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Pigeon Pea Utilization : Starch Characteristics and Transparency Noodle Preparation

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ABSTRACT

Pigeon pea *(Cajanus cajan* L.*)* starch was isolatad from pigeon pea seed and pigeon pea dhal (decorticated split dried seed) by a wet milling process. Physical properties of the starch including granule sizes, gelatinization temperature, swelling and solubility pattern, Brabender amylogram, gel strength and degree of syneresis, were examined. Transparency noodles were prepared from pigeon pea starch and compared with those from mung bean starch. Noodle quality was examined by organoleptic tests. The results indicated that the quality of noodles is comparable to mung bean noodles.

INTRODUCTION

Pigeon pea (*Cajanus cajan* L.) is grown throughout the tropics, but India accounts for over 85% of the 3.5 million ha sown with this crop around the world. Pigeon pea is a perennial shrub, but it is cropped annually in most farming systems. Because its early growth is slow and non competitive. Pigeon pea is commonly sown as an intercrop, particularly with sorghum and millets (Reed, 1977). The fresh pigeon peas can be either canned or used as vegetable while the dry seed can be used as "dhal". Legumes are known to contain high contents of protein and make a significant contribution to the protein and energy requirements of many people, especially in the tropics and subtropics. Low molecular weight carbohydrates, starch and oil are other main components in legumes. The starch content of pigeon pea varied between 53-59% of the dry weight. (Sharma and Pant, 1979) Very few studies have been reported on the pigeon pea starch, although starch is one of the major components and may influence the functional properties of pigeon peas. Hence, investigaions of the physicochemical characteristics of pigeon pea starch and the quality of pigeon pea starch noodles were initiated in this study. Among the legumes, mung bean has been repoted as the best raw material for transparency noodle preparation. It has been attempted to study the potential of other legume starches such as kidney bean, black bean and pigeon pea, etc. for transparency noodle preparation.

MATERIALS AND METHODS

Dehulling :

The raw material utilized for this study consisted of one cultivar (C 11) of pigeon pea and one cultivar (PS 16) of mung bean. These cultivars were grown at ICRISAT Center, Patancheru, near Hyderabad, India during 1987/88 season. The seed lots were cleaned and decorticated using Tangential Abrasive Dehulling Device (TADD). For decortication, seed material was soaked for 24 hr. at room temperature and dried in the oven at 55°C. for 6-8 hr. This dried material was processed in TADD to prepare dhal, decorticated dry split cotyledons.

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Preparation of starch:

The starch was isolated from the whole seed and dhal samples as follows: Seed were steeped in water overnigth but dhal were steeped in water for 4 hr. The steeped samples were washed and ground in a Waring Blender at low speed for 2 min. The slurry was filtered through the cloth bag (about 80 mesh size) and then through standard sieve (200 mesh size). The filtrate was settled for enough time to sediment the starch. The starch was reslurried in water and sedimented several times until the upper layer was clear. The recovered starch was then dried in an hot air oven at 50°C.

Determinations of starch properties:

Swelling power and solubility of starches from pigeon pea and mung bean were determined from 60-90°C at 10°C intervals using 200 mg starch for the measurement. (Leach *et al.* 1959)

Gelatinization temperatures were determined by using a compound microscope and congo-red 0.2% solution as a stain. Samples were taken from 60°C onwards at 1°C intervals until the temperature of gelatinization reaches. 5, 50, and 98% of stained starch granules were observed in the field, as initial, midpoint and complete gelatinization values, respectively.

Gel strength was measured using compressing cell (0-5 kg full scale) in Instron Food Tester following the method described previously (Yang *et al.,* 1980). 35 ml of 6% starch gel solution was used after storage at room temperature and at 4°C in refrigerator for 12 hr. The degree of syneresis of starch gels was determined from the volume of water separated from the gel after storage at 4°C for 12 hr.

