International Tree Nut Council (INC)
Consejo Internacional de los Frutos Secos

Official Response

to

World Health Organization (WHO)
Food and Agriculture Organization (FAO)
Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases

Geneva, June 15, 2002

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1. Introduction to INC

A. Background on Organization

The tree nut industry consists of almonds, brazil nuts, cashews, hazelnuts, macadamias, pecans, pinenuts, pistachios and walnuts. Tree nuts are produced in more than 40 developed and less-developed countries (see Table 1) and consumed worldwide. Millions of hectares of land are devoted to tree nuts, providing economic livelihood for hundreds of thousands of producers and small families.

The International Tree Nut Council (INC) is an international, non-profit, non-governmental organization that supports market research and promotional efforts throughout the world. Members include those associations and organizations that represent the nine tree nuts (almonds, brazils, cashews, hazelnuts, macadamias, pecans, pinenuts, pistachios and walnuts) in a number of producing countries. The INC's mission is to expand global consumption of all tree nuts. Among the key objectives:

- To increase understanding about nutritional benefits, growing, processing, marketing, distribution and consumption trends in the tree nut industry.
- To collect and distribute a single source of annual statistical information from producing and consuming countries of the nine tree nuts.
- To assure that global quality standards and trading terms are within the framework of existing national and international bodies and do not inhibit trade within the industry.
- To promote research and new product development.
- To facilitate international cooperation by interacting with various public, private, national and international organizations which share common goals.
- To increase goodwill and mutual understanding of the tree nut industry by promoting international scientific meetings in producing and consuming countries.

In 1994, INC began to support and participate in educational forums devoted to the scientific issues regarding the positive role that tree nuts play in prevention of heart disease and other chronic diseases (Oldways Monograph 1995). At this international symposium, it was concluded that tree nuts, as one of the integral plant foods in the traditional Mediterranean diet, had been overlooked by the nutrition research community. In 1997, the World Cancer Research Fund (WCRF) acknowledged that nuts and seeds, which have been common in human diets since pre-agricultural peoples, are nutrient dense and a good source of unsaturated fats, protein, dietary fiber and micronutrients. The WCRF referred to brazil nuts, macadamias and cashews as seeds.

However, the WCRF pointed out, nuts needed to be identified separately in human studies to better evaluate their protective effects on human health. Since the mid 1990’s, INC has supported research globally and has held research forums in Europe and North America.
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Table 1: Tree Nut Producing Countries

<table>
<thead>
<tr>
<th>ALMONDS (AL)</th>
<th>AMAZONIAS (BR)</th>
<th>CASHEWS (CA)</th>
<th>HAZELNUTS (HA)</th>
<th>MACADAMIAS (MA)</th>
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<tr>
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<td>BOLIVIA</td>
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<td>MOROCCO</td>
<td>TANZANIA</td>
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<td>SO. AFRICA</td>
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<td>SPAIN</td>
<td>VIETNAM</td>
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<td>TUNISIA</td>
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</table>

<table>
<thead>
<tr>
<th>PECANS (PE)</th>
<th>PINENUTS (PIN)</th>
<th>PISTACHIOS (PI)</th>
<th>WALNUTS (WA)</th>
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<td></td>
<td></td>
<td></td>
<td>MALDONIA</td>
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<td></td>
<td></td>
<td></td>
<td>NO. KOREA</td>
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<td></td>
<td></td>
<td></td>
<td>TURKEY</td>
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<td></td>
<td></td>
<td></td>
<td>UKRAINE</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>USA</td>
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</tbody>
</table>
B. Global Tree Nut Production

Following is a summary of global tree nut production. Data is based on information gathered from producing country government statistics and industry sources (brazil and cashew data from FAO production database).

<table>
<thead>
<tr>
<th>TREE NUT</th>
<th>2001 PRODUCTION (Metric Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shelled</td>
</tr>
<tr>
<td>Almonds</td>
<td>469,000</td>
</tr>
<tr>
<td>Brazil Nuts</td>
<td></td>
</tr>
<tr>
<td>Cashews</td>
<td>1,100,000</td>
</tr>
<tr>
<td>Hazelnuts</td>
<td></td>
</tr>
<tr>
<td>Macadamias</td>
<td>21,600</td>
</tr>
<tr>
<td>Pecans</td>
<td></td>
</tr>
<tr>
<td>Pine Nuts</td>
<td>5,000</td>
</tr>
<tr>
<td>Pistachios</td>
<td></td>
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<tr>
<td>Walnuts</td>
<td></td>
</tr>
</tbody>
</table>

International Tree Nut Council, 2002

C. Worldwide Tree Nut Consumption

Tree nuts are widely consumed in both raw and processed forms. Unlike groundnuts, which are predominantly used for oil and feeding stuff, tree nuts are primarily consumed as whole foods, as ingredients in foods, or in medicinal preparations. For example, in several Asian cultures, almonds play a significant role in Ayurvedic preparations, a philosophy which for thousands of years has promoted the interrelationship of nutrition/diet with healing, prevention and longevity.

<table>
<thead>
<tr>
<th>Location</th>
<th>Per Capita Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Location Kg/Year</td>
</tr>
<tr>
<td>Africa</td>
<td>1.0</td>
</tr>
<tr>
<td>N. and C. America</td>
<td>2.3</td>
</tr>
<tr>
<td>South America</td>
<td>0.5</td>
</tr>
<tr>
<td>Asia (inc. Middle East)</td>
<td>1.0</td>
</tr>
<tr>
<td>Europe</td>
<td>2.8</td>
</tr>
<tr>
<td>Oceania</td>
<td>2.6</td>
</tr>
<tr>
<td>World</td>
<td>1.3</td>
</tr>
</tbody>
</table>

FAO 1999 Food Balance Sheets

Based on data contained in the 1999 FAO Food Balance Sheets, it is apparent that tree nut consumption varies both among and within the regions where there is tree nut production. For instance, the European region is shown as having consumption of 2.8 kg/person per year. However, when looking more closely at individual country consumption within that region, Spain and Greece (tree nut producers) have consumption levels of 7.3 and 9.9 kg/person, respectively. The variations in consumption between North and South Europe are even more apparent in the food availability (as kg/cap/year) calculations done by Nanos and
Gerasopoulos (2001) with EU (4.0), Spain (6.7) and Greece (10.0). They also cite that tree nuts are five times more available to Greeks than U.S. consumers. Consumption levels in Asia, with vast population levels, are even more skewed.

