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THE ROLE OF VEGETABLE NUTRITION SOURCES IN THE PREVENTION OF CIVILIZATION DISEASES

Summary

Authors identified nutritional and clinical risks and investigated their effect on population health in Slovakia within more than the last 40 years. The results were supported by nationally representative, nutrition researches conducted on more than 20 000 people. Simultaneously, the following factors were studied: average lipid blood levels; prevalence of dyslipidaemia, obesity, diabetes mellitus (DM) and colorectal carcinoma in Slovak Republic; and the results of 4 dietetic tests (pectin + ascorbic acid, essential phospholipids, powder from *Pleurotus ostreatus*, and flavonoid preparation). As a result some improvement measures were suggested for the population in terms of nutrition, some regulation changes were proposed in food and nutritional policy, and finally some proposals were addressed to food processors.

Key words: food consumption, nutritional value, cholesterolemia, triacylglycerolemia, nutritional policy

In the population of developed countries of a high living standard, the health statistics from the last 3 decades show a gradual decrease in the death rate in a group of so called civilisation diseases, while in Slovakia an opposite tendency is observed [6]. The data obtained in this country from two years confirmed the latter tendency (Tab. 1). In this population the death rate from cardiovascular diseases (1st place) was 52,3% and 54,5% in the years 1993 and 2004, respectively, while at the same time from carcinogenic diseases (2nd place) it was 20,9% and 23,3% [1, 22, 23]. Taking the above into account more attention should be paid to draft proposals and food management as well as to nutritional policy realised in the Slovak population. The aim of this study was to suggest some changes in this area.

Because, the relevance of preventive influence of nutrition at cardiovascular diseases in an extent of possible 2/3, and at some carcinogenic 50% of participation in

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protective effect, we consider therewith as fully well-founded to pay appropriate attention to the analysis of consumption situation and selected health characteristic development, and at the same time to refer to their scientifically verified mutual relations [9, 13].

The biological conditionality of this association is represented by the reality that, on the one hand, the human organism forms a complicated bio-energetic system with many requirements of nutrition, on the other hand, these are satisfied just by food which represent an integrating factor between outer and internal environment of human – his intermediate metabolism.

As an introduction to illustration of the overall level of the consumption situation of the Slovak Republic (SR) population, we want to stare at the structure of its sources.

The overall food consumption in the SR accounts 594 kg/citizen/year in 2006, and from this 358 kg/citizen/year is of plant origin. Consequently, it is 60,3% of the overall nutritional ration of population, and by this plays a significant role. In the following survey we shall investigate how food acquit of several functions at SR population in long-time development of consumption. Figures 1 and 2 illustrate the development of nutritional factors in years 1964 - 2004 for average consumer/day of food consumption in SR [17, 19, 21]. The data were expressed as the percentage of recommended nutritional ration (RNR) fulfilment. It results from a long-time application of unbalanced nutrition conditions what is characterised by permanent redundancy of fats and proteins, while the energy supply favourably nears to the recommended nutritional ration in SR in the zone of $\pm 7\%$ in last years [12, 20]. But at the same time it is about permanently insufficient intake of nearly all vitamins, the most expressive for vitamins C and B₂, and of mineral matter for calcium, what is related with the alarming low consumption of milk and its products.

Although the similar development in consumption of various foods is observed, when comparing to their recommended consumption in SR [16], the data mostly refer to unfavourable redundancy (Fig. 3). On the other hand, insufficient consumption of several important food commodities such as fish or poultry is referred. It relates also to a serious drop in milk and its products (except of sour-milk) consumption. This, in turn, causes an unfavourable situation especially from the viewpoint of the requirements of optimal development of rising generation and other groups of the population. Real conditions are thereby created for broadening of osteoporosis, which according to WHO represents one of the most serious health risk during this century for the inhabitants in developed countries [15, 24]. The low consumption of vegetables, fruits, potatoes and legumes is also permanently unfavourable (Fig. 4). When accompanied by decreasing consumption of cereals, apart from shortness of several important nutritional factors (vitamins and minerals), it leads to a low intake of dietary fibre, with several protective effects against expansion of some civilisation diseases [3].

The above consumption pattern and its effect on the universal health characteristics strongly affects the reasons of population mortality (Tab. 1) and the mean life span (Fig. 5) that for inhabitants of Slovakia is from 5 up to 7 years shorter than for people living in western European Countries.

Table 1

Reasons of Slovak Republic population mortality in 2004 year.
Przyczyny śmiertelności w Republice Słowackiej w 2004 roku.

