ABSTRACT
Background: In 1997, the US Food and Drug Administration passed a unique ruling that allowed oat bran to be registered as the first cholesterol-reducing food at a dosage of 3 g β-glucan/d. 
Objective: The effects of a low dose of oat bran in the background diet only were investigated in volunteers with mild-to-moderate hyperlipidemia.
Design: The study was a double-blind, placebo-controlled, randomized, parallel study. Sixty-two healthy men (n = 31) and women (n = 31) were randomly allocated to consume either 20 g oat bran concentrate (OBC; containing 3 g β-glucan) or 20 g wheat bran (control) daily for 8 wk. Fasting blood samples were collected at weeks −1, 0, 4, 8, and 12. A subgroup (n = 17) was studied postprandially after consumption of 2 meals (containing no OBC or wheat bran) at baseline and after supplementation. Fasting plasma samples were analyzed for total cholesterol, HDL cholesterol, triacylglycerol, glucose, and insulin. LDL cholesterol was measured by using the Friedewald formula. The postprandial samples were analyzed for triacylglycerol, glucose, and insulin.
Results: No significant difference was observed in fasting plasma cholesterol, LDL cholesterol, glucose, or insulin between the OBC and wheat-bran groups. HDL-cholesterol concentrations fell significantly from weeks 0 to 8 in the OBC group (P = 0.05). There was a significant increase in fasting glucose concentrations after both OBC (P = 0.03) and wheat-bran (P = 0.02) consumption. No significant difference was found between the OBC and wheat-bran groups in any of the postprandial variables measured.
Conclusions: A low dosage of β-glucan (3 g/d) did not significantly reduce total cholesterol or LDL cholesterol in volunteers with plasma cholesterol concentrations representative of a middle-aged UK population. 

KEY WORDS β-glucan, oat bran, cholesterol, LDL cholesterol, triacylglycerol, atherogenic lipoproteins, postprandial evaluation, healthy adults, wheat bran

INTRODUCTION
In 1963, De Groot et al (1) were the first to report that the addition of an oat product to the diet of humans lowered blood cholesterol concentrations. Since that report, many animal and human studies have investigated the beneficial effects attributed to the ingestion of oat products, including improvements in gastrointestinal function, modulation of glucose metabolism, and decreased blood cholesterol concentrations (2). The hypocholesterolemic properties of oats have attracted much interest in recent years and have been the subject of many studies. Although the soluble fiber β-glucan appears to be the hypocholesterolemic ingredient, its mode of action is not fully understood.

A meta-analysis performed by Ripsin et al (3) concluded that the daily addition of 3 g β-glucan to the diet reduces cholesterol concentrations, independent of any change in the habitual diet that results from increased oat-bran consumption. In January 1997, the US Food and Drug Administration passed a unique ruling that allowed oat bran to be registered as the first cholesterol-reducing food, with a recommended dosage of 3 g β-glucan/d (4). However, many of the earlier human studies investigated the consumption of high quantities of oat bran each day, which can lead to an alteration in the background diet (5). Also, the amounts used would be impractical and unacceptable as a dietary strategy for the general population. Therefore, it was thought prudent to test the cholesterol-lowering efficacy of the minimum recommended dose of 3 g β-glucan incorporated into a palatable cereal product.

Although there are many reports on the effects of oat products on lipid and glucose metabolism, many areas have still not been fully explored; in particular, results on the effects on postprandial lipoproteins are inconclusive (6–8). Most people spend most of their time in a postprandial state, and it is now recognized that elevated postprandial lipemia is an independent risk factor for coronary heart disease (9, 10). For this reason it is important to evaluate potential beneficial effects of increased amounts of oat bran in the background diet on postprandial lipoprotein concentrations.

The aim of this study was to investigate the effect of 3 g β-glucan as 20 g of oat bran concentrate (OBC) in the background diets of free-living subjects with mild-to-moderate hyperlipidemia on fasting lipoproteins and on postprandial lipid

and glucose responses to standard meals that did not contain β-glucan. A cereal product incorporating 20 g wheat bran was used as a control to compare the effects of oat bran.