An obsession to lower fat took its toll on the consumption of tree nuts in North America in the 1980-1990s. As more recent research emerged on unsaturated fats and health, dietary recommendations have moved toward moderate rather than low fat with specific focus on the need for unsaturated fatty acids in the diet. Tree nuts are poised to lead the way to bring focus to and examine what is going on in scientific research as well as changes in dietary guidance, food and healthy eating patterns, media coverage and consumer nutrition and health trends that have implications for tree nuts. As the science on nuts unfolds in key nutrition research areas of health promotion and disease prevention, nuts are gaining more prominence as a whole food choice that can help promote good health. The strength of the scientific body of evidence is convincing that nuts, which contain predominantly unsaturated fat, are linked to lowering blood cholesterol and heart disease risk. Along with reduction in heart disease risk, there is new, emerging science in weight management, type II diabetes, hypertension and cancer all of which have further implications for nuts or the components of nuts in healthful eating.

D. Implications and Directions for Increased Trade and Consumption

Exports of tree nuts have seen double digit increases from 1990 to 2000\(^1\). In particular, increases have occurred in a number of developing countries in Africa, which dominates cashew production, and China, which is now a significant supplier of walnuts to the world market. With increased tree nut production, there is an opportunity for expanded consumption of tree nuts in a number of markets, particularly those in need of food-based nutritional supplements. Nutrition research, conducted in North America, Europe and Asia, has demonstrated that tree nuts provide important macro- and micronutrients including protein, unsaturated fats, vitamins and minerals. In addition, tree nuts are a source of important phytochemicals and antioxidants, which have been shown to have beneficial effects on overall health. Tree nuts also provide a valuable source of vegetable protein and calcium.

In many countries, a public health priority is basic nutrition and insufficient food supply. Tree nuts are perceived to be comparatively expensive to other plant foods such as legumes or beans. However, this constraint is being overcome by increased production, which is lowering cost and increasing availability. In addition, on-going bilateral and multilateral negotiations are resulting in agreements which reduce tariffs and duties, in addition to harmonizing phytosanitary requirements that are potential barriers to trade.

WHO (1990) recommended that a minimum of 30g/day of a combination of nuts, seeds and pulses be included within its recommendation of a minimum intake of 400g/day of vegetables and fruits. This recommendation was focused on some types of cancer, as well as coronary heart disease. In the current report of the Expert Consultation, nuts are only specifically mentioned in terms of CVD. It is important to note that nutrition research has demonstrated that as little as 30 grams of nutrient dense nuts per day can have a positive effect on

\[\text{\footnotesize 1 FAO Statistical Database, 1990-2000; exports of almonds, brazils, cashews, hazelnuts, pistachios and walnuts. No data was available for pinenuts, pecans, and macadamias.}\]
health. Moreover, tree nuts are a nutrient-dense, shelf-stable, non-perishable, whole food source of valuable micro- and macronutrients, which are crucial considerations in countries with limited controlled storage or processing facilities.

2. Summary of Tree Nut Research

A. Health Outcome Studies – USA

Nuts and Cardiovascular Disease
Hu and Stampfer (1999) summarized the relationship between nut consumption and risk of coronary heart disease (CHD) as, “So far, five large prospective cohort studies (the Adventist Health Study, the Iowa Women’s Health Study, the Nurses’ Health Study, the Physicians’ Health Study and the CARE Study) have examined the relation between nut consumption and the risk of CHD, and all have found an inverse association. In addition, several clinical studies have observed beneficial effects of diets high in nuts (including walnuts, peanuts, almonds and other tree nuts) on blood lipids. The beneficial effects of nut consumption observed in clinical and epidemiological studies underscores the importance of distinguishing different types of fat.” Ellsworth et al. (2001) further examined the specific relationship between the frequency of nut intake and risk of death in the 34,111 postmenopausal women in the 12-year Iowa Health Study and concluded frequent nut consumption may offer these women modest protection against the risk of death from all causes and CHD. They recommended that future studies should consider using a more precise way to measure nut intake.

Based on the data from the Nurses’ Health Study, the researchers estimated that substituting one ounce (~28 grams) of nuts for the equivalent energy from carbohydrate in an average diet, was associated with a 30% reduction in CHD risk. The substitution of nut fat for saturated fat was associated with a 45% reduction in risk. Hu and Stampfer (1999) concluded regular nut consumption can be recommended in the context of a healthy and balanced diet.

Fraser et al. (1992) reported on the cohort investigation of 31,208 non-Hispanic, white, California Seventh-Day Adventists with detailed information on how the nut-eating cohorts were healthier and less obese. For six years annual questionnaires were mailed to all participants as a screening mechanism for CHD and any hospitalization. Much to their surprise, upon study completion and analysis, subjects who consumed nuts frequently (>4x/week) had less CHD, despite all covariant adjustments. The apparent protective effect of nuts was independent of established coronary risk factors such as age, sex, smoking habits, history of hypertension, relative weight and physical exercise. They also found that consumers of nuts were less obese. Numerous components in nutrient dense tree nuts are reported to contribute to their protective effect in reducing the risk of heart disease: unsaturated fatty acids, vitamin E, magnesium, copper and arginine (Cooke et al. 1993, Durlach 1998, Klevay 1993, and Kris-Etherton et al., 1999). Kris-Etherton reviewed 18 feeding trials that used diets containing nuts and found that there was a 25% greater cholesterol lowering response than predicted from equations for blood cholesterol, in response to changes in dietary fatty acids. They concluded that these results suggest that there are non-fatty acid constituents in nuts that have additional cholesterol-lowering effects (Kris-Etherton et al., 1999).
**Nuts and Obesity/Vegetarianism**

Sabaté and Blix (2001) summarized the frequency of nut consumption in relation to all-cause mortality in several California Seventh-Day Adventist sub-populations and found reduced hazard ratios for nut consumers, regardless of age, sex, race or fitness status. In three dietary subgroups, the prevalence of obesity at baseline between vegetarian and non-vegetarian groups was also strikingly different (Sabaté and Blix, 2001). For both men and women, BMI increased as the frequency of meat consumption increased. Vegetarian men and women had a two point lower BMI value than non-vegetarians. Although these results were for middle aged (45-60 years) subjects, similar results were observed for other ages.

