Sigma J Eng & Nat Sci 38 (2), 2020, 875-887

Sigma Journal of Engineering and Natural Sciences
Sigma Mühendislik ve Fen Bilimleri Dergisi

Research Article

INVESTIGATION OF THE PROPERTIES OF STARCH OBTAINED FROM TARO (*COLOCASIA ESCULENTA* L. SCHOTT) GROWN IN MERSIN, TURKEY

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Received: 17.12.2019 Revised: 10.02.2020 Accepted: 18.03.2020

ABSTRACT

In present study, starch was isolated from the taro tubers grown in Mersin, Turkey and the physicochemical, structural, and pasting properties of starch were examined. Hydrocolloids (guar gum, xanthan gum, xanthan-guar gum mixture) were used with different concentrations (0.5 and 1%) with the purpose of investigating their effect on pasting properties of taro starch. Taro starch was isolated in 95.16% purity. The resistant starch content of the taro starch was 3.14% and the amylose content was 9.92%. X-ray diffractometry displayed an A-type crystal pattern for taro starch. Taro starch granules showed irregular structure with the polygonal shape and size that ranged between 0.5 and 3 μm. Increase of gum concentrations significantly increased the peak viscosity, final viscosity, setback viscosity and breakdown viscosity parameters as well as guar gum had more dominant effect when compared with the xanthan gum, and mixture of guar-xanthan gums. As the 1% guar gum added the peak, final, breakdown and setback viscosity values increased from 1786.50 cP to 8787.00 cP, from 2804.50 cP to 6439.00 cP, from 453.60 cP to 5760.00 cP and from 1471.50 cP to 3412.00 cP, respectively. The findings of this study highlighted that taro starch could be offered as an alternative source for food product development or industrial applications due to physicochemical, functional properties and positive interactions with gums. It is thought that this study to increase the use of taro will also benefit the economy of the regions where it is grown.
Keywords: Taro starch, physicochemical properties, pasting properties, xanthan gum, guar gum.

1. INTRODUCTION

Taro (*Colocasia esculenta* L. Schott) is a tropical and sub-tropical climate plant produced and consumed in many countries around the world as a leaf and especially as a root vegetable [1]. Taro is grown and consumed more than potatoes in Anamur and Bozyazı districts of Mersin province and Alanya and Gazipaşa districts of Antalya province [2].

Taro tuber includes high amount of carbohydrate, various minerals and vitamins. However it also has low fat and protein content in terms of chemical composition. Taro is a promising plant since it contains high amount of starch it can be used instead of other starches in many industrial applications [3]. There are two options for using taro which are using directly as raw material or

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after the processing. However, when high moisture content of the taro is taken into consideration, it is logical to extract starch or remove the water content in order to extend its use [4]. This in turn will provide extended shelf life and wider application area. Starch is an important energy source and primary carbohydrate source in human nutrition and it is important for the food industry due to its technological characteristics such as swelling power, gelatinization, thickening, providing consistency and viscosity, water absorption capacity characteristics. Because of these characteristics, starches are favorable to use in the food formulations. The starch granules are thought to be easily digestible due to their small size; therefore, it can be used in diets of infant formula, allergic to cereals and milk-sensitive children.

In food applications, it is important to characterize physicochemical and functional properties of the taro in order to consider it as a potential source of starch. Generally starches are used in industrial applications because of their good pasting and rheological properties [5]. These pasting and rheological properties can be modified in order to reach the desired properties from the product. Studies showed that different gums were used to improve gelatinization and rheological behavior of starch [6].

As starches are used in the food products for many purposes, some characteristics of starches such as high pasting temperature, syneresis, retrogradation and providing high consistency can restrict the usage. Therefore, starches are modified by chemical and physical treatments to overcome these problems. One of the widely used methods for this aim is using hydrocolloids with starches to suppress the defects. Therefore, investigations of the effects of hydrocolloids on technological properties of starches are important for usage of the starch/hydrocolloid combinations in the food formulations. While there are many studies about pasting and rheological characteristics of different starches developed by various hydrocolloids [7, 8, 9] there are not too many researches about effect of hydrocolloids on pasting behavior of taro starch which grown in Turkey. For this reason, the effect of widely used hydrocolloids, namely guar and xanthan gums on pasting properties of the taro starch was studied in the present study. It was also aimed to show that the use of hydrocolloids can improve the technological properties of taro starch. Otherwise some physical and chemical processes are required to modify starch or starches are used in limited food products.

