J Community Nutrition 1(1) : 52~59, 1999

☐ Original Article ☐

Dietary Fiber Intake of Subjects with Non-Insulin-Dependent Diabetes Mellitus and Hyperlipidemia*

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ABSTRACT

The present study was conducted to evaluate the dietary fiber intake of 130 subjects, that included 49 subjects(29 from Wonju, 20 from Kangnung) with diabetes mellitus, 23 hyperlipidemia patients, and 58 normal subjects. After the type and amount of foods that a subject took for one day were investigated using the 24-h recall method, the intake of various nutrients and dietary fiber were calculated using a program that already contained the information on dietary fiber contents. The results showed that diabetics from Kangnung who did not undergo dietary therapy had more fat intake than those from Wonju, hyperlipidemia patients, and normal subjects thus, had more energy intake. Also, the crude fiber intake in male and female diabetics from Kangnung were 8.43±3.47g and 8.35±3.29g, respectively, showing significantly high amounts compared to those of male and female diabetics from Wonju, hyperlipidemia patients, and normal subjects ; however, the intake of crude fiber per 1,000kcal in males and females was not significantly different among the four groups. Also, the dietary fiber intake(14.8 - 19.8g/day) and the dietary fiber intake per energy unit(7.7 - 10.9g/1,000kcal) were not significantly different between the four groups. The dietary fiber intakes of diabetics and hyperlipidemia patients were not significantly different from those in normal subjects, and these amounts were significantly lower than recommended levels. Thus, the methods of increasing dietary fiber intake, such as developing low-calorie, high-dietary fiber foods or additives, needs to be researched. (*J Community Nutrition* 1(1) : 52~59, 1999)

KEY WORDS : dietary fiber · diabetes · hyperlipidemia

Introduction

After the hypothesis that diabetes is maybe due to a lack of dietary fiber was proposed by Trowell & Woodgreen (1975), many epidemiological and clinical studies reported that the blood glucose level is lowered and the demand for insulin decreases with high dietary fiber intake, and consequently, nutritionists and medical professionals have recommended increasing the dietary fiber intake of diabetics. In the dietary guidelines for diabetics, the American Diabetes Association(1987) recommended more than 40g of dietary fiber intake per day. To emphasize the importance of dietary fiber in nutritional management for diabetics, the revised version of the "food-exchange guidelines for diabetics"(Korean Diabetes Society et al. 1988) of Korea mandates that foods containing high amounts of dietary fiber should be marked more noticeably. Also, in dietary management of hyperlipidemia, which is the main risk factor in the development of cardiovascular diseases, dietary fiber(especially water-soluble fiber) intake is recommended.

The presumed mean dietary fiber intake of each country in the world is 11-13g(Lanza et al. 1987) in the U.S., 12.4g(Mongeau et al. 1989) in Canada, 16g(Bagheri et al. 1990) in France, 16g(Englyst et al. 1982) in Finland, 17.3g(Tsuneyuki 1990) in Japan, 19.9g(Bingham et al. 1979) in England, 24g(Van Staveren et al. 1982) in the Netherlands, and 25.5g in Yugoslavia, showing the mean daily intake of an indivi-dual per day to be between 11 - 26g.

In the case of Korea, the dietary fiber intake of college students(Lee et al. 1991) was about 15g. However, virtually no study was conducted in this area during the last two decades(1969 - 1990). Therefore, crude fiber intakes during this period were estimated based on the National Nutrition Survey Report. According to Lee et al.(1994b),

*This work is supported(in part) by the Korea Science and Engineering Foundation(KOSEF) through the EMBRC(East Coastal Marine Bioresources Research Center) at Kangnung National University.

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this value was 25 – 60g from 1969 to 1970, but it decreased gradually and markedly dropped to 17.3g in 1990. According to the recent National Nutrition Survey Report(Ministry of Health and Welfore 1994) in 1992, the mean dietary fiber intake per person per day for the entire country was 7.2g ; out of this amount, it was investigated that 40% came from vegetables, 20% from grains, and 10 – 15% came from fruits.

By comparing the dietary fiber intake in diabetics and hyperlipidemia patients who were recommended to take high dietary fiber intake in their nutritional management to that of normal people, we attempted in the present study to find methods to increase dietary fiber intake in these patients.