SUBJECTS AND METHODS

Subjects

Volunteers were recruited from the population living in Reading, United Kingdom, and the surrounding areas. Those interested were asked to complete a lifestyle questionnaire. Volunteers were aged between 35 and 70 y, had a body mass index (BMI; in kg/m²) between 20 and 32, had not had a myocardial infarction, were free from a history of malignancy within the 5 y before the study, were not receiving drug treatment for hyperlipidemia or any other drug treatment that would affect their plasma lipid concentrations, did not abuse alcohol (assessed by gamma GT), and were not taking any dietary supplements, including dietary fatty acids. The volunteers followed a fairly regular lifestyle; consumption of breakfast and lunch was part of their daily routine and they consumed an average total dietary fat intake of 35–45% of total energy. The volunteers did not travel regularly or have vacations planned during the period of the proposed study, did not smoke, were not vegetarians and had no other dietary restriction, and did not have any food intolerances. The volunteers were not regular or vigorous exercisers (≤3 times/wk, 20 min each session). For the women, stable hormonal status was ensured throughout the study. The study excluded pregnant women, those whose use of oral contraceptives or hormone replacement therapy was likely to change over the course of the study, and women who had irregular menstrual cycles or who were perimenopausal. Volunteers who were accepted after completing the questionnaire were asked to attend the investigation unit to provide a fasted screening blood sample. Subjects were accepted if they fulfilled the following criteria: plasma total fasted cholesterol between 5.5 and 8.0 mmol/L, fasted HDL cholesterol between 0.8 and 2.5 mmol/L, fasted triacylglycerol between 0.6 and 3.0 mmol/L, and fasted glucose <6.2 mmol/L.

Sixty-two healthy middle-aged men and women (31 women and 31 men) with moderately elevated total cholesterol concentrations completed the study. These volunteers were selected from a group of 146 individuals who expressed an interest in participating in the study and who completed the lifestyle questionnaire. One hundred and forty volunteers were invited to attend for a fasted screening blood sample. Seventy-six subjects were accepted on the basis of the inclusion criteria. Seventy subjects commenced the study and 62 successfully completed the 12-wk protocol. Eight subjects left the study because of illness (n = 3), work (n = 2), dislike of the product (n = 1), or other reasons (n = 2). The characteristics of the subjects are shown in Table 1. The 2 groups were well matched and there was no significant difference between the groups in any of the variables measured.

The sample size (n = 30/group) was estimated by using the method of least significant difference, assuming a reduction in total cholesterol of 7% at P < 0.01 and a power of 80%. This study received ethical approval from the University of Reading Ethics and Research Committee and all subjects gave informed consent before the study commenced. The subjects were free to leave the study at any time without giving a reason.

Study design

This was a double-blind, randomized, placebo-controlled parallel study that compared the effects of consuming 20 g of an oat-bran concentrate (OBC; Nestlé, Vívey, Switzerland) in the form of cereal (containing 3 g β-glucan) or 20 g wheat bran (control) in the background diet only on fasting and postprandial lipid, glucose, and insulin concentrations over an 8-wk intervention period and a 4-wk follow-up period. The volunteers were assigned to either the OBC group or the wheat-bran group on the basis of stratified randomization. The strata used were sex, age (35–50, 50–65, and 65–75 y), plasma total cholesterol concentration (5.0–6.0, 6.0–7.0, and 7.0–8.0 mmol/L), and plasma fasting triacylglycerol concentration (<1.0, 1.0–2.0, and >2.0 mmol/L).

The OBC and wheat-bran products were supplied to the subjects in color-coded sachets (red and blue, respectively). The nutrient compositions of the OBC and wheat-bran concentrate are shown in Table 2. The volunteers were asked to eat the supplement with low-fat yogurt or low-fat milk each day. The sachets were stored at room temperature until the day of consumption. The volunteers were instructed to maintain their habitual diets. Compliance with the protocol was assessed on the basis of the volunteers’ self-report of any missed supplements and a count of the supplements returned at the end of the intervention period. All volunteers were given a random number of sachets exceeding the number required, so some sachets were always returned.