2. MATERIALS AND METHODS

2.1. Materials

Taro tubers were obtained from Anamur, Mersin which is a town located on the Mediterranean coast of Turkey (Figure 1). The experimental site was located at geographical location of 36° 4' 31¨ N latitude, 32° 50' 19¨ E longitude. Taro tubers were stored in cold room at +4ºC and 85% relative humidity until the starch was isolated. The resistant starch assay kit was obtained from Megazyme (Megazyme Co, Wicklow, Ireland). The amylose standard A0512, guar (Cyamopsis tetragonoloba) gum and xanthan gum from *Xanthomonas campestris* were obtained from Sigma (Sigma-Aldrich Chemie, Germany).

Figure 1. The location map of Anamur, Mersin in Turkey where taro is intensively planted

2.2. Starch isolation

The cleaned tubers were peeled, weighed, cut and washed under tap water to remove mucilage from tubers. The tubers were homogenized for 1.5 minute in a blender (Waring Commercial, USA) with 1:1 volumes of distilled water and this suspension was filtered with double layer muslin cloth. In order to increase the extraction performance, homogenization and filtration operations were repeated two times. The resulting slurry was sieved (mesh size 325) and finally centrifuged (Thermo scientific Heraeus, Multifuge X3 FR, Germany) at 8000 x g for 10 min. The washing and centrifuge process was repeated twice and final sediment was placed in an oven (JeioTech, S.Korea) for drying (at 40 ºC) overnight. The dried taro starch ground and stored at 25ºC in sealed plastic bags.

2.3. Physicochemical properties

Moisture, ash, crude protein (N×6.25%), fatty material content (% w/w) of taro starch were determined according to the methods as it is described in AACC [10]. Chroma Meter (Konica Minolta, Cr-400, Japan) was used in order to determine color characteristics on the base of L^*, a^* and b^* values. L* values measure brightness, a* values measure redness when positive and b* values measure yellowness when positive.

2.4. Total and resistant starch content

The amount of total and resistant starch content in taro starch was calculated according the AOAC method [11] using Megazyme resistant starch assay kit. The purity of the taro starch was evaluated using the total starch analysis results.

2.5. Amylose content

In order to determine total amylose content of taro starch, 0.1 g of taro starch was weighed and 1 mL of ethyl alcohol (95%) and 9 mL of 1 N sodium hydroxide was added to disperse the starch. The sample was heated in boiling water bath during 10 minutes and cooled to room temperature. After cooling, the volume was completed to 100 mL with distilled water. 5 mL of the solution was transferred to another flask and 1 mL of 1M acetic acid and 2 mL of stock iodine solution were added respectively. Final volume was completed to 100 mL using distilled water. The solution was shaken and waited during 20 minutes to observe complete color transformation

to blue. (In the presence of amylose, the color was expected to turn blue.) UV/Visible spectrophotometer (UV-1800, Shimadzu, Japan) was used in the wavelength of 620 nm, in order to read measurement. Amylose content of the taro starch was determined on percent basis using absorbance-amylose concentration calibration graph which was prepared with potato amylose (A0512, Sigma) in the concentration range of 0-24%.

2.6. Swelling power and water solubility

The swelling power and water solubility of taro starch were calculated using 0.5 g of starch, according to following method which is used by Sit et al. [1]. Weighted taro starch dispersed in 20 mL distilled water by means of a magnetic stirrer. Dispersion was transferred into centrifuge tubes, sealed and shaken in water bath (Wise Bath, Germany) at 60, 70, 80 and 90°C for half an hour. Then the samples were centrifuged at 12000 x g for 10 minute. The supernatant was transferred in a petri dish and dried at 103°C overnight. After decantation the weight of paste was determined and swelling power and solubility were calculated according to the following equations;

$$\textit{Swelling power}\ (\text{g/g}) = \frac{Weight\ of\ swollen\ granules}{Weight\ of\ sample - Weight\ of\ dissolved\ starch}\ x\ 100 \quad (1)$$

$$\textit{Solubility}\ (\%) = \frac{Weight\ of\ dried\ starch\ in\ petri\ dish}{Weight\ of\ sample}\ x\ 100 \quad (2)$$

