# Analysis of carotenoid in seed of several oil crops

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**Abstract**

Carotenoids are one of the most important members of plant pigments and have diverse functions such as antioxidant, preventing cardiovascular disease and cancer, anti-aging. Enhanced carotenoid content in seeds of oil crops improves not only the oil nutrition and health-care value, but also the oil stability. A fast, accurate, simple and convenient method was set up to extract and measure total carotenoid content in rape seeds. In addition, the carotenoid contents in seeds of six major oil crops including rapeseed, peanut, soybean, sesame, perilla and safflowers were analyzed, and compared with that of carrot, pumpkin, corn and orange. The results showed that in these six oil crops, only rapeseed and soybean demonstrated characteristic absorption peaks. In addiction, extensive variation in carotenoid content was detected among rapeseed and soybean varieties. The content of carotenoid in seeds of rapeseed is close to that of carrot. These results lay a good foundation for further screening of high carotenoid content rapeseed germplasm and the improvement of rapeseed and soybean varieties with high carotenoid content.

**Key words:** Carotenoids, Rapeseed,Mensuration, carotenoid content, oil crop, garden stuff

## Introduction

Vegetable oil is an important component of human food. It supplies energy, nutrient, fatty acid source for human. Rapeseed, soybean, peanut, cotton seed, sunflower seed and flax are the main source of vegetable oil in China. The beneficial elements of edible oil have great function in preventing disease and enhancing health. For enhancing the content of beneficial health, it is stringent and practicable to intensify the nutrition, healthy care, and security of edible oil.

Carotenoids are fat-soluble and carotene-β is a precursor of vitamin A. They are able to quench single oxygen, remove harmful effects of the internal free ion-oxygen efficiently, protect the immune response system, and cure some serious diseases, such as cancer (Bartley et al., 1994). Carotenoids are not only in vegetable organ such as stem, leaf and root, but also in plant seeds. So it is possible to obtain carotenoids from edible oil. The content of carotenoid in edible oil can be improved by producing oil crops seeds with high content of carotenoids.

In this study, a fast, accurate, simple and convenient method was set up to measure the total carotenoids content in rape seeds by selecting the optimum conditions, such as solvents, time, the ration of rapeseeds on extraction process. Using the method, carotenoids content of six major oil crops including rapeseed, peanut, soybean, sesame, perilla and safflower analyzed and compared with that of carrot, pumpkin, corn and orange, providing important data base for crop breeding and correlation study of high carotenoids.

## Material and methods

Material: Seeds of rapeseed, soybean, peanut, sesame, safflower, perilla came from Oil Crop Research Institute, carrot, pumpkin, corn and orange were bought from supermarket.

Methods: Seeds was pulverized in glass mortar, 0.3g was weighed accurately and filled in a triangular bottle with 9ml solution (petroleum ether:acetone, 1:1), soaked 6h in dark with shaking (100rpm). Then scan the solution within the range of 300-800nm and the absorption spectrum was obtained. Principle and method of mensuration about carotenoid content refer to GB/12291-1990 "the whole quantity mensuration of carotenoid in fruit and vegetable juice". Carotenoid content was calculated according to the following formula.

$$X(mg/100g) = \frac{A \cdot y(ml) \cdot 10^6}{A_{1cm}^{\%} \cdot 1000 \cdot g}$$

X—Carotenoid content. A—the highest absorbency value of 445nm Y—quantity of extracting solution
$A^{\%}_{1\,cm}$—average absorption coefficient 2500 of carotenoid molecule g—weight of sample

## Result and Discussion

*Measuring method of carotenoid in rapeseed*

Scanning within 300-800 nm using spectrophotometer, a typical carotenoid spectrum absorbtion mode was obtained in rapeseed with the highest peak at 445 nm, two acromions at 421 nm and 473 nm (Fig. 1). The carotenoids in rapeseed can be dissolved in acetone, petroleum ether and chloroform. The best extraction condition is acetone and petroleum ether mixed by 1: 1 for 360 min, and the ratio of the seed and solution is 1：30 (Gao, 2005)

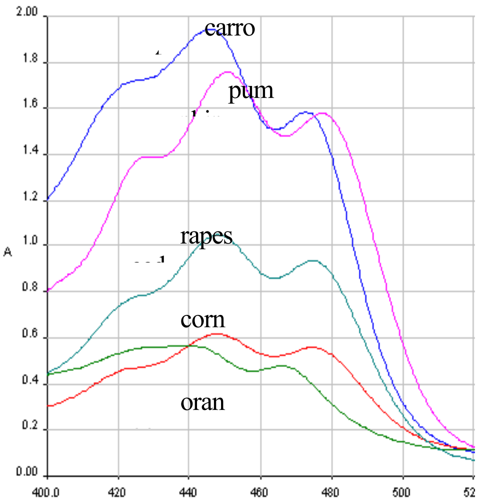


Fig. 1 UV-VIS spectra of carotenoid standard in fruit and vegetable

Carotenoid was previously reported in fruit and vegetable (Chug-Ahuja et al.,1993, Khachik,1992). There are typical absorption maximum of carotenoid in oilseed rape and four fruit and vegetable with the concentration of carrot and pumpkin solution diluted 5 times, the highest peak appears in 440-445nm (Fig 1), Which showed the typical absorption peak can be scanned by spectrophotometer in solution of carotenoid. Not only the content of carotenoid in fruit and vegetable but also of the oil crops can be analyzed by the method. The peak value, however, is different for different content and kind of carotenoids.

