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# The benefits and risks of short-term diet changes on the example of the use a 5-week long lactoovovegetarian diet. Analysis of 7-day nutritional surveys of women – preliminary study

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ABSTRACT

**Aim.** Due to more frequent incidence of diet related diseases, alternative methods of nutrition become more popular. The aim of this paper is to determine the degree of balance of a short-term lactoovovegetarian diet followed by those who do not have any previous experience with such a diet. Moreover, the study aims at comparing its findings with results of a nutritional analysis carried out in the case of volunteers following a long-term lactoovovegetarian diet.

**Material and methods.** The method chosen in this study is a nutritional analysis based on 7-day long nutritional surveys. Diet 5.0 software was used analyze this data. The tests were conducted among 9 lactoovovegetarians females (LVD – long-term vegetarian diet) and 9 females who decided to follow a lactoovovegetarian diet for the duration of 5 weeks (SVD – short-term vegetarian diet). In the latter case, nutritional surveys were performed in the week preceding the experiment (SVD1/control group) and the last week of the diet (SVD2).

**Results.** In LVD group, when compared with SVD1, significant differences in average daily intake of vitamin E, fat and plant fiber have transpired. After analyzing data from nutritional surveys of SVD2 group, significant differences in the amount of basic nutritional elements (e.g. smaller amount of fat and fiber), microelements (e.g. lower supply of calcium, iron, magnesium) and vitamins (vitamin E, thiamine, niacin) have been noted, as compared to LVD group. When comparing data within SVD group, i.e. a traditional diet and a 5 week long lactoovovegetarian diet significantly lower supplies of vitamins B1, B3, B12 and D were observed than before starting the experiment.

**Conclusions.** A short-term change of eating habits from a traditional diet into a lactoovovegetarian one may result in insufficient supply of numerous nutrients.

**Keywords:** short-term diet, lactoovovegetarians, nutritional survey.

## Introduction

There has been a great interest recently in a range of short-term and long-term diets. This is due to the fact that they are closely connected with the rising frequency of civilization diseases, their prevention and treatment, as well as a desire to achieve quick dietary results in the form of body mass reduction and maintenance of proper body mass. Pathologies such as obesi-

ty, diabetes and diseases related to circulation system, like atherosclerosis or ischaemic heart disease are on the rise [1]. In many cases, pharmaceutical treatment of these diseases is not effective and it is necessary for the patient to follow a short-term or long-term diet very restrictively. Increased physical or mental activity and stress require a change in one's eating habits to suit one's organism's needs. A proper diet may have a very beneficial influence on one's overall health state, physical shape and immune system, and this may concern both the sick and the healthy. However, it is crucial to emphasize the fact that introducing new eating habits, especially without regular control of a dietician, may result in undesired side effects, such as nutritional deficiencies among others. Moreover, professional supervision by a dietician is still a very uncommon procedure for those who decide to change their eating habits.

A lactoovovegetarian diet is considered to be a beneficial alternative eating habit for women, men and children of all ages [2]. This diet involves eliminating meat and fish products from one's menu, whereas dairy products and eggs are allowed. Numerous research has proven its positive influence inter alia on regulation of blood glucose level in diabetic patients, as well as on parameters of one's lipid profile and body mass reduction [1, 3–8]. At the same time, it has been researched that vegetarianism may play a role in increased risk of nutritional deficiencies [6, 9, 10]. Most of this research has been based on an analysis of long-term diets, ones that were applied for many weeks or even years. It should be noticed that a lactoovovegetarian diet may be considered rich in nutritional antioxidants [11], which play a crucial role in prevention of numerous illnesses and in recovery process, e.g. after poisoning caused by medicine or extreme physical activity. In these cases, a short-term change of diet into a lactoovovegetarian one may have a beneficial effect on one's antioxidant-oxidant profile. Moreover, relatively lenient dietary restrictions decrease the risk of an insufficient supply of essential vitamins and minerals.

There is scarce research that describes the influence of short-term vegetarian diets. Thus, the aim of this paper is to determine the degree of balance of a short-term lactoovovegetarian diet followed by those who do not have any previous experience with such a diet, but who decided to change their traditional eating habits into lactoovovegetarian ones. This paper specifically aims at comparing its findings with results of a nutritional analysis carried out in the case of volunteers with traditional eating habits and interviews with volunteers following a long-term lactoovovegetarian diet. This paper presents results of studies based on an analysis of 7 day long nutritional surveys among 18 females, 9 females undergoing a short-term 5 day long lactoovovegetarian diet (surveys collected before the dietary intervention and while it was in progress) and 9 long-term vegetarian females. In all cases, the factors to be compared included: dietary energy density, average consumption of carbohydrates, fats and protein and prominent vitamins and minerals.

