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# PALM OIL

A COMPILATION OF DOCUMENTED FACTS ON
NUTRITIONAL EFFECTS OF PALM OIL

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# FOREWORD

The following pages contain a compilation of 16 basic facts about palm oil, with particular emphasis on the nutritional effects of the oil. Each of the facts has been firmly established, and for each of them one or more references to the relevant scientific literature are given.

The compilation has been reviewed and endorsed by a panel of leading American nutritional scientists comprising the following:-

Professor Emeritus Roslyn B. Alfin-Slater,
University of California, Los Angeles;

Professor David Kritchevsky,
The Wistar Institute,
University of Pennsylvania;

Professor Charles E. Elson,
University of Wisconsin, Madison;

Professor Randall Wood,
Texas A&M University;

Associate Professor David Klurfeld,
The Wistar Institute,
University of Pennsylvania.

This compilation has been written for easy reading, and should be useful to those who want to know the truth about palm oil, but have little time to find it out for themselves. For those intending to embark on nutritional research on palm oil, this statement of 16 facts, together with the references cited, should provide both a convenient foundation of knowledge and a guide to further reading.

**DATUK PROF AUGUSTINE S.H. ONG**
Director-General
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# NUTRITIONAL EFFECTS OF PALM OIL

**FACT 1:** Palm oil has had a long history of food use dating back over 5,000 years.[1]

**FACT 2:** Like other common edible fats and oils, palm oil is easily absorbed, digested and utilized for the support of healthy growth.[2]

**FACT 3:** Palm oil is now consumed worldwide as a cooking oil, margarine and shortening, and is also incorporated into fat blends and a wide variety of food products.[3]

**FACT 4:** It contains an equal proportion of saturated and unsaturated fatty acids, containing about 40% oleic acid (monounsaturated), 10% linoleic acid (polyunsaturated), 44% palmitic acid (saturated) and 5% stearic acid (saturated).[3,4]

**FACT 5:** Its fatty acid composition is like that of human milk.[18]

**FACT 6:** Although there is a tendency to group palm oil with, palm kernel and coconut oils, palm oil should be distinguished from the latter two oils by its lower level of saturation and its lack of shorter chainlength fatty acids, such as capric, lauric and myristic.[4]

**FACT 7:** Preliminary results from recent human feeding studies conducted in Asia, namely, Malaysia and Pakistan, have shown that a palm oil-enriched diet did not raise blood cholesterol, but in fact reduced the levels of blood cholesterol and LDL-cholesterol compared with diet containing coconut oil, butterfat, vegetable ghee or hydrogenated cottonseed oil.[12,13]

**FACT 8:** Several human feeding studies using formula diets conducted in the U.S., not specifically designed to study palm oil, have revealed that a palm oil diet lowered plasma cholesterol compared with the starting periods during which the subjects were eating their habitual Western diets.[14,15]

**FACT 9:** As opposed to tallow, lard, dairy fat, and lauric oil, a palm oil diet lowered the levels of blood cholesterol and LDL-cholesterol in experimental animals.[7,9,10]

**FACT 10:** A palm oil diet fed to hamsters (which are regarded as a good model for the study of lipoprotein metabolism) leads to synthesis of the highest amount of the *protective* HDL-cholesterol and the greatest production of liver LDL receptors (key to removal of *harmful* LDL-cholesterol) of several fats tested including an American fat blend.[11]

**FACT 11:** Palm oil, as used in the U.S., is a rich source of Vitamin E -- the tocopherols and tocotrienols, with the latter predominating.

