INTRODUCTION

The Jamun, botanically identified as *Syzygium cumini* (L.) Skeels (Syns. *Syzygium jambolana* DC, *Eugenia cumini* Druce, *Eugenia jambolana* Lam.), belongs to the family Myrtaceae or Myrtle (Chase, 2009; Wealth of India, 2002). The other names of jamun are Indian blackberry, Java plum, Jambu, black plum and Jambul *etc.* (Kirtikar and Basu, 1999; Nadkarni, 2001). In the production of jamun, India ranks second in the world. Uttar Pradesh state is the largest producer followed by Maharashtra, Tamil Nadu, Gujarat, Assam. *S. cumini* is an emerging fruit crop of the twenty-first century as it yields table fruit that could play an important role in meeting demand for nutritious natural fruit of high medicinal value as well as different plants parts possess varied uses to mankind. It comes in the category of minor or underutilized fruit crop. Ripe fruits are purpulis with high anthocyanin content with a pleasant, astringent taste and are processed to make vinegar, jam, jellies and squash

It accredited due to the presence of the various pharmacological active phytochemicals such as alkaloids, fatty acids, steroids and tannins. It is multipurpose tree cultivating for varied uses as avenue tree for wind break. Due to its high tannin content bark yields a brown dye which is used in preserving fishing nets and tanning leather. The timber is used as fuel wood and preparation of different agricultural implements.
1.1 Religious Veneration

Due to a majority of Jamun trees the Indian subcontinent known as Jambudweep, Jambul regarded as 'fruit of the gods', by many Hindus especially in Gujarat. In southern Asia, the tree is adored by Buddhists, and it is considered sacred to Krishna. The leaves and fruits are devoted as elephant-headed god, Ganesha or Vinayaka (Morton, 1987; Warrier et al., 1996).

1.2 Taxonomy

The genus name *Syzygium* is derived from the Greek word *Syzygos*, meaning yoked together, possibly referring to the paired leaves. *S. cumini* (2n = 40) is a medium to large sized evergreen tree with smooth grey bark and attain the height of 20 m. The taxonomy of the *S. cumini* is as follows-

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plantae – Plants</th>
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<tbody>
<tr>
<td>Subkingdom</td>
<td>Tracheobionta – Vascular plants</td>
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<tr>
<td>Super division</td>
<td>Spermatophyta – Seed plants</td>
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<tr>
<td>Division</td>
<td>Magnoliophyta – Flowering plants</td>
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<tr>
<td>Class</td>
<td>Magnoliopsida – Dicotyledons</td>
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<tr>
<td>Subclass</td>
<td>Rosidae</td>
</tr>
<tr>
<td>Order</td>
<td>Myrtales</td>
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<tr>
<td>Family</td>
<td>Myrtaceae – Myrtle family</td>
</tr>
<tr>
<td>Genus</td>
<td><em>Syzygium</em> P. Br. ex Gaertn.</td>
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<tr>
<td>Complete scientific name</td>
<td><em>Syzygium cumini</em> (L.) Skeels</td>
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</tbody>
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(Source: USDA-NRCS, 2011)
1.3 Origin and distribution

*S. cumini* is an important indigenous, very common, large, evergreen beautiful tree, native to India but has naturalized throughout Myanmar, Sri Lanka, East Africa, South East Asia, Eastern Australia etc. (USDA-ARS, 2008).

**Figure 1.1: Worldwide distribution Syzygium species**


Native Range: India, Myanmar, Sri Lanka, Malaysia, Philippines, Thailand.

Exotic Range: Algeria, Antigua and Barbuda, Australia, Bahamas, Barbados, Colombia, Cuba, Dominica, Dominican Republic, Ghana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Indonesia, Jamaica, Kenya, Martinique, Mexico, Montserrat, Nepal, Netherlands Antilles, Nicaragua, Panama, South Africa, Sudan, Tanzania, Trinidad, Tobago, Uganda, US, Vietnam, Virgin Islands (US), Zambia and Zimbabwe.
The trees of jamun are mostly found in Western Ghats and scattered throughout the tropical and subtropical regions of Indian subcontinent (Singh and Bajpai, 2011). It has naturalized throughout the Nepal, Pakistan, Sri Lanka, Bangladesh, Philippines, Indonesia, Eastern Africa, Florida and Hawaii (Warrier et al., 1998; USDA-ARS, 2008). It is one of the hardy fruit crops and can be grown in waste and marshy areas where other fruits plants cannot be easily grown. The tree is naturalized in Philippines Java and East Indies, Queensland, New South Wales, Zanzibar, Pemba and Mombasa and the adjacent coast of Kenya. By 1870, it became established in Hawaii and in 1920 and 1940 Puerto Rico and Israel, respectively. It is grown in Algiers, Bermuda, Cuba, Haiti, Jamaica, the French Islands, Trinidad, Lancetilla, Honduras, Guatemala, Belize, Surinam, Venezuela and Brazil (Bhandary et al., 1995).

