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ASSESSMENT OF FOOD CONSUMPTION PATTERNS OF STUDENTS OF THE FACULTY OF FOOD TECHNOLOGY AT THE AGRICULTURAL UNIVERSITY OF CRACOW

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University students food consumption patterns, characterized mainly by an insufficient intake of energy, minerals (for calcium and copper less than 50 per cent of the recommended dietary allowance) and water-soluble vitamins, an appropriate intake of fat-soluble vitamins (A and E), but at the same time an excessive intake of sodium, are typical of and frequently found not only among young people, but also among other groups of the Polish population. The findings of this study confirm the necessity of taking actions aimed at changing young peoples nutritional habits.

INTRODUCTION

The nutritional habits of young people are formed primarily during childhood and adolescence. These two periods have a substantial impact on the attitude to food and nutrition in further life, hence special attention should be paid to the incorrect nutritional habits of age groups such as school children and students. The latter, the majority of whom live away from home, make their own decisions concerning their nutrition and do not always comply with the rules of healthy eating. It cannot be doubted that such decisions depend on individual preferences, financial situation, social conditions and home-formed habits. Thus, conducting nutritional assessment and studies into young people's eating habits may provide a basis for actions aimed at correcting their nutritional choices [Pierzynowska *et al.*, 1998; Świtoniak, 1999; Ostrowska *et al.*, 2000].

The purpose of this research was to assess the degree to which the RDAs for essential nutrients and energy are met by daily diets of young people whose subject of study is food and nutrition. The experiment was carried out in winter when the risk of food deficiencies (vitamin deficiencies in particular) is the highest.

MATERIAL AND METHODS

The assessment was made on the basis of 560 24-h dietary records from seven days of week, of third year students of the Faculty of Food Technology at the Agricultural University in Cracow. The assessment was conducted in the winter of 2002/2003.

Eighty participants, 64 females and 16 males (both groups aged 23–24), were involved in the study. The average body weight was 60 and 70 kg respectively, while the physical activity of all participants was classified as moderate. The subjects under study prepared their meals themselves or ate at home or at a cafeteria – in the latter case only lunches.

Portions and sizes of meals were estimated on the basis of photographs in the Album of Dishes and Foodstuffs of Various Portion Sizes [Szczygłowa *et al.*, 1991] and the household measurements. Personal questionnaires covered, among other things, the participants age and sex, job and physiological condition. On the basis of the collected data, RDA values were established and later they were compared with the actual intake of nutrients and energy.

The energy value and nutrient level of daily diets were calculated using FOOD-2 computer software, developed on the basis of the current Food Composition Tables [Kunachowicz *et al.*, 1998]. The loss of individual nutrients was calculated on the basis of coefficients derived from List No. 10 in FOOD-2. These amounted to: for vitamin C – 55%, for vitamin B_1 – 20%, for vitamin B_2 – 15%, for vitamin PP – 15%, for vitamin B_6 – 10%, for vitamin A – 25%, for vitamin E – 10%, for the remaining nutrients – 10%.

The participants did not receive any additional vitamins or mineral components in the form of supplements.

The intake of protein, vitamins, minerals (except for those itemized below) was compared to the safe level of recommended dietary allowances (RDAs), that of copper – to the lower limit of the safe intake range, while that of sodium and potassium – to the lowest recommended intake [Ziemlański, 2001]. The content of essential amino acids

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was compared with the FAO and WHO recommendations [FAO/WHO, 1991], while the intake of manganese – with the lower limit of the appropriate safe intake range [Recommended..., 1989]. The intake of cholesterol was compared with the acceptable value of 300 mg/person/24 h, and that of fibre – with the value of 30 g/person/24 h [Ziemlański, 2001].

Intake values which differed from the recommended dietary allowances by approx. 10% were classified as adequate.

The results of the study were analysed using one-way analysis of variance. The *a priori* hypothesis that there are no differences in average values between the students from urban and rural areas was verified using the F-Snedecor test at a significance level of $p \leq 0.05$. For male students, this criterion was not taken into consideration due to their small number. The results of the statistical analysis showed that most often there are no significant differences between the average intakes of individual nutrients by female students from urban and rural areas. Therefore the results concerning the female participants' dietary component intake were analysed collectively.

The standard deviation and the coefficient of variation were also determined.

TABLE 1. Nutrient intake in daily diets of male students.

