Dietary Sesame Meal Increases Plasma HDL-cholesterol Concentration in Goats

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ABSTRACT : Influence of dietary sesame meal on plasma glucose, non-esterified fatty acid (NEFA), triglyceride, total cholesterol, high-density lipoprotein (HDL)-cholesterol and urea concentrations in goats was examined. Goats were fed a control diet (50% timothy hay and 50% concentrates) (CD) or a sesame meal diet (50% timothy hay, 25% concentrates and 25% sesame meal) (SMD) during 12 days. Blood samples were taken after overnight fasting and afternoon every day. Body weight was not changed by feeding either CD or SMD. The concentrations of plasma triglyceride and urea were higher ($p<0.05$) in goats fed SMD than those fed CD. Plasma NEFA concentration was higher in plasma samples after overnight fasting. Plasma glucose concentration in plasma samples collected afternoon was higher than those after overnight fasting. Plasma total cholesterol concentration was significantly increased by feeding SMD but not by feeding CD, which was due to the remarkable increase of plasma HDL-cholesterol concentration. In conclusion, dietary sesame meal brought about an increase in plasma total cholesterol concentration accompanied with an increment in plasma HDL-cholesterol consentration in goats. ***(Asian-Aust. J. Anim. Sci. 2002. Vol 15, No. 11 : 1564-1567)***

Key Words : Sesame Meal, Plasma HDL-cholesterol,Goats

INTRODUCTION

Sesame was found chiefly in the tropics of Africa and Asia, and in general is known as one of healthy diets. It was reported that the sesame seed-containing diet has high vitamin E activity such as the suppressive effect of lipid peroxidation and oxidative hemolysis (Yamashita et al., 1992, 1995). Sesame seed includes a lot of oil and it has been well known that sesame oil is also effective for human health. For instance, when rats were fed a diet high in sesame oil, lymphatic absorption of cholesterol was significantly reduced compared with the control group (Satchithanandam et al., 1993). Sesame meal is by-product after sesame oil extraction from sesame seeds and is rich in protein. It was reported that sesame meal could be substituted for soybean meal by half in layer ration without adverse effect of egg production (Cheva-Isarakul and Tangtaweewipat, 1993). In ruminants, however, the influence of dietary sesame meal has not been clarified so far. In the present study, therefore, we evaluated the influence of dietary sesame meal on plasma concentrations of glucose, urea, non-esterified fatty acid (NEFA), triglyceride, total-cholesterol and high-density lipoprotein (HDL)-choleterol in goats.

MATERIALS AND METHODS

Animals and diets

The influence of sesame meal substitution for concentrate on plasma metabolite concentrations was examined. Six Japanese pygmy castrated male goats were used. These goats were 2 to 5 years old and castrated in 1 to 8 months old. The average body weight±SE was 30.6± 5.2 kg. In the control diet (CD) group, animals were fed CD which was a 50% timothy hay (Morinaga Milk Industry Co., LTD, Tokyo, Japan)/50% concentrates “Alfa wagyu land” (CHUBU SHIRYO Co., LTD, Chita, Japan) ration. In the sesame meal diet (SMD) group, goats were fed SMD which was a 50% timothy hay/25% sesame meal (Takemoto Oil & Fat Co., LTD, Gamagori, Japan)/25% concentrate ration. Half amount of concentrate in CD was substituted to the equal weight of sesame meal. The composition of CD and SMD is shown in Table 1.

Experiments

Goats were housed in individual metabolism cages. Lighting period was 14 h. (05:00-19:00). The CD was offered to all animals during preparatory period for 7 days. Then three goats each were allotted to one of two treatment groups. The CD and SMD were given to the groups of CD and SMD for 12 days, respectively. As shown in Table 1, these diets were given 300 g/day/goat, whose TDNs were met a nutrient requirement of goats in their weight (30 kg) (National Research Council, 1981) with 300 g/day/goat of timothy hay, and were divided equally and fed twice a day at 09:30 and 17:30. Goats were allowed free access to drinking water and trace-mineralized salt blocks “Cow candy” (Mercian Co., LTD, Tokyo, Japan). Blood samples were taken every day at 09:20 and 13:20 by jugular venipuncture. Plasma was separated and stored at -80°C

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Table 1. Feeding levels and composition of experimental diets

	Control diet	Sesame meal diet
Feeding levels (g/day)		
Timothy hay	300	300
Concentrates	300	150
Sesame meal	-	150
Chemical composition (%)		
Crude protein	8.9	16.1
Crude fat	2.0	5.2
Crude fiber#	9.5	19.3
TDN# (%)	61.4	61.9

Values were referred to Agriculture, forestry and fisheries research council secretariat, MAFF (1995).