Order L.p.	Classification groups of diseases Klasyfikacja według grup chorób	[%]
1.	Cardiovascular diseases Choroby układu krążenia	54.5
2.	Carcinogenic diseases Choroby nowotworowe	23.3
3.	Injuries, poisonings and other results of outer causes Zranienia, zatrucia i inne powodowane czynnikami zewnętrznymi	5.9
4.	Diseases of respiratory system Choroby układu oddechowego	5.7
5.	Diseases of digestive system Choroby układu trawiennego	5.4

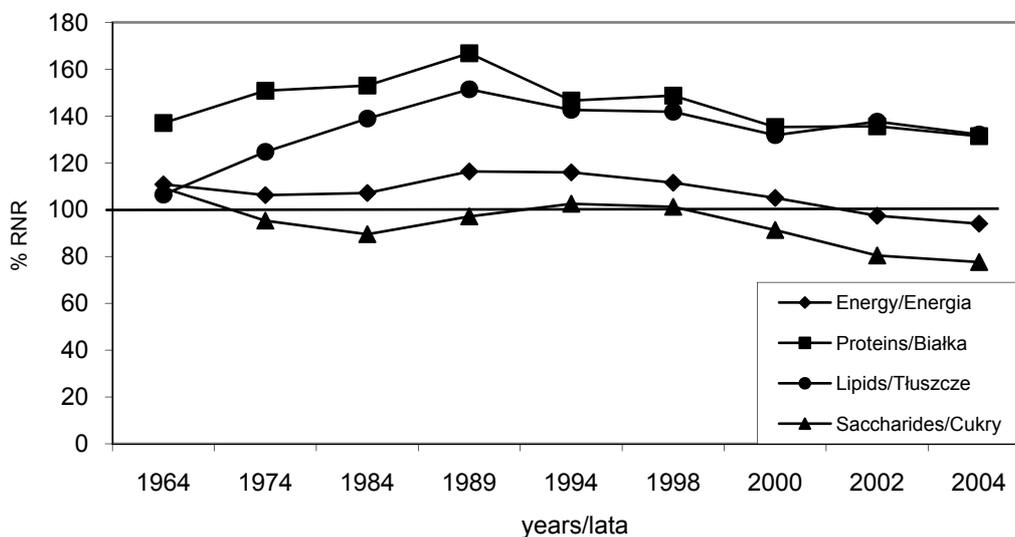


Fig. 1. Development of nutritional factors in Slovak Republic for a consumer per day in years 1964-2004 (% fulfilment of recommended nutritional ration [% RNR]).

Rys. 1. Zmiany konsumpcji składników żywności wśród obywateli Słowacji w latach 1964-2004 (% wykorzystania zalecanej racji pokarmowej [% RNR]).

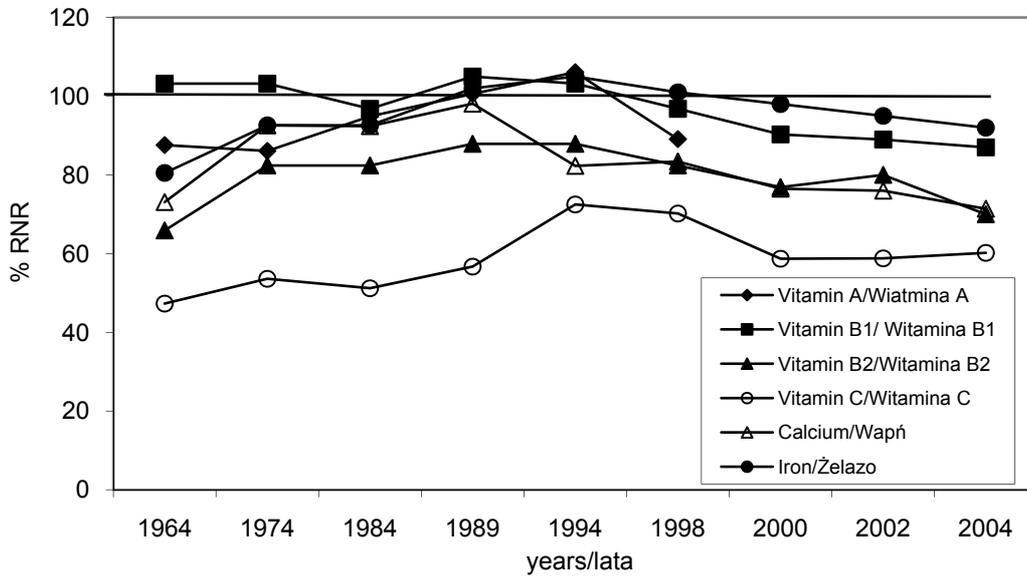


Fig. 2. Development of nutritional factors in Slovak Republic for a consumer per day in years 1964-2004 (% fulfilment of recommended nutritional ration [% RNR]).

Rys. 2. Zmiany konsumpcji składników żywności wśród obywateli Słowacji w latach 1964-2004 (% wykorzystania zalecanej racji pokarmowej [% RNR]).

