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# Evaluation of Quick Cooking Redgram Dhal (*Cajanus cajan* L.) Developed with PJTSAU Released Varieties (TDRG - 4, RGT - 1 and WRGE - 122)

Aparna Kuna, K. Lakshmiprasanna, K. Vijay Kumar, M. Bhagyamma, V. Sandhya Rani 10.18805/ajdfr.DR-1765

## ABSTRACT

**Background:** Demand for convenience foods that need less preparation time are gaining significant importance among many consumers. Redgram dhal which usually needs more cooking time, was evaluated for formulating and checking the suitability of its use as Quick cooking dhal on storage.

**Methods:** Popular PJTSAU released red gram dhal varieties TDRG - 4, RGT - 1 and WRGE - 122 were developed into quick cooking dhal and evaluated for their nutrient composition, colour and functional characteristics on storage for 6 months.

**Result:** Storage of both raw and QCD for six months period resulted in decrease in total ash, protein, carbohydrates and energy content, with no change in crude fiber content, but an increase in the fat content. Significant darkening of the QCD redgram dhal was observed on storage. There was decrease in solids dispersed and water absorption among all the three cultivars with a progressive increase in the cooking time, without affecting the organoleptic properties of the dhal.

**Key words:** Cooking time, Nutrient composition, Pigeon pea, Quick cooking dhal, Storage.

## INTRODUCTION

Pulses occupy an important place in human nutrition, as they are good source of protein, dietary fiber, minerals and vitamins. Pulses represent an important component of food crops consumed in developing countries and are considered a vital crop for achieving food and nutritional security for both poor producers and consumers. Pulses have an indispensable role in our daily diet as they are cheapest sources of protein, balancing the lysine deficient cereal diets (Bongirwar and Srinivasan, 1971, Ghadge *et al*., 2008). Pulses also contribute towards nutritional security and environmental sustainability, due to their high protein content (20 to 25%), carbohydrates (55 to 60%), calcium and iron content (Prem and Kumar, 2015). Pigeon pea (*Cajanus cajan* L.) is the second largest legume crop grown in India, after black gram. Pigeon pea belongs to family *Leguminosae* and is commonly called as Redgram dhal, arhar, tur dhal and is consumed in dehusked split form (Aparna *et al*., 2019; Nayak and Samuel, 2015).

India has lion share in area (42.6%) and production (28.34%) of pulses globally. Among major pulses grown and produced globally, Indian share is maximum for pigeon pea in area (73%) and production (67%) followed by chickpea, dry beans, lentil and dry peas. Pigeon pea (*Cajanus cajan*) is traditionally processed into consumable forms by dehulling (primary processing) to form dhal and then cooked or germinated or fermented (secondary processing) (Pulses, 2019). Almost all pigeon pea produced is milled to produce dhal (Faris and Singh, 1990). Out of 14.5 million tons of pulses, nearly 11 million tons are converted to dhal in India for consumption (Jain and Doharey, 2009).

MFPI - Quality Control Laboratory, Professor Jayashankar Telangana State Agricultural University, Hyderabad-500 030, Telangana, India.

**Corresponding Author:** Aparna Kuna, MFPI - Quality Control Laboratory, Professor Jayashankar Telangana State Agricultural University, Hyderabad-500 030, Telangana, India.
Email: aparnakuna@gmail.com

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One of the important quality attributes of pigeon pea is cooking time and studies by Jennifer, (2017) and Narasimha and Desikachar (1978) reported that pigeon pea takes about 32–68 min to be cooked, which depends on various factors. There is a need to develop products that need less preparation time in households and demand for such products is more due to increased urbanization and more women joining the workforce (Shruti *et al*., 2014). Hence, there is a need to have quick cooking red gram dhal (QCD). Foods like QCD will be suitable as ready to cook foods, convenience foods or as operational pack rations of armed forces because of their light weight, easy cooking characteristics and long shelf life. Greater emphasis is being given for marketing new products of legumes such as quick cooking dhal or instant dhals which have good market potential as convenience foods (Singh, 2007).

