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Walnuts and dietary approaches to the prevention and management of abnormal lipid profiles in Type 2 diabetes mellitus

Linda C. Tapsell
University of Wollongong, ltapsell@uow.edu.au

L. J. Gillen
University of Wollongong, lgillen@uow.edu.au

C. S. Patch
University of Wollongong, cpatch@uow.edu.au

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Abstract
Dietary fat is considered central to the management of obesity and heart disease risk, and more recently with the risk of type 2 diabetes, given its observed role in the development of insulin resistance in mechanistic studies. For changes in lipid profiles, foods delivering substantial amounts of polyunsaturated fatty acids relative to saturated fats are of interest, and walnuts fit this category.As a class of foods, nuts have been shown to provide benefits to health in a number of clinical trials. A review of the cardiovascular benefits of nuts indicated their value on thrombotic factors, inflammatory markers and endothelial function.Including 30g walnuts per day in a dietary advice scheme that related to all major food groups resulted in beneficial lipid profiles for adults with early type 2 diabetes mellitus. Walnuts should be 'prescribed' to adults with type 2 diabetes mellitus In clinical practice prescribing walnuts assists the clinician in giving more detailed dietary advice that is likely to be on target for the desired outcomes. The reality for 'free living' conditions is that foods such as walnuts may need to be considered core foods in these treatment strategies, as they help to 'take the guesswork' out of ensuring adequate intakes of polyunsaturated fats.

Keywords
walnuts, type 2 diabetes mellitus, lipids

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The position of walnuts in dietary approaches to the prevention and management of type 2 diabetes mellitus

Walnuts and Diabetes

Linda C Tapsell, PhD [1], Lynda J Gillen, B Nutr Diet (Hons)[2], Craig S Patch, PhD [1]

[1] National Centre of Excellence in Functional Foods, Northfields Avenue, University of Wollongong, NSW 2522, Australia.

[2] Smart Foods Centre, University of Wollongong, Wollongong, NSW 2522, Australia.

Corresponding author:

PROFESSOR LINDA TAPSELL

National Centre of Excellence in Functional Foods

Northfields Avenue

University of Wollongong

NSW 2522 Australia

Phone: +61 2 42213152

Fax: +61 2 42214844

Email: ltapsell@uow.edu.au

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Walnuts and Diabetes

Executive Summary

Dietary fat and diabetes

- Dietary fat is considered central to the management of obesity and heart disease risk, and more recently with the risk of type 2 diabetes, given its observed role in the development of insulin resistance in mechanistic studies.

- For changes in lipid profiles, foods delivering substantial amounts of polyunsaturated fatty acids relative to saturated fats are of interest, and walnuts fit this category.

Nutritional composition of walnuts

Per 100g	Energy (kJ)	Fat (g)	Fat Saturated (g)	Fat Monounsaturated (g)	Fat Polyunsaturated (g)	Fat Omega-3 (mg)
Walnut	2901	69.2	4.4	12.1	49.4	6260
Pistachio	2530	50.6	5.8	26.6	15.8	0
Pine Nut	2921	70.0	4.2	23.0	39.8	0
Pecan	2977	71.9	4.5	39.1	24.8	620
Macadamia	3068	76.2	10.3	61.4	0.9	0
Hazelnut	2693	61.4	2.7	48.6	7.1	120
Cashew	2437	49.2	8.4	31.1	7.5	0
Brazil	2888	68.5	14.8	21.8	29.0	0
Almond	2525	55.2	3.6	36	13.1	0

Benefits of walnuts

- As a class of foods, nuts have been shown to provide benefits to health in a number of clinical trials.

- A review of the cardiovascular benefits of nuts indicated their value on thrombotic factors, inflammatory markers and endothelial function.

Walnuts in the context of the whole diet

- Including 30g walnuts per day in a dietary advice scheme that related to all major food groups resulted in beneficial lipid profiles for adults with early type 2 diabetes mellitus.

Walnuts should be ‘prescribed’ to adults with type 2 diabetes mellitus

- In clinical practice prescribing walnuts assists the clinician in giving more detailed dietary advice that is likely to be on target for the desired outcomes.

- The reality for ‘free living’ conditions is that foods such as walnuts may need to be considered core foods in these treatment strategies, as they help to ‘take the guesswork’ out of ensuring adequate intakes of polyunsaturated fats.

Introduction

Walnuts are a high fat food, but they deliver desirable fats in a food matrix favourable to the prevention and management of type 2 diabetes mellitus. In the first instance, significance of walnut fatty acids is perhaps best viewed in the context of heart disease risk associated with diabetes.