2.7. Turbidity

In order to determine the turbidity, starch-water suspension (1 wt %) was prepared and kept in water bath at 90°C for 1 hour under continuous shaking. The starch paste was cooled down to 25°C and then stored at 4ºC. UV/Visible spectrophotometer (UV-1800, Shimadzu, Japan) was used in the wavelength of 640 nm, in order to measure the turbidity. Absorbance values were recorded at intervals of 24 hours during 6 days to determine turbidity of paste stability [12].

2.8. Freeze-thaw stability

5% (w/v) aqueous starch solution was prepared in order to determine the freeze-thaw stability of taro starch and kept in a water bath at 95°C for 30 minutes under continuous mixing. Ten mL of solution was transferred into centrifuge tubes and weighed. The samples were frozen at -20°C for 22 hours and removed from the freezer for 2 hours. The thawed samples were centrifuged (8000 x g) for 10 minutes and the separated water was weighed. The cycle was repeated for 6 days. The measurements were taken along the freezeing-thawing cycle and syneresis was calculated gravimetrically according to the exudates to the amount of paste [13].

2.9. Scanning Electron Microscopy

The morphological analysis of the taro starch was determined using scanning electron microscopy (SEM, Zeiss EVO® LS 10, Germany). The starch was placed on the aluminum stubs via carbon tape without coating. Then it was examined using accelerating voltage of 10 kV. The samples were examined under the microscope with magnifications of 5000× and 20000×.The range of the granule size was determined by measuring the length and width of granules from the pictures.

2.10. X-Ray Diffraction (XRD) Analysis

XRD measurements were done with X-ray diffractometer (PANalytical X'Pert PRO, Tokyo, Japan). The method used by Sit et al. [1] was applied with some modifications. The measurements were conducted at 40 kV and 30 mA. Scanning was performed with Cu-K alpha radiation, 2θ range from 4 to 60° (teta standing for the angle of diffraction) and at the scanning speed of 0.05°/s.

2.11. Pasting properties

The pasting properties of taro starch and starch-gum mixtures were characterized by rheometer (AntonPaar MCR-302, Austria) which has a starch-cell unit. Pasting properties of starches or starch–gum mixtures were determined with some modifications according to method of proposed by Huang [6]. Sample (2.35 g) was prepared by mixing taro starch with 0.5 wt % and 1 wt % of guar gum, xanthan gum, and guar-xanthan gum mixture (50-50 wt %). Finally required amount of distilled water was added to obtain dispersion at concentration of 12 g starch/100 g to starch-gum mixtures. Starch solution without gums (control) was also analyzed. During the measurement, the slurry was heated to 50°C at 5 ºC/min rate and kept at this temperature for 1 min. Temperature was increased to 95°C in 8 min, after holding at this temperature for 5 min, the temperature was decreased to 50°C in 7 min and held for 2 min. The pasting properties were determined from temperature-viscosity graph with using devices software.

2.12. Statistical analysis

The data were analyzed by one-way ANOVA using JMP 6.0 to determine the effect of gums on pasting properties of taro starch. Significance differences were selected to be 0.05.