Considering the above aspects, present investigation was carried out with the objective to develop quick cooking dhal from PJTSAU pigeon pea varieties and evaluate them for changes in cooking quality and nutritional attributes during storage. Dhal of selected cultivars was evaluated to study effect of storage on their nutrient composition, (total ash, moisture, crude protein, crude fat, crude fiber, carbohydrate and energy), functional characteristics (cooking time, water absorption and solids dispersed) and changes in color.

## MATERIALS AND METHODS

### Preparation of quick cooking dhal

Three pigeon pea varieties of PJTS Agricultural University namely TDRG - 4, RGT - 1 and WRGE - 122 were selected for the study. The study was conducted at MFPI - Quality Control Laboratory of PJTS Agricultural University during the years 2019 - 2021, on freshly harvested pigeon pea samples in two different seasons. QCD was processed by method described by Aparna *et al*., (2019). Sound, cleaned red gram dhal was soaked at ambient temperature for 8 h, after which excess water was removed. The soaked dhal was autoclaved at 15psi pressure for 15 min and cooled to room temperature. The cooled dhal was subjected to freezing at -24°C for about 3 h followed by drying of frozen redgram dhal in cabinet dryer at 65°C for 4 ½ h. Quick cooking dhals of TDRG - 4, RGT - 1 and WRGE - 122, were stored in High Density Polyethylene (HDPE) with Oxygen Transmission Rate (OTR) of 200ccm$^{-2}$d$^{-1}$ and Water Vapor Transmission Rate (WVTR) of 0.5 gm$^{-2}$d$^{-1}$ and stored at room temperature *i.e*., 33°C ± 4 for 6 months. Analysis was performed immediately after the product was prepared and again after 6 months of storage. Following analysis were carried out in the samples.

### Nutrient composition

Moisture content of raw and QCD was determined by IS 1155:1968/4333(2):2002 method. Protein content was estimated as per AOAC 992.23. - Generic Combustion method, 20$^{th}$ Edition, using Leco FP-528 Nitrogen Analyzer. Fat content was estimated as crude hexane extract of raw and QCD using automatic Gerhardt Soxtherm extraction unit (AOAC 2003.06). Crude fiber content of the samples was determined by the procedure given by Association of Official Analytical Chemists (AOAC 962.09). Total ash was determined using IS 1155:1968 (Reaffirmed 2010) procedure. Energy and carbohydrate content was calculated by difference method (AOAC, 2006).

### Cooking time

Cooking time was determined by cooking the dhal in distilled water until it softened to uniform mass, when pressed between the thumb and forefinger as described by Singh *et al*. (1984). Dhal sample (10 g) was boiled in 50 mL distilled water. During boiling, samples were removed at 1 min intervals and examined for softness. The time taken to achieve the desirable softness was recorded as the cooking time of the sample.

### Water absorption

Five gram of dhal was taken in a digestion tube and boiled in excess distilled water (35 mL) for 25 min. The excess water, after boiling, was decanted and the dhal was weighed. The amount of water taken up by the dhal was calculated and the results are expressed as per cent water absorption (Singh *et al*. 1984).

### Solids dispersed

The percentage of solids dispersed into the cooking water was determined by the method described by Singh *et al*. (1984). 5 g dhal was boiled for 25 min and the material was passed through a sieve and residue was washed thoroughly with distilled water. After washing, the residue was dried at 100°C for 3 h. The loss in weight of dhal after boiling was calculated as per cent solids dispersed into the cooking water.

### Colour

Colour attributes of the dhal treatments along with control sample was performed by spectrocolorimeter (Hunter lab Colorflex, Firmware versions 1.1, Reston, Virginia) with a measuring aperture of 36 mm (AOAC, 2016). Calibration was accomplished prior to each trial with manufacturer supplied white, green and black tiles. A circular glass cuvette was used to contain the dhal samples for measurement. Sample was placed on the reading lens and tested. A mean of 3 readings of the sample, produced values of L* (lightness), a* (redness) and b* (yellowness).