## Material and methods

The method chosen in this study is a nutritional analysis based on 7-day long nutritional surveys. Diet 5.0 software was used to collect and analyze this data. The tests were the following: 9 experienced female lactoovovegetarians (group I, LVD – long-term vegetarian diet), who have been on this type of diet for minimum 3 years and 9 females who decided to change their eating habits into a lactoovovegetarian diet for the duration of 5 weeks (group II, SVD – short-term vegetarian diet). In the latter case, nutritional surveys were performed in the week preceding the experiment (SVD1/ control group) and the last week of the diet (SVD2).

Only 18 females agreed to take part in this research, due to the fact that it would greatly interfere with their lifestyle. When choosing the sex of volunteers, the fact that vegetarian diets are most popular among women has been taken into account. Moreover, it is women who are more ready to change their eating habits for a short time than men. All volunteers were aged 18 to 30, were healthy and not very physically active. In Group I, females were students while taking part in the examination, 5 had a Master's degree. In Group II, 6 women were students and other 3 had a Master's degree. Before this research, all of them underwent a medical examination and were instructed how to follow a balanced lactoovovegetarian diet. They were also presented examples of proper vegetarian meals. All candidates agreed to exclude meat products, gelatin and fish from their diets for the duration of 5 weeks. They have not, however, committed themselves to a menu that had been prepared by a dietician, with respect to the type and amount of food products to be consumed. This was due to the fact that most tested volunteers were students and thus could not devote enough time to following a strict menu. The basic criterion for all of them was to eliminate meat and fish products from their menus. In the week preceding the experiment, all volunteers kept a nutritional survey in which they noted down exact amounts and types of

food products they consumed. They were asked to follow the same procedure in the last week of the experiment. If a person stopped the diet half way into the experiment or developed a disease, they would be excluded from it. The data analyzed on the basis of these surveys included a daily intake of minerals and vitamins (characteristic of a stable diet) and the percentage of fats, carbohydrates and protein, both before and during the experiment. Long-term vegetarians had the same data analyzed. Statistica software was used for statistical analysis.

## Results

The findings showed that the daily amount of nutritional elements in volunteers' diet changed and differed between two groups (LVD, SVD), as well as among SVD group, before starting the lactoovovegetarian diet (SVD1/control group) and while its duration (SVD2). In LVD group, when compared with those on a traditional diet, i.e. SVD1 (control group), significant differences in average daily intake of vitamin E, fat and plant fiber have transpired (**Table 1**). Vitamin E and fiber intake was higher, and the percentage of animal and plant fiber in the diet was more beneficial (taking norms into consideration) in LDV group.

After analyzing data from nutritional surveys of LVD group, significant differences in the amount of basic nutritional elements and microelements and vitamins have also been noted, as compared to data from nutritional interviews in SVD2 group, in the last week of the experiment (**Table 2**). These differences concerned lower dietary energy density, smaller amount of fat, fiber and lower supply of sodium, calcium, iron, magnesium, zinc, and vitamin E, thiamine, niacin and polyunsaturated fatty acids and fiber in SVD2 Group.

**Table 1.** Comparison of average daily intake of particular nutritional elements by long-term vegetarians (LVD) and people with traditional diets (SVD1/control group), before starting the dietary intervention (level of significance $p < 0.05$)