Component	Intake		SD*	CV**	Recommended intake	% of recommended intake		INQ****	%*** .
	Range	$\bar{x}$				Range	$\bar{x}$		
Energy (kcal)	1533–3100	2343	472	20.0	3 000	51–105	70		44
Fat (g)	68–141	100	22.8	23.0	100	68–141	100	1.28	0
Saturated fatty acid (g)	18.1–50.5	33.5	8.9	26.5					
Monounsaturated fatty acid (g)	26.7–61.2	42.2	10.4	24.7					
Polyunsaturated fatty acid (g)	9.7–27.6	16.3	5.5	33.7					
Cholesterol (mg)	233–607	440	109	24.0	300	78–202	147		0
Total carbohydrate (g)	156–421	293	18	25.0	400	39–105	73	0.94	19
Saccharose (g)	5.0–107.0	52.2	26.1	50.0					
Fibre (g)	14.9–34.3	19.7	5.7	29.0	30	50–114	66		63
Total protein (g)	58–120	85	20	23.0	56	103–215	151	1.94	
Animal protein (g)	33.9–83.4	55.5	16.9	30.0	18.6	173–457	283		
Plant protein (g)	18.6–41.9	29.5	5.8	19.5					
Isoleucine (mg/g protein)	45.3–49.3	47.0	9.72	24.3	28.0	162–176	168		0
Leucine (mg/g protein)	71.7–78.3	74.8	15.39	24.2	66.0	109–119	113		0
Lysine (mg/g protein)	55.9–66.9	63.2	13.56	25.2	58.0	96–118	109		0
Meth + Cys (mg/g protein)	36.9–41.1	38.7	3.93	24.0	25.0	148–165	155		0
Phen + Tyr (mg/g protein)	77.4–87.4	80.7	8.89	26.0	63.0	123–139	128		0
Threonine (mg/g protein)	36.5–42.3	39.6	8.19	24.3	34.0	107–124	117		0
Tryptophan (mg/g protein)	11.5–12.8	12.2	2.52	24.3	11.0	105–116	111		0
Valine (mg/g protein)	53.3–58.5	55.3	11.53	24.5	35.0	152–167	158		0
Histidine (mg/g protein)	25.4–29.8	27.3	5.62	24.2	19.0	134–157	144		0
Sodium (mg)*****	1472–5035	2861	959	33.5	575	256–876	498	6.37	0
Potassium (mg)	1391–3936	2447	559	22.9	3500	40–113	70	0.90	38
Calcium (mg)	365–1426	657	289	44.0	1100	33–130	60	0.77	57
Phosphorus (mg)	861–1818	1309	307	23.0	800	108–227	163	2.10	0
Magnesium (mg)	151–441	269	70.9	26.0	350	43–126	77	0.98	25
Iron (mg)	6.9–16.6	11.9	3.0	25.0	11.0	62–150	108	1.39	13
Zinc (mg)	6.3–15.8	11.2	2.9	36.0	14.0	45–113	80	1.02	31
Copper (mg)	0.55–1.75	1.06	0.31	30.0	2.0	28–88	53	0.68	81
Manganese (mg)	1.92–9.89	4.88	1.1	22.5	2.0	96–495	244	2.50	0
Equivalent of retinol (μg)	419–3525	1104	769	70.0	700	59–504	158	2.02	13
Retinol (μg)	275–3422	791	738	93.3					
β–Carotene (μg)	274–6075	1848	1505	81.5					
Vitamin E (mg)	6.9–21.0	12.7	4.16	33.0	10.0	69–210	127	1.63	0
Thiamine (mg)	0.76–1.77	1.21	0.28	23.3	1.8	44–100	67	0.86	50
Riboflavin (mg)	0.9–2.1	1.57	0.37	24.0	2.4	38–88	65	0.84	56
Niacine (mg)	8.9–25.8	15.6	4.04	26.0	21.0	43–123	74	0.95	25
Piridoxine (mg)	0.9–2.3	1.57	0.37	24.0	2.2	41–105	71	0.91	56
Vitamin C (mg)	12.2–83.0	30.0	19.0	63.0	60.0	20–138	50	0.64	81

*– standard deviation, ** – coefficient of variation, *** – percentage of population which meets the recommended intake < 66.7% of its value, **** – Index of Nutritional Quality, ***** – only sodium inherent to food; sodium chloride added during meal preparation was not considered

RESULTS AND DISCUSSION

Energy and basic nutrients

The recommended energy intake levels were not met in the daily diets of both male and female students, and the percentage of subjects receiving two-thirds of the Polish RDA was as high as ≈40% (Tables 1 and 2).

