

Vitamin levels in a selected population in the Czech Republic

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Abstract

OBJECTIVES: The work objective was to monitor nutritional habits in the observed group of professional soldiers with the focus on eating food with the content of antioxidant carriers. Then to show present state of health and nutrition in the group on the basis of anthropometric measurements and biochemical examinations and finally to observe the level of antioxidant vitamins in the observed group of professional soldiers.

METHODS: The group included 171 healthy individuals, 152 men and 19 women. Their average age was 34.2±7.9 years. The venous blood was taken for biochemical examinations in all individuals on a fast. Anthropometric measurements (weight, height, caliperation, waist circumferences), blood pressure and puls were taken continually in all individuals. Simple questionnaires were administered to all participants for the complete evaluation of present health and for the registration of eating habits of the observed persons.

RESULTS: The study results show that retinol and a-tocopherol levels in the observed group were within a normal range. The average concentration of vitamin C in this group was 54 mmol/l and reached nearly the values given in other European countries. But concentrations of β-caroten and lycopene in serum were up to 50% lower in comparison with concentrations in population in the countries of West Europe. Higher vitamin C and β caroten serum levels were found in individuals who respond in a questionnaire they eat fruit and vegetables or supplements of vitamin preparations every day. Statistically lower levels of vitamin C, β karoten and lycopene in the group of obese people (compared with the group of normal weight people) show decreased level of antioxidant protection of the organism and the risk of cardiovascular diseases.

CONCLUSIONS: The results show that it is necessary to ensure optimal food not only with an energetic diet value but also with a proper input of antioxidant carriers in the form of fresh vegetables and fruit every day.

INTRODUCTION

Reactive forms of oxygen and nitrogen are physiological components of living processes and significant protective agents of an organism. They participate in energy transformations in the living organism, they are present in enzymatic reactions and some of them are significant signal molecules in cells' information system. If the control fails, which each aerobic organism gained within the biological system development, these substances may cause damage of the organism. In this case, we talk about so called oxidative stress, that is a state of the reactive environment in tissues when oxidation reactions exceed the anti-oxidation prevention of the tissue, impairment of a balance between occurrence and elimination of reactive forms of oxygen and nitrogen is concerned. Free radicals represent normal as well as pathological metabolites and as such they play a significant role in pathogenesis of many morbid conditions. Recently, there has been made a great progress in the knowledge of consequences of overproduction of free radicals, and their destructive effects and harmfulness were explained in a great extent. A natural consequence of the mentioned above development was a concern about therapeutic and preventive usage of oxidative stress inhibitors, antioxidants. The antioxidant is defined as a substance which even though is present in a low concentration, in comparison with an oxidable substrate, it significantly slows down or inhibits the oxidation of this substrate (Labonté *et al.* 2008; Young 2001). There exist a wide range of exogenous and endogenous antioxidants which prevent a damage of cell components induced by free radicals.

METHODS

The aim of our study was to document eating habits in an observed group of military professionals focused on consumption of food antioxidant carriers and to examine a current health and nutritive status of this group using anthropometric and biochemical methods and to find out saturation with anti-oxidation vitamins in the observed group of military professionals.

The examination of the group was provided within the regular annual check-ups. 171 healthy persons, 152 males and 19 females were included into the group. The average age was 34.2 ± 7.9 years, from which 34.5 in males and 32.5 in females. 82% volunteers were non-smokers, 18% pointed out that they smoke regularly.

In the morning, venous blood was withdrawn them on an empty stomach for biological tests and identification of selected antioxidant vitamins concentrations in serum. Subsequently, in all probands, the anthropometric measurements (body mass, body height, amount of fatty tissue measurement, waist perimeter), measurement of blood pressure in a sitting position with the apparatus Omron, pulse with the apparatus Omron and examination of their fitness by means of simple

functional tests were performed. Simple questionnaires were handed out to all participants in order to provide overall assessment of examined persons.

RESULTS

Tab 1. Results of determination of antioxidants in serum. Values of particular antioxidants are in $\mu\text{mol/l}$

	vitamin C	retinol	alpha-tocopherol	beta-carotene	lycopene
mean	54.11	2.39	26.75	0.3	0.258
SD	21.25	0.48	6.76	0.358	0.138
max	108.5	3.76	63.29	2.801	0.782
min	7.6	1.31	13.21	0.014	0.055
median	53.1	2.31	25.65	0.191	0.238

Tab. 2. Influence of fruits and vegetables consumption on antioxidant serum levels. Assessment provided in items like – he/she does not eat fruits and vegetables at all, from time to time, or each day.

	not eat 29.4%	sometimes 39.4%	each day 31.2%
beta-carotene	0.183	0.25	0.373
lycopene	0.263	0.248	0.245
vitamin C	45.2	53.1	61.4

In the questionnaires there was no possibility to distinguish whether fresh or preserved antioxidant carriers are concerned. Nevertheless, we assume consumption of fresh fruit and vegetables mainly.