Chemical composition in ingredients (crude protein, crude fat and crude fiber) (g/100 g): 3.4, 1.3 and 28.9 in timothy hay; 15.1, 2.7 and 10.0 in concentrates; 42.5, 15.5 and 9.3 in sesame meal, respectively.

until analyzed. The same experiment was repeated after goats were switched in treatments.

Analyses

Crude protein in the ingredients of experimental diets was determined by using Kjeldahl distilling unit "Kjeltec System 1026" (Tecator, Hoganas, Sweden). Crude fat was analyzed by Soxhlet's extractor "FATEX Speedy Fat Extractor Auto Program System" (Mitamura Riken Kogyo Inc., Tokyo, Japan).

Plasma concentrations of glucose, urea, non-esterified fatty asid (NEFA), triglyceride, total cholesterol and high-density lipoprotein (HDL)-cholesterol was measured by using commercial kits (glucose: Glucose C II test Wako; urea: UN B test Wako; NEFA: NEFA test Wako; triglyceride: TG G test Wako; total cholesterol: T-Cho E test Wako; HDL-cholesterol: HDL-test Wako; Wako Pure Chemical Co. Ltd., Osaka, Japan).

Statistical analyses

Data was analyzed by mixed three-factor within subject design (split-plot design). The main factor with independent groups was experimental diet (control vs. sesame meal). Sub factors with repeated measures were blood sampling time (am vs. pm) and experimental period (days). Data was calculated by a commercial statistical package SAS (SAS Institute Inc., Cary, NC, USA). For all analytical procedures, P-value of less than 0.05 was considered statistically significant.

RESULTS

Body weight change and food intake

The body weight of goats in both dietary treatment groups was not changed significantly during experimental periods. Diets given to goats were not remained before giving next diets (data not shown).

Plasma glucose, urea and lipid concentrations

Influence of dietary sesame meal on plasma glucose concentration in goats is represented in Figure 1. Dietary

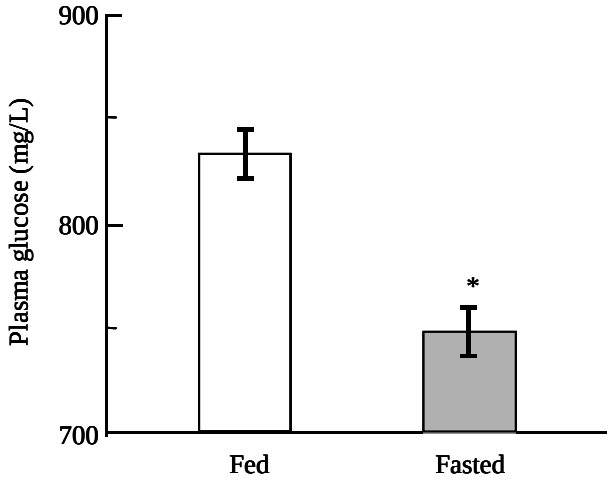

Figure 1. Influence of dietary sesame meal on plasma glucose concentration in goats.

* Significantly different between fasted and fed ($p<0.05$). Values are means±SE; n=144.

sesame meal did not affect plasma glucose concentration. When blood samples were taken at 09:20 after overnight fasting, plasma glucose concentration was significantly lower than that taken at 13:20. Figure 2 shows the influence of dietary sesame meal on plasma urea concentration in goats. There was an interaction between experimental diet and experimental period. Plasma urea concentrations over day 2 of experimental period were significantly higher than that on day 1. Thereafter, the urea level in the SMD group was significantly higher than that in the CD group. Influence of dietary sesame meal on plasma NEFA concentration in goats is shown in Figure 3. Dietary sesame meal did not affect plasma NEFA concentration. There was

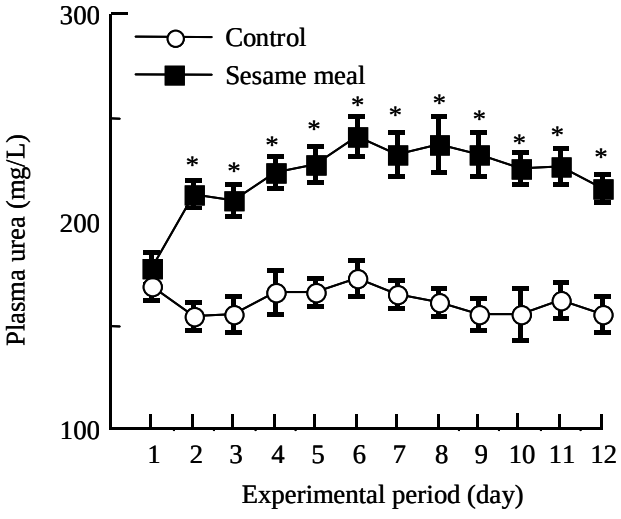

Figure 2. Influence of dietary sesame meal on plasma urea concentration in goats.

