academicJournals

Vol. 12(28), pp. 4477-4480, 10 July, 2013
DOI: 10.5897/AJB2013.12911
ISSN 1684-5315 ©2013 Academic Journals
http://www.academicjournals.org/AJB

African Journal of Biotechnology

Full Length Research Paper

Evaluation of luteolin from shells of Korean peanut cultivars for industrial utilization

Ramalingam Radhakrishnan, Suk-Bok Pae*, Byoung-Kyu Lee and In-Youl Baek

Legume and Oil Crop Research Division, Department of Functional Crop, National Institute of Crop Science, RDA, Miryang, 672-803, Republic of Korea.

Accepted 5 July, 2013

Luteolin is a medicinally valuable phyto-chemical, which was indentified in plants. This study was aimed to analyse the luteolin content in peanut waste (shell) of 42 peanut cultivars. The concentration of luteolin varied in the range of 546.8 to 4485.0 mg/kg and a significantly higher concentration of luteolin (4485.0 mg) was found in Mikwang. This is the first report on luteolin analysis in Korean peanut shells. The results of the present study suggest that Mikwang peanut shells have higher concentration of luteolin, which would be useful for agricultural, industrial and pharmaceutical purposes.

Key words: Luteolin, peanut, shell, Mikwang.

INTRODUCTION

Peanut is an important food crop grown in over 100 countries with a total production of 38 million tons in 2010 (Janila et al., 2013). Peanut seeds are rich source of oil (48 to 50%), protein (25 to 28%), vitamins and minerals and it provides 564 kcal of energy from 100 g of seeds (Win et al., 2011; Janila et al., 2013). India, China, Myanmar and Vietnam people use peanut oil extensively for cooking purpose, because it contains rich fatty acids such as oleic, linoleic, palmitic, stearic, acrachidic, gondoic and behenic acids. Peanut butter is most popular in North and South America, Canada and Australia. However, peanut pod contains 35% of shell, which is called agricultural waste. During the agriculture practice, a large quantity of wastes accumulates with the process of food materials and, this waste or by product can be recovered and often be upgraded to useful products (Gunjal et al., 2012). In addition, peanut shell contains lignin, cellulose, hemicelluloses and luteolin content. Powdered shell is used as fuel, filler in fertilizer and feed industry. Luteolin is one of the flavones present in Bryophyta, Pteridophyta, Pinophyta and Magnoliophyta. It is shown that their pharmacological activities include anti-oxidant, anti-inflammatory, antimicrobial and anticancer activities (Lopez-Lazaro, 2009). The luteolin sensitizes cancer cells to cytotoxicity through sup-pressing cell survival pathways such as phosphatidylinositol 3'-kinase, nuclear factor kappa B and X-linked inhibitor of apoptosis protein, and stimulating apoptosis pathways (Lin et al., 2008). The bioactivity of luteolin on plant is demonstrated by enhancing the seed germination of maize (El-Shafey and Abd-Elgawad, 2012). The composition of luteolin content in shell varies depending on the cultivar of peanuts. However, to the best of our knowledge, the reports on luteolin content in agro-waste products are scanty. Therefore, the present study was aimed to investigate the luteolin content in peanut shells harvested from 42 Korean peanut cultivars.

MATERIALS AND METHODS

The peanut (*Arachis hypogaea.* L) seeds of Saedl, Daekwang,

*Corresponding author. E-mail: paesb@rda.go.kr or ramradhakrish@gmail.com. Tel: 055-350-1222. Fax: 055-352-3059.

Table 1. Distribution of luteolin content in Korean peanut shells.

