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ESTIMATION OF THE PHYSICOCHEMICAL PROPERTIES OF HEAT-STABLE FRUIT FILLINGS

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Abstract

The objective of this work was to analyze the main physicochemical properties of the fruit fillings prepared by using a heat-stable blend based on two hydrocolloids: low acyl gellan gum and amylopectin starch. Cherry and peach purees thawed after 1 month of freezer storage were used as a primary raw material in the preparation of fruit fillings. These were assayed for pH, soluble solids, total titrable acidity and total polyphenols before being used in the process of making fruit fillings. The same physicochemical parameters were investigated in the fillings prepared from the fruit purees presented above. In order to find out how the main quality characteristics of fruit fillings are affected by the thermal treatment during preparation and how the heat-stable complex containing low acyl gellan gum and amylopectin starch is capable to save a part of the essential compounds naturally found in the used fruit-based raw material, the control samples of fruit fillings (without heat-stable complex) were additionally prepared.

Keywords*: gellan gum, amylopectin starch, fruit filling, heat-stable.*

INTRODUCTION

Cherries and peaches possess highly desirable taste for many food preparations and are widely consumed both fresh and processed not only in Republic of Moldova, but also in other European countries. The nutritional benefits of these fruits are related to the content of bioactive substances, such as phenolic compounds, which have been reported to possess potential health effects (Lee et al., 2007).

A large number of research works have been made on studying the influence of various processing methods on preservation of bioactive compounds in different products (purees, jams etc.) obtained from strawberries (Hartmann et al., 2008; Klopotek et al., 2005; Patras et al., 2009; Aaby et al., 2007), however only few studies have been reported about similar investigations made on cherries, peaches and products obtained from them (Kim et al., 2004).

In general, high processing temperatures for a longer period of fruit product preparation has negative effect on most of the final product quality parameters and induces loss of many bioactive compounds (Nicoli et al., 1999).

The food products obtaining after processing cherries and peaches could be analyzed together, because these fruits belong to the Rosaceae family, which also includes apricots and plums.

Owing to their delicate aroma and taste, bright color, and health properties, cherries and peaches have become extremely appreciated in the world (Crisosto et al., 2003; Heinonen et al., 1998; Serradilla et al., 2012; Gil et al., 2002; Tomas-Barberan et al., 2001).

The cherries and the peaches are normally cultivated mainly for fresh consumption, but taking part from a group of climacteric fruits, they also present a challenge in postharvest storage, limiting the time period within which they can be stored and consumed fresh (Kader, 1999). In order to ensure sufficient shelf life during storage and transportation, the cherries and the peaches are usually picked earlier than their ripening stage. Because these fruits are relatively perishable, a big part of them is processed into jam, juice, purees, baby food and other canned products. Processing plays a big role in extending fruit's shelf life and

facilitating year-round availability. This issue represents a successful combination of convenience and appeal with nutritive value, especially as processing type and conditions have been displayed to affect bioactive compounds (Hamama et al., 1991).

The manufacturing of jams and heat-stable fillings for bakery products submitted to a thermal process, such as pasteurization or sterilization, is a useful alternative to extend the shelf life and conservation period of seasonal fruits such as cherries and peaches. The heat-stable fruit fillings belong to a group of fruit preparations which may resist high oven temperatures and are generally used in use in bakery products and confectionery. In accordance with the German Association for Food Law and Food Science (BLL) guideline, fruit preparations (including fruit fillings) should be produced from healthy and fresh fruits that are unfermented and possess a ripeness degree appropriate for processing. However, fruit concentrates as well as concentrated fruit constituents may be also used (Carle, 1997).

The main disadvantage of fruit preparations such as fillings is that during the thermal processing (even short-term) the original fruit loses some of its nutritional value and may also acquire undesirable characteristics in aroma profile, texture and color. Although the processing of fruit can decrease the content of total polyphenols and other bioactive compounds, some studies have illustrated that significant amounts of these compounds can be found after three months of storage in the presence of light and at room temperature (Mota, 2006). It has also been shown (Falcão, 2007) that, during jam processing, temperature of 70°C and higher induces the inactivation of enzymes that degrade polyphenols.

The main goal of our study was to estimate the influence of adding heat-stable complex containing amylopectin starch and gellan gum on stability of phenolic compounds and quality parameters of cherry and peach fillings.

