Documentation prepared for Bottlegreen

for the product Tiger White

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The Mediterranean Diet and Health

Dr Melanie Moore
Nutrition Lecturer
Bath Spa University College
Newton Park
Bath BA2 9BN

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Overview of the nutritional properties of Tiger White

Introduction

Despite a growing awareness that our dietary intake can effect our health status we are still facing a continuing rise in the prevalence of obesity in the UK (Department of Health 2003) alongside worryingly high levels of diet-related conditions. Evidence suggests that substantial changes to our diet at the population level would decrease the levels of various conditions such as cardiovascular disease, diabetes and cancer as well as obesity. However, changing the diet of a population is notoriously difficult and often requires the shift in the population's attitude. Small changes in the intake of various nutrients may however confer health benefits such that we might start to ‘move in the right direction’.

For individuals looking to improve their dietary status, it is essential that they understand the basics of a healthy diet. The Committee on the Medical Aspects of Food (COMA) set current dietary guidelines in the UK in 1991 providing tables of recommended intake ranges for each nutrient stratified by sex and age (Department of Health 1991). Whereas early reference values for daily nutrient intakes were based upon levels to prevent nutrient deficiency diseases (e.g. vitamin C to prevent scurvy), these current recommendations were based on levels for optimal health and a decreased risk of disease.

In reality when we consume a meal or plan a menu, we do not refer to these tables for guidance. This is recognised by nutrition professionals, and consumers in Britain are encouraged to consume a variety of different foods each day, taken from different food groups. This is promoted as the ‘Balance of Good Health’ (refer to www.nutrition.org.uk) and hopes to ensure that all essential nutrients are consumed in adequate quantities over a short period of time. Consumers are advised that by following a balanced diet they should meet their vitamin, mineral and energy requirements. Further recommendations to improve our diet are also provided, for example, the recent ‘5 a day’ initiative to increase fruit and vegetable consumption to five portions per day have been introduced. Low intakes of fruit and vegetables have been linked to increased risk of cardiovascular disease and certain forms of cancer.

Unfortunately, whilst most of us meet (or exceed) our daily requirements for energy, few of us consume an optimal diet. Many of our diets are too high in saturated fat and free sugars and too low in dietary fibre and starchy carbohydrates. Whilst few individuals show signs of overt vitamin or mineral deficiency, micronutrient intakes are again often lower than optimal. In the UK healthy eating guidelines in general emphasise a low intake of dietary fat in order to reduce the dietary energy density and aid weight control. In the context of this report it is important to be aware that this balance of macronutrients is not necessarily optimal or the only means to achieve a healthy diet. For example, the dietary patterns of individuals living in the Mediterranean do not strictly comply with these guidelines yet levels of CHD and obesity are much lower (European Heart Network, 2003). This is discussed in document 3.

This document will undertake a brief overview of the nutrients in Tiger White, a product produced from a blend of chufas and filtered water. The chufa a tuber traditionally forming part of the diet in regions of Spain fits with the overall Mediterranean diet being high in monounsaturated fat. Nutrients within Tiger White are discussed in turn along with the relative contribution the product can make to the diet.

Macronutrients

Sixty two percent of the energy in Tiger White comes from fat (39% monounsaturated, 14% saturates, and 8% polyunsaturated), 11% from protein and 27% from carbohydrate. Despite its high percentage of fat the overall energy density (energy per gram of product) is low, with just 32kcal per 100ml similar to skimmed milk (see document 2). Tiger White contains half the amount (g) of saturated fat as an equivalent volume of semi-skimmed milk. Monounsaturated fatty acids (MUFAs) then provide the bulk of the energy in Tiger White and are discussed below. Also discussed within this section of the report is the major amino acid contributing to the protein content of the product, arginine. Since the original chufa has been documented to contain oligosaccharides these are also discussed in line with their role as prebiotics.

Fatty acids

Consumers are no doubt left confused about how to decipher the mixed messages portrayed in the media regarding how much fat they should consume. Gram for gram fat provides twice as much energy as carbohydrate or protein, thus low fat diets are recommended to aid weight control. It is not just the total amount of fat that the individual should be aware of, but the type of dietary fat. Different types of fat (fatty acids) have very different effects on health and the risk of diseases states such as coronary heart disease (CHD). Saturated fatty acids (SFA) increase levels of blood cholesterol and should be avoided whenever possible. Extensive research has shown that a raised blood cholesterol level is a marker for risk of CHD (Keys et al, 1986). Since there is no essential requirement for SFA in the diet low intakes pose no problem to health. Levels of SFA have declined over recent years (in line with a decrease in total fat) from an average of 52g per day in 1972 (19% of total energy intake) to 29g in 2000 (15% of total energy intake) (DEFRA, 2001). However we are still exceeding government recommendations to aim for a level of 10% of total energy intake from SFA.

Current dietary guidelines emphasise a replacement of the energy from SFA acids with complex carbohydrates to also reduce levels of total fat. However, there is evidence that the replacement of SFA with MUFA may have a more favourable effect on the risk of CHD (Kris-Etherton, 1999). A diet high in MUFA and low in SFA has been the mainstay of the diet in Mediterranean countries for many years. Early studies investigating levels of fat intake between different populations established a relationship between fat intake and plasma cholesterol level and subsequently CHD. However paradoxically the Mediterranean populations had diets high in total fat yet low plasma cholesterol levels and low CHD morbidity and mortality. This early work demonstrated that it was not just total levels of fat which were important to health but the specific fatty acid profile.

Later work has built upon these findings. For example Hu et al (1997) investigated type of fat intake in relation to CHD risk in women. They report that for every increase of 5% in energy from MUFA there is a decrease in CHD relative risk of 0.81. This study confirmed previous results in men of a beneficial effect of MUFA on health.