Gel consistency of 6% starch gel of pigeon pea and mung bean were measured by the general method using 2.0 × 10.5 mm. test tubes heated at 95°C min and measured the length of gel after laying on the table at room temperature for 30 min.

Brabender viscosity values were obtained with a Brabender viscoamy lograph (Model Viscrograph E) using 6% starch concentration according to the procedure of Lii and Chang (1981).

Starch granule size was measured by a compound microscope using 1% iodine solution as a stain.

Transparency Noodle preparation:

Noodles of mung bean and pigeon pea starches were prepared according to the procedure described by Chen (1987) with modification as shown in Figure 1.

RESULTS AND DISCUSSION

In both whole seed and dhal samples of mung bean, starch extraction was higher than those of the pigeon pea. Differences in whole seed samples were more pronounced and this might have been due to highest differences in fiber content of these legumes (Table 1). The recovery of mung bean dhal and pigeon pea dhal starches were 71.2% and 78.9% respectively.

Table 1 Recovery percentage of Pigeon pea and mung bean starch from whole seed and dhal

Crop	Recovery (%)	
	Whole seed	Dhal
Pigeon pea	49.3	71.2
Mung bean	59.5	78.9
Standard Error (SE)	± 2.79	± 3.38

The swelling power of pigeon pea and mung bean starches at different temperature is presented in Table 2. This table also shows the values on solubility index. The patterns of swelling power of mung bean and pigeon pea starches showed marked differences particularly at lower temperature. This indicated that mung bean starch undergo a rapid swelling at relatively lower temperature than pigeon pea whereas the swelling powers of pigeon pea and mung bean starches are comparable at high temperatures. The swelling power of pigeon pea starch is of the restricted

