INTRODUCTION

Legumes constitute an important source of carbohydrates for a large part of human population, mainly in the developing world. India is the largest producer and consumer of legumes in the world [Singh et al., 2008]. Rice bean (Vigna umbellata (thumb) Ohwi and Ohashi) is one of the underexploited and underutilized pulse crop widely grown in rice fields after the harvesting of paddy on residual soil moisture. This plant is grown in India chiefly by the natives of the eastern and northeaster region [Arora et al., 1980] and has some good qualities over greengram, blackgram and cowpea such as resistance to drought, pests and diseases during growth period, synchronising habit of pod maturity, resistance to attack of storage pests and a high percentage of seed viability [Mukherjee & Sarkar, 1999]. It is less preferred for direct consumption due to its disagreeable taste or flavour. The seeds contain about 24% protein and 60% starch. It can however be processed into value added products like protein concentrate and food-grade starch.

Chemical, biochemical, and physicochemical methods.

Total starch content in rice beans was determined according to McCready et al., [1950]. For starch extraction, the seeds were soaked separately in 0.5% (w/v) NaOH solution for 24 h at 60°C [Hoover & Sosulski, 1985]. Then starch was separated from the soaked seeds as described earlier by Chavan et al. [1999]. The separated starch was characterised for the content of moisture, ash, nitrogen, lipids, amylose, starch damage, enzymatic (α-amylase) and acid (2.2 mol/L HCl) hydrolysis, swelling factor, amylose leaching, water and fat absorption, and gelatinization temperature. The gross chemical composition of rice bean starch did not differ significantly from other edible legumes, for example, amylose content was 32.8%. The rice bean starch was found to absorb 83.2% of water, 77.6% fat and exhibit a gelatinization temperature of 66±2°C.

RESULTS AND DISCUSSION

The dry rice bean seeds contained 56.58% of starch and the yield of extraction was 36.5%. The separated starch was characterised for the content of moisture, ash, nitrogen, lipids, amylose, starch damage, enzymatic (α-amylase) and acid (2.2 mol/L HCl) hydrolysis, swelling factor, amylose leaching, water and fat absorption, and gelatinization temperature. The gross chemical composition of rice bean starch did not differ significantly from other edible legumes, for example, amylose content was 32.8%. The rice bean starch was found to absorb 83.2% of water, 77.6% fat and exhibit a gelatinization temperature of 66±2°C.

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34.4-35.5%, 32.9-35.6%, 31.8%, 38.0%-41.5%, and 31.7-33.8%, respectively [Nishinari, 2008; Kim et al., 2007; Chung et al., 2008]. In the study of Sandhu & Lim [2008] amylose content in six legume seeds ranged from 28.4% (pigeon pea) to 33.1% (field pea).

Starch damage of rice bean (3.01%) was compared with that reported before for beach pea (4.9%), green pea (1.9%), grass pea (1.7%) [Chavan et al., 1999], green arrow pea (2.4%), and lentil (1.8%) [Hoover & Manuel, 1996]. Much lower results for starch damage for black bean, pinto bean, and field bean (0.2-0.7%) were found by Hoover & Manuel [1996].

The rice bean starch was found to absorb 83.2% of water and 77.6% of fat (Table 2), which is in accordance with literature data [Hoover & Sosulski, 1985]. Starch obtained from rice bean exhibited a gelatinization temperature of 66±2°C. Starches separated from pigeon pea, chickpea, field pea, kidney bean and blackgram were characterised by gelatinization temperature from 68.3 to 69.3°C [Sandhu & Lim, 2008]. The same parameter for black bean, pinto bean, field bean, and lentil was of 82.0, 82.0, 69.0, 69.0°C, respectively [Hoover & Manuel, 1996].

The hydrolysis of rice bean starch by 2.2 mol/L HCl and porcine pancreatic α-amylase is presented in Figure 1. At the end of the 20th day, 37.1% of starch hydrolysis was observed. In the study of Chavan et al. [1999] at the same condition beach pea, grass pea, and green pea starches were hydrolysed to the extents of 49, 41, and 37%, respectively. The results are also comparable with those of Hoover & Manuel [1995; 1996] and Hoover et al. [1992]. After 24 h of α-amylase treatment 45.7% hydrolysis of rice bean starch was achieved. In the study of Chavan et al. [1999] the corresponding values for beach pea, grass pea, and green pea starches were 35, 22, and 16%, respectively. Application of pancreatin and amyloglucosidase resulted in approximately 75% of bean starch hydrolysis [Chung et al., 2008].

Swelling factor and amylose leaching were investigated over the temperature range of 50-95°C (SF), and 70-95°C (AML). The results are presented in Figure 2. The SF and AML were within the range reported for other legume starch. Starches of beach bean, green pea, and grass pea were char-

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Mean ± SD</th>
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<tbody>
<tr>
<td>Moisture</td>
<td>10.1 ± 0.2</td>
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<tr>
<td>Ash</td>
<td>0.21 ± 0.01</td>
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<tr>
<td>Nitrogen</td>
<td>0.04 ± 0.01</td>
</tr>
<tr>
<td>Lipids</td>
<td>0.16 ± 0.02</td>
</tr>
<tr>
<td>Amylose</td>
<td>32.8 ± 0.8</td>
</tr>
<tr>
<td>Starch damage</td>
<td>3.01 ± 0.5</td>
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TABLE 1. Characteristics of rice bean starch – proximate chemical composition (%) and percent of damage.

<table>
<thead>
<tr>
<th>Property</th>
<th>Mean ± SD</th>
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<tr>
<td>Water absorption capacity (%)</td>
<td>83.2 ± 2.2</td>
</tr>
<tr>
<td>Oil absorption capacity (%)</td>
<td>77.4 ± 1.8</td>
</tr>
<tr>
<td>Gelatinization temperature (°C)</td>
<td>66 ± 2</td>
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</tbody>
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FIGURE 1. Acid (A) and enzymatic (B) hydrolysis of rice bean starch.

FIGURE 2. Influence of temperature on swelling factor and amylose leaching of rice bean starch.
acterised at 95°C by a swelling factor of 30.7, 34.1, and 26.0% [Chavan et al., 1999]. At the same temperature leached amylose achieved the values of 12.9, 17.1, and 19.1%, respectively [Chavan et al., 1999]. Starch granule swelling is known to begin in the bulk relatively mobile amorphous fraction and in the more restrained amorphous regions immediately adjacent to the crystalline region [Donovan, 1979]. Furthermore, amylose-lipid complexes have been shown to inhibit granule swelling [Hoover & Manuel, 1996].

CONCLUSIONS

The gross chemical composition of rice bean starch does not differ significantly from other edible legumes. Work is now in progress to study the rheological and retrogradation properties of rice bean starch in order to assess the suitability of this starch for food and non-food related application.

REFERENCES


Received, revised and accepted December 2008.