CHAPTER I

INTRODUCTION

Pigeon pea (*Cajanus cajan* L.) belongs to the Fabaceae family and grows well in tropical and subtropical regions. Pigeon pea is one of the important pulse crop of India. The area under pigeon pea cultivation in India was 37 lakh hectares with an annual production of 28 lakh tonnes during the year 2015-16. The production of pigeon pea in Gujarat was about 2.4 lakh tonnes over an area of 2.1 lakh hectares during the same year (Anon., 2016).

Pulses are consumed as dehusked splits and are an important dietary constituent, especially for the vegetarian population of India, as a source of protein. It is estimated that pulses contain 20-25 % of protein by weight and have twice the protein available in wheat and thrice that is present in rice. Per capita net availability of pulses in India, however, has reduced from 51.1 g/day (1971) to 41.9 g/day (2013) as against World Health Organization recommendation of 80 g/day. This raises question about the nutritional aspect as pulses are considered to be ‘poor man’s protein’. Despite increase in production, India has been the largest importer of pulses since the beginning of the present millennium. The import has increased to more than 20 % of the domestic production during 2009-10 and 2012-13. The import bill for pulses also soared from Rs. 3160 crore during 2001-02 to Rs. 10551 crore during 2013-14 (Mohanty and Satyasai, 2015).

The pigeon pea is also known as tur and arhar. It is the second important pulse crop of India which has diversified uses as food, feed, fodder and fuel. Pigeon pea is significantly contributing to meet the dietary requirement of crude fibre, ash, fat, magnesium, manganese and copper. Pigeon pea contains high amount of vitamin B, carotene and ascorbic acid (Singh and Diwakar, 1993). These are deficient in cereals; therefore, pigeon pea has a good supplemental value of cereal based diet. Pigeon pea has several uses as medicine. It is used in Ayurveda as volerant, a medicine that heals wounds and sores, as an astringent, a medicine that stops bleeding by constricting the tissues, and as a medicine that cures diseases of the lungs and chest. It also works as antihelminthic to destroy internal worms (Faris and Singh, 1990).
Pigeon pea is consumed as dehulled splits, whole, canned, boiled, roasted or ground into flour to make a variety of desserts, snacks and main dishes. The cotyledons of dry grains excluding seed coat are called dhal. It contains considerable amount of several anti-nutritional factors, namely: protein inhibitors, amylase inhibitors and flab causing sugar and phytic acid. Dehulling of pigeon pea helps to remove anti-nutritional compounds such as polyphenols located in the seed coat.

The removal of the outer husk and splitting the grain into two equal halves is known as milling of pulses. Before cooking or other processing operations, it is necessary to remove the fibrous seed coat of pigeon pea in order to reduce the fibre content and improve its palatability. The hull of pigeon pea adheres tightly to the cotyledons though a gummy layer that does not allow separation of hull during milling, thus making the pulse more difficult to mill. To facilitate dehusking and splitting of pulses alternate wetting and drying method is used. Loosening of husk by conditioning is insufficient in traditional methods. To obtain complete dehusking of the grains a large number of abrasive force is applied in this case as a result high losses occur in the form of brokens and powder. Yield of split and pulses in traditional mills are only 65 to 75 % due to the above losses compared to 82 to 85 % potential yield (Kulkarni, 1989).

Pre-milling treatments are generally employed to loosen the seed coat to remove husk without losing any edible portion. There are two approaches to remove hulls, namely, wet and dry milling. Generally, the dry method of milling is used though out the Indian subcontinent for milling of pigeon pea because the quality of splits obtained from wet milling is poor (Kurien and Parpia, 1968; Kulkarni, 1991). There are many other pre-milling methods like CFTRI method, Pantnagar process, CIAE method and IIPR method for pigeon pea. In these methods, rewetting and drying is done to loosen portions of husk sticking after repeated rolling. Depending upon adherence of husk to grain, the pulse grains are passed through mill for two to three times. During dehulling, noticeable amounts of cotyledon material and germ are removed, which results in considerable losses (Siegel and Fawcett, 1976). All these treatments are time consuming require almost 4 to 7 days for the complete milling of pigeon pea. Moreover, these pre-treatments lead to higher processing cost, longer processing time and labour consuming for pigeon pea milling. In large-scale
processing of pigeon pea, the loss of cotyledon in terms of powder and broken grain can be as high as 12.8 % and 4.4 %, respectively (Singh, 1995).

