Anti-fatigue activity of polysaccharides from the fruits of four Tibetan plateau indigenous medicinal plants

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Abstract

Ethnopharmacological relevance

The fruits of *Hippophae rhamnoides* L., *Lycium barbarum* L., *Lycium ruthenicum* Murr. and *Nitraria tangutorum* Bobr. are traditional medicinal food of Tibetans and used to alleviate fatigue caused by oxygen deficiency for thousands of years. The present study focused on exploiting natural polysaccharides with remarkable anti-fatigue activity from the four Qinghai-Tibet plateau characteristic berries.

Materials and methods

The fruits of *Hippophae rhamnoides*, *Lycium barbarum*, *Lycium ruthenicum* and *Nitraria tangutorum* were collected from Haixi national municipality of Mongol and Tibetan (N 36.32°, E98.11°; altitude: 3100 m), Qinghai, China. Their polysaccharides (HRWP, LBWP, LRWP and NTWP) were isolated by hot-water extraction, and purified by DEAE-Cellulose ion-exchange chromatography. The total carbohydrate, uronic acid, protein and starch contents of polysaccharides were determined by a spectrophotometric method. The molecular weight distributions of polysaccharides were determined by gel filtration chromatography. Their monosaccharide composition analysis was performed by the method of 1-phenyl-3-methyl-5-pyrazolone (PMP) pre-column derivatization and RP-HPLC analysis. HRWP, LBWP, LRWP and NTWP (50, 100 and 200 mg/kg) were orally administrated to mice once daily for 15 days, respectively. Anti-fatigue activity was assessed using the forced swim test (FST), and serum biochemical parameters were determined by an autoanalyzer and commercially available kits; the body and organs were also weighted.

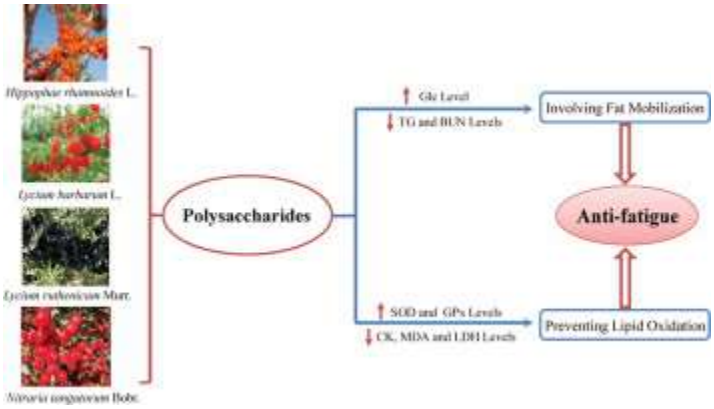
Result

LBWP, LRWP and NTWP were mainly composed of glucans and some RG-I pectins, and HRWP was mainly composed of HG-type pectin and some glucans. All the four polysaccharides decreased immobility in the FST, and the effects of LBWP and NTWP were demonstrated in lower doses compared with HRWP and LRWP. There was no significant difference in liver and heart indices between non-treated and polysaccharide-treated mice, but the spleen indices were increased in LBWP and NTWP (200 mg/kg) group. Moreover, the FST-induced reduction in glucose (Glc), superoxide dismutase (SOD) and glutathione peroxidase (GPx) and increase in creatine phosphokinase (CK), lactic dehydrogenase (LDH), blood urea nitrogen (BUN), triglyceride (TG) and malondialdehyde (MDA) levels, all indicators of fatigue, were inhibited by HRWP, LBWP, LRWP and NTWP to a certain extent while the effects of LBWP and NTWP were much better than that of HRWP and LRWP at the same dosage.

Conclusion

Water-soluble polysaccharides HRWP, LBWP, LRWP and NTWP, from the fruits of four Tibetan plateau indigenous berry plants, significantly exhibited anti-fatigue activities for the first time, through triglyceride (TG) (or fat) mobilization during exercise and protecting corpuscular membrane by prevention of lipid oxidation via modifying several enzyme activities. Moreover, it is demonstrated that LBWP and NTWP are more potent than HRWP and LRWP, which were proposed to be applied in functional foods for anti-fatigue and antioxidant potential.