Despite this knowledge about the benefits of MUFA, average individual intakes in the UK have fallen from 42.9g (15.8% of total energy) per day in 1972 to 26.3g (13.5% of total energy intake) in 2000 (DEFRA, 2001). The main contributors to MUFA intake in 2000 were fats and oils (28% / 7.4g), meat (28% /7.4g), cereals (16% / 4.1g), milk and cream (9% / 2.3g) and cakes, biscuits and pasties (9%/ 2.5g). Similar trends have been observed in the United States where a group of adults were reported to receive their major sources of MUFAs from french fries, whole milk, crisps and ground beef (Nicklas et al, 2004) sources also rich in saturates. In comparison to the UK and US diet, Mediterranean diets may be up to about 33% energy from MUFA.

One and a half servings of Tiger White would provide as much MUFA to the UK diet as that from fats and oils and would be a major contributor to MUFA intake. Kris-Etherton et al (1999) suggest that modest increases in MUFA which replace saturates in the diet are required to achieve an increase in MUFA. As an example substitution of 9g of SFA with 9g of MUFA in a 1500kcal diet would increase MUFA from 14% to 19% of total energy and decrease SFA from 13% to 8% of energy.

Arginine

The amino acid profile of the chufa and hence Tiger White is dominated by arginine. Arginine represents 24% by weight of the amino acids in Tiger White. Although arginine is not an essential amino acid, it has been termed ‘conditionally essential’. It is essential in the foetus and the neonate (Wu et al, 2000). In adults it may have a role in disease states especially where tissue is being broken down such as in sepsis or trauma. The area of arginine remains an exciting area of nutrition research, however it must be noted that some of the effects may require pharmacological doses, at a much higher level than that supplied by our regular diet. Much of the work has involved the study of arginine in the clinical setting at high doses. These are discussed briefly below.

Many of the postulated beneficial roles of arginine are related to the fact that it is a precursor for nitric oxide (NO). NO is a vasodilator produced by the endothelial cells of the vascular system and has an important role in the regulation of the cardiovascular system. This ‘endothelium-derived relaxation’ is impaired in conditions such as diabetes, high blood pressure and high plasma cholesterol. Animal studies have demonstrated that oral administration of L-arginine can normalise endothelial relaxation in diabetic rats (Pieper et al, 1996). Intravenous infusion of L-arginine (3-5g) to humans has been shown to reduce blood pressure in diabetic men (Guigliano et al, 1997). In men with high blood cholesterol levels, 21g per day of intravenously administered arginine improved endothelium derived relaxation. This intravenous dose is much higher than the level of arginine consumed in a usual diet.

Other studies have investigated the role of arginine in supplements in conjunction with n-3 fatty acids, branched chain amino acids and nucleotides in nutritional preparations. It seems that these formulas may reduce infectious complications in specific patient groups particularly following surgery. However it is difficult to isolate the effects of arginine from those of the other nutrients within the preparation.

The role of arginine in insulin release has also been investigated. Protein is known to stimulate insulin release, and arginine may be more powerful than other amino acids (Gannon et al, 2002). However orally administered arginine at a mean dose of 10.6g (dose given per kg lean body mass) did not increase plasma insulin concentration in a group of lean men and women (Gannon et al, 2002). An increased insulin response may increase the replenishment of glycogen stores which would be beneficial for the athletic population. However a 10g oral dose of arginine failed to increase insulin or carbohydrate replenishment compared to a placebo in healthy exercised or non-exercised males.

Data from a representative sample of US adults (NHANES III, 1988-1994) gives a mean arginine intake in 31-50y males of 5.61g/d and 31-50y females of 3.71g/d. Data from the Kuopio Heart Disease Risk Factor Study (Venho et al, 2002) reported that 38% of arginine intake derived from meat sources, 24% cereal and 23% from milk and milk products.

Venho et al (2002) investigated the effect of arginine intake on the risk of coronary events in middle-aged men in Finland. They found no significant difference in arginine intake between men who suffered coronary events and those who did not. The men in the highest quintile of arginine intake (>5691mg/d) did not have a lower risk of coronary events than those men in the lowest quintile of arginine intake (<4230mg/d) even when adjusted for other known coronary risk factors such as body mass index, blood pressure, plasma lipids and maximal oxygen consumption. Arginine intake was also not consistently associated with blood pressure. This study supports the work of Oomen et al (2000) in elderly Dutch men followed up over 10 years. Venho et al (2002) concluded that dietary arginine intake was not related to the risk of acute coronary events or blood pressure in middle aged men. However it is possible that the dietary intakes at the usual level may be too low to improve endothelial function.

Arginine is undoubtedly an important amino acid which becomes essential in certain conditions, including wound healing. However much of the work in this area reports large doses to observe an effect. Prospective studies that have looked at a range of more usual levels of intake have failed to report a significant effect of arginine on cardiovascular heath.
A 350ml portion of Tiger white supplies 0.22g arginine, thus 4% and 6% of the adult (31-50y) male and female typical intake respectively.

Prebiotics

It is increasingly being recognised the microbial status of our colon can impact on our health status (Gibson & Roberfroid 1995). The colon is a complex microbial ecosystem in which there is inter-play between bacteria that may be beneficial to our health and those that may be harmful. This delicate balance can be affected by our diet since the growth of beneficial or benign bacteria can inhibit the growth of the harmful forms. One type of functional food (a food with a dietary ingredient with an effect over and above its nutritional content) on today's market is that of the probiotic. These products introduce beneficial bacteria into the body. However possible limitations to these preparations is that the bacteria within them may not survive storage or may be destroyed due to conditions (e.g. the acidity) in the human gastrointestinal tract.

Another dietary means to alter the ratio of beneficial to harmful bacteria is to introduce products that can stimulate the growth of the 'good bacteria'. This is the essence of the prebiotic. A prebiotic is an ingredient of food which itself is not digestible (thus reaches the human colon intact) and which can selectively stimulate, in the colon, the growth of indigenous bacteria that can improve the individual's health (Gibson & Roberfroid, 1995).