| Variable | SVD1 | | | LVD | | | U | P |
|---|---|---|---|---|---|---|---|---|
| | Average | Median | SD | Average | Median | SD | | |
| Energy [kcal] | 1732.42 | 1661.92 | 621.80 | 1837.65 | 1660.37 | 625.51 | 42 | 0.6027 |
| Protein in total [g] | 65.84 | 60.12 | 20.50 | 59.14 | 56.47 | 18.89 | 38 | 0.4119 |
| Animal protein [g] | 42.49 | 38.09 | 12.70 | 28.16 | 29.03 | 14.47 | 22 | 0.0381 |
| Plant protein [g] | 22.89 | 19.08 | 9.92 | 30.17 | 27.70 | 6.50 | 20 | 0.0251 |
| FAT [g] | 61.12 | 53.60 | 25.06 | 65.89 | 60.17 | 30.77 | 45 | 0.7664 |
| Carbohydrates in total [g] | 233.72 | 213.76 | 81.61 | 264.53 | 240.63 | 87.41 | 33 | 0.2299 |
| Sodium [mg] | 2565.32 | 2590.00 | 831.76 | 2756.43 | 2779.35 | 979.73 | 39 | 0.4561 |
| Potassium [mg] | 2902.09 | 2756.65 | 670.53 | 3186.58 | 3067.87 | 1070.48 | 42 | 0.6027 |
| Calcium [mg] | 738.10 | 724.37 | 295.06 | 1045.00 | 848.28 | 523.25 | 30 | 0.1519 |
| Phosphorus [mg] | 1167.86 | 1090.13 | 272.14 | 1268.45 | 1185.97 | 435.73 | 45 | 0.7664 |
| Magnesium [mg] | 294.54 | 278.33 | 69.70 | 370.09 | 374.63 | 131.51 | 33 | 0.2299 |
| Iron [mg] | 9.59 | 8.73 | 2.69 | 11.52 | 11.65 | 2.77 | 28 | 0.1119 |
| Zinc [mg] | 8.27 | 8.38 | 1.80 | 8.56 | 7.80 | 3.20 | 48 | 0.9408 |
| Manganese [mg] | 4.15 | 4.37 | 1.75 | 5.54 | 6.05 | 2.18 | 36 | 0.3312 |
| Vitamin A (retinol equivalent/ [µg]) | 815.49 | 668.08 | 420.81 | 1269.26 | 1109.61 | 742.20 | 29 | 0.1308 |
| Vitamin E(alfa- tocopherol equivalent, [mg]) | 7.60 | 7.02 | 3.03 | 12.08 | 13.37 | 3.23 | 15 | 0.0074 |
| Thiamine [mg] | 0.95 | 0.87 | 0.32 | 0.98 | 1.01 | 0.22 | 42 | 0.6027 |
| Niacin [mg] | 16.76 | 14.04 | 5.81 | 13.92 | 11.98 | 9.29 | 27 | 0.0952 |
| Vitamin C [mg] | 109.34 | 75.39 | 89.34 | 131.95 | 133.54 | 71.68 | 38 | 0.4119 |
| Saturated acids [g] | 23.18 | 21.70 | 9.91 | 22.86 | 22.06 | 9.17 | 47 | 0.8820 |
| Monosaturated acids [g] | 24.49 | 22.05 | 10.50 | 22.41 | 21.34 | 7.76 | 44 | 0.7103 |
| Polysaturated acids [g] | 8.77 | 8.08 | 3.86 | 11.90 | 11.88 | 4.11 | 26 | 0.0804 |
| Cholesterol [mg] | 228.60 | 201.42 | 89.90 | 171.66 | 169.75 | 123.32 | 28 | 0.1119 |
| Fibre [g] | 14.60 | 14.11 | 3.66 | 21.65 | 22.31 | 6.65 | 18 | 0.0159 |
| Folate [µg] | 243.28 | 216.19 | 92.86 | 306.25 | 256.03 | 116.30 | 32 | 0.2014 |
| Vitamin B12 [µg] | 3.28 | 2.64 | 1.42 | 2.93 | 2.20 | 2.49 | 35 | 0.2947 |
| Vitamin D [µg] | 2.66 | 1.76 | 2.11 | 1.50 | 1.33 | 1.07 | 33 | 0.2299 |
| Percentage of protein energy | 15.81 | 16.85 | 2.56 | 13.55 | 11.40 | 3.88 | 30 | 0.1519 |
| Percentage of fat energy | 30.71 | 30.82 | 3.69 | 30.69 | 29.44 | 4.92 | 43 | 0.6556 |
| Percentage of carbohydrates energy | 52.03 | 50.58 | 6.05 | 53.97 | 53.89 | 5.57 | 39 | 0.4561 |

**Table 2.** Comparison of average daily intake of particular nutritional elements by long-term vegetarians (LVD) and people on a short-term lactoovovegetarian diet (SVD2) (level of significance p < 0.05)

