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Sangeeta
Department of Food Science and Technology CDLU, Sirsa, Haryana, India

Kawaljeet Sandhu
Department of Food Science and Technology CDLU, Sirsa, Haryana, India

Correspondence
Sangeeta
Department of Food Science and Technology CDLU, Sirsa, Haryana, India

Physico-chemical properties of native and acid hydrolyzed buckwheat starch

Sangeeta and Kawaljeet Sandhu

Abstract
Buckwheat, which contains high nutritional values of protein, dietary fibre, phenolic compounds and minerals, is a major pseudo-cereal for processing functional foods, especially the Japanese buckwheat noodles (soba noodles). In buckwheat flour, starch is a main component which plays an important role in the functional properties of end-use food products. The present aim to this study was to determine the physico-chemical properties of native and acid hydrolyzed starch extracted from buckwheat. Amylose content and swelling power of buckwheat starch decreased whereas, solubility and light transmittance of buckwheat starch increased after acid hydrolysis of starch obtained from buckwheat.

Keywords: Physico-chemical, native, acid hydrolyzed

Introduction
Buckwheat is a non-glutinous pseudo-cereal belonging to the family polygonaceae. It is cool climate crop cultivated throughout the world but main producers of buckwheat are China, Japan, Korea, Russian Federation, Ukraine and Kazakhstan. Major storage component of buckwheat grain is starch ranging from 59% – 69% which is 15-25% is amylose and rest is amylopectin (Skrabanja *et al*., 2004) [11]. Buckwheat starch granules are spherical, oval and polygonal in shape with noticeable flat areas due to compact packing in the endosperm (Christa and Soral-Smietana, 2008) [1], which plays significant role in appearance, structure and quality of food products.In native state, the starch exhibit limited applications due to low shear resistance, thermal decomposition, high tendency towards retrogradation and syneresis which limit its use in some industrial food applications (Singh *etal*., 2007) [10].
Starch modification, is often used to circumvent these limitations (Iheagwara, 2013) [4]. In modifications, starch is tailor made to meet the requirements of the end-user, giving rise to a range of specialty products. Starch modification is a process of altering the starch structure by affecting the hydrogen bond in a controllable manner. Usually, starch degradation can be done by several methods such as physical alteration, chemical degradation, enzymatic modification or genetic transformation (Yiu*et al*., 2008) [14] which involves the alteration of the physical and chemical characteristics of the native starch to improve its functional characteristics, which can be used to tailor starch to specific food applications (Hermansson and Svegmark, 1996) [3].
Thus to achieve the goal, the objective of the present study was to study the effect of acid hydrolysis on the physico-chemical properties of the starch extracted from buckwheat.

Material and Methods
Buckwheat seeds were procured from local market in Sirsa and were cleaned for extraneous matter. All the chemical used were of analytical grade.

Starch isolation from grains of buckwheat
Starch was isolated by the method described by Sandhu *et al.* (2005) [8]. About one kg of buckwheat grains were taken into a glass container. A pinch of potassium metabisulphite was added for softening of grains. The grains were steeped in sufficient amount of water for 24 hours. After 24 hours the steeped grains were ground in grinder properly. Required amount of water was added for easy grinding of grains. Obtained slurry was passed serial wise through 25, 40, 50, 75, 100, 125, 150, 250 and 300 (if possible). Required amount of water was added during sieving for easy pass out of slurry through sieve. After sieving, obtained slurry was kept in refrigerator for 24 hours at near about 4^0C temperature to settle down the starch. Next day the upper brown layer was discarded and remaining portion was mixed with distilled water. The slurry obtained was centrifuged at 4000 rpm for 10 minutes at 2^0C and the upper brown layer was discarded. Obtained starch was stored at 40-42^0C for a night for drying.

Acid hydrolysis of buckwheat starch

Acid hydrolyzed starch was prepared following the method described by Wang *et al.* (2003) [12].

100g starch and 500ml of 0.15M HCL were taken in a 1000ml beaker. The mixture was kept into magnetic stirrer for 8 hours temperature 50^{0}C in a water bath. Then slurry was filtered through Buckner funnel withsufficient amount of distilled water with the aid of a filter paper. Then the starch was dried at 40^{0}C.