1.4 Species distribution

The genus Syzygium comprises about 1000 species, the most of them are tropical in origin. Jamun is found in Western Ghats and very extensively in the tropical region (Singh and Bajpai, 2011). Syzygium cuminii (L.) Skeels is the most common and widely distributed and other species as Syzygium alternifolium (Wight) Walp., Syzygium aqueum (Burman. f.) Alston, Syzygium aromaticum (L.) Merrill & Perry., Syzygium Bracteatum (Willd.) Raizada, Syzygium malaccense (L.) Merrill & Perry., Syzygium samarangense (Blume.) Merrill & Perry., Syzygium jambos (L.) Alston., Syzygium fruticosum (Roxb.) DC., Syzygium javanica Lam., Syzygium densiflorum Wall ex. Wight & Arn., Syzygium
uniflora (L.) and Syzygium zeylanicum (L.) DC., found scattered in tropical and subtropical regions of the country (Singh et al., 2011).

Figure 1.2: Distribution of Syzygium species in India (Singh et al., 2011)
1.5 Pharmacological potential of different parts of *S. cumini*

The *S. cumini* occupy considerable place in our life that have efficacy to ameliorate the detrimental effects of many diseases. Its reference had been quoted in Rigveda and Atharva Veda. Since the time of Charaka and Susruta, it is also used extensively in the several traditional systems of medicine resembling in the Ayurveda, Unani, Siddha, Homeopathy, alternative and complementary medicine (Warrier *et al.*, 1996). Before the discovery of insulin, in the treatment of diabetes *S. cumini* was used either alone or in combination with other hypoglycemic plants even in Europe (Helmstadter, 2008). Its bark is acrid and good for sore throat, bronchitis, asthma, biliousness, dysentery, blood impurities and to cure ulcers (Kirtikar and Basu, 1999). Its decoction is used as lotion for removing ringworm of the head (Warrier *et al.*, 1996). It has significant decrease in blood glucose levels in mice (Villasenor and Lamadrid, 2006). Unsaponifiable matter of seed fat contains β-sitoterol. antidiabetic, anti-inflammatory, hepatoprotective, anti-hyperlipidemic, diuretic and antibacterial activities have been reported in various extracts of *Syzygium cumini* seeds by Duke (2006).

The powder, decoction, juice or pastes of the different parts of jamun tree were utilized for cure of various diseases (Ayyanar and Babu, 2012). The juice is taken mixed with milk every morning. Fresh leaf juice is taken orally for stomach pain (Bhandary *et al.*, 1999). The ash of the leaves is used as a dentrificant and is effective at strengthening the teeth and the gums. In the Siddha system of medicine, *S. cumini* is considered to be a haematinic, semen promoting and to decrease excessive heat of the body.
(Warrier et al., 1996). According to the Unani system of medicine, they are supposed to be a liver tonic, to enrich blood, strengthen teeth and gums. The leaves were used as for strengthen the teeth and gums, fever, gastropathy, dermopathy and constipation.

Several experimental and clinical studies have been confirmed antidiabetic activities of various parts of jamun (Grover et al., 2002; Ravi et al., 2004; Sridhar et al., 2005; Sahana et al., 2010; Dusane and Joshi, 2011; Ponnusamy et al., 2011). The various extracts of different parts of jmaun possess a range of pharmacological properties such as antibacterial (Gowri and Vasantha, 2010), antimicrobial (Oliveira et al., 2007; Siddiqi et al., 2011), antifungal (Chandrasekaran and Venkatesalu, 2004; Jabeen and Javaid, 2010), antiviral (Sood et al., 2012), antioxidant and free radical scavenging activity (Benherlal and Arumughan, 2007; Zhang and Lin, 2009; Banerjee and Narendhirakannan, 2011), cardioprotective (Mastan et al., 2009), anti-inflammatory (Kumar et al., 2008), neuropsychopharmacological (Kumar et al., 2007), antiallergic (Brito et al., 2007), radioprotective (Jagetia et al., 2008), chemopreventive (Parmar et al., 2010), larvicidal (Raghavendra et al., 2011), gastroprotective and anti-ulcerogenic (Chaturvedi et al., 2009) activities.

