

## Complex Dietary Supplements from Raw Plants Provide Nutrition for Athletes

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### Abstract

**The aim** of this study was to investigate the effectiveness of mechanically activated complexes from plant substances to enhance athletes' adaptability to intense physical activity.

**Methods:** The object of the study was the dietary supplement Kladorod, which is based on the reindeer lichen *Cladonia rangiferina* and *Rhodiola rosea* in weight ratio of 10:1. To test the dietary supplement, 10 elite athletes (boxers and mixfighters) were divided into 2 groups. Athletes of the experimental group were given the dietary supplement Kladorod (capsule of 0.4 g by mouth between meals 4 times a day for 28 days). The control group was given placebo (Ringer-Locke powder) capsules in the same terms in a similar way. During the experiment, the athletes were medically examined 3 times: at the beginning, in the middle, and after the course of intervention. We measured muscle performance, fat mass, muscle mass, and serum concentrations of cortisol and total testosterone.

**Results:** Administration of Kladorod for 28 days stabilized the absolute and relative muscle mass, preventing its reduction, in comparison with the placebo group. At the same time, indicators of fat mass decreased significantly in the experimental group; we did not observe a significant decrease in testosterone/cortisol ratio, compared to the control group. Thus, the use of biologically active supplements based on lichen raw materials and complexes of lichen raw materials with different plant substances enables the body to increase its adaptive potential and physical capacity. (**Int J Biomed. 2017; 7(1):60-62.**)

**Key Words:** *Cladonia rangiferina* • *Rhodiola rosea* • dietary supplement • physical capacity

### Introduction

In athletes, chronic overloading and psychoemotional stress lead to a decrease in adaptive capacities, a breach of immunological resistance, a reduction of general and special athletic performance, and also significantly reduce the effectiveness of the training process and sport performance.<sup>[1]</sup> In recent years, in order to recover and maintain the required physical condition of athletes, products that originate in plants have attracted an increasing interest due to their good tolerability and mild corrective effect on the body. In this regard, for specialized nutrition of athletes, we propose a plant complex from renewable raw materials with increased adaptogenic effect. This unique complex was developed in the laboratory "Mechanochemical biotechnologies" of NEFU.

The aim of this study was to investigate the effectiveness of mechanically activated complexes from plant substances to enhance athletes' adaptability to intense physical activity.

### Methods

The object of the study was the dietary supplement Kladorod, which is based on the reindeer lichen *Cladonia rangiferina* and *Rhodiola rosea* in weight ratio of 10:1.

The make-up of the multicomponent dietary supplement Kladorod is based on the intermolecular complexes of lichen  $\beta$ -polysaccharides and bioactive substances (BAS) from roots and rhizomes of *Rhodiola rosea*: salidroside and flavonoid aromatic acids formed during mechanochemical activation of the above-mentioned mixture.

In the composition of reindeer lichen, we identified reindeer lichen, lichen acids (perlatolic, fumarprototetraric, usnic), free sugars, amino acids, and oligo- and polysaccharides. In addition, the lichen genus *Cladonia* can serve as a source of

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chemical elements, especially Ca, Mg, P, K, Na and microdoses of Li, I, and Se.<sup>[2]</sup> It is known that lichens and *Rhodiola rosea* stimulate the immune system and protect it by restoring the body's metabolic balance.<sup>[3,4]</sup> The collection of raw materials was carried out in an ecologically clean area.

Quantitative assessment of the flavonoid content was performed in a known manner by UV spectrophotometry in terms of quercetin.<sup>[5]</sup> UV spectra were recorded on the Libra S12 device (quartz cuvettes with 1 cm absorbing layer thickness). Lichen flavonoid content in the raw material in term to quercetin was  $1.58 \pm 0.38\%$ .

To test the dietary supplement, we developed a special scheme for the experiment and selected 10 elite athletes (boxers and mixfighters) aged from 22 to 34 years with sport experience from 5 to 16 years. The experiment was conducted in the condition of the planned educational and training process of preparations for rating fights. Athletes were divided into 2 groups and were under the same conditions (nutrition, medical monitoring, living conditions and training process). Written informed consent was obtained from all participants.

Athletes of the experimental group were given the dietary supplement Kladorod (capsule of 0.4 g by mouth between meals 4 times a day for 28 days). The control group was given placebo (Ringer-Locke powder) capsules in the same terms in a similar way. During the experiment, the athletes were medically examined 3 times: at the beginning, in the middle, and after the course of intervention. We measured muscle performance, fat mass, and muscle mass. Serum concentrations of cortisol (C) and total testosterone (T) were estimated by the method of solid-phase, competitive chemiluminescent enzyme immunoassay.

Statistical analysis was performed using the statistical software «Statistica». (v6.0, StatSoft, USA). The mean (M) and standard error of the mean (SEM) were calculated. The Wilcoxon criterion was used to compare the differences between the paired samples. A probability value of  $P < 0.05$  was considered statistically significant.

