Olive Oil and Palm Oil: The Myths and the Facts

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INTRODUCTION

Many Greek young men have always wondered why longevity is a common phenomenon in their Greek village. Their parents had lived to a ripe old age and so did their grandparents. They were told that the phenomenon may be due to the Mediterranean diet.

People living in the Mediterranean such as in Greece, Italy, and Crete have been consuming their traditional diets for generations. These traditional diets, collectively called the Mediterranean Diet, with its apparent health benefits have baffled both the scientist and the layman. *What is so special about the Mediterranean diet?* There is no single version of the Mediterranean diet, but common dietary features include plenty of fruits, vegetables, wheat, and the most common food ingredient in the Mediterranean cuisine - olive oil (Nestle, 1995). This edible oil comes in 'virgin' and 'double virgin' forms and has become a hit as salad dressing not only in the Mediterranean region, but also in several countries around the globe.

The total fat intake among the population are relatively high, ranging from 25%-40% energy or more, depending on the country (Serra-Majem *et al.*, 2003). Forty percent energy fat is high by any standard but Mediterranean populations continue to enjoy longer longevity and a lower prevalence of cancer and coronary heart disease (CHD) compared to their European counterparts in other nations. This is supported by The Seven Countries study which showed that the Mediterranean populations had low rates of death attributed to CHD in the 1960s and 1970s (Keys *et al.*, 1986). This fact seems to be in conflict with the recent dietary recommendation in Western countries that limit total fat intake to 30% energy or lower (Serra-Majem *et al.*, 2003).

Olive oil is reported to have protective effects against CHD, various cancers and age-related cognitive decline (Keys, 1995). Scientists say that these beneficial effects are attributed to:

- a high content of monounsaturated fatty acids (MUFA) [mainly oleic acid (C18:1) ranging from 55%-85%] that exert important effects on lipid profile; and
- rich in antioxidants such as vitamin E and other diverse phenolic compounds (Visioli and Galli, 2001) especially in the extra virgin olive oil. The functions of these phenolic compounds are cardio-protective and anti-inflammatory (Serra-Majem *et al.*, 2003).

Yes, olive oil is a key contributor to the healthy aspects attributed to the Mediterranean diet (Serra-Majem *et al.*, 2003), but only when it is used as a salad oil. When

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used in deep-frying, the monounsaturates-rich olive oil is expected to be unstable and susceptible to the formation of peroxides and polar compounds which may have detrimental effects on health.

MYSTERIES OF THE PALM OIL DIET

Palm oil has been used as an edible oil in Africa for thousands of years and its long history of use testifies for its safety in the human food chain. It is an essential ingredient in the traditional West African cuisine. Palm oil is semi-solid in tropical regions and solid in temperate climates. It has 50% saturated fatty acid [mainly palmitic acid (C16:0)] and 50% unsaturated fatty acid [about 40% oleic acid and 10% linoleic acid (C18:2)] and for this reason, is often regarded as a saturated fat in the dietary recommendations of several countries.

But let's get to know palm oil better. Palm oil can be fractionated into a liquid fraction called palm olein and a solid fraction called palm stearin. Palm oil can also be processed to meet the many different requirements of the food industry. As such, the oil has a myriad of food applications. However, its liquid fraction, palm olein, is used extensively in Southeast Asian countries, including Malaysia, Singapore, China, Thailand, and others, in cooking and the food industry.

Palm olein contains approximately 42% MUFA. According to Malaysian Food Regulation, it may be regarded as MUFA oil, just like olive oil. Unlike olive oil, however, palm olein is very stable for cooking and frying.

By the wonders of innovative processing technology, palm oil is also marketed as red palm oil (RPO) with the bulk of natural carotenes retained together with the powerful antioxidants-btocotrienols, a form of vitamin E which are also cardioprotective, anti-cancer and anti-inflammatory. RPO has been used in food-based strategies to combat vitamin A deficiency in impoverished regions of third world countries (Rukumini and Benade, 1996).

THE FACTS

The Position Matters

Unlike other saturated fats, palm oil has a unique fat structure. Its major fat molecules have a fascinating 3-dimensional structure. Even though the major fatty acid present in palm oil is palmitic acid, however, this saturated fatty acid is distributed primarily at the two extreme ends of the fat molecules backbone namely stereospecific number 1 and -3 (sn-1 and -3) (*Figure 1)*. In contrast, other edible oils such as lard has the palmitic acid sitting in the middle of the fat backbone namely sn-2 position. Although the fatty acid composition of palm oil and lard are similar, however, instead of palmitic acid, oleic acid is the main fatty acid located in the sn-2 position in palm oil alongside with linoleic acid.