Methods

The subjects of the present study included 49 diabetics, 23 hyperlipidemia patients, and 58 normal people(Table 1). The diabetic group was composed of those diabetics who have participated in diabetic classes to learn about dietary treatment after they were diagnosed as having diabetes in Y General Hospital in Wonju and K General Hospital in Kangnung. Especially, those diabetics from Wonju were under dietary therapy to control their blood glucose level, whereas those diabetics from Kangnung relied more on oral antidiabetic drugs rather than diet therapy. Also, the study included those hyperlipidemia patients(serum cholesterol≥240mg/dl) who were diagnosed from K General Hospital from Kangnung, and normal people without any metabolic abnormality.

The height and body weight of the subjects were measured. Using these data, the degree of obesity(the ratio of current body weight to the ideal body weight) was calculated. A 24-hr recall method, in which a trained investigator obtains data on the type and amount of ingested foods for the past 24 hours through interview, was used to investigate the dietary fiber intake of these individuals. Using the nutrient intake analysis program (Can-Pro) developed by Korean Nutrition Society and inputting the data from the additional dietary fiber contents of 252 kinds of common foods used by Koreans reported by Hawng(1994) to this program, the dietary fiber and other nutrient intakes were analyzed.

Using Statistical Analysis System(SAS) package, the mean value and standard deviation of the dietary fiber and other nutrient intakes in each group were calculated with the obtained data, and the significant difference of the mean values among the groups was verified with the Tukey test. In addition, the correlation of dietary fiber intake with other nutrient intakes and food intakes was analyzed using Pearson's correlation coefficient. Energy-

Table 1. Distribution of subjects by gender and group N

Gender	Diabetes		Hyperlipidemia	Normal	Total
	Wonju	Kangnung			
Male	11	12	13	22	58
Female	18	8	10	36	72
Total	29	20	23	58	130

N : number of subjects

Table 2. General characteristics of subjects

		Diabetes		Hyperlipidemia	Normal
		Wonju	Kangnung		
Male	Age(years)	58.3 ± 7.7[a]	50.1 ± 10.8[ab]	46.2 ± 9.6[b]	54.1 ± 8.6[ab]
	Height(cm)	166.9 ± 4.9	169.3 ± 7.8	165.9 ± 5.8	169.0 ± 5.2
	Weight(kg)	66.7 ± 7.6	70.9 ± 12.7	68.3 ± 10.8	66.4 ± 8.5
	%IBW[1)]	114.4 ± 12.4	113.6 ± 12.9	115.3 ± 16.4	107.0 ± 12.7
Female	Age(years)	50.3 ± 12.1	56.6 ± 11.9	56.3 ± 7.8	49.3 ± 10.9
	Height(cm)	155.7 ± 4.9	155.0 ± 4.1	153.2 ± 5.1	155.7 ± 5.3
	Weight(kg)	57.9 ± 8.9	57.6 ± 5.0	56.6 ± 5.4	57.7 ± 7.3
	%IBW	115.7 ± 15.9	116.6 ± 9.5	119.5 ± 18.2	115.8 ± 15.7

1) %IBW : % Ideal body weight
Ideal body weight=[Height(cm) - 100] × 0.9
Values with different superscripts were significantly different at $\alpha=0.05$ by Tukey's test

adjusted partial correlation between dietary fiber intake and other nutrient intakes was also calculated.

Results and Discussion

The general characteristics of the subjects are shown in Table 2. In the case of males, the mean age of hyperlipidemia patients was 46.2±9.6 years, which was significantly younger than the diabetics from Wonju(58.3±7.7 years), but did not show a significant difference to other groups. In the case of females, the mean age did not show a significant difference among the four groups. Other factors, such as height, body weight, and the degree of obesity, did not show a significant difference among the four groups.

Although the energy, carbohydrate, protein, and fat intakes(Table 3) did not show significant difference among the four groups of females, the fat intake of male diabetics from Kangnung was 76.4±37.6g, showing significantly higher intake than those male diabetics from Wonju with 36.4±9.5g, hyperlipidemia patients with 43.6± 22.9g, and normal subjects with 43.9±23.4g. Thus, the ratio of energy composition(carbohydrate : protein : fat) was 53.2 : 17.4 : 29.4 in the diabetics from Kangnung, and the ratios were 63 – 67 : 15 – 18 : 18 – 19 in the other three groups, showing those diabetics from Kangnung getting little energy from carbohydrate but getting significantly high energy from fat. Those diabetics from Kangnung who were not under dietary therapy showed overall higher nutrient intakes than those diabetics from Wonju who were under diet therapy(Table 3, 4).