Fasted state

The volunteers were asked to come to the Investigation Unit to provide fasted blood samples on 2 occasions separated by 1 wk (baseline measurements: –1 and 0). At week 0 the subjects were given a 4-wk supply of the supplement and instructed on how to use it in combination with their usual foods. The subjects returned at 4 and 8 wk for fasting blood collection and for body weight measurements, dietary counseling, and provision of additional food supplements. The subjects also visited the unit at 12 wk (4 wk after completion of the study) for measurement of fasting blood variables and body weight.

Postprandial state

Ten subjects in each group volunteered to undertake a more detailed evaluation involving postprandial lipid and hormone measurements. Seventeen subjects completed the evaluation. Two subjects withdrew because of illness and one withdrew.
because of commencement of a cholesterol-lowering drug. The subgroups’ (OBC: \( n = 8 \); wheat bran: \( n = 9 \)) postprandial responses were measured at baseline (week 0) and at the end of the supplementation period. The subjects came to the study center at 0800 and underwent cannulation. After collection of 2 fasting blood samples the subjects ate a standard breakfast that consisted of a croissant, butter, jam, cereal, whole milk, and orange juice (containing 4.2 MJ, 52 g fat, 19 g protein, and 125 g carbohydrate) and a standard lunch that consisted of a soft-cheese and cucumber sandwich, a packet of potato chips, and a chocolate cookie (containing 2.6 MJ, 30 g fat, 15 g protein, and 79 g carbohydrate) 5 h and 30 min later (no OBC or wheat bran was added to these meals). Serial blood samples were collected at 30-min intervals for the first 90 min after each meal and at hourly intervals thereafter until 8 h from commencement of the study day. No other food or drink except water and decaffeinated, sugar-free drinks was allowed during the study.

**Plasma separation and analytic methods**

Fasting blood samples were collected into EDTA-containing evacuated tubes (HM & S, Northampton, United Kingdom) and a sample of blood was immediately removed and placed into a fluoride oxalate tube (LIP, Shipley, United Kingdom) for glucose analysis. The blood samples were centrifuged at 1700 \( g \) for 10 min at ambient temperature and plasma was separated into appropriately labeled LP3 tubes (LIP) before storage at \(-20^\circ \text{C} \) until analyzed. All samples for each subject were analyzed within a single run. For all of the fasting blood samples collected, total cholesterol, HDL cholesterol, triacylglycerol, and glucose were analyzed by using an IL Monarch centrifugal analyzer (Instrumentation Laboratory, Warrington, United Kingdom).

Triacylglycerol was measured by using a method involving triacylglycerol lipase and glycerol kinase (Instrumentation Laboratory), glucose concentrations were measured by using a hexokinase method (Instrumentation Laboratory), and total and HDL cholesterol were measured by using a method involving sterol esterase and cholesterol oxidase (Instrumentation Laboratory). HDL-cholesterol concentrations were measured after precipitation of the fresh plasma with dextran-magnesium chloride reagent (11). LDL-cholesterol concentrations were calculated by using the Friedewald formula (12). In addition, plasma insulin was measured by using a specific enzyme-linked immunosorbant assay incorporating monoclonal antibodies in the form of a kit (Dako Ltd, High Wycombe, United Kingdom).

In the postprandial plasma samples, triacylglycerol, glucose, and insulin were measured.

**Statistical analysis**

All data sets were tested for normality; if they were not normally distributed they were transformed to \( \log_{10} \). Two-way between-group analysis of variance was performed. In addition, a one-way between-group analysis of variance for the OBC and wheat-bran groups was performed to identify any changes over the intervention period. Two-way repeated-measures analysis of variance was performed on the postprandial data before and after supplementation. Tukey’s post hoc test was used when required. The area under the curve (AUC) and incremental AUC (IAUC) measurements for the triacylglycerol, glucose, and insulin postprandial responses were calculated by using the trapezoidal rule for the total 8-h postprandial period. A paired \( t \) test was used to compare the differences observed in the AUC and IAUC for plasma triacylglycerol, glucose, and insulin over the intervention period (baseline to week 8). In the tables, data are presented as means \( \pm \text{SDs} \). \( P \) values \( < 0.05 \) were considered significant. All statistical analyses were performed by using the statistical package SPSS (version 6.1; SPSS Inc, Chicago).