The following beneficial effects have been shown for tocopherols and tocotrienols in animal studies:

- Tocotrienols suppress cholesterol production in the liver.[19]
- Tocotrienols lower the level of serum cholesterol and damaging LDL-cholesterol.[19]
- Tocopherol and tocotrienols are anti-aggregatory to blood platelets, thereby reducing tendency for thrombosis.[20]
- Tocopherol and tocotrienols promote prostacyclin production, leading to a vasodilatory and anti-thrombotic state.[21]

- Tocopherol and tocotrienols give protection against certain types of experimental cancers.[22,23]

- Tocopherol (and tocotrienols) enhance the body's defense mechanism against infections.[24]

- Tocopherol and tocotrienols are natural anti-oxidants. They act as scavengers of damaging oxygen-free radicals that are hypothesized to play a role in cellular aging, atherosclerosis and cancer.[25-28]

**FACT 12:** Animals fed a palm oil-enriched diet have shown a reduced tendency for their blood to clot.[6] This beneficial anti-thrombotic effect may be associated with its ability to promote a favorable shift of two local hormones, prostayclin and thromboxane.[5-9]

**FACT 13:** A palm oil diet, as opposed to diets containing animal fats, or vegetable oils from corn or soybean, has a protective effect on the development and incidence of chemically induced breast cancer in an animal model.[16,17]

**FACT 14:** Unrefined palm oil is the richest source of beta-carotene, which is widely regarded as an anti-cancer agent of great promise.[29] Unrefined palm oil is currently used in a number of other countries.

**FACT 15:** Palm oil, like any other vegetable oil, is cholesterol-free.[4]

**FACT 16:** Palm oil does not contain trans-fatty acids and uncommon cis fatty acids found in hydrogenated fats. There is some evidence suggesting that trans-fatty acids (even though unsaturated) may act as saturated fatty acids.[30,31]

# EFERENCES


1 MacFarlane, N., Swetman, A.A. and Coursey, D.G. (1984) Comparison of traditional and industrial palm oil. Secretariat and Observers Papers, Appendix 4, Report No.4. In: *Proceedings of Second African Palm Oil Processing Workshop*, Nigeria, 5-9 December 1983. FAO, Rome, 1984.

2 Calloway, D.H. and Kurtz, G.W. (1956) The absorbability of natural and modified fats. *Food Research* 21: 621-629.

3 Pantzaris, T.P. (1987) Pocket Book of Palm Oil Uses, PORIM 1988.

4 Agriculture Handbook No. 8-4. Composition of foods. United States Department of Agriculture. Science and Education Administration. Washington, D.C. 1979.

5 Hornstra, G. (1988) Dietary lipids and cardiovascular disease: Effects of palm oil. *Oleagineux* 43: 75-81.

6 Rand, M.L., Hennissen. A.A.H.M. and Hornstra, G. (1988) Effects of dietary palm oil on arterial thrombosis, platelet responses and platelete membrane fluidity in rats. *Lipids* 23: 1019-1023.

7 Sugano, M. (1987) One counterargument to the theory that tropical oils are harmful. *Lipids* (Japanese) 40: 48-51.

8. Abyerwardena, M.Y., McLennon, P.L., and Charnock, J.S. (In press) Increase in myocardial PGI/TXA balance following long-term palm oil feeding in the rat. *J. Molec. Cell. Cardiol.*

9. Lee, J.H., Taguchi, S., Ikeda, I., and Sugano, M. (1988) The P/S ratio of dietary fats and lipid metabolism in rats: gammalinolenic acid as a source of PUFA. *Agric. Bio. Chem.* 52: 3137-3142.

10. Kris-Etherton, P.M., Ho, C.Y. and Fosmire, M.A. (1984) Effect of dietary fat saturation on plasma and hepatic lipoprotein in the rat. *J. Nutr.* 144: 1675-1682.

11. Hayes, K.C., Lindsey, S., Pronczuk, A., and Dobbs, S. (1988) Dietary 18:1/18:2 ratio correlates highly with hepatic FC and mRNAs for apo A1, apo E, and the LDL receptor. *Circulation* 78 (suppl 11): 96.

12. Lim, J.B. Ng, T.K.W., Hassan, K., Lye, M.S. and Ishak, R. (1988) Hypocholesterolemic effects of a palm oil diet on human volunteers. Presented at the National Conference on Oil Palm/Palm Oil, 11-15 October 1988, Kuala Lumpur, Malaysia

13 Khan, S.A., Chughtai, A.B., Khalid, L. and Jafry, S.A. (1988) Comparative physiological evaluation of palm oil and hydrogenated vegetable oils in Pakistan. Presented at the National Conference on Oil Palm/Palm Oil, 11-15 October 1988, Kuala Lumpur, Malaysia.

