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FOOD PREFERENCES OF GIRLS AND NUTRITIONAL VALUE OF DIETS AND THEIR EFFECT ON ORGANISMS OF RATS IN TERMS OF RISK OF OBESITY AND ATHEROSCLEROSIS

PREFERENCJE POKARMOWE DZIEWCZĄT A WARTOŚĆ ODŻYWCZA DIET I ICH WPŁYW NA ORGANIZM SZCZURÓW W ASPEKCIE ZAGROŻENIA OTYŁOŚCIĄ I MIAŻDŻYCĄ

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The study was conducted on 28 growing female Wistar rats, fed ad libitum for 84 days with four different diets. The diet intake, feed efficiency, weight/length ratio, serum TG, TC and HDL-C levels were determined. Results were verified statistically using one-way ANOVA and the Scheffe test. The poor preferred diet with predominating fruit and vegetables, in comparison to the rich preferred diet, containing sweets, lowered the risk of obesity and atherosclerosis.

Key words: preferences, diets, obesity, atherosclerosis, rats
Słowa kluczowe: preferencje, dieta, otyłość, miażdżyca, szczury

INTRODUCTION

The diet of individual people to a considerable degree depends on non-economic factors, including food preferences [3]. Results of studies confirm a statistically significant correlation between preferences for different foodstuffs and the frequency of their consumption [8, 9, 18]. This suggests that they may constitute an indicator, with which it should be possible to predict food consumption with high probability.

Young people are a group of special concern, as their nutritional mistakes may not only affect their growth and pubescence, but may also be connected with long-term implications for health in future life and increase the incidence of diet-dependent diseases. It may be observed that a too hedonistic attitude and indulging in one's eating requirements does not promote a variation in the diet and may cause negative effects to one's health [10, 16, 20]. Thus the aim of the study was to determine the effect of eating diets based on foodstuffs preferred by girls aged 13-15 years on organisms of rats in terms of risk of atherosclerosis and obesity.

MATERIALS AND METHODS

The study was conducted on 28 growing females of *Wistar* rats, aged approx. 6 weeks, coming from a breeding farm of laboratory animals in Brwinowo (opinion no. 47/2003 of the Regional Commission on Ethics in Experiments on Animals). Experiments were conducted on animals under natural lighting conditions, with relative humidity of 55-60% and temperature of 19-22°C.

Rats were divided into four groups, which were fed ad libitum four different diets for 84 days. Among the diets two were preferred and two were comparative.

The starting points in the development of preferred diets were some of the results obtained within the framework of research project no. 6 P06G 01520 of the Ministry of Science and Higher Education. The information, supplied by 785 girls aged 13-15 years, concerned their food preferences in relation to 144 products from the following groups: cereals, vegetables, fruit, dairy products, meat products, fish and eggs, as well as fats and sweets. The first step in designing the preferred diets was to conduct factor and cluster analyses, which made it possible to establish four models of food preferences of girls [6]. Next for each product arithmetic and modal means were calculated for the degree of liking and the distribution of the sample was determined depending on the degree of liking of these products, thanks to which products liked very much were identified. These calculations were performed for all the examined products and the four subgroups of girls from individual clusters, obtaining in this way assortment lists of products for five preferred diets. After analyzing the assortment composition of all the preferred diets two were selected for experiments on rats. The first was characterized by moderate variation, as it contained 5 vegetables, 18 fruits, 1 dairy product and 1 meat product, thus it was called "preferred poor" (PP). The other was definitely more diverse, as it contained 1 cereal product, 6 vegetables, 19 fruits, 4 products from the group of meat products, fish and eggs, as well as 6 products from the group of sweets, thus it was referred to as "preferred rich" (PR).

The last stage in the development of preferred diets was to establish the amounts of individual products, which was based on the recommended model food ration for girls aged 13-15 years [24]. This ration was also the basis in designing one of the comparative diets, which was called "recommended" (R). When determining the assortment of products in individual groups of products for the recommended diet, data on the contents of energy and nutrients in foodstuffs were applied and it was attempted to ensure its highest possible variation. The other comparative diet was pelleted maintenance feed for laboratory animals Labofeed B (LB) produced by a feed producer Wytwórnia Pasz in Kcynia.

Products for both preferred diets and the recommended diet were purchased in retail stores. Vegetables and fruit were bought fresh or frozen. Diets were prepared from raw products, weighing their edible parts. Ready diets were lyophilized in „Celiko", Poznań. The form of the diets after lyophilization was similar to LB feed, which is produced as pellets with the diameter of 12 mm and length of 10-20 mm.