Physico-chemical properties of native and modified starch

Amylose content

The amylose content was determined by the method described by Williams *et al.* (1970) [13].

Swelling power and solubility

The swelling power and solubility of starches were determined by using method described by Scoch, (1964) [9] with slight modification.

One g starch was taken in a conical flask and 49ml distilled water was added. The flask was covered the flask with aluminum foil then heated to 90°C and was kept at that temperature for one hour. The heated samples were cooled rapidly in ice water for ten min., equilibrated at room temperature. Sample was centrifuged at 4500 rpm for 15 min., the supernatant were drained into preweighed moisture dishes and evaporated to dryness in a hot air oven at 100°C. It was cooled to room temperature in a desiccator and weighed. Swelling power and solubility was calculated by using following formula:

$$\text{Swelling power (g/g)} = \frac{\text{Weight of sediment}}{\text{Initial weight of dry starch}}$$

$$\text{Solubility (\%)} = \frac{\text{Weight of the dried supernatant}}{\text{Initial weight of dry starch}} \times 100$$

Light transmittance

Light transmittance (%) was measured using method as described by Craig *et al.* (1989) [2]. 2% starch suspension in water was heated in a water bath at 90^{0}C for one hour with constant stirring. The suspension was cooled and held for one hour at room temperature. The sample was then stored for 7 days at 4^{0}C. The transmittance was determined after 24 hour by measuring the absorbance at 640 nm using Systronic spectrophotometer 106.

Results and Discussion

Native buckwheat starch showed amylose content of 19.8% (Table 1). Amylose content of 21.3% for buckwheat starch has been reported earlier by Zheng *et al.* (1998) [15]. Acid hydrolysis of buckwheat starch resulted in decrease in amylose content. Amylose content of native buckwheat starch decrease from 19.8 to 15.2% (Table 1) after acid hydrolysis of starch. The decrease in amylose content after acid hydrolysis may be due to the fact that acid preferentially attacks the amorphous regions (Komiya and Nara, 1986; Komiya *et al.*, 1987) [5, 6]. Amylose molecules cleaved more easily than amylopectin molecules during acid hydrolysis.

Significant variation in swelling power of native starch of buckwheat was observed after acid hydrolysis of starch extracted from buckwheat. Acid thinning decreased the swelling power from 17.4 to 10.7g/g (Table 1).

Physico-chemical properties of native and acid hydrolyzed buckwheat starch

Table 1: Physico-chemical properties of native and acid hydrolyzed buckwheat starch

Sample	Amylose content (%)	Swelling power (g/g)	Solubility (%)
Native buckwheat starch	19.8	17.4	10.8
Acid hydrolyzed buckwheat starch	15.2	10.7	23.4

Native starch extracted from buckwheat showed a solubility of 10.8% (Table 1). A significant variationin solubility of native starch after acid hydrolysis was observed. Acid thinning increased the solubility of native buckwheat starch from 10.8 to 23.4% (Table 1).

Decrease in swelling power and increase in solubility in acid treatment may be due to low molecular weight linear fraction increment with hydroxyl group that facilitated solubilisation. Theoretically these hydroxylgroups retain water molecules by means of hydrogen bonds, increasing the swelling power.

Light transmittance (%) of native and hydrolyzed buckwheat starch

Table 2: Light transmittance (%) of native and hydrolyzed buckwheat starch

Sample	Days					
	1	2	3	4	5	6
Native buckwheat starch	1.3	1.2	1.0	0.8	0.7	0.6
Acid hydrolyzed buckwheat starch	2.6	2.4	2.3	2.1	1.9	1.7

The light transmittance indicates the clarity of a cooked starch paste. Results indicated that acid treatment increased the light transmittance of native buckwheat starch from 1.3 to 2.6% (Table 2). Light transmittance of native and acid treated buckwheat starch decreased with the passage of time.

Higher light transmittance of acid treated buckwheat starch as compared to native buckwheat starch may be due to its decreased retrogradation tendency. The leaching of amorphous regions during acid hydrolysis enhances interactive bond formation between the amylopectin molecules and thus increasing its light transmittance (Lawal, 2004) [7].

Conclusion

From the present investigation, it was concluded that amylose content and swelling power of buckwheat starch decreased whereas, solubility and light transmittance of buckwheat starch increased after acid hydrolysis of starch obtained from buckwheat.

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