The oligosaccharides, which are short chain carbohydrates, have shown the most promise as potential prebiotics. These are found naturally in certain food products such as onions, bananas, leeks, soya beans and human milk. They can also be synthesised industrially from shorter or longer carbohydrates. Although further research in this area is required possible health benefits to humans from a beneficial modification of gut microflora may include an improved resistance to pathogens, a lowering of blood lipid levels, a reduced tumour risk, improved hormone regulation and an improved immune response (Gibson, 1999). Recent research has also suggested that oligosaccharides may increase the absorption of the minerals calcium and magnesium (Delzenne, 2003). These effects were observed with doses in the range of 5-10 g per day (Delzenne, 2003). Levels of the inulin-type fructans for a 75kg person has been estimated as 3-11g in Western Europe and 1-4 g in the USA (Van Loo et al, 1995).

Levels of oligosaccharides have not been measured in Tiger White, however they were found in the similar Spanish drink Horchata on which Tiger White was based.

<u>Micronutrients</u>

The major micronutrients found in Tiger White, are discussed below along with a guide to the amount present in a serving and their potential health contribution..

Vitamins

Vitamin E

There is no set recommended nutrient intake (RNI) for vitamin E. This is due to the fact that its requirements are largely dependent upon levels of polyunsaturated fat (PUFA) in an individual's diet. Since levels of PUFAs vary widely in the diets of individual's in the UK it was concluded that there was little practical value in providing an estimate of requirements.

However, it has been estimated that the average male aged 18-50y would require 7mg per day and the average female 5mg/d. Data from the National Food survey (DEFRA 2001) reported a mean intake of 10.1 mg/d thus exceeding these estimates. Since foods high in PUFA are usually also rich in vitamin E then this minimises the likelihood of deficiency.

Vitamin E is a fat-soluble vitamin, which acts as an anti-oxidantant to protect the body from free radical attack. It is vital for the maintenance of cell membranes. It is particularly important in areas of the body exposed to oxidative stress such as the lungs and the red blood cells. Vitamin E may reduce the risk of cancer and CHD due to its role as an anti-oxidant, however research in this area is currently inconclusive.

In supra-nutritional doses Vitamin E has been claimed to benefit diseases associated with oxidative stress including cardiovascular disease, cancer, Alzheimer's and Parkinson's disease (Brigelius-Flohe, 2002). However the current evidence remains persuasive rather than conclusive. These findings and the fact that we do not fully understand the mechanisms of Vitamin E's actions has meant that dietary recommendations in the US and certain European countries have not increased their guidelines further than 15mg per day. However this is greater than average intake in the UK suggesting that we may benefit from an increased intake. Salonen et al (2000) report a retardation in atherosclerosis with a combined Vitamin E (2 x 91 mg per day)and Vitamin C supplement in a population of Finnish men.

Vitamin E can be found in some suntan lotions and its topical use has been suggested to decrease the oxidative effects of ultraviolet light (Pinell, 2003). However there is also evidence to suggest that antioxidants within the skin may protect the skin from 'photodamage' which is partly mediated through oxidative pathways (Anstey, 2002). The specific role of Vitamin E in this process however requires further investigation.

Tiger White contains 0.5mg per 100ml, thus a 350ml serving contains 1.75mg or 25% and 35% of the estimated average requirements for males and females in the UK respectively.

Minerals

Phosphorous

The RNI for phosphorous is set equimolar to Calcium, for adults 19 - 50 years, 550mg per day. Phosphate is a constituent of all plant and animal cells, therefore is present in all plant and animal foods. Deficiency is therefore rare and average intakes in the UK are 1.2 -1.3 g per day. The lower limits for adequate phosphorous intake are estimated at 400mg per day. Phosphorous found in cereals and legumes is bound to a compound called phytate meaning that it is poorly absorbed from the gut into the body. Vegans are therefore a group of individuals who may have a low phosphate intake.

Tiger White contains 44mg of Phosphorous per 100ml, thus a 350ml serving provides 154mg or 28% of RNI.

Approximately 80% of the phosphorous in our body is present in bone where it combines with Calcium to form a compound that is laid down upon the framework of the bones to give rigidity to the skeleton. Phosphorous is also an integral part of the body's energy generation process since the currency of energy in the body, Adenosine-tri-phosphate (ATP), contains high energy phosphate bonds which provide energy for work (e.g. in the skeletal muscles) when they are broken down. Phosphates are also important in the body to help regulate acidity/ alkalinity since they can act as buffers.

Zinc

The RNI for zinc for adult males is 9.5mg/d and for females 7.0mg/d. Data from the National Food Survey estimates the average intake in the UK to be 8.0mg per day (DEFRA, 2001) suggesting that some individuals are below their recommended level. Since zinc is found complexed with protein, zinc intake is related to protein intake. 30% of the reported UK intake was derived from meat or meat products, 27% from cereal products and 23% from dairy sources. The bioavailability of zinc from animal sources is generally higher than that from plant sources due to binding of zinc to the compound phytate, which inhibits its absorption from the gut into the blood. Zinc is a mineral for which certain individuals are at risk of a low intake, especially those who do not consume meat. Zinc is generally lost from food through processing so marginal zinc deficiency may well increase in the future as we consume more processed foods.

Tigerwhite contains 0.2mg of zinc per 100ml. Thus a daily intake of 350ml would provide 0.7mg, or 7% of the male RNI or 10% of the female RNI.

Zinc has a wide variety of functions in the body and is found in all body tissues. It is involved in many enzyme reactions including those involved in energy generation from carbohydrate, fat and protein. It also has a role in cell division, the transport of carbon dioxide and oxygen in the blood and in immunity. Since it has a wide range of role in the body symptoms of zinc deficiency are also wide-ranging and include a delay in wound healing, poor appetite, a suppressed immune system and poor growth.

