α-Tocopherol Content in Oil Palm Leaflet

Ab. Gapor*, A. Kato and A.S.H. Ong
Palm Oil Research Institute of Malaysia (PORIM), Kuala Lumpur, Malaysia

Mature oil palm leaflets are readily available as by-products from oil palm plantations. α-Tocopherol and chlorophyll contents of palm leaflets obtained from oil palm trees of different ages and varieties were determined. α-Tocopherol and chlorophyll contents were in the range of 0.14–0.28% and 0.23–0.31%, respectively, in palm leaflets on wet bases. The molar ratios of α-tocopherol to chlorophyll were 0.78–2.37.

The oil palm industry in Malaysia has been expanding rapidly in the last two decades. The total oil palm hectarage rose from a mere 54,656 hectares (ha.) in 1960 to 308,803 ha. in 1970 and 1,023,306 ha. in 1980; the estimated acreage in 1985 is 1,362,900 ha. (1). As a result, Malaysia is now the world's largest producer and exporter of palm oil.

Palm leaflets which can be derived from the processes of frond pruning and oil palm replanting are byproducts of the oil palm. Total estimated production from the two sources are 4.7 and 5.6 million tons (dry bases) in 1985 and 1990, respectively (2). Pruned fronds are normally stacked neatly in the oil palm interow in such a way as to leave free access along the harvesters' path (3); this practice has been thought to give some beneficial effects such as moisture retention and soil conservation (4). As the availability of palm leaf is enormous, considerable interest has been shown in the effective utilization of this renewable resource. Currently, we are involved in the investigation of palm leaf as a source of Vitamin E. A study of tocopherol homologues in palm leaf extract showed that α-tocopherol was the major component (5,6). This report concerns our study of α-tocopherol content of mature palm leaves, which are available as byproducts of pruned fronds.

EXPERIMENTAL PROCEDURES

Materials. Oil palm fronds were collected at the field research station at Serdang and Universiti Pertanian Malaysia. The fronds below the lowest ripe bunches were pruned from oil palm trees from six to 20 years old. The variety was mainly tenera.

Lipid extraction. The leaflets from a frond were cut into small pieces, and 10 g of the cut leaflets were ground with a blender. The ground leaflets were extracted with 50 ml of methanol-chloroform (2:1, v/v) and homogenized with an AM7 Homogenizer (Nihon Seiki). The homogenization and extraction with 50 ml of methanol-chloroform (2:1, v/v) were repeated five more times with glass beads, 60–100 mesh (Applied Science Laboratories Inc., State College, Pennsylvania).

The extracts were added to 200 ml of water and 100 ml chloroform to separate into two phases. The lower phase was washed, dried and freed from solvent by vacuum distillation.

*To whom correspondence should be addressed at Palm Oil Research Institute of Malaysia (PORIM), Bandar Baru Bangi, Selangor, P.O. Box 10620, Kuala Lumpur, Malaysia.

Tocopherol analysis. α-Tocopherol was analyzed by a Hitachi 638-50 high performance liquid chromatograph equipped with a Hitachi 560-10LC fluorescence spectrophotometer. The operation conditions were similar to those of Tanabe et al. (7). Zorbax Sil column (4.6 mm × 25 cm) was used. Mobile phase was the mixture of hexane/tetrahydrofuran/methanol (972.5:25:2.5, v/v/v). The fluorescence spectrophotometer was used as a detector at an excitation of 298 nm with an emission of 325 nm.

α-Tocopherol was identified by retention time of HPLC and direct inlet electron impact mass spectrometry of a fraction by TLC.

Chlorophyll extraction. The 5 g of cut leaflets from a frond were prepared for the chlorophyll extraction and ground with a blender. The ground leaflets were extracted with 50 ml of 90% acetone and homogenized with an AM7 Homogenizer (Nihon Seiki). The homogenization and extraction with 90% acetone were repeated with glass beads five more times.

The extracts were filtered with a filter paper. The filtrate was diluted with 90% acetone to measure the absorbance at 630 nm, 647 nm and 664 nm. A Hewlett Packard 8450 Spectrophotometer was used. Chlorophyll contents were calculated according to Jeffrey (8).

