

Nuts and healthy diets

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Examines the history and composition of a variety of nuts from around the world. States that since ancient times, nuts and oil seeds have been considered healthful foods worldwide. Outlines various methods and results of studies previously undertaken on the effects of nuts as part of the diet, in particular the relationship between nuts and coronary heart disease (CHD) Concludes that nuts are an under-recognized and under-consumed food in modern diets. They provide an abundance of nutritional value and can play an important role as individuals move from animal-based diets to plant-based diets.

Vegetarian Nutrition: An International Journal 1/1 [1997] 12-16
© MCB University Press [ISSN 1364-31501]

Introduction

The health benefits of a plant-based, vegetarian-type diet, in which nuts are considered a source of high quality protein, are well recognized by a growing number of people. Notwithstanding the fact that nuts are an intrinsic part of the diets of some Mediterranean regions where both serum cholesterol levels and the incidence of heart disease are low[1,2], in recent years consumers have felt and still feel that low-fat foods are the ultimate choice for a healthy diet, weight control and disease prevention. It is interesting to note that as the public has demanded more low-fat foods and as more of these foods have become available, according to the Centers for Disease Control, the number of overweight people in the USA is at an all-time high.

Little clinical research on nuts was conducted until the late 1980s[3,4]. In this article we will focus on tree nuts with the exception of chestnuts, a unique high carbohydrate nut. Oil-rich seeds, such as peanuts, squash seeds and sesame seeds will be mentioned briefly since they have a chemical composition similar to nuts, and as some of these seeds have been part of the human diet for millennia. In reviewing the history, nutrient

composition, and the epidemiological and clinical studies of nuts, the need to make nuts and oil-rich seeds a more important part of modern, healthy diets should become evident to the reader.

Historical perspective

Since ancient times nuts and oil seeds have been considered healthful foods worldwide. Native Americans in the south-west USA ate pine nuts from pine cones much the same as they do now, and they, as well as other inhabitants of the American south-west, ate the seeds of native squashes, all of which were high in protein and unsaturated fatty acids. Nuts from pine cones were also used in Mediterranean countries, the better recognized of which are the pignolias, that come from the Italian stone pine, a nut that was praised by such Latin writers as Cato[5].

Sunflower seeds and peanuts, both protein- and oil-rich seeds, played important roles in the diet of the Incas at the peak of their civilization: ancient Peruvian peanut shells indicate that Incas roasted these seeds and nuts, similar to what we do currently[6,7]. Walnuts were used by the Greeks at least four centuries BC, and ancient fossil remains of hazelnuts (filberts) have been found in Sicily. Pistachios were considered a precious food in Persia in the sixth century BC, and from there this nut spread throughout Asia and Europe. The *Book of Genesis* in the Bible talks about almonds, and in Roman times Apicius wrote frequently about roasted almonds. In fourteenth-century English cookbooks[8], almond milk was used extensively after it had been brought to northern Europe from Asia and the Middle East. In tropical and subtropical regions, coconuts continue to be considered a primary source of food, while

Brazil nuts are part of the native Brazilian Amazon flora and are an ancient food of that region. Cashews are another nut native to the Amazons, but currently the largest producers are India and East Africa. Macadamia nuts are native to the rain forests of Australia, whereas pecans belong to the walnut family and are of North American origin where they were a staple of native Americans of the southern regions. Acorns are the "nut" of the oak tree and at one time were a staple food of native Americans.

Composition

The macronutrient and dietary fiber content of a dried ounce of nuts is given in Figure 1 [5,9]. Peanuts, which are technically a legume but are consumed widely and often used similarly to tree nuts, are also included in the figure. The protein content of nuts ranges from 10 percent in walnuts to 17 percent in almonds; the dietary fiber ranges from 5 percent in macadamia nuts to 10-14 percent in almonds and pistachios. The fat content of nuts ranges from about 35 percent in coconuts to over 70 percent in macadamia nuts. Most nuts are rich sources of monounsaturated fatty acids, with the exceptions of coconuts which contain predominantly saturated fat and walnuts which contain primarily polyunsaturated fat (Figure 2).

Nuts also supply important micronutrients as well as other beneficial biologically active constituents[5,9]. Some tree nuts, especially almonds and hazelnuts, are good sources of vitamin E and other tocopherols, while nuts also provide some niacin, B₆, folic acid, magnesium, zinc, copper, and potassium. Phytochemicals, many of them antioxidants such as phenolic compounds, add to protective properties of nuts. Additionally, peanuts,

similarly to soy beans, also contain phytoestrogens, which recent research suggests may play important health-protective roles.

