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SERUM LIPID EFECTS OF A MONOUNSATURATED (PALMITOLEIC) FATTY ACID RICH DIET BASED ON MACADAMIA NUTS IN HEALTHY YOUNG JAPANESE WOMEN

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Short title: Effect of macadamia nuts on serum lipids

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SUMMARY

1. Recent studies have identified potential beneficial effects of eating nuts, most of which have substantial amounts of monounsaturated fatty acid (MUFA). Macadamia nuts consist of 75% fat by weight, 80 % of which is monounsaturated fatty acid (Palmitoleic).

2. To examine variations in serum lipid levels in response to a high-MUFA diet based on macadamia nuts, 3 weeks interventions of macadamia nuts, coconuts, and butter were determined in young healthy Japanese female students.

3. After 3 weeks intervention, Serum total and LDL cholesterol concentrations were significantly decreased in macadamia nuts diet and coconuts diet groups, body weight and body mass index (BMI) were decreased in macadamia nuts group although there were no significant change in butter group.

KEY WORDS: macadamia nuts□palmitoleic acid□fatty acid□serum cholesterol□ intervention□human

INTRODUCTION

The experimental and epidemiological evidence have been reported that dietary monounsaturated fatty acids (MUFA) may have a beneficial health effect.[1, 2] Cholesterol Education Program guidelines to liberalized total fat intake, specially from MUFA, related to its ability to increase high density lipoprotein (HDL) cholesterol.[3] Macadamia nuts are one of the most popular nuts all over the world, called "King of Nuts". Macadamia nuts contain 75 % fat by weight, 80 % of which is monounsaturated fatty acids (palmitoleic acid). The aim of this study is to investigate the effects of MUFA-rich diet on serum total cholesterol levels and serum fatty acid profiles in young healthy subjects. In this study, we compared the effect of 3 kind of diets containing macadamia nuts, coconuts, and butter, rich in MUFA, saturated fatty acids and cholesterol, respectively.

METHODS

Seventy-one young Japanese healthy women recruited from Mukogawa Women's University students (age 19 – 23). After the approval of the study by Ethics Committee of the Mukogawa Women's University, written informed consents were obtained from all volunteers.

Macadamia nuts were supplied by Horticulture Australia.

We prepared the three kinds of breads, each bread contains 10g macadamia nuts, coconuts or butter.

The subjects were divided into three groups randomly. Group C (n=24) was assigned of coconuts breads; Group B (n=23) was assigned of butter breads; Group M: (n=24) was assigned of macadamia nuts breads. Subjects consumed 2 breads daily for 3 weeks.

Before and after the intervention, blood samples were collected at fasting, and serum lipids were measured. Serum total cholesterol, high density lipoprotein (HDL) cholesterol, and low density lipoprotein (LDL) cholesterol, triglycerides and free fatty

acids were measured by enzymatic methods (SRL Inc., JAPAN). Physical parameters including height, Body weight, %body fat (In body 3.0, Biospace, Co., Ltd., Tokyo, Japan) and blood pressure were measured in sitting position.

Statistical analysis was performed using SPSS 11.5J software (SPSS Inc). All data were presented as the mean ± SEM. The mean differences between each groups were evaluated by using oneway ANOVA. Changes within each group were analyzed by using Student's *t* test (paired). Atherogenic Index changes from baseline were analyzed by Wilcoxon matched pairs signed-rank test. Values of $p< 0.05$ were considered significant.

RESULTS

The energy content and lipid profiles of each bread were as follows: coconuts breads; 418 kcal/100g, saturated fatty acids (SFA) 59.4%, MUFA 24.7 % (palmitoleic acid 0.04g/100g), polyunsaturated fatty acids (PUFA) 15.1%, unknown (UN) 0.8%, butter

bread; 480 kcal/100g, SFA 55%, MUFA 32.3% (palmitoleic acid 0.34g/100g), PUFA 10.5%, UN 2.2%, and macadamia nuts bread; 483 kcal/100g, SFA 18.8%, MUFA 70.5% (palmitoleic acid 2.85g/100g), PUFA 10.1%, UN 0.6%.

The mean age of these 71 subjects was 19.5±0.1 (range 18-24 y). There were no significant differences in age and in any physical and serum lipid parameters examined among 3 groups before intervention (Table 1). Compliance was regarded as good based on the following percentages of the prescribed bread consumed. Group C, 91.7%, Group B, 78.3%, and Group M, 91.7%, and there were no significant differences among 3 groups.