| Variable | SVD2 | | | LVD | | | U | P |
|---|---|---|---|---|---|---|---|---|
| | Average | Median | SD | Average | Median | SD | | |
| Energy [kcal] | 1328.25 | 1429.28 | 352.27 | 1837.65 | 1660.37 | 625.51 | 23 | 0.0465 |
| Protein in total [g] | 46.15 | 52.19 | 13.03 | 59.14 | 56.47 | 18.89 | 32 | 0.2014 |
| Animal protein [g] | 24.81 | 25.85 | 7.50 | 28.16 | 29.03 | 14.47 | 44 | 0.7103 |
| Plant protein [g] | 21.04 | 20.64 | 7.62 | 30.17 | 27.70 | 6.50 | 17 | 0.0125 |
| Fat [g] | 43.22 | 43.09 | 10.25 | 65.89 | 60.17 | 30.77 | 18 | 0.0159 |
| Carbohydrates in total [g] | 197.35 | 212.92 | 60.94 | 264.53 | 240.63 | 87.41 | 26 | 0.0804 |
| Sodium [mg] | 1887.10 | 1919.61 | 636.53 | 2756.43 | 2779.35 | 979.73 | 20 | 0.0251 |
| Potassium [mg] | 2363.64 | 2358.33 | 706.28 | 3186.58 | 3067.87 | 1070.48 | 26 | 0.0804 |
| Calcium [mg] | 594.66 | 534.32 | 174.77 | 1045.00 | 848.28 | 523.25 | 17 | 0.0125 |
| Phosphorus [mg] | 935.54 | 867.37 | 288.85 | 1268.45 | 1185.97 | 435.73 | 29 | 0.1308 |
| Magnesium [mg] | 240.81 | 237.32 | 80.48 | 370.09 | 374.63 | 131.51 | 21 | 0.0310 |
| Iron [mg] | 7.68 | 7.38 | 2.66 | 11.52 | 11.65 | 2.77 | 16 | 0.0097 |
| Zinc [mg] | 6.25 | 5.98 | 1.85 | 8.56 | 7.80 | 3.20 | 23 | 0.0465 |
| Manganese [mg] | 4.13 | 3.76 | 2.18 | 5.54 | 6.05 | 2.18 | 32 | 0.2014 |
| Vitamin A ( retinol equivalent [µg]) | 825.35 | 606.61 | 539.24 | 1269.26 | 1109.61 | 742.20 | 31 | 0.1754 |
| Vitamin E(alfa tocopherol equivalent, [mg] | 6.75 | 6.07 | 2.56 | 12.08 | 13.37 | 3.23 | 11 | 0.0023 |
| Thiamine [mg] | 0.68 | 0.64 | 0.22 | 0.98 | 1.01 | 0.22 | 17 | 0.0125 |
| Niacin [mg] | 9.63 | 8.42 | 5.18 | 13.92 | 11.98 | 9.29 | 23 | 0.0465 |
| Vitamin C [mg] | 92.91 | 79.49 | 50.56 | 131.95 | 133.54 | 71.68 | 34 | 0.2610 |
| Saturated acids [g] | 17.05 | 15.48 | 3.62 | 22.86 | 22.06 | 9.17 | 27 | 0.0952 |
| Polysaturated acids [g] | 16.10 | 15.02 | 4.30 | 22.41 | 21.34 | 7.76 | 25 | 0.0674 |
| Monosaturated acids [g] | 7.14 | 6.67 | 3.46 | 11.90 | 11.88 | 4.11 | 16 | 0.0097 |
| Cholesterol [mg] | 178.78 | 184.16 | 72.03 | 171.66 | 169.75 | 123.32 | 41 | 0.5516 |
| Fibre [g] | 15.15 | 13.83 | 5.88 | 21.65 | 22.31 | 6.65 | 21 | 0.0310 |
| Folate [µg] | 221.06 | 217.68 | 67.95 | 306.25 | 256.03 | 116.30 | 27 | 0.0952 |
| Vitamin B12 [µg[ | 2.19 | 1.77 | 0.92 | 2.93 | 2.20 | 2.49 | 45 | 0.7664 |
| Vitamin D [µg] | 0.91 | 1.01 | 0.36 | 1.50 | 1.33 | 1.07 | 30 | 0.1519 |
| Percentage of protein energy | 14.19 | 14.48 | 1.39 | 13.55 | 11.40 | 3.88 | 34 | 0.2610 |
| Percentage of fat energy | 28.67 | 29.29 | 4.26 | 30.69 | 29.44 | 4.92 | 46 | 0.8238 |
| Percentage of carbohydrates energy | 56.13 | 55.41 | 4.68 | 53.97 | 53.89 | 5.57 | 39 | 0.4561 |

When comparing data within SVD group, i.e. a traditional diet (SVD1/control group) and a 5 week long lactoovovegetarian diet (SVD2), significantly lower amounts of vitamins B1, B3, B12 and D were observed than before starting the experiment (**Table 3**). A lactoovovegetarian diet has also shown lower amounts of zinc. The most beneficial change concerned the percentage of plant protein when compared to the amount of animal protein in the diet.