Clinical and epidemiological studies

Most clinical studies on nuts have been devoted to the relationship between nuts and coronary heart disease (CHD), while two prospective epidemiological investigations have reported on correlations between nuts and cancer[4]. The preponderance of direct experimental research has been conducted on almonds and walnuts, whereas a few clinical trials have included nuts as a major constituent of their study diets. Other nuts such as hazelnuts and pecans have not been studied except as part of studies with mixed nuts[11].

The majority of the epidemiological evidence has been provided by the prospective Adventist Health Study[4,10], while additional support for the protective role of nuts has come recently from the Iowa Women's Health Study[12]. Fraser and coworkers[10] in southern California studied a large population of Seventh-Day Adventists, the major proportion of whom neither smoked nor drank, and about half of whom followed a lacto-ovo vegetarian diet. Food frequency data showed that in general they tended to consume nuts on a more regular basis than the general population. About one-fourth of the subjects ate nuts at least five times a week, and 42 percent ate them one–four times a week, while the remainder ate them less than once a week. Results indicated that the frequency of nut consumption was related inversely to the risk of heart attack and CHD mortality, after stratifying for putative confounding variables. There was a 38 percent decrease in risk of CHD mortality in those who consumed a handful of nuts >4 times a week, and a 27 percent reduction in those who consumed nuts one-four times a week, as compared to those who consumed nuts less than once a week. Risk of heart attack was affected more dramatically by nut intake. There was a 48 percent risk reduction in those who ate nuts >5 times a week, and a 26 percent reduction in risk in those who ate nuts one-four times a week, as

compared to those who had consumed nuts less frequently. These protective effects also persisted across several different population subgroups. Inverse correlations were found for both men and women, for normotensive and hypertensive subjects regardless of relative weight, and for both vegetarians and omnivores. This group also observed no increase in cancer risk and further showed a decreased risk in total mortality among those who ate nuts frequently.

In the second observational investigation, the five-year follow up of 40,000 post-menopausal women in the Iowa Women's Study, Prineas *et al.*[12] also found a similar protective relationship between nuts and CHD. They showed that subjects with the highest nut intake had only 40 percent the risk of CHD, compared to those who never ate nuts, again after controlling for putative coronary risk factors and energy intake.

Direct experimental evidence supporting the beneficial effects of nuts began to be investigated in the late 1980s. Spiller and associates presented the results of two studies with almonds in late 1989 and in early 1990[13,14]. In both studies 100 g/day of almonds were fed to subjects. The first study[13] was a nine-week, single group free-living trial using raw almonds as the primary source of dietary fat and with almond oil as the only permitted vegetable oil or fat. Total cholesterol (TC) of the 27 hypercholesterolemic adult males and females who completed the study was reduced in three weeks by 10 percent and low density lipoprotein cholesterol (LDL-C) by 12 percent, with no change in high density lipoprotein cholesterol (HDL-C) or triglycerides. The lower levels were maintained over the seven-week study period. Further, there were no significant changes in body weight. Following this study, which had no control group, the same investigators[14] conducted a four-week randomized, controlled, parallel, supplemented feeding trial with 30 adult men and women, also using 100 g/day of raw almonds as the primary source of fat. This study too resulted in significant decreases in TC (15 percent) and LDL-C (17 percent), while again there were no significant changes in HDL-C. In the

same study a control group, which had been fed similar amounts of fat from cheese, showed no changes in TC or LDL-C.

Another early study which examined the relationship between almonds and walnuts and heart disease was the Jerusalem Nutrition Study. In that randomized, crossover feeding trial, Berry *et al.*[15] compared a high monounsaturated fat (MUFA) diet using almonds as sources of MUFA to a diet high in polyunsaturated fat (PUFA), with walnuts as sources of PUFA. The group consuming almonds had an average decrease in TC of 10 percent and LDL-C of 14 percent. The walnut group experienced 16 percent and 20 percent reductions, respectively, on the high PUFA diet. In neither study was HDL-C altered significantly. In a more recent investigation in Australia, Abbey *et al.* [16] also used both almonds and walnuts to study directly the effects of nuts with different fatty acid compositions on lipoproteins. They conducted a nine-week consecutive supplemented feeding study with 16 normolipidemic males. Study periods where nuts were fed resulted in significant changes in lipids, compared to the control diet. Raw almond supplementation resulted in 7 percent and 10 percent reductions in TC and LDL-C, respectively, while the walnuts reduced TC and LDL-C by 5 percent and 9 percent, respectively. HDL-C levels were unchanged.