The link between diet and the risk of coronary heart disease has been known for decades, beginning with the early observation by Keys and colleagues of higher rates of heart disease in populations with higher consumption of saturated fatty acids [1]. Since that time the knowledge base has expanded substantially through research from a number of disciplines. Cellular and animal model studies have provided explanations of possible mechanisms, epidemiological research has established relationships between dietary variables and risk factors, and clinical trials have demonstrated the effects of dietary intervention. Further, observations of pathological and treatment commonalities between type 2 diabetes, obesity and coronary heart disease have been described through the concept of metabolic syndrome [2].

Dietary fat is considered central to the management of obesity and heart disease risk, and more recently with the risk of type 2 diabetes, given its observed role in the development of insulin resistance in mechanistic studies [3]. A recent review of human research has argued how the type of fat may be linked to the development of diabetes, with studies showing that replacing saturated and trans fats with unsaturated fats, and including nuts in the diet may help to prevent diabetes [4].

In the case of obesity, a low fat approach to diet has been promulgated, given the energy density of high fat foods [5], and in cardiovascular disease the type of fat is addressed, given the differential effects of fatty acids on blood lipids [6]. While much of the focus of dietary treatment in diabetes has been on blood glucose control, and thereby dietary carbohydrate, a number of studies in patients with metabolic syndrome have proven the effects of manipulating the type of fat in improving insulin sensitivity [7]. A further reason for addressing dietary fat in the diabetic population has been the recognised need to treat dyslipidemia, given the higher risk of cardiovascular disease in this disease group [6, 8].

Translating theory to practice, however, remains a challenge, especially as advice should relate to foods not nutrients. The nutrient composition of foods provides some guidance, but further evidence is required on the impact of targeted foods on changing biomarkers of risk. For changes in lipid profiles, foods delivering substantial amounts of polyunsaturated fatty acids relative to saturated fats are of interest, and walnuts fit this category. This review examines the position of walnuts in the diet for the prevention and management of type 2 diabetes mellitus. First, the nutritional profile of walnuts is argued as favourable for the disease state and evidence of their benefits is cited from the literature.

Finally, it is emphasised that the means by which walnuts deliver benefits is dependent on their position in the whole diet, bearing in mind the patient's overall nutritional requirements and need for energy balance.

Nutritional composition of walnuts

Like all natural foods, walnuts have a distinct composition. Most notably, they contain substantial amounts of both n-6 and n-3 fatty acids, the latter in the form of α-linolenic acid. This differentiates walnuts from other nuts, bearing in mind that as a group, nuts deliver unsaturated fatty acids (Table 1). Both n-6 and n-3 fatty acids are limited in the diet, but n-3 even more so, and there is argument that the balance between n-3 and n-6 fatty acids is an important consideration in disease risk management [9].

Table 1 Nutritional analysis of tree nuts[a]

Per 100g	Energy (kJ)	Fat (g)	Fat Saturated (g)	Fat Monounsaturated (g)	Fat Polyunsaturated (g)	Fat Omega-3 (mg) [b]
Walnut	2901	69.2	4.4	12.1	49.4	6260
Pistachio	2530	50.6	5.8	26.6	15.8	0
Pine Nut	2921	70.0	4.2	23.0	39.8	0
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Brazil	2888	68.5	14.8	21.8	29.0	0
Almond	2525	55.2	3.6	36	13.1	0

[a] **Foodworks nutrient analysis software package, AusNut Database, Xyris software, Highgate Hill, Brisbane Australia 3.2, 2002.**

[b] **Foodworks nutrient analysis software package, Fatty Acid Database, Xyris software, Highgate Hill, Brisbane Australia 3.2, 2002.**

In addition to fatty acids, the walnut food matrix also includes protein (rich in arginine), fibre, and anti-oxidants, largely in the form of γ tocopherol and various polyphenolic compounds. Recent research has found a link between arginine intake and lower levels of a biomarker of heart disease, C-reactive protein [10]. Another study has found potential benefits of arginine in weight loss [11]. The arginine-rich protein and natural fibre components of walnuts may have benefits in themselves, bearing in mind that both protein and fibre play a role in appetite control.

Given the unsaturated fat content of walnuts, however, the presence of anti-oxidants is an important consideration. While foods containing polyunsaturated fats may be seen as desirable, supplemental studies indicate that the oxidative stability of plasma and LDL may be at risk with the delivery of high

levels of unsaturated fatty acids [12]. There is evidence that oxidative stress plays a role in atherogenesis, and that γ tocopherol may have protective functions [13]. Polyphenolics in walnuts have been found to act as effective inhibitors of in vitro plasma and LDL oxidation [14]. More recent animal model research has extended this view, showing oxidative stress to be reduced in mice supplemented for 4 weeks with a polyphenol-rich walnut extract [15]. While research on bioactive ingredients in food is necessarily reductionist, there is something to be said for the benefits of the whole food matrix via the synergies that are created from the combination of nutrients. This may partly explain the apparent anomalies in recent vitamin supplementation trials where nil benefits were found on CVD risk [16, 17], despite positive correlations between health outcomes and the intake of foods such as vegetables and fruits delivering these vitamins [18].

