

Effect of processing methods on qualities of instant whole legume: Pigeon pea (*Cajanus cajan* L.)

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ABSTRACT

The pigeon pea (*Cajanus cajan* L.) of variety BSMR-736 was evaluated to study effect of different processing methods on their physical characteristics (bulk density, water absorption, reconstitution time and sedimentation value), chemical characteristics, (moisture, protein, fat, carbohydrate and total ash content) and sensory characteristics (color, flavor, texture and overall acceptability). The attempts were made to prepare instant whole legume by using different processing techniques like soaking, precooking, frozen storage and cabinet drying. The results showed that, the cooking time of processed whole pigeon pea was found to be reduced significantly compared to cooking of raw pigeon pea to 14 min by using precooking, frozen storage and drying it by cabinet drying process. Further the effects of these processing methods on physical characteristics of instant whole pigeon peas suggest that the water absorption and the sedimentation value were higher and bulk density was lower compared to raw pigeon pea which indicates selectively lower damage to protein and starch during cabinet drying. The proximate composition of prepared instant whole pigeon pea by different methods indicates that there were no major changes except to moisture and total ash content.

Keywords: Pigeon pea, physicochemical, cooking, freezing, drying methods, India

1. INTRODUCTION

Among legumes, Pigeon pea (*Cajanus cajan* L.) is predominantly grown and consumed in India. It is also known as red gram, arhar, tur dhal which belongs to family Leguminosae. Numerous nodules are present on roots; these nodules contain Rhizobium bacteria, which fix atmospheric nitrogen. The flowers are self-pollinated but cross-fertilization may also occur to some extent. The fruit of the pigeon pea is a pod, each containing 3 to 5 seeds which are round or lens shaped. It is the second most important pulse in the country and also grown in some East African and south Asian countries. India is the largest producer (81.49 %) and consumer of pigeon pea in the world. Pigeon pea accounted for about 20 % of the total production of the pulses in the country during the year 2000-2001. Other major pigeon pea producing countries are Myanmar (10.02 %), Malawi (2.64 %) and Uganda (2.60 %). The productivity is highest in Uganda (1000 kg/ha) followed by Nepal (875 kg/ha) and India (728 kg/ha).

It is observed that pigeon pea is economically and nutritionally important legume as major source of proteins in poor communities of many tropical and subtropical regions of the world (Singh et al., 1984). Legumes represent a major source of nutrients, including valuable but incompletely balance protein, particularly in vegetarians' diet (Ghadge *et al.*, 2008). It has been estimated that the total production of legumes provide almost as much protein (20-30 %) to the world as wheat and over 50 % more than rice or corn (Rockland *et al.*, 1981 and Gopalan *et al.*, 1985). In addition, legumes supply significant amount of energy through carbohydrates (60-70 %), lipids (1-7 %), dietary fibers and minerals (2-5 %), also the legume oilseeds contains reasonable levels of thiamine, riboflavin and niacin (Bressani *et al.*, 1974 and Arora, 1977). In spite of the nutritional potential of the legumes, they are underutilized as food.

In India, several seed legumes have been traditional supplement [either in the form of splits (Ghadge *et al.*, 2008) or whole legume] to staple cereals [cooked rice, chapattis and poories] (Kachroo, 1970). Legumes and cereals have complementary nutritional effects and their consumption together fulfils the need of balanced protein. The nutritive value of legumes depends upon the processing methods, presence or absence of antinutritional or toxic factors and possible interaction of nutrient with other food components. Boiling in water and subsequent seasoning with oil and spices is the most widely employed method of cooking of pulses as well as to reduce the antinutritional factors. At higher altitudes cooking takes too much time and many attempts have been made to reduce the cooking time either by incorporating salts or by precooking and drying. Pressure cooking and subsequent high temperature pneumatic drying (70-80°C) has been successfully employed for preparing quick cooking precooked dehydrated product.