When comparing eating habits of long-term, experienced female lactoovovegetarians (LVD) and those with traditional eating habits – SVD1/control group (a diet including meat and fish) one can claim that the differences which are visible in this research show a more balanced and healthy way of eating on the part of female vegetarians (**Table 4**). What is worth noticing is the percentage of animal and plant protein in this group, which represents the recommended percentage (1:1). The intake of vitamin E by vegetarians was also higher than that in traditional diets, which in fact are characterized by a deficiency of this vitamin. What is more, experienced vegetarians consumed much more fiber, an amount recommended by Polish Institute of Nutrition and Food IŻŻ [12].

After comparing traditional eating habits (SVD1/control group) and a short-term lactoovovegetarian diet (SVD2) applied by females who had not had any previous experience with changing their diets, the diet which contains meat and fish products turned out to be a more balanced kind of nutrition. The results of this research showed a significant decline in dietary energy density of a daily food ration. Moreover, the 5 week long vegetarian diet resulted in lower intake of B1, B3 and B12 vitamins, as well as zinc and vitamin D (the intake was below recommended norms). The beneficial result of this type of diet was proportionate consump-

**Table 3.** Comparison of average daily intake of particular nutritional elements in the duration of traditional diet (SVD1/control group) and lactoovovegetarian diet (SVD2) (level of significance $p < 0.05$)

| Variable | SVD1 | | | SVD2 | | | T | P |
|---|---|---|---|---|---|---|---|---|
| | Average | Median | SD | Average | Median | SD | | |
| Energy [kcal] | 1732.42 | 1661.92 | 621.80 | 1328.25 | 1429.28 | 352.27 | 7 | 0.0663 |
| Protein in total [g] | 65.84 | 60.12 | 20.50 | 46.15 | 52.19 | 13.03 | 3 | 0.0209 |
| Animal protein [g] | 42.49 | 38.09 | 12.70 | 24.81 | 25.85 | 7.50 | 1 | 0.0109 |
| Plant protein [g] | 22.89 | 19.08 | 9.92 | 21.04 | 20.64 | 7.62 | 20 | 0.7671 |
| FAT [g] | 61.12 | 53.60 | 25.06 | 43.22 | 43.09 | 10.25 | 7 | 0.0663 |
| Carbohydrates in total [g] | 233.72 | 213.76 | 81.61 | 197.35 | 212.92 | 60.94 | 12 | 0.2135 |
| Sodium [mg] | 2565.32 | 2590.00 | 831.76 | 1887.10 | 1919.61 | 636.53 | 8 | 0.0858 |
| Potassium [mg] | 2902.09 | 2756.65 | 670.53 | 2363.64 | 2358.33 | 706.28 | 7 | 0.0663 |
| Calcium [mg] | 738.10 | 724.37 | 295.06 | 594.66 | 534.32 | 174.77 | 11 | 0.1731 |
| Phosphorus [mg] | 1167.86 | 1090.13 | 272.14 | 935.54 | 867.37 | 288.85 | 6 | 0.0506 |
| Magnesium [mg] | 294.54 | 278.33 | 69.70 | 240.81 | 237.32 | 80.48 | 8 | 0.0858 |
| Iron [mg] | 9.59 | 8.73 | 2.69 | 7.68 | 7.38 | 2.66 | 7 | 0.0663 |
| Zinc [mg] | 8.27 | 8.38 | 1.80 | 6.25 | 5.98 | 1.85 | 3 | 0.0209 |
| Manganese [mg] | 4.15 | 4.37 | 1.75 | 4.13 | 3.76 | 2.18 | 21 | 0.8590 |
| Vitamin A(retinol equivalent/ [µg]) | 815.49 | 668.08 | 420.81 | 825.35 | 606.61 | 539.24 | 21 | 0.8590 |
| Vitamin E (alfa-tocopherol equivalent [mg]) | 7.60 | 7.02 | 3.03 | 6.75 | 6.07 | 2.56 | 16 | 0.4413 |
| Thiamine [mg] | 0.95 | 0.87 | 0.32 | 0.68 | 0.64 | 0.22 | 3 | 0.0209 |
| Niacin [mg] | 16.76 | 14.04 | 5.81 | 9.63 | 8.42 | 5.18 | 3 | 0.0209 |
| Vitamin C [mg] | 109.34 | 75.39 | 89.34 | 92.91 | 79.49 | 50.56 | 20 | 0.7671 |
| Saturated acids [g] | 23.18 | 21.70 | 9.91 | 17.05 | 15.48 | 3.62 | 12 | 0.2135 |
| Monosaturated acids [g] | 24.49 | 22.05 | 10.50 | 16.10 | 15.02 | 4.30 | 6 | 0.0506 |
| Polysaturated acids [g] | 8.77 | 8.08 | 3.86 | 7.14 | 6.67 | 3.46 | 14 | 0.3139 |
| Cholesterol [mg] | 228.60 | 201.42 | 89.90 | 178.78 | 184.16 | 72.03 | 6 | 0.0506 |
| Fibre [g] | 14.60 | 14.11 | 3.66 | 15.15 | 13.83 | 5.88 | 22 | 0.9528 |
| Folate [µg] | 243.28 | 216.19 | 92.86 | 221.06 | 217.68 | 67.95 | 15 | 0.3743 |
| Vitamin B12 [µg] | 3.28 | 2.64 | 1.42 | 2.19 | 1.77 | 0.92 | 0 | 0.0077 |
| Vitamin D [µg] | 2.66 | 1.76 | 2.11 | 0.91 | 1.01 | 0.36 | 1 | 0.0109 |
| Percentage of protein energy | 15.81 | 16.85 | 2.56 | 14.19 | 14.48 | 1.39 | 10 | 0.1386 |
| Percentage of fat energy | 30.71 | 30.82 | 3.69 | 28.67 | 29.29 | 4.26 | 13 | 0.2604 |
| Percentage of carbohydrates energy | 52.03 | 50.58 | 6.05 | 56.13 | 55.41 | 4.68 | 9 | 0.1097 |