MATERIALS AND METHODS

Raw materials

The cherries of the variety "ERDI Urojainaia" were handpicked in June, 2013 from the experimental orchards “Codru” of the Practical Scientific Institute of Horticulture and Food Industry of Moldova. Peaches of the variety “Collins” variety were harvested in July, 2013 from the experimental orchards of “Surinmih” Ltd. (Rezina region, Lalovo village, Republic of Moldova). In order to have homogeneous trials, both fruit samples were collected randomly from external and internal parts of the selected trees. The cherries and the peaches were frozen at -20°C and stored in deep freezer for one month before the experiments. The sugar was purchased from a local supermarket (Chisinau, Republic of Moldova). The amylopectin potato starch Eliane BC-160 (AVEBE) was kindly supplied by the Trading House AVERS (Sankt-Petersburg, Russian Federation). A low acyl gellan gum powder (KELCOGEL F) was acquired at the Moscow International Exhibition for Food Ingredients, Additives and Flavorings - “Ingredients Russia-2013” (Moscow, Russian Federation).

Chemical reagents

Folin and Ciocalteu’s phenol reagent, sodium hydroxide solution (0.1 n) and citric acid solution (50%) were prepared in the Laboratory of Functional Foods at the Practical Scientific Institute of Horticulture and Food Technology (Chisinau, Republic of Moldova).

Fruit filling processing

The fresh cherries and peaches were washed, dried, sliced, pitted and frozen by experienced personnel in the Functional Foods Laboratory of the Practical Scientific Institute of Horticulture and Food Technology (Chisinau, Republic of Moldova). Prior to the processing, unpeeled peaches and cherries were thawed after freezing and pureed with a portable blender up to homogeneous mass.

The fruit filling samples were locally processed at the Practical Scientific Institute of Horticulture and Food Technology of the Republic of Moldova, Laboratory of Functional Foods. The frozen peaches and cherries were kept at room temperature for 60 minutes before they were filled into the stainless-steel pan for filling preparation before sugar was added. Fruits and sugar were mixed (separately peaches and cherries) together before heating to 70°C and complete solubilization of the sugar.

Starch-gellan gum blend (0.6 g starch and 0.5 g gellan gum in 100 ml water) was then added as a heat-stable complex for fruit fillings when the temperature rose to 80°C and held under continuous heating up to 90°C for 3 min before obtaining the homogeneous mixture. In the final stage of heat-stable fruit fillings' preparation, citric acid was added and the mixture was stirred for 5 minutes before hot filling in transparent glass jars and the required total soluble solids were verified using an ABBE benchtop refractometer. Further cooling was done at 20°C for 4 hours before refrigeration. The fruit filling processing was performed in triplicates.

There were also made control samples of fruit fillings without heat-stable complex containing amylopectin starch and low-acyl gellan gum according to the procedure described above. All cherry and peach fillings were prepared on the basis of 70% fruit puree for every formulation, having the same pH and soluble solids, but different amount of citric acid added in each formulation.

All fruit fillings' samples were stored refrigerated (4°C) for one week, and then analyzed.

Physicochemical analysis

The physicochemical analysis of the cherry and peach purees and the fillings prepared from them were carried out in the Laboratory of Functional Foods of the Practical Scientific Institute of Horticulture and Food Industry of the Republic of Moldova.

The soluble solids of the prepared fruit fillings were determined at ABBE benchtop refractometer and expressed in °Brix. The pH value was measured by the potentiometric method, introducing the electrode directly into the analyzed fruit purees and fillings.

In order to establish the amount of acids in the fruit preparations, we used titration as the most common chemical method with the standard laboratory solution of 0.1M sodium hydroxide as counteractive reagent. 1% w/v solution of phenolphthalein in 95% v/v ethanol was used as indicator, while the point of neutrality was reached when the indicator changed from colourless to pink. We also calculated the sugar/acid ratio for both fruit purees and fillings, because this parameter is a very important indicator of the commercial and sensory quality of the raw material and fruit-based products.

The total polyphenols in the fruit preparations was determined by the spectrophotometric method (Singleton et al., 1999), using the Folin-Ciocalteu reagent. The reaction is based on the reduction of phosphomolybdic acid by phenols in aqueous alkali. The method detects the total free phenolic groups and thus establishes the total soluble phenolic compounds in a sample. The total content of polyphenols was measured in peach puree before preparing peach fillings, and subsequently in the filling samples prepared with heat-stable complex and separately without it (control samples) by short-term concentration of the peach puree. The difference between the initial content of polyphenols in peach puree and their remaining content in peach fillings showed the total polyphenol loses in each sample. All experimental measurements were expressed as the average of conducted analyses ± standard deviation.