## RESULTS AND DISCUSSION

Quick cooking dhals of TDRG - 4, RGT - 1 and WRGE - 122 cultivars, were analyzed to study the changes in nutrient composition (total ash, moisture, crude protein, crude fat, crude fiber, carbohydrate and energy), functional characteristics (cooking time, water absorption and solids dispersed) and changes in color. The nutrient composition of raw and QCD at 0 days and 6 months storage are given Table 1 and 2.

The raw red gram dhal samples had higher ash, protein and fiber content in the raw samples than the quick cooking dhal. The carbohydrate and energy content of the raw and QCD varied between 61.16 to 66.89gm/100gm and 354.92 to 363.37Kcal/100gms. Protein and ash content were high in TDRG - 4 variety. Protein, fat and fiber content in all the samples ranged between 19.64 g% - 23.73 g%; 1.73 - 1.92 g% and 1.21 - 1.92 g% respectively. The ash, protein, fat and fiber content decreased in QCD samples as compared to raw samples in all the three varieties indicating that processing the dhal to QCD could lead to slight reduction in the nutrient content. Similar results were reported by Aparna *et al*., (2019); Shruti *et al*., (2014) and Nayak and Samuel (2015).

During storage period of 6 months, the moisture content in the raw and QCD samples increased significantly. Similar increase in moisture content during storage from 8.49% to

9.80% and 6.04% to 6.39% was reported in pigeon pea samples by Talawar (2005) and Shruti *et al.*, (2014). Storage of both raw and QCD for six months period resulted in decrease in total ash content, protein, carbohydrates and energy content. There was no change in the crude fiber content, but an increase in the fat content was observed, which could be due to increase in free fatty acids content. A slight reduction in the protein and fat content was reported by Shruti *et al.*, (2014), in QCD stored for 10 months. Pushpamma and Vimla (1984) reported a loss of 0.59 to 0.70 g protein per 100 g in rice and 0.51 to 0.74 g per 100 g in jowar. Another study by Pushpamma and Chittemma Rao (1981) on home-level storage of legumes for 9 months, reported a progressive decrease in protein content during storage among all legumes with a maximum loss of protein in green gram (11%) after 9 months. Partial protein hydrolysis during long term storage of legumes at high temperature and humidity was reported by Leterme (2004). A study by Peace *et al*. (2006) on the effect of storage (3 years) on protein nutritional quality of grain legume reported a little change in legume amino acid contents, relative net protein ratio (RNPR) and true crude protein digestibility over three years of storage. As per previous storage studies on various legumes, it is indicative that certain loss in nutrient composition occurs as storage progresses, which is evident in our study also in both raw and QCD.

There were significant changes in the colour of the red gram dhal as per the results of the colour studies given in Table 3. *L** is an approximate measurement of luminosity. The parameter *a** takes positive values for reddish colours and negative values for the greenish ones, whereas *b** takes positive values for yellowish colours and negative values for the bluish ones. There was significant increase in the L* values indicating increasing darkness of the dhal samples on storage. Values of a* also increased on storage indicating increased redness on storage of the dhal samples. Values of b* decreased indicating decrease in yellow colour of the dhals on storage. The results indicate that there was a significant increase in darkening of the QCD redgram dhal on storage, which can be prevented by addition of preservatives. Patki and Arya (1994) and Semwal *et al.* (1994) reported rapid autooxidation in pre-cooked and dried pulses during storage, that lead to disappearance of yellow colour and formation of off flavour.

