

Viscosity of Starch: A Comparative Study of Indian Rice (*Oryza Sativa L.*) Varieties

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Abstract

Rice (*Oryza Sativa L.*) is widely consumed and important cereal crop in India. Rice is one of the excellent sources of starch and starch isolated from rice has been used for various food and non food applications. In this study three Indian rice cultivars viz., HMT, Swarna and Basmati were studied and starch was isolated by alkali extraction method and characterized for viscosity studies by Brookfield Viscometer. Starch yield was found to be in the range of 81-84% on fresh weight basis. The highest starch yield of 84% was obtained from Basmati and the lowest yield of 81% was obtained by HMT where as that of Swarna variety was 82%. For viscosity studies, The gruels were prepared by heating the 1 %, 2%, 3% and 4% solutions of the starch in the distilled water, after heating them to boiling temperature were cooled to the ambient temperature and used for the determination of viscosity . The viscosity determined by using standard type of viscometer at 100 rpm in units of Centipoise. The viscosity studies showed that the processing pretreatment has undoubtedly changed the nature of the starch. The different varieties showed a difference in their viscosity proportional to their concentration in which The HMT starch solution showed highest viscosity of 20.5 Centipoise followed by Swarna, 15.5 Centipoise and Basmati, 13.5 Centipoise at 4 % concentration.

Keywords: Rice starch; Alkali extraction; Viscosity; Centipoise; Brookfield Viscometer.

1. Introduction

1.1 Rice (*Oryza sativa* L.)

Rice (*Oryza sativa* L.) is one of the world's most important cereals for human consumption. In the densely populated countries of Asia especially Bangladesh, China, India, Indonesia, Iran, Japan, Korea, Pakistan and Sri Lanka rice is the most important staple food. India is the world's second largest producer of white rice, accounting for 20% of all world rice production. Rice is India's prominent crop, and is the staple food of the people of the eastern and southern parts of the country. The type of rice grown in different parts of India depends on the weather, soil, structure, characteristics and purposes. Rice in India is grown under diverse conditions. There are various varieties of rice cultivated in India. Some of them are *Samba*, *Masuni*, *Vijayantha*, *Pusa JB*, *Basmati*, *Deepakratna*, *Swarna*, *HMT* etc. For the present investigation three different rice cultivars viz. *HMT*, *Swarna* and *Basmati* were used.

1.2 Starch

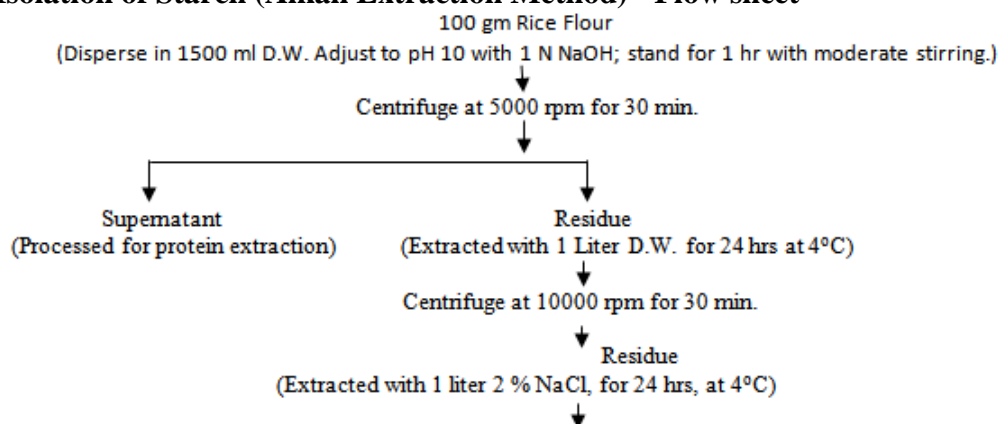
Starch is the major dietary source of carbohydrates and is the most abundant storage polysaccharide in plants. It is present in high amounts in roots, tubers, cereal grains and legumes and also occurs in fruit and vegetable tissues. Starch is a polymer of glucose linked together by α -D-(1-4) and/or α -D-(1-6) glycosidic bonds. The starch granule mass comprises 70% amorphous regions, which consists of amylose and branching points of amylopectin molecules, and 30% crystalline, which is mainly composed of the outer chains of amylopectin