The low energy values of daily diets, as shown in this study, were directly caused by the low intake of total carbohydrates (≈70% of the recommended value in the case of both groups) with as many as 50% of the females and 19% of the males receiving less than 66.7% of the recommended dietary allowance.

The contribution of saccharose in the overall amount of energy supplied by the female students' diets was too high, *i.e.* ≈12.5%, whereas in the male students' diets it was only ≈8.9%. The contribution of saccharose to the total energy supplied by food should not exceed 10% [Ziemiański, 2001]. The high amount of saccharose was caused by the fact that the majority of female (56%) and 37% of male students consumed snacks such as buns, doughnuts, wafers, candy bars, and chocolate.

TABLE 2. Nutrient intake in daily diets of female students.

Component	Intake		SD*	CV**	Recommended intake	% of recommended intake		INQ****	%*** .
	Range	$\bar{x}$				Range	$\bar{x}$		
Energy (kcal)	902–2712	1673	402	24.0	2350	38–115	72		39
Fat (g)	18–110	63	21	32.3	78	23–142	81	1.14	36
Saturated fatty acid (g)	4.6–41.2	21.4	8.7	40.6					
Monounsaturated fatty acid (g)	5.2–46.2	26.6	9.1	34.1					
Polyunsaturated fatty acid (g)	4.5–17.2	10.3	3.2	30.7					
Cholesterol (mg)	57–651	313	132	42.0	300	19–217	104		17
Total carbohydrate (g)	117–400	237	58	24.0	330	36–121	72	1.01	48
Saccharose (g)	5.0–107.0	52.2	26.1	50.0					
Fibre (g)	6.9–26.1	16.0	4.03	25.0	30	23–87	54		91
Total protein (g)	36–84	56	13	23.0	48	75–174	115	1.64	0
Animal protein (g)	17.5–58.8	33.5	10.2	30.0	26.0	67–226	128		0
Plant protein (g)	13.7–42.8	22.6	5.5	24.2					
Isoleucine (mg/g protein)	28.6–51.0	45.9	11.2	24.3	28.0	102–182	164		0
Leucine (mg/g protein)	67.3–86.4	74.6	18.1	24.2	66.0	102–1301	113		0
Lysine (mg/g protein)	52.1–70.6	59.7	15.0	25.2	58.0	90–122	103		0
Meth + Cys (mg/g protein)	23.9–41.4	38.4	8.9	23.1	25.0	96–166	154		0
Phen + Tyr (mg/g protein)	64.1–85.7	79.5	20.7	26.0	63.0	102–136	126		0
Threonine (mg/g protein)	34.7–41.1	38.5	9.4	24.3	34.0	102–121	113		0
Tryptophan (mg/g protein)	11.3–13.2	12.0	2.9	24.3	11.0	103–120	109		0
Valine (mg/g protein)	35.0–59.5	54.6	13.4	24.5	35.0	100–170	156		0
Histidine (mg/g protein)	21.5–38.3	27.0	6.5	24.2	19.0	113–202	142		0
Sodium (mg)*****	662–2741	1633	469	28.7	575	115–477	284	3.99	0
Potassium (mg)	1169–3308	2153	427	19.8	3500	33–95	62	0.86	70
Calcium (mg)	207–1271	496	151	30.0	1100	19–116	46	0.63	94
Phosphorus (mg)	596–1445	902	233	26.0	800	75–181	111	1.58	0
Magnesium (mg)	104–381	215	48	22.0	280	37–136	76	1.08	37
Iron (mg)	5.19–15.50	9.04	2.04	23.0	14.0	37–111	64	0.91	63
Zinc (mg)	4.21–12.0	7.60	1.70	22.0	10.0	42–120	76	1.07	26
Copper (mg)	0.50–1.63	0.88	0.21	24.0	2.0	25–82	44	0.62	98
Manganese (mg)	1.20–7.05	3.88	1.09	28.2	2.0	61–353	194	2.18	4
Equivalent of retinol (μg)	162–2077	803	399	49.0	600	27–346	133	1.88	13
Retinol (μg)	101– 1716	385	299	77.7					
β-Carotene (μg)	262–7027	2491	1572	63.1					
Vitamin E (mg)	4.95–15.0	8.93	2.50	28.0	8.0	62–187	110	1.57	2
Thiamine (mg)	0.37–1.36	0.84	0.22	25.4	1.7	22–80	50	0.69	91
Riboflavin (mg)	0.65–1.72	1.20	0.26	22.0	1.6	41–108	72	1.05	39
Niacine (mg)	5.66–20.6	10.7	2.84	27.0	19.0	30–108	57	0.79	72
Piridoxine (mg)	0.71–1.86	1.20	0.27	23.0	1.8	39–103	67	0.94	50
Vitamin C (mg)	20.4–82.6	35.4	16.5	46.0	60.0	18–138	59	0.83	63