Summarized BMI data from the four large published studies of adult vegetarians, (Key et al., 1998), allow a comparison with non-vegetarian counterparts of the same cohort. Vegetarians in each study on average had 1 to 2 points lower BMI values than meat eaters within the same group. This difference is similarly observed in men and women. There is a substantial variation in BMI values, with USA having greater BMI than European cohorts. This can be attributed to methodological differences in data collection, geographic location, secular trends, and ethnic or genetic differences. Overall, these epidemiological data clearly suggest that meatless diets are associated with lower overall BMI scores and low prevalence of obesity in adults.

Hu et al. (1998) concluded from the Nurses’ Health Study that persons who consumed more nuts tended to weigh less, indicating that in practice, the energy contained in nuts can readily be balanced by reductions in other sources of energy or increased physical activity.

Finally, it is well known that vegetarians consume more nuts than non-vegetarians (3.7 servings/wk vs. 2.1 for non-vegetarians) (Rajaram and Wien, 2001).

**B. Health Outcome Studies – Europe**

In respect to prevention of degenerative diseases such as cardiovascular disease (CVD) and cancer, the importance of antioxidant supply with daily nutrition is increasingly recognized (Langseth 1995). Ginter (1998) reports that the CVD epidemic in Central and Eastern Europe seems to be only partially associated with a high prevalence of traditional risk factors (hypercholesterolemia, hypertension, smoking). Hence, the effect of traditional risk factors may be intensified by additional unidentified factors, such as environmental and psychosocial problems, and specific nutritional antioxidant deficiencies (antioxidant vitamins, flavonoids, folic acid). The intake of antioxidants from fruits, vegetables, nuts and vegetable oils was reported to be substantially lower in most Eastern European countries than in the West (Ginter 1998). Thus, in Eastern Europe factors increasing free radical production may not be sufficiently counterbalanced by protective nutritional antioxidants, and oxidative stress plays a crucial role in CVD pathogenesis.

In contrast, Mediterranean diets are known for a high tocopherol (vitamin E) content, a particularly important antioxidant (Trichopoulou and Vasilopoulou 2000; Kafatos, 1999; Colquhoun, 2000). It’s been shown that apparent benefits of the Mediterranean diet seem to be transferable to population groups from different origins and dietary habits (Kouris-Blazos et al., 1993; Noah and Truswell, 2001), Trichopoulou and Vasilopoulou (2000) concluded, that a diet that adheres to the principles of the traditional Mediterranean one is associated with longer survival. The Mediterranean diet as secondary prevention measure is also inexpensive.
compared to other diets or drug treatments (see Table 9 in Colquhoun, 2000). As a primarily plant food-based diet, the Mediterranean diet is characterized by a large variety of foods high in beta-carotene, vitamin C, vitamin E, minerals and phytochemicals. This traditional diet also has a moderate to high fat content (e.g., Italy 30%, Greece 40% of daily energy intake) (Trichopoulou and Lagiou, 1997), compared to widely promoted lower fat diets. However, the Mediterranean dietary fat is typically rich in beneficial unsaturated, primarily monounsaturated, fatty acids (MUFA), and is low in saturated fatty acids (SFA).

Tree nuts provide a similar fatty acid profile and also contain protein, fiber, important vitamins and minerals, and phytochemicals. For example, almonds and hazelnuts are excellent sources of natural alpha-tocopherol (AT). One ounce (28.35 g, 1 handful) provides 7.3 mg AT (USDA, 2001). Walnuts are a rich, plant-based source of omega-3 fatty acids and contain a favorable ratio of omega-6 to omega-3 fatty acids. One brazil nut provides all of the selenium needed per day (N.A.S., 2000). Dr. de Longeril, the principal investigator from the Lyon Heart Study, makes a compelling argument that scientists and physicians should have as high priority to study natural foods such as nuts to better understand the nature of their cardioprotective properties since they do better than aspirin or prevastatin for primary prevention of CHD (de Longeril et al., 2001).

Many European epidemiological studies have assessed nut intake. However, assessment and/or analysis was often done without differentiation, and different dietary assessment methodologies were used (i.e., diet history, Food Frequency Questionnaire, 24-hour dietary recall or dietary records/diary). For example, (a) tree nuts and groundnuts (peanut, a legume) are assessed together as 'nuts' or 'snacks' (e.g. Slimani et al., 2000; DIFE, 1995; Thiebaut et al., 2001; Verschuren et al., 1993); (b) nuts are assessed or listed in the food group 'fruits', maybe combined with seeds as a specific food sub-group (e.g. Slimani et al., 2000; Döring et al., 1998; Panico et al., 1992). Hence additional analyses of existing databases should be warranted to get a better picture of specific tree nut intake and their contribution to energy and nutrient supply in conjunction with chronic disease prevention. In development of future dietary instruments for health surveillance tree nuts should be separately considered as key foods.