S/No	Peanut Cultivars	Luteolin (mg/kg)
1	Saedl	2055.7 ± 359.2^{f}
2	Daekwang	1332.1 ± 358.4^{gh}
3	Namkwang	1162.5 ± 221.4^{h}
4	Daewon	1264.6 ± 187.2^{9gh}
5	Sinnamkwang	0664.7 ± 124.2^{i}
6	Wang	0546.8 ± 104.6^{ij}
7	Daepung	0876.0 ± 146.8^{h}
8	Sindaekwang	0677.8 ± 152.5^{i}
9	Sinkwang	2935.3 ± 553.0^{de}
10	Jokwang	2362.6 ± 438.6^{ef}
11	Gipung	1255.3 ± 302.1^{gh}
12	Daecheong	0587.1 ± 115.1^{ij}
13	Palkwang	2576.3 ± 489.1^{e}
14	Mikwang	4485.0 ± 864.4^{a}
15	Joan	1996.1 ± 179.1^{f}
16	Sekwang	1348.8 ± 230.5^{gh}
17	Hokwang	1367.0 ± 235.3^{gh}
18	Daeyang	2203.0 ± 270.5^{ef}
19	Daeshin	1590.3 ± 191.5^{g}
20	Bowan	1345.2 ± 261.2^{gh}
21	Dakwang	1614.2 ± 277.9^{g}
22	Pungkwang	2783.9 ± 509.8^{de}
23	Akwang	1653.1 ± 349.1^{fg}
24	Daemyeong	1943.2 ± 431.0^{fg}
25	Gokwang	2095.2 ± 396.8^{ef}
26	Jakwang	2289.1 ± 503.7^{ef}
27	Baekjung	3696.9 ± 900.1^{bc}
28	Danuri	2408.9 ± 538.0^{ef}
29	Baekseon	3421.5 ± 615.1^{cd}
30	Sangpyeong	4008.8 ± 710.5^{b}
31	Baekan	3219.0 ± 657.4^{cd}
32	Jopyeong	3726.2 ± 778.5^{bc}
33	Charmwon	1809.6 ± 464.8^{fg}
34	Charmpyeong	3576.2 ± 791.4^{c}
35	Pungsan	2830.8 ± 632.7^{de}
36	Seonan	3043.1 ± 790.9^{d}
37	Pungan	4012.1 ± 819.1^{b}
38	Ilpyeong	2064.6 ± 420.4^{f}
39	Yeonpung	2723.7 ± 477.3^{de}
40	Boreom 1	2816.7 ± 525.6^{de}
41	Sangan	2258.5 ± 264.5^{ef}
42	Jaseon	2172.7 ± 555.8^{ef}

Values are means plus standard error (n = 3). Means followed by the different superscript letter (a, b, c, d, e, f, g, h, I and j) are significantly different (P<0.05) as determined by DMRT.

Namkwang, Daewon, Sinnamkwang, Wang, Daepung, Sindaekwang, Sinkwang, Jokwang, Gipung, Daecheong, Palkwang, Mikwang, Joan, Sekwang, Hokwang, Daeyang, Daeshin, Bowan, Dakwang, Pungkwang, Akwang, Daemyeong, Gokwang, Jakwang, Baekjung, Danuri, Baekseon, Sangpyeong, Baekan, Jopyeong, Charmwon, Charpyeong, Pungsan, Seonan, Pungan, Ilpyeong, Yeonpung, Boreom 1, Sangan and Jaseon cultivars were sown in experimental field at National Institute of Crop Science, Miryang, Republic of Korea in May 2011. The pods were harvested and peanut shells were separated by hand. The collected shells were air-dried and stored at dry condition until use.

For the luteolin analysis, the dried peanut shells were homogenized with a grinder, and crude extract of luteolin (1.0 g) was extracted from powdered samples added with 80% methanol for 3 h at 250 rpm, and then filtered through a nylon syringe filter (0.45 µm). To identify luteolin, the filtered sample was separated using a high performance liquid chromatography (HPLC) equipped with Agilent Eclipse XDB–C18 column. The mobile phase was (A) H_2O_2 (0.1% acetic acid) and (B) acetonitrile (0.1% acetic acid) at a flow rate of 1.0 ml/min with the following gradient: 0 min- 5% B, 5 min- 10% B, 10 min- 20% B, 15 min- 25% B, 20 min- 30% B, 30 min- 50% and 40 min- 65% B. Elution of luteolin was detected by photodiode array detector at 330 nm. The luteolin content of peanut shells was calculated by comparisons with known concentrations of their standards. The luteolin content was analyzed in peanut shell at three times and the results were statistically analysed according to Duncan’s multiple-range test (DMRT) at a significance level of P<0.05 by using SPSS software.