RESULTS AND DISCUSSIONS

The total polyphenol content was determined in the fruit purees and fillings made from them.

The results obtained after analyzing the fruit fillings show that not only fresh cherries and peaches, but also fillings produced from them represent a rich source of polyphenols – bioactive phytocomponents characterized by the presence of more than one phenol group in the molecule (Table 1). A large number of studies show that the increased consumption of fruit polyphenols is beneficial for maintaining good human health (Lee et al., 2007; Rissanen et al., 2003), because it contribute to many life processes, resulting from their interactions with bio-molecules in the same way as enzyme regulators (Lee et al., 2007; D'Ischia et al., 2006).

We used freezing/thawing before purees analysis and fillings' preparation because these processes result in the disruption of the cellular matrix and an easier extraction of the polyphenols.

The most significant information, visualized by comparing the results of physicochemical

analysis of the heat-stable fillings and control samples of fruit fillings (Table 1), was the difference between influence of the two different formulations (with and without starch-gellan gum blend), explaining 15% of the total variation in total polyphenols. The samples prepared with starch-gellan gum complexes (both peach and cherry) had a higher content of polyphenols than control samples, confirming one of the existing hypothesis about polyphenol loses (Lin, 2007) that colloidal structures in the solution influence the chemical stability of polyphenols and certain colloidal aggregates could influence the oxidation rate if the polyphenols are incorporated or closely interacting with the aggregates (Lin, 2007).

Table 1. Quality parameters of the cherry and peach purees and fruit fillings prepared from them

Product type	SSC, ºBrix	TA, %	SSC/ TA, ºBrix/ % acid	pH	TPC, mg/kg
Cherry puree	14.0 ±0.01	1.15 ±0.01	12.17 ±0.25	3.27 ±0.01	1514.5 ±12.5
Peach puree	12.25± 0.35	0.67 ±0.01	18.28 ±0.15	3.80 ±0.01	372.94 ±3.48
Cherry filling with heat-stable blend	40.0 ±0.35	0.68 ±0.01	58.82 ±0.25	3.25 ±0.01	978.5 ±1.21
Control sample of cherry filling	40.0 ±0.35	0.69 ±0.01	57.97 ±0.25	3.25 ±0.01	835.21 ±3.15
Peach filling with heat-stable blend	40.0 ±0.35	0.53 ±0.01	75.47 ±0.25	3.25 ±0.01	208.25 ±0.45
Control sample of peach filling	40.0 ±0.35	0.55 ±0.01	72.73 ±0.25	3.25 ±0.01	176.83 ±0.18

Data are expressed as mean ± standard deviation (n=3)
SSC – soluble solid content, TA – titrable acidity,
SSC/TA – sugar/acid ratio, TPC – total polyphenol content.

The investigation of the total polyphenols in cherries and peaches processed into fruit fillings at 80-90°C for 10 minutes indicated that the addition of the heat-stable blend containing amylopectin starch and gellan gum that represents a colloidal aggregate, may lead to a small decreasing in the total polyphenol loses up to approx. 15% in comparison with the control samples of fillings.

CONCLUSIONS

Due to actual trends for heath living proposing the increased consumption of fruits and vegetables and greater awareness of health complications and diseases resulting from poor diet, consumers are looking for high-quality products with health benefits obtained from processing of fruits and vegetables. In order to increase microbiological stability and extended shelf life, manufacturers generally have to perform the thermal processing of these products, which affects their beneficial properties.

The objective of the present study was to investigate the impact of traditional thermal processing on the total phenolics and quality parameters of cherry and peach fillings prepared with heat-stable blend of amylopectin starch and gellan gum, by comparing them with the control samples of fillings

In prepared cherry and peach fillings, the phenolic compounds were negatively impacted by short-time concentration under elevated temperature and free access of oxygen. However, the total phenolic content was much higher in heat-stable fruit fillings prepared with amylopectin starch-gellan gum blend than in the control samples prepared under the same processing conditions.

Thus, it was demonstrated that adding heat-stable blend which consists of amylopectin starch and gellan gum, represents a very more effective tool not only for manufacturing bakery-stable fillings, but also for saving polyphenols from thermal damage during processing of fruits.

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