CHAPTER V

DISCUSSION

The present study was designed to evaluate the effect of nutrition counseling and nutrition counseling with *O. canum* seed supplementation on nutrient intake and serum lipids in hypercholesterolemic subjects.

1. Effect of nutrition counseling on dietary assessment questionnaire scores

In this study, the subjects can achieve TLC diets (scores < 40). The mean scores were significantly decreased to 30.57 ± 20.29 and 30.03 ± 16.77 after nutrition counseling and nutrition counseling with *O. canum* seed supplementation respectively. The scores of questionnaire were less than 40 indicating good dietary adherence. After dietary advice, the subjects could control dietary intake and improved their dietary habit by reducing intake of high fat and cholesterol containing foods.

The results from this study agree with previous studies (Acharaya Samphao-ngern, 1999; Manee Udomdejwat, 2005) which found that the scores of dietary assessment questionnaire were decreased and the patients improved their dietary control after nutrition counseling.

2. Effect of nutrition counseling on nutrient intakes

After dietary advice and 6 weeks of dietary control, the subjects improved their eating habits. Total energy intake was significantly decreased from baseline. Previous studies demonstrated that the mean total energy intake was significantly reduced after dietary control (Wanpen Mesomya, 1995; Orapin Choothawornchaikul,

2000). King and Gibney (1999) found that energy intake decreased significantly in the groups given dietary advice and this advice also decreased intake of total fat. In the present study, the percentage of total fat intakes did not alter but the total fat intakes were within the range (25-35% of total calories) recommended by NCEP ATP III (NCEP, 2001). The Food and Nutrition Board also accepts this recommendation for fat intake and set the upper range for fat intake at 35% of energy intake (Wardlaw, Hampl, and Disilvestro, 2004). However, the amounts of fat intake were significantly decreased after nutrition counseling. The results may indicate that the subjects decreased total energy intake by reducing consumption of high fat foods.

In the present study, after experimental period at week 6 and week 12, PUFA intake decreased with no statistical significance while MUFA and SFA intakes were significantly decreased compared with baseline. SFA intakes were less than 7% of total calories. The amount of MUFA and SFA intakes were not significant difference between week 6 and week 12. Amount of MUFA intakes was lower than at recommended by NCEP ATP III (NCEP, 2001).

The mean dietary cholesterol intakes in this study were statistically decreased from week 0 after dietary control with *O. canum* seed supplementation. After dietary control, the mean dietary cholesterol intakes did not significantly change. The amounts of daily dietary cholesterol intakes at week 6 and week 12 were less than 200 mg and achieved NCEP recommendation. Reduction of dietary cholesterol intakes showed good benefit because reducing the daily cholesterol intake to below 200 mg can reduce the risk of CHD (NCEP, 2001). However, for maximum reduction of serum cholesterol by dietary means, dietary cholesterol has to be reduced in minimal levels of 100-150 mg/day (Hopkins, 1992). With the advent of more efficacy

cholesterol-lowering agents, it soon may be possible to test the benefits and risks of lowering dietary cholesterol levels below 150 mg/day (Mahley and Bersot, 2001).

Dietary fiber intakes from ordinary meal of the subjects did not significantly changed but tended to decreased from baseline. After nutrition counseling, dietary fiber intakes were very low (5.73 ± 2.35 g/day) compared with the recommended intake of fiber by NCEP guidelines (20-30 g/day). While the Dietary Reference Intake (DRI) of dietary fiber for Thais is 25 g/day (อาฒดี นิติธรรมยง, 2546). Small amounts of dietary intake in the present study may due to inaccuracy in the estimation of portion size of food consumed. Food record may not provide valid estimates of actual intakes (Schaefer et al., 2000). Previous study by Lansky, and Brownell (1982) suggested that training in food estimation techniques may be necessary to ensure an accurate self-report. This study was consistent with a previous study of Manee Udomdejwat (2005) who found that the mean dietary fiber intake by the subjects was very low ranging from 3-5 g/day after nutrition counseling.

High fiber intake, especially viscous fiber, is associated with lower serum cholesterol and lower risk of CHD (Anderson et al., 1994; Keogh et al., 2003; Behall et al., 2004). NCEP and American Heart Association (AHA) guidelines recommend increasing consumption of dietary fiber rich-diets for the management of elevated plasma cholesterol. Furthermore, nutrition counseling should continue to emphasize the importance of increasing the intake of dietary fiber.