Serra Majem et al. (2000) observed in their Canary Island cross-sectional dietary survey, a fairly low nut consumption of 2 g/day for the 6-75 year old representative population sample. Also the Spanish enKid Study, a population-based, cross-sectional nutrition survey in children and youth aged 2-24 years, showed for both gender a low mean daily consumption of 5 g/day of 'dry fruits and nuts' (Serra-Majem et al. 2001), and moreover, low consumption of fish, fruits and vegetables. All typical elements of the Mediterranean diet. The authors stressed the changes in feeding habits that have occurred in Spain, especially in the youth, where the characteristics of the Mediterranean diet are unraveling. Data from the Dietary and Nutritional Survey of British Adults showed that only 12% of the adult population ate any unsalted nuts, with an average intake of only 8 g/week (Gregory et al., 1990). Results from the German Nutrition Survey 1998 (Mensink et al., 2000) show low mean intakes for the combined food group of 'nuts, seeds and oil fruits', ranging from as low as 1 g/day in women aged 65-79 years to 6 g/day in men in the age strata 35-44 and 45-54 years.
C. Human Clinical Trials

Cardiovascular Disease, Mixed Nut Studies

There have been six published clinical trials involving mixed nuts (Bruce et al., 2000; Jenkins et al., 1997; Bruce et al., 1997; Abbey et al., 1994; Singh et al., 1992; Berry et al., 1991). In all of the studies, the “nut diets” significantly reduced total cholesterol (TC) from 7-25% and low-density lipoprotein (LDL) cholesterol by 10-33%. No studies found any significant effect on HDL, and two found a significant decrease in triglycerides (TG) (Jenkins et al., 1997; Bruce et al., 1997; Abbey et al., 1994; Singh et al., 1992).

The most recent study involved 12 hyperlipidemic women in a crossover design that lasted for two 4-week periods. Subjects first consumed a refined-food diet and then switched to a phytochemical-rich diet primarily consisting of whole grains, legumes, fruits, vegetables, seeds and two tablespoons of almonds, hazelnuts or pecans per day. Compared to the refined-food diet, the phytochemical-rich diet lowered TC by 13% and LDL by 16% with no significant changes in HDL or TG (Bruce et al., 2000).

A second study involved 10 adults in a randomized crossover design that lasted for two 2-week periods. The control diet was the subjects’ habitual diet. The study diet consisted of mainly vegetables, fruit, avocados and nuts (limited to 60-120g/day, average consumption was 100g/day). Compared to the control diet, TC was reduced by approximately 25%, LDL by 33% and TG by 20%, with no significant change in HDL (Jenkins et al., 1997).

Another intervention study, conducted in Australia, involved 15 adults who ate a plant-based diet that included whole grains, sun-dried raisins and mixed nuts (almonds, hazelnuts and walnuts) and nut butters (almond and sesame). After four weeks, TC decreased by approximately 8%, LDL decreased by 15% and HDL was not significantly effected (Bruce et al., 1997).

The fourth study involved 16 normolipidemic men in a consecutive, supplemental field study that lasted for three 3-week dietary periods. During the first three weeks, subjects consumed a reference diet that included a background diet supplemented with 50g/day of peanuts, 40g/day of coconut, and 50g/day of a coconut confectionary bar. During the second three weeks, subjects consumed the background diet supplemented with almonds (84g/day) and during weeks 7-9, subjects consumed the background diet supplemented with walnuts (68g/day). Compared to the reference diet, the almond diet lowered TC by 7% and LDL by 10%, while the walnut diet lowered TC by 5% and LDL by 9%. Neither diet had a significant effect on HDL or TG (Abbey et al., 1994).

A fifth study, conducted in India, involved 406 patients who were recruited 24 to 48 hours after having an acute myocardial infarction (MI). The randomized, single-blind intervention study lasted 6 weeks. Subjects were divided into two groups. One group consumed Diet A in which meat and eggs were replaced by fish, vegetarian meat substitutes and nuts (almonds and walnuts). Those following Diet B ate a low-calorie, typical hospital diet, followed by a diet prescribed by their doctors. Those consuming Diet A had a 9% decrease in TC, 10% decrease in LDL and 9% decrease in TG compared with the initial levels and the changes in diet group B. Those following Diet A also had a 36% decrease in cardiovascular events compared to those consuming Diet B (Singh et al., 1992).
Finally, the Jerusalem Nutrition Study was a randomized, controlled crossover study involving 18 young men that examined the effects of a high mono-unsaturated fat (MUFA) diet (including almonds, olive oil and avocado) versus a high polysaturated fat (PUFA) diet (including walnuts, safflower and soy oils) during two 12-week dietary periods. The MUFA diet lowered TC by approximately 10% and LDL by 14% compared to baseline values, while the PUFA diet lowered TC by 16% and LDL by 21%. There were no significant effects on HDL or TG (Berry et al., 1991).

Cardiovascular Disease, Single Nut Studies (alphabetical order)

**Almonds**

An almond meta-analysis was just reported for seven studies (Fulgoni et al., 2002). There have been four published clinical trials involving almonds and all found that the almond diets significantly reduced TC (range 8-12%) and LDL (range 9-15%). There were no significant changes in HDL or TG (Hyson et al., 2002; Spiller et al., 1998; Berry et al., 1992; Spiller et al., 1992.) The Mediterranean-diet-type study involved 45 hypercholesterolemic adults in a randomized, controlled, parallel study that lasted four weeks (following one week on a baseline diet). The control group consumed a diet of whole and unrefined foods plus 85g/day of cheddar cheese, 28g/day of butter, and 21g/day of rye crackers. The olive oil group consumed a base diet of whole and unrefined foods plus 48g/day of olive oil, 113g/day of cottage cheese and 21g/day of rye crackers. The almond group consumed the same base diet of whole and unrefined foods plus 100g/day of raw, unblanched almonds (both whole and ground). The almond diet lowered TC by 12% and LDL by 15% compared to baseline values, while the olive oil diet had no significant effects (Spiller et al., 1998). A recent clinical trial on almonds compared whole almonds and almond oil and found they had similar cholesterol-lowering effects, which were greater than accounted for by the MUFA content alone, indicating that other fat soluble components (alpha-tocopherol vitamin E, phytosterols) contribute to the beneficial effects on plasma lipids (Hyson et al., 2002). The first dose response study, a randomized, crossover study of 27 hyperlipidemic men and women with full (73g) or half almond dosage, has been accepted to a medical journal (Kendall et al., 2002a,b). The almonds had favorable effects on serum blood lipids and lipoprotein profile for those at risk for CHD. A dose-response relationship was evident and almonds reduced oxidation of LDL cholesterol. The authors concluded that the significant reduction in CHD risk factors was in part related to the non-fat components of the almond (Kendall et al., 2002a,b).