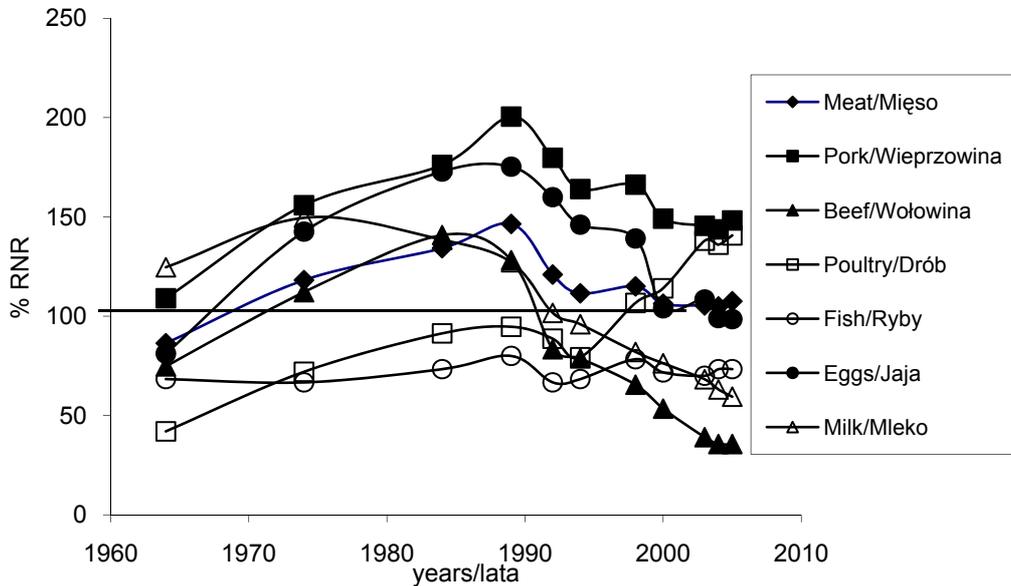


Fig. 3. Development of animal origin food consumption by Slovak Republic population in years 1964 – 2005 (% fulfilment of recommended nutritional ration [% RNR]).

Rys. 3. Zmiany konsumpcji żywności pochodzenia zwierzęcego wśród obywateli Słowacji w latach 1964-2005 (% wykorzystania zalecanej racji pokarmowej [% RNR]).

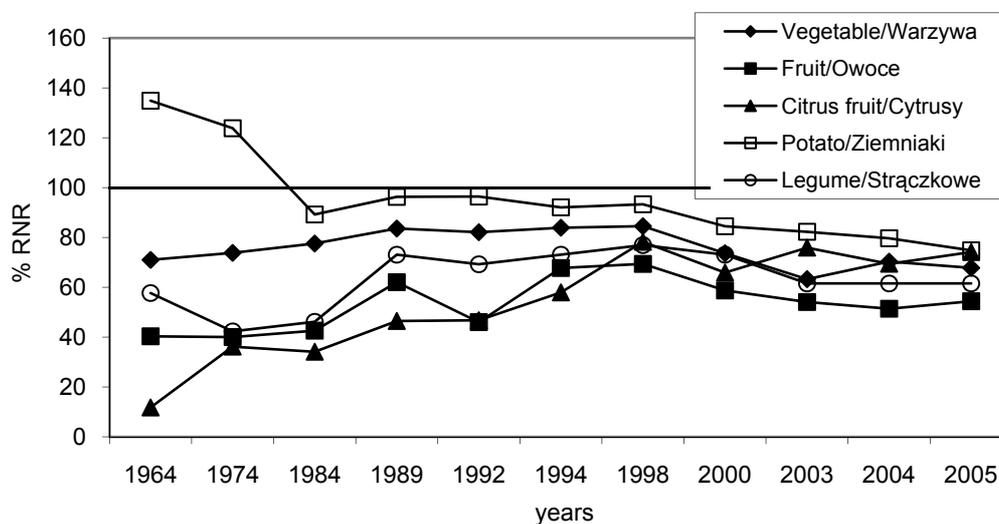


Fig. 4. Development of plant origin food consumption by Slovak Republic population in years 1964 – 2005 (% fulfilment of recommended nutritional ration [% RNR]).

Rys. 4. Zmiany konsumpcji żywności pochodzenia roślinnego wśród obywateli Słowacji w latach 1964-2005 (% wykorzystania zalecanej racji pokarmowej [% RNR]).