3. RESULTS AND DISCUSSION

3.1. Physicochemical properties

Taro starch was produced with 95% purity with white color. Şimşek & El [14] extracted starch with 98% purity with extra purification methods. In the process of starch production, purification with various chemicals and purifying from different components such as fat and protein affect the efficiency of starches to be obtained. However, in order to avoid destructing the gel structure that was formed by the starch, no extra-purification was applied in this study. The moisture content of taro starch was 11.42% within the expected limit range for starch. The amounts of ash, protein and lipid in the taro starch were 1.39%, 1.29% and 0.11%, respectively. In previous studies, these values ranged from 0.24% to 0.31% for ash, from 0.42% to 0.53% for protein, and from 0.23% to 0.27% for fat [1, 4] Low lipid and protein content of taro starch is good for utilization purpose of starches considering technological properties. Presence of fat and protein results in delaying of hydration and viscosity [15]; therefore, the low content of them in starch is preferred. The differences between these values can be related to a number of reasons that affect the technological properties of taro starch such as taro species, grown region characteristics of taro, starch production process from taro, differences in starch composition of taro and taro structure. Fat and protein lipid content of the widely used starches, namely, corn, potato and wheat starches ranged between 0.1-0.9% and 0.1-0.4% on dry basis, respectively [16]. Protein content of taro starch was found to be high in the present study when compared to the other starches in the literature. The L^*, a^* and b^* parameters of the taro starch were determined to be 90.87, 2.19 and 4.71 respectively. Color is an important feature which reflects starch quality. High L^* value and low a^* and b^* values of taro starch exhibited similar results with previous

studies. In this sense, it was suggested that taro starch is a useful product for the application areas where clarity and uniformity in color is needed [1].

3.2. Total and resistant starch content

The total starch content of taro starch was determined as 84.29%. In the similar studies it was shown that the total starch content of the starch obtained from the taro tubers varied from 75.40% to 84.2% [14, 17]. It is remarkable that our result is close to the highest level acquired at previous studies, indicating purity of the produced starch. Starch has beneficial physicochemical effects such as gel formation, enhancement of viscosity, white appearance, swelling, and water absorption capacity. The resistance starch content of taro starch was calculated as 3.14%, which is in the gap of the findings of the previous studies [14, 17]. Resistant starch is an important starch portion in human diet due to its availability for fermentation in the large bowel. In this sense taro is an alternative plant for obtaining resistant starch and has beneficial effects for human health. Therefore, taro starch can be preferred due to its functional properties as well as its technological properties. According to nutrition facts label, 25 g of fiber recommended daily for a 2000 calorie diet [18]. This is the recommended value for general health benefits of DF, not just probiotics.

3.3. Amylose content

Amylose content of taro starch was determined as 9.92%. It was shown that the amylose content values are varied between 4.3% and 30.6% [19]. Amylose amounts of starches obtained from different plant sources varied between 23% and 31% for potato starch, between 18% and 30% for wheat starch, and between 22.4% and 32.5% for corn starch in various studies. These changes in amylose content can be attributed to plant sources, botanical cultures and different isolation methods of starch. Low amylose, high amylopectin content also corresponds to high swelling power of starch, which makes taro starch advantageous. Starches with high amylose can form gel and easily protect their shape. Therefore, amylose/amylopectin concentration is very important for the quality of end product, considered during selection of starch type depending on technological properties.

3.4. Swelling power and water solubility

The swelling power and water solubility of the taro starch increased by temperature increase as it can be seen in Figure 2(a) and 1(b). The highest values were observed at 90°C with the values of 16.86% and 14.22 g/g for solubility and swelling power respectively. Increasing solubility at higher temperatures is related to the movements of starch chains to continuous phase. At higher temperatures, kinetic energy increases and water molecules are distributed higher in granules. This results in more starch chains separating from each other and increased water content [20]. As can be seen there is a sharp increase in swelling power and water solubility values of the starch when temperature increased from 70ºC to 80ºC, which can be related with the pasting temperature of the taro starch. According to literature, swelling is related with feature of amylopectin. Crystallites of amylopectin molecules are important for the onset of swelling and gelation [21]. Compared with other starch species, the swelling power of taro starch is relatively higher compared to wheat, corn and rice starches, and lower compared to potato and banana starches. So the results showed that taro starch exhibits satisfactorily level of swelling power for the food industry.

