

Nutrition Research on Palm Oil and its Components: The PORIM Experience

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INTRODUCTION

Since its inception in 1979, the Palm Oil Research Institute of Malaysia (PORIM) has emerged as the leader in oil palm and palm oil research. Important contributions from PORIM are also evident in all fields of research on edible oils and fats. Scientific understanding of the nutritional properties of palm oil and its components has been one of the several areas of research focus at PORIM. This research was initiated at the PORIM laboratories in 1983 using an animal model to understand palm oil's effects on cholesterol and plasma lipoproteins.

In the mid-1980s, a barrage of adverse publicity that demeaned the value of palm oil as a food commodity and raised questions regarding its safety for human consumption faced the palm oil industry. This anti-tropical oil campaign waged by a competing producer cashed in on the lack of data on palm oil nutrition that could have otherwise been used to counter the adverse campaign. An executive decision was therefore made to initiate an accelerated research programme that could make significant contributions towards the understanding of palm oil nutrition.

This programme is more than a dozen years today and has yielded a remarkably large volume of scientific papers on the nutritional properties of palm oil and its components. To date, 132 research studies have been undertaken. These have been conducted at the PORIM laboratories and through research collaborations or contracts at some of the most prestigious biomedical

centres of the world. It would therefore appear that within a short span of time, palm oil has emerged as an edible oil that has been studied extensively for its nutritional properties. This is further evidenced by the increasing number of studies that are being undertaken by research laboratories worldwide that are independent of PORIM.

MECHANISMS OF FUNDING NUTRITION RESEARCH AT PORIM

A Programme Advisory Committee at PORIM that is composed of eminent scientists has identified research requirements related to palm oil nutrition. Since its inception, this Committee has met periodically to review the progress of projects and to advise the management on new research directions. At PORIM, a Nutrition Committee headed by the Director-General is tasked with evaluating research proposals that are submitted for funding considerations.

All research proposals are hence scrutinized for their scientific merit and relevance to the palm oil industry's needs. Important considerations are given to the design of the study, research methodology, data management and when applicable, obtaining clearance from their institutional ethics committees for animal and human studies. Over the years, the success rate of applicants has become more competitive. Presently, the average success rate is about 30%. Final approval to fund studies is then obtained from the Palm Oil Research and Development Board.

Projects are also undertaken at PORIM by the Nutrition Research group, which has

a reasonably well equipped laboratory for all aspects of lipid nutrition. In-house projects are also subjected to the above evaluation procedures. In addition, the PORIM Programme Advisory Committee scrutinizes progress at its annual meeting and a science committee headed by the Director-General subjects completed projects to a viva examination. This ensures quality outputs from the PORIM researchers that are comparable to internationally acclaimed nutrition centres.

OBJECTIVES OF NUTRITION RESEARCH

The main objective of PORIM in sponsoring nutrition research was to obtain new data, and to confirm or extend existing data on the wholesomeness and safety of palm oil and its components. This strategy was considered crucial so that the palm oil industry could continue to maintain and further exploit the growing market for edible oils and fats in which more than 85% of world's palm oil production is used for human consumption.

The entire PORIM research programme has focussed on the following areas of importance:

1. Effects of palm oil and its components on Coronary Heart Disease (CHD).
2. Effects of palm oil on experimental carcinogenesis.
3. Nutritional effects of the minor components of palm oil with particular reference to palm vitamin E (tocotrienols) and carotenoids.

In its effort to tap the best research brains in the field of lipid nutrition, PORIM made conscious efforts to commission these projects at leading biomedical laboratories around the world. Invariably, the bulk of these studies were commissioned in the United States and Canada where most of the existing expertise in oils and fats nutrition research was apparent. As a result, 58 projects or 44% of the total studies were undertaken in the United States and Canada. Other regions included Europe, Australia, Asia Pacific, Middle East and Africa (*Table 1*).

TABLE 1. PORIM NUTRITION RESEARCH PROGRAMME (1983-1998)
REGIONAL DISTRIBUTION OF PROJECTS

Region	Coronary Heart Disease		Palm Vitamin E		Carcinogenesis		Red Palm Oil		Other Studies		Total	
	C	OG	C	OG	C	OG	C	OG	C	OG	C	OG
USA/Canada	21	4	16	3	7	1	1	2	3	-	48	10
Europe	6	-	2	-	-	-	-	1	1	-	9	1
Australia	7	-	5	-	-	-	-	-	-	-	12	-
Asia Pacific/ Middle East	10	1	-	-	-	1	-	3	-	-	10	5
Africa	-	1	-	-	-	-	-	1	-	-	-	2
Malaysia												
(i) PORIM												
(ii) Others	5	3	4	3	2	3	1	-	-	1	12	10
	6	-	2	-	3	1	-	-	1	-	11	2
	55	9	29	6	12	6	2	7	5	1	102	30
Total	64		35		18		9		6		132	

C: completed
OG: on-going

A special effort was also made to develop expertise within the country (Malaysia). Local universities and the Institute of Medical Research were encouraged and contracted to undertake studies whenever trained expertise was available. As a result, 13 projects were executed by Malaysian institutions (excluding PORIM).