* Significantly different compared to day 1 in each dietary treatment ($p<0.05$). Values are means±SE; n=12.

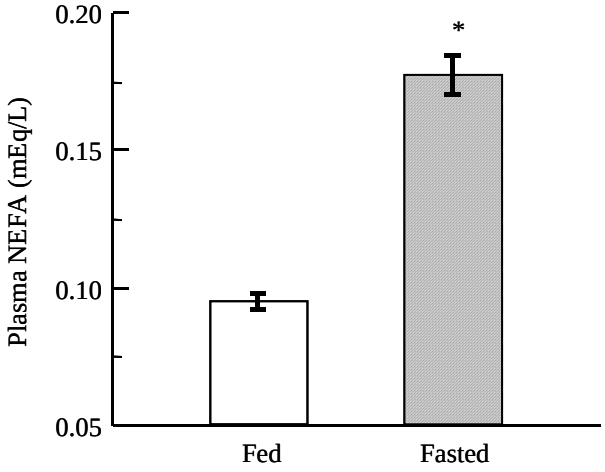

Figure 3. Influence of dietary sesame meal on plasma non-esterified fatty acid (NEFA) concentration in goats.
* Significantly different between fasted and fed ($p<0.05$). Values are means±SE; n=144.

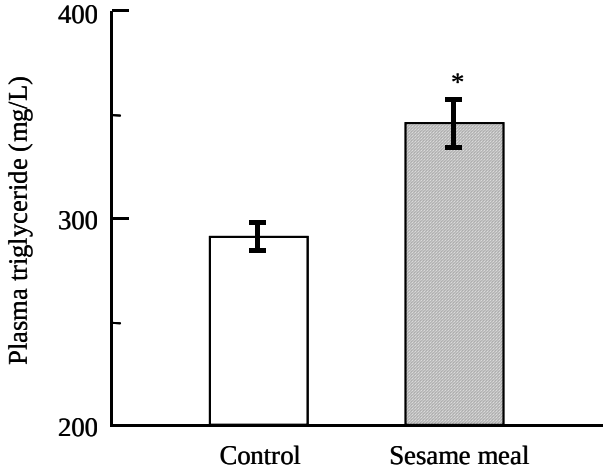

Figure 4. Influence of dietary sesame meal on plasma triglyseride concentration in goats.
* Significantly different between control and sesame meal ($p<0.05$). Values are means±SE; n=144.

significantly difference between blood sampling times. Plasma NEFA concentration of goats after overnight fasting was significantly higher than that in blood taken in the afternoon. Influence of dietary sesame meal on plasma triglyceride concentration in goats is shown in Figure 4. Plasma triglyceride concentration of goats fed SMD was significantly higher than that of the CD group. Influence of dietary sesame meal on plasma total cholesterol concentration in goats is shown in Figure 5. The significant interaction between experimental diet and experimental period was observed. In the SMD group, plasma total cholesterol increased gradually with experimental days, and the concentrations over day 9 of experiment were significantly higher than that on day 1. In the control group, it didn't markedly change during experimental periods. Figure 6 represents the influence of dietary sesame meal on plasma HDL-cholesterol concentration in goats. Similarly to plasma total cholesterol, the interaction between dietary treatment and experimental period was significant. When goats fed SMD, plasma HDL-cholesterol increased with experimental days. The concentrations over day 5 of experiment were significantly higher than that on day 1. However, no change was observed in the control group during experimental period.