For all of these reasons, the nutritional profile of walnuts clearly suits the dietary needs of patients with type 2 diabetes mellitus.

Benefits of walnuts

As a class of foods, nuts have been shown to provide benefits to health in a number of clinical trials. Given the higher unsaturated fat content of nuts, this outcome would be expected under conditions where the P:S ratio of the whole diet was favourable. It is also shown in studies where patients consumed nuts on a daily basis. Outcomes in hypercholesterolemic patients included reduced total and/or LDL-cholesterol concentrations [19-21], and changes to lipid distribution among lipoprotein sub-classes with walnuts [22]. Not surprisingly, given the links between dietary fats and insulin resistance, analyses from cohort studies have suggested reduced risk of type 2 diabetes mellitus in women with higher nut consumption [23].

Given the high energy density of nuts, however, energy balance may be an issue in those wishing to lose weight. One review found inclusion of nuts in the diet did not result in body weight change in 12 of the 13 trials reporting body weight change [24]. A more recent review argued that the continued observation of no weight gain with inclusion of nuts (even in the context of apparent increased energy intake) may be due to inefficient absorption, increased energy expenditure, and increased satiety [25]. This again, points to the whole food matrix as being a significant dietary consideration. In a recent study of patients with type 2 diabetes mellitus, percent body fat remained below the baseline measurement with the diet inclusive of walnuts compared to standard clinical practice [26], a finding that warrants further investigation with greater numbers of subjects.

A review of the cardiovascular benefits of nuts indicated their value on thrombotic factors, inflammatory markers and endothelial function [27]. Walnuts were singled out as associated with

reduced total cholesterol, LDL, triacylglcerol, and LDL:HDL ratios, as well as improved brachial artery reactivity and reduced levels of vascular cell adhesion molecule-1.

While the favourable fatty acid profile of nuts would explain cardiovascular benefits, the differences seen between studies involving nuts may be due to differences in overall composition. It may also reflect the extent of detail in the attention paid to overall diet in the research design. An extensive review of the scientific evidence for the beneficial health relationship between walnuts and coronary heart disease conducted in 2002 found lowered blood cholesterol concentrations in heart health promoting diets containing walnuts [28]. The limitations of the research to date related to the length of time of the studies and the need for research more reflective of 'real life' contexts. The latter is a problem for randomised controlled trial (RCT) methodology, but in dietary trials especially, the closer the study can match free living conditions the closer the evidence will lie to efficacy in clinical practice.

Walnuts in the context of the whole diet

Current practice guidelines recommend the inclusion of food sources of nutrients targeted as beneficial in the treatment of diabetes and heart disease in particular. [20, 29-32]. To meet dietary targets for nutritional adequacy a variety of core foods is required; to meet targets of macronutrient proportions, specific foods need to be emphasised because of their unique value and attributes. For example, American Heart Association recommends including unsaturated fatty acids from fish, vegetables, legumes and nuts in order to achieve a healthy diet [6].

Including 30g walnuts per day in a dietary advice scheme that related to all major food groups resulted in beneficial lipid profiles for adults with early type 2 diabetes mellitus [26]. This study demonstrated the way in which walnuts needed to be located in the overall diet by exposing a dietary modelling process whereby other foods in the diet were encouraged or delimited [33]. The beneficial effects were no doubt due largely to the dietary fatty acid profile of the overall diet, but clearly the inclusion of the walnuts enabled that to happen much more effectively than standard clinical practice or even a more detailed advice scheme that nevertheless did not name specific foods. This is the way in which whole foods can exert their effects. The clinical outcome is not a single food effect, but the positioning of single foods delivering significant and important nutrients makes all the difference. In another study of hypercholesterolemic men and women emphasising walnuts in a Mediterranean diet (over other monounsaturated fat rich foods) resulted in greater improvement in endothelium dependent vasodilation and greater reductions in levels of vascular cell adhesion molecule – 1 compared to the standard Mediterranean diet. Reductions in cholesterol were correlated with increased dietary ALA and LDL γ tocopherol levels, both reflecting walnut composition [34]. Again this demonstrates the impact of positioning walnuts in the context of the whole diet.

In clinical practice prescribing walnuts assists the clinician in giving more detailed dietary advice that is likely to be on target for the desired outcomes. The reality for 'free living' conditions is that foods such as walnuts may need to be considered core foods in these treatment strategies, as they help to 'take the guesswork' out of ensuring adequate intakes of polyunsaturated fats, in addition to the other benefits they bring as whole foods. Other foods such as fish and dairy foods may have the same role to play, and their attributes may be demonstrated in a similar fashion. As knowledge of the composition of whole foods and their unique attributes increases there are implications for the improved formulation of manufactured foods, in particular snacks. While it is unlikely that whole foods will play a role in therapeutics, their real significance in the prevention and management of risk factors for lifestyle disease is clearly unfolding.

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