The pool of research officers at PORIM itself has been increased gradually and presently represents five trained officers and supported by a nutrition consultant. The scope of research at PORIM has also widened and present day studies constitute human clinical trials supplemented by animal and cell culture studies. To date, PORIM has undertaken 22 projects representing 16.7% of the entire research programme. These studies have been very successful and evidenced by the high quality publications by the Nutrition Research Group in international peer reviewed journals. With the availability of better research facilities at PORIM, the group's contribution is expected to increase further.

ACHIEVEMENTS OF THE PORIM NUTRITION RESEARCH PROGRAMME

Effect of Palm Oil and its Components on Coronary Heart Disease (CHD)

Research into the effects of palm oil on CHD was viewed as the most important requirement in order to win consumer confidence. This was hence assigned the highest priority and 64 projects were commissioned and sub-divided as follows:

1. Blood lipids, lipoproteins and fatty acid effects (animal models).
2. CHD risk in humans.
3. Effects on atherosclerosis.
4. Effects on thrombosis and cardiac arrhythmia.

Palm oil containing almost 50% of its composition as saturated fatty acids was postulated to increase CHD risk by increasing plasma total and LDL cholesterol levels. Generalisation of results from the early

American studies was assumed to support this hypothesis. However, newer studies commissioned by PORIM addressed these questions through research that were better designed and measured a wide variety of associated risk parameters. Both animal and human studies provided new evidence that palm oil did not behave like a saturated fat and did not increase the risk for heart disease.

The human studies were especially convincing since they showed that the effects of palm olein were comparable to that of olive, canola, rapeseed, ricebran and soyabean oils. PORIM's research findings even challenged the classical Keys-Hegsted equations used to predict plasma cholesterol levels. It became evident, from these studies, that not all saturated fatty acids were equal in their cholesterol raising effects. Palmitic acid, the major saturated fatty acid in palm oil was demonstrated to be neutral in its ability to increase plasma cholesterol levels. Presently, mechanistic studies to elucidate the neutrality of palmitic acid are underway. These studies, using stable isotopes in humans and iodinated lipoproteins in animals are expected to have a major impact on understanding fatty acid effects on plasma cholesterol synthesis.

There are presently many debates on the safety on hydrogenated fats for human consumption since they increase CHD risk by increasing total and LDL-cholesterol while depressing HDL-cholesterol. Attempts are underway to either reduce or eliminate *trans* fatty acids from many solid fat formulations. We are of the opinion that palm oil is a natural choice as the replacement fat in such solid fat formulations. Human studies at PORIM and elsewhere, have also demonstrated that palm oil decreases CHD risk relative to hydrogenated fats. This is presently being viewed as a major advantage for palm oil in food formulations requiring solid fats.

The findings on the hypocholesterolemic effects of palm oil have also been matched by favourable observations in animal stud-

ies of atherosclerosis (hardening of the arteries due to fatty deposition), thrombosis (blood coagulation effects) and cardiac arrhythmia. These studies again provide evidence that palm oil does not generally promote the above mentioned clinical manifestations that are harmful in humans.

Effects of Palm Oil on Experimental Carcinogenesis

Animal studies initiated at PORIM provided evidence that palm oil inhibited the progression of chemically induced cancers in animals. Independent researchers subsequently confirmed these observations. In an effort to identify the anti-cancer fraction(s) in palm oil, research was focussed on its minor components namely the tocotrienols and carotenoids. Tocotrienols in palm vitamin E have been shown to inhibit the proliferation of human breast cancer cells in culture. The results are promising and pilot human studies have been initiated.

The palm carotenoids have also been shown to have anti-cancer effects. For example, palm carotenoids conferred greater protection against liver and lung cancer in mice than synthetic beta-carotene. Alpha-carotene present in palm oil has potent anti-cancer properties in a variety of cancer models. This is considered important in light of the negative publicity associated with synthetic beta-carotene preparations. Studies examining palm carotene concentrates in cancers of the colon and skin are presently in progress. A total of 18 projects were commissioned to examine the effects of tocotrienols and carotenoids on different types of cancer.

