

# Effect of a palm-oil–vitamin E concentrate on the serum and lipoprotein lipids in humans<sup>1–3</sup>

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**ABSTRACT** The effect of a capsulated palm-oil–vitamin E concentrate (palmvitee) on human serum and lipoprotein lipids was assessed. Each palmvitee capsule contains ~18, ~42, and ~240 mg of tocopherols, tocotrienols, and palm olein, respectively. All volunteers took one palmvitee capsule per day for 30 consecutive days. Overnight fasting blood was taken from each volunteer before and after the experiment. Serum lipids and lipoproteins were analyzed by using the enzymatic CHOD-PAP method. Our results showed that palmvitee lowered both serum total cholesterol (TC) and low-density-lipoprotein cholesterol (LDL-C) concentrations in all the volunteers. The magnitude of reduction of serum TC ranged from 5.0% to 35.9% whereas the reduction of LDL-C values ranged from 0.9% to 37.0% when compared with their respective starting values. The effect of palmvitee on triglycerides (TGs) and HDL-C was not consistent. Our results show that the palmvitee has a hypocholesterolemic effect. *Am J Clin Nutr* 1991;53:1027S–30S.

**KEY WORDS** Palm oil, vitamin E, serum lipids, low-density-lipoprotein cholesterol, high-density-lipoprotein cholesterol

## Introduction

Plasma cholesterol has been shown to be a major risk factor in the development of atherosclerosis and cardiovascular diseases. A high plasma cholesterol concentration is associated with a higher risk of cardiovascular diseases (CVD) (1–4). Reducing plasma cholesterol concentration is generally considered an effective measure for reducing the risk of CVD (5, 6). The reduction of plasma cholesterol concentration can be achieved by administering hypocholesterolemic substances and by controlling dietary fat intake.

Palm oil is very rich in tocopherols and tocotrienols (7, 8). Tocotrienols are structural analogs of tocopherols and are present in palm oil in higher concentrations than are seen in any other fats and oils (9). Recently, Qureshi et al (10) showed that tocotrienols isolated from barley flour inhibited the activity of 3-hydroxy-3-methylglutaryl coenzyme A reductase (HMGR) in chickens.

A palm-oil–vitamin E concentrate (palmvitee) in gelatin capsules was recently prepared by the Palm Oil Research Institute of Malaysia (PORIM). Each capsule contains ~18, ~42, and ~240 mg of tocopherols, tocotrienols, and palm olein, respectively. In view of the findings of Qureshi et al (10), it was of interest to investigate the effect of palmvitee intake on human

serum and lipoprotein lipids, and the results of that study are reported in this communication.

## Subjects and methods

### Materials

Palmvitee in gelatin capsules was provided by PORIM. Enzymatic cholesterol estimation kits for serum total cholesterol (TC), total triglyceride (TG), and lipoprotein cholesterol analysis were obtained from E Merck, Darmstadt, FRG.

### Human subjects

Apparently healthy male and female human volunteers were recruited from the staff and students of the Medical Faculty, University of Malaya. No age or body-weight limits were imposed, but volunteers on any medication were excluded from the study. The study procedures were approved by the ethics committee on human experimentation of the Faculty of Medicine, University of Malaya.

### Preliminary study

Nine apparently healthy volunteers were involved. Each volunteer took one capsule of the palmvitee per day for 30 d. At the end of the feeding trial, an interview was conducted to see if the volunteers complied to the feeding schedule. Ten milliliters of overnight fasting blood was taken from each individual before and after the experimental period. Sera were prepared by centrifugation of the coagulated blood at  $2000 \times g$  for 20 min at room temperature and were stored at  $-20^\circ\text{C}$  until analysis. Serum total cholesterol concentration was determined by the enzymatic cholesterol oxidase, *p*-aminophenazone, peroxidase (CHOD-PAP) method (Merckotest system, E Merck).