14. Mattson, F.H. and Grundy, S.M. (1985) Comparison of effects of dietary saturated, monounsaturated, and polyunsaturated fatty acids on plasma lipids and lipoproteins in man. *J. Lipid Res.* 24: 194-202.

15. Bonanonme, A. and Grundy, S.M. (1988) Effect of dietary stearic acid on plasma cholesterol and lipoprotein levels. *N. Engl. J. Med.* 318: 1244-1248.

16. Sylvester, P.W., *et al* (1986) Comparative effects of different animal and vegetable fats fed before and during carcinogen administration on mammary tumorigenesis in rats. *Cancer Res.* 46: 757-762.

17. Sundram, K., Khor H.T. and Ong, A.S.H. (In press) Effect of dietary palm oils on mammary carcinogenesis in female rats induced by 7, 12-dimethylbenz (a) anthracene. *Cancer Res.*

18. Patton, S., and Jensen, R.G. (1975) Lipid metabolism and membrane functions of the mammary gland. *Prog. Chem. Fats Other Lipids.* 14: 167-277.

19. Qureshi, A.A., Burger, W.C., Peterson, D.M. and Elson, C.E. (1986) The structure of an inhibitor of cholesterol biosynthesis isolated from barley. *J. Biol. Chem.* 261: 10544-10550.

20. Steiner, M. and Anastasi, J. (1975) Vitamin E and platelet aggregation. *J. Clin. Invest.* 57: 732-737.

21. Chan, A.C and Leith, M.K. (1981) Decreased prostacylin synthesis in vitamin E deficient rabbit aorta. *Am. J. Clin. Nutr.* 34: 2341-2347.

22. Kato, A., Yamoka, M. Tanaka, A., Komiyama, K. and Umezewa, I. (1985) Physiological effect of tocotrienol. *Yukagu* (J. Japan. Oil Chem. Soc.) 34: 375-376.

23. Tengerdy, R.P. Effect of vitamin E on immune response. In *Vitamin E, A Comprehensive Treatise,* ed. by L.J. Machlin, Marcel Dekker, Inc., New York 1980, pp. 495-512.

24. Corwin, L.M. and Gordon, L.M. (1982) Vitamin E and immune regulation. *Ann. N.Y. Acad. Sci.* pp. 437-451.

25. Walton, J.R. and Packer, L. Free radical damage and protection: Relationship to cellular aging and cancer. In: *Vitamin E, A Comprehensive Treatise,* ed. by L.J. Machlin, Marcel Dekker, Inc., New York 1980, pp. 495-512.

26. Hirai, S., Okamoto, K. and Morimatsu, M. Lipid peroxide in the aging process. In: *Lipid Peroxides in Biology and Medicine* ed. by K. Yagi, Academic Press, New York 1982, pp. 305-314.

27. Cross, E.E., (1987) Oxygen radicals and human disease. *Ann. Intern. Med.* 107: 526-545.

28. Chisolm, G.M. and Morel, D.W. (1988) Lipoprotein oxidation and cytoxicity: effect of probucol on streptozotocon-treated rats. *Am. J. Cardiol.* 62: 20B-26B.

29. Temple, W.J. and Basu, T.K. (1988) Does beta-carotene prevent cancer? A critical appraisal. *Nutr. Res.* 8: 685-701.

30. Life Sciences Research Office. The Health Aspects of Trans-Fatty Acids. Federation of American Societies for Experimental Biology. Bethesda, MD 1985.

31. Report of the Ad Hoc Committee on the Composition of Special Margarines. Ministry of Supply and Services, Ottawa, Canada 1980.

# Efectos nutricionales del aceite de palma*

**HECHO 1:**
La historia del aceite de palma como aceite comestible es larga y data de más de 5.000 años atrás.

**HECHO 2:**
Al igual que otras grasas y aceites comestibles comunes, el aceite de palma se absorbe fácilmente y se digiere y utiliza en el organismo, lo cual contribuye a un crecimiento saludable.