Magnesium

The adult RNI for magnesium is 300mg/d and 270mg/d for men and women respectively. Data from the National Food Survey (DEFRA, 2001) reports an average UK intake of 227mg per day, which is lower than the RNI. This low intake was apparent across the spectrum of socio economic status. Green plants contain magnesium within their chloroplasts, thus a major source of magnesium is green plants and cereals. The major source of magnesium in the UK diet was from cereals (33%) and fruit and vegetables (including potatoes) (26%). Other sources included milk and milk products (15%) and meat and meat products (11%). Tiger White contains 5.0mg/100ml thus a 350ml daily intake would provide 17.5mg or 6% of men's and 7% women's RNI.

Approximately 60% of the magnesium found in our bodies resides in our skeleton. It plays a role in skeletal development and provides a reservoir from which magnesium can be drawn upon to maintain plasma magnesium levels. Magnesium is also involved in many enzyme systems and in particular those involving the currency of energy in the body, ATP. Magnesium is also required for the synthesis of proteins, the production of energy and muscle contraction. Recent studies have suggested that a low intake of magnesium may increase the risk of coronary heart disease (Al-Delaimy et al, 2004) and type 2 diabetes (Lopez-Ridaura et al, 2004).

Copper

The RNI for adults for copper is 1.2mg per day. Estimates suggest that the average intake in the UK exceeds this at 1.8mg/d. The major sources of copper in the UK diet were meat (27%) and cereals (27%). Intakes in vegetarians have been reported to be higher than this level at 2.1-3.9mg per day.

Tigerwhite contains 0.06mg per 100ml, thus a daily intake of 350ml would provide 0.21mg or 17% of RNI.

Approximately 40% of copper in the body is found in the muscles where it is involved in enzyme systems involved in energy transfer.

Sodium

Intake of sodium (excluding table salt) is estimated as 2.6g per day which is 175% of the recommended intake (DEFRA 2001) and this *excludes* sodium from table salt. Food manufacturers are currently being warned that they must aim to decrease the levels of salt added to foods since this contributes to the majority of our sodium intake. We are currently recommended to consume not more than 6g of salt per day (equivalent to 2400mg sodium). However this exceeds the RNI of 1600mg per day.

A serving (350ml) of Tiger White contains just 112mg of sodium thus 7% of our RNI.

<u>Summary</u>

Tiger White conforms to a product typically representing the Mediterranean diet being high in MUFAs and low in saturates and low in free sugars. It can make a substantial contribution to the MUFA intake in the UK diet. As discussed above this balance of macronutrients may help to reduce the risk of CHD. Tiger White is also rich in Vitamin E an antioxidant vitamin which may have many health related effects within the body. One serving of Tiger White provides a quarter of the recommended daily intake of Vitamin E for males and over a third for women.

Overall Tiger White is rich in a variety of nutrients and would provide a valuable contribution to an individual's diet.

DOCUMENT 2

A comparison of Tiger White with cow's milk and soya milk

<u>Energy and macronutrients</u>

The energy density (energy per gram of product) of Tiger White is similar to that of skimmed milk and soya milk at 32kcal per 100g (table 1). Tiger White has similar amounts of total fat to semi skimmed milk and soya milk. However the contribution of saturated fats is approximately half that found in semi skimmed milk and similar to that in soya milk. Tiger White contains more monounsaturated fat (1.4g/100g) than any of the types of milk or soya milk and about one third the amount of protein. The carbohydrate content of Tiger White is just over half that found in the milks and with less than half the amount of sugars. Tiger White has a small contribution from Englyst fibre whereas this is lacking in the milks and soya milk.

Table 1: Energy and macronutrient composition of whole, semi-skimmed, skimmed cow's milk, soya milk with Tiger White (g per 100g)

	Whole Milk	Semi Skimmed Milk	Skimmed Milk	Soya Milk, Plain	Tiger White plain
Energy kJ (kcal)	274 (66)	195 (46)	136 (32)	132 (32)	135 (32)
Total fat (g)	3.9	1.7	0.2	1.9	2.2
Saturates	2.5	1.1	0.1	0.3	0.5
Monounsaturates	1.0	0.4	0.1	0.4	1.4
Polyunsaturates	0.1	0.0	0.0	1.1	0.3
Protein (g)	3.3	3.5	3.4	2.9	0.9
Carbohydrate (g)	4.5	4.7	4.4	0.8	2.5
Sugars (g)	4.5	4.7	4.4	0.8	1.8
Englyst fibre (g)	0	0	0	0	0.2

If you look at the percentage contribution from each of the macronutrients to the energy provided by the beverages (table 2), you can see that Tiger White does have a very different composition to the milks or soya milk. The most notable fact is that 62% of the energy in Tiger White is derived from fat, with 39% coming from MUFAs. Whole milk and soya milk also have a high contribution from fat (52% and 54% of energy respectively). In the whole milk this is dominated by saturates and in the soya milk by PUFAs. This higher fat content in Tiger White will result in it having a much richer taste than skimmed milk yet with a similar amount of energy.

Table 2: Percentage contribution of macronutrients to the energy content of each beverage (%)

	Whole Milk	Semi Skimmed Milk	Skimmed Milk	Soya Milk, Plain	Tiger white plain
Fat	52	30	7.5	54	62
Carbohydrate	29	42	53	10	27
Protein	19	28	39	36	11
Saturates	32	19	2.5	8.5	14
MUFA	15	9	2.5	11	39
PUFA	1.3	0	0	31	8
sugars	28	42	53	10	21

Oleic Acid

Using data from Paul and Southgate (1978), 87% of the monounsaturated fatty acids (MUFAs) in cow's milk are oleic acid. This is comparable to the average dietary proportion of MUFAs in the diet being approx 92% oleic acid. The estimated concentration of oleic acid in each of the beverages is shown in table 2.