**Hazelnuts**

Thirty healthy medical students added 1 gram of hazelnuts per kilogram of body weight per day to their normal daily diet for 30 days. TC was lowered by 6%, LDL by 19%, while HDL increased 7% and TG 25% compared to baseline values. Plasma antioxidant potential (AOP) also increased by 20% (Durak et al., 1999). Alphan et al. (1997) gave 19 patients with non-insulin dependent diabetes a diet supplemented with hazelnuts to provide 40% of energy from carbohydrates and 45% from fat. Compared to the baseline diet (60% carbohydrates, 25% fat), triglycerides were not significantly altered after consumption of the hazelnut diet. Total cholesterol and LDL were significantly lowered, HDL was not significantly changed.

**Macadamias**

Two randomized, crossover studies have examined the effects of macadamias on cholesterol levels. Both studies reported a reduction in TC (range 5-8%), LDL (range 5-11%) and TG
Only one of the studies found a significant effect on HDL (5% decrease) (Curb et al., 2000; Colquhoun et al., 1996). The more recent study involved 30 subjects who consumed three different diets each for 30 days. The first diet was a typical American diet (AM), high in saturated fat, the second diet was the American Heart Association (AHA) Step 1 diet, and the third diet was a macadamia-based diet (MAC) high in monounsaturated fatty acids. Compared to the AM diet, the MAC diet lowered TC, LDL and HDL each by 5% and TG by 10%. The AHA diet had similar results except for an 8% increase in TG (Curb et al., 2000).

**Pecans**

A randomized, controlled, parallel study involved 19 healthy adults who followed either a control diet (no nuts) or a pecan diet which included 68 grams of pecans per day (with no additional nuts). After eight weeks, those following the pecan diet had a 6% decrease in LDL compared to the baseline value. Effects on TC, HDL and TG were not significant (Morgan and Clayshulte, 2000).

**Pistachios**

Two studies have looked at the effects of pistachios on blood lipid levels. In one study, 10 patients with moderate hypercholesterolemia were enrolled in a controlled, randomized, crossover study for two 3-week periods. A reference diet of 37% total fat was compared to a pistachio diet of 39% total fat (66g/day of pistachios) in which 20% of the daily caloric intake was substituted with pistachios. Compared to initial values, the pistachio diet decreased total cholesterol by 2% and increased HDL by 12%, while there was no significant effect on LDL or TG (Edwards et al., 1999).

Most recently, researchers observed that daily inclusion of pistachios in the diet can decrease total cholesterol and LDL in subjects with moderate hypercholesterolemia (fasting serum cholesterol > 250 mg/dl). Ten subjects were randomized to the pistachio group (20% of daily caloric intake from pistachios) and 10 to the regular snack group and crossed-over at four weeks. Both diets were maintained isocaloric, with pistachios substituted for the usual snacks the subjects consumed during the day. On the pistachio diet, significant reductions were seen in total cholesterol (247±5 vs. 234±6, p=0.02), LDL (165±6 vs. 147±8, p=0.006) and APOB (133±4 vs. 117±4, p=0.002). Significant increase was observed in APOA (139±7 vs. 151±7, p=0.006). In subjects on the regular snack food diet, no lipid values were significantly different from baseline. (Erario et al., 2001).

**Walnuts**

A recent scientific review of all walnut-specific clinical research concluded that the body of research is strong that eating walnuts reduces the risk for heart disease due to their preventative properties. Key findings suggest that: (1) consuming walnuts did not cause a net gain in body weight; (2) walnuts decreased serum cholesterol and reduced heart disease risk; (3) walnuts are unique among nuts due to their polyunsaturated fat (omega-3 and omega-6) fatty acid content. The author, and four independent experts, evaluated the content and quality of scientific evidence for a potential beneficial health relationship between the intake of walnuts and the reduction and prevention of coronary heart disease. Five controlled, peer-reviewed, human clinical walnut intervention trials involving approximately 200 subjects considered representative of the adult population in the United States at risk of coronary heart disease were reviewed. Daily intake of 48-84 grams of walnuts lowered low-density
lipoprotein cholesterol with little effect on high-density lipoprotein cholesterol and had other beneficial effects on blood lipids, all of which have been shown in numerous other studies to reduce the risk of coronary heart disease, according to the lead author. (Feldman, 2002).

In four published clinical trials involving walnuts, all found that the walnut diets reduced TC (range 4-12%) and LDL (range 8-16%) (Zambon et al., 2000; Chisolm et al., 1998; Sabaté et al., 1993). HDL decreased by 5% in one study (Sabaté et al., 1993), increased by 14% in another (Chisolm et al., 1998), and remained unchanged in the other two (Zambon et al., 2000; Iwamoto et al., in press 2002). No significant changes were reported in TG levels in three of the studies (Iwamoto et al., 2002; Chisolm et al., 1998; Sabaté et al., 1993), while one found an 8% decrease (Zambon et al., 2000). Apo A-I levels were measured in only one study, which showed a 5% decrease (Zambon et al., 2000). Three studies measured APOB levels and observed a decrease of 7-13%. Only one study recorded lipoprotein(a) levels (9% decrease) and VLDL levels (12% decrease) (Zambon et al., 2000).