Graphical abstract



Protective Effect of Lycium Barbarum Polysaccharides on Oxidative Damage in Skeletal Muscle of Exhaustive Exercise Rats

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- DOI: 10.1016/j.ijbiomac.2008.02.003

Abstract

The aim of this study was to determine the modulatory effect of Lycium barbarum polysaccharides (LBP) on the oxidative stress induced by an exhaustive exercise. 32 male Wistar rats were taken in the study. The experiment was a 30-day exhaustive exercise program. We determined the lipid peroxidation, glycogen levels, and anti-oxidant enzyme activities in skeletal muscle. The results demonstrated that L. barbarum polysaccharides administration significantly increases glycogen level and anti-oxidant enzyme activities, and decreased malondialdehyde (MDA) level and creatine kinase activities. In conclusion, L. barbarum polysaccharides administration can significantly decrease the oxidative stress induced by the exhaustive exercise.

[Isolation and Purification of Lycium Barbarum Polysaccharides and Its Antifatigue Effect]

[Article in Chinese]

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Abstract

A purified component of lycium barbarum polysaccharide (LBP-X) was isolated from lycium barbarum L. by DEAE ion-exchange cellulose and sephacryl gel chromatography. LBP-X was tested on five different doses (5, 10, 20, 50 and 100 mg.kg-1.d-1) in mice. The results showed that LBP-X induced a remarkable adaptability to exercise load, enhanced resistance and accelerated elimination of fatigue. LBP-X could enhance the storage of muscle and liver glycogen, increase the activity of LDH before and after swimming, decrease the increase of blood urea nitrogen (BUN) after strenuous exercise, and accelerate the clearance of BUN after exercise. The dosage of LBP-X 10 mg.kg-1.d-1 was the best amount among the five tested doses.

Berry Fruits: Compositional Elements, Biochemical Activities, and the Impact

of Their Intake on Human Health, Performance, and Disease

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Abstract

An overwhelming body of research has now firmly established that the dietary intake of berry fruits has a positive and profound impact on human health, performance, and disease. Berry fruits, which are commercially cultivated and commonly consumed in fresh and processed forms in North America, include blackberry (Rubus spp.), black raspberry (Rubus occidentalis), blueberry (Vaccinium corymbosum), cranberry (i.e., the American cranberry, Vaccinium macrocarpon, distinct from the European cranberry, V. oxycoccus), red raspberry (Rubus idaeus) and strawberry (Fragaria x ananassa). Other berry fruits, which are lesser known but consumed in the traditional diets of North American tribal communities, include chokecherry (Prunus virginiana), highbush cranberry (Viburnum trilobum), serviceberry (Amelanchier alnifolia), and silver buffaloberry (Shepherdia argentea). In addition, berry fruits such as arctic bramble (Rubus articus), bilberries (Vaccinuim myrtillus; also known as bog whortleberries), black currant (Ribes nigrum), boysenberries (Rubus spp.), cloudberries (Rubus chamaemorus), crowberries (Empetrum nigrum, E. hermaphroditum), elderberries (Sambucus spp.), gooseberry (Ribes uva-crispa), lingonberries (Vaccinium vitis-idaea), loganberry (Rubus loganobaccus), marionberries (Rubus spp.), Rowan berries (Sorbus spp.), and sea buckthorn (Hippophae rhamnoides), are also popularly consumed in other parts of the world. Recently, there has also been a surge in the consumption of exotic "berry-type" fruits such as the pomegranate (Punica granatum), goji berries (Lycium barbarum; also known as wolfberry), mangosteen (Garcinia mangostana), the Brazilian açaí berry (Euterpe oleraceae), and the Chilean maqui berry (Aristotelia chilensis). Given the wide consumption of berry fruits and their potential impact on human health and disease, conferences and symposia that target the latest scientific research (and, of equal importance, the dissemination of this information to the general public), on the chemistry and biological and physiological functions of these "superfoods" are necessary.