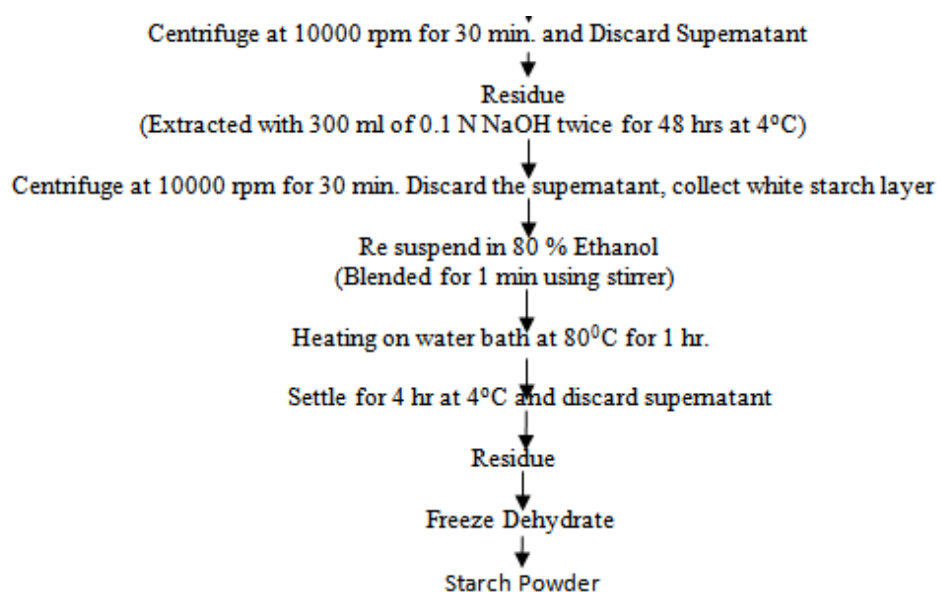
2. Materials and Methods

2.1 Rice Grains

Three cultivars of Rice (*Oryza sativa* L.) viz., Basmati, HMT and Swarna were procured from local market of Nagpur city. The rice grains were cleaned, ground in mixture grinder and stored properly at room temperature prior to their use in actual experiment.

2.2 Isolation of Starch (Alkali Extraction Method) - Flow sheet





2.3 Viscosity of starch by Brookfield Viscometer

A Brookfield Viscometer was used to determine the viscosity. The starch solution (1%, 2%, 3% and 4%) was prepared by mixing the rice starch of three different varieties (Basmati, Swarna and HMT) of Rice with distilled water. The starch solution was boiled for 20 minutes and then cooled to room temperature (30°C). The reading of time was noted at 100 rpm, the reading of viscosity in Centipoise. During heating and cooling gussels were stirred intermittently.

3. Results and Discussions

3.1 Isolation of Starch

The three different rice cultivars viz., Basmati, HMT and Swarna were processed in the present investigation for isolation of Starch and % yield of obtained starch was compared and shown in Table 1.

Table 1: % Yield of starch from Rice Flour.

Sr. No.	Variety of Rice	Yield of Starch (%)
1	Basmati	84
2	HMT	81
3	Swarna	82

The table 1 Indicates the % yield of starch is highest for Basmati (84%) followed by Swarna (82%) and HMT (81%). The starch yield found directly correlated to the dry matter contents of the cereals.

3.2 Viscosity of starch

The viscosity of the rice starches of three different varieties was studied by the Brookfield Viscometer. The viscosity, determined by using standard type of viscometer at 100 rpm, of the starch samples of the different varieties is shown in the Table 2. The HMT starch solution showed highest viscosity followed by Swarna and Basmati. The comparative study of viscosity were shown in the plot of % starch solution verses viscosity (Fig.1)

The processing pretreatment has undoubtedly changed the nature of the starch. The different varieties showed a slight difference in their viscosity. Variations in carbohydrate and dietary fiber contents and variations in their starch properties in different varieties may explain this difference. There is change in the physical state of the starch occurring as a function of temperature and water content. Also the degree gelatinization considerably affects the rheological properties of the dried **product**.