The most recent walnut study was a randomized, crossover feeding study in which 49 adults with hypercholesterolemia consumed a Mediterranean diet (MD) emphasizing vegetable products, fish and olive oil (no nuts), and a walnut diet (WD) which partially replaced olive oil and other fatty foods of the MD with 41-56 grams of walnuts per day. Compared to baseline values, the WD and MD lowered TC by 9% and 5%, and LDL by 11% and 6%, respectively, but had no significant effect on HDL. Only the WD lowered TG by 8% (Zambon et al., 2000).

Obesity/Weight Reduction
Citing results from various almond, macadamia, and walnut clinical studies, Fraser (1999) stated: “Several investigators have noted that in certain human nut feeding studies, that included only limited dietary advice, weight gain was not a problem despite supplements of several hundred calories of nuts and/or nut fat each day. Suggested explanations for such a possible result include a satiety effect of nuts compensating for the additional nut calories by decrease intake of other foods; limited absorption of the fat due to the nut fiber or poor mastication; or an unexplained metabolic effect whereby nut fats are ‘burned’ rather than stored, perhaps associated with a higher metabolic rate.” Fraser et al. (2002) found that incorporating 320 kcal of almonds into the daily diet of 81 free-living subjects for six months did not lead, on average, to statistically or biologically significant changes in body weight. Long term daily almond consumption improved the fatty acid and micronutrient profiles and eating patterns of free-living individuals.

In a recent randomized, parallel study, 101 overweight adults were followed for 18 months. Subjects were divided into two groups and consumed one of two study diets, both of which were calorie controlled (1200 kcal/day for women; 1500 kcal/day for men). The low-fat diet (LF) had a total of 20% calories from fat, while the high-unsaturated fat diet (UNSAT) consisted of 35% total fat and included tree nuts, peanuts, canola and olive oils.

After six months the average weight loss was comparable in both groups. However, there was a significant difference at the end of the 18 months in participation rates. In the LF group, only 20% were still actively participating in the study compared to 54% of the UNSAT group. One factor which may contribute to the greater participation rate is that a moderate fat diet
may induce the feelings of satiety after a snack or meal. In addition, the participants in the unsaturated group reported that they did not feel like they were “dieting” and therefore, did not feel deprived (McManus et al., 2001).

**Diabetes**

A number of studies have linked the rate of carbohydrate digestion with risk of chronic disease. The standardized method of measuring the rate of carbohydrate digestion *in vivo* is by use of the glycemic index. The glycemic index (Jenkins et al., 1981; Brand Miller, 1994; Wolever et al., 1991) allows ranking of foods from those which give rise to the highest blood glucose and insulin response (high glycemic food) to those associated with the lowest blood glucose and insulin response (low glycemic index foods). Epidemiological studies have shown that a low glycemic index diet is linked to reduced risk for type II diabetes (Salmeron et al., 1997; Salmeron, Ascherio et al., 1997), cardiovascular diseases (Liu et al., 2000) and cancer (Corpet et al., 1998). In experimental studies in type II diabetic subjects, a low glycemic index diet is seen to improve important risk factors, such as glycated hemoglobins (Jenkins et al., 1988; Brand et al., 1991; Järvi et al., 1999), clotting factors (Järvi et al., 1999) and HDL levels (Luscombe et al., 1999).

Nuts are good sources of unsaturated fatty acids, vegetable protein, fiber and associated antioxidant flavonoids, which in a limited number of studies, have independently been shown to have a number of effects including blunting the postprandial glucose rise, improving carbohydrate tolerance and reducing risk factors for diabetic complications (Garg, 1998; Sarkkinen et al., 1996; Chandalia et al. 2000; Kaneto et al., 1999; Paolisso et al., 1993). Nuts are also associated with protection from the development of type II diabetes in large cohort studies (Salmeron et al., 1997a,b).

INC is currently funding research at the University of Toronto to look at the glycemic effect of tree nuts in both non-insulin dependent and non-diabetics. Preliminary findings show that nuts are a very low glycemic food. The researchers plan to conduct a large, multi-center, multi-national study to further investigate the effects of nuts on diabetes. In collaboration with this study, other research is ongoing to evaluate the relationship between the structure of nuts, digestibility, and bioavailability of nutrients (Ren et al., 2001).

**Cancer**

In a report by the World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR) the authors concluded, “While there are theoretical reasons to believe that diets high in nuts and seeds might protect against some cancers, the evidence is currently lacking.” (AICR, 1997).

A year later, a study was published on prostate cancer, the most prevalent cancer among men, representing a large and growing health problem in the U.S. and other Western countries. In this large, 59-country study, researchers tried to identify predictive measures for prostate cancer mortality. They concluded, “The specific food-related results from this study are consistent with previous information and support the current dietary guidelines and hypothesis that grains, cereals and nuts are protective against prostate cancer.” (Hebert et al., 1998).
Currently, a clinical trial study is underway in China to evaluate the effect of fortified almond milk on the antioxidant status and immune systems of cancer patients while undergoing treatment.

3. Tree Nut Composition

In 1999, INC worked closely with U.S. Department of Agriculture (USDA) to reanalyze all of the tree nuts for their nutritional content. This information was then added to the USDA nutrient database (see Table 2).

