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# Variability in physico-chemical properties and nutrient composition of different pea cultivars

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Two each of the vegetable and field pea varieties were investigated for physicochemical properties and proximate composition. Density ranged from 1·27 to 1·30 g/ml in different pea cultivars. The vegetable pea variety Arkel had higher hydration capacity, hydration index, swelling capacity and swelling index than the field pea cultivars. Varietal differences in field peas had no influence on the physicochemical properties. Field pea varieties contained higher amounts of total carbohydrates and lower amounts of ash, fat and crude fibre than vegetable peas. Bonneville, Arkel and Rachna varieties had similar crude protein values.

## INTRODUCTION

Food legumes are potential suppliers of several important nutrients. They not only add to variety in the human diet but also serve as an economical source of supplementary protein, especially in underdeveloped and developing third-world countries. Moreover, in a vegetarian diet containing low amounts of animal products, they constitute an important source of protein.

Although India is one of the major pulse-producing countries, with an aggregate production of $137{\cdot}03 \times 10^5$ tonnes, the average intake is only 35 g/CU/day which is far below the recommended levels (CU = consumption unit). Over-population may be a reason for this. Hence, there is a growing need for making more grain legumes available to meet the protein requirements of people in developing countries such as India.

To increase the pulse production, one of the approaches is to develop varieties with higher yields than the existing ones. With this objective, breeding trials for growth potential of new varieties such as field and vegetable peas (*Pisum sativum*) have been carried out by plant breeders. It is of paramount importance that, before popularising these new varieties, they should be thoroughly analysed for their physicochemical properties and nutritional quality. Therefore, an attempt has been made in the current study to evaluate some physicochemical properties and proximate compositions of four newly developed varieties of vegetable and field peas.

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## MATERIALS AND METHODS

### Seeds

The seeds of four high-yielding varieties of vegetable and field peas were procured from the Department of Vegetables/Plant Breeding, College of Agriculture, Haryana Agricultural University, Hisar, India. All these varieties of peas were grown in the same season (October 1989 to March 1990) under similar field conditions but with different purposes. Field peas were grown for grain purposes and vegetable types for green pods/table purpose. However, the seeds of both these types were taken at maturity. Normal agronomic practices required for pea crops were followed. The seeds of field peas were round, off-white and smooth, whereas those of vegetable peas were green and wrinkled.

### Physicochemical properties

Unprocessed seeds of the given varieties were analysed for the following physicochemical properties:

### Density

Seeds (100 g) were weighed accurately, and transferred to a measuring cylinder, where 100 ml distilled water were added. Seed volume was obtained after subtracting 100 ml from the total volume (ml). Density was recorded as g/ml.

### Hydration capacity

Seeds weighing 100 g were counted and transferred to a measuring cylinder and 100 ml water were added. The

cylinders were covered with aluminium foil and left overnight at room temperature. Next day seeds were drained, superfluous water removed with filter paper and swollen seeds reweighed. Hydration capacity was determined by using the following formula:

$$\text{Hydration capacity per seed} = \frac{\text{weight of soaked seeds} - \text{weight of seeds before soaking}}{\text{no. of seeds}}$$

**Hydration index**

Hydration index was calculated using the formula

$$\text{hydration index} = \frac{\text{hydration capacity per seed}}{\text{weight of one seed (g)}}$$

**Swelling capacity**

Seeds weighing 100 g were counted, their volume noted and soaked overnight. The volume of the soaked seeds was noted in a graduated cylinder. Swelling capacity per seed was calculated as

$$\text{swelling capacity} = \frac{\text{volume after soaking} - \text{volume before soaking}}{\text{no. of seeds}}$$

**Swelling index**

The swelling index was calculated as below:

$$\text{swelling index} = \frac{\text{swelling capacity per seed}}{\text{volume of one seed (ml)}}$$

**Cooking time**

Seeds (100 g) were taken in beakers fitted with condensers to avoid evaporation during boiling. Water was added in the ratio 1:4 (w/v). Samples were stirred at 2 min intervals. After 45 min, one seed was withdrawn without interrupting the boiling. 'Degree of cooking' was tested by pressing the seed between index finger and thumb.

If seeds remained 'uncooked', one seed was again tested after 5 min. This procedure continued until five seeds were found to be cooked. At this time, total cooking time (minutes) was recorded.

**Proximate composition**

Moisture, crude protein, fat, ash, crude fibre and carbohydrate contents were calculated by standard methods of analysis (AOAC, 1980).

**Statistical analysis**

The data were subjected to statistical analysis for analysis of variance, and correlation coefficients were derived in a complete randomised design according to standard methods (Panse & Sukhatme, 1961).

## RESULTS AND DISCUSSION

**Physicochemical properties**

Physicochemical properties such as density, hydration capacity, hydration index, swelling capacity, swelling index and cooking time of four varieties of pea are presented in Table 1.

Density among the four varieties of pea varied from 1·18 to 1·30 g/ml, the highest being in Rachna and the lowest being in Arkel. Rachna had a significantly ($P < 0·05$) higher density followed by HFP4, Bonneville and Arkel. Bonneville and HFP4 had similar density values.

Hydration capacity (g/seed) ranged from 0·18 to 0·24 among the different vegetable and field pea varieties (Table 1). Rachna (field peas) had the minimum whereas Arkel (vegetable pea) had the maximum hydration capacity. Varietal differences did not seem to have an effect on the hydration capacities of vegetable or field peas. The vegetable pea cultivars had significantly ($P < 0·05$) higher hydration indices than field peas. Arkel variety had the highest hydration index followed by Bonneville, HFP4 and Rachna. Rachna, having the lowest hydration capacity also had the minimum hydration index.

