Arctium lappa L. Root Polysaccharides: Therapeutic Potential and Prospects for Use

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Introduction. *Arctium* L. (*Asteraceae* Juss. family) is a genus of biennial herbs, comprising approximately 20 species. *Arctium lappa* L. (Burdock) is the biennial herb, the fleshy taproot of which can grow up to 1 m deep. Burdock is the ruderal plant growing along roads, in gardens, meadows, and fields.

Burdock is an ethnomedicinal plant widely used in Europe, North America and Asia. Nowadays, Burdock root is a traditional herbal medicinal product used as diuretic agent. Burdock roots are also used in temporary loss of appetite and in treatment of seborrhoeic skin conditions.

Since Burdock belongs to *Asteraceae* family known as a source of various polysaccharides, Burdock is considered as a prospective polysaccharide-containing plant, and nowadays, much attention is paid to the therapeutic potential of polysaccharides from Burdock roots.

Aim. In the present abstract, we summarized data on chemical characterization, *in vitro* and *in vivo* pharmacological studies of *A. lappa* root polysaccharides in order to show a therapeutic potential of *A. lappa* root polysaccharides as well as to justify phytochemical studies of extracts from *A. lappa* roots.

Materials and methods. For this abstract, we carried out a search in NCBI-PubMed database using "*Arctium lappa* roots polysaccharides" as a keyword. Today, we report results of chemical characterization and *in vitro* and *in vivo* pharmacological studies of *A. lappa* root polysaccharides.

Results and discussion. From Burdock roots, three polysaccharide fractions ALP40-1, ALP60-1, and ALP80-1 were obtained. The fractions studied were composed of mannose, glucose, fructose, and galactose. The results of the antioxidant studies showed strong scavenging activities of ALP60-1 on 1,1-diphenyl-2-picryhydrazyl, hydroxyl, and superoxide radicals. The results obtained indicate that ALP60-1 is a potential novel natural antioxidant [2].

Also, four water-soluble polysaccharide fractions (ALP-1, ALP-2, ALP-3 and ALP-4) were obtained from *A. lappa* roots. ALP-1 and ALP-2 were mainly composed of fructose; ALP-3 and ALP-4 mainly contained fructose, arabinose and galactose. All polysaccharides showed potent antioxidant effects. The most prominent effect was observed for ALP-4 in H2O2-induced HepG2 cell model, and for ALP-1 in metronidazole-induced in zebrafish model. This comparative study provided additional knowledge on the structure and antioxidant activity of Burdock root polysaccharides [4].

A water-soluble fructan from Burdock roots, composed of fructose and glucose in the ratio of 13.0:1.0, showed promising antioxidant activity *in vitro* and *in vivo* studies. The studied fructan possessed moderate ABTS(+) scavenging activity, strong hydroxyl radical scavenging activity and strong ferrous ion chelating activity *in vitro*. *In vivo* antioxidant assays demonstrated significantly increase in antioxidant enzyme activity and total antioxidant capacity after fructan administration, as well as decreased in malondialdehyde levels of in both the serum and liver of aging mice [5].

A pectin composed of rhamnose, glucuronic acid, galacturonic acid, glucose, galactose, xylose and arabinose was extracted from Burdock roots at doses of 200 mg/kg and 400 mg/kg, this pectin showed potent *in vivo* anti-constipation activity. In constipation mice, established were an improvement of small intestinal movement rate and an increase of the feces weight. Therefore, this substance can be considered as a promising active phytochemical with anti-constipation activity [3].

Promising anti-inflammatory properties were reported for an alkali-soluble polysaccharide from Burdock

roots. The polysaccharide was composed of rhamnose, arabinose, xylose, glucose and galactose in a molar ratio of 1.2: 4.4: 0.9: 0.9: 2.6. This plant-derived substance effectively alleviated inflammation by improving the dysregulation of pro-inflammatory and anti-inflammatory cytokines; namely, a significant inhibition of nitric oxide production and pro-inflammatory cytokines was observed in treated macrophages and in the serum of inflammatory mice, as well as an increase in anti-inflammatory cytokines IL-10 production.

Also, a relative abundance of *Firmicutes*, *Alistipes*, *Odoribacter* and *Lactobacillus* in mice significantly increased after administration of the polysaccharide studied. The researchers concluded that anti-inflammatory properties of this plant substance can be justified by influence on the composition of the gut microbiota [6].

In type 2 diabetic rats, the regulatory effect of Burdock root polysaccharide on lipid metabolism was studied. The results obtained demonstrated that the polysaccharide studied effectively reduced triglycerides and cholesterol synthesis. Histopathological observation demonstrated an effective regulation of lipid metabolism in the liver, as well as the inhibition of liver fibrosis. Immunohistochemistry analysis showed that the polysaccharide studied can effectively regulate the expression of sterol regulatory element-binding protein-1 and stearoyl-CoA desaturase 1, and thus reduce the risk of atherosclerosis [1].

Conclusions. Currently, data available in public domain on chemical characterization and pharmacological studies of *A. lappa* root polysaccharides demonstrate antioxidant, anti-inflammatory and anti-constipation properties of the plant-derived substances studied.

The results obtained provide the basis for the further research in biological properties and search for prospect applications of *A. lappa* root polysaccharides, as well as justify phytochemical studies of complex extracts from *A. lappa* roots.

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