

Omega-3 Fatty Acids: Potential Sources in the Malaysian Diet with the Goal Towards Achieving Recommended Nutrient Intakes

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ABSTRACT

Omega-3 fatty acid nutrition is widely recognised as essential to health and general well-being. However, health professionals and the general public in Malaysia may lack knowledge on the sources or the amounts of these essential fat components in foods. This paper attempts to correct this scenario by identifying the potential sources of omega-3 fatty acids [α -linolenic acid (ALA), or eicosapentaenoic acid (EPA) + docosahexaenoic acid (DHA)] in the Malaysian diet and calculating the amounts of these “nutrients” provided per serving of a wide variety of foods. The information generated provides Malaysian health professionals and consumers with options in food choices or meal planning with the goal towards achieving the recommended nutrient intakes for omega-3 fatty acids. The findings in the present study revealed that the potential sources of omega-3 fatty acids in the Malaysian diet in decreasing order are: edible oils (ALA), fish and fish products (EPA+DHA), vegetables (ALA), meat and eggs (EPA+DHA), and milk/milk products (EPA+DHA). Edible oils which are exceptionally high in ALA such as flaxseed oil and perilla oil are presently unavailable at local retail outlets and supermarkets. However, consumers can still meet the recommended nutrient intakes (RNIs) for omega-3 fatty acids of 0.3 to 1.2% energy (equivalent to 0.67g-2.67g) by choosing a well-balanced diet prepared preferably with a cooking oil blend containing ALA, and one or more servings daily from at least three of the following food groups: (i) fish (“jelawat”, “siakap”, sardines, tuna, mackerel, salmon)/seafoods (shrimps, crab)/meat, (ii) vegetables/soybean/soybean-based products/beans and peas, (iii) omega-3 enriched/fortified foods (eg. “omega-3 eggs”), and (iv) ready-to-drink omega-3 milk preparations/soybean milk.

INTRODUCTION

Dietary fats and oils, often portrayed as “bad guys” in the health columns of the popular press, are actually very important food components for our nutritional well-being. They provide the essential fatty acids (EFAs), are important components of

cell membranes, impart taste and texture to foods, and are precursors of the “local hormones” called eicosanoids which regulate body metabolism including arterial thrombosis tendency (NCCFN, 2005). Fatty acids are the building blocks of dietary fats. Unsaturated fatty acids comprise three large families, namely the

omega-6, omega-3 and omega-9 fatty acids. Of these, the omega-6 linoleic acid (LA: 18:2, n-6) and the omega-3 α -linolenic acid (ALA: 18:3, n-3) cannot be synthesised by the body and are known as essential fatty acids (EFAs). These EFAs are polyunsaturated fatty acids (PUFAs) with LA being abundant in common PUFA-rich vegetable oils such as corn oil, soybean oil and sunflower oil.

There are three major omega 3 fatty acids that are ingested in foods and used by the body, namely ALA (18:3, n-3), EPA (20:5,n-3), and DHA (22:6, n-3). Once consumed, the body metabolises ALA to the longer-chain EPA and DHA, the two types of omega-3 fatty acids more readily used by the body (British Nutrition Foundation, 1992). Scientific research indicates that omega-3 fatty acids can either reduce risk or help attenuate the following conditions: heart disease (Dyerberg *et al.*, 1978) or sudden cardiac death (Albert *et al.*, 1998), hypertriglyceridaemia (Davidson *et al.*, 1997; Covington, 2004), hypertension (Andreassen *et al.*, 1997), inflammation (Calder, 2001), and rheumatoid arthritis (Nordstrom *et al.*, 1995; Volker *et al.*, 2000). In addition, EPA and DHA are highly concentrated in the brain and appear to be particularly important for early development of visual acuity and cognitive function (Birch *et al.*, 2000; Hoffman *et al.*, 2003).

