in more and more countries worldwide to raise the shelf life and improve hygienic quality of food products. Irradiation technology is used worldwide for the purpose of sterilizing the medical instrument, pharmaceuticals, processing the cosmetics, food packaging, and to improve the manufactured product quality.

1.3 Objectives

- To irradiate the amla varieties such as Banarasi, Chakaiya and Francis using microtron technology.
- To analyses the physicochemical changes in irradiated products.
- To enumerate the antioxidant properties in irradiated fruits.
- To determine the shelf-life of irradiated products
- To calculate the amount of minerals in irradiated fruit sample
- To enumerate the microbial load of irradiated sample
- To optimize the irradiation dose for selected amla fruits
- To assess the suitability of the irradiated products for human consumption.