1.6 Genetic resources and extent of genetic variability

In India, due to the diversity in climate, soil, altitudes and other eco-geographical conditions, rich genetic resource of genus Syzygium are available. In India, the variability was recorded in small farms/ orchards, in backyards, roadside avenues and marginal lands across the country, which
has predominantly arisen from seedling origin. Owing to cross-pollination and seed propagation, there is enormous variability in fruit morphology, quality, maturity and productivity. The large number of seedling strains have variation with respect of fruit shape, size, pulp colour, TSS, acidity and maturity period particularly in Goa (Devi et al., 2002), Uttar Pradesh and Jharkhand (Patel et al., 2005; Srivastava et al., 2010), Gujarat (Singh and Singh, 2012), Karnataka and Maharashtra (Ghojage et al., 2011). There are no standard cultivars available in *S. cumini*, however, several farmers have been identified selection of jamun which is area-specific. These types of selections are made on the basis of fruit size, shape, taste, fruiting period and maturity of fruits. One natural selection is known as *Ra jamun*, grown widely is famous in northern India (Pathak et al., 2006). Its fruits are big sized length 2-3.50 cm and diameter 1.5-2.0 cm, oblong deep purple, highly juicy and sweet fruits. A seedling selection has considerable tree variation exists in the Pune and Ahmednagar district of Maharashtra named as *Paras* yields sweet fruit (Keskar et al., 1989).

There are some local selections/ varieties from Haryana and Western Uttar Pradesh *i.e.* Badama (large size and very juicy fruits), Kaatha (with small and acidic fruits), Jathi and Ashada (matured in June), Bhado (matured in August). Some recently released varieties of jamun are Goma Priyanka from CHES, Godhra Gujarat (semi-dwarf, spreading growth habit, dense foliage and drooping branches, early, precocious bearer), Rajendra Jamun 1 from Bhagalpur, Bihar (lanceolate leaf, acute apex, comparatively early flowering profusely, Dark black fruit, oval in shape with blunt apex and smooth skin surface). The Central Institute for Sub-
tropical Horticulture, Lucknow, UP were also released two selections of jamun namely **CISH-J-37** (fruit is bold, oblong, small seed with higher pulp content, high TSS, lowest acidity, mid season maturity, high nutraceutical value due to relatively high ascorbic acid content and total antioxidant value) and **CISH-J-42** (seedless, round shape fruit, high pulp content, enhanced shelf-life with High TSS and ascorbic acid content).

### 1.7 Objectives

Keeping this in view, the present study entitled **“Studies on genetic variability in jamun (Syzygium cumini Skeels) related with morphological, biochemical and medicinal attributes”** was carried out with following objectives

1. To assess morphological and biochemical variation in fruits of different accessions of Jamun (*Syzygium cumini* Skeels).
2. To identify superior accessions for maximum antioxidant value and to assess genetic variability in elite accessions of jamun using morphological and molecular marker.
1.8 Prospects of study

Jamun (*Syzygium cumini* L.) Skeels is an important under-exploited fruit crop, widely grown successfully due to its wider adaptability and nutraceutical properties. In India, its variability occurs largely roadside avenues and marginal lands across the country, which has predominantly arisen from seedling origin. Jamun has importance for providing delicately flavoured attractive natural edible fruits that possess high medicinal values as various parts of plant including seeds, bark, leaves and fruits have been studied and investigated for various pharmacological properties. It is well known fact that germplasm are the building blocks of new varieties however, some of the valuable varieties are eroding fast under varying environmental pressures.

Therefore, the evaluation of physico-biochemical, total antioxidant and nutraceutical properties along with assessment of genetic variability would be an important approach for exploiting jamun genotypes at commercial scale by increasing area under its cultivation. The seeds have efficacy in amelioration of diabetic conditions as it is used as integral parts of various antidiabetic products in different alternative systems of medicine thus will provide additional income to the growers. There are various jamun based herbal products, manufactured in India and other Asian countries are well known among consumers. The commercial exploitation of *S. cumini* would be attributed to higher GDP of the nation by increasing the income of growers besides providing better health to the society.
1.9 References