In addition to the macro- and micronutrients, a variety of phytochemicals (i.e., ellagic acid, phenolic compounds, luteolin and tocotrienols) are also present in tree nuts (Borchers, 2001). Research has shown that these plant chemicals may help reduce the risk of heart disease, certain cancers and other chronic diseases. INC is currently working with USDA again, to analyze the flavonoid content of tree nuts, as part of a large program to establish a flavonoid database. This is an area of great interest for plant based foods overall, as flavonoids are antioxidants, and a number of in vitro and in vivo studies are showing protective effects (Hollman et al, 2000). For almonds two recent studies have identified and quantified the range of flavonoids in almonds skins for the first time (Frison-Norris and Sporns, 2002; Sang et al., 2002). Research to assess the beneficial effects for humans are ongoing. Preliminary data should be available by Fall 2002. The final data will appear in the USDA nutritional database and the findings will be published in 2003.
Table 2. All Nut Composition (Micro and Macronutrients)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Units</th>
<th>Almonds</th>
<th>Brazils</th>
<th>Cashews</th>
<th>Hazelnuts</th>
<th>Macadamias</th>
<th>Peanuts</th>
<th>Pecans</th>
<th>Pinenuts</th>
<th>Pistachios</th>
<th>Walnuts</th>
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<td>567</td>
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<td>629</td>
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<td>2402</td>
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<td>116</td>
<td>220</td>
<td>102</td>
<td>NA</td>
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g = gram
mg = milligram
mcg = microgram
NA = not applicable

Vitamin A Explanation:
I.U. = International Units
R.E. = Retinol Equivalents
Vitamin A in RE is calculated by dividing Vitamin A in IU by 10.

Vitamin E Explanation:
AT = alpha-tocopherol; ATE = alpha-tocopherol equivalents.
Alpha-Tocopherol Equivalents (ATE) are calculated from the total of: (alpha-tocopherol values X 1) + (beta-tocopherol values X 0.5) + (gamma-tocopherol values X 0.1) + (delta-tocopherol values X 0.0) = total ATE’s.
International Units for Vitamin E are calculated from: (alpha-tocopherol values only X 1.49) = Vitamin E (IU)

The Expert Consultation raises many important considerations in advancing the crucial role of diet and nutrition in the prevention of chronic diseases. In particular, noting the changes in the world food economy from the standpoint of dietary patterns and lifestyle is a key element to moving a nutrition dialog forward. However, equally important is to recognize there is no “worldwide” dietary strategy - rather than trying to encourage categorization of “good foods” versus “bad foods,” the nutrition discussion must elevate the strategy to one which promotes balance in food and nutrition choices and respects regional, ethnic, and cultural differences.

Unlike earlier reports, the current report often associates energy-density with high fat, without always acknowledging the beneficial effects of the type of fat in a diet - e.g. foods which are energy-dense in mono- and polyunsaturated fats versus saturated fats can play a vital role in an overall healthy diet. Krawczyk (2001) has clearly shown when reviewing the dietary guidelines for fat around the world that guidance on dietary fat is influenced by level of prosperity or poverty within a country (which may encompass the two extremes), local culture and tradition, and domestic food production. He concludes that although some countries recommend limiting total fat, more focus is placed on reducing saturated fat in the diet, with an increasing number of countries starting to give advice on levels of polyunsaturated and/or monounsaturated fatty acids in the diet. Among the authorities which have moved in the direction of types of fat recommended is the American Heart Association (Krauss et al., 2001). Scientific research is refining our understanding of nutritional benefits, allowing greater flexibility in food choices which provide diversity and alternative sources of valuable micro-/macronutrients. The report therefore must provide a framework for incorporating foods into dietary strategies as research clarifies and demonstrates their contribution to an overall healthy diet.

The role of the food industry should not be undervalued in this discussion. From the producer through the processor, it is often the food industry which is working in partnership with governments, NGOs, consumer organizations, and health influencers to support nutrition research and the dissemination of dietary information. In addition, it is these producer-industry groups which must balance the commercial, practical aspects of the sustainability of production in light of growing environmental concerns. In the case of tree nuts, production is largely traditional, low-intensity farming which is concentrated in developing countries.

The report is correct to notice the importance of organizations such as Codex Alimentarius in any dialog which involves dietary recommendations and management of chronic disease. However, Codex Alimentarius has the dual responsibility of also ensuring fair international trade. Food safety guidelines agreed at an international level must consider the abilities of the most developed and the least developed; it makes no sense to establish international standards which are based on analytical methods of detection as opposed to true consumer health risks. In those situations, developing countries are unable to compete internationally, causing greater economic pressure and balance of trade inequities.

There is some concern regarding the report’s recommendation to “tax” those foods which are associated with being energy-dense or nutrient-poor as well as to pressure schools and other public facilities to not have vending machines. WHO/FAO’s role should focus on the provision of guidance in terms of nutrition recommendations and dietary guidelines.
However, the actual public policy strategies determined to be appropriate - whether it is to limit vending machines in schools, fiscal pricing policies or limited advertising to children - is a discussion which must be left to national authorities, based on their individual internal policies and priorities.
5. Conclusions and INC Recommendations

Evolving Dietary Recommendations Highlight the Potential Role of Tree Nuts in Healthy Eating for Disease Prevention and Health Promotion

The emphasis on low-fat diets is now under scrutiny in the United States as a more moderate approach has currently been taken for making dietary recommendations for fat intake. While lowering saturated fat to lower heart disease risk is well accepted, examining the amount and type of fat associated with healthy eating has become the focal point. A “moderate” dietary recommendation approach to total fat, emphasizing unsaturated fat and whole food choices is included in the USDA Dietary Guidelines for Americans 2000. The 2000 American Heart Association (AHA) Dietary Guidelines recommendation to “limit foods high in saturated fat and cholesterol; and substitute unsaturated fat from vegetables, fish, legumes, and nuts” includes nuts in a more predominant role than the past (Krauss et al. 2000). In May 2001, the National Institutes of Health’s National Cholesterol Education Program Report formalized its recommendation to keep total fat in the diet between 25-35% of calories (N.I.H. 2001). The recommendation for polyunsaturated fat in the diet is up to 10 % of calories. It also recommended the consumption of monounsaturated fat up to 20% of calories. This is the first time monounsaturated fat has been officially “increased” as part of a recommended healthy eating plan. This has a major implication for all tree nuts, which contain significant amounts of unsaturated fatty acids.