## Results

The results obtained during experimental testing on athletes served as the basis for conclusions about the efficacy of this dietary supplement. It is known that at the stage of specialized training under conditions of high-intensity training (submaximal and maximal power) in athletes specializing in martial arts, their body composition undergoes regular changes in labile components.<sup>[6]</sup> At this stage of training (up to the beginning of the competition), lean body mass decreases significantly, while fat mass increase. This effect of intensive loads reflects a decrease in adaptation of the body to stress and negatively affects the efficiency of the whole cycle of preparing for a competition.

Based on these data, it is assumed that indicators of labile components of body composition are sufficiently reliable criteria (albeit indirect) of combat athletes' adaptation to training loads. It was established that during the intensive training of boxers and mixfighters for rating fights, administration of the dietary supplement Kladorod for 28 days

stabilized the absolute and relative muscle mass, preventing its reduction, in comparison with the placebo group. At the same time, indicators of fat mass decreased significantly in the experimental group (Table 1).

**Table 1.**

**Morphological body composition parameters during training process in experimental and control groups**

Parameter	Experimental group		Control group	
	Day 1	Day 28	Day 1	Day 28
Body weight, kg	75.8±4.4	75.0±6.8	76.2±2.25	75.8±7.0
Muscle mass, kg	39.15±4.16	39.4±4.10	40.53±2.88	39.48±5.2*
%	53.7±0.1	54.0±0.3	53.2±0.1	52.3±0.4*
Fat mass, kg	9.15±0.12	9.09±0.24*	9.39±0.25	9.87±0.4*
%	12.9±0.1	12.7±0.2*	12.1±0.1	12.9±0.16*

\*-  $P < 0.05$  vs. initial data in each group

To monitor the athlete's response to exercise intensity, we investigated the T/C ratio. It is known that well-conditioned athletes have more controlled cortisol secretion during exercise; however, when an athlete is overtrained, the cortisol rises more and testosterone decreases, creating a low T/C ratio. The control and experimental groups did not differ in initial values of the T/C ratio. After administering the course of Kladorod, we did not observe a significant decrease in T/C ratio, compared to the control group (Table 2).

**Table 2.**

**Serum levels of testosterone and cortisol during training process in experimental and control groups**

Parameter	Experimental group		Control group	
	Day 1	Day 28	Day 1	Day 28
Testosterone, nM/l	28.9±3.7	29.9±4.0	25.2±5.2	16.3±2.1*
Cortisol, nM/l	141±16.2	179±11.0	137±17.4	281 ±10.8*
T/C ratio	0.21±0.04	0.18±0.06	0.18±0.04	0.11±0.01*

\*-  $P < 0.05$  vs. initial data in each group

Mechanochemical processing of the plant raw material destroys the cell walls, where the bulk of BAS is contained, and contributes to formation of ultrafine particles in the solid phase, thereby contributing to effective BAS release from the cells.<sup>[4]</sup>

We can conclude that during the period of training with high-intensity loads of submaximal power on the background of a course of the dietary supplement Kladorod in athletes there is stabilization of muscle mass with a parallel decrease in fat mass. This type of dynamics of morphological parameters of the body composition corresponds to a stable level of the adaptation of the organism. Thus, the use of biologically active supplements based on lichen raw materials and complexes of lichen raw materials with different plant substances enables the body to increase its adaptive potential and physical capacity. BAS contained in the plant lichen raw materials demonstrate a significant membrane-stabilizing effect and a positive effect

on the course of metabolic processes, and they stimulate the enzyme cascades of different biochemical reactions, which is important for enhancing the totality of an athlete's physical adaptations during high-intensity training.

## Competing interests

The authors declare that they have no competing interests.

## References

1. Tsyigan VN, Mokeeva EG. Sport. Immunity. Food. St. Peterburg: ELBI -SPb Publ.; 2012, 240 pp.
  2. Anshakova VV, Smagulova ASH. Chemical analysis of the lichen as a potential biological raw materials. *Sovremennye problemy nauki i obrazovaniya*. 2014;6. Available at: <https://www.science-education.ru/ru/article/view?id=15430>
  3. Saratikov AS, Krasnov EA. *Rhodiolarosea (Golden Root)*. Tomsk: TSU Publ.; 2004, 292 pp.
  4. Stepanova AV, Anshakova VV, Slepokurov YaA, Zagorenko AV, Uvarov DM, Vasilyev PP. Antioxidant bio-complexes from renewable arctic raw materials. *Int J Biomed*. 2016;6(2):136-137. doi: 10.21103/Article6(2)\_ShC2
  5. Sorokina ON, Barysheva SV. Spectrophotometric determination of total flavonoid content in herbal medicine. *Izvestiya Saratovskogo Instituta*. 2013;3(13):8-10.
  6. Abramova TF, Kochetkova NI. Labile components of body weight as criteria for physical form and control of current and long-term adaptation to training loads. *Methodical recommendations*. Moscow: LLC Skayprint; 2013, 132 pp.
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