

Effect of Dietary Fiber, *Ocimum canum* and Psyllium Seed, in High Cholesterol-diet Fed Rats

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Abstract

The aim of this study was to investigate the long term effect of dietary fiber, *Ocimum canum* and psyllium seed, on body weight and lipid level in blood of high cholesterol-diet fed rats. A total of 36 rats were divided into 3 groups. There were 6-male and 6-female rats in each group. The control group (CTR) received the standard diet added with 2.5% cholesterol of dry feed (HCD). The *Ocimum canum* (Trt-OC) and the psyllium seed group (Trt-PS) received the HCD added with *Ocimum canum* and psyllium seed at the amount of 10% of the dry feed, respectively. Daily feed intake was recorded. Body weight was measured and blood was collected on the starting date and on the 4th, 8th, 16th, and 24th weeks. Complete blood count and blood chemistry were analyzed. Analyses of variance were performed using the PROC GLM in SAS software for body weight (BW), cholesterol, and triglyceride (TG). There was a significant effect of the diet on BW ($p<0.001$) and cholesterol ($p<0.01$). The BW and cholesterol in the TRT-PS group was lowest ($p<0.05$). There was a significant effect of time on BW, cholesterol, and TG ($p<0.001$). A significant increase in BW was observed in both sexes in all groups ($p<0.05$). The cholesterol and TG of the male rat, in the CTR group, significantly increased from the starting date to the 24th weeks ($p<0.05$). These results suggest that mixing of dietary fiber (i.e. *Ocimum canum* seeds and psyllium seeds) might be beneficial to control of the cholesterol level in high fat diet.

Keywords: cholesterol, dietary fiber, *Ocimum canum* seed, psyllium seed, triglyceride

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บทคัดย่อ

ผลการเสริมอาหารเยื่อใยจากเมล็ดแมงลักและไซเลียมฮีดในอาหารที่มีไขมันสูงสำหรับหมูแรท

อลิศรา สุริยสมบุรณ์¹ อรรณพ สุริยสมบุรณ์^{2*} สุรัชย์ จันทรทิพย์³ อมร เพชรสม¹

วัตถุประสงค์ของการศึกษานี้ คือ เพื่อศึกษาผลของการผสมผงเมล็ดแมงลักและไซเลียมฮีดในอาหารที่มีคอเลสเตอรอลในระดับสูง ต่อน้ำหนักตัวและระดับไขมันในเลือดของหมูแรทในระยะยาว แบ่งหมูแรทจำนวน 36 ตัว ออกเป็น 3 กลุ่มๆละ 12 ตัว เป็นเพศผู้และเพศเมีย อย่างละ 6 ตัว ในกลุ่มควบคุม (Control: CTR) หมูแรทได้รับอาหารพื้นฐานที่มีการผสมคอเลสเตอรอลในระดับร้อยละ 2.5 ของอาหารแห้ง (high cholesterol diet: HCD) ส่วนในกลุ่มทดลองทำการผสมอาหารที่มี เยื่อใยหรือกากใยสูง ได้แก่ ผงเมล็ดแมงลัก (*Ocimum canum* seeds: Trt-OC) และผงไซเลียมฮีด (Psyllium seeds: Trt-PS) หมูแรทจะได้รับอาหารพื้นฐานของกลุ่มควบคุมที่ผสมผงเมล็ดแมงลักหรือผงไซเลียมฮีดในระดับร้อยละ 10 ของอาหารแห้ง บันทึกปริมาณอาหารที่หมูแรทกินได้ในแต่ละวัน ชั่งน้ำหนัก และเก็บเลือดของหมูแรทตั้งแต่วันแรกของการทดลองและในสัปดาห์ที่ 4 8 16 และ 24 ทำการตรวจค่าโลหิตวิทยาและค่าทางเคมีคลินิกของหมูแรท วิเคราะห์ความแปรปรวนทางสถิติ (Analyses of variance) สำหรับน้ำหนักตัว คอเลสเตอรอลและไตรกลีเซอไรด์ ด้วยวิธีการ PROC GLM ในโปรแกรมสถิติ SAS การศึกษา พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของประเภทของอาหารต่อน้ำหนักตัว ($p < 0.001$) และระดับของคอเลสเตอรอล ($p < 0.01$) และพบว่าน้ำหนักตัวและระดับของคอเลสเตอรอลของหมูแรท มีค่าต่ำสุดในกลุ่มทดลองที่ได้รับอาหารที่ผสมผงไซเลียมฮีด ($p < 0.05$) และพบความแตกต่างอย่างมีนัยสำคัญทางสถิติของระยะเวลาในการศึกษาต่อน้ำหนักตัว ระดับของคอเลสเตอรอลและไตรกลีเซอไรด์ ($p < 0.001$) นอกจากนี้ยังพบว่าน้ำหนักตัวของหมูแรทเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติในทุกกลุ่มการทดลองและทั้งในเพศผู้และเพศเมีย ($p < 0.05$) และระดับของคอเลสเตอรอลและไตรกลีเซอไรด์ของหมูแรทเพศผู้ในกลุ่มควบคุมมีการเพิ่มขึ้น อย่างมีนัยสำคัญทางสถิติ ตั้งแต่เริ่มการศึกษานจนถึงสัปดาห์ที่ 24 ($p < 0.05$) ผลของการศึกษานี้ สามารถกล่าวได้ว่า การผสมอาหารที่มีเยื่อใยสูง เช่น ผงเมล็ดแมงลักหรือผงไซเลียมฮีด ในอาหารที่มีไขมันสูงให้ผลในทางบวก คือสามารถควบคุมระดับของคอเลสเตอรอลได้

