CordyMax™ Cs-4 Improves Steady-State Energy Status in Mouse Liver

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Abstract

The traditional Chinese herb, *Cordyceps sinensis*, found on the Qinghai-Tibetan plateau, has been advocated for centuries to enhance human vitality. The natural substance has been refined as a mycelial fermentation product of a specific strain of *Cordyceps sinensis* (Cs-4; CordyMax™). Our objective was to study the effect of Cs-4 on tissue energetics using non-invasive ^{31}P NMR spectroscopy. Studies were performed using male C57-BL/6 mice, weighing 20-22 g, and receiving a standard diet. The animals were divided into three groups. Group A (n=5) received an aqueous extract of fermented Cs-4, 200 mg/kg/day, Group B (n=5) received a higher dose of Cs-4, 400 mg/kg/day, and Group C (n=6) received placebo. All treatments were given by gavage for 7 days and then discontinued. Hepatic b-ATP and inorganic phosphate were measured using a ^{31}P NMR spectroscope [Bruker]. The mice were fasted for 6 hours, anesthetized with pentobarbitol (55 mg/kg) by intra-peritoneal injection, and immobilized on shielding belt. An MDPA reference was placed on the back of the coil. Measurements were made at baseline, after 7 days of treatment, and 7 days after discontinuing treatment (washout phase). Tissue pH was calculated from chemical shift differences between b-ATP and Pi. At the end of the treatment phase, b-ATP was increased in relation to the MDPA reference in mice receiving Cs-4 (Group A: 3.81±0.03; Group B: 4.00±0.04; compared with Group C: 3.36±0.04; P<0.001). Inorganic phosphate was decreased in Groups A and B, but not in Group C. Consequently, the ratio b-ATP/Pi was also significantly increased in mice receiving Cs-4 (Group A: 4.81±0.05; Group B: 4.50±0.09; compared with Group C: 3.10±0.04; P<0.001). At the end of the washout phase, b-ATP had returned to baseline in Group A and Group B. Hepatic compared with placebo tissue pH was unchanged throughout the study. We conclude that Cs-4 increased hepatic energy state when administered to mice for 7 days. These findings might have broader implications in terms of the reported energizing effect of Cs-4 in human subjects.

Cordyceps sinensis (Berk.) Sacc. 冬虫夏草

(Collected from Qinghai-Tibetan plateau of China)

↓ Isolation

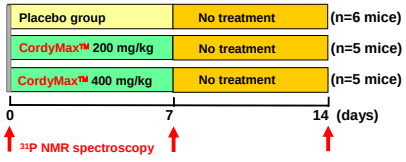
Cs-4 (A *Paecilomyces hepiali* Chen mycelial Cs-4 strain)

↓ Industrial Fermentation

(7 days in soybean-containing medium)

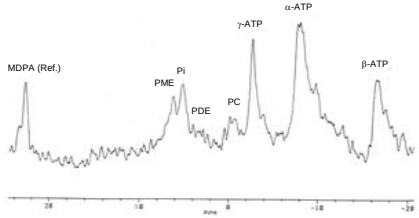
CordyMax™ Cs-4 金水宝 → **CordyMax™ Cs-4 Extract**

Experimental Design



- **At the time indicated, anaesthetized mice with Pentobarbital.**
- **^{31}P NMR Spectroscopy: α-, β-, γ-ATP, other triphosphorate compounds, and inorganic phosphate; calculate cellular pH.**

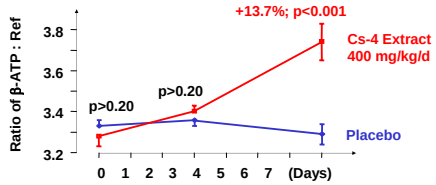
^{31}P NMR Spectroscopy



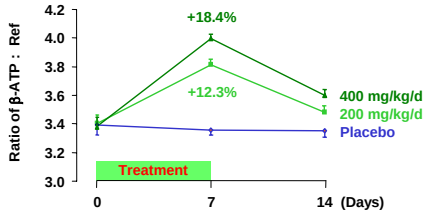
Note:

MDPA, methylene diphosphonic acid;
PME, phosphomonoesters;
Pi, inorganic phosphate;
PDE, phosphodiesters;
PC, phosphocreatine.

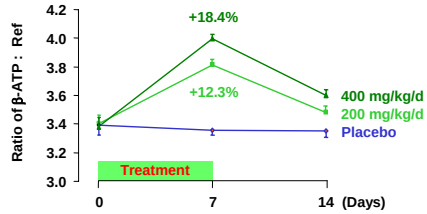
Changes in Hepatic β-ATP In Response to Oral CordyMax™ Cs-4



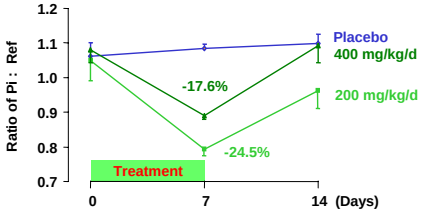
Changes in Hepatic β-ATP



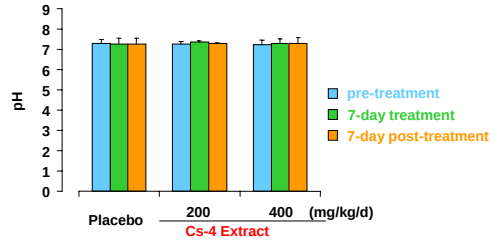
Changes in Hepatic β-ATP



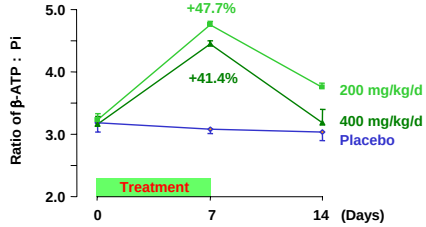
Changes in Hepatic Inorganic phosphate



Changes in Hepatic Tissue pH



Changes in Ratio of β-ATP : Pi



Summary

7-day CordyMax™ Cs-4 Treatment:

- **↑ Hepatic ATP**
- **↓ Hepatic inorganic phosphate**
- **↑ Hepatic ratio of ATP:Pi**
- **No Δ in hepatic tissue pH**

Conclusion

- **CordyMax™ Cs-4 improved steady-state hepatic bio-energy status**