Compared to the results obtained from diabetics in the Kyongbuk region(Lee et al. 1994a), the fat intake was higher but with lower carbohydrate and protein intakes, showing a higher ratio of fat and lower ratios of carbohydrate and protein than the ratio of energy composition reported by Lee et al.(1994a – 65 : 19 : 16). Also, the energy intake in the diabetics in the present study was higher than the energy intake of male and female diabetics(1704.7±135.8kcal and 1245.1±77.6kcal, respectively) from the Ansung area(Rho & Ko 1997).

The intakes of minerals and vitamins of the subjects are listed in Table 4. Except iron and vitamin A intakes in females, no significant differences were found in the intakes of mineral and vitamin among the groups. However, in females, the iron intake was significantly higher in the diabetics from Kangnung, and the vitamin A intake was significantly higher in the diabetics from Wonju and Kangnung.

In order to estimate the nutrient intake of a certain group accurately, the three-day 24-hr recall method is recommended. However, we used the one-day 24-hr recall method in the present study due to difficulties in interviewing patients ; thus, the results of this study may

Table 3. Mean daily nutrient(carbohydrate, protein and fat) intakes of subjects

		Diabetes		Hyperlipidemia	Normal
		Wonju	Kangnung		
Male	Energy(kcal)	1816.6 ± 314.3	2247.0 ± 552.9	1993.4 ± 586.4	1981.2 ± 399.0
	Carbohydrate(g)	299.0 ± 61.4	292.9 ± 69.2	326.6 ± 85.2	306.8 ± 70.6
	Protein(g)	67.9 ± 19.4	100.3 ± 35.0	75.2 ± 34.6	88.0 ± 36.1
	Fat(g)	36.4 ± 19.5[a]	76.4 ± 37.6[b]	43.6 ± 22.9[a]	43.9 ± 23.4[a]
	Energy composition				
	Carbohydrate(%)	66.5 ± 5.7[a]	53.2 ± 11.0[b]	66.3 ± 8.3[a]	63.0 ± 12.0[a]
	Protein(%)	15.2 ± 3.9	17.4 ± 2.5	14.5 ± 4.2	17.8 ± 6.4
	Fat(%)	18.3 ± 3.8[a]	29.4 ± 9.3[b]	19.2 ± 6.9[a]	19.3 ± 7.3[a]
Female	Energy(kcal)	1599.5 ± 488.1	1962.3 ± 575.0	1653.2 ± 560.4	1699.0 ± 333.3
	Carbohydrate(g)	246.7 ± 67.3	299.2 ± 78.6	282.9 ± 63.9	274.6 ± 60.8
	Protein(g)	63.7 ± 29.2	85.1 ± 34.8	60.2 ± 29.7	66.9 ± 20.0
	Fat(g)	39.2 ± 21.1	51.4 ± 31.8	31.9 ± 26.6	38.8 ± 20.7
	Energy composition				
	Carbohydrate(%)	62.6 ± 9.3	61.2 ± 10.6	70.3 ± 9.7	64.5 ± 10.1
	Protein(%)	15.7 ± 3.9	61.7 ± 3.0	14.3 ± 3.9	15.6 ± 3.7
	Fat(%)	21.7 ± 7.9	22.2 ± 10.3	15.5 ± 7.7	19.9 ± 8.2

Values with different superscripts were significantly different at $\alpha=0.05$ by Tukey's test