คำสำคัญ: คอเลสเตอรอล อาหารเยื่อใย เมล็ดแมงลัก ไซเลียมฮีด ไตรกลีเซอไรด์

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Introduction

High cholesterol and high triglyceride level are well established as a major health problem of coronary heart disease and atherosclerosis. There are several methods to control hyperlipidaemia such as exercise, dietary control, and hypolipidaemic drugs (Stone, 1996). It is known that decreased feed intake of fat, and in the same time, increased feed intake of dietary fiber might lowers blood cholesterol (Stone, 1996; Brown et al., 1999). Therefore, dietary modification is recommended as a first step to reduce cholesterol levels (Piper, 1996). Using food high in viscous fiber or soluble dietary fiber seems to be effective in reducing blood cholesterol (Anderson et al., 1994). Dietary sources of viscous fiber are found in fruits, vegetables, legumes, oats, rye, barley, psyllium seed, and *Ocimum canum* seed. Psyllium seeds and *Ocimum canum* seeds are well-known as a laxative. *Ocimum canum* seed or holy basil is a popular

supplementary diet used in drinks and desserts in Thailand. The *Ocimum canum* seed is small, oval and black, and contains 80% dietary fiber (Premwatana et al., 1985) with about 8.8% viscous fiber. *Ocimum canum* seeds are soaked in water causing a gelatinous coat to form, similar to psyllium seeds. However, psyllium seeds are expensive and have to be imported from other countries. Therefore, using *Ocimum canum* seeds could be an alternative choice for substitution of psyllium seeds as a supplement product produced in Thailand. Several studies reported positive physiological effects of *Ocimum canum* seeds, including cholesterol lowering, laxative, and blood glucose lowering (Leelahagul et al., 1992). Supplementation of *Ocimum canum* seeds in addition to dietary control may enhance in reducing blood cholesterol (Chularojmontri et al., 1987). However, there are inconsistent benefits of *Ocimum canum* seeds on blood lipids in individuals with hypercholesterolemia (Kangsadalampai et al., 2007). Furthermore, most of the studies conducted used

Ocimum canum seeds that were not milled and/or oil extracted. In addition, some of the *Ocimum canum* seeds available in the market were found to contain some mycotoxins e.g. aflatoxin (Paranusorn, 2010). To get rid of the mycotoxins from the *Ocimum canum* seeds and extend the preservation time, some researchers used the method of oil extraction with the supercritical fluids technique (Sooksai and Noitang, 2007). To our knowledge, no studies of the *Ocimum canum* seed, with oil extracted, supplementation have been conducted. Therefore, the objective of this study was to investigate the long term mixed of *Ocimum canum* seeds, with oil extracted, on body weight gain, cholesterol and triglyceride level in blood of high cholesterol-diet fed rats.