Table 3 Concentration of oleic acid in each of the beverages (per 100g)

	Whole Milk	Semi Skimmed Milk	Skimmed Milk	Soya Milk, Plain	Tiger White plain
Oleic acid (g)	0.9	0.3	0.1	0.4[a]	1.4[a]

[a] Based on the average MUFA being composed of 92% oleic acid.

Current UK dietary recommendations (Department of Health, 1991) suggest that cis-MUFAs should provide on average 12% of total energy for the population. Based on an estimated requirement for energy for an adult male of 2500kcal/d and for women 2000kcal per day, males should be consuming ~33g of MUFA per day and females ~27g per day.

A 350ml serving of Tiger White provides 4.9g MUFA thus approximately 15% and 18% of the recommended intake for males and females respectively. In contrast a similar serving of skimmed milk would provide 3% and 4% of recommended intake for males and females respectively.

Mediterranean diets may contain a much higher proportion of energy from MUFAs. For example, Kris-Etherton et al, (2000) in a review of the effect of high MUFA diets included those in which 17-33% of total energy was supplied by MUFA's. Further details regarding the role of MUFAs in the diet can be found in document 1 and will be expanded on in document 3.

Amino acid profile

The amino acid profile of Tiger White in comparison to whole milk and wheat is shown in table 3. Expressed as mg of arginine per ml of beverage, milk contains 1.33mg/ml and Tiger White 0.62mg/ml. The lower concentration in Tiger White is due fact that levels of total protein are lower than in milk. Data from a representative sample of US adults (NHANES III, 1988-1994) gives a mean arginine intake in 31-50y males of 5.61g/d and 31-50y females of 3.71g/d. A 350ml portion of Tiger White supplies 0.22g arginine, thus 4% and 6% of the adult (31-50y) male and female typical intake respectively.

Table 4 Amino acid composition of various protein sources. Data is displayed as mg amino acid per g total nitrogen.

	Milk[1]	Wheat[1]	Tiger White
Essential			
Histidine	190	130	69
Isoleucine	350	210	49
Leucine	640	420	104
Lysine	510	150	111
Methionine	180	100	35
Phenylalanine	340	280	42
Threonine	310	170	83
Tryptophan	90	70	-
Valine	460	280	76
Nonessential			
Arginine	250	290	430

[1] From Paul and Southgate (1978)

Micronutrients

Minerals

Selected levels of vitamins in comparison to milk and soya milk are shown in table 5. The role of various minerals contained in Tiger White are discussed in document 1. Levels of iron in Tiger White are higher than in milk and similar to that found in soya milk.

Table 5 Selected Minerals (per 100g of product)

Whole
Milk
Semi Skimmed Milk
Skimmed Milk
Soya Milk, Plain
Tiger White
plain
Sodium (mg)
43
43
44
32
32Potassium (mg)15515616012019Phosphorous (mg)9394964745Iron (mg)0.00.00.00.40.3Zinc (mg)0.40.40.50.20.2Calcium (mg)118120122131.7

Vitamins

The most notable vitamin in Tiger White is the fat soluble antioxidant vitamin E (table 6). Levels of vitamin E in Tiger White greatly exceed those found in milk and one serving may provide a quarter of the recommended daily intake for an adult male (1/3 for a female). The role of vitamin E in health is discussed in document 1.

Table 6 Selected Vitamins (per 100g of product)
Whole
MilkSemi Skimmed MilkSkimmed MilkSoya Milk, PlainTiger White
plainVitamin E (mg)0.080.040.000.740.5Thiamin (mg)0.030.030.030.060.01Niacin (mg)0.80.70.80.60.01Vitamin B6 (mg)0.060.060.060.070.01Vitamin B12 (g)0.90.90.80.0Folate (g)899196Pantothenic acid0.580.680.480.00Biotin (g)2.53.02.40.00Vitamin C (mg)220.00.0

DOCUMENT 3

The Mediterranean Diet and Health

Introduction

The term 'The Mediterranean diet' was first used by Ancel Keys to describe the traditional diet consumed by individuals in some of the Mediterranean regions such as Crete, parts of the rest of Greece and Southern Italy in the early 1960's (Keys et al, 1986). The interest in the intake of these populations stemmed from the finding that the life expectancy in these regions was among the highest in the world and rates of certain diet-related diseases were among the lowest in the world, despite limitations in medical services (Coronary Heart Disease Taskforce, 2000). It is now recognised that there are variations of the Mediterranean diet (Noah and Truswell, 2001), differing by region with many countries having moved away from the traditional diet over the intervening years.

The traditional diet is characterised by an abundance of plant foods (including fruit, salad, vegetables, bread, legumes, beans, nuts and seeds); low to moderate amounts of fish, poultry, meat, dairy products and eggs, and olive oil as the main source of dietary fat. The diet also contains low to moderate amounts of alcohol, usually in the form of wine taken with meals. In terms of nutrients this results in a diet high in carbohydrate, monounsaturated fatty acids (MUFA), antioxidants (especially Vitamins C and E), fibre and folic acid yet low in saturated fatty acids (SFA). Since the diet varies from region to region it is difficult to define exact percentage contributions to energy from each of the macronutrients. It is estimated that levels of total fat vary from less than 25% to over 35% whilst saturates provide between 7-8% of energy (Coronary Heart Disease Taskforce, 2000).

This report will review the literature investigating the role of the Mediterranean diet in human heath with particular emphasis on cardiovascular disease (CVD). Since CVD (including coronary heart disease and stroke) accounts for 49% of all deaths in Europe (British Heart Foundation, 2000) it is important to understand this link. It will also review studies investigating the effect of MUFAs on human health outside the context of a Mediterranean diet. Finally it will look at how Tiger White might contribute to this type of diet within the UK.