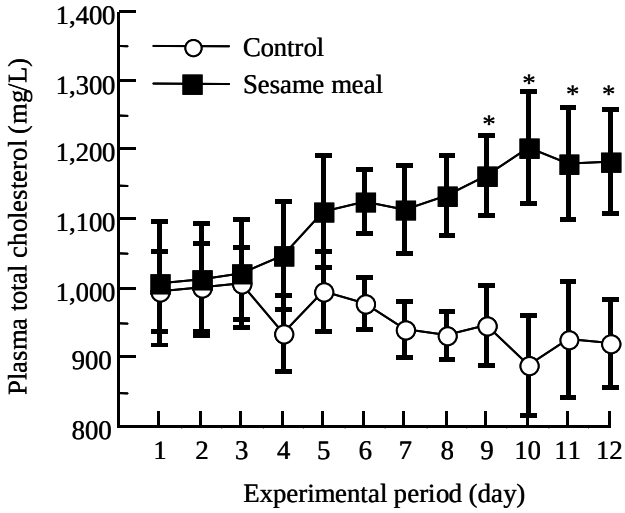

Figure 5. Influence of dietary sesame meal on plasma total cholesterol concentration in goats.
* Significantly different compared to day 1 in each dietary treatment ($p<0.05$). Values are means±SE; n=12.

DISCUSSION

The body weight of goats in all dietary treatment groups were not changed significantly, which indicated that goats in all experimental groups were satisfied with the requirement of TDN and any nutrients for goats (National Research Council, 1981).

As shown in Figure 1 glucose concentration in plasma taken at 09:20 was lower than that taken at 13:20. In contrast to plasma glucose, plasma NEFA concentration in goats increased after overnight fasting (Figure 3). These phenomena observed in the present study confirmed other observation found in sheep (Schwalm and Shultz, 1976; Gaal et al., 1993). As represented in Figure 2, plasma urea concentration in goats fed SMD increased very rapidly. Sahlu et al. (1992) reported that plasma urea in goats fed the diet including 19% crude protein was higher than that in the 12% crude protein group. In the present study, the increase in plasma urea of goats fed SMD seemed to be associated with the high amount of crude protein in the SMD, because 16.1% of crude protein was included in SMD compared to 8.5% in CD.

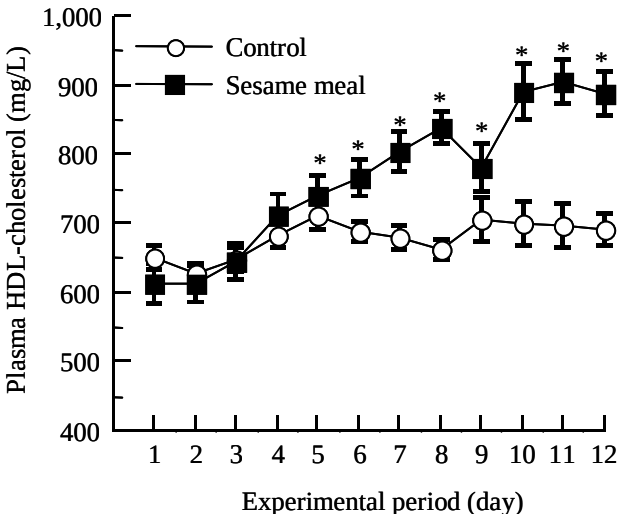

Figure 6. Influence of dietary sesame meal on plasma HDL-cholesterol concentration in goats.
* Significantly different compared to day 1 in each dietary treatment ($p<0.05$). Values are means±SE; n=12.

As shown in Figures 5 and 6, the increase in plasma total cholesterol concentration in goats fed SMD was parallel to the increase in plasma HDL-cholesterol level in the same animals. Therefore the increase in plasma total cholesterol concentration may be due to that of plasma HDL-cholesterol in goat fed SMD. Recently it has been reported that available effects of sesame seed and sesame oil are resulted from several effective ingredients called by lignans such as sesamin, sesamolin and sesaminol (Hirose et al., 1991; Kang et al., 1998, 2000). Sesamin has been shown to decrease the serum level of cholesterol, particularly of LDL-cholesterol, a risk factor for atherosclerosis in humans (Hirata et al., 1996), by inhibiting absorption and synthesis of cholesterol simultaneously (Hirose et al., 1991). Sesamolin was reported to be useful as an inhibitor of lipid peroxidation in the rat liver (Kang et al., 1998). Moreover sesaminol acts as a potentially effective antioxidant that can protect the peroxidation in LDL (Kang et al., 2000). These ingredients are mainly contained in sesame oil, but a little left in sesame meal after sesame oil extraction. However, there has been no reports that the influence of dietary sesame lignans on lipid metabolism in ruminants was examined, and this issue should be studied in the future.

In conclusion, the present study is the first report to show that dietary sesame meal significantly increases plasma total and HDL-cholesterol concentrations in goats. This result brings to do further study for the purpose of identifying the unknown ingredients in sesame meal which causes a increase in plasma HDL-cholesterol concentration in goats.

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