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PHYSICOCHEMICAL PROPERTIES OF BAKERY-STABLE FILLINGS MADE FROM UNPEELED PEACHES

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Abstract

Fruit samples of 20 yellow-fleshed peach of the variety "Collins" were collected from the experimental orchards of "Surinmih", Ltd (Rezina region, Lalovo village, Republic of Moldova) in July 2013, and stored frozen at -20ºC for one month. These were tested for pH, soluble solids and total titratable acidity before being used in fruit filling production. The same physicochemical characteristics were determined in fillings prepared from these peaches, and the difference between the quality parameters of raw material and the final product was established.
This study also addresses the impact of adding heat-stable complex containing gellan gum and amylopectin starch in the peach filling prepared in open kettles on the total polyphenol content. We investigated how total polyphenols from the unpeeled peach puree thawed after one month of freezer storage were affected by short-time concentration during fruit filling preparation and how heat-stable complex was able to save a part of these essential compounds. Our results indicate that processing peach puree into fruit fillings resulted in decreasing the total polyphenols, but the finished products could still be considered excellent sources of these bioactive compounds after adding heat-stable complex containing gellan gum and amylopectin starch.

***Key words**: peach, heat-stable filling, complex, polyphenols.*

INTRODUCTION

Peaches (*Prunus persica*) belong to the Rosaceae family. This fruit is a very important food product for customers owing to its pleasant sensory characteristics and various health benefits. Peaches are best eaten fresh and unpeeled, because they contain high quantities of water soluble vitamins (C, A, thiamin B_1, riboflavin B_2) and bioactive compounds such as polyphenols and carotenoids (Byrne et al., 2007). However, they are also widely used frozen, canned or in a variety of ways such as juice, jam, jelly, fillings and baby food, while providing the finished food products with essential minerals (iron, potassium, phosphorus, calcium) which are not significantly damaged during thermal treatment. There is also a strong correlation between total phenolics and the antioxidant activity of fresh peaches and food products on their base (Gil et al., 2002). Fresh peach puree, peach pulp and peel extracts may have benefits on various chronic diseases as they demonstrate the capacity to inhibit LDL oxidation (Chang et al., 2000).

Phenolic compounds are natural components of peach fruit that not only contribute to overall quality and nutritional value in terms of modifying flavour, aroma and colour, but also serve in plant defense mechanisms to prevent oxidative damage and damage by microorganisms, insects, and herbivores (Stevenson et al., 1993; Kwok et al., 1997; Vaya et al., 1997; Duval et al., 1999). A growing number of scientific reports indicate that plant polyphenols also play a very significant role in human health and disease prevention (Block et al., 1992; Ness et al., 1997; Chang et al., 2000).

Peach peel has been found to hold high concentrations of these compounds which are often removed during fruit peeling prior to canning. Nowadays, not much information is available about how postharvest and processing conditions impact the levels of total polyphenols in food products. In regard to increased recognition of the polyphenols role in human health, it has become increasingly important to study the influence of postharvest and processing conditions on the total polyphenol levels in foods. The composition of polyphenolic compounds in peaches is influenced by both internal and external factors. They comprise genetic variation in the species and subspecies (cultivar) level, maturity degree during the harvest period (Amiot et al., 1995; Bostock et al., 1999; Kabuto et al., 2000), preharvest agronomic conditions and postharvest processing conditions (Tomas-Barberan et al., 2001). Moreover, polyphenols are not uniformly distributed within the fruit tissue (Macheix et al., 1990). The distribution of polyphenolic compounds is highly essential with respect to the antioxidant capacity of industrially processed foods. While mechanically harvested peaches must be processed quickly in order to prevent softening and tissue decay, hand-harvested ones which are destined to produce high quality food products (especially baby food) may be stored under refrigeration conditions for days.

Of all the existent tree fruit crops, apples and peaches are among the best adapted to the Moldavian conditions and mostly processed into fruit jams, jellies, juices and fillings. Apples bloom later and are less sensitive to spring frosts than peaches but, with the right selection of a proper variety for each region, peaches can give rather regular crops and are favoured over apples by the Moldavian consumers.

The peach cultivar selection is of greater importance for further processing and should not be neglected. The peach variety “Collins” gives early season crops. Its fruit has medium size, but with nicely balanced sweet and tart flavour. This peach cultivar was first developed in the USA and then was zoned in the Republic of Moldova in 1980. The fully-ripe peach has yellow flesh, but the seed does not come off. The peach cultivar “Collins” has high productive potential and has performed well under the Moldavian conditions.