*– standard deviation, ** – coefficient of variation, *** – percentage of population which meets the recommended intake < 66.7% of its value, **** – Index of Nutritional Quality, ***** – only sodium inherent to food; sodium chloride added during meal preparation was not considered

Dietary fibre accounted for as little as ≈66% and 54% of the recommended intake value (30 g/person/24 h) in the male and female students, respectively. The insufficient intake of fibre by both subgroups was related to the small consumption of wholemeal grain products, vegetables and fruit. Dark bread was found in the diets of 38% of the male subjects and 63% of the female subjects, and at the same time the diets of 100% of the female participants and 88% of the male participants did not contain enough vegetables and fruit.

The female diets (as opposed to the male diets) were characterized by a low content of total fat. In this subgroup, the percentage of subjects receiving less than two-thirds of the recommended dietary allowance for that nutrient was also high (36%).

The ratio of saturated : monounsaturated : polyunsaturated fatty acids in the male students' diets was 1.0:1.3:0.5, thus – in terms of the overall percentage of energy from fat – it amounted to 12.7:16.0:6.2%. In the females' daily diets the ratio of the above-mentioned fatty acids was 1.0:1.2:0.5, *i.e.* amounted to 11.3:14.1:5.5% of energy from fat. According to the recommendations, the maximum contribution of saturated fatty acids should not exceed 10% of the overall energy of a diet, whereas for monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) it should be 13% and 6%, respectively (but it can be as high as 9%) [Ziemlański, 2001].

The cholesterol intake of the male subjects exceeded the acceptable value of 300 mg/person/day by 47%, but as far as the females were concerned it met the recommended level [Ziemlański, 2001]. According to reference data, the primary sources of cholesterol in diets are: animal fats and fatty meats [Kunachowicz *et al.*, 1998; Ziemlański, 2001]. Butter, a rich source of cholesterol, was used with bread by 56% of men, while exactly the same percentage of women used soft margarines.

The intake of protein in daily diets of both subgroups met the RDAs and reached 151% RDA in the case of males and 115% RDA in the case of females. The contribution of animal protein in the total dietary protein in male and female diets was 65% and 60%, respectively. All of the male diets and 80% of the female diets included meat and meat products, and at the same time fish was eaten once a week by 69% of men and only 37% of women. As regards the content of essential amino acids in the protein supplied, the FAO/WHO requirements [1991] were fully met for both men and women.

The contribution of fats, carbohydrates and protein to the total energy supplied by male diets amounted to 38.1, 47.1 and 14.8%, whereas in the case of girls this contribution was 33.6, 52.8 and 13.7%, respectively. Thus, in the case of carbohydrates it was too low, and in the case of fats – too high.

The recommended energy intake was not met by the majority of daily diets, as it was also shown by the assessment of food consumption patterns of students from other academic institutions in Poland. Females' diets supplied less energy than males' diets [Pierzynowska *et al.*, 1998; Olędzka *et al.*, 2003]. The data on the energy value of diets collected from the students of the Medical Faculty of the Medical University and the Mechanical Faculty of the Białystok Polytechnic supports earlier findings. Female diets did not met the recommended energy intake, whereas male diets fully met such recommendations [Stopnicka *et al.*, 1999; Świtoniak, 1999; Olędzka *et al.*, 2002].

In the study conducted among university students in Olsztyn and Poznań the opposite tendency was found. The study showed that the energy value of male students' diets was lower and insufficient when compared with female students' diets [Szymelfejnik *et al.*, 2003]. The analysis of food consumption patterns carried out at the Faculties of Horticulture and Human Nutrition of the Warsaw Agricultural University (SGGW) demonstrated that the recommended energy intake was not fully met by their students either [Pierzynowska *et al.*, 1998]. However, the assessment of diets of the students of the Medical University of Gdańsk showed that they meet the energy intake recommendations [Krechniak & Zaborski, 1999].