**RESULTS**

**Subjects**

The 62 subjects who completed the study showed good compliance with the study protocol. The maximum number of supplements missed by an individual subject was 3 in the 8-wk period; most subjects reported no missed supplements. The self-reported data were confirmed by the supplement count.

**Fasted state**

There was no significant difference between the 2 groups over the 12-wk study period in plasma total cholesterol, LDL cholesterol, triacylglycerol, insulin, or BMI (Table 3). There was a significant reduction in fasting HDL-cholesterol concentrations after the OBC treatment from baseline to 8 wk (\( P = 0.05 \)). It was also observed that the fasting glucose concentration for both the OBC and wheat-bran groups increased significantly from baseline to week 8.

**Postprandial state**

There was no significant difference in postprandial plasma triacylglycerol and insulin responses from baseline to week 8 for either the wheat-bran or the OBC group. However, there was a significantly lower IAUC for glucose after the 8-wk treatment period in the wheat-bran group, as shown in Table 4.

**DISCUSSION**

In 1997, the US Food and Drug Administration published a final rule on the relation between soluble fiber from whole oats and plasma cholesterol concentrations (4). It concluded that the soluble fiber \( \beta \)-glucan is the primary component responsible for the hypcholesterolemic properties of oat bran. The present study was performed to determine the lipid-lowering effect of the minimum recommended dosage of \( \beta \)-glucan (3 g/d) for an 8-wk period in free-living subjects with mild-to-moderately elevated plasma total cholesterol concentrations (\( \bar{x} \pm \text{SD}: 6.4 \pm 0.8 \text{mmol/L} \)). In these
TABLE 3
Mean fasting values at baseline and at weeks 4, 8, and 12 of the intervention with oat bran concentrate (OBC) or wheat bran

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Week 4</th>
<th>Week 8</th>
<th>Week 12</th>
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<tbody>
<tr>
<td>Total cholesterol (mmol/L)</td>
<td></td>
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<tr>
<td>OBC</td>
<td>6.4 ± 0.7</td>
<td>6.5 ± 0.9</td>
<td>6.3 ± 1.1</td>
<td>6.3 ± 0.8</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>6.4 ± 0.8</td>
<td>6.5 ± 0.9</td>
<td>6.5 ± 0.8</td>
<td>6.3 ± 0.8</td>
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<tr>
<td>LDL cholesterol (mmol/L)</td>
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<tr>
<td>OBC</td>
<td>4.3 ± 0.6</td>
<td>4.4 ± 0.7</td>
<td>4.2 ± 0.8</td>
<td>4.2 ± 0.7</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>4.3 ± 0.8</td>
<td>4.4 ± 0.8</td>
<td>4.3 ± 0.8</td>
<td>4.2 ± 0.7</td>
</tr>
<tr>
<td>HDL cholesterol (mmol/L)</td>
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<tr>
<td>OBC</td>
<td>1.5 ± 0.4</td>
<td>1.4 ± 0.4</td>
<td>1.4 ± 0.5&lt;sup&gt;2&lt;/sup&gt;</td>
<td>1.4 ± 0.5</td>
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<tr>
<td>Wheat bran</td>
<td>1.5 ± 0.5</td>
<td>1.4 ± 0.4</td>
<td>1.5 ± 0.7</td>
<td>1.5 ± 0.5</td>
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<tr>
<td>Triacylglycerol (mmol/L)</td>
<td></td>
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<tr>
<td>OBC</td>
<td>1.4 ± 0.6</td>
<td>1.4 ± 0.6</td>
<td>1.5 ± 0.8</td>
<td>1.5 ± 0.7</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>1.5 ± 0.7</td>
<td>1.6 ± 0.8</td>
<td>1.7 ± 0.8</td>
<td>1.5 ± 0.9</td>
</tr>
<tr>
<td>Glucose (mmol/L)</td>
<td></td>
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<tr>
<td>OBC</td>
<td>4.9 ± 0.7</td>
<td>5.0 ± 0.7</td>
<td>5.2 ± 0.7&lt;sup&gt;1&lt;/sup&gt;</td>
<td>5.2 ± 0.7</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>5.0 ± 0.6</td>
<td>5.1 ± 0.6</td>
<td>5.3 ± 0.6&lt;sup&gt;4&lt;/sup&gt;</td>
<td>5.2 ± 0.5</td>
</tr>
<tr>
<td>Insulin (pmol/L)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBC</td>
<td>39 ± 32</td>
<td>38 ± 30</td>
<td>40 ± 30</td>
<td>44 ± 35</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>41 ± 21</td>
<td>43 ± 25</td>
<td>40 ± 21</td>
<td>35 ± 19</td>
</tr>
<tr>
<td>BMI (kg/m&lt;sup&gt;2&lt;/sup&gt;)</td>
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</tr>
<tr>
<td>OBC</td>
<td>26.2 ± 3.2</td>
<td>26.2 ± 3.2</td>
<td>26.1 ± 3.1</td>
<td>25.3 ± 5.7</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>26.3 ± 3.2</td>
<td>26.3 ± 3.3</td>
<td>25.4 ± 5.7</td>
<td>24.6 ± 7.3</td>
</tr>
</tbody>
</table>