### Follow-up study

Twenty-two apparently healthy volunteers were involved in the follow-up study. The same feeding protocol of palmvitee for

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**TABLE 1**  
Effect of palmvitee supplementation on serum total cholesterol concentrations in adult males and females (study 1)

Group, subject, sex, age	Starting		Final	
	mmol/L			
<b>Group I (&lt;5.20 mmol/L)</b>				
1, M, 40 y	4.63	4.40 (-5.0%)*		
2, M, 31 y	4.65	4.21 (-9.4%)*		
<b>Group II (5.20-6.18 mmol/L)</b>				
3, M, 48 y	5.66	4.60 (-18.7%)*		
4, M, 43 y	5.87	4.81 (-18.1%)*		
5, F, 28 y	5.79	5.04 (-13.0%)*		
6, M, 54 y	5.90	5.02 (-14.9%)*		
<b>Group III (&gt;6.21 mmol/L)</b>				
7, F, 23 y	6.49	4.16 (-35.9%)*†		
8, M, 40 y	8.09	5.43 (-32.9%)*†		
9, M, 54 y	6.72	5.04 (-25.0%)*†		

\* Percent difference between starting.

† Significantly different,  $P < 0.05$ .

each volunteer as in the preliminary study was followed. Blood was taken and serum was prepared as described in the preliminary study. However, in this follow-up study, the body weights

of the volunteers before and after the experimental period were recorded. The serum TC, low-density-lipoprotein-cholesterol (LDL-C), and high-density-lipoprotein-cholesterol (HDL-C) concentrations were determined by the enzymatic CHOD-PAP method as in the preliminary study. Serum TG was determined by the enzymatic GPO-PAP method (Merckotest, E. Merck).

#### Statistics

A two-tailed  $t$  test was used to assess the significance of differences in serum and lipoprotein lipid concentrations before and after the oral intake of palmvitee.

#### Results

On the basis of the starting serum TC concentrations, the volunteers involved in this study were divided into three groups: I, those with normal TC concentrations (< 5.20 mmol/L); II, those with borderline-high TC concentrations (> 5.20 but < 6.18 mmol/L); and III, those with high TC concentrations (> 6.21 mmol/L). In our preliminary study, two volunteers had starting TC values < 5.20 mmol/L (group I), four had starting TC values > 5.20 mmol/L but < 6.21 mmol/L (group II), and three had TC values > 6.21 mmol/L (group III).

Our results (Table 1) show that there was a reduction in the serum cholesterol concentration in all the volunteers 30 d after

**TABLE 2**  
Effect of palmvitee supplementation on serum cholesterol and triglyceride concentrations in adult males (study 2)

Group, subject, age	Body weight		Total cholesterol		Triglyceride	
	Starting	Final	Starting	Final	Starting	Final
	kg		mmol/L		mmol/L	
<b>Group I (&lt;5.20 mmol/L)</b>						
1, 32 y	63.3	63.9	4.86	4.42 (-9.0%)*	1.04	0.60 (-42.4%)*
2, 42 y	64.2	61.8	4.66	4.34 (-6.7%)*	0.89	0.93 (+3.8%)
3, 42 y	60.6	58.9	4.63	4.27 (-7.8%)*	1.05	1.21 (+15.1%)*
4, 43 y	83.7	84.6	4.42	4.01 (-9.4%)*	1.74	2.69 (+54.6%)*
<b>Group II (5.20-6.18 mmol/L)</b>						
5, 43 y	65.1	64.1	5.77	4.89 (-15.3%)*	3.43	2.92 (-14.8%)*
6, 42 y	62.7	61.1	6.00	5.61 (-6.5%)*	1.38	1.69 (+23.0%)*
7, 43 y	56.5	56.5	6.08	5.59 (-8.1%)*	1.94	2.13 (+9.9%)*
8, 50 y	76.7	75.5	6.16	5.82 (-5.5%)*	3.15	2.83 (-10.0%)*
9, 42 y	90.2	88.3	6.16	5.07 (-17.7%)*	2.56	1.39 (-45.8%)*
<b>Group III (&gt;6.21 mmol/L)</b>						
10, 45 y	73.3	70.8	6.52	5.17 (-20.6%)*	1.02	1.14 (+12.2%)*
11, 32 y	93.0	92.5	6.28	5.74 (-8.6%)*	3.06	4.12 (+34.7%)*
12, 39 y	75.2	74.3	7.60	5.22 (-31.3%)*†	4.16	2.70 (-35.1%)*
13, 38 y	69.7	69.2	6.52	4.84 (-25.8%)*†	1.77	1.74 (-1.9%)*
14, 40 y	70.3	68.7	6.80	5.59 (-17.9%)*	0.89	1.52 (+70.9%)*
15, 45 y	72.6	71.7	7.21	6.49 (-10.0%)*	7.52	4.33 (-42.3%)*†
16, 50 y	87.4	85.5	6.34	5.25 (-17.1%)*	1.58	1.85 (+17.1%)*
17, 40 y	56.3	55.7	6.85	6.00 (-12.5%)*	0.91	1.08 (+18.5%)*
18, 43 y	60.6	59.7	7.63	6.31 (-17.3%)*	1.33	1.11 (-17.0%)*
19, 50 y	83.2	81.3	6.83	6.46 (-5.3%)*	3.57	2.41 (-32.6%)*
20, 46 y	76.7	76.8	6.62	5.64 (-14.8%)*	0.99	1.23 (+23.9%)*
21, 40 y	84.3	83.7	11.25	9.67 (-14.0%)*†	22.58	20.81 (-7.9%)*
22, 47 y	70.7	69.6	11.82	9.13 (-22.8%)*†	17.13	14.37 (-16.1%)*†