In all diets contents of dry matter, protein, fat and ash were determined using standard methods. Moreover, content of total dietary fiber, soluble and insoluble fractions, were determined using the enzymatic method [2]. When calculating the metabolizable energy of the diets, contents of total fiber were subtracted from the total carbohydrate content and next energy from soluble dietary fiber was taken into consideration (8.37 kJ/g). Energy and nutritive values of dry matter in the diets are presented in Table I.

Table I. Energy and nutritive value of dry matter of diets (x±SD)

Parameter	Experimental group			
	LB	R	PP	PR
Energy (MJ/100 g)	1.25	1.68	1.46	1.71
Protein (%)	22.50±0.07	16.35±0.17	14.62±0.65	15.85±0.17
Energy from protein (%)	30.1	16.3	16.7	15.6
Fat (%)	2.57±0.06	9.02±0.11	1.96±0.19	10.30±0.94
Energy from fat (%)	7.8	20.2	5.0	22.7
Carbohydrates (%)	68.41	71.25	78.40	70.28
Energy from carbohydrates (%)	62.1	63.5	78.3	61.7
Dietary fiber (%)	24.60±0.02	8.95±0.39	11.22±0.41	8.77±0.37
Insoluble fiber (%)	19.48±0.14	6.11±0.47	8.54±0.84	5.90±0.76
Soluble fiber (%)	5.12±0.12	2.84±0.27	2.68±0.45	2.87±0.39
Crude ash (%)	6.51±0.26	3.38±0.08	5.03±0.14	3.57±0.05

LB – Labofeed B, R – recommended, PP – preferred poor, PR – preferred rich

After the completion of the planned feeding period and 12-h fasting animals were put down by intraperitoneal injection of thiopental and weighed, their length from the base of the tail was measured and blood was collected from the heart. After the blood was centrifuged levels of triglycerides (TG) and total cholesterol (TC) in the serum were determined using enzymatic methods, while HDL cholesterol level (HDL-C) was determined after previous isolation of LDL and VLDL cholesterol using phosphotungstic acid and $MgCl_2$. Results were verified statistically using one-way analysis of variance and in order to assess differences between groups the Scheffe test was applied.

RESULTS AND DISCUSSION

As it was indicated by results in Table II, the type of diets had a significant effect on their consumption by rats. The highest consumption was observed in rats from the Labofeed B group, a significantly lower in animals receiving preferred diets (poor and rich), while the lowest in rats receiving the recommended diet. Due to the different energy values of individual diets energy intake by rats varied slightly. The highest energy intake was found for animals receiving the rich preferred diet, as they were fed the diet with the highest energy value. In turn, the lowest energy intake was found in animals receiving the recommended diet, since the consumption of this diet was definitely the lowest.

Body weight gain and the ratio of weight to body length of rats, adopted as an approximate index of adipose tissue development, were significantly dependent on the type of the applied diet. The highest values of both parameters were observed in rats fed the rich preferred diet, containing sweets. In contrast, the lowest values of these parameters were recorded in rats fed the recommended diet, based on the model food ration for girls aged 13-15 years. Results suggest that the rich preferred diet promoted obesity, while the recommended diet reduced the risk of this disorder. No significant differences were found in the efficiency of feeding the analyzed diets, expressed in body weight gain per a unit of metabolizable energy intake.

The type of diet had a significant effect on triglyceride level, total cholesterol content and percentage of total cholesterol connected with the HDL fraction (HDL-C/TC). Mean values of TG and TC were highest in rats fed the Labofeed B diet, while the lowest in animals receiving

Table II. Feed intake and feed efficiency and serum lipid levels in rats (x±SD)

Parameter	Experimental group				p
	LB	R	PP	PR	
Feed intake (g dm/84 d)	1931±170^{c}	1286±199^{a}	1596±138^{b}	1558±67^{b}	<0.0001
Energy intake (MJ/84 d)	24.1±2.1^{ab}	21.6±3.3^{a}	23.4±2.0^{ab}	26.6±1.1^{b}	<0.01
Body weight gain (g)	202.3±28.7^{ab}	155.9±39.4^{a}	182.4±18.9^{ab}	215.8±24.7^{b}	<0.01
Feeding efficiency (g/MJ)	8.4±0.8	7.1±0.8	8.0±1.3	8.1±1.0	ns
Weight/length ratio (g/cm)	13.6±1.4^{ab}	12.7±1.7^{a}	13.3±0.5^{ab}	14.8±0.7^{b}	<0.01
TG (mmol/L)	0.80±0.09^{b}	0.51±0.06^{a}	0.66±0.10^{ab}	0.73±0.14^{b}	<0.001
TC (mmol/L)	2.25±0.25^{b}	1.68±0.18^{a}	1.78±0.22^{a}	1.83±0.28^{ab}	<0.01
HDL-C (mmol/L)	1.12±0.14	0.92±0.12	1.01±0.09	0.95±0.14	ns
HDL-C/TC (%)	49.7±1.7^{a}	55.0±3.9^{ab}	57.0±4.0^{b}	52.2±4.6^{ab}	<0.05