The Seven-Countries Study

The 'Seven countries study' (Keys et al, 1986) initiated in the 1950's by Keys and colleagues, set the foundations for current research into the benefits of the Mediterranean diet. This groundbreaking epidemiological study compared levels, in seven different countries, of CVD and blood cholesterol with the population's fat intake. In general countries with high intakes of dietary fat had higher levels of blood cholesterol and subsequently higher CVD mortality and morbidity. However not all countries fitted into this general pattern. Of particular note was the fact that the population on the island of Crete in Greece had diets high in fat (33-40% of total energy) yet had very low levels of plasma cholesterol, coronary heart disease (CHD), certain forms of cancer and a long life expectancy. Later work has established a closer relationship between not only total fat but different types of dietary fat, and the effect of changes in different components of plasma cholesterol with CHD risk. A decrease in CHD risk is achieved by a reduction in LDL-cholesterol and an increase in HDL-cholesterol. CVD risk also increases with an increase in triglyceride (TG) concentrations (Feldman, 1999). Keys and Kimura (1970) found a closer relationship between the percentage of energy derived from SFA and coronary heart disease (CHD) than total fat helping to explain the lower incidence of CHD in the Cretan population whose diets although high in total fat were low in saturates (7-8% of total energy).

Intervention Studies

It is now well established that SFAs increase total and LDL-cholesterol levels. The role of MUFAs has however been less clear-cut. Earlier research suggested that MUFAs were neutral in their effect on plasma cholesterol level whilst polyunsaturated fatty acids (PUFAs) reduced them. Both Keys et al (1957; 1965) and Hegsted et al (1965; 1993) developed equations to estimate changes in blood cholesterol levels with changes in dietary SFA and PUFA intakes. The Keys equation estimated that SFA increased blood cholesterol by approximately twice the amount that PUFAs reduced it. Levels of MUFAs were not involved in these calculations. However, in 1985 the role of MUFAs was challenged by an intervention study showing that both MUFAs and PUFAs lowered LDL-cholesterol when used in replace of SFA (Mattson & Grundy, 1985). Since 1985, many other intervention studies have tested the relative effects of MUFAs and PUFAs on blood cholesterol levels. Although a few of these studies have shown effects favouring either MUFA or PUFA, the majority of these studies have shown no significant difference in the effects of either of these types of unsaturated fatty acid on LDL-, HDL-cholesterol or TG. Gardner and Kraemer (1999) attempted to clarify the situation using a meta-analysis of 14 intervention studies that had compared the relative effects of MUFA and PUFA on blood cholesterol fractions. Replacement of SFA with either PUFA or MUFA significantly decreased both total and LDL-cholesterol with no significant difference between the 2 types of unsaturated fat. Neither the PUFA or the MUFA intervention altered levels of HDL-cholesterol or TG compared to a high SFA control diet.

Mensink et al (2003) recently published a further meta-analysis comparing the replacement of SFA with either MUFA, PUFA or carbohydrate on the ratio of total cholesterol: HDL cholesterol which is a stronger predictor of CVD risk than LDL-cholesterol alone. 60 studies were included in their analysis. They reported that the replacement of SFA with an isoenergetic amount of carbohydrate did not improve the total: HDL cholesterol ratio. However, replacement of SFA with either PUFAs or MUFAs did improve this ratio with a slightly more favourable effect from the PUFAs. This suggests that contrary to current UK dietary recommendations a replacement of SFA with unsaturated fat may improve CHD risk to a greater extent that replacement with carbohydrate.

An example intervention is that published recently by Gill et al (2003). Middle aged subjects with mildly raised blood cholesterol levels followed three 6 weeks dietary interventions of (a) a low MUFA diet (7% of total energy intake), (b) a medium MUFA diet (10% total energy intake) and (c) a high MUFA diet (14% of total energy intake). The replacement of SFA with MUFAs caused a dose-dependent decrease in LDL-cholesterol levels. The medium MUFA diet caused a 5% decrease and the high MUFA diet a 12% decrease in LDL-cholesterol compared to the low-MUFA diet. HDL-cholesterol levels and TG levels were unaffected by the intervention. This study demonstrated that even relatively small increases in MUFAs, without approaching the levels found in the Mediterranean diet may have beneficial effects on LDL cholesterol levels and subsequently CHD risk.

A further recent intervention by Muller et al (2003) found that a reduction in saturates without a change in the SFA: PUFA ratio did *not* decrease LDL-cholesterol but did adversely decrease HDL cholesterol. This suggests that it is not only the absolute levels of fat but their relative proportions in the diet that can effect CHD risk. As observed in other studies, replacing SFA with carbohydrate was less efficient than replacing them with unsaturated fats if the primary aim was to improve the LDL: HDL ratio.

Clinical trials

The Lyon diet heart study (de Lorgeril et al, 1999) was the first clinical trial to investigate whether a Mediterranean diet could reduce the recurrence of a myocardial infarction (MI) (heart attack). 605 survivors of a first MI were randomized into either a control (Western-style diet) or a Mediterranean diet group. After an average follow-up of almost 4 years, patients following the Mediterranean style diet had a remarkable 50-70% lower risk of recurrent heart disease, including both major and minor cardiac events. Subjects in the control group consumed a diet that was similar to the typical US diet (34% total fat, 12% SFA, 11% MUFAs, 6% PUFA). Those in the Mediterranean diet group consumed 30% total fat, 8% SFA, 13% MUFA, 5% PUFA. This study again demonstrated that fairly minor dietary changes had a dramatic effect on the risk of cardiac events this time in a high-risk population. Another important finding in this study was that compliance of the subjects to the Mediterranean diet was high. Changing people's dietary habits is notoriously difficult and the high level of compliance to this diet may suggest a higher level of acceptance compared to the usually recommended low fat diet.