Pre-milling treatments play an important role in improving dhal recovery by loosening husk from cotyledons (Saxena, 1999). During pre-milling treatments water, oil, chemical, heating actions leads to the structural changes, shape deformation and therefore in terms of cooking quality of dhal may be affected. Long cooking time results in a decrease in protein quality and a loss of vitamins and minerals. This necessitated the suitable pre-treatment for pigeon pea milling that can shorten the processing time and improve the product quality. A novel pre-dehulling technique involving enzyme is prospective to improve dehulling efficiency upon reducing the dehulling loss and improving cooking quality of pigeon pea (Deshpande et al., 2007; Sreerama et al., 2009; Bhowmik, 2012; Sangani et al., 2014a). Partial hydrolysis of the mucilaginous bonds (in the interface of hull and cotyledon) by enzymatic reactions facilitates the easy dehulling of legumes (Verma et al., 1993).

In India, different varieties of pigeon pea are cultivated. The major varieties are BDN 2, BSMR-736, VAISHALI, ICPL 87119, C-11. Amongst different varieties of pigeon pea, the ICPL 87119 variety is most commonly grown by the farmers in central and south zone of India. Moreover, ICPL 87119 variety is a line obtained by the pedigree method of selection from the cross C-11*ICP1-6 at ICRISAT (Reddy et al., 1995). ICPL 87119 is a high-yielding pigeon pea variety. In view of this, ICPL 87119 variety of pigeon pea is selected for the present investigation.

PRACTICAL UTILITY OF THE RESEARCH

The pigeon pea grain is considered as most difficult for dehulling as compared to other pulses. Pre-milling treatments are generally employed to loosen the seed coat to remove husk without losing any edible portion. There are many pre-milling methods like wet milling, dry milling, CFTRI method, Pantnagar process, CIAE method and IIPR method for pigeon pea milling. All these methods are time consuming process for the complete milling of pigeon pea. Moreover, these pre-treatments lead to higher processing cost, longer processing time and labour consuming for pigeon pea milling. It also requires large space for milling.

Pre-milling treatments play an important role in improving dhal recovery and improving the quality. During pre-milling treatments water, oil, chemical, heating
actions leads to the structural changes as well as shape deformation and therefore quality of dhal in terms of cooking time may be affected. Long cooking time results in a decrease in protein quality and a loss of vitamins and minerals. A novel pre-dehulling technique involving enzyme is prospective to improve dehulling efficiency upon reducing the dehulling loss and improving cooking quality of pigeon pea. Partial hydrolysis of the mucilaginous bonds by enzymatic reactions facilitates the easy dehulling of legumes.

The mechanism of enzymatic activity is governed by four interacting parameters viz., seed moisture content, enzyme concentration, incubation time and incubation temperature (Sarkar et al., 1998). Optimum levels of these parameters are necessary to get maximum recovery and better quality of dhal. Hence enzyme treated pigeon pea dhal requires a detailed study by optimizing the parameters to get maximum recovery with good quality of dhal and reduce the cooking time of dhal.

Hence, the present study was undertaken to optimize the milling efficiency of enzyme treated pigeon pea with following objectives:

**OBJECTIVES**

1. To study proximate composition of pigeon pea grain.

2. To determine the effect of enzymatic pre-treatments on dehulling efficiency and recovery of pigeon pea dhal.

3. To determine the effect of enzymatic pre-treatments on quality parameters of pigeon pea dhal.

4. To optimize the process parameters on recovery and quality of pigeon pea dhal.