

Extraction residue of dried persimmon fruits shows antioxidant potential in vivo

Fruits and vegetables are useful for human health. They have bioactive constituents called “phytochemicals”, which show antioxidant activities. Most of the phytochemicals are small molecules and soluble compounds. Therefore, *in vitro* evaluation of the antioxidant activity of plant materials is performed using their solvent extracts and rarely the extraction residue; on the other hand, *in vivo* evaluation is generally performed using whole fruits and vegetables.

Persimmon fruit (*Diospyros kaki* Thunb.) contains antioxidative compounds such as condensed tannins and carotenoids. In this study, we investigated the antioxidant activities of the extraction residue of dried persimmon fruits both *in vitro* and *in vivo*. Dried persimmon fruits harvested and processed in Yoshino-gun, Nara, Japan, were extracted using 90% aqueous ethanol, and the extraction residue was dehydrated to obtain dried powder.

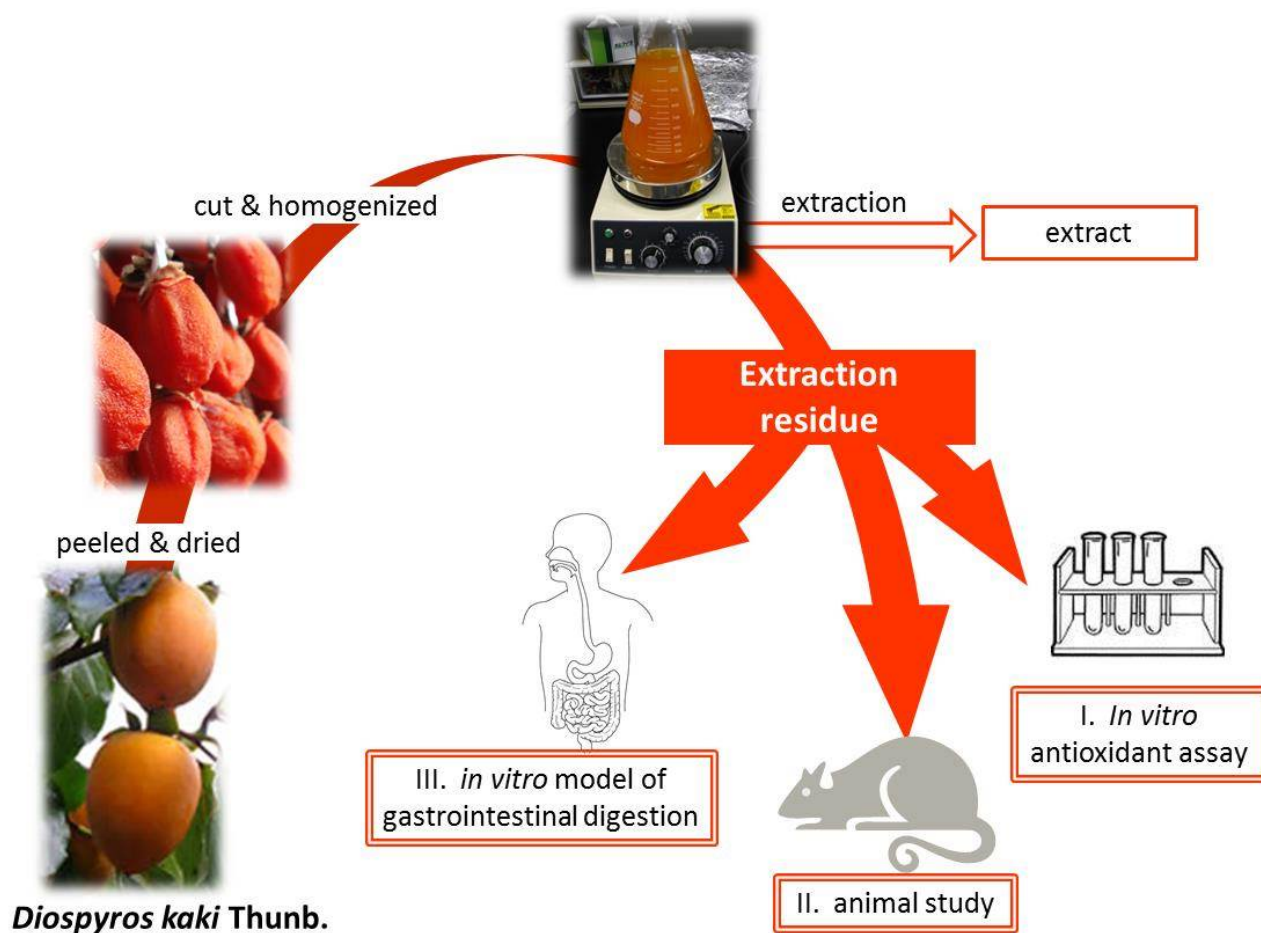


Fig. 1. Sample preparation and flow of experiments

First, the *in vitro* antioxidant activity of dried persimmon extract and the extraction residue were evaluated on the basis of their oxygen radical absorbance capacity (ORAC) and 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical-scavenging activity, these are two of the methods for the measurement of antioxidant potential. The extraction residue was insoluble, so it was hydrolysed using hydrochloric acid and by heating. We found that the extraction residue contributed to 81.7% of the total ORAC of the edible portion of dried persimmons. Similarly, its contribution to the DPPH radical-scavenging activity was as high as 96.1%. These results show high antioxidant activity in the extraction residue of dried persimmon *in vitro*.