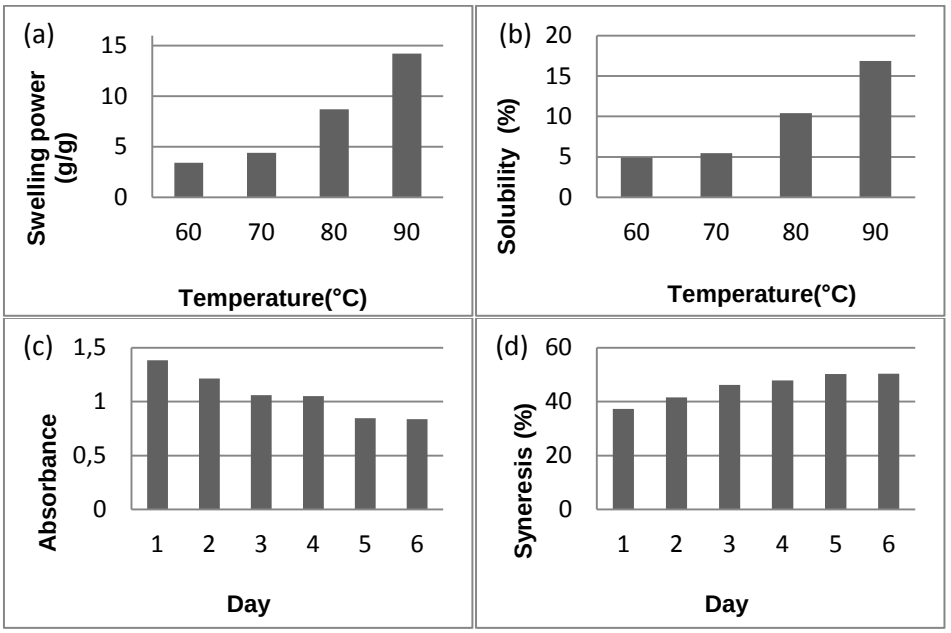

Figure 2. Swelling power (a) water solubility (b) turbidity (c) and syneresis (d) of taro starch

3.5. Turbidity

The highest turbidity was determined on the first day with the absorbance value of 1.38 (Figure 2(c)). On the second and third day the turbidity value decreased significantly. The decrease in the fourth day was very low and the increase of the clarity was observed on the 5th day while the maximum clarity was determined to be 0.84 absorbance value on the 6th day. While the decrease of paste clarity is related to the retrogradation of amylose and amylopectin molecules, which can finally cause an increase in light absorption [22] on the contrary the increase in clarity is related to the collapse of large molecules or foreign substances in the starch solution [1].

3.6. Freeze-thaw stability

In the industrial applications, it is important to determine the freeze-thaw stability of a starch gel since it affects the textural properties of starch-based foods drastically due to amylose and amylopectin crystallization (retrogradation). The amount of water separated (% syneresis) is presented in Figure 2(d). As it can be understood from the Figure 2(d) the syneresis rate increases with increasing storage time. The highest value was measured as 50.31% at 6th day. The results showed that taro starch has poor freeze-thaw stability and that its stability should be increased in order to use it in frozen foods. When the freeze-thaw stability of taro starch was compared to other common starches, the syneresis of taro starch was found to be lower than potato and corn starch but comparable to wheat starch [23].

3.7. Granule characteristics

The scanning electron micrographs of taro starch are presented in Figure 3. Granules of taro starch structurally have irregular, polygonal shape and agglomerate and discrete distribution. The average size of starch granules are varied from 0.5 and 3 μm. Sukhija et al. [19] informed that the granule size of taro starch was the smallest among the starches analyzed from different starches (native banana, native ginger, native taro, elephant foot yam starches). Dhital et al. [24] reported that the small granules are easily digested by enzymes because they have a larger surface area.

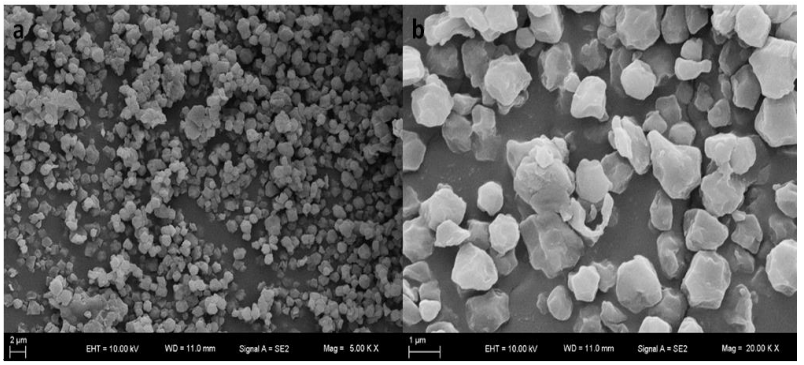

Figure 3. Scanning electron micrographs of taro starch (a) × 5000 and (b) × 20000

