

The Composition and Activity of Germinated Broccoli Seeds and Their Extract

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Abstract : Glucosinolate is a family of glucosides that can be found in a family of brassica vegetables. Upon the damage of the plant, glucosinolate breakdown by an internal enzyme myrosinase (thioglucosidase; EC 3.2.3.1) into isothiocyanates, such as sulforaphane. Sulforaphane is formed by glucoraphanin cleaving the sugar off by myrosinase and rearranged. Sulforaphane nitrile is formed in the same reaction as sulforaphane with the active of epithiospecifier protein (ESP). Most common food processing procedure would break the plant and mix the glucoraphanin and myrosinase together, and the formed sulforaphane would be further degraded. The purpose of this study is to understand the glucoraphanin/sulforaphane and the myrosinase activity of broccoli seeds germinated at a different time and technological processing conditions that keep the activity of the enzyme to form sulforaphane. Broccoli seeds were germinated in the house. Myrosinase activities were tested as the glucose content using glucose assay kit and measured UV-Vis spectrophotometer. Glucosinolates were measured by HPLC/DAD. Sulforaphane was measured using HPLC-DAD and GC/MS. The 6 hr germinated sprouts have a myrosinase activity 32.2 mg glucose/g, which is comparable with 12 and 24 hour germinated seeds and higher than dry seeds. The glucoraphanin content in 6 hour germinated sprouts is 13935 $\mu\text{g/g}$ which is comparable to 24 hour germinated seeds and lower than the dry seeds. GC/MS results show that the amount of sulforaphane is higher than the amount of sulforaphane nitrile in seeds, 6 hour and 24 hour germinated seeds. The ratio of sulforaphane and sulforaphane nitrile is high in 6 hour germinated seeds, which indicates the inactivated ESP in the reaction. After evaluating the results, the short time germinated seeds can be used as the source of glucoraphanin and myrosinase supply to form potential higher sulforaphane content. Broccoli contains glucosinolates, glucoraphanin (4-methylsulfinylbutyl glucosinolate), which is an important metabolite with health-promoting effects. In the pilot clinical study, we observed the effects of a glucosinolates/glucoraphanin-rich extract from short time germinated broccoli seeds on blood adenosine triphosphate (ATP), reactive oxygen species (ROS) and lactate levels. A single dose of 50 mg of broccoli sprouts extract increased blood levels of ATP up to 61% ($p=0.0092$) during the first 2 hours after the ingestion. Interestingly, this effect was not associated with an increase in blood ROS or lactate. When compared to the placebo group, levels of lactate were reduced by 10% ($p=0.006$). These results indicate that broccoli germinated seed extract may positively affect the generation of ATP in humans. Due to the preliminary nature of this work and promising results, larger clinical trials are justified.

Keywords : broccoli glucosinolates, glucoraphanin, germinated seeds, myrosinase, adenosine triphosphate

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