<sup>1</sup> ± SD; <i>n</i> = 31/group.
<sup>2</sup>–<sup>4</sup> Significantly different from baseline: <sup>2</sup><i>P</i> = 0.05, <sup>1</sup><i>P</i> = 0.03, <sup>4</sup><i>P</i> = 0.02.

subjects, who were carefully counseled to maintain their normal diets, the daily addition of this amount of β-glucan, provided in a daily serving of cereal, did not reduce total or LDL-cholesterol concentrations. A lack of an effect was also reported at a β-glucan dosage of ≥3 g/d (5, 13–17), although many studies showed significantly lower cholesterol and LDL-cholesterol concentrations at a dosage of 3 g/d (8, 18–25). Discrepancies in the reported effects of oat products could be due to several factors.

Studies that showed the most marked reduction in cholesterol concentrations (11.5–19%) in response to oat-bran intake (8, 24, 26) were those that used high doses of oat bran in various products. The dose of oat bran (and therefore β-glucan) used is known to be important; a dose-dependent reduction in LDL-cholesterol concentrations was reported by Davidson et al (24). A recent meta-analysis of the cholesterol-lowering effects of dietary fiber showed that there was an inverse association between the dose of soluble fiber (oat products, psyllium, pectin, and guar gum) and the mean changes in total and LDL cholesterol (<i>P</i> < 0.001), although there was nonlinearity with dosages > 10 g/d for total cholesterol and with dosages > 8 g/d for LDL cholesterol (27). A dose-response relation was also reported in an earlier meta-analysis of the lipid-lowering properties of oat products (3). The present study used a low dose of β-glucan (3 g β-glucan). This dose was chosen because it was practical, as reflected in the volunteers’ high compliance, and also corresponded to the minimum recommended dose reported to have beneficial total and LDL-cholesterol-lowering effects (4). However, in the present study a significant reduction in total and LDL cholesterol at this β-glucan intake was not observed.

The types of oat-bran products used in these studies varied considerably. The β-glucan content of good-quality commercial oat bran varies between 6% and 10%; wide ranges in concentration are found as a result of different processing methods of the oat bran (28). The linear structure of β-glucan is very susceptible to depolymerization during processing of the oats. This leads to reduced viscosity and physiologic activity. The lack of an effect of a high dosage of β-glucan (11.2 g/d) in a group of free-living men with mild-to-moderate hypercholesterolemia was explained by the poor solubility and viscosity of the β-glucan used (13). The β-glucan content of the OBC used in the present study was high, which resulted in a high viscosity (3221 compared with 509 mPa for the wheat bran control). This viscosity was comparable to that of many gums (29); therefore, lack of viscosity was unlikely to be responsible for the lack of an effect in this study.

