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Preliminary Note

INCREASE OF SERUM CHOLESTEROL IN MAN FED A BRAN DIET

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Summary

The effects of wheat bran and other sources of dietary fibre on serum total and high density lipoprotein(HDL)-cholesterol were investigated in a group of 62 subjects, with rigid control of dietary intake.

It was found that a high-fibre diet with vegetables and fruits as well as a low-fibre diet, to which isolated citrus pectin had been added to the same level as present in the vegetables and fruits diet, caused a small decrease in the concentration of serum cholesterol after 5 weeks. Surprisingly, addition of bran (on average 38 g/day) to a low-fibre diet caused an increase in the level of serum cholesterol by on average 0.34 mmol/l ($P \leq 0.005$). The amount and type of dietary fibre had no substantial effect on the HDL-cholesterol concentration.

Key words: *Bran — Dietary fibre — High density lipoprotein-cholesterol — Pectin — Serum cholesterol*

Introduction

The dietary fibre hypothesis [1] suggested that a high fibre intake can reduce coronary heart disease through a depression of serum cholesterol. Dietary fibre was defined as the plant polysaccharides and lignin which are

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resistant to hydrolysis by the digestive enzymes of man [2]. The main components of dietary fibre are cellulose, hemicellulose, pectic substances (polygalacturonic acid compounds) and lignin.

Short-term controlled experiments with healthy volunteers have shown that isolated pectin can indeed lower the level of serum cholesterol [3], while wheat bran has been concluded to have no significant effect [4].

In most reported studies, only a small group of subjects was involved. We have investigated the effect of wheat bran and other sources of dietary fibre in a large group of healthy subjects with rigid control of dietary intake.

Subjects and Methods

62 volunteers (40 male and 22 female; 18–28 years of age) consumed a moderately low-fibre diet for 2.5 weeks. The subjects were then divided into 4 groups, each group continuing on different diets for another 5 weeks. Group 1 continued on the low-fibre diet of the first period, Group 2 received a diet rich in vegetables and fruits, Group 3 the low-fibre diet to which citrus pectin had been added (on average 9 g/day) and Group 4 got the low-fibre diet enriched with wheat bran (on average 38 g/day).

Throughout the eight-week period all foodstuffs, except for 0.42 MJ (100 kcal)/day, were individually supplied, appropriate to each subject's energy needs. Measurement of actual nutrient intake by weighing plus individual records (using Dutch food composition tables), revealed that differences in intake of total fat, polyunsaturated fat, protein, carbohydrates and cholesterol,

TABLE 1
MEAN DAILY INTAKE OF NUTRIENTS

	Control period ^a		Experimental period ^b		
	Diet				
	Low-fibre	Low-fibre	Veget./fruits	Citrus pectin	Bran
Number of subjects	62	16	15	15	16
Energy (MJ)	10.6	11.0	10.5	11.4	11.1
Protein (energy%)	13	13	13	12	13
Total fat (energy%)	36	37	37	36	37
Poly-unsaturated fatty acids (energy%)	4	4	3	4	4
Carbohydrates (energy%)	48	48	48	48	48
Alcohol (energy%)	2	1	1	2	2
Cholesterol (mg)	357	382	357	390	360
Total dietary fibre (g) ^c	18	18	43	28	37
Polygalacturonic acid (g) ^d	1.6	1.7	7.5	8.8	1.7

^a 2-day records.

^b 5-day records.

^c Calculated with data of [7–9] (before experiment); fibre-containing foodstuffs used during the experiment were analysed according to [10].

^d Analysed according to [11,12].

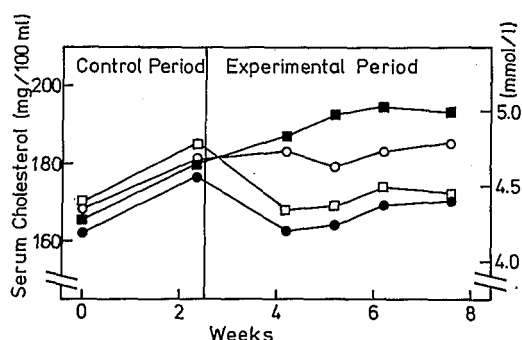


Fig. 1. Mean levels of serum cholesterol per group. ○, control, low-fibre diet; ●, high-fibre diet containing vegetables and fruits; □, citrus pectin added to the low-fibre diet; ■, bran added to the low-fibre diet.

both between the 4 groups and between the control and experimental period, were negligible (Table 1).

