# EVOLUTION OF THE POLYPHENOLIC CONTENT DURING THE TECHNOLOGICAL FLOW OF APRICOT COMPOTE FABRICATION

## EVOLUTIA CONTINUTULUI IN POLIFENOLI PE PARCURSUL FLUXULUI TEHNOLOGIC DE FABRICARE A COMPOTULUI DE CAISE

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***Abstract.*** *Apricots are seasonal fruits and compote fabrication is a method to prolong the period of their consumption. In the present research is studied the extent to which the main processes involved in the compote fabrication reduce the content of some antioxidants, namely polyphenols and flavonoids, and influence the main enzymes' activities. Only the thermal processes seriously decreased the total polyphenols and flavonoids content and flavonoids were more sensitives than non-flavonoidic polyphenols. In the apricot compote the total polyphenols decreased by 27.40% - 34.54% and the flavonoids by 46.49% - 49.02%, compared to the initial fruits.*

**Key words:** thermal processes, phenolic compounds, flavonoids, polyphenol oxidase, antioxidants, enzymes

***Rezumat.*** *Caisele sunt fructe sezoniere, iar fabricarea compotului este o metodă de prelungire a perioadei lor de consum. În lucrarea prezentă este studiată măsura în care principalele procese implicate în fabricarea compotului reduc conținutul unor antioxidanți, şi anume, polifenoli şi flavonoide şi influențează activitățile principalelor enzime. Numai procesele termice au scăzut serios conținutul în polifenoli totali şi flavonoide, iar flavonoidele s-au dovedit mai sensibile decât polifenolii non-flavonoidici. În compotul de caise, polifenolii totali au scăzut cu 27.40% - 34.54%, iar flavonoidele cu 46.49% - 49.02%, comparativ cu fructele inițiale.*

**Cuvinte cheie:** procese termice, compuşi fenolici, flavonoide, polifenol oxidaza, antioxidanți, enzime

## INTRODUCTION

Apricots are delicious fruits with high content in nutrients. According to Rahović *et al.* (2017) citing previous studies, the content in sugar is 8–13%, organic acids 0.5–1.0%, proteins 0.9%, pectin 0.59%, beta carotene 1.20 mg/100 g, ascorbic acid 7–10 mg/100 g, and also minerals, iodide and other nutrients are present. According to same authors, the content of dry matter is only 10–16%, which means 84-90% moisture. It is well known that the higher the water content of a product, the shorter its shelf-life. In these conditions, the industrialization of apricots is a solution to prolong the duration of

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their consumption. In fact, only about 20% of produced apricots are consumed fresh and the rest are processed as dried, frozen, compote, jam, juice, or puree (Siddiq *et al.*, 2012). There are many previous data reflecting the content in nutritious compounds of apricots and derived products (Alexe *et al.*, 2017, Rahović *et al.,* 2017, Siddiq *et al.*, 2012), but the content in functional compounds, as polyphenols was barely studied.

The phenolic compounds are very important for the quality of fruits and derived products, as they influence their appearance, taste, flavour and health-promoting properties (Tomás -Barberán and Espín, 2001). Their content in fruit products is affected by many factors that involve the phenolic stability and degradation, as technological processes of industrialisation and preservation. Also, the enzymes existing in the fruit are responsible for the phenolic compounds transformations. There are two enzymes strongly involved in their oxidative degradation: polyphenol oxidase and peroxidase. These enzymes lead to the generation of brown polymeric compounds (melanins) and decrease the antioxidant status (by oxidizing the antioxidants), which affect the product quality (Tomás-Barberán and Espín, 2001). According to same authors, a concern of the food industries is to prevent the enzymatic browning before, during and after the technological processes, since the formation of melanins not only decrease the phenolic content, but alter the organoleptic qualities of the products, generating a repulsive reaction from the consumers.

Phenolic compounds are one of the most important groups of antioxidants in fruits and vegetables. This group include a few thousands representatives which range from simple, low molecular-weight compounds to large, complex tannins. They can be classified in flavonoids (flavonols, flavones, flavan-3-ols, flavanones, anthocyanidins and others) and non-flavonoids (benzoic acids, hydroxycinnamic acids, stilbenes and others) (Cartea *et al*., 2011).

The present research analyses the evolution of polyphenols and flavonoids, during the technological flow of apricot compote fabrication. The activities of the polyphenol oxidase and the main antioxidant enzymes (peroxidase, superoxide dismutase, and catalase) were also studied.

