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〈TECHNICAL NOTE〉

Elucidation of Anti-tumor Initiator and Promoter Derived from Seaweed-1: Anti-tumor Promoting Activity of Seaweed Extracts

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It is known that chemical carcinogenesis is a multi-step process involving at least two distinct and independent stages so called initiation and promotion process (Boutwell, 1978). In the initiation step, carcinogen interacts with DNA of normal cells and the resultant dormant tumor cells are induced. These induced tumor cells are converted into visible tumor cells in the promotion step. This step needs long-term and is irreversible. The inhibition of tumor promotion stage which might be play an important role in the progress of carcinogenesis, has been suggested as one of the most promising ways for chemoprevention of cancers (Wattenberg, 1985). The Epstein-Barr virus (EBV)-early antigen (EA) induction test which has been used as a short-term detection method of tumor promoters is very useful to examine anti-tumor promoting activity *in vitro* (Ito et al., 1981). Using this bioassay, anti-tumor promoting properties of edible plants (Koshimizu et al., 1988; Ohigashi et al., 1992), medicinal plants (Murakami et al., 1992) and their active components (Ohigashi et al., 1986; Tokuda et al., 19 86) have been investigated. In the present study, we focused to elucidate anti-tumor promoting properties of seaweed, some of which are important daily foods. Eight fresh seaweed, *Agarum cribrosum, Sargassum thunbergii, Sargassum miyabei, Sargassum horneri* (gulf weed), *Grateloupia elliptica, Gracilaria verrucosa* (sea string), *Lomentaria catenata* and *Plocamium telfairiae* were collected at Pusan, Tongyeong and Jumoonjin, Korea and eight dried seaweed, *Ecklonia cava, Ecklonia stolonifera* (seaweed cava), *Undaria pinnatifida* (sea mustard), *Laminaria japonica* (tangle), *Hizikia fusiforme, Porphyra tenera* (laver), *Codium fragile* (sea staghorn) and *Ulva pertusa* (green laver) were purchased at Pusan and Gijang, Korea. Seaweed was extracted with five volumes of 75% methanol, and the anti-tumor promoting activity was determined by EBV-EA induction caused by a tumor promoter, teleocidin B-4. An EBV activation test was done as follows: Lymphoblastoid cells (Raji cell, 5×10^5/ml) were incubated with n-butyric acid (3 mM), teleocidin B-4 (50 nM) and a proper amount of methanol solubles of seaweed dissolved in 5μl DMSO in RPMI 1640 medium at 37℃ under a current of 5% CO_2 for 48hr. Early antigen (EA)-positive cells produced by the viral activation were detected by an indirect immunofluorescence method. The anti-tumor promoting properties of 16 species of seaweed are listed in Table 1. The extracts from Phaeophyta showed stronger anti-tumor promoting activity than those from Rhodo-

Table 1. Anti-tumor promoting activity of seaweed extracts

Seaweed		Concentration (μg/ml)	Inhibition of EBV-EA induction (%)*	Viability (%)
Division	Species			
Phaeophyta	*Ecklonia cava*	100	17.6	85.3
	Ecklonia stolonifera	100	24.3	84.9
	Agarum cribrosum	100	13.8	75.0
	Undaria pinnatifida	20	83.5	82.5
	Laminaria japonica	40	82.5	57.6
	Sargassum thunbergii	100	22.4	82.2
	Sargassum miyabei	20	40.1	90.1
	Sargassum horneri	20	41.8	89.3
	Hizikia fusiforme	50	-	89.9
Rhodophyta	*Porphyra tenera*	100	42.0	85.5
	Grateloupia elliptica	50	31.8	91.9
	Gracilaria verrucosa	100	14.6	75.7
	Lamentaria catenata	50	1.5	88.8
	Plocamium telfairiae	50	25.9	93.7
Chlorophyta	*Codium fragile*	20	30.5	87.5
	Ulva pertusa	50	-	90.0

*EBV-EA means Epstein-Barr virus early antigen.

phyta and Chlorophyta. Among Phaeophyta, the activity was strong in *U. pinnatifida* (83.5%/20μ), *L. japonica* (82.5%/40μ), S. *miyabei* (40.1%/20) and *S. horneri* (41.8%/20μ). Cell viability of seaweed extracts was more than 75.0% except for *L. japonica* (57.6%). Most of seaweed examined were not toxic against the Raji cell. However, *L. japonica* (82.5%/40μ) exhibited a strong inhibitory activity toward EBV activation and showed a weak cytotoxicity. On the other hand, extracts of *G. elliptica* (31.8%/50μ), *C. fragile* (30.5%/20μ) and *P. tenera* (42.0%/100μ) inhibited tumor promotion weakly, and the others were not effective. The present results on anti-tumor promoting activity of seaweed reveal that daily intake of seaweed may partly serve for cancer prevention. The resultant data might be used as an useful information for developing functional foods and food materials, and for chemoprevention of cancer using seaweed. Now, elucidation of active anti-tumor promoters from seaweed is in progress.

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References

Boutwell, R. K. 1978. Biochemical mechanism of tumor promotion. In Carcinogenesis-A Comprehensive Survey. Slaga, A. Sivak and R. K. Boutwell (eds.), Raven Press, New York, Vol. 2, pp.49~58.

Ito, Y., S. Yanase, J. Fujita, T. Harayama, M. Takashima and H. Imanaka. 1981. A short-term in vitro assay for promoter substances using human lymphpblastoid cells latently infected with Epstein-Barr virus. Cancer Letters, 13, 29~37.

Koshimizu, K., H. Ohigashi, H. Tokuda, A. Kondo and K. Yamaguchi. 1988. Screening of edible pla-

nts against possible anti-tumor promoting activity. Cancer Latter, 39, 247~257.

Murakami, A., S. Tanaka, H. Ohigashi, M. Hirota, R. Irie, N. Takeda, A. Tatematsu and K. Koshimizu. 1992. Chalcone tetramers, Lophirachalcone and Alatachalcone, from Lophira alata as possible anti-tumor promoters. Biosci. Biotech. Biochem., 56 (5), 769~772.

Ohigashi, H., H. Takamura, K. Koshimizu, H. Tokuda and Y. Ito. 1986. Search for possible antitumor promoters by inhibition of 12-O-tetradecanoylphorbol-13-acetate induced Epstein-Barr virus activation; ursolic acid and oleanolic acid from an anti-inflammatory Chinese medicinal plant, Glechema hederacea L. Cancer Letters, 30, 143~151.

Ohigashi, H., Y. Sakai, K. Yamaguchi, I. Umezaki and K. Koshimizu. 1992. Possible anti-tumor promoting properties of marine algae and in vitro activity of wakame seaweed extract. Biosci. Biotech. Biochem., 56 (6), 994~995.

Tokuda, H., H. Ohigashi, K. Koshimizu and Y. Ito. 1986. Inhibitory effects of ursolic and oleanolic acid on skin tumor promotion by 12-O-tetradecanoylphorbol-13-acetate. Cancer Letters, 33, 279~285.

Wattenberg, L. W.1985. Chemoprevention of cancer. Cancer Res., 45 (1), 1~8.

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