The energy structure differed from the recommendations to a similar extent as in the study discussed in this paper. It was found that the contribution of fat was too high, that of carbohydrates – too low, and that of protein – generally correct in terms of covering energy requirements [Krechniak & Zaborski, 1999; Stopnicka *et al.*, 1999; Świtoniak, 1999].

The results of an analysis of students' daily diets, as opposed to the results of this study, showed excessive consumption of fats by both female and male students [Krechniak & Zaborski, 1999; Stopnicka *et al.*, 1999; Olędzka *et al.*, 2002 or their excessive consumption by males and nearly appropriate consumption by females [Świtoniak, 1999]. The findings of other researchers indicate low fat intakes which correspond to the fat intakes of the female students who were the subjects of this study [Stopnicka *et al.*, 1999; Szewczyński & Ostrowska, 1999; Olędzka *et al.*, 2002]. In similarity to the findings of this study, the male students of the Medical University in Warsaw were found to fully meet the recommended dietary allowances for fats, while the male students of the Warsaw Polytechnic exceeded them. Female students met such recommendations to a similar degree, receiving 80% of the appropriate amount [Olędzka *et al.*, 2002, 2003].

The total consumption of carbohydrates and fibre by male and female students, as shown by the results of this study, was in most cases unsatisfactory [Szewczyński & Ostrowska, 1999; Ostrowska *et al.*, 2000; Szymelfejnik *et al.*, 2003] or was in keeping with the recommended dietary allowance only among males [Świtoniak, 1999; Krechniak Zaborski, 1999]. The students of the Pharmaceutical Department of the Medical Academy in Warsaw and the Warsaw Polytechnic consumed fibre in sufficient amounts [Olędzka *et al.*, 2002, 2003].

Students fully met the recommendations for protein intake [Stopnicka *et al.*, 1999], as shown in this study, or even exceeded them [Olędzka *et al.*, 2002, 2003; Szymelfejnik *et al.*, 2003]. Some authors reported that female students met just 60–70% of the recommended dietary allowances for protein [Krechniak & Zaborski, 1999; Stopnicka *et al.*, 1999]. According to other literature sources, the recommended dietary allowances for protein intake were met only by male students [Krechniak & Zaborski, 1999; Świtoniak, 1999].

Minerals

Male students satisfied the demand for minerals to a greater extent than female students. Calcium, alongside copper, belonged to the minerals whose content in the diets of both subgroups was the lowest in relation to the recommended dietary allowances. Males received only ≈60% of the recommended dietary allowances for calcium and copper, females – only 46%. As many as 94 of females and 57% of males received less than two-thirds of the safe level of intake for this element. The main cause of such low calcium intake was insufficient consumption of milk and dairy products. Milk and its products such as cheese, yoghurt or kefir were consumed by students three times a week on average. Apart from this main source of calcium, small amounts of this very important element can be supplied by grain products (cereals and wholemeal bread), legumes and vegetables (white cabbage, beetroots and carrots).

The lowest phosphorus intake levels amounted to 108% of the recommended dietary allowances for males, and 75% for girls. The average values were 163% and 111%, respectively. In the diets that have been analySed phosphorus came mainly from meat products, grain products and cheese (especially processed cheese). It was also supplied by soft drinks such as cola, which appeared in the participants dietary recalls and, according to literature, can be an important sources of this mineral [Kunachowicz, 1998; Ziemlański, 2001].

A too low calcium intake and, at the same time, a high phosphorus intake are responsible for the fact that the Ca:P ratio in male and female diets was 0.39:1.0 and 0.42:1.0 respectively. The recommended ratio is 1:1 (or, to be more precise, 1.2:1.0 which equals to 40.0 g Ca:30.9 g P) [Szajkowski, 1996a; Ziemlański, 2001]. The situation when the dietary Ca:P ratio differs considerably from the appropriate value for a long period of time, can be one of the causes of disturbances in calcium-phosphorus metabolism and increase the risk of bone deformation or fracture later in life. A chronic deficiency of calcium may lead to the increase of arterial blood pressure [Szajkowski, 1996a; Ziemlański, 2001].

As regards the intake of copper, 53% of males and 44% of females met the lower range of the recommended intake. At the same time as many as 81% of male students and 98% of female students received less than two-thirds of the recommended dietary allowance for copper.