## MATERIAL AND METHOD

The studied material was represented by 5 stages of the technological flow of apricot compote fabrication: apricot raw material (A), washed fruits (W), after stalk (peduncle) removal (PR), after blanching at 70 °C for 3 min (B) and finished product (after pasteurisation – by maintaining at 95 °C the inside temperature of filled and closed jar for 15 min) – apricot compote (AC). The samples were supplied by the company S.C. Contec Foods S.R.L. Tecuci in two consecutive years.

Total polyphenolic content (TPC) was analyzed by Folin-Ciocalteu method and results were expressed as mg gallic acid equivalents/100 g fresh weight (mg GAE/100 g FW) (Patras *et al*., 2017).

Total flavonoid content (TFC) was measured also by Folin-Ciocalteu method, after precipitation with formaldehyde and results were expressed as mg GAE/100 g FW (Cristea *et al.*, 2019).

Enzymes’ activities were determined as follow: catalase (CAT) by gasometric method, superoxide dismutase (SOD), peroxidase (PER) and polyphenol oxidase

(PPO) by spectrophotometric methods and were expressed as enzyme units/g/min (EU/g/min) (Ermakov *et al*., 1987).

## RESULTS AND DISCUSSIONS

The initial apricots contained 43.73 - 45.26 mg GAE/100 g FW total polyphenols, from which 24.01 – 25.42 mg GAE/100 g FW flavonoids. Similar results were obtained by Dragović-Uzelac *et al*.: 50.6 mg GAE/100 g FW total phenolics, from which 26.0 mg GAE/100 g FW flavonoids (Dragović-Uzelac *et al*., 2009).

Total polyphenolic content (TPC), as well as total flavonoid content (TFC) of all samples are slightly diminished in the 2$^{nd}$ year, comparing to the 1$^{st}$ year (figs. 1 and 2).

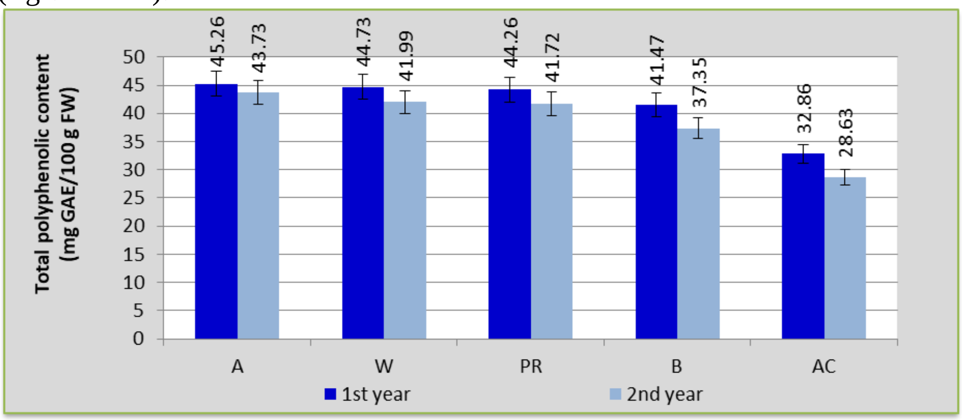


**Fig. 1** Total polyphenolic content (TPC) of apricots in five stages of the technological flow of compote fabrication: apricot raw material (A), washed fruits (W), after peduncle removal (PR), after blanching (B) and apricot compote finished product (AC), during two different years. Presented values are means of 3 determinations±standard deviation

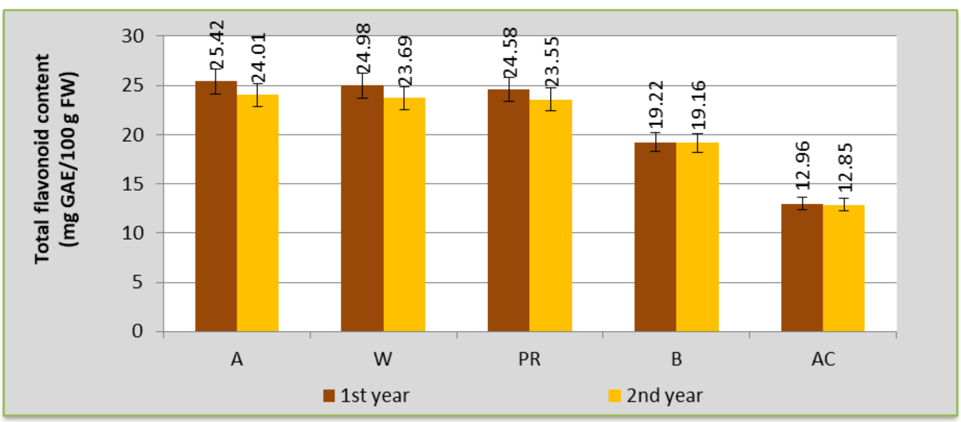


**Fig. 2** Total flavonoid content (TFC) of apricots in five stages of the technological flow of compote fabrication: apricot raw material (A), washed fruits (W), after peduncle removal (PR), after blanching (B) and apricot compote finished product (AC), during two different years. Presented values are means of 3 determinations±standard deviation