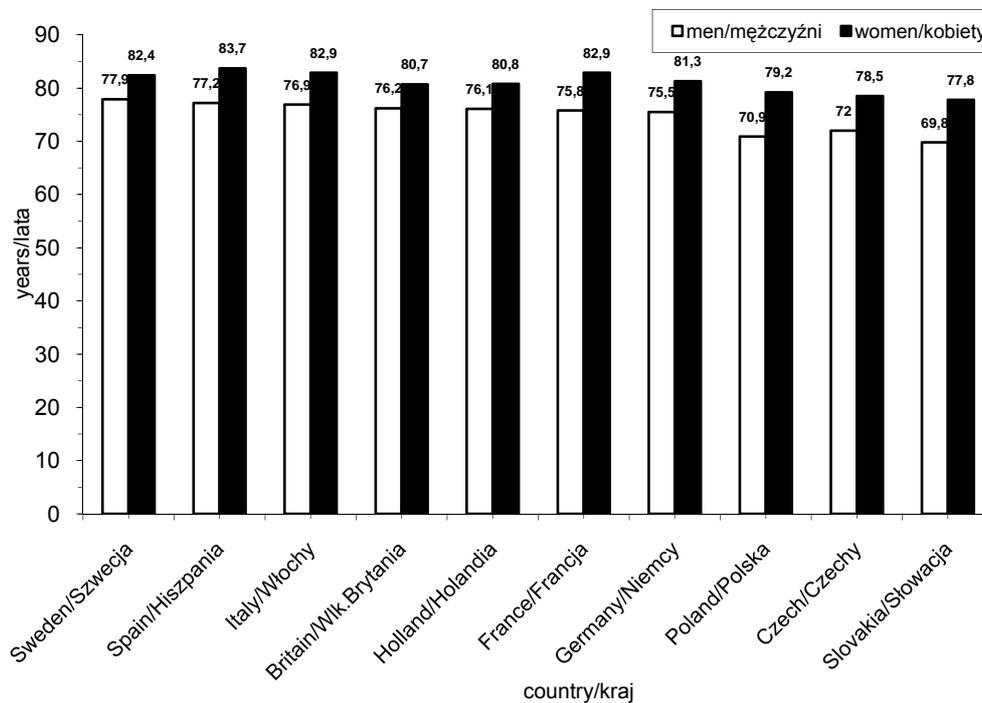


Fig. 5. Mean life span of population in selected countries of European Union in year 2004.

Rys. 5. Średnia długość życia w populacjach wybranych krajów Unii Europejskiej w 2004 r.

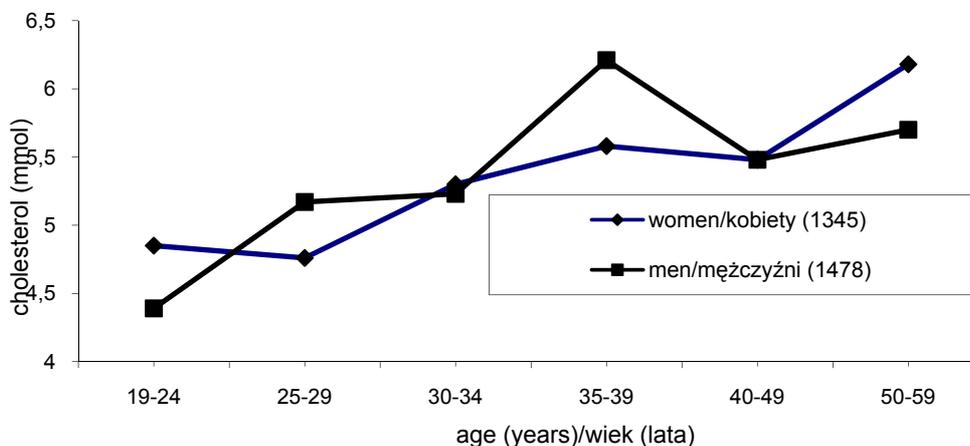


Fig. 6. Average cholesterolemias at Slovak Republic of women and men (n = 2823 from nationwide research of nutrition in years 1983-1989).

Rys. 6. Średnie wartości cholesterolemii w grupie kobiet i mężczyzn (n = 2823) uzyskane w badaniach żywieniowych przeprowadzonych na skalę krajową w latach 1983 – 1989 w Republice Słowackiej.

Dyslipidemy characterised by increased amount of cholesterol, especially of fraction LDL-cholesterol and triacylglycerols in serum together with arterial hypertension, defects of glucose tolerance and cardiovascular diseases accounts about 25% prevalence at SR population, while in USA population it is 30–35% [4, 15, 23].

Because average levels of cholesterol in blood serum represent, at abnormal values, an important indicator of prevalence risk of atherosclerosis and its clinical manifestations [6, 8, 10, 13, 18] we illustrate the data obtained at a representative nationwide research [11] in figure 6. What results of them it is a different sexually conditioned risk for men at the age of 35–40 years and for women 50 years and more. Prevalence of serum HDL-cholesterol decreased values shows, together at both sexes, evident dependence on age, more markedly at women.

Considering the combination of mentioned risk factors, in Slovakian population the most frequent finding presents an increased amount of triacylglycerols and at the same time decreased values of HDL-cholesterol in serum [11].