Zinc intake was similar in the case of both subgroups, and constituted approximately 80% of the recommended dietary allowance.

The above-mentioned zinc intake in combination with the fact that the recommended dietary allowance for copper was only partially met resulted in an unfavourable Zn:Cu ratio for both male and female students which amounted to 10.6 and 8.5 respectively, whereas the preferred value is 6 [Szajkowski, 1996b]. The increased value of the dietary Zn:Cu ratio is conducive to the development of atherosclerotic diseases, whereas the decrease of this ratio prevents the occurrence of such diseases.

The average magnesium intake was ≈70% of the recommended dietary allowances in the case of both groups. Among female students the iron intake was equally low, whereas males received this trace element in satisfactory amounts.

Deficiencies of magnesium may be accompanied by disturbances of many enzymatic and metabolic reactions in the organism. Such metabolic changes may cause, among other things, hypocalcemia and hypokalemia, which in the presence of calcium and potassium deficiency, as shown in this study, might pose additional risks [Hardwick *et al.*, 1991; Miller *et al.*, 2001; Ziemlański, 2001].

The minimum recommended sodium intake was exceeded 5 times by males, and 3 times by female diets. Salt added to meals during preparation was not taken into account.

Too low calcium and copper intakes were also reported by other authors. In their opinion, only 50% of the recommended dietary allowances for female students are met. Among male students, the intake of these minerals is slightly higher, but still unsatisfactory [Świtoniak, 1999; Czapska *et al.*, 2000; Olędzka *et al.*, 2002, 2003; Szymelfejnik *et al.*, 2003; Wądołowska, *et al.*, 2004]. However, some data indicate that the calcium intake by male students meets the dietary recommendations [Krechniak & Zaborski, 1999; Stopnicka *et al.*, 1999]. The intake of other minerals, namely magnesium and iron, was fully satisfied and in the case of magnesium was even twice as high as the recommended dietary allowance for male students. Among female students the intakes of these minerals was lower than the recommended dietary allowances (except for that of phosphorus) [Krechniak & Zaborski, 1999; Olędzka *et al.*, 2002, 2003; Szymelfejnik *et al.*, 2003]. Inadequate intakes of calcium, magnesium, iron, zinc and copper (by female students) has also been pointed out by other authors [Świtoniak *et al.*, 1999].

Vitamins

Consumption of water-soluble vitamins by both males and females was found to be insufficient, and the lowest intake, meeting only half of the recommended dietary allowance was recorded for vitamin C. The inadequate intake of fruit and vegetables rich in vitamin C might have been caused by the fact that the study was conducted in winter, when the intake of these food products is the lowest [Sekuła, 1998].

Chronic deficiencies of vitamin C may cause, among others, disruption of immunological functions of the organism and in winter – the time of the year when the study was carried out – increase susceptibility to colds and infections [Wartanowicz & Ziemiański, 1999].

The average supply of B-group vitamins in students' diets did not meet the safe intake levels. In the case of males ≈70% of the recommended dietary allowances for these vitamins were met. Among females these figures ranged from 50% (thiamine) to 72% (riboflavin). Such a low intake of B-group vitamins was mainly connected, as it was stated above, with the low supply of wholemeal grain products, cereals, milk and its products in students' diets. The main sources of thiamine among the population under study were grain products, then meat and its products and potatoes. The primary sources of riboflavin were milk and its products, meat and its products, and grain cereal products, while the source of niacine were meat and its products, and then grain products and potatoes. An additional source of

B-group vitamins might have been beer as 44% of males and 48% of females declared that they drink it.

For both populations under study the average intake of vitamins A and E fully met the recommended dietary allowances. Inadequate consumption of fruit and vegetables containing β-carotene and high contribution of the rich sources of retinol to the diets of both subpopulations account explain why two-thirds of retinol equivalent in the male students' diets were supplied by retinol and only one--third by β-carotene, while in the female diets each of these sources supplied 50% of the total amount.

The quantitative ratio of α-tocopherol (mg) to polyunsaturated fatty acids (g) should not be lower than 0.6 [Ziemlański, 2001]. Among the male and female students under study, this ratio was 0.78 and 0.87 respectively.