Tab. 3. Influence of supplements of vitamin preparations on antioxidants level in serum. Assessment provided in items – without supplements, occasionally or every day

	no suppl. 26.9%	occasionally 55%	every day 18.1%
beta-carotene	0.204	0.265	0.375
lycopene	0.231	0.249	0.292
vitamin C	41.1	55.9	64.5
retinol	2.5	2.39	2.25
alpha tocopherol	27.9	26.3	25.5

The name of the vitamin preparation was not always mentioned in the questionnaires. Most often various preparations containing especially the vitamin C were named.

DISCUSSION

Average serum concentrations of vitamin C, retinol and tocoferol were confirmed within standard ranges presented in literature. Ascorbemia lower than $17 \mu\text{mol/l}$ was determined in 3.5% of followed-up persons and within $17\text{--}39 \mu\text{mol/l}$ in 21% of persons. That means that more than 20% of persons had lower vitamin C

Tab. 4. Selected parameters in age categories

age categ.	under 25	25–35	35–45	over 45
TCHOL mmol/l	4.37	5.04	5.65	6.27
beta-carotene	0.298	0.257	0.263	0.236
lycopene	0.313	0.251	0.244	0.168
vitamin C	58.35	53.94	48.55	62.38
retinol	2.18	2.3	2.6	2.54
alpha tocoph.	22.61	25.36	28.96	30.76
waist cm	84.8	87.5	93.5	88.6
WHR	0.86	0.878	0.928	0.933

Tab. 5. Selected parameters in BMI categories

BMI (kg/m ²)	20–25	25–28	28–30	30–35	over 35
TCHOL mmol/l	4.9	5.19	5.53	5.94	6.76
Beta-carotene	0.328	0.27	0.218	0.135	0.182
lycopene	0.274	0.26	0.238	0.202	0.191
vitamin C	57.84	54.94	49.43	44.15	48.1
retinol	2.24	2.43	2.48	2.64	2.25
alpha tocoph.	24.93	27.02	27.95	29.52	25.52

concentration parameters compared with generally accepted standards. (Demirag 2001; Levine 2001). On the other hand, the average concentration of vitamin C in this group was 54 µmol/l and reached values indicated for populations in countries of southern and western Europe.

Higher concentration values of particular antioxidants were determined above all in these members of the group who mentioned a supplementation of vitamin preparations and eating fruits and vegetables in the questionnaire (Barbosa *et al.* 2008; Broekmans 2000).

In comparison with citizens of western and southern Europe, serum levels of selected antioxidants in the Czech population were low. The incidence of classic avitaminoses arising from the complete shortage of some vitamins in nutrition in developed countries as well as in the Czech Republic is low. The state of antioxidant levels in conditions of the Czech Republic reflects a low consumption of its sources in nutrition mainly fresh fruits and vegetables (Bobak *et al.* 1998; Mojzíšova & Kuchta 2001).

Dependence of plasmatic antioxidants levels on consumption of fruits and vegetables is reliably proved, however, simultaneously it was found out that there exist different effects of chemically clean substances of these antioxidants and substances originated from natural sources and foods (Marian 2001; Olmedilla 2001). Besides antioxidants, even other substances, so far partly known, may be present in these natural sources,

which have or may have protective effects (fiber, bioflavonoids, selen) (Mc Quillan 2004).

The examination results show that members of the group who eat fruits and vegetables every day have more favorable values of β-carotene and vitamin C and the average concentration of β-carotene in serum is in those eating fruits and vegetables daily two times higher in comparison with those who did not eat them. The concentration is in the same group higher in average by 33%. Nevertheless, it is necessary to emphasize that a majority of examined probands who eat vegetables and fruits daily take vitamins as well.

Another interesting result showed a comparison of antioxidant levels depended on body mass of examined individuals. Average values of fat inherence ratio in a body were within a normal range in both males and females. In males the values higher than 20% were measured in 12% cases, in females values higher than 30% were not measured. The fact cited in the past was proved again that the antioxidant capacity of the organism is decreasing with increasing BMI value. A statistical drop of ascorbemia was concerned as well as a decrease of β-carotene and lycopene concentrations. On the other hand, retinol levels and α-tocopherol levels in serum showed a slight increase together with BMI grow. These vitamins are soluble in fats and have effect in cell membranes of lipophil environment or they are bounded directly on LDL particles, thus in enhanced lipid concentration in serum, a slight increase of serum concentrations in fat soluble vitamins has occurred (Labonté *et al.* 2008). Statistically significantly lower vitamin C, β-carotene and lycopene levels found in the group of obese individuals in comparison with the group of normal weight ones indicate decreased level of antioxidant protection of the organism in the obese individuals. The statistically significant negative correlation of serum vitamin C level with adipose tissue ratio was found. On the contrary, the statistically significant positive correlation was found between serum concentration of retinol and α-tocopherol and adipose tissue ratio.

Values of serum antioxidant levels depend on the age of a patient. A composition of organism is changing with increasing age, a proportion of body fat is growing, a volume of total body water is decreasing and height-weight indexes are moving to higher values. With higher age, concentrations of total cholesterol were going up together with retinol and tocoferol levels. Whereas, with increasing age a tendency of decreased β-carotene and lycopene serum levels may be observed which is connected with lower consumption of fruits and vegetables in higher age groups. (Skodova 1991; 1993).