Table 4. Mean daily(mineral and vitamins) intakes of subjects

		Diabetes		Hyperlipidemia	Normal
		Wonju	Kangnung		
Male	Calcium(mg)	548.3 ± 204.8	618.8 ± 246.2	453.7 ± 229.2	454.0 ± 261.3
	Phosphorus(mg)	1113.4 ± 322.1	1430.4 ± 446.7	1065.8 ± 338.8	1197.6 ± 441.1
	Iron(mg)	12.9 ± 5.2	14.0 ± 5.8	11.8 ± 5.9	12.4 ± 6.5
	Vit A(R.E.)	602.5 ± 410.6	937.0 ± 429.1	746.5 ± 744.5	525.0 ± 426.4
	Vit B_1(mg)	1.1 ± 0.4	1.6 ± 0.8	1.3 ± 0.5	1.1 ± 0.4
	Vit B_2(mg)	1.0 ± 0.5	1.5 ± 0.5	0.9 ± 0.6	1.1 ± 0.7
	Niacin(mg)	15.1 ± 5.2	23.0 ± 6.9	16.5 ± 7.4	19.5 ± 10.4
	Vit C(mg)	101.5 ± 56.8	148.8 ± 147.1	131.2 ± 94.7	96.0 ± 55.4
Female	Calcium(mg)	441.4 ± 165.2	633.6 ± 235.4	405.7 ± 254.0	470.0 ± 284.8
	Phosphorus(mg)	927.6 ± 375.1	1298.3 ± 465.7	939.3 ± 421.5	1006.2 ± 335.5
	Iron (mg)	10.7 ± 4.3^{ab}	14.8 ± 3.2^{b}	8.8 ± 4.0^{a}	10.5 ± 3.5^{a}
	Vit A (R.E.)	651.5 ± 460.2^{a}	617.8 ± 213.9^{a}	312.5 ± 118.3^{b}	384.8 ± 172.1^{b}
	Vit B_1(mg)	1.1 ± 0.6	1.2 ± 0.5	1.0 ± 0.3	1.0 ± 0.4
	Vit B_2(mg)	1.0 ± 0.5	1.2 ± 0.6	0.8 ± 0.5	0.8 ± 0.3
	Niacin(mg)	17.7 ± 15.3	19.9 ± 11.3	13.6 ± 5.2	14.1 ± 5.3
	Vit C(mg)	99.0 ± 55.7	201.3 ± 213.5	108.6 ± 72.3	132.3 ± 130.3

Values with different superscripts were significantly different at α=0.05 by Tukey's test

Table 5. Crude and dietary fiber intakes of subjects

		Diabetes		Hyperlipidemia	Normal
		Wonju	Kangnung		
Male	Crude fiber(g) : CF	6.02 ± 2.36^{ab}	8.43 ± 3.47^{b}	7.03 ± 2.79^{ab}	5.81 ± 2.01^{a}
	Dietary fiber(g) : DF	14.87 ± 5.81	18.86 ± 7.02	16.37 ± 6.22	15.21 ± 6.74
	DF/CF	2.56 ± 0.78	2.27 ± 0.38	2.41 ± 0.58	2.69 ± 0.84
	Crude fiber(g/1000kcal)	3.30 ± 1.02	3.75 ± 1.21	3.63 ± 1.24	2.96 ± 0.99
	Dietary fiber(g/1000kcal)	8.34 ± 3.51	8.33 ± 2.19	8.50 ± 2.80	7.71 ± 3.03
Female	Crude fiber(g) : CF	6.00 ± 2.41^{ab}	8.35 ± 3.29^{b}	6.51 ± 3.05^{ab}	5.40 ± 1.95^{a}
	Dietary fiber(g) : DF	15.77 ± 6.86	19.80 ± 6.94	14.84 ± 9.42	14.74 ± 5.49
	DF/CF	2.78 ± 1.00	2.44 ± 0.29	2.45 ± 1.02	2.91 ± 1.03
	Crude fiber(g/1000kcal)	3.80 ± 1.31	4.49 ± 2.20	3.99 ± 1.58	3.22 ± 1.19
	Dietary fiber(g/1000kcal)	10.24 ± 4.18	10.87 ± 5.44	9.12 ± 4.24	8.85 ± 3.33

Values with different superscripts were significantly different at α=0.05 by Tukey's test

suggest nutrient intake with a decreased confidence level. In studies on nutrient intake of patients, analyzing usual food habit of patients is very important so that if this study was conducted together with food frequency test, this limitation could have been complemented.

The intakes of crude fiber and dietary fiber were analyzed in each group(Table 5). The crude fiber intakes in the diabetics from Kangnung in males and females were 8.43±3.49g and 8.35±3.29g, respectively, showing higher intakes than in the normal group. However, these values were not significantly different from those of the diabetics from Wonju and hyperlipidemia patients. Moreover, when the crude fiber intakes were adjusted on the energy intake, a significant difference was not seen in both males or females. The crude fiber intake of the diabetics was lower than those from Ansung(Rho & Ko 1997 males : 7.20±0.86g, females : 5.36±0.60g) and the Kyongbuk region(Lee et al. 1994a - 8.7±4.9g).

The dietary fiber intake and energy adjusted dietary fiber intake(g/1,000kacl) did not show any difference among the four groups of both males and females. However, the dietary fiber intake of the diabetics in Kangnung (males : 18.86±7.02g, females : 19.80±6.94g) tended to be higher than that from the diabetics in Wonju, hyperlipidemia patients, and normal subjects(14.8 - 16.4g). On the other hand, the dietary fiber intake of diabetics

from the Kyongbuk region was reported to be 17.0±8.8g. When converted based on the energy intake(Lee et al. 1994a), the dietary fiber intakes were 8.3±3.5g/1,000kcal and 8.3±2.2g/1,000kcal respectively, which were lower than diabetics from the Kyungbuk region with 10.5±5.5g/1,000kcal. The intakes of crude fiber and dietary fiber in female diabetics were similar to those in male diabetics, but when converted based on energy intake(1,000kcal), females turned out to take in more fiber than males.

