

**PROSPECT FOR PHYTOCHEMICAL AND PHARMACOLOGICAL RESEARCH
OF FIREWEED FERMENTED RAW MATERIALS**

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Introduction. *Chamaenerion angustifolium* (*Ch. angustifolium*) or *Epilobium angustifolium*, known in North America as fireweed, in some parts of Canada as great willow herb, and in Britain as

rosebay willow herb, is a perennial herbaceous flowering plant in the willow herb family (*Onagraceae*). It is native throughout the temperate Northern Hemisphere, including large parts of the boreal forests.

C. angustifolium is a traditional food and medicinal plant. Currently in Ukraine the herb of the fireweed is produced by PRAT “Liktravy” as a dietary supplement “IVAN-TEA”, which is recommended to be used in form of infusion as an additional source of biologically active substances that contribute for normalization of the functions of the gastrointestinal tract, cardiovascular, nervous and urogenital systems; increasing of immunity and resistance of the organism to negative environmental factors, including the seasonal infections.

Fireweed extracts were traditionally used in many European countries for the prevention and treatment of early-stage benign prostatic hyperplasia. The large number of the experimental data is presented in the literature on *in vitro* and *in vivo* studying of anti-inflammatory activity of fireweed extracts. The results obtained during these studies are not completely consistent, but suggest that hydrophilic extracts of the aerial part of this species exhibit anti-inflammatory activity and most scientists associate it with the suppression of prostaglandin synthesis. This type of activity is explained by the sufficiently high content of phenolic compounds in the raw material of *Ch. angustifolium*, more precisely by presence of oenothien B and myricetin-3-O-glucuronide. Oenothien B content is also associated with antioxidant, anti-proliferative activity on prostate physiological and cancerous cells, immunomodulatory and anticancer action of fireweed raw materials.

Also dried leaves, herb and flowers of this species after fermentation are traditionally used as tea in the territory of Ukraine and are widely exported in neighboring countries as food and dietary supplements in the form of single component teas and blends with other plant raw materials.

Aim. The aim of this study is to give a brief review on the chemical composition, reported pharmacological activities of fireweed fermented raw materials and potential for developing medicines from its raw materials.

Materials and methods. For this abstract information was collected in main scientific bases: NCBI-PubMed, Web of Knowledge, Science Direct Wiley Online Library and eLIBRARY.RU.

Results and discussion. Fermentation significantly changes the chemical composition of fireweed leaves and herb. HPLC analysis of processed and unprocessed raw materials showed opposite data regarding its phenolic compound composition.

Study of fireweed leaves reported increasing of the content of total flavonoids after fermentation. The flavonoid glycoside (quercetin-3-O-rutinoside, quercetin-3-O-glucoside) content did not change or decrease after 24 h fermentation. However, this value significantly grew after 48 h processing, except one sample in which quercetin-3-O-rutinoside reduction was observed after 24 hour and 48 hour fermentation. Quercetin content increased after 24 h fermentation, probably due to hydrolysis of its glycosides, but later its oxidation was most likely observed and its content reduced slightly. Luteolin content decreased after 24 h fermentation and then did not vary significantly after 48 h processing. However, such clear patterns were not observed in the content of other aglycones. The experiments on fermentation of fireweed aerial part showed that content of total flavonoids was not changed significantly after 6h fermentation. However, other results, obtained in fermented fireweed shoots study (30–40 cm long upper parts of cc.1–1.5 m long shoots), reported the opposite: 27–33 h fermentation decreased the total flavonoid content.

Non-fermented fireweed raw materials and extracts contain significant amounts of oenothien B, an unique macrocyclic ellagitannin dimer. After 24h and 48 h fermentations of fireweed leaves the level of oenothien B increased, especially after short term fermentation. This can be explained by intensification of the microbial metabolism of high-molecular ellagi- and gallotannins and the activity of enzymes breaks them down into compounds with a lower molecular weight. Absolutely opposite results were obtained in the study of 6h fermented fireweed aerial part and its aqueous extract: those samples were deprived of oenothien B and enriched in gallic acid, protocatechuic acid and ellagic acid. The 27–33 h fermentation decreased oenothien B content by 50–71% in fireweed shoots. This compound reduction was smallest by processing at 40 °C.

There is evidence regarding vitamins that the content of ascorbic acid and carotene in fireweed leaves increases after 24 hours and even 48 hours fermentation. Although these data could be slightly overestimated since non-specific titrimetric and photometric methods were used. Rising of ascorbic acid content was also confirmed by HPLC analysis in aqueous extract of fireweed aerial part.

Fermentation also changes pH of fireweed infusion. Non-fermented leaves infusion was *slightly acidic*, its pH was 5.97. Although this value decreased to 4.95 for 24h fermented raw material, it changed to 6.2 in 48h fermented leaves infusion.

Despite the relatively high popularity among population, the impact on the organism of these raw materials is not reliably known. Antioxidant activity of 24 h and 48h fermented leaves was studied. The samples were collected over 2 years. In 2017 non-fermented fireweed leaves were characterized by a lower antioxidant activity compared to short (24 h) and long (48 h) fermentation processes. In 2018, unprocessed samples were characterized by a higher antioxidant activity compared to fermented combinations. Only the short fermentation time gave positive results in antioxidant activity of fireweed leaves *in vitro*. The effect of extracts of fermented fireweed leaves on human immune cells was reported too. The study of anti-proliferative activity of extracts of fireweed aerial part after 6h fermentation was also carried out. Exposure of prostate cancerous cells (LNCaP, DU 145 and PZ-HPV-7) to extract of 6h fermented fireweed aerial part resulted in decrease of cell proliferation in the highest concentration by ~40% for the fermented ones without significant apoptosis.

Conclusions. Although fermented fireweed leaves products are widely represented in the food and dietary supplement markets, their processing technology has not been scientifically justified and pharmacological activity has not been sufficiently studied. Also during the fermentation the chemical composition of fireweed raw materials significantly changes, but their comprehensive phytochemical studies have not been carried out yet. Therefore, further phytochemical and pharmacological studies of fireweed fermented raw materials are perspective. The aim of this research could be to study of chemical composition of fireweed fermented leaves, herb and flowers, compare them with unprocessed raw materials, select the optimal technological conditions for obtaining drug substances or dietary supplements and screen its pharmacological activity.

MORPHOLOGICAL AND ANATOMICAL STUDY OF CALYX *DIOSPYROS KAKI THUNB* "CHARON" S SORT

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Introduction. In modern pharmacy, cultivated food, fodder and ornamental plants come to the fore in the search for new sources of biologically active substances. Of particular importance are those components of raw materials, which are wastes in the preparation of plants or their parts. Despite the growing volume of processing persimmon fruit, the cup, which is preserved in fruits and is a waste production, like seeds, has some prospects for use as economical sources of BAS.

Aim. To establish diagnostic signs of morphological and anatomical structure of the *diospyros kaki thunb* calyx of Oriental "Sharon" variety.

Materials and methods. Raw materials for research selected cups of *diospyros kaki thunb* of Eastern variety "Sharon". Morphological features were studied using a magnifier x2, x10, stereomicroscope "MBS-10" (Russia) (16h, 32h) by conventional methods, measurements were made on at least 10 samples of raw materials. The anatomic structure was examined with the microscope "Granum" (Austria) (40x, 100x, 400x).