Narsimha and Desikachar (1978) observed that chemicals for reducing the cooking time of split red gram (*Cajanus cajan*), were added either to cooking water or coated on dhal or added to the soaking water prior to cooking. These chemicals reduced cooking time about 50 % as compared to control (60 min). Chemical coated on the dhal was more effective than that added to cooking water. Jayaraman *et al.*, (1980) studied on development of quick cooking dehydrated pulses by high temperature short time pneumatic drying, where he found marginal reduction in the reconstitution time of processed dhal. It is observed that presoak treatment of different legume seeds, dhal in water soak solution at 25°C decreased the cooking time substantially. Soaking in soak solution was found to be more effective method in reducing cooking time than that in water

alone (Chavan et al. 1983). It is reported that iodine value, protein digestibility of horse gram and moth bean increased during germination while cooking decreased the protein digestibility of horse gram either of germinated or ungerminated form (Satwadhar et al. 1981).

Whole legume takes much longer time for cooking than splits or washed dhal. Cooking of seeds by traditional method requires prolonged time, which involves cost in terms of fuel, energy and also affects the nutritional quality adversely. Quick cooking product may be suitable for commercial marketing. Boiling or simmering, if necessary, should not exceed more than 5 min to bring any dehydrated food product into ready to serve form. Reduction in cooking time of pulses by a simple process is requirement of today's consumer. Taking into consideration present investigation was carried out with the objective to study the effect of processing methods (pre-cooking, frozen storage and cabinet drying) on qualities of instant whole legume: Pigeon pea (Red gram).

2. MATERIALS AND METHODS

2.1 Material

The whole pigeon pea or red gram of variety BSMR-736 (*Cajanus cajan* L.) was obtained from local grain market of Parbhani city. Sample was cleaned properly and utilized for further purpose.

2.2 Preparation of Instant Whole Pigeon Peas

The sound, cleaned whole pigeon peas are taken and soaked at an ambient temperature for 10 h, after which the excess water is removed. The soaked whole pigeon peas are cooked in pressure cooker for 20 min, and cooled to room temperature. Then the freezing is carried out at -20°C for about 3 h followed with the drying of frozen pigeon peas in cabinet dryer at 65°C for 3 ½ h. The packing of prepared dried instant whole pigeon peas are done in polythene bags by adding some spices.

2.3 Proximate Composition

Pigeon pea samples were tested for their ash, fat, and protein content by employing the standard methods of analysis (AOAC, 1984). The carbohydrate content was calculated by:

The sample (500 mg) was suspended in methanol (few drops) and made a paste in ice-cold water followed by addition of 72% H₂SO₄ (2 ml) drop-wise with vigorous stirring and kept for 30 min and the resultant suspension was then diluted with distilled water (23 ml) to obtain 2N H₂SO₄ concentration in sample and refluxed at 98°C for 4h. The hydrolysate was filtered through Whatman no.1 paper and total sugar was estimated by phenol-H₂SO₄ method (Dubois *et al.*, 1976) as modified by Wankhede and Tharanathan (1976).

2.4 Reconstitution Time and Water Absorption

The 10 g samples were boiled with 100 ml water till they become soft and attained the consistency of cooked product. The time taken was noted and expressed as reconstitution time. The excess water was drained and surface moisture was removed by pressing grains in between

two filter papers. The moisture content in the cooked grains was determined and expressed as percentage water absorbed.

2.5 Sedimentation Value

The sedimentation value of raw, cooked and dried samples was determined by grinding the samples to pass through a 30 mesh sieve. The ground sample 10 g was mixed thoroughly with distilled water in 100 ml stopper measuring cylinder. The cylinder was kept aside for 10 min and the volume of sediment was noted exactly after 10 min and expressed as sedimentation value.

2.6 Sensory Evaluation

Sensory evaluation was done using 9 point hedonic scale for color, aroma, taste, texture and overall acceptability. A panel of 20 semi-trained panelists was formed from the sound technical background with students as well as teachers of the College of Food Technology, Marathwada Agricultural University, Parbhani, M. S., India.

2.7 Statistical Analysis

Statistical analysis may be defined as, “Analyzing the collected data for the purposes of summarizing information to make it more usable and making generalizations about a product based on a sample drawn from that product”. In the present study, the results are expressed as mean \pm S. D. (standard deviation).

