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High coverage profiling of phenolic compounds in rapeseed based on metabolomics and its application

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Background:

Rapeseed is one of the major oil crops in the world. Phenolic compounds are an important bioactive component in rapeseed, which can effectively eliminate the adverse effects of free radicals and are an important material basis for rapeseed and its processed products, such as rapeseed oil, to play a beneficial role.

Objective:

At present, research on phenolic compounds in rapeseed mostly focuses on the detection of several common phenolic compounds, while there are few reports on the comprehensive profiling of all phenolic compounds in rapeseed. Therefore, establishing a comprehensive qualitative and accurate quantitative analysis method for phenolic compounds in rapeseed is an urgent problem to be solved in the efficient utilization and nutritional research of rapeseed.

Methods:

This study proposes a new two-step extraction strategy (TSES) and optimizes the extraction conditions using a single factor experiment. It was found that the total phenol content extracted by the optimized two-step extraction method (4458.93 ± 223.83 mg/100 g) was significantly higher than that extracted by organic solvent methanol (376.85 ± 24.55 mg/100 g) and low eutectic solvent (1596.51 ± 38.90 mg/100 g). Furthermore, the two-step extraction method combined with non-targeted profiling of phenolic compounds by LC-MS was used for high coverage analysis of rapeseed polyphenols with a total of 117 phenolic compounds in rapeseed being identified.

Results:

The relationship between colour differences and phenolic compounds in rapeseeds was investigated. Syringin, kaempferol, isorhamnetin, and sinapic acid were found to be the differential phenolics for the six different coloured rapeseeds and their spatial distribution in rapeseeds were presented. The total phenolic content of different genotypes of rapeseed was further measured; it was found that the total phenolic content of Brassica napus rapeseed was significantly higher than that of Brassica campestris and Brassica juncea. It was also found that the ability of rapeseed extract to scavenge DPPH free radicals and ABTS cationic free radicals is directly proportional to the total phenolic content. The effects of different processing and pre-treatment methods on the content of phenolic compounds in rapeseed were studied. It was found that microwave pre-treatment had a lower degree of loss on the phenolic compounds compared to other pre-treatment methods, followed by radio frequency pre-treatment, while roasting and explosion pre-treatment had a greater loss on the phenolic compounds. It was also found that the rapeseed after explosion pre-treatment had the strongest ability to scavenge DPPH free radicals, significantly stronger than the untreated group and the rapeseed after other pre-treatments.

Conclusions:

This research can provide reliable theoretical support and technical guidance for the selection of high-quality rapeseed varieties, the evaluation of rapeseed nutritional quality, the exploration of characteristic nutritional components in rapeseed, the development of functional oilseed oils, and the improvement of nutritional quality of oilseed products. The evaluation and exploration of phenolic compounds in rapeseed are of great significance for improving the quality of oilseed products, meeting people's nutritional needs, and promoting the development of the oilseed industry.