CONCLUSION

The obtained results disclosed the need to provide soldiers at work and training with meals not only with corresponding energetic value but also with appropriate supply of antioxidant carriers in the form of daily fresh vegetables and fruits.

In off-garrison boarding where fresh fruits and vegetables supplies are not possible to assure, it is necessary, in compliance with other NATO countries standard, to develop and further improve new tinned rations which besides energetic value also assure appropriate supply of antioxidant carriers, that means besides meat tins, fruits and vegetables concentrates and vitaminized beverages are to be included into the rations. In addition, this group of troops should be supplied with vitamin preparations.

Supplementation of substances with antioxidant effects seems to be effective mainly in some types of troops with enhanced physical and mental load, i.e. the Rapid Reaction Brigade, the Chemical Protection Company or in participants of foreign missions.

A majority of soldiers have a daily supply with quality and fresh foods in field catering facilities. The supplementation would deal with few numbers of individuals permanently deployed in risky areas who are dependent on combat tinned rations for couple of days or weeks. However, a rule that a sufficient supply of antioxidants from fruits and vegetables, where individual vitamins are well-balanced, seems to be the most reasonable preventive measure. As far as the convincing evidence on appropriate dosing of antioxidants for prevention of cardiovascular and metabolic diseases exists, the most reasonable recommendation is to obtain antioxidants from natural sources, i.e. from fruits, vegetables and whole-grain products, positive effects of which was proved. Increased attention should be paid to the consumption of foods of vegetables origin, purposefully selected vitamins seem to be reasonable as well. Vitamin and mineral supplements should be used efficiently and differentially in different groups of citizens, i.e. women in menopause, pregnant women, physically active men etc. In general, besides antioxidant vitamins there should be present also vitamins of the group B

and D, respectively in the amount which should not exceed a value of a daily dose (Tran 2001).

It is possible to claim that taking pharmaceutical vitamin preparations should be strictly purposeful and reasonable. Intake of healthy and desirable natural antioxidants has its peaks and the rule the more the better does not stand. It is necessary to stress that the intake of β -carotene and other carotenoids, vitamins C and E and flavonoids in food does not represent any risk and should not be limited at all. Harmful effects may be developed after the excessive consumption of preparations of the former substances.

REFERENCES

- 1 Barbosa KB, Bressan J, Zulet MA (2008). Influence of dietary intake on plasma biomarkers of oxidative stress in humans. *An. Sist. Sanit. Navar.* **31**: 259–80.
- 2 Bobak M, Brunner E, Miller NJ (1998). Could antioxidants play a role in the high rates of coronary heart disease in the Czech Republic? *J. Clin. Nutr.* **52**: 632–636.
- 3 Broekmans W (2000). Fruits and vegetables increase plasma carotenoids and vitamins and decrease homocysteine in humans. *J. Nutr.* **130**:1578–1583.
- 4 Demirag K (2001). The protective effect of high dose ascorbic acid on myocardial ischaemia. *Middle East J. Anest.* **16**: 67–79.
- 5 Dey P, Gupta P, Acharya NK, Ray S (2008). Antioxidants and lipid peroxidation in gestational diabetes-a preliminary study. *Indian J. Physiol. Pharmacol.* **52**: 149–56.
- 6 Labonté M, Dionne IJ, Bouchard DR (2008). Effects of antioxidant supplements combined with resistance exercise on gains in fat-free mass in healthy elderly subjects. *J. Am. Geriatr. Soc.* **56**: 1766–8.
- 7 Levine M (2001). A new recommended dietary allowance of vitamin C. *Proc. Natl. Acad. Sci.* **98**: 14–17.
- 8 Marian L (2001). Serum concentrations of retinol, tocopherol and carotenoids. *J. Nutrition.* **131**: 2184–2191.
- 9 Mc Quillan RM (2004). Antioxidant vitamins and the risk of carotid atherosclerosis. *J. Amer. Coll. Cardiol.* **38**: 1795–1798.
- 10 Mojzisoava G, Kuchta M (2001). Dietary flavonoids and risk of coronary heart disease. *Physiol. Res.* **50**: 529–35.
- 11 Olmedilla B (2001). Serum concentrations of carotenoids and vitamin A, E and C. *Brit. J. Nutr.* **85**: 227–238.
- 12 Skodova Z (1991). Cardiovascular risk factors in the Czech population. *Cor et Vasa.* **33**: 114–122.
- 13 Skodova Z (1993). Development of the cardiovascular risk in the population of the Czech Republic. *Cor et Vasa.* **35**: 178–182.
- 14 Tran L (2001). Antioxidancia a prevence kardiovaskulárních onemocnění. *Medicína po promoci.* **2**: 49–54.
- 15 Young I (2001). Antioxidants in health and disease. *J. Clin. Pathol.* **54**: 176–186.