The percentage of palmitoleic acid of blood after intervention in Group M was significant increased (before: 1.6 ± 0.1 %, after: 1.9 ± 0.1 %, $p < 0.05$). There were no significant differences of them in Group C (before: 1.5 ± 0.1 %, after: 1.7 ± 0.1 %, n.s.). and Group B (before: 1.4 ± 0.1 %, after: 1.6 ± 0.2 %, n.s.).

The physical parameters and serum lipid profiles before and their changes after intervention were shown in Table 1. Serum total and LDL cholesterol concentrations after intervention in Group C and Group M, were significant decreased compared with

their baseline levels, although there were no significant changes in Group B. There were no significant changes in HDL cholesterol in all groups. Atherogenic Index (AI) after intervention in Group C was increased significantly. Body weight and body mass index (BMI) were decreased in Group M after intervention, significantly. There were no significant changes in serum triglycerides and free fatty acid concentrations from the baseline levels in any groups. Systolic blood pressures were normal range, and there were no change in all groups after intervention.

DISCUSSION

The purpose of the present study was to evaluate the effect of macadamia nuts rich in MUFA (palmitoleic acid) on serum lipid profiles. To the best of our knowledge, this is the first study about the effect of macadamia nuts intervention on serum lipid profile in young healthy women.

Many papers indicated MUFA rich diet decreased serum total cholesterol levels.

Curb *et. al.* demonstrated the macadamia nut-based diet high in MUFA had potentially beneficial effects on total and LDL cholesterol levels when compared with a typical American diet.[4] In this study, the serum concentrations of total and LDL cholesterol after intervention in Group M tend to be lower than those of Group B. Furthermore, after intervention, serum total and LDL cholesterol levels were decreased significantly compared with their baseline levels in Group M. These effects observed in this study are similar to in same studies. Further more, the body weight and BMI in Group M was significant decreased during intervention, although those in Group C and Group B did not change. Wien *et. al.* reported low calorie diet (LCD) supplementation with almonds (high MUFA), in contrast to complex carbohydrates, was associated with greater reductions in weight/BMI.[5] Our study did not LCD program, but the mechanisms of significantly decreased effect on body weight and BMI in M group may be same.

In conclusion, we have found that moderate modification of a natural diet through intervention with nuts that contain MUFA (palmitoleic acid) decreased serum total and LDL cholesterol levels and reduced body weight in healthy Japanese young women.

Whether these differences may be due to difference in fatty acid composition is still to be resolved.

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Table 1. Effects of diet on physical parameters and serum lipid levels.

	Coconuts		Butter		Macadamia nuts	
	Before	After	Before	After	Before	After
Age (y)	19.4±0.3		19.6±0.2		19.4±0.3	
Height (m)	1.57±0.01		1.58±0.01		1.58±0.01	
Body weight (kg)	51.6±1.2	51.5±1.2	49.9±1.3	49.9±1.2	49.4±1.2	49.0±1.1*
Body mass index (kg/m2)	21.0±0.4	20.9±0.4	19.9±0.5	20.0±0.5	19.9±0.4	19.7±0.4*
%Body fat	25.8±1.0	25.6±0.9	24.9±1.0	24.6±1.0	24.7±1.0	24.7±0.9
Systolic Blood Pressure (1	106±2	105±2	101±3	101±2	102±1	100±2
Total cholesterol (mg/dl)	180±5	169±5*	177±6	175±7	180±6	169±5 *
LDL-cholesterol (mg/dl)	103±4	94±3 *	98±4	96±5	97±5	90±4 *
HDL-cholesterol (mg/dl)	71±3	64±2 *	71±4	69±3	75±3	69±2 *
Atherogenic Index	1.6±0.1	1.7±0.1*	1.6±0.1	1.6±0.1	1.5±0.1	1.5±0.1
Triglyceride (mg/dl)	53±4	62±7	62±6	69±7	58±7	55±4
Free fatty acid (mEq/l)	0.55±0.05	0.59±0.07	0.58±0.06	0.58±0.07	0.55±0.05	0.59±0.04

Results expressed as mean±SEM. *$p < 0.05$ compared to before intervention.