

STUDIES OF THE VARIABILITY OF POLYPHENOLS AND CAROTENOIDS IN DIFFERENT DURATION FERMENTED ORGANIC LEAVES OF FIREWEED (*CHAMERION ANGUSTIFOLIUM* (L.) HOLUB)

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Introduction

- The demand for organic production is increasing worldwide.
- The fireweed, grown in an organic way, contributes greatly to the idea of a healthier society and clean land.
- Fireweed is widespread in the world and has high polyphenols, carotenoids, and antioxidant properties.
- At present, foods and food supplements rich in antioxidants are very important, but more important is that these products are made from organic raw materials.
- More and more people tend to consume organic products, because they are associated with higher quality, compared to conventionally grown products.
- The fireweed (*Chamerion angustifolium* (L.) Holub) is a plant that can solve health problems, and is a very popular medicinal plant in Lithuania.
- **The purpose** of this experiment was to determine the influence of solid-phase fermentation (SPF) under different duration on the quantities of polyphenols (phenolic acids, tannin oenothien B, flavonoids) and carotenoids (lutein, zeaxanthin, beta-carotene) in organic fireweed leaves.
- According to the results of this experiment, SPF with different durations could be used to prepare high-quality organic products (food and food supplements) from organic fireweed leaves.

Methodology

The organic leaves of fireweed (*Chamerion angustifolium* (L.) Holub) that grew up in Jonava district, Safarkos village, Giedres Nacevicienes organic farm (No. SER-T-19-00910, Lithuania) were picked and investigated in 2019.

The organic leaves of fireweed were gathered at random from various places of the plot at the outset of mass blossom in July.

The composite leaf sample was 3.6 kg. For experiments in the laboratory, the samples were divided into two components:

1. Control: 0.900 kg not fermented (0 h).
2. Aerobic solid-phase fermentation: 2.7 kg for lasting 24, 48, and 72 h.

During the SPF, to cut fresh leaves, special plastic knives were used. The samples were divided into parts of 0.300 kg. For aerobic SPF: glass containers were covered with an air-passing lid. The SPF passed at a temperature of 30 °C in a dark chamber for durations: 24, 48, and 72 h. All variations of the experiment were carried out in three replications. Then, the raw leaves were lyophilized in freeze-drying plant sublimator (ZIRBUS GmbH, Harz, Germany), and leaves were milled and kept in closed containers at a temperature of 25 °C in the ventilated, dry, dark, and cool room.



Results

- In this experiment, SPF changed the amounts of polyphenols and carotenoids in organic fermented fireweed leaves under different duration fermentation. The content of total polyphenols, phenolic acids, and flavonoids was highest under the 24 h SPF, but the total quantity of carotenoids was higher 48 h SPF (Table 1).

Table 1. The influence of solid-phase fermentation (SPF) on the matter of bioactive compounds (mg 100 g⁻¹ dry weight (DW)) in organic fireweed leaves. Mean value ± standard error, *n* = 3.

Fermentation Duration/Bioactive Compounds	Total Polyphenols	Total Phenolic Acids	Total Flavonoids	Total Carotenoids
Control (notfermented)	2681.96 ± 62.01 b ¹	1654.75 ± 80.14 c	1027.21 ± 102.07 c	36.34 ± 1.05 e
Aerobic fermentation method				
Fermented 24 h	3209.20 ± 152.06 a	1895.23 ± 59.33 a	1313.97 ± 99.75 a	34.80 ± 1.47 e
Fermented 48 h	2772.47 ± 13.21 b	1615.34 ± 27.69 cd	1157.13 ± 13.43 b	39.64 ± 0.12 d
Fermented 72 h	2458.52 ± 95.04 c	1544.15 ± 40.46 d	914.37 ± 59.05 d	34.70 ± 0.44 e

¹ The differences between the means in columns marked by not the same small letter (a, b, c, d, e, f) are significant at *p* < 0.05. ² SPF—solid-phase fermentation.

Main conclusions

The results showed that solid-phase fermentation significantly improves the isolation of bioactive compounds from the leaves of fireweed. Moreover, the selected organic fireweed samples varied significantly in the composition of polyphenolic compounds and carotenoids.

According to experimental results, 24 h or 48 h duration aerobic solid-phase fermentation could be recommended for organic fireweed health-promoting products.