**HECHO 3:**
Hoy en día, el aceite de palma se consume a nivel mundial como aceite de cocina y en forma de margarina y grasa para hornear. Además, se incorpora a las mezclas de grasas en una amplia variedad de productos comestibles.

**HECHO 4:**
Contiene ácidos grasos saturados e insaturados, en igual proporción, con aproximadamente un 40% de ácido oleico (monoinsaturado), un 10% de ácido linoleico (polinsaturado), un 44% de ácido palmítico (saturado) y un 5% de ácido esteárico (saturado) 3,4

**HECHO 5:**
Su composición de ácidos grasos es similar a la de la leche humana. 18

**HECHO 6:**
Aunque existe la tendencia a clasificar el aceite de palma dentro de la misma categoría del de palmiste y coco, el primero debe diferenciarse de los últimos, debido al bajo nivel de saturación y a que carece de ácidos grasos de cadena corta, los cuales aumentan el colesterol, como el cáprico, láurico y mirístico. 4

**HECHO 7:**
Los resultados preliminares de estudios alimentarios recientes conducidos en Asia –Malasia y Pakistán– han demostrado que la dieta a base de aceite de palma no aumenta el colesterol sanguíneo sino que de hecho reduce el nivel del mismo en la sangre. Así mismo, reduce el nivel de las lipoproteínas de baja densidad, a diferencia de las dietas a base de aceite de coco, mantequilla, ghee vegetal o aceite hidrogenado de algodón. 12

**HECHO 8:**
Varios estudios alimentarios, en los cuales se utilizaron diversas fórmulas dietarias, conducidos en los Estados Unidos, aunque no específicamente diseñados para estudiar el aceite de palma, revelan que la dieta a base de aceite de palma reduce el colesterol plasmático, a diferencia de los períodos iniciales, durante los cuales los sujetos de los estudios consumían la dieta occidental habitual. 14,15

**HECHO 9:**
A diferencia del sebo, la manteca de cerdo, las grasas lácteas, y los aceites de coco y palmiste, la dieta a base de aceite de palma reduce el nivel de colesterol sanguíneo y de las lipoproteínas de baja densidad en animales experimentales. 7,9,10

**HECHO 10:**
La dieta a base de aceite de palma en los hamsters (los cuales se consideran un buen modelo para el estudio del metabolismo de las lipoproteínas) conduce a la síntesis de una gran cantidad de lipoproteínas de alta densidad, las cuales protegen el organismo contra el colesterol, y a una mayor producción de receptores hepáticos de las lipoproteínas de baja densidad (que son la clave para la remoción del colesterol nocivo de las lipoproteínas de baja densidad). Se estudiaron varias grasas, incluyendo la mezcla típica norteamericana. 11

**HECHO 11:**
El aceite de palma, como se utiliza en Estados Unidos, es una fuente rica en Vitamina E –predominan con ella los tocoferoles y tocotrienoles.

Los siguientes efectos benéficos de los tocoferoles y tocotrienoles se han demostrado en los animales:

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* Declaración dada a la prensa por el señor Y Bhg Datuk Prof Augustine S.H. Ong el 6 de marzo de 1989 en Washington, D.C.
**Fuente**: Oil Palm Developments 10.

- Los tocotrienoles reducen la producción de colesterol en el hígado. 19

- Los tocotrienoles reducen el nivel de colesterol sérico y de las lipoproteínas de baja densidad. 19

- Los tocoferoles y tocotrienoles desagregan las plaquetas sanguíneas y por lo tanto reducen la tendencia a la trombosis. 20

- Los tocoferoles y tocotrienoles promueven la producción de prostaciclina, la cual conduce a un estado de vasodilatación anti-trombótica. 21

- Los tocoferoles y tocotrienoles protegen el organismo contra algunos tipos de cáncer inducidos en forma experimental. 22,27

- Los tocoferoles (y tocotrienoles) optimizan el mecanismo de defensa del cuerpo contra las infecciones. 24