RESULTS AND DISCUSSION

Luteolin is present in edible plants and used in traditional medicine to suppress the diseases effects (El-Shafey and Add-Elgawad, 2012). It has been identified in many plant species and the quantity of luteolin was varied in plant parts and speices. In the present study, we identified and quantified the luteolin content in peanut shell harvested from 42 peanut cultivars (Table 1, Figures 1 and 2). The low quantity of luteolin was found in Wang (546 mg/kg), followed by Daecheong (587 mg/kg), Sinnamkwang (664 mg/kg), Sindaekwang (677 mg/kg) and Daepung (876 mg/kg). Saedl, Sinkwang, Jokwang, Palkwang, Mikwang, Joan, Daeyang, Pungkwang, Daemyeong, Gokwang, Jakwang, Baekjung, Danuri, Baekseon, Sangpyeong, Baekan, Jopyeong, Charmpyeong, Pungsan, Seonan, Pungan, Ilpyeong, Yeonpung, Boreom 1, Sangan and Jaseon peanut cultivars showed the higher concentration of luteolin content which ranged from 1943.2 to 4485.0 mg/kg. Among these peanut cultivars, Mikwang expressed the maximum amount of luteolin in their shells.

In an earlier study, Miean and Mohamed (2001) detected the luteolin content only in broccoli (74.5 mg/kg), green chili (33.0 mg/kg), bird chili (1035.0 mg/kg), onion leaves (391.0 mg/kg), belimbi fruit (202.0 mg/kg), belimbi leaves (464.5 mg/kg), French bean (11.0 mg/kg), carrot (37.5 mg/kg), white radish (9.0 mg/kg), local celery (80.5 mg/kg), limau purut leaves (30.5 mg/kg), and dried asam gelugur (107.5 mg/kg), among the 62 edible tropical plants. The results obtained from the current study suggest that peanut shells have maximum amount of luteolin content than other plants. In addition, Liu et al. (2011) isolated luteolin (133 mg/27 kg) content from *Elsholtzia rugulosa* and demonstrated the neroprotective effect of luteolin, and suggested that the luteolin (1 and 10 µM) content increased cell viability, reduced intracellular