LB – Labofeed B, R – recommended, PP – preferred poor, PR – preferred rich, mean values denoted with different letter inscriptions differ significantly

the recommended diet. High blood TG and TC contents were also recorded in rats fed the rich preferred diet, while their low levels were reported for rats fed the poor preferred diet. In turn, the highest HDL-C/TC value was observed in animals receiving the poor preferred diet, in contrast to rats fed the Labofeed B diet. Results indicate that the Labofeed B diet, characterized by high contents of protein, probably casein, promotes arthrosclerosis. In contrast, the poor preferred diet may be defined as preventing atherosclerosis. The diet contains the lowest amounts of fat and protein, as the dominant products were fruit and vegetables. The rich preferred diet and the recommended diet may be ascribed analogous names (promoting and preventing atherosclerosis), with their antagonistic action on blood lipid parameters not being so strongly manifested. Only HDL cholesterol concentration was similar, irrespective of the feeding method. It needs to be emphasized that this parameter, in contrast to the percentage of HDL cholesterol, is not very useful in the interpretation of the effect of nutritional factors on the organism in terms of risk of atherosclerosis. This pertains also to studies on rats, although these animals have a different blood lipid profile than humans, with markedly higher amounts of HDL lipoproteins.

No obvious conclusions arise from a review of literature on the effect of nutritional factors on blood lipid indexes, although the number of studies concerning this problem is very high. This makes it difficult to formulate opinions and to interpret results, mainly due to the contradictory nature of results and opinions of many authors [7, 12, 15, 21]. Individual differences in the reaction of the organism to diet composition also need to be emphasized. Some animals react with strong hypocholesterolemia to the presence of unsaturated fats, soy protein, starch and pectins, in comparison to saturated fats, casein, sucrose and cellulose, while others under the same conditions do not exhibit any or only a slight decrease in blood serum cholesterol level [5]. Another crucial problem are mutual interactions between different components of the diet [13, 17, 23]. This explains all the complexity of the reactions of the organism to food and difficulties in the interpretation of results connected with

it. Thus, the high TG and TC levels found in this study in blood of rats fed the Labofeed B diet, containing the highest amount of total dietary fiber, is not easy to explain. On the other hand, results are not so controversial if we take into account the considerable share of insoluble fiber in this diet, as well as the above mentioned high protein content. The effect of fiber on the concentration and distribution of cholesterol in blood is still currently investigated. It was shown in many studies that blood lipid level depends among other things on such factors as the initial blood cholesterol level, individual reactivity of a given human or animal, the dose and form of fed dietary fiber and the type of consumed diet [1, 4, 11, 14, 19, 22].

CONCLUSIONS

The poor preferred diet with predominating fruit and vegetables, in comparison to the rich preferred diet, containing sweets, lowered the risk of obesity and atherosclerosis. The recommended diet, based on the model food ration for girls aged 13-15 years, lowered the risk of these diseases too.

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Summary

The study was conducted on 28 growing female *Wistar* rats, fed *ad libitum* for 84 days with four different diets: preferred poor, preferred rich, recommended and Labofeed B. The diet intake, feed efficiency, weight/length ratio, serum TG, TC and HDL-C levels were determined. Results were verified statistically using one-way ANOVA and the *Scheffe* test. The poor preferred diet with predominating fruit and vegetables, in comparison to the rich preferred diet, containing sweets, lowered the risk of obesity and atherosclerosis. The recommended diet, based on the model food ration for girls aged 13-15 years, lowered the risk of these diseases too.

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Streszczenie

Badania zrealizowano na 28 rosnących samicach szczurów rasy *Wistar*, które żywiono 4 dietami *ad libitum* przez 84 dni: dwiema preferowanymi (ubogą i bogatą) oraz dwiema porównawczymi (zalecaną i Labofeed B). Określono spożycie i wykorzystanie paszy przez zwierzęta, wskaźnik masa/długość oraz oznaczono poziom: TG, TC i HDL-C. Weryfikację statystyczną wyników przeprowadzono jednoczynnikową ANOVA i testem *Scheffego*. Dieta preferowana uboga, w której dominowały owoce i warzywa, w porównaniu do diety preferowanej bogatej, zawierającej w swoim składzie słodycze, zmniejszała ryzyko rozwoju otyłości i miażdżycy. Dieta zalecana, oparta o modelową rację pokarmową dla dziewcząt w wieku 13-15 lat, również zmniejszała ryzyko rozwoju tych chorób.

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