tion of animal and plant protein. On analyzing two variants of lactoovovegetarian diets: short-term (LVD) and 5 week long (SVD2), it has been noticed that females who do not have any previous experience with preparing and composing vegetarian meals consumed insufficient amounts of basic microelements and vitamins, specifically calcium, magnesium, zinc, iron, B vitamins of group B, D vitamins and polysaturated fatty acids (**Tables 3, 4**).

Each tested group made some nutrition mistakes which resulted in insufficient intake of vitamin D and iron, as well as too low intake of vitamin E and calcium and magnesium (in the case of traditional and short-term vegetarian diets) (**Table 5**) and excess of phosphorus in each variant of the diet in question. The ratio of sodium and potassium content in the diet should also be taken into serious consideration.

## Discussion

A properly balanced lactoovovegetarian diet does not cause a greater risk of nutrient deficiencies than in the case of a diet rich in meat and fish products [2]. This fact can be proven by this research based on an analysis of nutritional surveys of long-term experienced vegetarians. The analysis has shown that the level of balance and health benefits of their diet were higher than in the two other groups when it comes to daily consumption of nutritional antioxidants, such as vitamin E and fiber. Some deficiencies that have been observed concerned fewer nutrients than in the case of the other two groups. As noted in the introduction to this paper, this type of diet does not rule out products of animal origin which are rich source vitamins of group B and calcium. Minerals such as magnesium, iron, phosphorus, manganese, zinc and copper can be found in many

**Table 4.** Mean value of daily intake of particular minerals and vitamins among females on a traditional diet and a vegetarian diet, recommended norms (level of significance $p < 0.05$)

| Nutrient (average daily intake) | Traditional diet (SVD1/control group) | Long-term vegetarian diet (LDV) | 5-week-long lactovegetarian diet (SVD2) | Recommended dietary allowances for women [12] |
|---|---|---|---|---|
| Vitamin B (thiamine) | 0.94 | 0.98 | 0.68 | 1.1 |
| Vitamin B3 (niacin) | 16.76 | 13.92 | 9.62 | 14 |
| Vitamin B12 [µg] | 3.27 | 2.93 | 2.18 | 2.4 |
| Vitamin D [µg] | 2.65 | 1.5 | 0.90 | 5 |
| Zinc [mg] | 8.26 | 8.56 | 6.25 | 8 |
| Animal protein [g] | 42.48 | 28.16 | 24.80 | 0.45g/kg/ body weight /daily |
| Protein in total [g] | 65.84 | 59.14 | 46.14 | 0.9g/kg body weight/daily |
| Magnesium [mg] | 294.53 | 370 | 240.80 | 320 |
| Iron [mg] | 9.58 | 11.52 | 7.67 | 18 |
| Calcium [mg] | 738.09 | 1045 | 594.65 | 1000 |
| Sodium [mg] | 2565.31 | 2756 | 1887.1 | 1500 |
| Potassium [mg] | 2902.09 | 3186.5 | 2363.64 | 4700 |
| Phosphorus [mg] | 1167.8 | 1268.4 | 935 | 700 |
| Manganese [mg] | 4.14 | 5.54 | 4.12 | |
| Vitamin A [µg] | 815.48 | 1269.2 | 825.35 | 700 |
| Vitamin C [mg] | 109.34 | 131.95 | 92.91 | 75 |
| Vitamin E [mg] | 7.60 | 12.08 | 6.75 | 8 |
| % of caloric requirement covered by carbohydrates, protein and fats | Protein:15.81<br>Fats:30.71<br>Carbohydrates:52.03 | 11.40<br>29.44<br>53.89 | 14.19<br>28.67<br>56.13 | <15%<br><35%<br>50–70% |
| Dietary energy density [kcal] | 1732 | 1838 | 1328 | - |