Effect of nutrition counseling on serum lipids

From dietary assessment, the subjects improved their dietary habit. However, serum total cholesterol and LDL cholesterol concentrations were not significantly decreased after 6 weeks of diet control. Similarly, Mhurchu et al. (1998) found that

although dietary interventions achieved statistically changes in reported dietary knowledge and behavior, serum cholesterol concentrations did not significantly change. This may be due to the overestimation of true dietary change by the subjects and educated subjects could overestimate the performance of the food frequency questionnaire (FFQ) (Shai et al., 2005). Moreover, one third of subjects in this study had to attend seminar more than 3 days during the last week of dietary control. During the seminar, they could not select foods that appropriate for hypercholesterolemic patients. Bauer and Sokolik (2002) found that social eating, eating out or social situations were barriers to achieving a desired dietary change. Difficulties in complying with the prescribed dietary change were the principle cause of the failure to achieve the expected reductions in cholesterol concentrations. Changing dietary behavior is a complicated process requiring numerous lifestyle adjustments. This process often interferes with pleasurable activities compromising a client's motivational level (Bauer and Sokolik, 2002). Generally, gradual stepwise modifications are recommended for changing dietary patterns that will endure. Results from this study were consistent with earlier studies that found no significant effect of nutrition counseling (dietary control) on blood lipids (Cupples and McKnight, 1994; Neil et al., 1995; Steptoe et al., 1999; Van Der Veen et al., 2002). Neil et al. (1995) found that dietary advice had only a modest effect on lipid concentrations. No significant differences were found in mean concentration of lipids and lipoproteins after dietary advice.

Dietary fiber plays an important role in human health. High intakes of fiber in diets are associated with lower blood cholesterol concentrations (Jenkins, Spadafora, et al., 1993; Anderson et al., 1994). Ballesteros et al. (2001) demonstrated that there is an association between dietary fiber intake and favorable lipid status in free living

men. The mechanisms for hypocholesterolemic effect of dietary fiber are likely complex and possibly include increased bile salt loss, altered site and rate of lipid absorption, reduced hepatic lipogenesis secondary to reduced postprandial glucose and insulin responses, and enhanced colonic synthesis and uptake of short chain fatty acids (Jenkins, Wolever, et al., 1993). Low dietary fiber intake may not result in decreasing serum lipids significantly. Failure to comply with dietary fiber recommendations is the likely explanation for limited significant reducing on serum lipid levels.

There was no change in PUFA intake after 6 week of dietary counseling; however, it tended to decrease from the baseline. MUFA and SFA intakes were significantly lower after the 6 weeks of dietary control. MUFA intakes was lower than at recommended by NCEP (NCEP, 2001). Low intake of these dietary fatty acids may be one of possible reasons for unchanged blood cholesterol in this study. Mensink and Katan (1992) estimated from a meta-analysis that if MUFA replace carbohydrate in the diet, there was relatively small decrease in LDL cholesterol. Replacement of SFAs by unsaturated fatty acids raised the HDL to LDL cholesterol ratio. A reduction in the intake of SFAs and total fat, and an increase in the intake of PUFAs have favorable effects on LDL and HDL cholesterol (Nydahl et al., 1994; Hodgson et al., 1995; Krummel, 2004). An increase in consumption of PUFAs and a decrease in SFAs has become the standard dogma of nutritionist and clinicians attempting to improve the plasma lipid profile (Hays, 2001). Furthermore, the balance of SFA, MUFA and PUFA is important to lower LDL cholesterol (Hays, 2002).

The predictors of LDL cholesterol responsiveness are still not clear. Mietus-Snyder et al. (1993) found that the change in LDL cholesterol was not significantly associated with nutrition counseling. Nutrition counseling for dietary modification

alone may not reduce cholesterol to a desired concentration (Hunninghake et al., 1994; Goldsmith et al., 1999). However, the results from this study indicated that nutrition counseling was important for the improvement of serum lipids. For effective blood cholesterol control, nutrition counseling should continue to emphasize the importance of increasing the intake of dietary fiber in the form of complex carbohydrate, fruits and vegetables and reducing the consumption of high fat or cholesterol containing foods such as animal products which high in fats and cholesterol.