Materials and Methods

Animals: 36 Wistar rats, aged 12-weeks at the time of delivery, were obtained from National Laboratory Animal Center (NLAC, Salaya Campus, Mahidol University, Thailand). Two rats with the same sex were housed in a stainless steel cage with raised mesh floors. The rat were kept in a temperature-controlled room (21±2°C) with humidity at 40 to 60% RH, and maintained on a 12-hour light/dark cycle. Food and water were provided with *ad libitum* access. The animals were acclimatized to the facility for 4-weeks and given free access to commercial diet mixed with cholesterol (HCD) to increase serum cholesterol.

After 4-weeks acclimatization, the rats were given free access to experimental diets and water for 24-weeks. The 36 rats were grouped by stratified allocation, based on body weight, and divided into 3 groups of 12 rats with 6-male and 6-female rats each. The 12 rats in each group were similar in sex and initial weight, and were randomly assign to one of the three different diets. The first group or control group (CTR) received the HCD diet. The second and the third group received the HCD diet added with *Ocimum canum* seeds (Trt-OC) or psyllium seeds (Trt-PS), respectively. Food intake was monitored daily. Uneaten food was removed daily and replaced with fresh food. This study was approved by the Animal Committee, Faculty of Veterinary Science, Chulalongkorn University, Thailand (Protocol No. 1031051).

Diet: To obtain the *Ocimum canum* seeds in this study, the *Ocimum canum* seeds were mesh and applied for oil extraction with the supercritical fluids technique, using liquid carbondioxide extraction at low temperature and high pressure (Sooksai and Noitang,

2007). However, the specific swelling volume and water holding capacity of *Ocimum canum* seed residues after extraction were higher than those of *Ocimum canum* seeds before extraction (Sooksai and Noitang, 2007). Psyllium seeds were obtained from a drug company.

To prepare the basal diet, the commercial feed was bought from NLAC. The commercial diet is produced by a contracted manufacturer which was selected by NLAC. The commercial diet was mesh into dry form and mixed with cholesterol at 2.5% of the dry feed (HCD), to induce hypercholesterolemia (Suanarunsawat et al., 2009). To prepare the experimental diets, the HCD diet was added with extracted *Ocimum canum* or psyllium seeds at 10% of the dry feed, based on the studied of (Carter et al., 1998). The mixture of the feed was pelleted at 85°C, with 2 cm in length. The pelleted feed was collected and sent to the laboratory for testing of bacterial contamination. The proximate analyses of the diets are presented in Table 1.

Blood collection and measurements: The rats' body weights were measured on the starting date (0-weeks) and on the 4th, 8th, 16th, and 24th weeks. The rats were anesthetized by Isofuran® inhalation under the supervision of trained veterinarian. Two ml of blood samples were collected from anterior vena cava after 12-hour overnight fast, and place into a tube coated with or without EDTA (1 ml in each tube). Blood samples were collected on the starting date 0-weeks) and on the 4th, 8th, 16th, and 24th weeks of the experiment. All blood samples were analyzed at the NLAC, according to the standard operating procedure of NLAC (2010), for complete blood count (SOP-QC.HMU-01.09; NLAC, 2010), serum lipids, cholesterol and triglyceride, creatinine, BUN, SGOT, and SGPT (SOP-QC.HMU-01.11; NLAC, 2010).

Statistical analysis: Data were statistically analyzed using the SAS program (Version 9, SAS Institute Inc., Cary, NC, USA). Analyses of variance were performed using PROC GLM for body weight (BW), cholesterol, triglyceride (TG), average daily feed intake (ADFI), percentage changes of weight gain (%BW), percentage changes of cholesterol (%CHO), and percentage changes of triglyceride (%TG),

where

$$\%BW = \frac{\text{weight at the end point} - \text{weight at the starting point}}{\text{weight at the starting point}} \times 100$$

$$\%CHO = \frac{\text{cholesterol at the end point} - \text{cholesterol at the starting point}}{\text{cholesterol at the starting point}} \times 100$$

$$\%TG = \frac{\text{triglyceride at the end point} - \text{triglyceride at the starting point}}{\text{triglyceride at the starting point}} \times 100$$

Table 1 Proximate analyses of experimental diets.