Table 2: Viscosity of starch solution by Brookfield Viscometer.

Sr. No.	Variety of Rice Starch	Viscosity (Centipoise)			
		1 % Solution	2 % Solution	3% Solution	4 % Solution
1	Basmati	2.0	7.73	10.64	13.5
2	HMT	3.5	8.35	14.64	20.5
3	Swarna	2.5	7.42	11.45	15.5

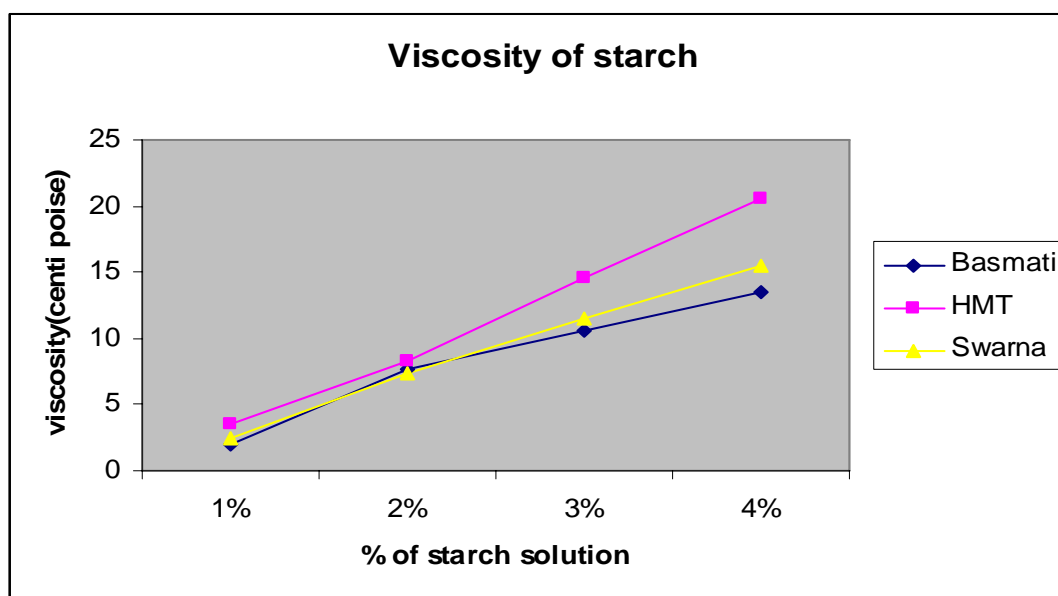


Fig. 1: Comparison by Viscosity values at different concentrations.

Viscosity of the gruels prepared from the different types of starch, to a large extent can be attributed to the starch in the sample. In the manufacture of the food aimed at supplying a substantial amount of nutrient such as weaning and supplementary foods, it is desirable to include materials that do not form highly viscous pastes at low solids concentrations.

4. Conclusions

The three different rice cultivars showed significant variation in % yield of starch and other properties. The percent yield of starch ranging from 81 to 84%. The viscosity studies showed that the processing pretreatment has undoubtedly changed the nature of the starch. The different varieties showed a difference in their viscosity proportional to their concentration in which The HMT starch solution showed highest viscosity of 20.5 Centipoise followed by Swarna, 15.5 Centipoise and Basmati, 13.5 Centipoise at 4 % concentration. Pasting properties of starch have been reported to be affected by amylose and lipids contents and by branch chain-length distribution of amylopectin. Amylopectin contributes to swelling of starch granules and pasting, while amylose and lipids inhibit the swelling. Also, the amylopectin chain-length and amylose molecular size produce synergistic effects on the viscosity of starch pastes. Other components naturally present in the starchy material or additives interact with starch and influence pasting behavior.

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