It is necessary to mention that the hyperlipoproteinemy HLP prevalence (3 types – 2 isolated and 1 combined) in Slovakian productive-age population equals as average 20% with the dominance of men, while in post-productive age as 25% of population with the dominance of women. The average HLP prevalence at children and youth group shows 8–10%.

Although hypertension only partly relates to nutrition, we present data of its prevalence with the regard to its participation in metabolic syndrome. In the younger-

age group it is ca 6–8%, in the middle-age ca 20%, with the dominance of men and for the people in post-productive age (mainly women) about 50% and more [2, 11].

An important risk factor of health standard shows the prevalence of obesity and associated complications in population [8, 17]. Within 4 decades its prevalence in the group of children tends to increase of about 4% (in average), what, in European context, is a very favourable dynamics observed to more extend in a group of girls than boys. As there is a lack of recent data on preobesity, the trend of obesity development in adults is presented in comparison with the relative findings of clinical obesity prevalence ($\text{BMI} \geq 30 \text{ kg/m}^2$). This reveals the stabilisation of its extension in the last years in this group of SR population, again as at children with prevalent extension at women, and with marked dependence on age (Fig. 7). Although these data are a bit lower as its prevalence with about 1/3 of USA population [7], it is fully justifiable the introduction of complex measures of its primary prevention from child age with significant partnership of food industry.

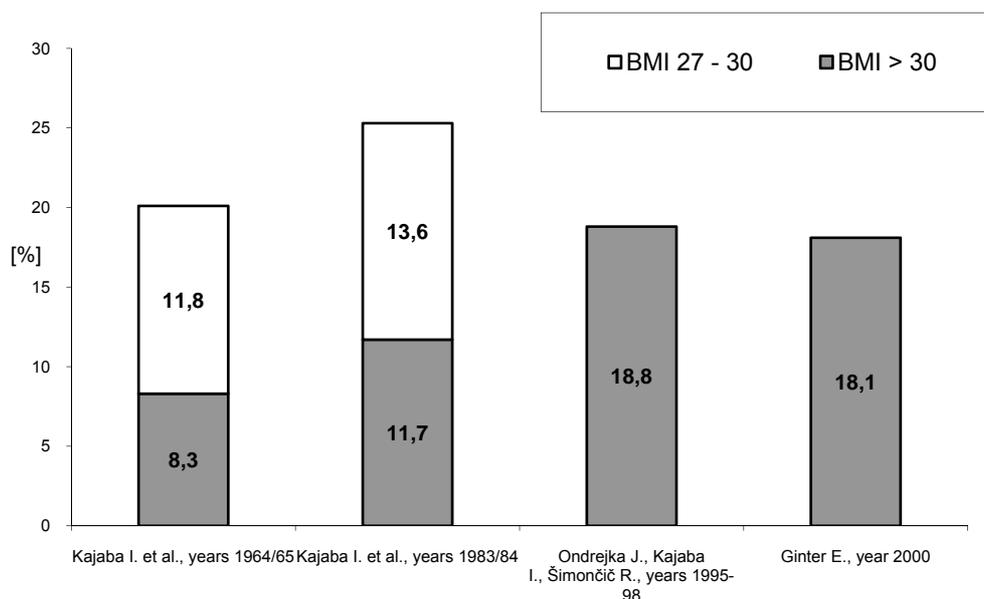


Fig. 7. Development of obesity prevalence at Slovak Republic adult population (women and men) at the age of 19 - 75 years.

Rys. 7. Zmiany w występowaniu otyłości w odniesieniu do osób dorosłych w wieku 19-75 lat w populacji słowackiej.

It has also been shown the problem of diabetes mellitus (DM) 1st type in young generation that testifies the unfavourable increase in the number of diabetics among children and youth in the SR. The increasing trend of diabetes mellitus in the adult population is revealed by an increase in average prevalence from 2,5% in year 1980 to

5,3% in year 2005, with extension dominance at women. As to structure of DM types in adults, this shows a share of about 10% of the 1st type and 90% of the 2nd type. It is necessary to complete that approximately 85% of DM 2nd type is at the same time corpulent that is important not only at cure but also at DM prevention.

Table 2 presents the importance of extension of chronic carcinogenic diseases significantly depending on nutrition. Trend of colorectal carcinoma in Slovak population illustrate a 71% rise of death rate of mentioned diagnosis, mainly at men compared to women, which testifies in years 1985–2005. Generally, it can be stated that civilisation diseases are in the last years a cause of some above 3/4 of all death in SR population, what invokes the acute request for an effective prevention against their spreading in population, including the application of goal-directed measures in nutrition. Also, the results of our clinical studies of secondary prevention directed at persons with combined form of hyperlipoproteinemy are suggestive for food producers. The influence of natural components of diet was tested in a selected group of patients with primary dyslipidemy, who were monitored during 4 till 6 weeks in terms of the expected hypolipidemic effect. The results of this research are shown in the figures 8–10.