The results of this study are consistent with the findings of other authors, who reported that male students from other academic centers met the recommended intake of vitamin A and E, or even exceeded the recommended dietary allowances [Krechniak & Zaborski, 1999; Stopnicka *et al.*, 1999; Świtoniak, 1999; Olędzka *et al.*, 2002, 2003; Szymelfejnik *et al.*, 2003]. The only exception were the diets of the students of the Higher School of Management and Finance in Białystok, where the intake of vitamin A amounted to 69% of the recommended dietary allowance for males and 55% for females [Stopnicka *et al.*, 1999].

Some literature sources report that the intake of vitamin C by university students is generally higher than the one indicated in our study, yet still below the recommended dietary allowance [Krechniak & Zaborski, 1999; Stopnicka *et al.*, 1999; Świtoniak, 1999; Seidler & Aleksiejewicz, 2001; Szymelfejnik *et al.*, 2003; Wądołowska *et al.*, 2004] while other authors state that it meets or even exceeds such an allowance [Olędzka *et al.*, 2002, 2003].

Likewise, some authors indicated insufficient amounts of B-group vitamins in the diets of students from different academic institutions in Poland [Pierzynowska *et al.*, 1998; Stopnicka *et al.*, 1999; Świtoniak 1999; Seidler & Aleksiejewicz, 2001; Olędzka *et al.*, 2003; Szymelfejnik *et al.*, 2003]. Unlike females, males in most cases met their recommended dietary allowances for B-group vitamins [Olędzka *et al.*, 2002]. According to other sources, females as opposed to males met the recommended dietary allowances for selected B-group vitamins [Krechniak & Zaborski, 1999].

It was reported by Gibson 1990 that in a well-balanced diet the Index of Nutritional Quality (INQ) for protein, all the vitamins and minerals should be higher than 1. The acceptance of this criterion means that male students diets should be changed so as to contain more potassium, calcium, copper and water-soluble vitamins, whereas female students' diet should be supplemented with larger amounts of the above-mentioned nutrients (except for riboflavin) and iron.

The incorrect nutrition observed in this study among university students, characterized by the insufficient energy value of diet, an inadequate intake of minerals, mainly calcium and copper and water-soluble vitamins, and at the same time an adequate intake of fat-soluble vitamins and an excessive intake of sodium, are typical and have been frequently indicated by other authors conducting studies on nutritional habits of not only young people, but also other population groups in Poland.

The variety of food consumption patterns among university students in other countries can be linked to different culinary traditions and eating habits and also the ethnic composition of the population under study. Besides, in different geographical regions characterized by different climate conditions, there may be considerable differences in the consumption of certain food products [Burghardt & Devaney, 1995; Devaney *et al.*, 1995; Gordon & Mc Kinney, 1995; Quiles *et al.*, 1996; Westerterp-Plantega, 1999; Pearcey & de Castro, 2002].

The results of this study confirm the necessity of taking actions aimed at changing the nutritional habits of young people. The application of the Diet Quality Index-International (DQI-I) to the study of sufficiently large populations would make it possible to compare the Polish nutritional patterns with those of other countries and to develop a common programme (programmes) of public health improvement [Kim *et al.*, 2003].

CONCLUSIONS

According to the Index of Nutritional Quality, diets of female students were well-balanced in terms of the content of basic nutrients, phosphorus, magnesium, zinc, manganese, vitamins A and E and riboflavin in relation to their energy value, while the diets of male students also in terms of the content of iron and the above-mentioned nutrients with the exception of carbohydrates and riboflavin. The incorrect eating habits, which have been pointed out in this study, such as too low intakes of calcium, copper, vitamin C and B-group vitamins, are similar not only to the nutritional faults made by students from other academic institutions, but also by other population groups in Poland.

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OCENA SPOSOBU ŻYWIENIA STUDENTÓW WYDZIAŁU TECHNOLOGII ŻYWNOŚCI AKADEMII ROLNICZEJ W KRAKOWIE

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Sposób żywienia młodzieży akademickiej, polegający głównie na niedostatecznym spożyciu energii, składników mineralnych (w przypadku wapnia i miedzi 50% normy) i witamin rozpuszczalnych w wodzie, równocześnie właściwym spożyciu witamin rozpuszczalnych w tłuszczach (A i E), ale nadmiernym sodu, jest typowy i często stwierdzany w ocenie sposobu żywienia nie tylko młodzieży, ale i innych grup populacyjnych w Polsce (tab. 1 i 2). Uzyskane w niniejszej pracy wyniki potwierdzają konieczność podejmowania działań zmierzających do zmiany nawyków i zwyczajów żywieniowych młodzieży.