In a second investigation, also part of the Jerusalem Nutrition Study, Berry *et al.*[17] investigated the effects of almonds on lipoprotein function and structure in a crossover trial. They demonstrated reductions of about 8 percent and 14 percent in TC and LDL-C, respectively, again without significantly altering HDL-C. Additionally, in a four-week experiment in our center[18] with 15 hyperlipidemic, free-living subjects, we fed a Mediterranean-type vegetarian diet that was high in total and soluble fibers and monounsaturated fats and based on unrefined and whole plant foods. Sun-dried raisins and whole grain raisin bread (major sources of total and soluble fibers), almonds and almond butter, other nuts including some walnuts, along with

sesame butter and olive oil were fed. The plant-based diet induced reductions in TC of 8 percent and LDL-C of 15 percent, with no significant changes in HDL-C. We subsequently conducted an eight-week crossover study[11] with 12 non-smoking women (34-84 years old) to compare the effects of a low fruit and vegetable, highly refined diet, designed to reflect a typical Western diet (TWD), with a high fruit and vegetable, unrefined, plant-rich diet (PRD), on lipids. Nuts were excluded from the TWD, while almonds and almond butter, hazelnuts and pecans along with sun-dried raisins and whole grains were major constituents of the PRD. After four weeks on the PRD there were reductions in both TC and LDL-C of 13 percent and 16 percent, respectively, with essentially no change in HDL-C.

Sabaté and colleagues have conducted the only investigation published to date using walnuts[19]. In their controlled, randomized crossover design that compared the effects of a diet high in walnuts with a low fat, low cholesterol diet (control), walnuts induced reductions in TC and LDL-C of 12 percent and 16 percent, respectively. Although they also found that HDL-C decreased by 5 percent, there was a beneficial 12 percent reduction in the LDL/HDL ratio. Finally, in a relatively recent, but unpublished study, Curb *et al.* [20] studied the effects of macadamia nuts on lipids in a crossover supplemented feeding trial with two four-week study periods. Macadamia nuts induced reductions of 7 percent and 9 percent in TC and LDL-C, but these changes were not significant. HDL-L increased by 9 percent, but this also was not significant.

Nuts in a vegetarian diet

In summary, several lines of evidence demonstrate significant and consistent results indicating that nuts exert beneficial and protective effects on chronic diseases, such as CHD and cancer. Not only do experimental studies show beneficial lipid altering by reducing LDL-C and not lowering HDL-C, observational data suggest that frequent consumption of nuts has protective effects.

While in some special clinical situations very low fat diets have a definite place, in general nuts are an ideal food for the vegetarian diet. They have a balance of protein, fat, carbohydrates and fiber that complements whole grains and beans as staple foods. Many nut proteins also have an arginine-rich amino acid profile that is thought to be cardio-protective[21], as may be their copper content[22]. Additionally, nuts contain alpha, gamma and other tocopherols, plus many other phenolic compounds that act as natural antioxidants. These protect the fats in the nut itself and contribute to antioxidant activity in the human body. In turn, this may help protect plasma cholesterol from oxidation and help lower heart disease risk. Nuts help to replace animal proteins with plant proteins and contribute to dietary fiber needs. Ideal combinations are with fresh or dried fruits such as sun-dried raisins, with cereals or as part of whole grain breads. Collectively, these favorable attributes, along with the abundance of other compounds in nuts, are incentives to vegetarians to include nuts in their diets on a regular basis. For people transitioning from an animal-based diet to a plant-based diet, nuts can play a key role by providing fats which research shows to be beneficial. The fat from nuts may also add to the satiety value of the diet. In our almond studies, subjects reported that a few almonds in the mid-afternoon would suppress feelings of hunger and help to prevent the tendency to overeat in the evening meal.

Nuts are an under-recognized and under-consumed food in our modern diets. They provide an abundance of nutritional value and can play an important role as individuals move from animal-based diets to plant-based diets. We need to expand the clinical and epidemiological research of the past ten years to understand better the health benefits of nuts and related foods such as peanuts, sesame and other oil-rich seeds.

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