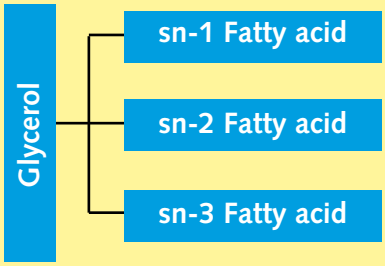

Figure 1. Structure of a fat molecule.

The fatty acid situated at the sn-2 position will be absorbed intact and has downstream influence on lipid metabolism (Hayes, 2001). The recent human post meal feeding studies (Sanders *et al.*, 2011; Teng *et al.*, 2011) results tend to support this sn-2 paradigm. Teng *et al.* found that palm olein and olive oil have similar post meal lipid trend (postprandial lipemia) but differ with that of a high lard test meal. Sanders *et al.* found that the lipid trend in human is similar after a palm olein and or a high oleic sunflower oil rich meal were ingested. In addition, in terms of post meal lipid trend, the sn-2 palmitic acid rich meals differ with the sn-2 oleic acid rich meal. The key point is that the unsaturated part of palm oil is absorbed intact as a sn-2 monoglycerides while the saturated part at the sn-1 and -3 fatty acids are absorbed as free fatty acids that metabolize independently (Hayes, 2001). It is also noted that long chain saturated fatty acid (*e.g.* fatty acid with chain length greater than 12 carbon atoms) situated at the sn-1 and -3 positions are reassembled into new fat molecules (triglycerides structures) which is slower than the short and medium chain fatty acid and hence might lower secretion into the blood stream. These long chain fatty acids normally have higher melting point than body temperature and therefore they tend to form calcium soap and are excreted in the form of faeces (Mu and Hoy, 2004).

These unique three dimensional structures together with the natural occurring goodness in palm oil give the reason why palm oil

behave very differently from other fats that have been labelled as saturated fats by the Western countries.

Identical Total Unsaturated Fat

The sn-2 positional distribution of triglycerides profile of olive oil and palm olein is shown in *Figure 2*. The total unsaturated fats in palm olein and olive oil are identical which is 94% and 98% respectively. In our unpublished data, palm olein has 68% of oleic acid at the sn-2 position while olive oil has 84%. Apart from that, palm olein also contains high linoleic acid at the sn-2 position which is 26% compared to 12% in that of olive oil. Scientists have found that linoleic acid in the sn-2 position is beneficial to HDL (good-cholesterol) pool (Hayes, 2001). Interestingly, in palm olein and olive oil, the palmitic to linoleic ratio is low (0.2) and identical to each other. Therefore, there is possibility that the cholesterol raising effect of a palmitic acid (in sn-1, and -3) could be masked by the presence of the linoleic acid. Again, these similarities between palm olein and olive oil have attracted scientists to compare the effects of these two oils on the risk markers of cardiovascular disease.

STUDIES ON OLIVE OIL *vs.* PALM OLEIN

Since palm oil is regarded as a saturated fat, most scientists would expect that palm oil will raise the CHD risk profile of consumers. However, several scientific studies have not supported this expectation.

In the 1990s, Hayes *et al.* reported that palmitic acid from palm oil is essentially non-cholesterolemic in non-human primates. The Keys and Hegsted regression equations gave a good fit and the predicted total cholesterol response gave a regression, r of 0.995 for both equations when palmitic acid was considered neutral and being removed from the equation (Keys, 1957 and Hegsted, 1965). Therefore, under these conditions palmitic acid was found to be less cholesterolemic than lauric and myristic acid (C12:0 + 14:0) mixtures. Following this, Malaysian and Australian studies conducted by Ng *et al.* and Choudhury *et al.* have reported that palm olein diet behaved identically with olive oil diet in terms of lipid risk markers (*e.g.* total cholesterol, high density lipoprotein (HDL-good cholesterol), low density lipoprotein (LDL-bad cholesterol) and plasma triglycerides). In 2000, Truswell suggested the reason for no reduction of total cholesterol on olive oil compared with palm olein was due to the higher linoleic and phytosterols in palm olein and higher squalene in the olive oil.

