Antioxidative Effect of Sesamol on Fish Oil

Oxidation

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All foods and food products containing fat are susceptible to oxidative rancidity. In particular, marine products are easily deteriorated by the oxidative reaction with atmospheric oxygen because of their high content of unstable polyunsaturated fatty acids. Various kinds of synthetic antioxidants have been explored and used in many seafoods to prevent the fat rancidity. For example, BHA, BHT, and ethoxyquin have been widely used in processed marine products such as dried small sardine (Niboshi), dried horse mackerel, and fish meal.

However, the use of these synthetic antioxidants for foodstuffs must be restricted from the stand point of food safety. Only tocopherols are up to the present natural antioxidant which is widely used with safety. However, they are not so effective as synthetic antioxidants and also involve high manufacturing costs. Especially, in case of processed marine products, there is an urgent need for effective and safe natural antioxidants.

Osawa et al. found in sesame seed with the presence of sesamol derivatives belonging to a lignan-type compound which display strong antioxidative effects. The present work was undertaken to apply the antioxidative ability of the sesamol-type compounds to fish oil during preservation. First of all, the antioxidative activity of sesamol (1) (3,4-methylenedioxyphenol, Aldrich Chem. Co., Inc.) was examined as an additive of fish oil, and then analogous compounds of sesamol were also examined to obtain the information of the structure-activity relationship of sesamol-type antioxidants. Each compound was added to pollack oil as substrate at a level of 0.2% and a thin film of each mixture (500mg) was put into a Petri dish (27mm in diameter, 15mm in height) and allowed to stand at 40°C. The peroxide value (PV) of each specimen was monitored at intervals to determine the relative activity of the additive.

As shown in Fig. 2, the sesamol appeared to be more active than α-tocopherol, and activities of the analogs (diol type) of sesamol, such as methylhydroquinone (2) (Wako Pure Chem. Industries, Ltd.) and 4-methylcatechol (3) (3,4-dihydroxytoluene, Wako Pure Chem. Industries, Ltd.) whose methyl group was substituted for one of α-functions of sesamol were much the same as that of sesamol. Compared with 3,4-dimethylphenol (4) (mono alcohol type) whose two methyl groups were substituted for methylene group of sesamol, sesamol is considerably effective as a compound having one free hydroxy group. The antioxidative activity of the sesamol derivatives (acetate (5) and triol (6) (1,2,4-trihydroxybenzene, Wako Pure Chem. Industries, Ltd.)) were also compared. The protected derivative acetate did not show the activity at all. On the contrary, the cleaved derivative triol decelerated the initial rise of PV. However, the PV rose thereafter rapidly, indicating that the triol lost its activity with the lapse of time. Finally, the PV of sample oil with triol as additive increased almost the same as that of control oil containing no additives. It may fairly be presumed that this phenomenon is due to the instability of the triol.

From these results, sesamol was considered to be an advantageous antioxidant to fish oil, and its activity was presumed to depend on hydroquinone or catechol type structure, because both they are analogous compounds of sesamol with respect to their resonance effect on aromatic ring having α- or p-diols. Though sesamol has only one free hydroxy group, it is nearly as active as hydroquinone and catechol type structure, because both they are analogous compounds of sesamol with respect to their resonance effect on aromatic ring having α- or p-diols.

Fig. 1. Structures of compounds used in antioxidative assay.

Fig. 2. Changes in PV of pollack oil after addition of the sesamol-type compounds.

Fig. 3. Changes in PV of pollack oil after addition of the sesamol derivatives.

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References