**Table 5.** Types of nutritional deficiencies during nutritional intervention (groups SVD1/control group and SDV2) and in log-term lactoovovegetarian diet (LVD)

| Analysis of nutrition interviews in each group | Nutrients consumed in insufficient amounts | Health benefits |
|---|---|---|
| LVD (long-term vegetarian diet) | Potassium, iron, vitamin D, B1 | High fibre and vitamin E content, beneficial ratio of plant and animal protein consumed |
| SVD1 (traditional diet) | Potassium, iron, vitamin D, vitamin B1, vitamin E, calcium, magnesium | Lower risk of vitamin B3 and B12 deficiencies |
| SVD2 (5 week long vegetarian diet) | B1, B3, B12, D, zinc, magnesium, iron, calcium, potassium, vitamin E | Beneficial ratio of plant and animal protein consumed |

**Table 6.** Zinc, vitamin B1 [mg], B3 [mg], B12 [µg], and vitamin D [IU] content in particular food products [per 100 g]

| | |
|---|---|
| Zinc [16] | Veal liver (8.40), Ementaler cheese (4.05), beans (3.77), buckwheat (3.50), pork shoulder (3.11), oatmeal (3.10), rye whole-wheat bread (2.54), hen's eggs (1.76) |
| B1 vitamin [21] | Sunflower seeds (1.318), red lentils (1.072), pork (0.98), pistachio nuts (0.82), pea seeds (0.77), millet (0.73), white beans (0.67), peanuts (0.66), buck-wheat (0.54) |
| B3 vitamin [21] | Peanuts (17.2), liver (13.6), pork (0.8–5.6), trout (8.4), plaice (8.3), cheese (1.2), parsley (1.2) |
| B12 vitamin [22] | Liver (25–110), fish (1–15), milk and milk products (0.4–2.2), eggs (1.6) and meat (0.6–1.2) |
| Vitamin D [22, 23] | Fresh eel (1200), fresh cod (480), pickles salmon (540), egg yolk (54), cheese (7.6–28) |

food products of both animal and plant origin. This research has shown that a short-term vegetarian diet has a significant influence on testees' insufficient supply of nutrients as compared to a traditional diet and a long-term vegetarian diet.

One of such nutrients is zinc, the amount of which was not sufficient in the case of volunteers who underwent our dietary intervention. Products rich in this element include: brown bread, buckwheat, eggs, rennet cheese, but also meat and liver (**Table 6**). Eliminating the last two on the list from one's diet without finding a proper substitute may result in lower zinc intake. Moreover, this research has shown that volunteers examined both before and during their diets consumed insufficient amounts of calcium, iron and magnesium, elements which are present in dairy products, eggs, whole grains, groats, fruit and vegetables. As a consequence, eliminating meat and fish (rich in zinc) and eat-

ing habits which do not include sufficient amounts of meat-free and rich in zinc products mentioned before led to problems with a balanced amount of zinc in a vegetarian diet. The research also shows a significantly lower supply of vitamins of group B i.e. B1, B3, B12 (during the 5 week long vegetarian diet), which in turn shows too small consumption of meat-free products such as groat, whole grains, seeds and legumes, nuts (vitamin B1, B3) and dairy products (vitamin B12) (**Table 6**). Lower supply of both zinc and B1, B3, B12 vitamins confirms the fact that a properly balanced vegetarian diet should include a higher consumption of the food products mentioned before [13, 14]. It is worth noticing that vitamin B3 can be synthesized endogenously. Tryptophan is a substrate in this reaction [13]. It has been suggested that the biosynthesis of niacin from this amino acid is sufficient to supply the organism with a proper amount of vitamin B3. However, it is necessary to consume 100 g of protein daily. Volunteers did not include such an amount before or after the experiment. B12 vitamin is present in products of animal origin exclusively. When choosing a vegetarian diet, one should pay particular attention to the consumption of dairy and eggs which substitute meat, which in turn is the primary source of cobalamin (**Table 6**) [15].