Components	Cholesterol added commercial diet (HCD: CTR)	<i>Ocimum canum</i> added HCD (Trt-OC)	Psyllium seed added HCD (Trt-PS)
Protein (%) (w/w)	25.4	26.2	27.3
Fat (%) (w/w)	5.5	6.0	5.6
Fiber (%) (w/w)	3.9	6.2	7.8
Ash (%) (w/w)	6.0	6.2	6.2
Carbohydrate (%) (w/w)	59.2	55.4	53.2
Moisture (%) (w/w)	6.3	5.9	6.1

For analyzing BW, cholesterol, and TG, the statistical models included the fixed effects of dietary, sex, time, and all the combination interaction between the fixed effects. For analyzing ADFI, %BW, %CHO, and %TG, the statistical models included the fixed effects of dietary, sex, and the two way interaction between the fixed effects. A regression on body weight at the starting point was included in the statistical model when analyzing BW, ADFI, and %BW. Regressions on body weight and cholesterol and body weight and triglyceride at the starting point were included in the statistical model when analyzing cholesterol, %CHO, TG, and %TG (Table 2). Multiple comparison testing of least-squares means (LSmeans) was performed using Bonferroni correction to reduce the risk of obtaining false significances. Levels of significance were given conventionally: ns = no significant difference ($p>0.05$); and significant difference $*0.01<p<0.05$, $**0.001<p<0.01$, $***p<0.001$.

Results

The proximate analyses of the three diets after mixed are shown in Table 1. The protein level in the CTR group (cholesterol added commercial diet: HCD) was lower than in the Trt-OC (*Ocimum canum* added HCD) and Trt-PS (Psyllium seed added HCD) (LSmeans: 25.4%, 26.2, and 27.3%, respectively). The fat content was highest in the Trt-OC than in the CTR and Trt-PS groups (LSmeans: 6.0%, 5.5%, and 5.6%, respectively). In additional, fiber was highest in the Trt-PS group than in the CTR and Trt-OC group (LSmeans: 7.8%, 3.9%, and 6.2%, respectively). There was no bacterial contamination found in the three diets after re-mixing and pelleting.

Effect of dietary: The levels of significance for all fixed effects included in the statistical models are presented in Table 2. There was a significant effect of dietary on BW ($p<0.001$) and cholesterol ($p<0.01$). The BW, cholesterol and TG level were similar at the starting point. In addition, the BW and cholesterol were lowest in the Trt-PS group (LSmeans: 409.9 g and 88.7 mg/dl [Trt-PS]: 432.9 g and 103.3 mg/dl [CTR]: and 432.5 g and 95.9 mg/dl [Trt-OC]; see Table 3). Moreover, there was a significant effect of dietary on %BW ($p<0.001$) and %CHO ($p<0.05$). The %BW and %CHO was lowest in the Trt-PS group (LSmeans: 12.2% and 67.6% [Trt-PS]: 19.6% and 89.2% [CTR]: and 16.6% and 74.4% [Trt-OC]).

Effect of sex and time: No significant effect of sex was found on any of the variables analyzed, except on BW and %TG ($p<0.05$). On average, the BW of male rat was heavier than of female rat (444.1 g and 406.2 g, respectively). There was a significant effect of time on BW, cholesterol, and TG ($p<0.001$). In general, the body weight, cholesterol and triglyceride increased in all groups, in order to the time passing. However, all the cholesterol and triglyceride levels in the serum were in normal range. The ADFI was highest in the Trt-PS group (22.5 g). The ADFIs in the CTR and TRT-OC group were 20.7 g and 19.7 g, respectively ($p<0.001$). There was a significantly positive regression of body weight at start ($p<0.001$) on BW. An increase in body weight at start, of 1 gram, led to an increase in BW of 0.9 g. Moreover, there was a significantly positive regression of cholesterol ($p<0.01$) and triglyceride at start ($p<0.001$) on cholesterol and TG, respectively. An increase in cholesterol and triglyceride at start of 1 mg/dl led to an increase in cholesterol and TG of 0.55 and 0.44 mg/dl, respectively.

Combined effect of dietary and sex: There was a significant interaction between dietary and sex on BW, %BW, %CHO and %TG ($p<0.001$). The BW and %BW of the male rats were lowest in the Trt-PS (LSmeans: 418.2 g and 13.4% [Trt-PS]: 457.5 g and 20.8% [CTR]: 456.5 g and 21.1% [Trt-OC]) ($p<0.05$), while the %BW of the female rats was lowest in the Trt-OC and Trt-PS group (9.7% and 11.1%). The %BW of the female rats in the CTR group was 18.3% ($p<0.05$). The %CHO and %TG of the male rats were lower in the Trt-OC and Trt-PS group than in the CTR group (LSmeans: 58.5% and 68.9% [Trt-OC]: 58.5% and 113.3% [Trt-PS]: 118.0% and 132.4% [CTR]) ($p<0.05$). The interactions between dietary and sex in most cases only described the independent effects of dietary. In addition, there was a significance between sex and time on BW ($p<0.001$), cholesterol ($p<0.05$), and TG ($p<0.01$). Sometimes inconsistent and insignificant increases in body weight and serum lipid were found when the effect of dietary was combined with the effect of sex and time (see Fig 1). There was a significant increase in BW ($p<0.05$) in both sexes of all diet groups. The cholesterol ($p<0.01$) and TG ($p<0.05$) significantly increased in the male rats of the CTR group when time progress from the first to the 24th week.

