

## Variations of sugar composition and genes expression under elevated CO<sub>2</sub> concentration in *Lycium barbarum*

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### Abstract

Goji berry (*Lycium barbarum*) is a unique medicinal and edible homologous plant because its fruits are rich in *L. barbarum* polysaccharides, taurine, betaine, carotenoids and other bioactive substances. Goji berry is mainly distributed and planted in the northwest of China as an economic forest species. Our former study shows that elevated CO<sub>2</sub> concentration significantly affected Goji berry substance metabolic and accumulation, especially under long periods (120 days) treatment of elevated CO<sub>2</sub> concentration, its sugar and secondary metabolite content was reduced. It is of high interest to understand the impact of elevated CO<sub>2</sub> concentration on Goji berry fruit growth and development, and explore the affecting mechanism in the carbohydrate content and gene expression aspects. In this study, the Goji berry plants were planted in two atmospheres with CO<sub>2</sub> concentration conditions controlled with Open-top-chamber CO<sub>2</sub> simulation system. The fruit samples from the young fruit (YF, 60 days), green fruit (GF, 70 days), coloring fruit (CF, 80 days), and red fruit (RF, 90days) stages of Goji berry expose to ambient (400±20 μmol·mol<sup>-1</sup>) and elevated (800±20 μmol·mol<sup>-1</sup>) CO<sub>2</sub> levels were analyzed for various sugar compound and gene expression. The results showed that elevated CO<sub>2</sub> promoted the accumulation of carotenoids, galactose, sucrose, flavonoids, and total sugar during fruit development. The gene expression levels of *LbGALA* (*L. barbarum* alpha-galactosidase) and *LbMS* (*L. barbarum* malate synthase) at the red fruit stage were significantly higher than those of the ambient CO<sub>2</sub> concentration treatment. Elevated CO<sub>2</sub> concentration significantly increased the expression levels of *LbGALA*, *LbGAE* (*L. barbarum* UDP-glucuronate 4-epimerase), and *LbNI* (*L. barbarum* neutral invertase) genes in fruits at the coloring fruit stage, and the expression level of *LbGAE* was 11.69-fold higher than that of ambient CO<sub>2</sub> concentration treatment. Correlation analysis indicated that the content of polysaccharides in Goji berry fruits was significantly correlated with the expression of *LbGAE* and *LbSS* (*L. barbarum* sucrose synthase) under elevated CO<sub>2</sub> concentration treatment. The significant expression of *LbGALA* and *LbAI* (*L. barbarum* acid invertase) promoted glucose accumulation. In addition, the contents of galactose, fructose, glucose, sucrose, and total sugar were significantly correlated with *LbGALA* content. All these revealed the regulatory relationship between carbohydrate accumulation and gene expression at different developmental stages of Goji berry fruits under elevated CO<sub>2</sub> concentration, which provides gene sources and is fundamental for the further study in sugar metabolism response to climate change of Goji berry.

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