Table 2

Death rate of Slovak Republic population according to sex in the group of carcinogenic diseases (NCZI).
Współczynnik śmiertelności w Republice Słowackiej w grupie chorób nowotworowych z podziałem na płeć.

Order L.p.	Classification groups Grupy klasyfikacyjne	[%]
Women / Kobiety		
1.	Malignant breast tumors Złośliwy rak piersi	17.5
2.	Non-melanoma skin tumors and others Nowotwory skóry inne niż czerniak	17.0
3.	Colorectal tumors Rak jelita grubego	11.7
4.	Tumors of female genitals Rak kobiecych narządów rodnych	11.5
Men / Mężczyźni		
1.	Tumors of windpipe, bronchi and lungs Rak tchawicy, oskrzeli i płuc	15.6
2.	Colorectal tumors Rak jelita grubego i odbytnicy	15.0
3.	Non-melanoma skin tumors and others Nowotwory skóry inne niż czerniak	14.8
4.	Tumors of prostate Rak prostaty	8.9

The figure 8 refers to the hypocholesterolemic ($P < 0,001$), hypotriacylglycerolemic ($P < 0,02$) and HDL cholesterol stabilising effect of the apple-pectin with vitamin C. In this experiment 20 g of the apple pectin of esterification degree $>67\%$ was used with the addition of 300 mg of vitamin C in tablets/daily for the support of cholesterol catabolism in a liver. With an aim to refer the effect of feeding with pectin on the cholesterol in gastrointestinal system (GIS), we monitored its waste and cholesterol derivatives in excrement at both penultimate and the last day of the 4 weeks tests. The obtained results proved their increased secretion from organism as an effect of the pectin addition. We monitored for comparison also the secretion and balance of the basic representatives of vegetable sterols, at which pectin did not influenced their secretion in excrement, whereby the confirmed positive balance testifies their detention in organism. At observed difference, it is possible to suppose prevalent bond of pectin with cholesterol, as with vegetable sterols in small intestine and thereby it's decreased resorption.

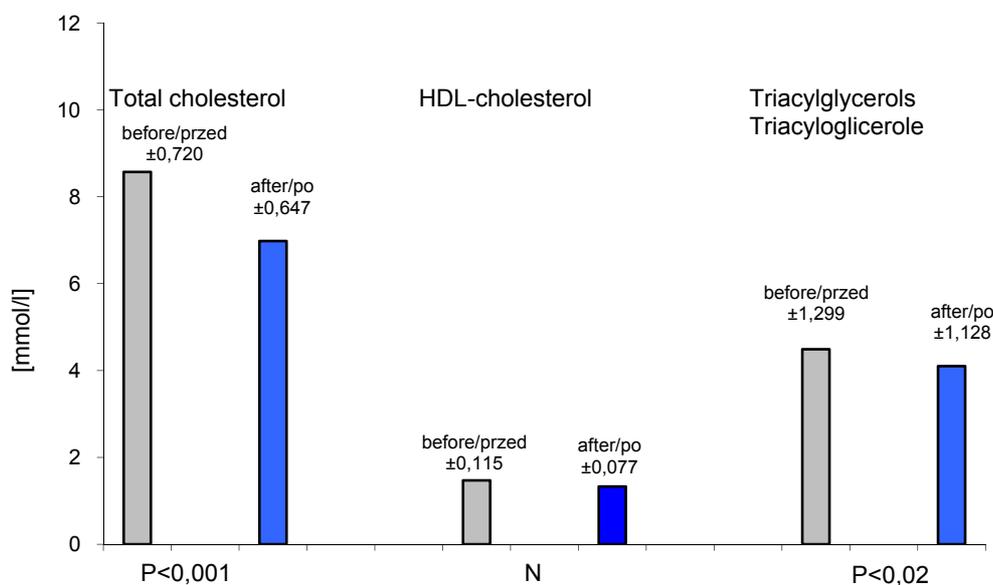


Fig. 8. Effect of daily consumption of 20 g powdered pectin and 300 mg vitamin C at people with combined HLP during 4 weeks ($n = 27$; age = 46.5 years).

Rys. 8. Wpływ 4-tygodniowego, codziennego podawania 20 g sproszkowanej pektyny i 300 mg witaminy C na osoby ze złożoną hiperlipoproteinemią ($n = 27$; wiek = 46.5 lat).

Figure 9 depicts the result of feed with essential phospholipids consumption (1500 mg/daily during 4 weeks) by people with HLP. Besides generally hypolipidemic effect a significant increase of HDL cholesterol level in serum ($P < 0,01$) can be observed, what is important from the point of view of effective nutritional prevention of atherosclerosis.

