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Production of Phenolic-Rich Pregelatinized Starch

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Abstract

Cold water swelling capacity and low gelatinized temperature make pregelatinized starch desirable. The aim of this study was to produce phenolic rich pregelatinized starch. Therefore, corn, wheat and potato starches were processed in pomegranate, cherry and black mulberry extracts. This process followed by drying and grinding. The pasting properties of the phenolic-rich pregelatinized starch were determined in the rapid visco-analyser (RVA). The pasting and gel properties of the phenolic rich pregelatinized starch samples were different than the control (pregelatinized starch prepared in water). It was thought that the organic acids in the phenolic extracts reduced the pH, which decrease the viscosity of starch paste. Therefore, an acidity (pH) adjustment is required for the phenolic extracts before the RVA analysis.

Keywords: Pregelatinized Starch, Extracts, Phenolic

Introduction

Pregelatinized starch is a kind of physically modified starch. These starches have cold water swelling properties [1]. The pregelatinization process includes heating the dispersed starch with water, causing the starch granules to lose their polarization crosses and disintegrate into smaller granular fragments [2].

Pregelatinized starches are widely used in many food applications. It is widely used in instant (dry prepared) foods, cake mixtures, frozen foods that require a preserved texture, and gelatin formulations prepared for desserts [1]. Gluten-free doughs are more liquid than normal dough due to the lack of gluten network and pregelatinized starch can be utilized in this formulas. In addition, the gas holding forces are lower. The use of pregelatinized starches as a tool for the stabilizing mechanism is recommended [3]. It is also concluded that pregelatinized starch is the most effective type of starch that delays staling process [4].

Phenolic compounds are present as secondary metabolites in the structure of plants. They play an effective role in protecting plants from insects, animal and other pests. Many foods contain different type and amount of phenolic substances. The source of the astringent taste in fruits and vegetables is also the phenolic compounds. Phenolic compounds serve as a kind of colorant for foods to have their specific colors. It also causes color changes with enzymatic browning. Polyphenol oxidase enzymes (PPO) catalyze reactions that cause oxidation of phenolic compounds [5]. Phenolic compounds have antioxidant effects. Antioxidants inhibit or stop reactions caused by free radicals. Thus plays an important role in the prevention of diseases [6].

In this study, starch samples were heated to a certain amount above the gelatinization temperature in phenolic extracts. Following drying and grinding processes, it is aimed to produce phenolic rich pregelatinized starch.

Materials and Methods

Materials

Pomegranate, cherry and black mulberry fruits were supplied from the local markets and used as raw materials. Pomegranate, sour cherry and black mulberry fruits were stored in refrigerator at +4 °C until the juice was extracted. Wheat, corn and potato starch were used in the production of pregelatinized starch and they were supplied from a local distributor (Tito A.Ş. İstanbul).

Methods

In the current study it was aimed to prepare pregelatinized starch in phenolic rich fruit juice extracts. However, the sugars in the extracts prevent the crispiness at the end of the drying process and obstruct the grinding process. Thus, the sugar found in phenolic rich fruit juices were eliminated by fermenting it using

the wine yeast, *Saccharomyces cerevisiae* (Proferm-W, Germany). Briefly, the fruit juices squeezed by the aid of a clean cheese cloth manually and fermented at 25˚C for 7-10 days in a laboratory oven [7]. The alcohol was removed by using a rotary evaporator at the end of the fermentation process.

Acidic forces of pomegranate, sour cherry and black mulberry extracts were determined by a pH meter. pH is a unit of measure by definition that describes the degree of acidity and the alkaline of a solution (although it is a selective measure of hydrogen ion activity) [8].

Wheat, potato and corn starches were dispersed at 10% (w/w, db) solids in pomegranate, sour cherry and black mulberry extracts and a little above the pasting temperature pregelatinized in a hot plate for 5 or 10 min with continuous stirring. The entire dispersion was transferred into a metal tray and dried at 60 °C in a laboratory oven. After drying process, the pregelatinized starch sample was ground in a grinder and passed through a 212-micron sieve [9]. As a result of this method, pregelatinized starches were obtained.

The pasting properties of the pregelatinized starches were conducted by rapid visco-analyser (RVA). In this study, the method modified properly. 3 grams of sample was used and 27 ml of purified water was added. Pasting properties of starches samples were determined using the "Standard 1" profile of the device (Table 1) [10].

Table 1. "Standard 1" profile (temperature-speed change in RVA)

Time Hour:Min:Sec	**Criterion**	**Value**
00:00:00	Temperature	50 °C
00:00:00	Speed	960 rpm
00:00:10	Speed	160 rpm
00:01:00	Temperature	50 °C
00:08:30	Temperature	95 °C
00:13:30	Temperature	95 °C
00:21:00	Temperature	50 °C
00:23:00	Temperature	50 °C

Results and Discussions

The pH values of pomegranate, cherry and black mulberry extracts are given in Table 2. It is seen that all extracts show acidic character. The most acidic is sour cherry extract.

Table 2. Acidity-Alkalinity pH values of extracts.