Table 2 The levels of significance for the fixed effects included in the statistical models.

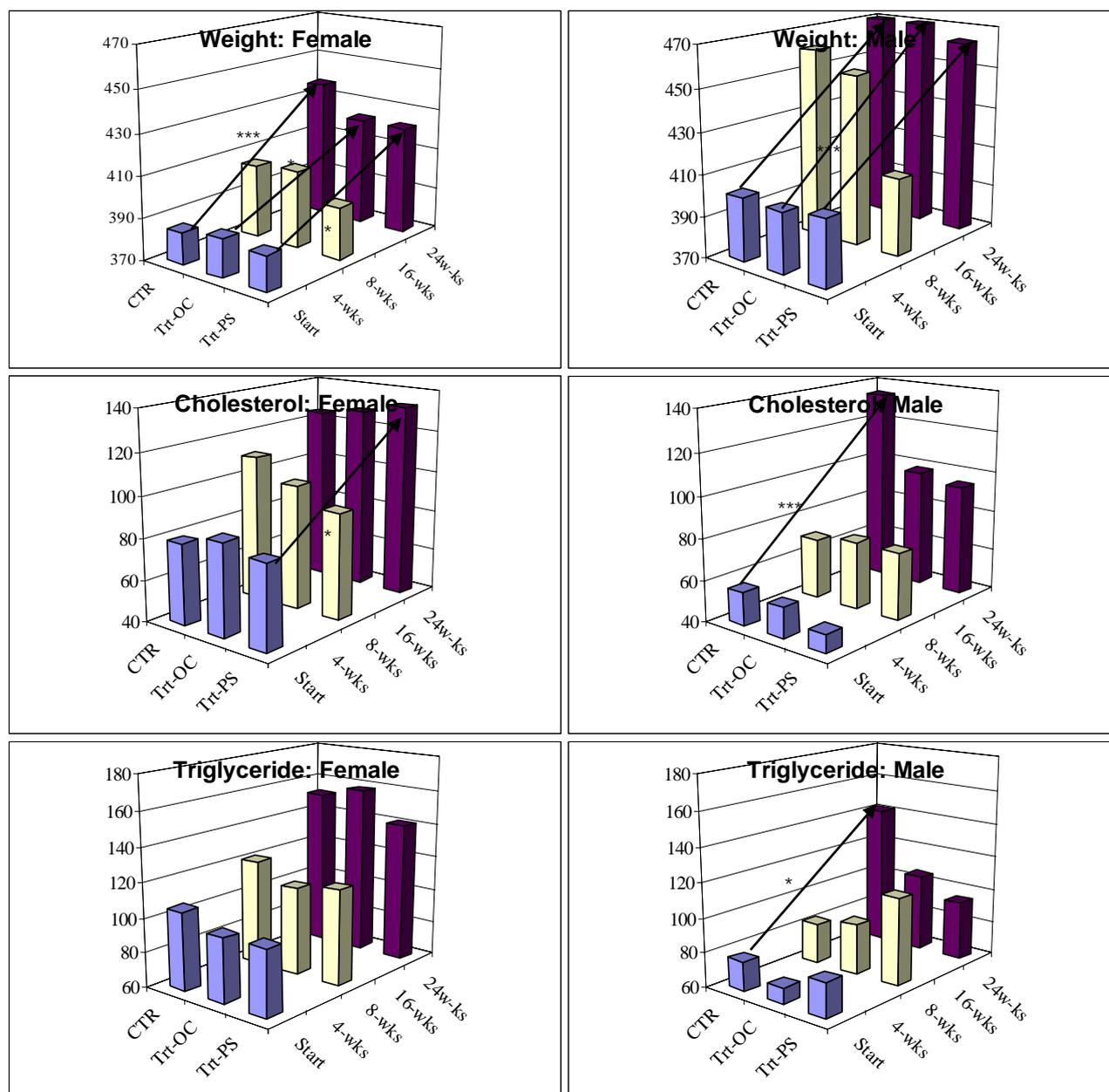
Fixed effect and interactions	Body weight	Cholesterol	Triglyceride	Percentage changes of			Average daily feed intake
				Body weight	Cholesterol	Triglyceride	
Dietary	***	**	ns	***	*	ns	***
Sex	*	ns	ns	ns	ns	*	***
Time	***	***	***	-	-	-	-
Interaction between							
Dietary and Sex	***	ns	ns	***	***	***	***
Dietary and Time	***	ns	ns	-	-	-	-
Sex and Time	***	*	**	-	-	-	-
Dietary and Sex and Time	**	*	ns	-	-	-	-
Regression on							
Body weight at starting point	***	ns	ns	ns	ns	ns	ns
Cholesterol at starting point	-	**	-	-	***	-	-
Triglyceride at starting point	-	-	***	-	-	***	-