Prospective studies

Early work suggested that the low intake of SFA may have been the protective factor against CHD in the Mediterranean population. However, evidence from a large epidemiological study in the US (The Nurses Health Study) where over 80,000 women were followed up over >14 years showed that MUFAs were protective against CHD (Hu et al, 1997). For each 5% increase in energy from SFA there was a 17% increase in CHD risk, relative to the energy being provided from carbohydrate. Replacement of each 5% of energy from SFA with MUFA resulted in a 19% decrease in CHD risk. A similar replacement by PUFAs gave a 38% decreased risk. In contrast total fat intake did not effect the risk of CHD. From this very large, extensive study, the authors concluded that replacing saturated fats with either MUFAs or PUFAs was more effective at reducing CHD risk than reducing total fat intake. Other large epidemiological studies that have controlled for confounding variables, have also reported a decrease in CHD with increased MUFA intake (Artaud-Wild et al, 1993; Pietinen et al, 1997). Some studies have not reported this association (Kromhout et al, 1984; McGee et al, 1984), possibly due to the fact that they did not control for confounding variables.

Fatty acid recommendations in the UK

There is currently no consensus on optimal levels of MUFA in the diet, or indeed levels of total fat. Current UK dietary guidelines suggest that total fat should not provide greater than 35% of total energy intake with SFA providing not more than 10%. The latest data (DEFRA, 2001) shows that we exceed both of these guidelines (38% and 15% for total fat and SFA respectively, table 1). Current guidelines emphasise a replacement of the energy from SFA with complex carbohydrates. From the data presented above it is possible that by replacing SFA with MUFAs or PUFAs instead of carbohydrate we might more effectively meet the target to reduce SFA in our diets since individuals may find a low fat diet less palatable. If the replacement of SFA with MUFA occurred at the level of the food manufacturer then this would assist in the reduction of SFA intake within the population.

An argument against an encouragement of increasing any type of dietary fat is the fact that the energy density of fat is double that of carbohydrate, each gram of fat provides 9kcal of energy whereas each gram of carbohydrate provides approximately 4kcal. High fat (energy dense) diets have been linked with a higher spontaneous energy intake and increased risk of obesity. Markman and Astrup (2000) warn individuals in our modern sedentary society (sedentary lifestyles inevitably mean a relatively low requirement for total energy intake) against consuming a diet high in fat regardless of the fatty acid profile due to the higher energy density. They also suggest that at relatively low levels of energy intake a high fat intake discourages fruit and vegetable intake. Kris-Etherton et al (2000) (in reply to Markman and Astrup, 2000) acknowledges that the benefits of a high MUFA diet must be looked at in the context of weight control since overweight and obesity increase CVD risk. However they stress that a high MUFA intake can be accompanied by a high intake of fruit, vegetables, whole grains and legumes and that this diet may be successful for both weight control and CVD risk reduction. This pattern of dietary intake would fit with the traditional Mediterranean diet.

The question of whether to replace SFA with MUFAs or PUFAs still remains a controversial issue. However since PUFA intakes in excess of 10% of total energy intake may adversely effect cardiovascular risk by decreasing beneficial HDL-cholesterol then replacement of SFA with MUFAs may be more appropriate. A theoretical reason for increasing MUFAs rather than PUFAs is that the reduced number of double bonds (MUFAs have one double bond and PUFAs greater than one) results in LDL-cholesterol which is less susceptible to oxidation. The oxidation of LDL-cholesterol forms an early stage in the process resulting in atherosclerosis. However whether an extreme in PUFA intake actually does increases CHD risk has yet to be established since there is a paucity of data.

Of importance when promoting the Mediterranean diet within non-Mediterranean populations is whether the benefits of this diet are actually transferable to other populations. This question was addressed in a cohort study in Australia (Kouris-Blazos et al, 2004). They reported that a higher adherence to features of the traditional Mediterranean diet decreased overall mortality. This was evident in both Anglo-celts and among Greek-Australians. The authors concluded that a diet adhering to the traditional principles of the Mediterranean diet is associated with longer survival in populations both of Mediterranean and non-Mediterranean origin.

Health within Mediterranean population

Risk factors for chronic diseases are currently increasing in Mediterranean countries (Kafatos et al, 1997), in part due to changes in their traditional diet. However in 1991, their life expectancy at the age of 45 years (32.5 y) was still only exceeded by Japan (33.3y) and exceeded that of the UK (30.9y) and the USA (30.8y). Total life expectancy at birth in Greece (71 y) still exceeds that of the UK (70.6 y) and USA (69.3 y) (World Health Organisation, 2003) despite expected differences in health care. Data from the Greek branch of the European Prospective Investigation into Cancer (EPIC) study suggests that even within a Mediterranean population, a higher adherence to the traditional diet is linked to a lower CHD mortality (Trichopoulou et al, 2003). This study followed over 22,000 individuals living in Greece between 1994 and 1999. Subjects were scored (0-9) on their adherence to a traditional Mediterranean diet. After adjusting the data for known CVD-risk factors an increase in diet score by 2 resulted in a reduced hazard ratio for all-cause mortality of 0.75 (i.e. 25% decreased risk), for CHD 0.67 and for cancer 0.76. When the authors attempted to link individual dietary components to decreased disease risk, the only significant predictors of reduced mortality were a higher intake of fruit and nuts (hazard ratio 0.82) and a higher MUFA: SFA ratio (hazard ratio 0.86). However these foods/ nutrients did not fully explain the lower incidence of disease with a higher adherence to the diet. It is possible that the effect of some individual nutrients is too small to measure but that the synergistic effect of multiple nutrients can be observed. This serves to highlight the fact that even within a Mediterranean population a higher adherence to a traditional diet has proven health benefits.