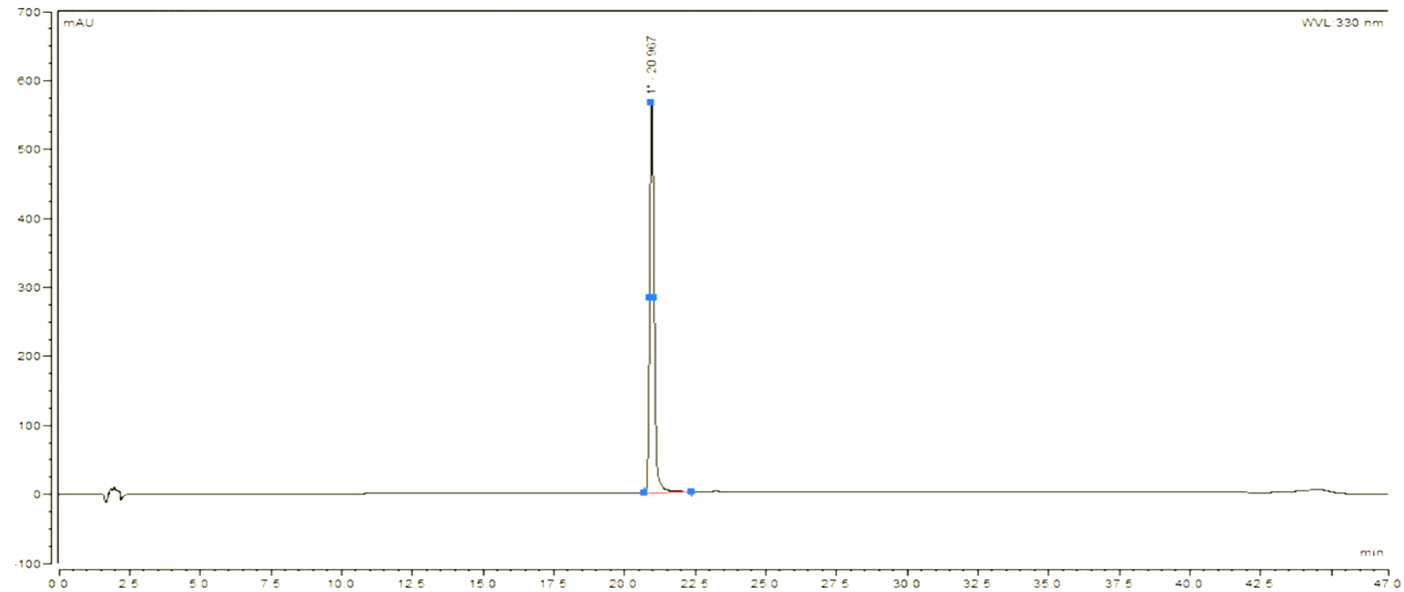

Figure 1. Chromatogram of luteolin standard.