Second, *in vivo* antioxidant activity of extraction residue was evaluated through animal experiments. Eight-week-old male rats were randomly divided into three groups: the control diet group was fed a basal diet, the positive control group was fed tea catechin-supplemented diet (TC diet group), and the study group was fed a basal diet supplemented with the extraction residue of dried persimmon (NEP diet group). In these experiments, plasma was collected from rats after feeding the respective diets and the ORAC values were measured. After 1 week, the values in the NEP diet group were 1.5 times greater than those in the control diet group. Accordingly, the plasma ORAC values in the NEP diet group increased earlier than those in the TC diet group.

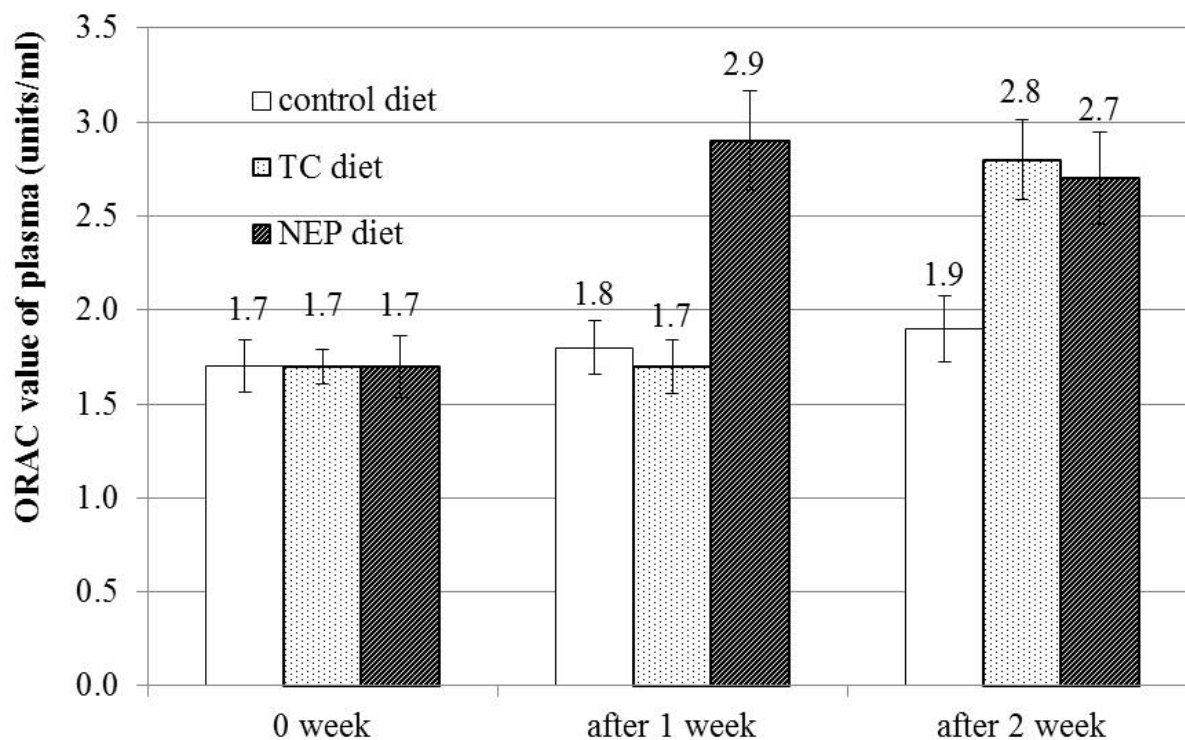


Fig. 2. Plasma ORAC values of animal study

Third, the extraction residue was subjected to four *in vitro* digestion processes and the ORAC values were estimated for each. The ORAC values were found to be low after the oral stage; they gradually increased following the stomach and small intestinal digestion stages and significantly increased following subsequent digestion at the large bowel stage. The extraction residue appeared to contain insoluble condensed tannins with a high antioxidant potential. These condensed tannins may be phenolic oligomers such as proanthocyanidin that act as *in vivo* antioxidants following decomposition in the digestive tract. Thus, insoluble condensed tannins in the present extraction residue may be fermented in a similar manner.

In many earlier studies, antioxidant activities of fruits and vegetables were investigated based on the analyses of their solvent extracts, and not the extraction residue. In this study, we demonstrated that the extraction residue of dried persimmon had high antioxidant potential *in vitro* and exhibited antioxidant activity in rats, suggesting digestion and/or fermentation by enteric bacteria, followed by the absorption of smaller antioxidant molecules *in vivo*. These data indicate that the extraction residue of various food samples is seldom investigated but contains important antioxidant potential.

***Shin-ichi Kayano*¹, *Yoko Matsumura*^{1,2}, *Toshihiro Ito*²**

¹*Department of Health and Nutrition, Faculty of Health Science,
Kio University, 4-2-2 Umaminaka, Koryo-cho, Kitakatsuragi-gun, Nara, Japan*

²*Department of Immunology, Nara Medical University, 840 Shijo-cho, Kashihara-city, Nara, Japan*

Publication

[Antioxidant potential in non-extractable fractions of dried persimmon \(*Diospyros kaki* Thunb.\).](#)

Matsumura Y, Ito T, Yano H, Kita E, Mikasa K, Okada M, Furutani A, Muroto Y, Shibata M, Nishii Y, Kayano S

Food Chem. 2016 Jul 1