Nutritional Effects of Palm Minor Components

Palm vitamin E (tocopherols and tocotrienols) and the carotenoids are the most important minor constituents of palm oil. PORIM has developed patented technologies to isolate and concentrate these natural components of interest.

The tocopherols and tocotrienols in palm oil are natural vitamin E active components and have potent anti-oxidant properties. Tocotrienols have been demonstrated to have unique nutritional and physiological properties, the most important of which appear to be its cholesterol lowering effects. PORIM has commissioned a number of animal, human and cell culture studies to elucidate the cholesterol lowering effects of palm vitamin E and the tocotrienols. Our present understanding suggests that the tocotrienols have the ability to inhibit HMG-CoA reductase activity, which regulates cholesterol synthesis in the liver. It also appears that the tocopherol content in palm vitamin E mixture (approximately 30%) can interfere with the cholesterol lowering potential of the preparation. In addition, tocotrienols have shown significant promise as natural anti-oxidants and as possible anti-cancer agents. Their biological anti-oxidant capacity has been estimated to be several times higher than that of alpha-tocopherol. This area is being pursued actively. A total of 35 projects have been commissioned to elucidate the nutritional properties of palm vitamin E and carotenoids.

RED PALM OIL

Red palm oil is presently being produced commercially through a patented technology developed at PORIM. This product has a high content of carotenoids (500ppm) with beta- and alpha-carotene predominating. This has been tested for its pro-vitamin A efficacy in a total of five human trials. It has been reported that the pro-vitamin A effect of red palm oil is often better than that of synthetic beta-carotene preparations. Moreover, its presentation as edible oil confers better stability against loss of carotene activity. This was demonstrated in a study using carotene-enriched biscuits made from red palm oil. Despite normal baking temperatures used in making the biscuits, carotene retention was almost 80% of the initial value and sufficient to meet the vitamin A requirements of a child.

Red palm oil has also been demonstrated to have protective effects in an atherosclerosis rabbit model by reducing the number of fatty lesions in the aortic and thoracic arches. These research efforts are progressing well. A total of nine projects were commissioned in this area of interest.

RESEARCH OUTPUTS

The large number of publications on palm oil nutrition that have emerged as a result of the PORIM nutrition research programme best measures our achievements and success. Without the strong and persistent commitment from PORIM in commissioning these projects, the understanding of palm oil nutrition would have been rather poor. Present knowledge has positioned palm oil favourably and helped to garner and maintain the market share for palm oil.

PORIM Funded Research Findings Published in Journals

Names of Journals/Supplements	No. of Papers
1. American Journal of Clinical Nutrition 1991	18
2. Nutrition Research 1992	22
3. United Nations University Food & Nutrition Bulletin 1993	7
4. Journal of Nutritional Biochemistry 1995	6
5. LIPIDS 1995	7
6. Journal of Nutrition 1997	7
7. Asia Pacific Journal of Clinical Nutrition 1997	16
8. Independent Peer Reviewed Journal Publications*	40
Total	124

* Estimated number

The PORIM International Palm Oil Congresses (PIPOC) have also been instrumental in disseminating research findings on palm oil nutrition. Since 1991, every PIPOC Nutrition Conference has resulted in the publication of a supplementary issue of an international journal devoted to palm oil nutrition. This effort has been a great boost

to overcome any pockets of adverse publicity and to win over skeptics. The journal publications have acquired a tradition of international respectability since the papers published therein have all been peer-reviewed. In addition, researchers have also independently published their findings in a large number of scientific journals. Also on record, more than 200 conference presentations have resulted from these nutritional studies.

This tradition will be continued at the 1999 PORIM International Palm Oil Congress. A total of 33 presentations have been confirmed for the PIPOC 1999 Nutrition Conference. Once again, this will provide a state-of-art forum for discussions on palm oil nutrition and map out future research directions that will be useful to the industry.

CONCLUSIONS

The research programme devised at PORIM to elucidate the nutritional properties of palm oil and its components can be considered a successful one. The large number of publications in the literature has forced many to re-look at the data and to re-consider their views on the subject. This has helped the industry greatly through a greater acceptance of palm oil and its fractions. Nevertheless, many pockets of resistance are still evident. Scientific knowledge on oils and fats in general has also been enriched.

We do not claim to have solved all the issues related to the subject. As a result, research in this area will be continuous. It is anticipated that PORIM will again subject the existing programme to a fresh review process and new research ideas to fill existing gaps in our knowledge will be encouraged. This process will also be assisted by the large number of active nutrition researchers attending the 1999 PIPOC in February 1999. The discussions at the meeting and views of these scientists will most likely form the basis of our research strategy in the new millenium.

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