RESULTS AND DISCUSSION

Palm leaves from pruned fronds are available during annual pruning as well as during harvesting rounds, and they are mature. The α-tocopherol contents in mature palm leaves obtained from oil palm trees of different ages and varieties are summarized in Table 1. The results showed that the α-tocopherol contents were in the range of 0.32–0.56% (dry basis) in palm leaves; total α-tocopherol in leaflets of a frond was 2.81–10.18 g. It was thought that the great variation of total α-tocopherol in a frond was due to the variation of the weight of leaflets in a frond, and that this weight may be related to soil fertility. α-Tocopherol content in leaflets was 0.14–0.28% (wet basis), higher than the level in wheat germ oil (9). In view of the high content of α-tocopherol in palm leaf, this renewable resource may serve as a source of the compound.

The chlorophyll contents of the palm leaves also were examined and the results, as shown in Table 1, indicate that levels were 0.54–0.75% (dry basis). Booth (10) suggested that in plants, chlorophyll is always accompanied by α-tocopherol and both are situated inside the chloroplasts. Table 1 shows that the molar ratios of α-tocopherol to chlorophyll were 0.78–2.37. The relationship between α-tocopherol and chlorophyll is of biological interest. In a study on the role of α-tocopherol in photosystem II of spinach, Barr et al. (11) suggested that α-tocopherol functions in electron transfer chain of chloroplasts. Recently, Erin et al. (12) showed that α-tocopherol functions as a singlet oxygen quencher in thylakoid membrane. The biosynthesis of α-tocopherol has been shown to be localized in chloroplasts (13).

TABLE 1

α-Tocopherol and Chlorophyll Contents in Oil Palm Leaflet

Sample	1	2	3	4	5	6	7	8	9	10	11	12
Variety	Tenera	Tenera	Tenera	Tenera	Tenera	Tenera	Tenera	Tenera	Tenera	Tenera	Dura	Hybrid
Age of tree in years	6	9	9	12	13	13	13	13	20	20	17	17
Total leaflets in a frond weight (kg)	1.2	3.2	3.0	4.0	2.5	2.3	3.6	3.4	2.5	2.7	4.2	3.6
Leaflets, moisture (%)	56.70	60.04	57.14	58.69	56.72	59.75	60.53	59.73	53.44	52.13	59.67	58.40
Total α-tocopherol in leaflets of a frond												
g	2.81	6.93	6.92	8.82	3.39	3.64	7.48	5.32	5.94	5.67	7.46	10.18
m mol	6.53	16.12	16.09	20.51	7.88	8.47	17.40	12.37	13.81	13.19	17.35	23.67
α-tocopherol content in leaflets												
%	0.23	0.22	0.23	0.23	0.14	0.16	0.21	0.16	0.24	0.21	0.18	0.28
%[a]	0.53	0.55	0.54	0.54	0.32	0.40	0.59	0.40	0.59	0.50	0.39	0.58
Chlorophyll a in leaflets of a frond												
g	2.38	5.98	5.25	8.03	7.00	—	7.27	7.05	7.25	—	9.62	7.67
m mol	2.66	6.71	5.89	9.06	7.82	—	8.15	7.90	5.89	—	10.78	8.60
Chlorophyll b in leaflets of a frond												
g	0.67	1.89	1.56	2.56	2.03	—	2.05	1.85	1.65	—	3.32	1.12
m mol	0.74	2.08	1.72	2.83	2.24	—	2.26	2.04	1.82	—	3.66	1.24
Chlorophyll content in leaflets												
%	0.25	0.25	0.23	0.27	0.26	—	0.26	0.26	0.28	—	0.31	0.24
%[a]	0.58	0.63	0.54	0.65	0.60	—	0.66	0.65	0.60	—	0.77	0.58
Molar ratio α-tocopherol/ chlorophyll	1.92	1.83	2.11	1.72	0.78	—	1.67	1.24	1.79	—	1.20	2.37

[a]Dry basis.

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