Swelling capacity did not vary significantly among the different pea cultivars. HFP4 and Rachna had similar values of swelling index. Among all the varieties, Arkel had the highest hydration capacity, hydration index, swelling capacity and swelling index; hence, it may also require less cooking time, which is useful for saving fuel energy.

**Table 1. Physicochemical properties of peas**

| Varieties | Density (g/ml) | Hydration capacity (g/seed) | Hydration index | Swelling capacity (ml/seed) | Swelling index | Cooking time (min) |
|---|---|---|---|---|---|---|
| Vegetable peas | | | | | | |
| Bonneville | 1·26 ± 0·01 | 0·21 ± 0·01 | 1·09 ± 0·04 | 0·49 ± 0·04 | 0·75 ± 0·02 | 83 ± 0·04 |
| Arkel | 1·18 ± 0·04 | 0·24 ± 0·03 | 1·59 ± 0·04 | 0·55 ± 0·02 | 2·36 ± 0·03 | 102 ± 0·03 |
| Field peas | | | | | | |
| HFP4 (aparna) | 1·27 ± 0·01 | 0·22 ± 0·03 | 0·98 ± 0·01 | 0·50 ± 0·02 | 1·59 ± 0·02 | 106 ± 0·01 |
| Rachna | 1·30 ± 0·07 | 0·18 ± 0·03 | 0·93 ± 0·09 | 0·43 ± 0·05 | 1·59 ± 0·09 | 106 ± 0·07 |
| SE (m) | ± 0·07 | ± 0·03 | ± 0·02 | ± 0·06 | ± 0·20 | ± 0·06 |
| CD ($P < 0·05$) | 0·21 | 0·09 | 0·06 | 0·20 | 0·60 | 0·20 |

Values are the mean ± SD of three independent determinations.

**Table 2. Proximate composition of peas (g/100 g on a dry matter basis)**

| Varieties | Moisture | Protein | Fat | Ash | Crude fibre | Carbohydrates |
|---|---|---|---|---|---|---|
| Vegetable peas | | | | | | |
| Bonneville | 6·41 ± 0·16 | 20·26 ± 0·57 | 2·79 ± 0·12 | 4·08 ± 0·07 | 9·33 ± 0·08 | 57·1 ± 0·05 |
| Arkel | 5·41 ± 0·04 | 20·56 ± 0·20 | 2·28 ± 0·12 | 4·71 ± 0·09 | 10·3 ± 0·06 | 56·7 ± 0·05 |
| Field peas | | | | | | |
| HFP4 (Aparna) | 4·89 ± 0·05 | 19·50 ± 0·47 | 1·55 ± 0·02 | 3·06 ± 0·05 | 6·02 ± 0·05 | 65·0 ± 0·01 |
| Rachna | 6·62 ± 0·08 | 20·47 ± 0·34 | 1·47 ± 0·11 | 2·83 ± 0·10 | 3·97 ± 0·03 | 64·6 ± 0·09 |
| SE (m)[a] | ± 0·17 | ± 0·18 | ± 0·13 | ± 0·11 | ± 0·11 | ± 0·34 |
| CD ($P < 0·05$)[b] | 0·51 | 0·54 | 0·39 | 0·35 | 0·35 | 1·12 |

Values are means ± SD of three independent determinations.
[a] Standard error (mean).
[b] Critical difference at 5% level.

Generally, legumes require a long period of cooking; hence, consideration of cooking time is of paramount importance. Vegetable peas were cooked in less time when compared to field peas. Bonneville, a vegetable pea variety, required the minimum cooking time, i.e. 83 min. Both the field pea varieties, i.e. Rachna and HFP4, required the maximum and similar cooking times, i.e. 106 min. As Bonneville and Arkel, the vegetable pea cultivars, had higher hydration and swelling capacities, they therefore required less cooking time.

Physicochemical characteristics, as mentioned above, are important parameters which ultimately play an important role in cooking legumes. The results of the present study are consistent with those mentioned by previous workers (Ahmed & Shehata, 1982; Sharma, 1989; Latunda Dada, 1991) for other legumes. They reported that the legumes having the higher hydration and swelling coefficients require less cooking time and hence are preferred by the consumer and processors alike. As cooking of vegetable peas would require less fuel and energy, they should be preferred.

### Proximate composition

Table 2 gives the proximate composition of newly evolved high-yielding cultivars of vegetable and field peas. Moisture contents ranged from 4·89 to 6·62 in different pea varieties. Peas had 19·5 to 20·5% crude protein, the highest being in Arkel and the lowest in HFP4. There were no significant differences in the crude protein contents of three varieties of pea, namely, Bonneville, Rachna and Arkel.

Vegetable pea varieties, i.e. Bonneville and Arkel, had significantly ($P < 0·05$) higher levels of fat, ash and crude fibre than did field pea varieties. Bonneville had significantly ($P < 0·05$) more fat and less ash and crude fibre than did Arkel. HFP4 and Rachna had almost similar fat and ash values, whereas crude fibre content was significantly ($P < 0·05$) more in HFP4. Field pea cultivars had significantly higher amounts of total carbohydrates; it was found to be greatest, i.e. 65·0%, in HFP4 followed by Rachna (64·6%), Bonneville (57·1%) and Arkel (56·7%).

The values for crude protein, fat, ash and crude fibre are within the range reported earlier for peas (Lopez *et al.*, 1986; Gueguen & Barbot, 1988; Savage & Deo, 1989).

Vegetable pea cultivars have the best proximate compositions because their hydration index is high and hence they require less cooking time and should be preferred by food processors. Hence these varieties have potential for incorporating in weaning mixtures and supplementary foods so as to combat the problem of protein energy malnutrition in developing countries. Further studies will be carried out on the antinutritional factors and in-vitro digestibility of starch and protein of peas as affected by various domestic processing and cooking methods.

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