CHAPTER I

INTRODUCTION

At present customers are focusing on the quality and origin of the food they consume, prioritizing ingredients that offer the better health benefits viz. high protein, fibre, antioxidant, low sugar or saturated fat content. India has an extensive traditional native fruit trees, which having wide variability in their physical, chemical and morphological combination. Nutritional value and health conscious have become major trends in the food industry. Nutrient rich native fruits, which are currently categorized as underutilised, can play a significant part in meeting the demand for wholesome, aesthetically pleasing, delicately flavoured, and highly therapeutic natural foods.

Jamun (*Syzygium cuminii L.*) is an under-utilized fruit tree from Indian subcontinent. It belongs to the family of Myrtaceae. Jambul, black palm, java palm, and Indian blackberry are the common names of jamun. It is also referred as "Fruit for the Future" (Madani *et al.,* 2021). The promising number of phytochemicals, minerals and vitamins gives a great therapeutic value for jamun. It exhibits proven pharmacological properties in animal systems, including hypoglycaemic, anti-inflammatory, antimicrobial, antioxidant, antidiarrheal, analgesic, astringent, and gastro-protective effects. Studies on the use of jamun for managing diabetes have also demonstrated positive results (Jagetia, 2017).

India ranks second in jamun production, with an annual output of 13.5 million tonnes in 2013, contributing 15.4% to the world's total estimated production (Pharate *et al.,* 2018). The largest producer of jamun in India is Maharashtra followed by Uttar Pradesh, Tamil Nadu, Gujarat, Assam and others. There are a few standard varieties of this fruit under cultivation. Ram jamun is a common variety in north India. Konkan bhadoli, madhura, Badama, Bhado, Narendra Jamun 6, Goma Priyanka, CISH J-42 (Seedless type), CISH J-37 are some of the well-known varieties of jamun (Patil *et al.,* 2018; Singh *et al.,* 2019). Among the many varieties "konkan bhadoli" is famous. Jamun is widely grown in the larger parts of India from the Indo-Gangetic plains in the North to Tamil Nadu in the South. The data about its total acreage in India are not available.

Rasheed *et al.* (2024), reviewed the potential of jamun fruit for increasing the food security in the areas which was affected by salinity. Jamun fruit is rich in antioxidants, vitamins, and minerals so the composition makes a benefit of diet source for salinity regions. Jamun is rich in anthocyanin, flavonols, and flavanonols. The highest concentrations present in jamun are anthocyanin and hydrolysable tannins (Tavares *et al*., 2016).

Jamun is used to produce a variety of processed food items, including juice, wine, muffins, and frozen yogurt (Singh *et al.,* 2015; Tavares *et al*., 2016). The fruit pulp is utilized in the preparation of squash, instant drink mixes, cakes, dairy products, chapattis, and flatbreads (Kaur *et al*., 2024). Rich in anthocyanins, jamun serves as a natural colorant, preservative, and flavour enhancer in the food industry (Das *et al*., 2023).

According to Das *et al*. (2023), jamun juice processing has an effect of anthocyanin and other bioactive compounds degradation due to temperature rising during processing. The phenolics present in the jamun also having uneven distribution. So proper process technologies and control is needed for preserving the great nutritive values. Vitamins like C and A, as well as substances with antioxidant qualities like flavonoids and carotenoids, are abundant in fruits like jamun. Juice flavour and colour can be altered by thermal treatments, which can also lower the quantity of certain vitamins and antioxidants. Though jamun contains 80% pulp, juice extraction using conventional methods remains challenging. To enhance both yield and nutritional quality, improved extraction techniques are essential. Ultrasound is a potential sustainable alternative to thermal methods because of the nutritional losses brought on by heat (Lepaus *et al.,* 2023). Ultrasound is a sound wave which is above 20 kHz (Yao *et al.*, 2020). It is used in the food industry for extraction and encapsulation of bioactive ingredients (Mehta *et al.,* 2022).

In order to support 5-log pathogen reduction and enhance the microbiological safety of juices, the FDA advises to use ultrasound in sterilisation procedure. However, Ultrasound (US) application in juices is considerably more successful than merely ensuring the microbiological quality of products. This technique is also evaluated to determine how to maintain the nutritional qualities of juices and improve the stability

of parameters during storage (Bernardi *et al.,* 2021). With all these considerations, this is promising preservation technique in fruit and vegetable juices. It has an advantages of short process time, effectiveness, less solvent and effective for thermal sensitive compounds. These are the features which make this technology into low cost, feasible, non-thermal with significant results to preserve the juice quality.

The seasonal and tropical products are having important nutrient contents and the market demand is also high. It is important to make a product that should be available throughout the year. Preservation is important, in order to make the product availability worldwide with good shelf-life and physicochemical properties (George *et al*., 2023). Drying is an important unit operation in food processing to extend the shelf-life. The common industrial drying techniques are microencapsulation by spray drying, freeze drying and foam mat drying etc. where each one has unique set of dehydration principles (Verma and Singh, 2015). Food industries are focusing the functional food development and improved technology like spray drying for getting product which give additional nutritional benefits apart from regular nutrients (Sobulska *et al.,* 2020).

According to Samborska *et al.* (2022), spray drying is a well-established technique to make powder with stable physicochemical properties when the process is optimized. Spray drying is the transformation of feed from a fluid state into a dried particulate form by spraying the feed into a hot drying medium. Spray drying makes it possible to continuously produce free-flowing powder from liquid feed that is composed of uniformly spherical particles, agglomerates, or granules. The product from spray drying having low moisture content and water activity which make the product highly stable activity (Shishir and Chen, 2017). Microencapsulation can be defined as the packaging of solid, liquid and gaseous material in sealed capsules of sizes from sub microns to millimetres. Atomizers involved in spray drying are capable to produce droplet sizes from 10 to 500 μm preferably 100 to 200 μm. For improving the bioactive compound distribution in food and its delivery to gastrointestinal tract, microencapsulation is the best method. Encapsulation by spray drying is the most effective technique to protect the bioactive compounds due to the ease of use, cost effective and high quality (Jafari *et al*., 2023)

Considering the above-mentioned factors, a study was conducted to develop an ultrasound assisted micro encapsulation of jamun juice by spray drying with the following objectives:

1) To optimize the operating parameters for ultrasound assisted extraction of jamun juice
2) To optimize the concentration of feed solution and operating parameters for spray drying of jamun juice
3) To conduct the storage studies of optimally produced jamun juice powder