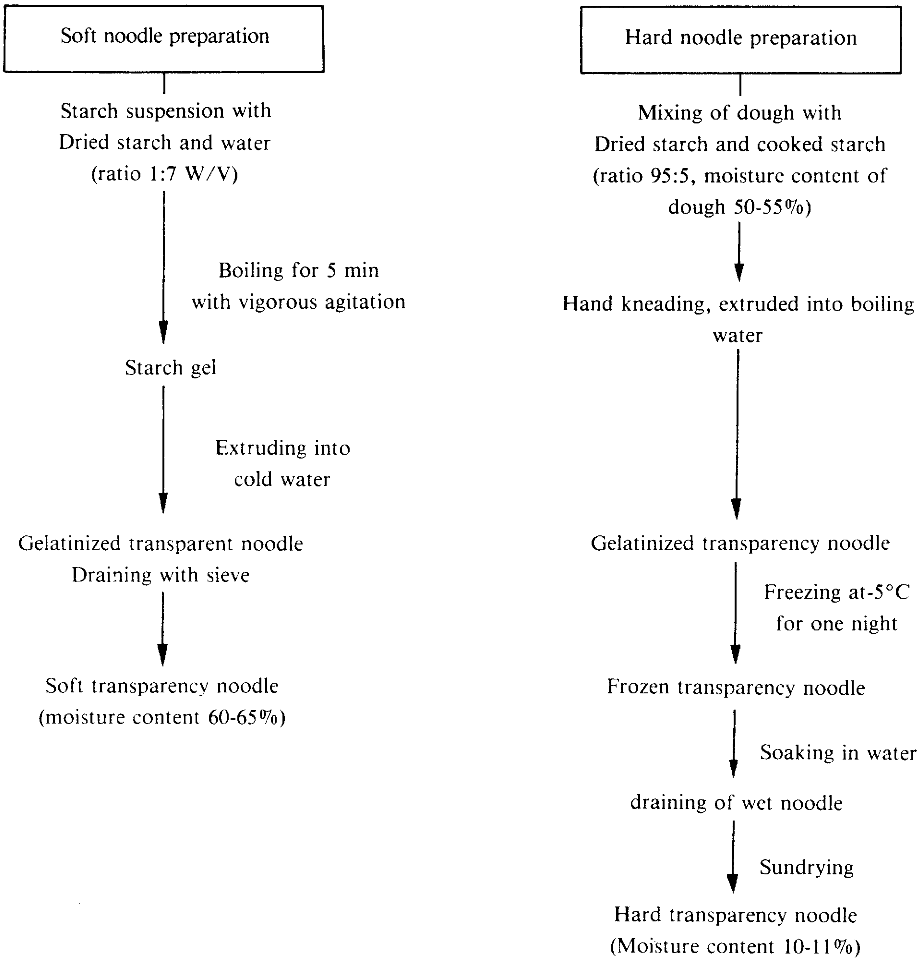

Figure 1 Preparation of soft and hard transparency noodle of pigeon pea and mung bean

Table 2 Swelling power and solubility of starches of pigeon pea and mung bean

Crop	Swelling power Temperature °C				Solubility (%) Temperature °C			
	60	70	80	90	60	70	80	90
Pigeon pea	1.0	3.0	10.1	11.5	0.7	6.9	18.0	23.1
Mung bean	4.0	6.1	9.2	11.9	0.8	11.3	17.9	23.8

Table 3 Gelatinization temperature, gel strength, gel consistency and degree of syneresis of pigeon pea and mung bean starches

Crop	Gel Temp.[a/] (°C)	Gel strength[b/] (Force, kg)	Gel consistency[c/] (length, cm)	Degree of syneresis[d/] (ml H_2O)
Pigeon pea				
Whole seed	65-71-76	1.4	3.0	2.9
Dhal	65-71-76	1.1	3.0	3.2
Mung bean				
Whole seed	61-65-72	2.5	3.3	1.1
Dhal	61-65-72	1.7	2.8	1.1
Standard Error		± 0.04	± 0.05	± 0.02

[a/] 5, 50, and 98% of starch granules gelatinized.
[b/] Determined at room temperature using Instron Food Tester Compression Cell.
[c/] Determined after boiling at 95°C for 5 min and after standing at room temperature for 30 min.
[d/] Determined as the volume of water separated from 35 ml of starch gel after storage at 4°C for 12 hr.
b,c,d values obtained by using 6% starch solution.

Table 4 Shape and sizes of pigeon pea and mung bean starche granules

Crop	Shape	Size (μ)[a/]
Pigeon pea	Irregular	9.5 - 55.1
	(oval/round/bean-shaped)	24.7
Mung bean	Irregular	9.5 - 47.5
	(oval/round/bean-shaped)	21.7

[a/] Average of 100 measurements using 40 XOc. (1 Div = 1.99 μ.)

Table 5 Viscoamylographic properties of pigeon pea and mung bean starches[a/]

Crop	Viscosity (Brabender Units)				Set back Value[c/]
	95 °C		50°C	35°C	
	Initial	Final[b/]			
Pigeon pea	277	302	480	593	178
Mung bean	300	315	665	972	350
Standard Error	± 6.5	± 5.8	± 12.4	± 15.8	± 7.9

[a/] Values obtained using 6% starch.
[b/] After holding for 60 min.
[c/] Difference in viscosity between 95°C (final) and after cooling to 50°C

Table 6 Organoleptic properties of soft transparency noodle of pigeon pea and mung bean starch[a/]

Crop	Colour	Texture	Clarity	General acceptability
Pigeon pea				
Whole seed	Poor-Fair (1.6)	Fair (2.0)	Poor-Fair (1.7)	Poor-Fair (1.9)
Dhal	Good-Excellent (3.6)	Fair-Good (2.6)	Good-Excellent (3.5)	Good-Excellent (3.4)
Mung bean				
Whole seed	Fair-Good (2.5)	Good-Excellent (3.2)	Fair-Good (2.5)	Fair-Good (2.7)
Dhal	Fair-Good (2.8)	Fair-Good (2.9)	Fair-Good (2.6)	Fair-Good (2.6)
SE	± 0.34	± 0.27	± 0.30	± 0.30

a/ Average values of ten panel members. Rating scale : 4 = excellent, 3 = good, 2 = fair and 1 = poor.