**Functional properties**

With regard to changes in percentage of solids dispersed in the cooking media and the water absorption parameters, it was observed that as storage period progressed, there was a significant decrease in solids dispersed and water absorption among all the three cultivars in conjunction with a progressive increase in the cooking time (Fig 1). The cooking time in raw dhal ranged between 70 - 82 minutes, which reduced to 12 - 16 minutes in QCD. However, after six months of storage, the cooking time in QCD increased to 17 - 20 minutes. The present findings are in agreement with the results obtained by earlier workers Aparna *et al*., (2019), Shruti *et al*., (2014), Singh *et al*., (1984) and Manimekalai *et al*., (1979), who reported that the water uptake and amount of solids dispersed in cooking water were negatively correlated with cooking time. In case of dhals, it is the water absorbing capacity and solids dispersed (%) that makes the difference in cooking time. The water absorbing capacity of dhals depends on composition of seed, cell wall structure and compactness of the cells in the seed (Rosaiah *et al*., 1993). Vimala and Pushpamma, (1987) in

**Table 1:** Nutrient composition of raw and quick cooking red gram (0 Days).

| Nutrient | TDRG - 4 (Hanuma) - Raw | TDRG - 4 (Hanuma) - QCD | RGT - 1 (Raw) | RGT - 1 (QCD) | WRGE 122 (Raw) | WRGE 122 (QCD) |
|---|---|---|---|---|---|---|
| Total ash (%) | 4.51 | 3.29 | 4.48 | 3.04 | 4.44 | 2.94 |
| Moisture (%) | 7.65 | 8.46 | 7.69 | 8.69 | 9.42 | 8.19 |
| Crude protein (%) | 23.73 | 21.41 | 22.50 | 19.64 | 23.25 | 21.30 |
| Crude fat (%) | 1.83 | 1.81 | 1.73 | 1.74 | 1.92 | 1.73 |
| Crude fibre (%) | 1.63 | 1.21 | 1.68 | 1.27 | 1.92 | 1.75 |
| Carbohydrates (gm/100gm) | 62.28 | 65.03 | 63.60 | 66.89 | 61.16 | 65.65 |
| Energy (K.cal/100gm) | 360.51 | 362.05 | 359.97 | 361.78 | 354.92 | 363.37 |

**Table 2:** Nutrient composition of raw and quick cooking red gram - after 6 months storage.

| Nutrient | TDRG – 4 (Hanuma) - Raw | TDRG – 4 (Hanuma) - QCD | RGT – 1 (Raw) | RGT – 1 (QCD) | WRGE 122 (Raw) | WRGE 122 (QCD) |
|---|---|---|---|---|---|---|
| Total ash (%) | 3.80 | 3.21 | 3.85 | 3.18 | 3.89 | 3.14 |
| Moisture (%) | 9.67 | 10.13 | 9.77 | 10.40 | 10.94 | 9.82 |
| Crude protein (%) | 21.49 | 20.77 | 18.89 | 19.09 | 20.19 | 19.34 |
| Crude fat (%) | 1.85 | 1.48 | 1.85 | 1.43 | 1.88 | 1.56 |
| Crude fibre (%) | 1.63 | 1.40 | 1.63 | 1.45 | 1.65 | 1.57 |
| Carbohydrates (gm/100gm) | 63.19 | 64.41 | 65.64 | 65.90 | 63.1 | 66.14 |
| Energy (K.cal/100gm) | 355.37 | 354.04 | 354.77 | 352.83 | 350.08 | 355.96 |