In recent years, nutrition experts and Oldways Preservation and Exchange Trust have begun to recommend a Mediterranean-like diet characterized by abundant plant foods (fruit, vegetables, breads, other forms of cereals, beans, nuts and seeds), fresh fruit, olive oil, dairy products (principally cheese and yogurt), fish and poultry consumed in low to moderate amounts, zero to four eggs consumed weekly, red meat consumed in low amounts, and wine consumed in low to moderate amounts, normally with meals (Oldways, 1995). Dietary data from the Mediterranean region shows the lowest recorded rates of chronic diseases and the highest adult life expectancy. And, it has been shown that apparent benefits of the Mediterranean diet seem to be transferable to population groups from different origins and dietary habits (Kouris-Blazos et al., 1999). The Mediterranean diet as a secondary prevention measure is also much less expensive compared to other diet or drug treatments (Colquhoun, 2000).

While the majority of unsaturated fat and tree nut research-to-date has focused on heart disease prevention, researchers are beginning to investigate the potential impact of unsaturated fat and tree nut consumption on prevention of other chronic diseases including weight management, diabetes type II, hypertension and cancer. These research areas are emerging and deserve some attention although much more research is needed.

Weight Management
Addressing the increasing problem of obesity in America has become the major focal point of dietary recommendations in the United States. This shift in thinking ideally suits the recommendation for individual or whole foods to help build healthy eating patterns. However, caloric intake then becomes of greater importance. Nuts continue to shoulder common misperceptions of being too high in fat and calories, and a food to be avoided. Healthy weight management requires an emphasis on calories and exercise. Recent studies do
not implicate unsaturated fat or nuts in the diet as a contributor to weight gain (Fraser et al., 2002). For example, a report in the 2001 Journal of International Obesity showed that an energy-restricted diet containing 35% calories from fat (the extra fat coming from unsaturated fat foods such as peanuts, peanut butter, tree nuts and olive oil) produced similar improvements in body weight to a low-fat diet. And, an extra serving of vegetables were consumed by the high-unsaturated fat diet. Participation rates were significantly higher over an 18-month period for the high-unsaturated fat diet (McManus et al., 2001).

**Diabetes Type II**
The American Diabetes Association currently recommends an individualized approach to nutrition that is based on the nutritional assessment and desired outcome of each patient. This approach takes into consideration patient preferences, control of high blood sugar and high blood lipids (ADA, 2002). To achieve these nutritional goals, either high-unsaturated-fat diets or low-saturated fat, high-carbohydrate diets are currently advised. A meta-analysis of various studies comparing these two approaches to diet therapy in patients with type II diabetes, revealed that high-monounsaturated-fat diets improve lipoprotein profiles as well as glycemic control (Garg, 1998). Furthermore, there is no evidence that high-monounsaturated-fat diets induce weight gain in patients with diabetes mellitus, provided that energy intake is controlled.

**The DASH Diet and Blood Pressure Control**
Research has shown that diet can affect high blood pressure (hypertension). The clinical study, called "DASH" (or “Dietary Approaches to Stop Hypertension) (Svetkey et al., 1999), found that elevated blood pressure can be reduced with an eating plan low in saturated fat, total fat and cholesterol, and rich in fruits, vegetables and low-fat dairy foods. The plan includes 50g of nuts, seeds, and dry beans 4-5 times per week. The DASH diet is rich in magnesium, potassium and calcium, as well as protein and fiber. Pistachios, almonds, walnuts and other tree nuts, peanuts, sunflower seeds, kidney beans, lentils and peas provide these important nutrients.

**Diet and Cancer**
Current recommendations for cancer prevention from the American Institute for Cancer Research (AICR) include, "Choose a diet rich in a variety of plant-based foods." While the 1997 AICR report, Food, Nutrition and the Prevention of Cancer: a Global Perspective reports no data on nuts and cancer, an epidemiological study has been published linking nut consumption with decreased incidence of prostate cancer. The data on phytochemicals and bioactive components in nuts and other foods like fruits and vegetables is just beginning. Nuts contain phytosterols (beta-sitosterol), polyphenols (flavonoids, ellagic acid), phytoestrogens (isoflavonoids), tocotrienols, antioxidants, and nutrients like vitamin E and selenium which have been implicated in cancer prevention, although the science is still in its infancy stages.

INC appreciates the opportunity to contribute its comments to this draft report and to provide WHO/FAO with a summary of the diversity of research on tree nuts. In terms of the recommendations of the report, research has demonstrated that tree nuts are consistent with the profile of plant-based foods which should be incorporated in a nutritionally balanced diet.
Among our specific recommendations:

1. The report indicates that a probable level of evidence exists demonstrating a decreased risk of CVD from nuts. Additional compelling results of almond and walnut meta-analyses are in publication. Given the growing body of research which demonstrates the contribution of nuts in the dietary management of other chronic diseases:
   - Specify nuts under the fresh fruits/vegetable category to increase awareness of their contribution as a nutrient- and energy-dense plant food.
   - Include the recommendation of incorporating 30g of nuts, seeds and pulses within the 400g fruits and vegetable category (as previously recommended in the 1990 report of the WHO study group).

2. Continue to encourage joint research which further explores the contribution diverse foods such as tree nuts can make to traditional diets (e.g. Mediterranean, vegetarian, etc.) which are more focused on plant-based foods.

3. Encourage partnerships with NGOs and the food industry in moving forward a global nutrition and dietary education agenda which encourages balanced food choices and food diversity.

4. Since food knowledge and nutrition is an evolving science, provide a structure to incorporate the growing body of research pointing to the role nutrient- and energy-dense foods such as tree nuts can provide in managing chronic diseases.

5. Promote dietary management policies from the context of an overall approach, recognizing that access to safe water and medical services are also paramount contributors to food safety.

6. Given the fact that a number of plant-based crops are subject to naturally-occurring contaminants/mycotoxins which vary depending upon production capabilities:
   - Encourage establishment of international food safety standards based on science-based risk assessments rather than advances in analytical techniques.
   - Ensure that valuable foods are not excluded from the overall diet solely due to improved analytical detection methods rather than true health risks.
6. References


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