Therefore, it would be prudent to consume sufficient amounts of these omega-3 fatty acids in order to maintain the omega-6/omega-3 fatty acid ratio at 5 to 10 as recommended (IOM, 2002; WHO, 2003; NCCFN, 2005). Apart from the traditional sources of dietary omega-3 fatty acids such as fish oil and vegetable oils (eg. flaxseed oil, canola oil and soybean oil), there have emerged in the local food chain, products enriched with the omega-3 fatty acids, EPA and DHA.

How much of these omega-6 and omega-3 fatty acids do we need? Over the past two decades, recommendations by

the World Health Organisation (WHO) for the intake of LA, which is also the main EFA, have changed in pendulum-fashion from 7% energy (WHO, 1990) to a very high 10% energy four years later (WHO/FAO, 1994), and then lowered to 5-8% energy a decade later (WHO, 2003). The only consistent recommendation concerning PUFAs seems to be that the omega-6/omega-3 fatty acid ratio should be between 5 and 10.

The rationale for the recommended high intakes of LA, the major cholesterol-lowering dietary component, is that this PUFA would counter the cholesterol-raising effects of the dietary C12-16 saturated fatty acids (lauric, myristic and palmitic acids) [WHO/FAO, 1994]. However, this high recommendation of LA in the diet has posed two "problems" with regard to the local diet. Firstly, dietary levels of LA of 5% energy and above can only be achieved with diets prepared with a cooking oil (pure or blended) adequately-rich in LA. Secondly, the high intakes of LA would mean that it would be very difficult for the normal diet to provide sufficient amounts of omega-3 fatty acids to maintain the omega-6/omega-3 fatty acid ratio between 5 and 10, even with a varied and balanced diet.

In cognisance of the above, the Technical Committee for Malaysian Dietary Guidelines has considered the WHO 1990 recommendation of 3 to 7% energy PUFA (LA) as appropriate and has recommended these levels of dietary LA for the Malaysian population (NCCFN, 1999). The same Committee, in updating the Malaysian recommended dietary allowances published by Teoh (1975) 30 years ago, has advocated this range of LA intake with corresponding dietary omega-3 fatty acid levels at 0.3-1.2% energy in the publication "Recommended Nutrient Intakes for Malaysia" (NCCFN, 2005). This range takes care of the basic EFA (as LA) needs of 3% energy, as well as increased LA requirements of 4.5% energy and 7%

energy during pregnancy and lactation, respectively (FAO, 1978).

Currently, health professionals involved with meal planning are focussing primarily on total fat and LA requirements as far as dietary fat nutrition is concerned, with little consideration given to daily omega-3 fatty acid needs. This is mainly due to a lack of knowledge or information on the latter family of fatty acids in local foods. Therefore, this paper identifies in terms of serving sizes, the amounts of omega-3 fatty acids in a wide variety of foods which could be incorporated into the Malaysian diet. At the same time, reference to the recommended nutrient intakes- RNIs for Malaysia (2005) is made in order to gauge what sort of food choices are necessary in order to match up to the RNI for omega-3 fatty acids.

METHODOLOGY

The omega-3 fatty acid content of food items listed in this paper was obtained from the labels of local food products (eg. milk and milk products) as well as from published data on the fatty acid composition of foods. For example, the fatty acid composition of local fish is as cited by Endinseau and Tan (1993) and that of deep-sea marine fish by Fogerty and Svoronos (1987). Where information on local foods are not available, data from corresponding foods in the literature are used (Hepburn *et al.*, 1999).

Serving sizes used are those cited in Tee *et al.* (1997) and on the food labels of the products concerned. The serving size for edible oils is taken as 1 teaspoon (or 6g), cooked vegetables- half a cup (or 50g), and edible portion of fish, 55g.

The ALA provided per serving or 6g of edible oil is calculated from the known ALA content of the oil. For example, canola oil has 11% ALA and one serving of the oil will provide $6 \times (11/100)$ g or 660 mg.