3.8. XRD analysis

Figure 4 shows the X-ray diffractogram of the taro starch. Crystal structure of the starch granules provides valuable information which is obtained by XRD analysis. XRD pattern is called the "fingerprint" of the crystal structure for the starch granules [25]. Many features such as digestion and retrogradation are evaluated by the XRD pattern of starches. According the X-ray diffractogram of the taro starch, diffraction peaks are clearly exhibited at 15.05°, 17.23° and 23° at 2θ. It can be deduced from the results that taro starch exhibits an A-type XRD pattern, which is a characteristic structure for cereal starches. This result is also compatible with previous study of Sit et al. [1].

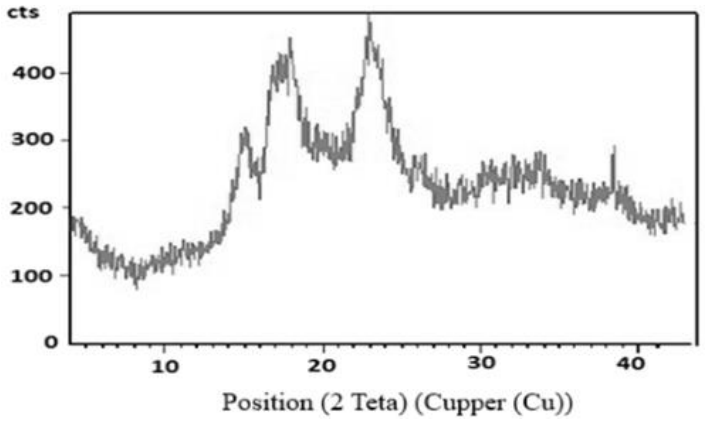

Figure 4. X-ray diffractogram of taro starch

3.9. Pasting properties

Pasting curves of the taro starch (TS) and starch-gum mixtures are shown in Figure 5. Guar gum (GG) and xanthan gum (XG) affected the pasting behavior of the taro starch. The effect became more significant when the concentrations of GG or XG increase.