In 2011, Voon *et al.* reported the similar outcomes as the earlier studies in a human dietary feeding trial with a diet formulated with high protein (20% energy) and 30% energy of experimental fats. The recent findings show that palm olein is not significantly different with olive oil in lipid risk markers as well as non lipid risk markers (*e.g.* total homocysteine, inflammatory cytokines *e.g.* high sensitive C-reactive protein, interleukin-6, tumor necrosis factor-α *etc.*) in healthy Malaysian adults. In contrast, in a Danish study conducted by Tholstrup *et al.*, palm olein was reported to raise LDL moderately compared to olive oil diet but there is no clinical significant. Interestingly, Tholstrup *et al.* also found that palm olein decreased the plasma triglycerides levels significantly compared to that of olive oil diet and the reason is unexplainable. However, results from Tholstrup *et al.* contradict with the earlier 3 studies in terms of LDL. Nevertheless, all four studies reported a similar total/HDL-cholesterol ratio in both palm olein and olive oil di-

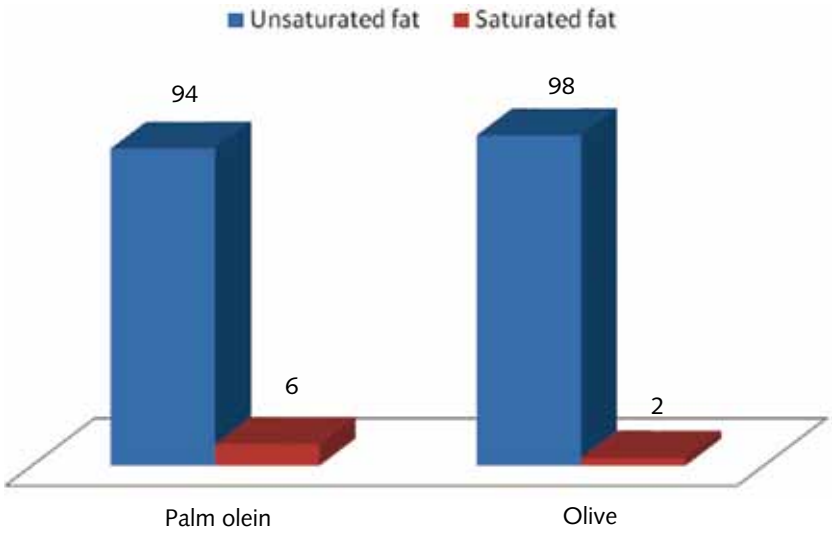

Figure 2. The sn-2 fatty acids of palm olein and olive oil.

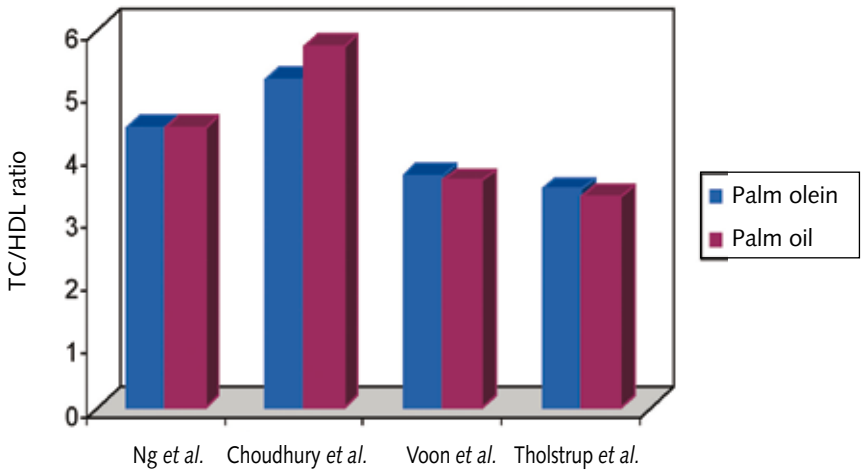

Figure 3. The insignificant effect of palm olein vs. *olive oil on total/HDL ratio.*

ets *(Figure 3).* It is known that total/HDL-cholesterol ratio is a more robust marker of cardiovascular risk (Lewington *et al.,* 2007).

TAKE HOME MESSAGES

The health impact of edible oils cannot be judged solely on their fatty acid composition because not all SFAs have the same impact on the cardiovascular risk profile. Several other aspects, such as content of micronutrients and the 3-dimensional structure of fat molecules need to be taken into consideration. Scientists so far have found that olive oil and palm olein have comparable non-adverse effects on CHD risk. As far as cooking and frying operations are concerned, palm oil is definitely more stable than olive oil due to its natural high oxidative stability.

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