The RNI for omega-3 fatty acids recommended by the NCCFN (2005) is 0.3-1.2% energy. Based on a 2000-kcal diet reference, these amounts of omega-3 fatty acids work out to be $(2000 \times 0.003)/9$ g i.e. 0.67g to $(2000 \times 0.012)/9$ g i.e. 2.67g.

In the same way, the RNI range for omega-3 fatty acids of 1.0-2.0% energy recommended by WHO (2003) works out to be 2.22g (2,220 mg) to 8.89g (8,890 mg), using the same 2000-kcal diet reference.

These minimum values of 0.67g and 2.22g for the Malaysian and WHO RNIs, respectively are marked off in Figure 1 for easier interpretation of the number of servings of food items examined needed to match the authoritative recommendations concerned.

RESULTS

The serving sizes and omega-3 fatty acid content (ALA or EPA + DHA) of a wide variety of foods are shown in Table 1.

The same data is also shown in Figure 1 with reference to the basal RNI for omega-3 fatty acid of 0.3% energy (equivalent to 0.67g) for Malaysians cited by the National Coordinating Committee on Food and Nutrition Malaysia (NCCFN, 2005) and the much higher corresponding value of 1.0% energy (equivalent to 2.22g) cited by WHO (2003).

From Table 1, it can be seen that the potentially richest sources of omega-3 fatty acids (as ALA) in the diet are certain edible oils, with flaxseed oil and perilla oil topping the list. Unfortunately, these oils are not normally used as cooking oils locally or abroad but are more popular for use in animal feeds to push up the omega-3 fatty acid content of animal meat or hen eggs. Next on the omega-3 fatty acid dietary source list are the fish and fish products, followed in decreasing order by vegetables, meat and eggs, and milk and milk products.

Table 1. Potential sources of omega-3 fatty acids in the diet

<i>Food item/supplement</i>	<i>Serving size</i>	<i>Omega-3 fatty acids (mg)</i>
Edible oils		
Flaxseed oil	6g	2640
Perilla oil	6g	2400
Cod liver oil	6g	1170
Canola oil	6g	600
Walnut oil	6g	560
Soybean oil	6g	400
Palm oil	6g	30
Fish & fish products		
Mackerel (temperate)	55g	1450
Salmon (temperate)	55g	930
Jelawat	55g	350
Omega-3 capsule	1g	300
Tuna	55g	170
Sardines	55g	165
Perch (<i>Siakap</i>)	55g	130
Crab	55g	175
Shrimp	55g	135
Eel (<i>Belut</i>)	55g	95
Haruan	55g	20
Tilapia	55g	20
Carp (<i>"Lee koh"</i>)	55g	15
Anchovy	10g	5
Vegetables		
Soyabean milk	1 pkt (250 ml)	400
Soyabean curd "tau-hoo"	½ pc (76g)	276
Soyabean curd: "fucok"	1 sheet (28g)	126
Soyabean sprout ("taugeh')	½ cup (52g)	77
Legumes (beans, peas)	½ cup (98g)	75
Green leafy vegetables	½ cup (60g)	50
Meat & eggs		
Egg (hen, omega-3 enriched)	1 egg (50 g)	300
Egg (hen, regular)	1 egg (50 g)	50
Pork	55 g	115
Beef	55 g	60
Chicken	55 g	50
Milk & milk products		
Butter/cream	10g	150
Milk (omega-3 enriched)	1 cup (250 ml)	90
Milk (regular)	1 cup (250 ml)	40