3. RESULTS AND DISCUSSION

3.1 Effect of Different Processing Methods on the Reconstitution Time of Whole Pigeon Pea

It is observed from Table 1 that precooking and cabinet drying of whole legume, pigeon pea considerably reduced the reconstitution or cooking time. While unprocessed raw pigeon pea required 85 min for cooking by open pan boiling method. The corresponding pre-cooked and cabinet dried sample required 20 min. It is further seen that, frozen storage before conventional drying reduced the reconstitution time. The reconstitution time for precooked, frozen and cabinet dried Pigeon pea was only 14 min. The frozen storage before drying accelerated the rate of drying. This may occurred as a result of migration of moisture at the surface in the form of ice crystals which is expected to evaporate faster than the matrix moisture. Frozen storage is also expected to cause channels in the matrix of the grain, which will also help in the mass transfer in the conventional hot air drying methods.

3.2 Effect of Different Processing Methods on Physical Characteristics of Whole Pigeon Pea

The different processing methods such as precooking, use of frozen condition and cabinet drying affect the physical characteristics of whole legume and the related data is presented in Table 1. Faster reconstitution of precooked, frozen and cabinet dried samples was due to higher porosity as indicated by lowest bulk density and relatively higher water absorption and higher sedimentation values (Table 1). Higher sedimentation value also indicates higher dispersability of particulate matter indicating selectively lesser thermal damage of protein and starch during cabinet drying.

Table 1. Effect of different processing methods on physical characteristics of whole legume: Pigeon pea

Physical characteristics of Pigeon pea (BSMR-736)	Pigeon pea		
	Raw	Pre-cooked and cabinet dried	Pre-cooked, frozen and cabinet dried
Reconstitution time (min)	85.03±0.76	20.04±0.68	14.03±1.18
Bulk density (g/ml)	0.90±0.01	0.85±0.02	0.70±0.02
Water absorption (%)	51.00±1.07	54.10±1.49	61.00±1.97
Sedimentation value (ml)	18.00±0.50	33.00±0.50	45.00±0.50

3.3 Effect of Different Processing Methods on Proximate Composition of Whole Pigeon Pea

Effect of different processing methods on proximate composition of raw and precooked, frozen and cabinet dried Pigeon pea is shown in Table 2. There are no major changes in chemical composition during precooking, frozen storage and drying as compared to raw Pigeon pea except there is reduction in moisture, protein and ash content of precooked, frozen and cabinet dried whole pigeon pea.

Table 2. Proximate composition of raw pigeon pea and precooked frozen and cabinet dried pigeon pea (Moisture free basis)

Parameters (%)	Pigeon pea	
	Raw	Pre-cooked, frozen and cabinet dried
Moisture	10.40±0.99	05.80±0.40
Protein	24.43±0.85	24.23±0.88
Fat	03.60±0.13	03.92±0.06
Total ash	03.36±0.20	03.02±0.04
Total carbohydrate	68.05±0.13	68.83±0.12

3.4 Effect of Different Processing Methods on Sensory Characteristics of Whole Pigeon Pea

Sensory characterization of whole legumes as affected by different processing method is shown in Table 3 and graphically depicted in Fig. 1. The mean score values for color and aroma for raw pigeon pea were more as compared to other treatments, whereas the values for taste and texture were rated more for precooked, frozen and cabinet dried pigeon pea by the panelist. As the sensory characteristics are important in consumer point of view, the prepared product must possess good sensory attributes on the basis of overall acceptability. The mean score values for

overall acceptability indicates that precooked, frozen and cabinet dried pigeon peas were liked more than raw one. Similar types of results were noted by Patki et al. (2002).