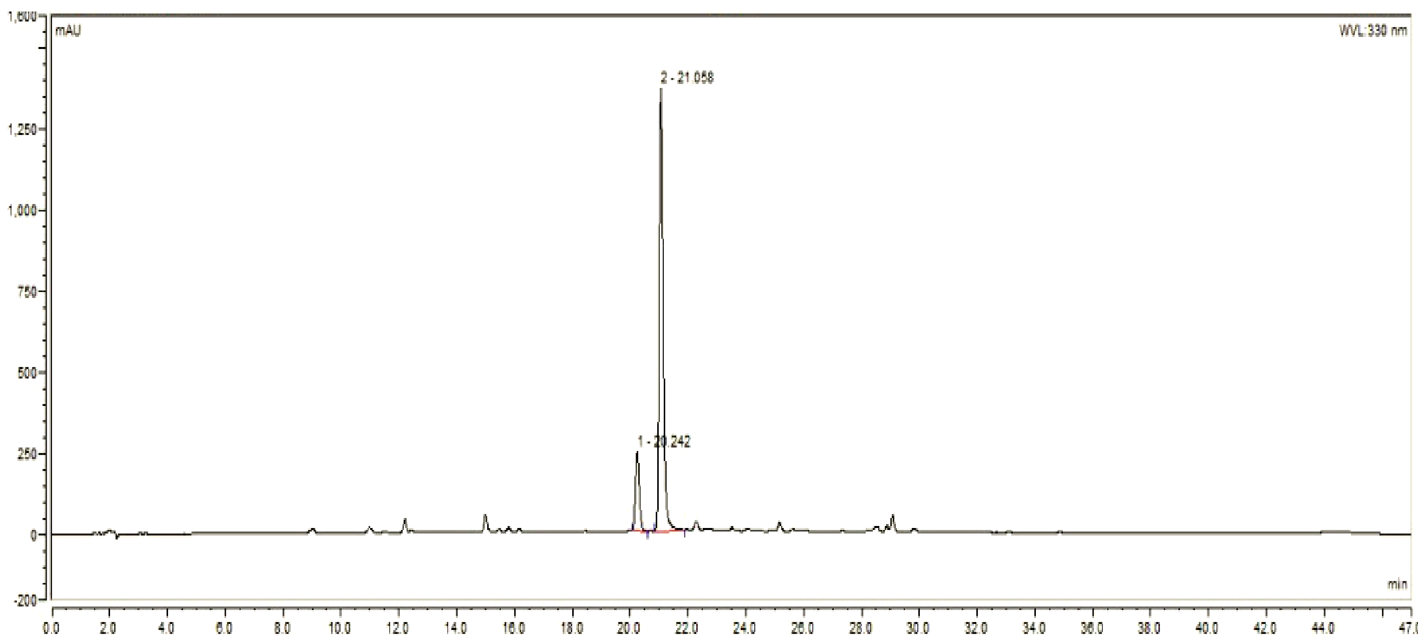

Figure 2. Chromatogram of luteolin content in Mikwang peanut shell.

intracellular reactive oxygen species (ROS) generation, enhanced the activity of superoxide dismutase (SOD) and reversed mitochondrial membrane potential dissipation in infected cells. The mechanism of the effects of luteolin against chronic diseases is still poorly understood, but some of the studies showed that luteolin inhibits the proliferation of human esophageal carcinoma cells (Wang et al., 2012) and could be an anticancer agent for various cancers (Lin et al., 2008). The pharmaceutical use of luteolin is giving more attention to identify the rich source of luteolin from natural materials. Thus, the current study suggests that the abundant quantity of peanut waste (shell) is a rich source of luteolin.

In conclusion, the higher concentration of luteolin (3576 to 4485 mg/kg) was found in Mikwang, Pungan, Sangpyeong, Jopyeong, Baekjung and Charmpyeong peanut shells. The further study is needed for commercialization of luteolin extraction and purification; it would be useful to agro-solid waste management.

ACKNOWLEDGMENT

This work was financially supported by National Institute of Crop Science, Rural Development of Administration, Republic of Korea (2013).

REFERENCES

El-Shafey NM, Abd-Elgawad H (2012). Luteolin, a bioactive flavone compound extracted from *Cichorium endivia* L. subsp. *divaricatum* alleviates the harmful effect of salinity on maize. Acta. Physiol. Plant. 34(6): 2165-2177.

Gunjal A, Kapadnis B, Pawar N (2012). Agroindustry by-products as a carrier resource for plant-growth-promoting rhizobacterium, *Bacillus subtilis*. J. Mater. Cycles Waste Manag. 14: 274-80.

Janila P, Nigam SN, Pandey MK, Nagesh P, Varshney RK (2013). Groundnut improvement: use of genetic and genomic tools. Front. Plant Sci. 4: 1-16.

Lin Y, Shi R, Wang X, Shen HM (2008). Luteolin, a flavonoid with potentials for cancer prevention and therapy. Curr. Cancer Drug Tar. 8: 634-646.

Liu R, Meng F, Zhang L, Liu A, Qin H, Lan X, Li L, Du G (2011). Luteolin isolated from the medicinal plant *Elsholtzia rugulosa* (Labiatae) prevents copper-mediated toxicity in β-amyloid precursor protein swedish mutation overexpressing SH-SY5Y cells. Mol. 16: 2084-2096.

Lopez-Lazaro M (2009). Distribution and biological activities of the flavonoid luteolin. Mini Rev. Med. Chem. 9: 31-59.

Miean KH, Mohamed S (2001). Flavonoid (myricetin, quercetin, kaempferol, luteolin, and apigenin) content of edible tropical plants. J. Agric. Food Chem. 49: 3106-3112.

Wang TT, Wang SK, Huang GL, Sun GJ (2012). Luteolin induced-growth Inhibition and apoptosis of human esophageal squamous carcinoma cell line Eca109 cells *in vitro*. Asian Pac. J. Cancer Prev. 13: 5455-5461.

Win MM, Abdul-Hamid ZA, Baharin BS, Anwar F, Sabu MC, Pak-Dek MS (2011). Phenolic compounds and antioxidant activity of peanuts skin, hull, raw kernel and roasted kernel flour. Pak. J. Bot. 43: 1635-1642.