Moldavian peaches are generally preserved using thermal processing methods such as canning. The most popular manufactured canned foods in the Republic of Moldova are: peach juice, jam, bakery fillings and baby food. The thermal treatment applied in the canning technology is usually greater than the treatment required for microbiological destruction, because the processing goal is related more to the concentration up to the required level of soluble solids, homogenization and texture modification. However, part of the essential compounds (including polyphenols) are lost during the traditional open kettle canning method.

Peach filling is a type of filling made with peaches as a fruit base. In fruit fillings, structure stability is one of the most significant properties because these food products obtained generally from fruit purees may easily be separated into several phases without adding stabilizer systems, due to the damage of the structure after freezing/thawing and blending. Therefore, in order to stabilize peach fillings and to provide high bake-stability to the finished food product, heat-stable food complex containing low acyl gellan gum and amylopectin starch was added to the initial peach puree. It was clearly observed that control samples of peach fillings prepared from peach puree without adding the heat-stable complex created in the Functional Foods Laboratory of the Practical Scientific Institute of Horticulture and Food Technology for bakery-stable fruit fillings (Cropotova & Popel, 2012) displayed an unstable structure, easy to damage during preparation due to the intensive mixing of recipe ingredients and thermal treatment.

The nutritional value of fresh fruit is highly important for modern food manufacturers owing to the constantly growing interest in the “health-providing” properties to some food products based on the observation and scientifically proved postulates that their regular consumption beneficially influences human health by strengthening the body’s defense against several chronic diseases (Peri, 2006). Antioxidants, such as phenolic compounds, carotenoids and tocopherols, which can protect the human body from reactive oxygen species that are responsible for chronic diseases, are present in high concentrations in peaches (Dalla Valle et al., 2007) and may provide beneficial health effects to the food products prepared on their base, such as fruit fillings.

Investigations on the influence of postharvest and processing conditions on the total polyphenol content in processed foods are becoming crucial as a result of the health effects of fruit-based polyphenols and their role in disease prevention. Establishing the relationships between the processing conditions and the polyphenol levels in fruit (particularly in peaches) and the food products prepared from peaches is important to know how to optimize and maintain levels of useful polyphenols in commercially processed foods.

Numerous studies have demonstrated that polyphenol oxidation could be induced chemically (Jensen et al., 1983; Young et al., 1987), enzymically by using polyphenoloxidase (Goodenough et al., 1983; Rouet-Mayer et al., 1990), and by peroxidase (Weinges et al., 1971; Richard-Forget et al., 1997).

Most investigations were conducted in aqueous solutions. Therefore, another objective of the research was to study the influence of the heat-stable food complex consisting in two hydrocolloids (low acyl gellan gum and amylopectin starch) on the chemical stability of polyphenols from peach puree during fruit filling preparation in open pans.

MATERIALS AND METHODS

Our study describes the impact of common postharvest processing practices on the levels of total polyphenols in peaches of the variety "Collins" and heat-stable fruit fillings prepared from these peaches after freezer storage and thermal treatment. We present the influence of freezer storage of peaches at -20°C during one month and three different time-temperature concentration during peach filling preparation on the total polyphenols.

Raw materials

Peaches of the variety "Collins" variety were hand picked in July, 2013, from the experimental orchards of "Surinmih" Ltd. (Rezina region, Lalovo village, Republic of Moldova). Aiming to obtain homogeneous trials, peach fruit was harvested randomly from both the external and internal parts of the selected trees. Peaches were frozen at -20°C and stored in deep freezer for one month, for further processing purposes. Sugar was acquired from a local supermarket (Chisinau, Republic of Moldova). Amylopectin potato starch Eliane BC-160 (AVEBE) was kindly supplied by the Trading House AVERS (Sankt-Peterburg, Russian Federation). Low acyl gellan gum powder (KELCOGEL F) was purchased from the Moscow International Exhibition for Food Ingredients, Additives and Flavourings - "Ingredients Russia-2013" (Moscow, Russian Federation).

Chemicals

Folin and Ciocalteu's phenol reagent, sodium hydroxide solution (0,1n) 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).

Peach processing into heat-stable fillings

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 filling preparation, unpeeled peaches were thawed after freezing and pureed with a portable blender up to homogeneous mass.

Peach filling samples having the same pH value and soluble solids content were produced locally from peach puree obtained in a previous phase, sugar, citric acid and heat-stable complex containing amylopectin starch and gellan gum. For further preparation of bakery-stable peach fillings in the first phase, a heat-stable complex was prepared by the complete dissolution of gellan gum and amylopectin starch in hot distilled water under intensive mixing. In the second phase, sugar was blended with peach puree and heated up to complete concentration up to requested dry matter. After adding the heat-stable complex and citric acid solution into peach filling compositions and complete homogenization under intense blending, the total soluble solids were determined by using an ABBE benchtop refractometer in order to reach the required ºBrix according to the best selected bakery-stable filling formulations established in our previous studies.