\* Percent difference from starting.

† Significantly different,  $P < 0.05$ .

TABLE 3  
Effect of palmvitee supplementation on serum LDL- and HDL-cholesterol concentrations in humans (study 2)

Subject	LDL cholesterol		HDL cholesterol	
	Starting	Final	Starting	Final
mmol/L				
Group I (<5.20 mmol/L)				
1	3.05	3.02 (-0.9%)*	1.09	1.16 (+7.1%)
2	3.05	2.28 (-25.4%)	1.21	1.27 (+4.3%)
3	2.74	2.61 (-4.7%)	1.03	1.03 (0.0%)
4	3.44	3.13 (-9.0%)	0.90	0.80 (-11.4%)
Group II (5.20-6.18 mmol/L)				
5	4.34	3.28 (-24.4%)	1.11	0.83 (-25.6%)†
6	4.76	3.78 (-20.7%)	0.96	0.85 (-10.8%)
7	4.37	3.72 (-14.8%)	0.83	0.96 (+15.6%)
8	4.29	3.93 (-8.4%)	0.98	0.98 (0.0%)
9	4.66	4.03 (-13.3%)	0.88	0.78 (-11.8%)
Group III (>6.21 mmol/L)				
10	4.55	3.46 (-23.9%)	1.42	1.19 (-16.4%)
11	5.17	5.07 (-2.0%)	0.72	0.65 (-10.7%)
12	5.71	4.32 (-24.4%)†	1.16	0.88 (-24.4%)†
13	4.73	3.52 (-25.7%)†	0.90	0.80 (-11.4%)
14	5.28	4.76 (-9.8%)	0.93	0.83 (-11.1%)
15	5.77	5.27 (-8.5%)	0.90	0.78 (-14.3%)
16	4.16	3.85 (-7.5%)	1.42	1.09 (-23.6%)†
17	4.86	4.40 (-9.6%)	1.34	1.40 (+3.9%)
18	5.59	3.52 (-37.0%)†	1.42	1.40 (-1.8%)
19	5.41	5.09 (-5.7%)	0.80	0.90 (+12.9%)
20	4.60	2.95 (-36.0%)†	1.78	1.71 (-4.4%)
21	9.65	8.66 (-10.2%)	0.85	0.93 (+9.1%)
22	9.08	7.55 (-16.8%)†	0.90	0.83 (-8.6%)

\* Percent difference from starting.