Due to the recommendation of dietary fiber intake for treating diabetes and hyperlipidemia, the importance of dietary fiber intake is being emphasized in the educational materials on dietary treatment. In reality, however, these patients take in about the same amount of dietary fibers as normal people as can be seen in the present study. Thus, the dietary fiber intake in diabetics is a lot less than 40g per day or 25g/1,000kcal of food intake recommended by the American Diabetes Association(1987). Virtanen et al.(1988) reported that dietary fiber intake in diabetics in Finland was 33g per day ; this high intake in Finns was due to their traditional habit of eating rye breads processed from whole grain. In Japan(Tsuneyuki 1990), 20g is recommended to healthy individuals and more to diabetics ; in France(Bagheri 1990), 30-40g is recommended ; and the recent study by Schweizer & Wursch(1991) shows that 30g of dietary fiber intake is good for health. Compared to the above levels, the actual dietary fiber intake in diabetics in the present study is considerably low.

If food preference of the subjects was investigated in this study, it would have provided useful information in coming up with the methods that would increase the dietary fiber intake in diabetics or hyperlipidemia patients.

Many studies reported that increasing fiber content in the diet -especially soluble dietary fiber- has beneficial effects in lowering plasma cholesterol. In other words, soluble fibers, such as pectin, oat-bran and guar gum lower cholesterol levels, whereas insoluble fibers such as cellulose do not show this effect(Anderson & Tietyen 1986 ; Cara et al. 1992 ; Dubois et al. 1995). However, most studies point out that a significant decrease in cholesterol concentration due to the ingestion of dietary fibers occurs when the dietary intake is more than 50g/day or water-soluble intake is more than 20g/day(Anderson & Gustafson 1988). Since hypoglycemic effect of dietary fiber shows differences according to the types of dietary fiber, it is difficult to suggest uniform guidelines on fiber intake. Thus, based on more research results of hypoglycemic effect according to the types of dietary fiber, the recommended level of dietary fiber in diabetics needs to be established.

The ratios of dietary fiber/crude fiber in male and female normal subjects were 2.69±0.84 and 2.91±1.03 respectively, showing higher ratios than in hyperlipidemia patients(males : 2.41±0.58, females : 2.45±1.02) and diabetics. This ratio in diabetics from the Kyongbuk region (Lee et al. 1994a) was 2.1±0.6, which was lower than those of this study.

The correlation between dietary fiber intake and other nutrient intakes is shown in Table 6. The correlation coefficient of dietary fiber with crude fiber was 0.715, showing a strong positive relationship. When the energy was adjusted, all of the partial correlation coefficients decreased compared to those before adjustment : the dietary fiber intake showed a significant correlation with carbohydrate intake(r=0.242) and fat intake(r=0.232), but after adjusting for energy intake, the coefficients changed to r=-0.004 and r=-0.042, showing no relationship.

The subjects of the present study obtained most of their mineral and vitamin intakes from plant foods, and the dietary fiber intake showed a significant correlation with mineral(iron, calcium, phosphorus, etc.) and vitamin (vitamin A and vitamin B_2) intakes even after adjusting for energy intake.

The crude fiber intake had a significantly positive correlation with the intakes of vegetables(r=0.671), fish

Table 6. Correlation coefficients of dietary fiber with various nutrient intakes

	r	r (abjusted by energy intake)
Energy(kcal)	0.340***	-
Carbohydrate(g)	0.242**	-0.004
Protein(g)	0.383***	0.200***
Fat(g)	0.232**	-0.042
Calcium(mg)	0.559***	0.484***
Phosphorus(mg)	0.507***	0.405***
Iron(mg)	0.594***	0.518***
Vit A(R.E.)	0.400***	0.327***
Vit B_1(mg)	0.376***	0.205*
Vit B_2(mg)	0.457***	0.330***
Niacin(mg)	0.358***	0.222*
Vit C(mg)	0.266**	0.199*
Crude fiber(g)	0.715***	0.669***

*$p<0.05$, **$p<0.01$, ***$p<0.001$

Table 7. Correlation coefficients of dietary fiber and crude fiber intakes with various food intakes