All peach fillings were prepared on the basis of 90% peach puree for every formulation, having the same pH and soluble solids, but different quantity of citric acid added in each formulation. The effects of introducing heat-stable complex and different doses of citric acid solution into the peach filling compositions on the stability of the total polyphenols from the initial peach puree were studied using the Folin-Ciocalteu method as an accurate method for the determination of the total phenolic content.

Physicochemical analysis

The physicochemical analysis of peach puree and the fillings prepared from it was conducted 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 measured by using the ABBE benchtop refractometer and expressed in °Brix. Their pH was determined byy the potentiometric method, introducing the electrode directly into the analyzed fruit fillings.

To determine the amount of acids in the peach products, we used titration as the most common chemical process with the standard laboratory solution of 0.1M sodium hydroxide as counter-active 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 peach puree and fillings, as this parameter is a very important indicator of the commercial and organoleptic quality of the raw material and fruit-based products. The total polyphenols content in peaches and peach fillings 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. Samples were duplicated for each analysis and the mean value of absorbance was obtained. All experimental measurements were expressed as the average of conducted analyses ± standard deviation.

RESULTS AND DISCUSSIONS

Total polyphenols were measured in both unpeeled thawed peaches and the prepared heat-stable fillings. We used freezing/thawing before peach analysis and filling preparation because these processes result in the disruption of the cellular matrix and an easier extraction of the polyphenols and other beneficial compounds, especially the colour and aromatic ones. The polyphenol levels ranged between 375.4 and 370.48 mg/kg in the unpeeled peaches (Table 1).

Studies of the total polyphenol content in peaches processed into fruit filling composition at 90°C for 10 minutes indicated that the addition of the heat-stable complex containing gellan gum and amylopectin starch may decrease the total polyphenol loses up to 15-16%, compared with the control samples of peach fillings prepared without the heat-stable complex.

Table 1. Quality characteristics of peach puree obtained from unpeeled peaches variety “Collins” immediately after thawing and peach fillings prepared from this puree

Product type	SSC, ºBrix	TA, %	SSC/ TA, ºBrix/ % acid	pH	TPC, mg/kg
“Collins” peaches	12.25 ±0.35	0.67 ±0.01	18.28 ±0,25	3.8 ±0.01	372.94 ±3.48
Peach filling nr. 1	47.85 ±0.21	0.49 ±0.01	96.86 ±0.14	3.8 ±0.01	246.8 ±0,99
Peach filling nr. 2	47.75 ±0.35	0.59 ±0.01	80.93 ±0.25	3.8 ±0.01	209 ±2,83
Peach filling (control)	47.85 ±0.07	0.59 ±0.01	81.10 ±0.05	3.8 ±0.01	150.78 ±0.96

Data are expressed as mean ± standard deviation (n=2)
SSC – soluble solid content, TA – titratable acidity, SSC/TA – sugar/acid ratio, TPC – total polyphenol content.

Moldavian peaches are usually thermally processed at the canning cultivars using standard conditions that guarantee commercial sterility under normal conditions of transportation and storage. However, it was demonstrated that thermal processing may lead to the polymerisation of phenolic compounds (Howard et al., 1996). This item should be futher investigated, as it is not clear whether polymerised phenolics possess the same biological activity as lower-molecular-weight phenols and at what specific size their effectiveness as antioxidants declines.

The results presented in Table 1 display less total polyphenol loses in peach fillings prepared with heat-stable food complex after thermal treatment, compared with the initial content of these compounds in peach puree and control samples of peach fillings.

All prepared peach filling had the same value of pH – 3.8. However, the value of titratable acidity for each filling was different. It was clearly noticeable that the acid content influenced the polyphenol loses – in peach puree and peach fillings having more acidic profile with the same pH value and soluble solids, the total polyphenol content was somewhat higher, because organic acids protect plant phenols from oxidation.

CONCLUSIONS

After presenting the final results of the study, we may freely postulate that heat-stable food complex containing low acyl gellan gum and amylopectin starch influences the chemical stability of polyphenols from fruit-based raw material. The results show a slower decrease in the total polyphenol content in the peach fillings prepared with heat-stable food complex after thermal treatment, compared with the initial content of these compounds in the peach puree. It may also be assumed that the presented hydrocolloid complex affects the oxidation rate of the polyphenols if they are incorporated in or closely interacting with the hydrocolloids. However, the protective mechanisms of the complex are still unclear and further investigation is necessary in order to discover them.

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