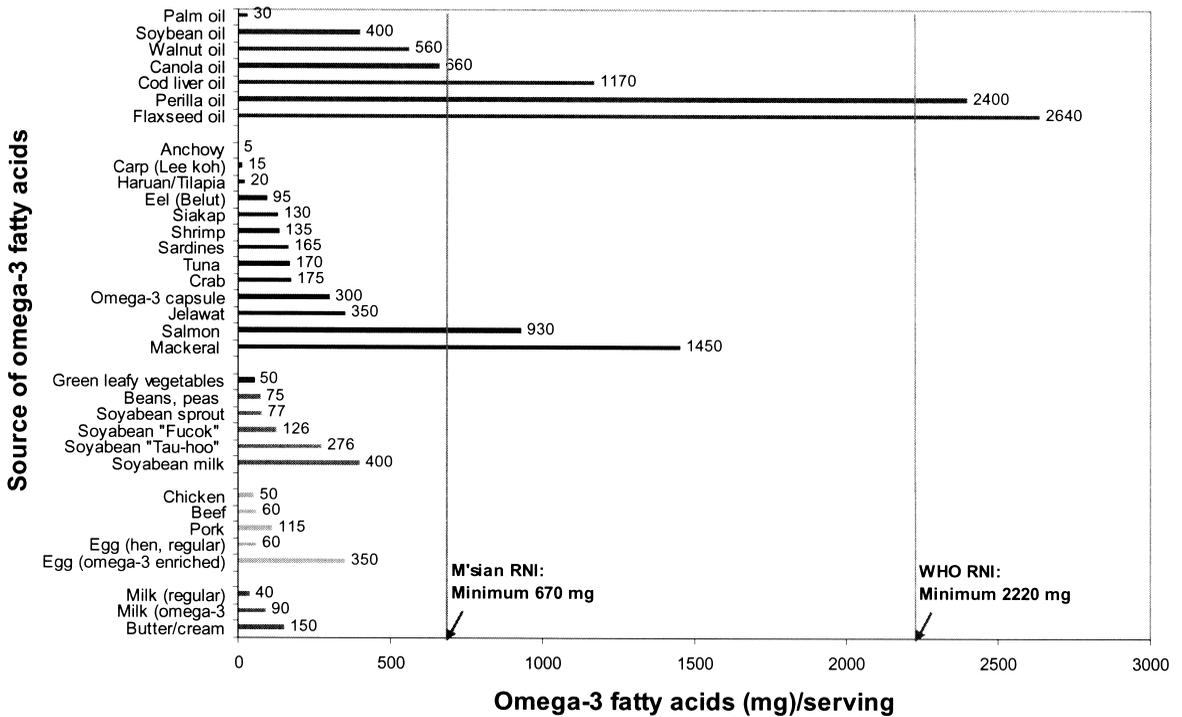


Figure 1. Omega-3 fatty acids from various sources

DISCUSSION

The author has attempted to quantify the amount of omega-3 fatty acids (ALA or EPA + DHA) per serving of a wide variety of food items. Many of the food items listed in Table 1 are available in Malaysia, with the exception perhaps of flaxseed, perilla and walnut oils. These three edible oils are included in the list of food items examined for comparison purposes as well as to highlight their potential as "omega-3" food sources and provide the stimulus for food manufacturers to include these oils in new food formulations or products.

When matched against the Malaysian RNI for omega-3 fatty acids (NCC-CFN, 2005) only five potential food sources are able to provide the day's omega-3 fatty acid needs with only one serving of the food item concerned, and these are flaxseed oil, perilla oil, cod liver

oil, mackerel and salmon. Of these food items, the first two oils are relatively unavailable in the local market, while the third item (cod liver oil) is normally consumed as a food supplement. The fourth and fifth food items are imported marine fishes, which on the average are only consumed sparingly because of its relative high-price tag. This would imply that the average Malaysian adult would have to get his/her daily omega-3 fatty acid requirements from a combination of different food sources.

Novel protein foods such as omega-3-enriched eggs (300 mg/serving) and butter/cream (150 mg/serving) and omega-3 fortified milk preparations (90 mg/serving) provide moderate amounts of EPA + DHA. In addition, one serving of soybean products ("taufu", "fucok" and bean sprouts) provides from 77 to 300 mg ALA while one 250-ml pack of soybean

milk provides an impressive 400 mg ALA. It would be prudent, therefore, to include these food items in the household food basket.