Food group	Crude fiber	Dietary fiber
Rice	0.009	−0.060
Other cereals	0.104	0.224*
Soybeans	−0.045	0.115
Potatoes	0.104	0.029
Vegetables	0.671***	0.561***
Fruits	0.201*	0.124
Meats	0.084	−0.031
Fishes	0.221*	0.225*
Seaweeds	−0.972	0.286**
Milk	0.164	0.104
Eggs	0.014	−0.075

*$p<0.05$, **$p<0.01$, ***$p<0.001$

(r=0.221) and fruits(r=0.201)(Table 7). Also, dietary fiber intake showed a positive correlation with the intakes of vegetables(r=0.561) and fish(r=0.225). There was no correlation between crude fiber intake and intakes of seaweed and other cereal. However, dietary fiber intake showed a significantly positive correlation with seaweeds intake(r=0.286) and other cereals intake(r=0.224). Thus, these results indicated that seaweed and other cereals were major sources of dietary fiber in the subjects of this study.

Although high dietary fiber diet is being recommended in diabetics and hyperlipidemia patients, it is not easy for these patients to carry out this diet. Thus, developing low-calorie supplementary foods containing large amounts of dietary fiber and subsequently providing them to the patients would be extremely helpful in dietary treatment of diabetics and hyperlipidemia patients. Although many clinical trials(Gatti et al. 1984 ; Jenkins et al. 1975 ; Jenkins et al. 1978 ; Todd et al. 1990 ; Torsdottir et al. 1991) using refined dietary fibers reported that water-soluble dietary fibers providing high viscosity, such as guar and pectin, were effective in lowering blood sugar and plasma cholesterol. These fibers, however, have not been used practically due to the side effects, such as unpleasant taste, nausea and vomiting. Legumes such as soybeans(Mahaiko et al. 1984), red kidney beans(Dilawari et al. 1981), pinto beans(Potter et al. 1981), pea fiber (Hamberg et al. 1989) were known not to affect the taste and lower the concentrations of triglyceride and blood sugar. Other substances, such as psyllium fiber (Pastors et al. 1991), water-soluble alginate fiber(Torsdottir et al. 1991) extracted from seaweed and carrageenan(Watanabe et al. 1990) extracted from red algae, were also reported to bring about a significant decrease in blood sugar and blood insulin level. It was reported in Korea that the administration of refined fibers, glucomannan and guar, in diabetics favorably affected carbohydrate and fat metabolisms in non-insulin-dependent diabetics(Kim et al. 1990 ; Thorne et al. 1983). However, unpleasant taste and nausea still remained as the problems. Therefore, if natural foods containing high amounts of dietary fiber without unpleasant taste and commonly eaten by Korean people were found and developed as dietary fiber additives, its usefulness would be tremendous. One of the foods in this category might be seaweed ; not only the total contents of dietary fibers of seaweed are in the range of 32.7−74.6% with 51.6−85.0% of these fibers being water-soluble dietary fibers(Lahaye 1991), but also alginate and carrageenan that are extracts from seaweed and red algae were recently reported to improve carbohydrate metabolism(Torsdottir et al. 1991 ; Watanabe et al. 1990). From this point of view, examining the usefulness of these seaweed extracts that Koreans commonly use as high dietary fiber additives is thought to be valuable.

Summary

To evaluate the dietary fiber intake in subjects with non-insulin-dependent diabetes mellitus and hyperlipidemia, a dietary survey was carried out on 130 subjects (49 diabetics, 23 hyperlipidemia patients, and 58 normal people), using a 24-hr recall method.

1) The crude fiber intakes in the male and female diabetics from Kangnung were 8.43±3.49g and 8.35±3.29g, respectively. These values were higher than that of the normal group. However, energy adjusted dietary fiber intake(g/1,000kcal) did not show any difference among the four groups of both males and females.

2) The dietary fiber intake and energy-adjusted dietary fiber intake did not show significant differences among four groups. The energy-adjusted dietary fiber intakes were in the range of 8.85−10.87g/1,000kcal and 7.71−8.50g/1,000kcal in females and males, respectively.

3) The dietary fiber intake had a partial correlation (energy intake controlled) with mineral(iron, calcium, phos-

phorus, etc.) intake, and vitamin A and vitamin B_2 intakes.

4) Intakes of crude fiber and dietary fiber had significantly positive correlation with those of vegetables and fishes. Dietary fiber intake alone showed a significantly positive correlation coefficients with seaweed intake($r=0.286$) and other cereal intake($r=0.224$).

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