This can be explained by the quality and the initial content of the raw material (A). It is known that the biochemical composition of fruits depends of the geo-pedo-climatic conditions, variety, maturity stage and harvest period. But the present study was focused on the changes of the phenolic content of the raw material due to the technological processes of compote fabrication, no matter of the initial quality of the fruits and no matter of their variety, origin or year of production.

The TPC and TFC of fruits after washing (W) and peduncle removal (PR) show insignificant and gradually decrease, because these two procedures are not affecting the biochemical characteristics of fruits and is mostly caused by the time elapsed during these processes, as it is known that in time, the content of all phenolic compounds drops down.

After blanching (B), was noticed the significant diminution of TPC compared to raw material (8.38% in the 1st year and 14.59% in the 2nd year) and especially, of TFC (24.4% - 1st year and 20.2% - 2nd year). The decreases are normal, because the blanching was performed with hot water at 70 °C. The differences between years must be due to the quantities of individual polyphenols/flavonoids in every year. More than that, there were no information if the origin and variety of apricots raw material were the same or not from a year to another.

In the finished product (AC) the TPC was diminished by 27.40% (1st year) and 34.54% (2nd year), while TFC by 49.02% (1st year) and 46.49% (2nd year), respectively, compared to the initial apricots (A), which proved that flavonoids are less stable at thermal treatments than non-flavonoids.

The activities of polyphenol oxidase (PPO) and the main antioxidant enzymes were measured in 3 stages of the technological flow: raw material, after blanching and in the finished product, and results are presented in table 1.

*Table 1*

**The activities of polyphenol oxidase and main antioxidant enzymes in 3 stages of the technological flow of compote fabrication: apricot raw material (A), after blanching (B) and apricot compote finished product (AC), during two different years. Presented values are means of 3 determinations±standard deviation**

| Enzyme | 1st year | | | 2nd year | | |
|---|---|---|---|---|---|---|
| | A | B | AC | A | B | AC |
| Polyphenol oxidase [EU/g·min] | 12.6±0.9 | 4.65±0.35 | 0.0±0.0 | 14.3±1.3 | 4.87±0.36 | 0.0±0.0 |
| Superoxid dismutase [EU/g·min] | 4.34±0.27 | 1.58±0.08 | 0.0±0.0 | 4.12±0.2 | 1.52±0.07 | 0.0±0.0 |
| Catalase [$cm^3 O_2/g$] | 0.12±0.04 | 0.052± 0.01 | 0.0±0.0 | 0.15±0.04 | 0.058± 0.01 | 0.0±0.0 |
| Peroxidase [EU/g/min] | 14.32± 1.22 | 4.99±0.42 | 0.0±0.0 | 15.01± 1.28 | 5.15±0.37 | 0.0±0.0 |

PPO catalyses the aerobic oxidation of polyphenols and their derivatives, producing the corresponding quinones, and is involved in fruit browning. The higher activity of PPO in the 2nd year could explain the lower level of TPC and TFC. The blanching at 70 °C for 3 min, as expected, caused an important inhibition of all enzymes activities, and the pasteurisation (maintaining at 95 °C the inside temperature for 15 min), employing a higher temperature applied longer, determined the complete inactivation of enzymes. Otherwise, the enzymes' inactivation and the microorganisms' destruction are the goals of the thermic treatments applied during fabrication of compotes or canned fruits.

## CONCLUSIONS

1. The compote fabrication is a method of apricot conservation, which ensures a good level of final total polyphenols (28.6 and 32.9 mg GAE/100 g FW) and the total inhibition of main enzymes, including the polyphenol oxidase, the enzyme responsible for aerobic oxidation of polyphenols and fruits' browning.

2. The flavonoids are less stable than the non-flavonoidic polyphenols of apricots. The flavonoids content decreased during compote fabrication by 46.5% and 49.0% compared to fresh apricots, while the total polyphenols decreased by 27.40% and 34.54%.

3. The thermal processes employed during compote fabrication (blanching and pasteurisation) strongly influenced the contents of polyphenols and flavonoids, as well as enzymes' activities.

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