Effect of *O. canum* seed supplementation on serum lipids

After dietary control with *O. canum* seed supplementation, the serum total cholesterol and LDL cholesterol levels were not statistically decreased from baseline. The mean serum total cholesterol and LDL cholesterol concentrations at week 12 in this study were less than that diet control only (week 6). However, none of these differences were significant.

O. canum seeds contain dietary fiber 80% (Premwatana et al., 1985), but contain viscous fiber only 8.8% (Food and Nutrition Technical Services, 2006). Therefore, in this study subjects received 15 grams of dried *O. canum* seeds which contained only 1.32 g of viscous dietary fiber. In general, the effective dose of the viscous fibers required to lower serum cholesterol levels range from 12 to 30 g/day (Jenkins, Spadafora, et al., 1993).

Factors that may have contributed to the lack of significantly hypocholesterolemic effects in the present study may be due to low viscous fiber, low viscosity, and the insufficient dose of *O. canum* seeds. The hypocholesterolemic capacity of fibers depends on its solubility, fermentability and viscosity. Water solubility alone probably does not explain the hypocholesterolemic effects (Davidson

and Maki, 1999). The action of viscous fibers depends on viscosity, not chemical binding in the small intestine (Truswell, 1999).

The efficacy of viscous fiber may be due to the viscosity. Keogh et al. (2003) and Lovegrove et al. (2000) investigated the efficacy of low viscosity, soluble fiber, β-glucan and found no significant improvement in lipid control. Poor solubility of β-glucan resulted in low viscosity in the intestine (Törrönen et al., 1992). Haskell et al. (1992) demonstrated that 4-12 weeks consuming 15 g/day of low viscosity water soluble dietary fiber (acacia gum) did not produce a significant lipid lowering effect versus placebo. On the other hand, medium viscosity (psyllium husk, pectin, and guar and locust bean gums) or high viscosity (guar gum) water soluble dietary fiber mixture in equivalent amount and duration reduced total cholesterol and LDL cholesterol in healthy men and women (plasma cholesterol > 200 mg/day). However, Davidson, Dugan et al. (1998) did not demonstrate a serum lipid-lowering effect of a gum Arabic-pectin supplement in hypercholesterolemic subjects. The absence of a lipid response to this soluble fiber supplement may be due to insufficient dose or low viscosity of the fiber mixture. In addition to viscosity, other properties may contribute to soluble dietary fiber effect including fermentability and ability to bind bile acids (Everson et al. 1992).

Total cholesterol-lowering effect of *O. canum* seeds was found when subjects consumed *O. canum* seeds 24-30 g/day (Chularojanamontri et al., 1987; Montana Theerajantranon, 1996). This study tried to lower the amount of *O. canum* seeds to 15 g/day which was found no significant hypocholesterolemic effect. The intake of *O. canum* seeds ranging from 4 to 10 g/day were not significant decreased in serum total cholesterol and LDL cholesterol concentrations (Leelahagul et al., 1992; Kijsirikul, Suputtitada, and Aksaranugraha , 2001). Wanpen Mesomya (1995) also found that

there were no significant changes in plasma total cholesterol and LDL cholesterol levels in obese women during receiving 4 g/day of sweet basil seed extract.

Variations in plasma cholesterol concentrations of the subjects may also influenced the outcomes of the studies (Lovegrove et al., 2000). Some individuals may experience a drastic reduction on blood cholesterol when they increase their intake of soluble fiber, but others may be no effect (Freiburger, 2001). However, in a recent meta-analysis performed by Brown et al. (1999) demonstrated that initial total cholesterol concentration was not a significant predictor of lipid changes in response to soluble fiber after adjustment for dose.

There were no significant changes in triglyceride and HDL cholesterol concentrations after *O. canum* seed supplementation. Other studies also indicated that *O. canum* seeds did not affect serum triglyceride and HDL cholesterol concentrations (Leelahagul et al, 1992; Wanpen Mesomya, 1995; Montana Theerajantranon, 1996). Although no significant cholesterol-lowering effect was observed with the intake of *O. canum* seeds 15 g/day, the likelihood of multiple small benefits from consumption of various potential cholesterol-lowering foods may achieved the desired outcome.