Variations in the plasma cholesterol concentrations of the subjects studied may also have been an important factor that influenced the outcomes of oat-bran intervention studies. The observation that the initial cholesterol concentrations of the subject group could be used as a reliable predictor of the beneficial hypocholesterolemic outcome of OBC intervention was reported previously (19). It has also been suggested that the lack of an effect of the intervention with oats reported by Swain et al (5) could be attributed to the low initial cholesterol concentrations of the 20 subjects (<i>x</i>: 4.8 mmol/L). In addition, the 12.8% reduction in total cholesterol concentration in the metabolic ward trial reported by Anderson (30) could be explained in part by the high initial cholesterol concentrations of the subjects (<i>x</i>: 6.9 mmol/L) and by the high dose of oat bran used (13.4 g soluble fiber). However, in a recent meta-analysis performed by Brown et al (27) it was reported that initial total cholesterol concentration was not a significant predictor of lipid changes in response to soluble fiber after adjustment for dose. In the OBC and wheat bran groups in our study the mean initial concentrations of total cholesterol and LDL cholesterol were 6.4 and 4.3 mmol/L, respectively, which indicate moderate hypercholesterolemia and are representative of concentrations in the middle-aged United Kingdom population. This concentration was similar to that of the group of subjects investigated by Anderson et al (30), who
reported a 12.8% reduction in plasma cholesterol. In addition, a more detailed analysis of the subjects’ responses in the present study did not show that individuals with higher initial cholesterol concentrations were more responsive to the OBC treatment than those with low cholesterol concentrations.

Polymorphisms in the apolipoprotein (apo) e gene are known to influence cholesterol concentrations and also the cholesterol response to low-fat diets (31, 32). In the general population, the highest cholesterol concentrations have been reported in individuals with the e3 allele and the lowest in those with the e2 allele (31). It has also been reported that the responsiveness of an individual to a dietary change involving dietary fiber can be influenced by the individual’s apo e genotype; carriers of the e2 allele are more responsive than are noncarriers (32). In another study, postprandial fat metabolism in dyslipidemic subjects with apo e3 and apo e4 genotypes was investigated (33). It was reported that long-term increases in the intake of dietary soluble fiber enhanced apparent fat absorption in subjects with the e3 allele because of an increased bile acid pool and increased micelle formation. Because of this observed significance of the apo e genotype in the response to oat-bran feeding, subject genotyping may be an additional approach that could be considered for subject recruiting purposes and may help to explain some discrepant findings. However, this test is expensive and time-consuming and is therefore not suitable as a routine screening test in most studies.

It is clearly important to ensure that studies such as those described here have sufficient power to detect the predicted changes in cholesterol concentrations. From previous data, 11.5–19% reductions in total cholesterol concentrations were reported after consumption of β-glucan-containing products (8, 24, 26). These large reductions in total cholesterol were associated with high doses of β-glucan. However, at doses of β-glucan similar to those used in our studies (3 g), more modest, but significant, reductions in total cholesterol of 13% (20) and 9% (21) were reported. In the present study, sample size was calculated on the basis of a predicted decrease in cholesterol of 7% with a population variance of 9%. However, a recent meta-analysis suggested that 3 g β-glucan/d would be associated with only a 1.8% reduction in cholesterol concentration, a change that would require a sample size of > 500 subjects to show statistical significance (27). This could explain the lack of a significant hypocholesterolemic response in the present study. Although our subject group was large (n = 62) compared with those of other studies, it appears from the results of the meta-analysis by Brown et al (27) that the number of subjects would have to be increased almost 8-fold for a significant cholesterol-lowering effect to be detected. Although no significant cholesterol-lowering effect was observed with this modest dosage of β-glucan (3 g/d), the likelihood of multiple small benefits from a variety of potential cholesterol-lowering foods, achieving the desired outcome within the total diet, is probably justified. Small daily intakes of soluble fiber possibly fall into this category.

Although no significant reductions in total or LDL-cholesterol concentrations were found in the present study, a significant reduction in total HDL cholesterol was found in the OBC group from weeks 1 to 8 (P = 0.05). The fall in HDL-cholesterol concentrations seen in our study was also observed in previous studies (15, 26), although this effect may be only temporary (26). It was also reported by Brown et al (27) that diets high in oat products reduce HDL cholesterol by 0.002 mmol · L⁻¹ · g⁻¹ soluble fiber (P < 0.001). Although this reduction was statistically significant, quantitatively it represents a much smaller reduction than the observed reduction of total and LDL cholesterol (−0.04 and −0.03 mmol · L⁻¹ · g⁻¹ soluble fiber, respectively). The lack of an effect of 3.0 g β-glucan for 8 wk on fasting plasma triacylglycerol was not unexpected and is supported by a lack of a significant effect of oat products on fasting triacylglycerol reported by Brown et al after their meta-analysis of 20 studies.