Citrus pectin NF was obtained from Bulmer Ltd. Hereford, England; the polygalacturonic acid and total dietary fibre content amounted to 76 and 95 g/100 g respectively; the degree of esterification was 78%. Coarse wheat bran was produced by Meneba, Rotterdam, from a grist of 65% European and 35% North-American bread wheat (*T. aestivum*); total dietary fibre content was 50 g/100 g (wet weight).

Serum cholesterol was measured by an indirect Abell-Kendall method in a laboratory certified by the WHO Collaborating Centre for Research in Blood Lipids C.D.C., Atlanta, GA (U.S.A.) [5]. Mn-heparin precipitation [6] was used for determining HDL-cholesterol.

Results

As shown in Fig. 1, during the first 2.5 weeks the level of serum cholesterol went up in all 4 groups, because of the higher fat and cholesterol content of the control diet compared with the habitual diet of the subjects. (Prior to the study the diet of the subjects contained on average 32 energy % fat, 256 mg/day cholesterol and 44 g/day dietary fibre.) Thereafter, with the diet containing citrus pectin the level of serum cholesterol decreased on average by 0.34

TABLE 2
SERUM HIGH-DENSITY-LIPOPROTEIN-CHOLESTEROL CONCENTRATIONS

	HDL-cholesterol (mmol/l)
At entry into the study (n = 62)	1.50 ± 0.33 ^a
After 2.5 wk of control diet (n = 62)	+0.03
After 5 wk of experimental diet	
control group (n = 16)	+0.01
vegetables/fruit group (n = 15)	+0.01
pectin group (n = 15)	+0.02
bran group (n = 16)	+0.07

^a ± 1 SD.

mmol/l ($P < 0.005$, two-tailed paired *t*-test) and with the vegetables and fruit diet it decreased by 0.17 mmol/l (N.S.).

Surprisingly, the bran diet caused an average increase in concentrations of serum cholesterol of 0.34 mmol/l ($P < 0.005$), whereas in the control group the level of serum cholesterol did not change significantly. No significant effect was found on concentrations of High-Density-Lipoprotein-cholesterol: during the experimental period all 4 groups showed a very small increase (Table 2).

Discussion

Different sources of dietary fibre may have different physiological effects. A slightly increasing effect of bran on serum cholesterol can be found in earlier reports [13,14]. These effects were not considered of importance because they did not reach statistical significance. Eastwood [15] also observed in a trial with monks that removing cereal fibre from a vegetarian diet was associated with a decrease in serum cholesterol.

Van Dokkum [16] recently reported the results of a study with 8 healthy volunteers living in a metabolic ward. It was found that replacing white bread with bread containing 15 g wheat bran per 100 g dry matter, caused a statistically significant increase in serum cholesterol of 0.4 mmol/l.

A comparison of these data with our own suggests that in controlled short-term trials, bran has a slightly hypercholesterolemic effect. However, Munoz et al. [17] very recently reported that a certain type of bran (hard red spring wheat bran) significantly lowered the level of plasma cholesterol in a group of 9 men, whereas other cereal brans had no effect. At present, no satisfactory explanation is available for the discrepancies found in studies with bran. Differences in particle size, fibre composition, water-holding capacity, bile acid-binding capacity, or the form in which the bran is consumed may play a role. In addition, there may be variations in individual susceptibility and in fat and cholesterol consumption, both within and between studies. Unfortunately, in many papers no details on actual food intake were given. In a study with 6 subjects it was found that in the absence of strict controls the addition of bran to the diet lowered fat and cholesterol consumption [18].

In controlled experiments, pectin is the only component of dietary fibre that has been shown to significantly lower the concentration of serum cholesterol [19]. Our results with the group consuming a vegetable and fruit diet indicate that pectic substances in normal foodstuffs can also reduce serum cholesterol. This effect is small compared with the well-established effects of the amount and degree of saturation of dietary fats and the amount of dietary cholesterol. However, in practice a fibre-rich diet may indirectly reduce levels of serum cholesterol because of its low fat and cholesterol content [19].

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