Rapeseed and soybean had absorption peaks of carotenoid with the highest peak at 443nm, two acromions at 419nm and 472nm. But the typical peak is absent in peanut, sesame, safflower, perilla, which nay contain less carotenoid (Fig. 2)

*Content of carotenoid in six oil crops*

The highest peak of carotenoid is in the range of 440±10nm by scan, so 443nm was used to calculate the content in the experiment with formula. The result showed the content has diversity for the different varieties in rapeseed and soybean. The average content of carotenoid was 1.426 mg/100g in *Brassica napus*, 3.342 mg/100g in *Brassica juncea*, 2.472 mg/100g in *Brassica campestris*, and 0.603 mg/100g in soybean that is lower than in rapeseed (Table 1). In addition, we found that the carotenoid content in *B.juncea* is higher than in *B.napus* and *B.campetris* by analyzing large number of varieties.

**Table1 Carotenoid content in seed of different oil crops**

| Type | Name | Content of carotenoid (mg/100g) | Type | Name | Content of carotenoid (mg/100g) |
|---|---|---|---|---|---|
| *B.napus* | Ningyou 5 | 1.88 | Soybean | xiangchun10 | 0.38 |
| | Qianyou 1 | 0.83 | | zhongdou32 | 0.41 |
| | Niujiaoyoucai | 0.75 | | zhongdou29 | 0.80 |
| | Huyou 2 | 1.36 | | 01－45 | 0.67 |
| *B. campetris* | qianyang259 | 2.31 | | Suzao 3 | 0.54 |
| | Beishanyoucai | 1.98 | | Zhe 3641 | 0.82 |
| | huanggangbaiyoucai | 2.17 | Peanut | Zhonghua 12 | ND+ |
| | Xiezuo 1 | 2.49 | | Fenghua 4 | ND+ |
| | anqingziyoucai | 2.66 | | 99－1－2 | ND+ |
| | nanchangtianyoucai | 3.06 | | Minhua 6 | ND+ |
| *B. juncea* | wensuheiyoucai | 2.79 | | Jihua 4 | ND+ |
| | Shaosuhuangyoucai | 3.16 | | 984－12－4 | ND+ |
| | Tianjiazaiyoucai | 3.72 | Sesame | Zhongzhi 11 | ND+ |
| | Niuweihuang | 1.85 | | Zhongzhi 13 | ND+ |
| | Yuxigaoke | 5.19 | | Ezhi 1 | ND+ |
| Safflower | Honghua 3 | ND+ | | Zhongzhi 10 | ND+ |
| perilla | 0518 H37 baisu | ND+ | | Zhongzhi 14 | ND+ |
| | 0512 H31 baisu | ND+ | | Zhongzhi 12 | ND+ |
| | 0509 H28 zisu | ND+ | | Ezhi 2 | ND+ |
| | 0520 H39 zisu | ND+ | | Zhongzhi 9 | ND+ |

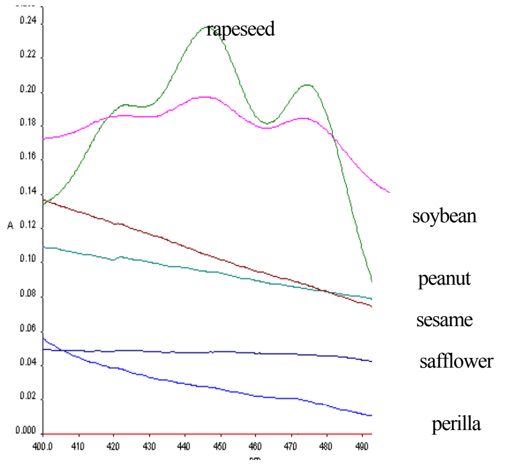


Fig. 2 UV-VIS spectra of carotenoid standard in six oil crops

*Content of carotenoid in oilseed and four fresh fruit and vegetable*

The carotenoid content in carrot is higher than the other three fruit and vegetable, and is close to that of some rapeseed varieties (Table 2). This showed that there exists abundant carotenoid in oil seeds. The content of carotenoid varies largely in rapeseed, which is propitious to select high content material for breeding.

**Table 2 Carotenoid content of fresh fruit and vegetable and of rapeseed**

| Type | Content of carotenoid (mg/100g) |
|---|---|
| Carrot | 6.13 |
| Punpkin | 3.24 |
| Orange | 4.19 |
| Corn | 0.91 |
| rapeseed | 0.75－5.19 |

## Conclusion

The content of carotenoid can be analyzed by spectrophotometer through distillation with organic solvent in oil crops and fruit and vegetable. In six oil crops, only the rapeseed and soybean showed the absorption peak of carotenoid, and the content of carotenoid in some rapeseed varieties is close to that of carrot. So we can enhance content of carotenoid in edible oil through processing the seed of oil crops with high carotenoid content. Up to date, the biosynthesis approach of carotenoid has been illustrated with the development of biochemistry and molecular biology (Zhao et al., 2004). In addition, the key gene affecting and controlling the approach has been separated and identified (Fraser et al., 1994). So it is of high significance for enhancing carotenoid content of oil crops by regulation and controlling the process. Edible oil with high carotenoid content can improve the life quality and will bring significant profit for oil processing industry.

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