The postprandial (after consumption of 2 meals, neither of which contained OBC) effects of a dietary intake of a low dose of 3 g β-glucan for an 8-wk period were investigated in the present study. It was stated by Dubois et al (6) that because fasting plasma variables were only slightly altered by long-term feeding of oat bran, postprandial lipid and lipoprotein responses were much more sensitive to metabolic changes than were fasting responses. This has also been observed in patients with coronary heart disease (10) and has been a diagnostic tool (glucose tolerance test) in diabetic research for decades. For these reasons it was thought important and more meaningful to investigate the effect of a modest background β-glucan intake on postprandial responses to mixed meals, which did not contain OBC, in a subset of the group. Many of the previously published postprandial studies investigated the effect of oat bran added to the test meal and found significant beneficial effects on lipid responses (7, 34, 35) in addition to the glycemic response (36).

However, this study investigated the fasting and postprandial effects of a modestly higher background intake of oat bran than of placebo (wheat bran) by using a standard test meal containing

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**TABLE 4**

Area under the postprandial response curve (AUC) and the incremental AUC (IAUC) for plasma triacylglycerol, glucose, and insulin at baseline and after 8 wk of supplementation with oat bran concentrate (OBC) or wheat bran.

<table>
<thead>
<tr>
<th></th>
<th>Week 0</th>
<th>Week 8</th>
<th>Week 0</th>
<th>Week 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triacylglycerol (mmol·min⁻¹·L⁻¹)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>OBC</td>
<td>858 ± 212</td>
<td>926 ± 212</td>
<td>307 ± 177</td>
<td>318 ± 85</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>1060 ± 515</td>
<td>1049 ± 346</td>
<td>322 ± 192</td>
<td>359 ± 183</td>
</tr>
<tr>
<td>Glucose (mmol·min⁻¹·L⁻¹)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBC</td>
<td>3056 ± 195</td>
<td>3127 ± 225</td>
<td>539 ± 200</td>
<td>492 ± 188</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>3324 ± 350</td>
<td>3106 ± 191</td>
<td>709 ± 247</td>
<td>515 ± 166²</td>
</tr>
<tr>
<td>Insulin (mmol·min⁻¹·L⁻¹)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBC</td>
<td>84 ± 27</td>
<td>95 ± 45</td>
<td>71 ± 24</td>
<td>79 ± 37</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>104 ± 59</td>
<td>89 ± 43</td>
<td>84 ± 49</td>
<td>71 ± 32</td>
</tr>
</tbody>
</table>

¹± SD; n = 8 in the OBC group and 9 in the wheat-bran group.
²Significantly different from baseline, P = 0.03.
no added oat bran. No significant difference was reported for the postprandial triacylglycerol concentrations between the 2 supplements, which strengthens the results from another study (8). Indeed, the lipemic response, measured by the plasma triacylglycerol concentration, was higher after OBC consumption in our study, although not significantly so. Both Dubois et al (6) and Wolaver et al (33) reported significantly higher postprandial triacylglycerol concentrations after an increase in the background oat-bran consumption than after consumption of a control. It was concluded that oat-bran feeding alters the postmeal response in humans (6). In the present study we also did not observe any significant effect of the background oat-bran consumption on postprandial glucose or insulin response, which agrees with the results of some other studies (6, 8, 37–40).

In conclusion, the results of the present study suggest that free-living, moderately hyperlipidemic individuals cannot rely on oat-bran (at a daily dose equivalent to 3 g β-glucan) supplementation as an effective means of reducing their cholesterol concentrations. There appear to be no adverse effects of modest intakes of β-glucan on postprandial lipid, glucose, or insulin responses, although a small decrease in fasted HDL-cholesterol concentrations was observed in subjects consuming these low amounts of additional β-glucan.

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