ns: $p>0.05$; *: $p<0.05$; **: $p<0.01$; ***: $p<0.001$.

Table 3 Effect of dietary treatment on body weight and serum lipid changes in high cholesterol-diet fed rats.

Parameter	CTR (N=9)	Trt-OC (N=11)	Trt-PS (N=10)
Body weight (g)	432.9 ^a	432.5 ^a	409.9 ^b
at the starting point	393.1 ^a	393.9 ^a	394.5 ^a
at the end point	467.9 ^a	464.8 ^a	442.7 ^b
Cholesterol (mg/dl)	103.3 ^a	95.9 ^{ab}	88.7 ^b
at the starting point	67.4 ^a	69.8 ^a	64.8 ^a
at the end point	129.5 ^a	113.0 ^a	113.7 ^a
Triglyceride (mg/dl)	117.9 ^a	112.3 ^a	111.0 ^a
at the starting point	88.3 ^a	83.0 ^a	89.0 ^a
at the end point	145.7 ^a	134.2 ^a	119.1 ^a
Percentage change of			
Weight gain (%BW)	19.6 ^a	16.6 ^b	12.2 ^c
Cholesterol gain (%CHO)	89.2 ^a	74.4 ^{ab}	67.6 ^b
Triglyceride gain (%TG)	51.1 ^a	48.2 ^a	56.4 ^a
Average daily feed intake (g)	20.7 ^a	19.7 ^a	22.5 ^b

LSmeans with one letter in common in row are not significantly different ($p>0.05$).

**Figure 1** Combined effects of dietary treatment and sex and time on body weight and serum lipid changed in 24-weeks in high cholesterol-diet fed rats.

Complete blood count: The complete blood counts and other clinical chemistry (i.e. creatinine, BUN, SGOT and SGPT) of the rats in all groups were in the normal range (range of creatinine: 0.30-0.70 mg/dl; BUN: 16.98-23.07 mg/dl; SGOT: 71.49-151.45 U/l; SGPT 37.08-64.96 U/l). Moreover, there were no clinical signs of any disease during the study. However, 6 rats died during the study, 3 rats in the CTR group, 1 rat in the Trt-OC group, and 2 rats in the Trt-PS group. All the rats died during the blood collection process, caused by anesthesia which resulted in hypothermia.

Discussion

The present study demonstrates the long term effect of dietary fiber supplementation on the body weight and serum lipid in high cholesterol-diet fed rats. In this study, we added the 2.5% cholesterol in the basal diets to mimic the situation of high fat contents in the food. This is in accordance with the study of the anti-lipidemic ability of essential oil extracted from *Ocimum sanctum* L. leaves in rats fed with high cholesterol diet (HCD) (Suanarunsawat et al., 2009). Furthermore, we added the dietary fiber, extracted *Ocimum canum* or psyllium seeds at 10% of the dry feed, in the HCD. Carter et al. (1998) mentioned that a diet containing 10 g/100 g dry weight of dietary fiber (i.e. pectin and/or guar gum) can decrease in serum cholesterol in rats.