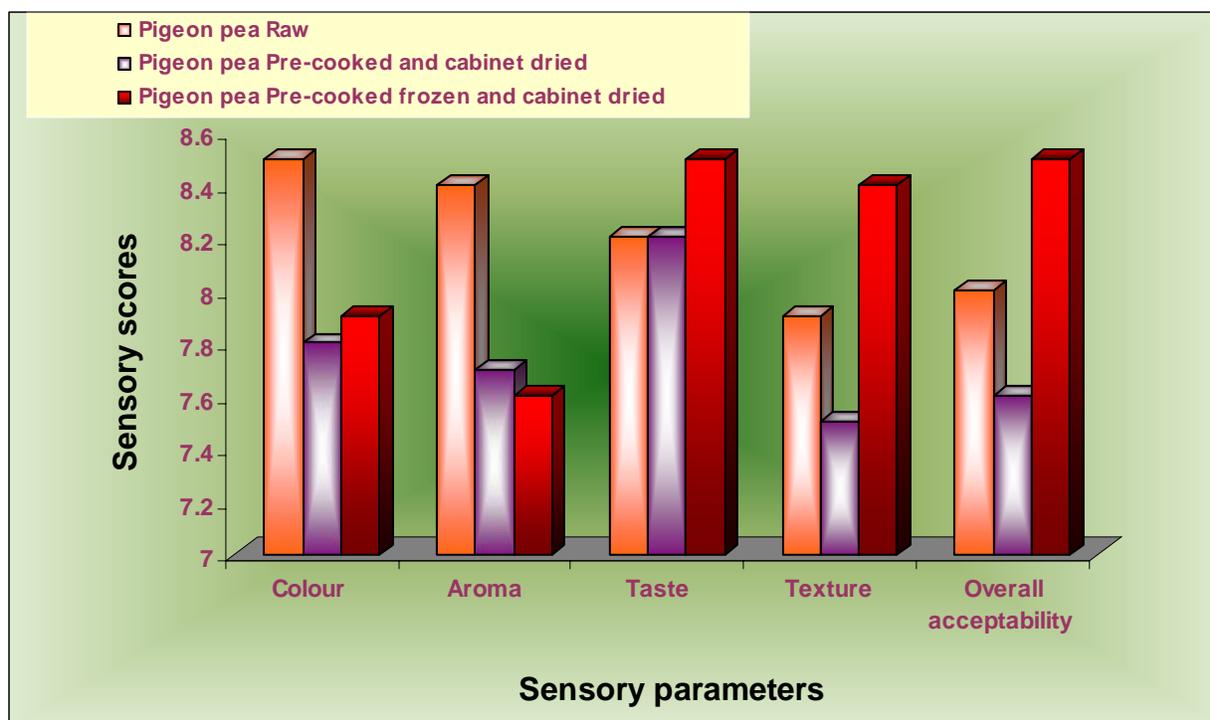


Fig.1. Sensory evaluation of whole pigeon pea

Table 3. Sensory evaluation of the instant whole legume: Pigeon pea

Parameters (Sensory attributes)	Pigeon pea		
	Raw	Pre-cooked and cabinet dried	Pre-cooked, frozen and cabinet dried
Color	8.5±0.53	7.8±0.63	7.9±0.57
Aroma	8.4±0.52	7.7±0.48	7.6±0.52
Taste	8.2±0.63	8.2±0.63	8.5±0.53
Texture	7.9±0.74	7.5±0.85	8.4±0.52
Overall acceptability	8.0±0.67	7.6±0.52	8.5±0.53

4. CONCLUSIONS

Attempts were made during present investigation to prepare and study the effect of various processing methods on instant whole legume and the following conclusions are obtained:

- The different processing techniques like soaking, precooking, frozen storage, cabinet drying used for preparation of instant whole pigeon pea shown positive effect on physical characteristics studied.
- The cooking time of whole pigeon pea was found to be reduced significantly to 14 min by using precooking, frozen storage and cabinet drying processing compared to cooking of raw pigeon pea which is beneficial aspect for legume process industries.
- Further the effects of these processing methods on other physical characteristics of pigeon pea suggest that the water absorption and the sedimentation value were higher and bulk density value was lower which indicates, selectively lower damage to protein and starch during cabinet drying.
- The proximate composition of instant whole legumes prepared by using different methods specifies that there were no major changes observed, indicating minimum nutrient loss in final product.
- The instant pigeon peas prepared by using precooking, frozen storage and cabinet drying processing were ranked highest on the basis of overall acceptability.

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