- Los tocoferoles y tocotrienoles son anti-oxidantes naturales. Actúan como reductores de los radicales del factor libre de oxígeno, los cuales se hipotetizan para desempeñar un papel importante en el envejecimiento celular, la arteroesclerosis y el cáncer. 25,28

**HECHO 12:**
Los animales alimentados con dietas a base de aceite de palma han demostrado que se reduce la tendencia a la coagulación de la sangre. 6 Este efecto antitrombótico benéfico puede estar relacionado con la capacidad de promover el desplazamiento ...orable de dos hormonas locales, la prostaciclina y el tromboxano. 5,9

**HECHO 13:**
Las dietas a base de aceite de palma, a diferencia de las dietas que contienen grasas animales o aceites vegetales de maíz o soya, proporcionan un efecto de protección contra el desarrollo y la incidencia del cáncer mamario inducido químicamente en modelos animales. 16,17

**HECHO 14:**
El aceite de palma sin refinar es la fuente más rica de beta-carotenos, los cuales se consideran agentes anti-cancerígenos muy prometedores. 29 El aceite de palma sin refinar se utiliza en la actualidad en varios países.

**HECHO 15:**
El aceite de palma, al igual que otros aceites vegetales, no contiene colesterol. 4

**HECHO 16:**
El aceite de palma no contiene trans-ácidos grasos ni los raros ácidos grasos cis que se encuentran en las grasas hidrogenadas. Existen pruebas de que los trans-ácidos grasos (aunque sean insaturados) pueden actuar como ácidos grasos saturados. 30,31

## BIBLIOGRAFIA


1. MacFarlane, N, Swetman, A.A. and Coursey, D.G. (1984) Comparison of traditional and industrial palm oil Secretariat and Observers Papers. Appendix 4. Report No. 4. In: *Proceedings of Second African Palm Oil Processing Workshop*, Nigeria, 5-9 December 1983. FAO, Rome, 1984.

2. Calloway, D.H. and Kurtz, G.W. (1956) The absorbability of natural and modified fats. *Food Research* 21: 621-629.

3. Pantzaris, T.P. (1967) Pocket Book of Palm Oil Uses, PORIM 1988.

4. Agriculture Handbook No. 8-4, Composition of foods. United States Department of Agriculture. Science and Education ministration, Washington, D.E. 1979.

5. Hornstra, G. (1988) Dietary lipids and cardiovascular disease: Effects of palm oil. *Oleagineux* 43: 75-81.

6. Rand, M.L., Hennissen, A.A.H.M. and Hornstra, G. (1988). Effects of dietary palm oil on arterial thrombosis, platelet responses and platelate membrane fluidity in rats. *Lipids* 23: 1019-1023.

7. Sugano, M. (1987) One counterargument to the theory that tropical oils are harmful, *Lipids* (Japanese) 40: 48-51.

8. Abyerwardena, M.Y., McLennon, P.L., and Charnock, J.S. (In press) Increase in myocardial PG1/TXA balance following long-term palm oil feeding in the rat. *J. Molec. Cell. Cardiol.*

9. Lee, J.H., Taguchi, S., Ikeda, I., and Sugano, M. (1988). The P/S ratio of dietary fats and lipid metabolism in rats: gamma-linolenic acid as a source of PUFA. *Agric. Bio. Chem.* 52: 3137-3142.

10. Kris-Etherton, P.M., Ho, C.Y. and Fosmire, M.A. (1984). Effect of dietary fat saturation on plasma and hepatic lipoprotein in the rat. *J. Nutr.* 144: 1675-1682.

11. Hayes, K.C., Lindsey, S., Pronczuk, A. and Dobbs, S. (1988) Dietary 18: 1/18:2 ratio correlates highly with hepatic FC and mRNas for apo A1, apo E, and the LDL receptor, *Circulation* 78 (suppl 11): 96.

12. Lim, J.B., Ng, T.K.W., Hassan, K., Lye, M.S. and Ishak, R. (1988) Hypocholesterolemic effects of a palm oil diet on human volunteers. Presented at the National Conference on Oil Palm/Palm Oil, 11-15 October 1988. Kuala Lumpur, Malaysia.