**Table 3:** Colour values of raw and quick cooking red gram.

| Colour | TDRG - 4 (Hanuma) - Raw | TDRG - 4 (Hanuma) - QCD | RGT - 1 (Raw) | RGT - 1 (QCD) | WRGE 122 (Raw) | WRGE 122 (QCD) |
|---|---|---|---|---|---|---|
| **Cooked dhal - after processing** | | | | | | |
| L* | 60.73 | 56.44 | 62.49 | 56.75 | 59.04 | 55.98 |
| a* | 3.45 | 6.87 | 2.55 | 6.94 | 2.56 | 8.08 |
| b* | 33.97 | 32.03 | 33.26 | 31.83 | 30.36 | 30.74 |
| DE* | 35.76 | 36.84 | 34.66 | 36.98 | 31.98 | 37.18 |
| **After 6 months of storage - uncooked dhal** | | | | | | |
| L* | 96.12 | 96.65 | 96.21 | 96.02 | 96.07 | 96.48 |
| a* | 8.89 | 9.38 | 8.37 | 8.56 | 8.62 | 9.05 |
| b* | -11.30 | -10.87 | -10.86 | -10.87 | -11.24 | -10.55 |
| DE* | 16.09 | 16.15 | 15.43 | 15.53 | 15.84 | 15.68 |
| **After 6 months of storage - cooked dhal** | | | | | | |
| L* | 96.06 | 96.64 | 96.21 | 96.02 | 96.07 | 96.48 |
| a* | 8.38 | 9.12 | 8.36 | 8.57 | 8.62 | 9.06 |
| b* | -11.26 | -10.45 | -10.86 | -10.87 | -11.24 | -10.54 |
| DE* | 15.72 | 15.66 | 15.43 | 15.53 | 15.84 | 15.68 |

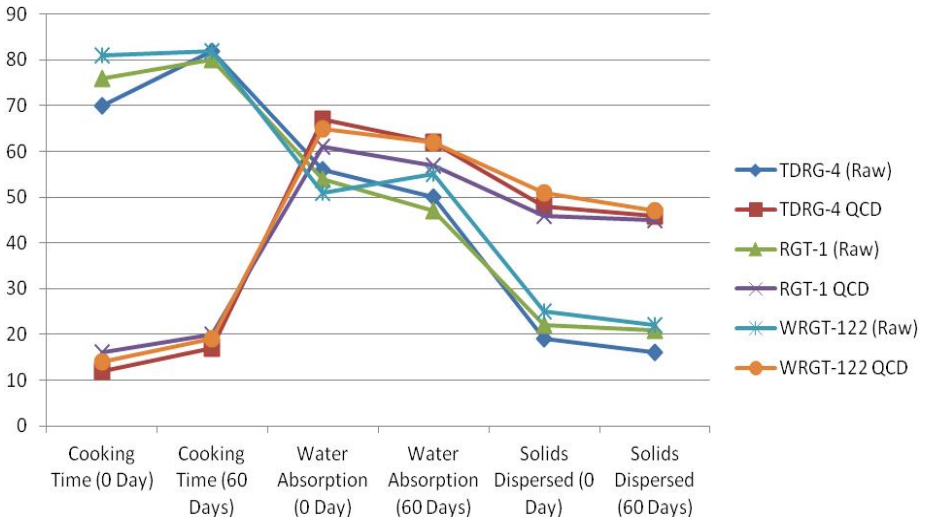


**Fig 1:** Changes in a cooking time, water absorption and solids dispersed of quick cooking dhal stored for 6 months.

their study on storage of legumes observed an increase in cooking time and a simultaneous reduction in water uptake as the storage period of green gram, black gram, pigeon pea and chickpea increased. It is evident that even though the cooking time of QCD increased, the quick cooking dhal was very much acceptable organoleptically till end of storage period and the cooking time was far lower than the raw dhal.

## CONCLUSION

Cooking time of the dhal can be decreased with various pretreatments like soaking followed by autoclaving, freezing and dehydration. The quick cooking dhal thus developed shows appreciable decrease in cooking time and no significant loss of nutritional value. Quick cooking dhal may be suitable for commercial marketing if the experiment is tried on a large scale along with addition of green leafy vegetables *etc*. TDRG - 4 variety (raw and QCD) had excellent aroma, optimal cooking time, low free fatty acids and peroxide values during storage indicating its superiority over RGT-1 and WRG-122. All the three varieties of university *ie*., TDRG - 4, RGT - 1 and WRGE - 122 are suitable for preparation of quick cooking dhal, a convenience product. However, TDRG-4 is the best in terms of nutritional composition, functional properties and storage stability, among the three dhals tested for preparation of quick cooking dhal.

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