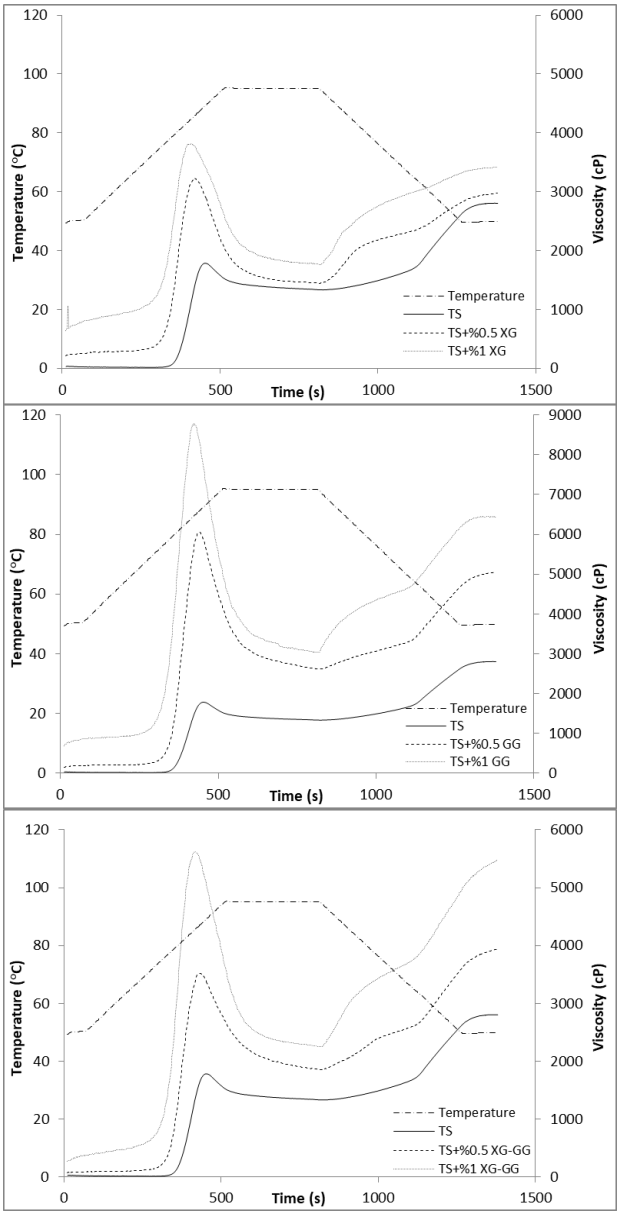

Figure 5. Pasting curves of the taro starch and starch-gum mixtures

The pasting temperature is an important value obtained from rheological analysis defined as a parameter when the increase in viscosity observed at a specific temperature. Pasting temperature of the taro starch or taro starch/gum mixtures was found to between 71.55°C and 75.41°C (Table 1). Gum usage didn't significantly influenced the pasting temperature ($p<0.05$) except using of xanthan and guar gums at 1% concentration. The values were found to be lower than wheat starch, while being close to corn, pea, tapioca and waxy maize starches [26]. Pasting temperature is associated with the energy required for cooking of the starch-including material.

Table 1. Effect of the addition of gums at concentrations of 0.50 and 1.0%, on the pasting properties of the taro starch

Starches	PT (°C) *	PV (cP) *	HS (cP) *	FV (cP) *	BV (cP) *	SV (cP) *
TS	74.12±0.40^{ab}	1786.50±9.19^{f}	1333.00±16.97^{e}	2804.50±26.16^{f}	453.60±7.78^{e}	1471.50±9.19^{d}
TS + 0.5% XG	74.76±0.43^{ab}	3225.50±173.78^{e}	1444.50±174.66^{e}	2976.50±91.22^{f}	1780.50±2.12^{d}	1532.00±83.43^{d}
TS + 1% XG	71.55±4.05^{b}	3823.00±77.78^{d}	1763.50±123.74^{d}	3419.50±70.00^{e}	2060.00±45.25^{c}	1656.50±53.03^{d}
TS + 0.5% GG	74.64±0.18^{ab}	6064.50±210.01^{b}	2613.00±8.49^{b}	5051.00±82.02^{c}	3451.00±217.79^{b}	2437.50±89.80^{b}
TS + 1% GG	75.41±1.10^{a}	8787.00±128.69^{a}	3027.00±79.20^{a}	6439.00±83.44^{a}	5760.00±49.50^{a}	3412.00±162.63^{a}
TS + 0.5% XG-GG	73.59±0.72^{ab}	3529.00±41.01^{de}	1853.00±7.07^{d}	3937.00±14.14^{d}	1675.50±34.65^{d}	2084.00±7.07^{c}
TS + 1% XG-GG	74.30±0.19^{ab}	5617.50±187.38^{c}	2248.50±20.51^{c}	5469.50±242.54^{b}	3369.00±166.88^{b}	3221.00±222.03^{a}

Data are mean of two replicates per sample. Mean ± SD values in the same column followed by different superscripts are significantly different ($p<0.05$). cP: Centipoise; TS: Taro starch; GG: Guar gum; XG: Xanthan gum; PT: Pasting temperature; PV: Peak viscosity; HS: Holding strength; BV: Breakdown viscosity; FV: Final viscosity; SV: Setback viscosity

The peak viscosity (PV) is affected with change of swelling granules of the starch [7]. The PV value of the taro starch was found to be 1786.50 cP. PV values in the gum-starch mixtures varied between 8787.00-3225.50 cP (Table 1) indicating that taro starch-gum combination could be recommended as an alternative in order to use as gelatinization and/or thickener agent in food industry. The peak viscosity of taro starch is found to be lower than the other common starches [26]. In this sense, gum addition makes taro starch more suitable for use as a thickening agent. An increase in the PV values was observed when the concentrations of the gums are increased. TS + 1% GG has the highest PV value while TS + 0.5% XG has the lowest PV value in suspensions prepared using gums. In another study in the literature peak viscosity of taro starch was found to be lower than sweet potato, potato, edible canna starches while higher than corn and rice starches [27].