Table 7 Organoleptic properties of hard transparency of pigeon pea and mung bean dhal starches[a/]

Crop	Colour	Texture	Clarity	Uniform appearance	General acceptability
Mung bean	3.3 (Good-Excellent)	3.2 (Good-Excellent)	3.2 (Good-Excellent)	2.8 (Fair-Good)	3.0 (Good-Excellent)
Pigeon pea	3.7 (Good-Excellent)	3.1 (Good-Excellent)	3.0 (Good)	3.2 (Good-Excellent)	3.1 (Good-Excellent)
SE	± 0.23	± 0.08	± 0.17	± 0.34	± 0.12

a/ Average values of ten panel members. Rating scale : 4 = excellent, 3 = good, 2 = fair and 1 = poor.

type, like mung bean starch (Chen, 1978) and slightly more restricted than that of black bean and more restricted than that of red bean. On the other hand, solubility of starches of these two legumes did not show large differences.

The gelatinization temperature range of pigeon pea starch was 65-71-76°C and mung bean starch was 61-65-72°C slightly lower than pigion pea starch (Table 3). The range is close to other legume starches such as red bean and black bean. (Lii and Chang, 1981, Lai and Varriano-Marston, 1979).

The strength and the degree of syneresis of pigeon pea and mung bean starch gels at 6% concentrations are shown in Table 3. The results indicated that the degree of syneresis of pigeon pea starch gel is higher than that of the mung bean. On the other hand, gel strength of pigeon pea starch was weaker than those of mung bean but stronger than those of red bean (Lii and Chang, 1981)

Microscopically most pigeon pea and mung bean starch granules had irregular shapes which varied from round to oval and bean-shaped. A large variability existed in the starch granule sizes of both pigeon pea and mung bean (Table 4). In general, it was observed that pigeon pea starch granules are slightly bigger than the mung bean starch granules.

The Brabender viscosity patterns of 6% starch pastes of pigeon pea and mung bean gave no pasting peak during heating at 95°C. Both showed a stable curve indicating that there was no breakdown of the hot paste. Such a pattern is similar to those of most legume starch pastes and could be classified into type c, according to Schoch's Classification (Schoch and Maywald, 1968). Marked differences in viscosity patterns of pigeon pea and mung bean starches were observed at different temperatures (Table 5). Pigeon pea starch showed much lower set back value as compared to mung bean starch.

Noodle qualities:

The noodle quality of whole seed and dhal extracted starches of pegeon pea and mung bean was examined by sensory evaluation. Organoleptic properties such as color, texture, clarity and general acceptability were determined by 10 taste panels from the biochemistry staff. Soft and hard noodles were prepared and tested. Sensory evaluation score of soft and hard noodles of these legumes are shown in Tables 6 and 7. Noodles prepared from starches from dhal samples of those legumes showed noticeable differences in their qualities (Table 6). It was observed that pigeon pea noodles from whole seed starch with poor-fair quality in general acceptability due to the colour, whereas the mung bean noodles from whole seed were rated as fair-good with an average score of 2.8 considerably higher than the corresponding value for pigeon pea. On the other hand, pigeon pea noodles from dhal starch were better than in general acceptability comparing with the mung bean noodles from dhal starch. No marked differences in the quality of boiled hard noodles of pigeon pea and mung bean dhal starches were observed as shown in Table 7. Observed results on organoleptic evaluation indicated that noodles made from pigeon pea and mung bean dhal samples had comparable scores.

CONCLUSION

Although, there are differences in swelling power of mung bean and pigeon pea starches at lower temperatures, both legumes show restricted swelling and a c-type Brabender viscosity curve. To conclude it may be mentioned that pigeon pea starch possesses the characteristic desirable for transparency noodle preparation. Organoleptic tests also indicate that pigeon pea dhal starch is as good for transparency preparation as from the mung bean.

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