	Pomegranate extracts	**Sour cherry extracts**	**Black mulberry extracts**
pH values	3.71	3.47	4.02

The effect of acetic acid on the physical properties of pregelatinized wheat (PGWS) and corn starch (PGCS) gels was investigated. Increasing the concentration of acetic acid causes the pH value to decrease. Low pH can cause changes in the physical, viscosity and gelling properties of the samples by hydrolyzing the starch molecules [11].

Peak viscosity values of plain pregelatinized starches were higher than native starches. But peak viscosity values of phenolic rich pregelatinized starches were lower than native starches and plain pregelatinized starches (Figure 1).

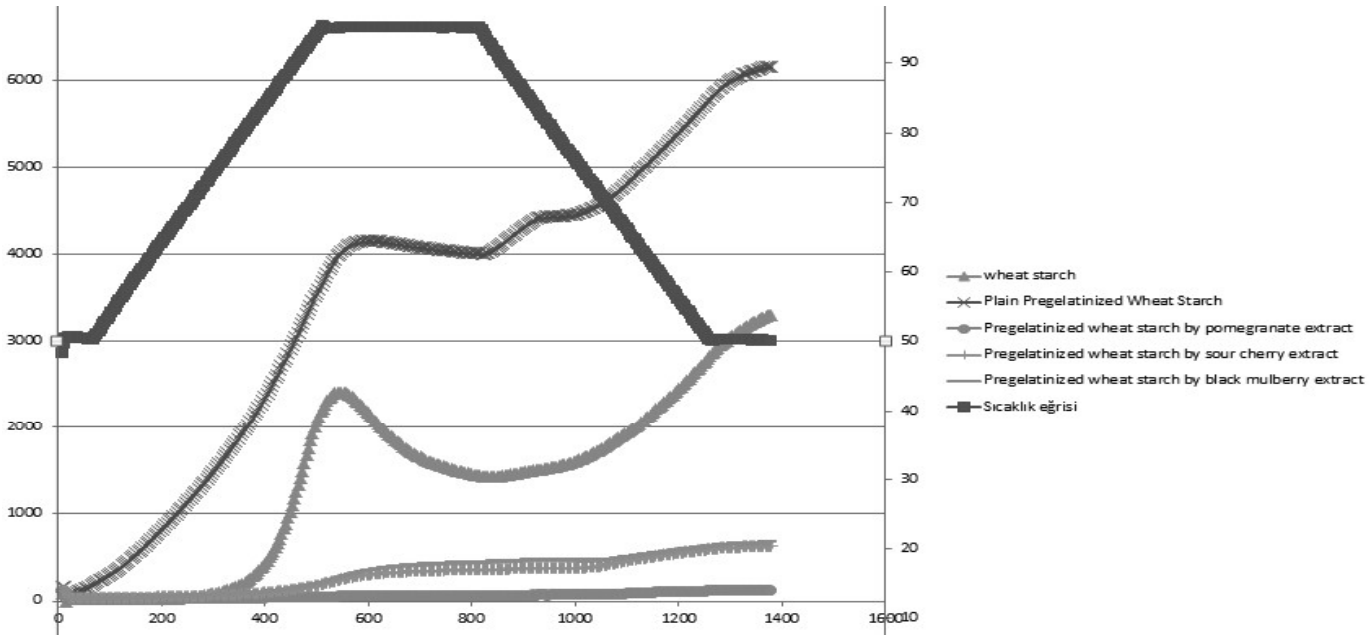

Figure 1. RVA pasting properties of native starches and phenolic-riched pregelatinized starched.

The effect of dry heating on the physicochemical properties of pregelatinized rice starch was determined in another study. The peak viscosity and final viscosity values of pregelatinized rice starches were found to be higher than natural rice starches [9].

Two phenolic compounds affected sorghum and maize starch pasting properties. Catechin and ferulic acid did not cause a significant change in the peak viscosity (PV) value of corn starch. However PV was markedly decreased for sorghum starches when ferulic acid was included [12].

The effect of acetic acid on the physical properties of pregelatinized wheat (PGWS) and corn starch (PGCS) gels was investigated. The addition of acetic acid to the pregelatinized wheat and corn starch resulted in a significant reduction in cold water viscosity (25 °C). The decrease in cold viscosity was found to be 8.11% in PGWS and 23.67% in PGCS. It was found that PGWS had higher viscosity than PGCS at various acetic acid concentrations. This is due to the fact that PGWS has higher water absorption and a larger molecular size. As a result, these starches in the presence of acetic acid exhibited lower viscosity than expected and produced softer and less cohesive gels [11].

Addition of acetic acid, malic acid, citric acid, lactic acid, tartaric acid and ascorbic acid caused a decrease in viscosity at low pH values. It has been found that the addition of these organic acids hydrolyses the amylose and amylopectin chains in the starch [13].

Conclusion

In phenolic rich pregelatinized starches, due to the low pH of phenolic extracts, the peak viscosity was found to be quite low. The low pH value directly affected the pasting properties of phenolic rich pregelatinized starch. It is thought that this problem will be solved by adjusting the pH of phenolic extracts (increasing the alkalinity of the extracts) and retrying. The study will be improved by determining the phenolic content and antioxidant capacity of the phenolic rich pregelatinized starch.

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