13. Khan, S.A., Chughtai, A.B., Khalid, L. and Jafry, S.A. (1988). Comparative physiological evaluation of palm oil and hydrogenated vegetable oils in Pakistan. Presented at the National Conference on Oil Palm/Palm Oil, 11-15 October 1988. Kuala Lumpur, Malaysia.

14. Mattson, F.H. and Grundy, S.M. (1985). Comparison of effects of dietary saturated, monounsaturated, and polyunsaturated fatty acids on plasma lipids and lipoproteins in man. *J. Lipid Res.* 24: 194-202.

Jeanrenaud, A. and Grundy, S.M. (1988). Effect of dietary stearic acid on plasma cholesterol and lipoprotein levels. *N. Engl. J. Med.* 318: 1244-1248.

16. Sylvester, P.W., *et al* (1986). Comparative effects of different animal and vegetable fats fed before and during carcinogen administration on mammary tumorigenesis in rats. *Cancer Res.* 46: 757-762.

17. Sundram, K., Khor H.T. and Ong, A.S.H. (In press). Effect of dietary palm oils on mammary carcinogenesis in female rats induced by 7, 12-dimethylbenz (a) anthracene. *Cancer Res.*

18. Patton, S., and Jensen, R.G. (1975). Lipid metabolism and membrane functions of the mammary gland. *Prog. Chem. Fats Other Lipids.* 14: 167-277.

19. Qureshi, A.A., Burger, W.C., Peterson, D.M. and Elson, C.E. (1986). The structure of an inhibitor of cholesterol biosynthesis isolated from barley. *J. Biol. Chem.* 261: 10544-10550.

20. Steiner, M. and Anastasi, J. (1976) Vitamin E, and platelet aggregation. *J. Clin. Invest.* 57: 732-737.

21. Chen, A.C. and Leith, M.K. (1981). Decreased prostacylin synthesis in vitamin E deficient rabbit aorta. *Am. J. Clin. Nutr.* 34: 2341-2347.

22. Kato, A., Yamoka, M. Tanaka, A., Komiyama, K. and Umezawa, I. (1985). Physiological effect of tocotrienol. *Yukagu* (J. Japan. Oil Chem. Soc.) 34: 375-376.

23. Tengerdy, R.P. Effect of vitamin E on immune response. In *Vitamin E, A Comprehensive Treatise*, ed. by L.J. Machlin., Marcel Dekker, Inc., New York 1980. pp. 495-512.

24. Corwin, L.M. and Gordon, L.M. (1982) Vitamin E and immune regulation, *Ann. N.Y. Acad. Sci.* pp. 437-451.

25. Walton, J.R. and Packer, L. Free radical damage and protection: Relationship to cellular aging and cancer, In: *Vitamin E. A Comprehensive Treatise*, ed. by L.J. Machlin, Marcel Dekker, Inc., New York 1980. pp. 495-512.

26. Hirai, S., Okamoto, K. and Morimatsu, M. Lipid peroxide in the aging process. In: *Lipid Peroxides in Biology and Medicine* ed. by K. Yagi, Academic Press, New York 1982, pp. 305-314.

27. Cross, E.E., (1987) Oxygen radicals and human disease, *Ann. Intern. Med.* 107: 526-545.

28. Chisolm, G.M. and Morel, D.W. (1988). Lipoprotein oxidation and cytotoxicity: effect of probucol on streptozotocontreated rats. *Am. J. Cardiol.* 62: 208-268.

29. Temple, W.J. and Basu, T.K. (1988). Does beta-carotene prevent cancer? A critical appraisal, *Nutr. Res.* 8: 685-701.

30. Life Sciences Research Office. The Health Aspects of Trans-Fatty Acids. Federation of American Societies for Experimental Biology. Bethesda, MD 1985.

31. Report of the Ad Hoc Committee on the Composition of Special Margarine. Ministry of Sypply and Services, Ottawa, Canada 1980.