As far as other minerals are concerned, this research has not shown any significant differences in their amounts for those on a vegetarian diet as compared to their diets preceding the experiment. Numerous sources point out, nevertheless, that a properly balanced vegetarian diet supplies more antioxidant A, C, E vitamins in comparison to a traditional diet, which confirms our results for long-term vegetarians [7]. This is due to the fact that a vegetarian diet is richer in fruit and vegetables than a traditional one. Having no proper eating habits before undergoing the vegetarian diet a low intake of fruit and vegetables can influence nutritional behavior while diet is in progress. A relatively small amount of these nutrients in both traditional and 5 week long vegetarian diets correlates with a relatively small amount of fibers.

Another aspect worth noticing is the excessive amount of phosphorus, both before and during the experiment, as well as in the case of the long-term vegetarian diet (**Table 4**). Phosphorus is present in many food products [16] and its excess in one's organism is quite common. It might be suggested, thus, that a diet which eliminates meat and fish products does not influence total phosphorus content, as this element is present to a high extent in seeds and whole grain products.

The research has also shown higher amounts of potassium as compared to those supplied in a traditional diet. Consumption of this element was insufficient in all three types of diets discussed in this paper. Compared to a high concentration of sodium, deficiency of potassium was quite significant. However, studies of long-term vegetarians showed that vegetarian diets should include relatively higher amounts of potassium than diets rich in meat and fish. This may be achieved by including dry and fresh fruit and vegetables in one's diet.

Calcium deficiencies in Poles' diets are quite common [17]. It has been calculated that average daily intake of this element equals 50% RDA [18]. The **Table 4** confirms that traditional eating habits in most cases do not supply one's organism with sufficient amounts of calcium required for proper metabolism. Here, the amount of calcium consumed in a traditional diet and in a 5 week long vegetarian diet did not differ and in both cases was below the minimum. However, nutritional surveys with long-term vegetarians confirmed the fact that a lactoovovegetarian diet which included a higher supply of dairy products, as compared to a diet rich in meat and fish, does cover the daily requirements of this nutritional element.

This research has also shown that all tested group did not receive enough vitamin D with their diets. Despite the fact that 90% [12] of this compound is synthesized endogenously, it is claimed that proper supply of this vitamin is indispensable to maintain proper calcium phosphorus ratio of an organism. Vitamin D is present, among others, in fish, eggs but also in products enriched by this element, as well as in mushrooms [19] (**Table 6**). When concentration of vitamin D and calcium in blood is not sufficient, one might suspect that metabolic processes of these two elements may be disturbed, which might result in calcium absorption disorders and inadequate bone mineralization and some cell changes [20].

In both cases of the lactoovovegetarian diet, i.e. a long-term and a short-term example, the analysis of nutritional surveys showed a beneficial change in the amount of consumed animal protein in relation to plant protein. Adequate supply of animal protein is connected with providing the organism with bigger amounts of unsaturated fatty acids and eliminating saturated fats at the same time.

This research also shows a relatively low dietary energy density, especially in the case of volunteers undergoing a dietary change. In all cases, nutritional surveys were performed on women who described the

level of their physical activity as low, which explains the data. A significant difference between the dietary energy density before choosing a vegetarian diet as compared to data collected during the dietary change proves that these volunteers' eating habits had not been properly balanced and as a consequence, accounts for the deficient supply of all aforementioned nutrients.

## Conclusion

A short-term change of eating habits from a traditional diet into a lactoovovegetarian one by those who do not have previous experience in planning vegetarian meals may result in insufficient supply of numerous nutrients, especially calcium, iron, magnesium and group B vitamins deficiencies. This is mainly due to the fact that those people do not know how to compile a balanced vegetarian diet. In order to prevent them from all the deficiencies mentioned earlier, it is necessary to provide them with regular assistance and consultations of a dietician.

A properly balanced lactoovovegetarian diet, even one applied over many years, may turn out to be a very beneficial eating habit, especially for those at risk of diabetes or heart disease. Consumption of products which comprise this diet, i.e. whole grains, groats, rice, seeds and vegetables and fruit may significantly lower the risk of those diseases. This diet may also have a positive influence on the supply of antioxidants, especially vitamin E. Big dietary awareness and experience in preparing vegetarian meals (which results in adequate supply of dairy and eggs) lowers the risk of many nutritional deficiencies, such as those of calcium.

This research has also proven that each of the diets discussed here may result in deficiencies of some nutrients. Two of such nutrients include vitamin D and iron.

Limitations of the study include small research group as well as inclusion of only female volunteers. Therefore results of this study cannot be attributed to the general population. Moreover the studies did not include any biochemical analysis that could assess the actual nutritional status of respondents.


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The authors declare that there is no conflict of interest in the authorship or publication of contribution.

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