† Significantly different,  $P < 0.5$ .

taking the palmvitee capsules. The magnitude of reduction in serum TC concentrations varied from 5% to 35.9% when compared to their respective starting TC concentrations. The group I volunteers, who had normal starting serum cholesterol concentrations, experienced only a small reduction (< 10%) in serum TC concentrations, whereas the group II and group III volunteers, who had borderline-high and high starting TC concentrations, respectively, experienced a much greater reduction in serum TC concentrations after taking the palmvitee capsules. The reduction in serum TC concentrations for the group III volunteers was statistically significant ( $P < 0.05$ ), but the reduction in serum TC concentrations in groups I and II was not statistically significant. However, when the means of all the volunteers were compared, the reduction in TC concentrations after taking the palmvitee was highly significant ( $P < 0.01$ ).

In the follow-up study, a larger group of volunteers was used; of these, four were of the group I type, five of the group II type, and 13 of the group III type. The body weights of the volunteers were recorded before and after the experiment. Our results (Table 2) show that there was no significant change in the body weight of the volunteers participating in this study. In this study more detailed serum and lipoprotein lipid profiles were examined. Our results (Table 2) show that all individuals taking the palmvitee capsules demonstrated a reduction in serum TC concentrations when compared with their respective starting concen-

trations. The magnitude of reduction in serum TC concentrations ranged from 5.3% to 31.3%, which is comparable to that obtained in the preliminary study. However, the responses of the volunteers with normal (group I), borderline-high (group II), and high TC (group III) concentrations to the palmvitee intake were more variable when compared with those observed in the preliminary study. Only 4 of the 13 hypercholesterolemic individuals showed significant ( $P < 0.05$ ) reduction in TC concentrations after taking the palmvitee, whereas for the other volunteers the reduction in TC concentrations was not big enough to be statistically significant at the 5% level. However, when the means of all the volunteers were compared, the overall reduction in TC concentrations was significant ( $P < 0.01$ ), as seen in the preliminary study.


The effect of palmvitee on serum TG was less consistent because about half of the volunteers responded with increases whereas the other half experienced decreases in serum TG concentrations.

All individuals showed a reduction in LDL-C concentrations after taking the palmvitee capsules when compared with their respective starting LDL-C concentrations (Table 3). The magnitude of reduction in LDL-C concentrations was from 0.9% to 37%. Four individuals in group III showed significant ( $P < 0.05$ ) reduction in LDL-C concentrations after taking the palmvitee. On the other hand, the effect of palmvitee on HDL-C concentration was not consistent. Six out of 22 volunteers showed increases, from 3.9% to 15.6%, whereas 14 individuals showed a reduction of 1.8% to 25.6% when compared to their respective starting HDL-C concentrations. Two individuals did not show any change in their HDL-C concentrations.

## Discussion

To differentiate the responses of various individuals to the supplementation of palmvitee to their normal diets, the volunteers involved in this study were divided into three groups according to their respective starting TC concentrations, according to the guidelines suggested by the report of the National Cholesterol Education Program (11). The results from the preliminary study (Table 1) and the follow-up study (Table 2) showed that supplementation of one palmvitee capsule per day to one's normal diet for 30 d resulted in a reduction of one's serum TC and LDL-C concentrations. The reductions in serum cholesterol and LDL-C concentrations were marginal in certain individuals, whereas in others the reductions were quite substantial. Our results, therefore, indicate that palmvitee possesses hypocholesterolemic effect on humans. The effectiveness of palmvitee for the treatment of various types of hypercholesterolemia under clinical conditions remains to be investigated.

Because the palmvitee used in our studies contains tocopherols, tocotrienols, and palm olein, it is not possible at this stage to ascribe the observed hypocholesterolemic effect of palmvitee to the tocopherols, tocotrienols, or the palm-olein TGs. However, earlier studies in humans demonstrated that tocopherol supplementation to one's diet had no effect on serum cholesterol concentration (12-16) or actually resulted in slight increases in serum cholesterol concentrations in some individuals (17, 18). Hence, it appears that the hypocholesterolemic effect of the palmvitee could be due to the tocotrienols or the palm-olein TGs. Studies in broilers (10) showed that tocotrienols isolated from barley flour inhibited the activity of HMGCR and cholesterol biosyn-

thesis. Therefore, it is very likely that the hypocholesterolemic effect of the palmvitee is exerted through the action of the tocotrienols. 

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