Holding strength (HS) is an important pasting parameter due to represent materials resistance to the heat and the shear stress. Holding strength (trough viscosity) of the taro starch was 1333.00 cP and changed between 1444.50-3027.00 cP for starch-gum mixtures. Breakdown viscosity (BV) is calculated from the difference between peak viscosity and trough viscosity, BV was found to be 453.60 cP for taro starch, while it increased from 1675.50 to 5760.00 cP in other starch-gum mixtures depending on concentrations. The BV indicates the resistance of the samples to heating. The increase in the BV value reduces the resistance of the samples. In this context, the increase in the BV value is associated with quality disturbances during production.

Final viscosity (FV) is a widely used parameter, which shows that if a material form a gel or viscous paste after food is thermally processed [28]. The FV of the taro starch was 2804.00 cP and was less than that of other starch-gum mixtures. On the other hand the FV of the taro starch was found to be higher than corn, wheat and tapioca starches. The addition of xanthan gum and guar gum to the taro starch gels drastically increased the values of the final viscosity. The greatest increase was again observed in the addition of the guar gum.

Setback viscosity (SV) value is a parameter representing the retrogradation of starch and found to be 1471.50 cP for the taro starch. The lower setback value indicates that the specimens

are more resistant to retrogradation. It is also seen that the syneresis phenomenon occurs more slowly in samples with low setback value. As seen in Table 1, this value was significantly influenced by gum addition and was 3412.00 cP with the addition of guar gum used at 1% concentration.

These findings highlighted that the pasting behavior of the taro starch were significantly influenced by guar gum and xanthan gum addition. GG exhibited a more pronounced effect on increasing the peak, final, setback and breakdown viscosities than XG at 0.5% and 1.0% gum concentrations demonstrating different interactions between amylopectin and the gum molecules. These different behavior characteristics on pasting properties can be attributed to the difference in molecular structure and the flexibility of the gum chains.

The increase in viscosity parameters is attributed the interaction between starch granules and gums. The main modification caused by hydrocolloids is to thicken the solution by decreasing the activity of the water fraction in the system. When the medium is dilute, the hydrocolloid molecules do not thicken because they can move freely, but in the concentrated dispersion the movement of the molecules increases. Thus, less hydrolysis is observed in the gel containing hydrocolloids compared to those prepared with starch, and thickening begins. In the food industry thickening ability of starch is an important parameter for the production. The results of our study indicated that usage of gum in the starch paste remarkably increased the viscosity of the gels.

4. CONCLUSIONS

In present study, the physicochemical and structural properties of taro starch and effect of XG, GG and mixture of XG-GG on pasting behavior of taro starch was investigated. Protein and lipid content of taro starch was found to 1.29 and 0.11%. Protein present in the starch can negatively affect some technological properties, eliminated by application of purification process. Amylose content of the starch was determined to be 9.92%. Taro starch gel showed low freeze-thaw stability, which can be improved by addition of hydrocolloids. The addition of XG, GG and mixture of XG-GG to taro starch promoted a considerable effect on the pasting properties. Hydrocolloids changed system viscosity by acting on granule swelling during and after gelatinization. Guar and xanthan gum addition increased peak, final, breakdown and setback viscosity values. Guar gum had a more dominant effect on taro starch pasting behavior. In this sense it is thought that the taro starch can be a good candidate as a thickener in foods such as ready-made soups and cake blends, puddings, filled cakes, ready-made sweeties, jelly fillings, together with gums. The present study was investigated the effect of hydrocolloids on the pasting properties of taro starch, which can provide beneficial information about the utilization area of the taro starch. The results show that taro starch can be offered as an alternative source for food product development due to its physicochemical, functional properties and positive interactions with various gums.

Acknowledgements

This study conducted with the support of the Scientific and Technological Research Council of Turkey's (TUBITAK, Ankara, Turkey, Project number: 114O391).

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