The most spread flavonoid from the group of flavonols is quercetin. Its a richest domestic source is an onion, where it is found in form of glucosides, as quercetin – 4 glucosid and 3, 4 diglucosid, which are biologically the most effective, and also oats which is also characterised by its rich content.

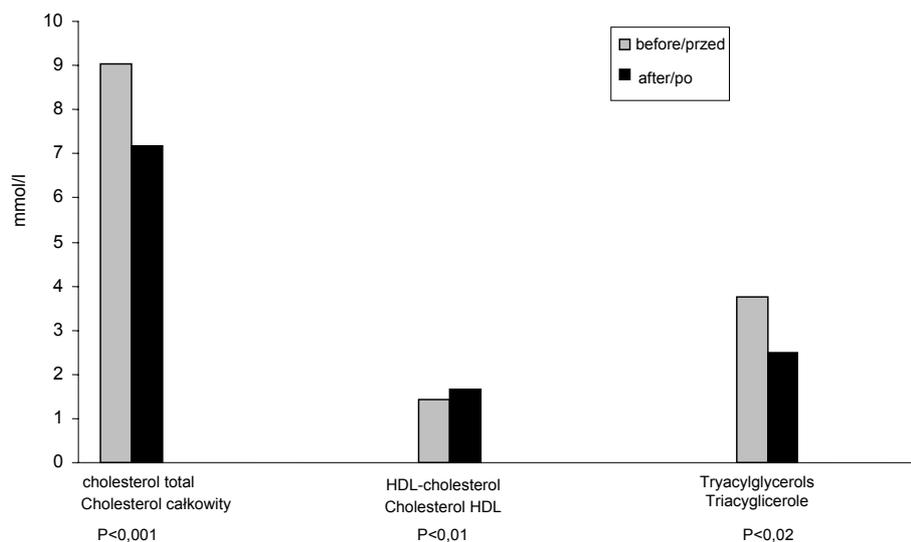


Fig. 9. Clinical test of hyperlipoproteinemia (HLP) correction by application of Palmlecitin 30 g/day (Phosphatida essentialia 1500 mg/d) at 25 people with hyperlipoproteinemia during 4 weeks.

Rys. 9. Badania kliniczne nad zastosowaniem preparatu Palmlecitin (Phosphatida essentialia 1500 mg/d) w dawce 30 g/dzień przez 4 tygodnie w celu korekty poziomu lipoprotein u 25 osób z ich podwyższoną zawartością.

In the dietetic test 32 selected people of both sexes, mainly at pensionable age (62 ± 7 years) were fed for 2 months with cereal oaten biscuits with onion concentrate, with the regulation of daily intake at an average level about 50 mg of quercetin [18]. In epidemiological studies, for comparison, the daily intake of quercetin in a current meal is given at intervals of 5 – 25 mg, whereby it is accentuated that its intake over 20 mg reduces the risk of cardiovascular diseases. We determined a significant drop of atherogenic index, favourable effect on antioxidant parameters in plasma, and a rise in glutathione and quercetin level.

The effects of cereal biscuit consumption were manifested most significantly in the decrease of malondialdehyde (MDA) levels $P < 0,001$, which is one of key markers of oxidation stress, by which was confirmed the significant antioxidant effect of consumed biscuit. At the same time the decrease of homocysteine amount in serum ($P < 0,01$) was also confirmed, what predicts the decrease of cardiovascular harms of future origin.

For the dietetic test an oyster truffle (*Pleurotus ostreatus*) was selected taking into account the fact, that a mushroom contains some important ingredients. These are

mevinolin-K, the natural statin of a valuable hypocholesterolemic effect multiplied by the presence of a fibre, and beta-glucans with antioxidant and immunomodulatory properties [5]. During 6 weeks of experiment the expected hypocholesterolemic and hypotriacylglycerolemic effect (at both $P < 0,01$) together with a HDL-cholesterol of serum stabilising effect was determined (Fig. 10). Additionally, the simultaneous antioxidant effect of oyster truffle was confirmed as well as the decrease of lipoperoxidation PUFA, expressed by the decrease of conjugated diene amount from PUFA in plasma $P < 0,02$), what is again suggestive to apply in nutrition as a prevention of several civilisation diseases, including carcinogenic.