Different sources of MUFA

Most studies have used olive oil as the source of MUFA in controlled studies. However, Kris-Etherton et al (1999) compared the effects of high MUFA peanut oil with that of olive oil on blood cholesterol levels. Both diets decreased LDL-cholesterol and TG to similar extents. This study demonstrated that peanut products were as effective as olive oil at improving blood lipid levels and suggested that is it the MUFA *per se* rather than the olive oil causing the beneficial effects. Further evidence that a variety of MUFA sources will improve the plasma lipid profile derives from an intervention using macadamia nuts (75% energy from fat, 80% of which is MUFA) (Curb et al, 2000). The macadamia-based MUFA diet had potentially beneficial effects on LDL-and total cholesterol levels compared to an 'average American diet'. Although olive oil consumption is now more widespread than in the Mediterranean region, the above data highlights the fact that other food options can be used to increase MUFA intake in populations with varied dietary intakes. A variety of MUFA sources may be key to increasing MUFA intake in non-Mediterranean populations.

Non-MUFA effects of the Mediterranean diet

This report has focused on the role of MUFA within the Mediterranean diet and its effect on CVD risk factors. This is due to the fact that much research has focused upon this dietary component in relation to this health issue. However as mentioned above many components within this traditional diet may contribute to the decreased morbidity, mortality and increased longevity. The high intake of fruit, vegetables and wholegrains provides a wide variety of antioxidants that may inhibit the oxidation of LDL-cholesterol and reduce the risk of atherosclerosis. A level of alcohol consumption similar to that observed in the Mediterranean can reduce the risk of CHD both by reducing the oxidation of LDL-cholesterol and reducing blood coagulation. The Mediterranean diet also contains a high level of complex carbohydrates (fruit, legumes, vegetables, whole grains), which can aid glycaemic control in type 2 diabetics. Levels of certain types of cancer are also lower in Mediterranean populations, including cancer of the colon, breast and prostate). Delegates of a British Nutrition Foundation conference (Stanner, 2000) agreed that components of the Mediterranean diet were likely to be protect against these forms of cancer. A high intake of antioxidants and phytochemicals from fruit and vegetables may for example reduce the risk of colon cancer. This area of research warrants further investigation.

Tiger White and the Mediterranean Diet

Tiger White fits into the typical Mediterranean diet since it is a plant product, high in MUFAs, relatively low in SFA and contains the antioxidant, Vitamin E. As shown in document 2, table 2, 39% of the energy in Tiger White is derived from MUFA. In comparison, this ranges from 15% in whole milk to 3% in skimmed milk. 11% of energy is derived from MUFA in plain soya milk. Tiger White contains 1.4 times as much MUFA as whole milk, 3.5 times as much as semi skimmed milk and soya milk and 14 times as much as in skimmed milk.

Table 1 shows the contribution that milk made to the GB diet in 2000. This is made up of approximately 100ml of whole milk and 160ml of semi-skimmed milk. Replacement of this milk by a portion (350ml) of Tiger White would reduce the level of saturates in the diet to from 15.0% to 14.1% and increase the level of MUFAs from 13.5% to 15.4% and PUFAs from 6.9% to 7.5%. This would therefore be a move towards the Mediterranean diet. Although protein intake would be reduced by 6g, since protein intakes are generally in excess of requirements this would pose no problem to health and protein would still contribute 14% to total energy intake.

Table 1 Contribution made by milk to the UK diet (DEFRA, 2001)
Energy
kcalProtein
gFat
gSFA
gMUFA
gPUFA
gWhole milks653.33.92.51.10.1Skimmed milks765.92.51.60.70.1Total milks1419.26.44.11.80.2Total intake175066.374.229.226.413.4% of energy38%15.0%13.5%6.9%

As discussed above, data from the Nurses Health Study suggested that the replacement of each 5% of energy from SFA with MUFA decreased CVD risk in their population by 19%. If we assume their diet was similar to that in the UK, intake total energy intake is estimated as 1750kcal/d (DEFRA 2001), thus 5% of total energy intake is approximately 350kcal equivalent to about 39g of fat. A portion of Tiger White provides about 5g of MUFA. This increase in MUFA would need to accompanied by a decrease in a similar amount of saturates for the benefits to be realised. It is important to note that even small dietary changes can confer significant health benefits, especially if these are at the population level.

Conclusion

From both epidemiological evidence and intervention studies it is evident that there are numerous benefits to health from consuming a traditional Mediterranean diet. This review has focused on the role of MUFA in cardiovascular health since this has been the most intensively investigated aspect of this diet. Numerous studies suggest that replacing SFA with MUFAs or PUFAs may improve cardiovascular risk to a greater extent than the currently recommended replacement by carbohydrate (Kris-Etherton, 1999). Concern has been raised that the promotion of fat intake would increase the risk of obesity due to a higher energy density. However it is possible that a higher adherence to a non low-fat diet may increase compliance and be more likely to achieve the recommended decrease in levels of SFA, which would be expected to improve blood cholesterol and CVD risk.

There is however undoubtedly more to the Mediterranean diet than its fatty acid profile. Data from the Greek branch of the EPIC study found a significant improvement in CVD mortality with a higher MUFA: SFA ratio and a higher intake of fruit and nuts. However these nutrients / foods alone could not fully explain the benefits of the diet. The traditional Mediterranean diet may therefore contain many nutrients, which may work synergistically to reduce CVD risk. Since CVD accounts for a large proportion of all deaths in Europe (British Heart Foundation, 2000) and it is evident that dietary changes can significantly reduce risk it is important that improvements in our dietary intakes are continually promoted.

Olive oil is often the food source recommended to increase MUFA intake. Whilst its use is becoming more widespread it is important to source other food options such that consumers may have a wider food choice. Tiger White can be easily incorporated into the UK diet and would therefore provide an alternative means to increase MUFA intake within the UK. This increased choice may be a key factor in increasing MUFA intake within a non-Mediterranean population.

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