The overall results of proximate analyses were to some extent different in protein, fat, fiber and moisture content in the three diets. These differences might be explained by the supplementing of *Ocimum canum* seeds and psyllium seeds in the diets. Moreover, the Trt-PS group had highest fiber content in the diet. The lower fiber content in the Trt-OC than in the Trt-PS group can be explained by the differences in source of the dietary fiber and the particle size. Psyllium seeds used in this study was bought from a drug company. The mucilage from the psyllium seed husk had already been extracted, and had had high fiber content. Van Craeyveld et al. (2009) reported that psyllium seed husk can be extracted up to 70%. Meanwhile, the *Ocimum canum* seeds were crushed into smaller size and performed the oil extraction before used in the study. Sooksai and Noitang (2007) reported that *Ocimum canum* after oil extraction with particle size of less than 90 µm had less fiber content than particle size of 90-315 µm (7.4% and 38.0%). Unfortunately, we did not measure the particle size of *Ocimum canum* seeds in this study. On the other hand, we used mixed particle size which had fiber content around 34.5% (Sooksai and Noitang, 2007). Moreover, Sooksai and Noitang (2007) mentioned that the specific swelling volume and water holding capacity of *Ocimum canum* seeds after extracted was higher than before extracted (90.0 ml/g and 52.3 g/g vs 49.0 ml/g and 34.0 g/g), while the specific swelling volume of psyllium seed was 60.4 ml/g and 48.3 g/g (Palanuvej et al., 2009). The higher specific swelling volume and water holding capacity of the seed resulted in the lower moisture in the diet.

The overall results from the present study reveal that not only the dietary type but also the duration of having diet have an impact on body weight and lipid profile of the rat. No effect of sex of rat on lipid profile, except on body weight, was found. This study demonstrates that supplementation of *Ocimum canum* seeds or psyllium seeds, providing predominantly in fiber, have some effect on body weight and cholesterol level. Body weight was significantly different among the groups of rats, lower in the Trt-PS than in the CTR and the Trt-OC. Moreover, the %BW was significantly lower in the Trt-PS than in the Trt-OC and the CTR group. This is in agreement with the results of another study (Anderson et al., 1994; Carter et al., 1998) which reported that dietary fiber might influence weight gain by inhibiting energy intake resulting in lower weight gain. Moreover, the ADFI in the Trt-PS group was highest (22.5 g/day). This might be explained by the level of dietary fiber that had a marginally significant effect on food consumption with high fiber groups consuming more food, but fewer calories, than the low-fiber groups. However, this explanation might not be correct for the Trt-OC and CTR group. The ADFI in both groups were similar amounts (19.7 g/d in Trt-OC and 20.7 g/day in CTR). Moreover, the fiber contents in the Trt-PS and Trt-OC groups were higher than in the CTR group (see Table 1). Therefore, the dissimilarity in ADFI between the CTR, Trt-OC and Trt-PS groups might be explained by the variation of specific swelling volume and water holding capacity of each dietary fiber.

The present study showed that mixing of dietary fiber, the Trt-PS group, had lower cholesterol level and percentage change of cholesterol than in the CTR group. The reason for lower cholesterol might be that soluble dietary fibers decrease serum cholesterol by modification of bile acid absorption and metabolism, or capture bile acid resulting in decreased absorption and increased excretion of the bile acid in feces (Miettinen and Tarpila, 1989). In addition, an increased bile acid synthesis from cholesterol in the liver consequently resulting in decreased cholesterol level in blood. Unfortunately, we didn't measure the liver cholesterol concentration in this study. Other explanations of lower cholesterol level in the blood might be associated with an increased viscosity of intestinal contents. Gallaher et al. (1993) showed that an increased viscosity of dietary fiber in hamster feed reduced the uptake of bile acids and cholesterol by limiting access to the epithelial surface resulted in decreased serum cholesterol concentration. Therefore, the results obtained agree in principle with those of some previous studies, showing decreased cholesterol level in supplementing of dietary fibers (Chularojmontri et al., 1987; Anderson et al., 1994; Carter et al., 1998).

In conclusion, the mixing of dietary fiber (i.e. *Ocimum canum* seeds and psyllium seeds) in the high cholesterol-diet fed rats might be an alternative choice for controlling body weight and cholesterol level without any health problems. Further investigations on the defined mucilage extraction of *Ocimum canum* seed are needed.

Acknowledgements

The authors would like to thank the 90th Anniversary of Chulalongkorn University Fund (Ratchadaphiseksomphot Endowment Fund) for financial support.

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