Figure 1 shows that the minimum daily omega-3 requirement of 2,220 mg (equivalent to 1% energy) recommended by the Institute of Medicine (IOM) [2002] and WHO (2003) appears very high in the context of the common foods featured in the Malaysian diet. The LA intakes of western populations such as that of United States are estimated to be 6 to 7% energy (NCCFN, 2005), which have prompted the recommendation of between 1% and 2% energy omega-3 fatty acids by IOM and WHO. However, Malaysians consume far less LA, estimated to be in the region of 3.5% energy (Ng, 1995; NCCFN, 2005), and therefore the Malaysian RNI for omega-3 fatty acids is a minimum of 0.3% energy, which is much lower than that of IOM or WHO.

One serving of canola oil or 6g (equivalent to 1 teaspoon) provides 600 mg ALA, which is close to the Malaysian RNI of 670 mg for omega-3 fatty acid. It is noted, however, that the metabolism of ALA to the longer-chain PUFA- EPA and DHA, is not efficient due in part to the competition from LA for 6-desaturase in the initial metabolism of ALA (British Nutrition Foundation, 1992). As such, pre-formed EPA or DHA from fish, fish oils, or fortified food products in the diet are preferred for optimal omega-3 fatty acid nutrition. In this context, a variety of novel or "designer" foods, which are enriched with EPA or DHA, have become available in the local market. Consumption of these products may help consumers to achieve their daily requirements for these important fatty acids. In terms of availability, the more common of such novel foods are the "omega-3 eggs" and milk formulae and ready-to-drink milk preparations.

Nutrition experts are divided as whether to propose dietary guidelines that are practical with regard to the local food

situation versus guidelines that border on the ideal. While we argue on the two options, it may serve us well to remember that it is very difficult to change peoples' dietary habits. As such, the former practical option seems more logical.

The intake of food supplements in the form of capsules or tablets are often discouraged by health professionals in the school of "basic nutrition" who often advocate that a well-balanced diet would provide all the nutrients one needs. In this case, the well-balanced diet should preferably include at least one serving of fish/seafood ("Jelawat", sardines, tuna or crab), 3 to 5 servings of vegetables with inclusion of types that are soybean-based ("fucok" and "taufu"), one serving of an omega-3 enriched egg, or 2 to 3 servings of EPA + DHA- enriched milk/milk product. If the cooking oil (pure or blended) used in food preparation contains some ALA, then it is an added bonus.

In order to achieve the goal for omega-3 fatty acid intake for the general population, it is recognised that the food industry plays a very important role, particularly in the area of food fortification. As the consumer becomes more aware of omega-3 fatty acid nutrition, it is envisaged that more EPA + DHA-enriched food products would become available in the Malaysian market. Meanwhile, the gazetting of appropriate food labelling laws and consumer education on the reading of food labels would go a long way towards helping consumers make smart food choices.

CONCLUSION

The data compiled and findings in this paper show that the basal Malaysian RNI for omega-3 fatty acids of 0.3% energy corresponding to about 670 mg of ALA, EPA, or DHA either singly or in combination, may be achieved only if the consumer takes a varied well-balanced diet. This diet

should include one or more servings from at least three of the four groups of omega 3-containing local foods identified, namely i) fatty fish ("jelawat", "siakap", tuna, sardines or if the household budget permits, imported varieties such as mackerel and salmon) and meat, ii) vegetables such as soybean/soybean products ("taufu", "fucok" and "taugeh") and legumes (beans and peas), iii) omega-3 enriched/fortified foods (eg. "omega-3 eggs"), and iv) ready-to-drink omega-3 milk/soybean milk. If the edible oil used in cooking/food preparation contains some ALA, then it would lend weight to the goal at hand.

In the event that a well-balanced diet is not possible for whatever reason, then food supplements such as cod liver oil and others may be considered as a useful complement toward achieving the RNIs for omega-3 fatty acids.

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