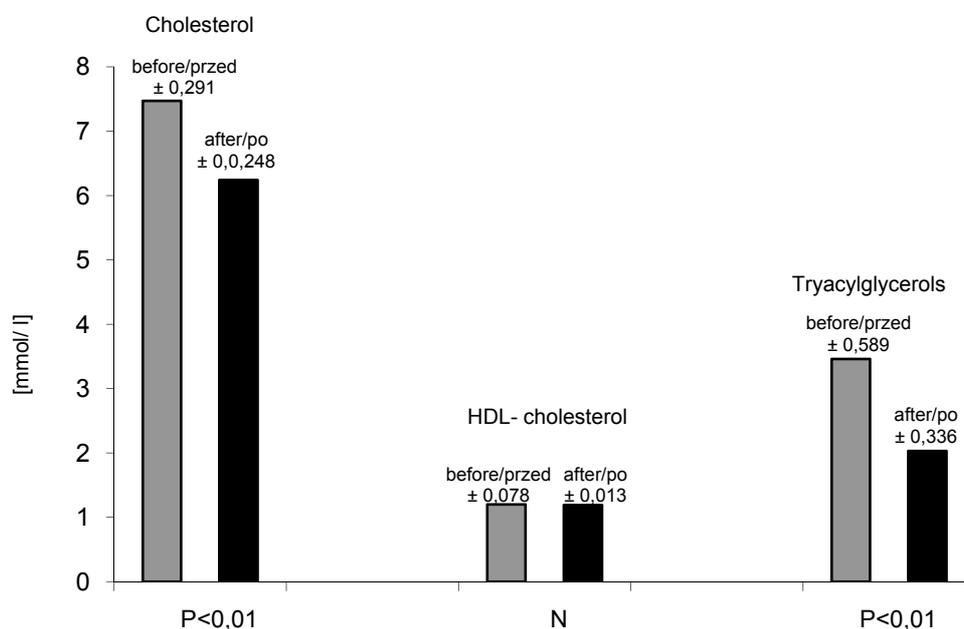


Fig. 10. Changes of serum lipids at people with combined dyslipidemy after oyster truffle (*Pleurotus ostreatus*) in powder 10 g/day intake during 6 weeks; n = 57 (women 32, men 25), age 43 years.

Rys. 10. Zmiany w lipidach serum u osób ze złożoną dyslipidemią po podawaniu sproszkowanego boczniaka ostrygowatego (*Pleurotus ostreatus*) w dawce 10 g/dzień w okresie 6 tygodni (n = 57 ; 32 kobiety, 25 mężczyzn; wiek - 43 lata).

Conclusions

Summarising, the nutritive-metabolic risk of Slovak Republic population was assessed basing on a long-term development of nutritional and health characteristics. The most important task was to give a solution of excessive consumption of fats considering both their quantity and structure, by a form of preferred reduction of animal fat.

The actual key health problem of Slovakia's population is an extension of circulatory system diseases and their main representative ischemic heart disease on the basis of atherosclerosis. Today we gained a several, relevant information on the ways of effective prevention of atherosclerosis and its serious complications, that was also revealed by the results obtained in our clinical studies on implementing some selected nutritive factors with hypolipemic and antioxidant effect.

The recommendation for the modern food production will be therefore to produce food of a lower energetic, and at the same time higher biologic value (nutritive density). Besides lighter, enriched in vegetable, consumption pattern is suggested, according to the example of meridional meal. Furthermore, the attention must also be paid to the food production oriented towards the nutrition requirements of individual population groups, including institutions of public catering. Taking into account the prognosis of the development of demographic population and so called SR population ageing, it will soon be observed a consumer demand for a sufficient and scratch assortment of foods and beverages assigned not only for preventive, but also for therapeutic nutrition, the significance of which will gradually increase in society. Also, in new products their health safety, quality, aesthetic and sensoric attraction will still remain desirable. It is obvious that the fulfilment of these tasks and suggestions can be realised only by the very close co-operation between science and practice. From the one side food producers and processors from a broad regions must be engaged, from the other human and veterinary medicine employees.

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ROLA ŻYWNOŚCI POCHODZENIA ROŚLINNEGO W ZAPOBIEGANIU CHOROBYM CYWILIZACYJNYM

Streszczenie

Autorzy określili aktualne zagrożenia żywieniowe i kliniczne, badając ich wpływ na stan zdrowotny populacji ludności Słowacji w ciągu ponad czterdziestu lat. Wyniki uzupełniono rezultatami badań żywieniowych przeprowadzonych w skali kraju na grupie ponad 20 000 osób. Jednocześnie przeanalizowano: średni poziom lipidów we krwi, powszechność występowania takich zjawisk, jak: zaburzenia obecności tłuszczu we krwi, otyłość, cukrzyca i rak jelita grubego. Zamieszczono również wyniki czterech testów dietetycznych (diety uzupełnianej pektyną i kwasem askorbinowym, fosfolipidami, sproszkowanym boczniakiem ostrygowatym (*Pleurotus ostreatus*) oraz związkami flawonoidowymi). Na podstawie badań zaproponowano poprawę sposobu odżywiania się, zmiany przepisów dotyczące polityki żywnościowej i sposobu żywienia oraz przedstawiono sugestie odnoszące się do produkcji żywności.

Słowa kluczowe: konsumpcja żywności, wartość odżywcza, cholesterolemia, triacyloglicerolemia, polityka żywieniowa 