Progress in Nutrition 2018; Vol. 20, N. 2: 212-219 DOI: 10.23751/pn.v20i2.6370 

Original article

# Assessment of nutrition and nutritional status in women using the high–protein diet in the past

*Julita Regula[1], Roksana Jurczak[2], Joanna Wyka[3], Sandra Baczynska[1]*

[1]Institute of Human Nutrition and Dietetics,, Poznan University of Life Sciences, Polandd - E-mail: julita.regula@up.poznan.pl; [2]Department of Food Industry Processes and Facilities, Faculty of Mechanical Engineering, Koszalin University of Technology, Poland; [3]Department of Human Nutrition, Faculty of Food Science, Wroclaw University of Environmental and Life Science, Poland

**Summary.** *Background.* High-protein diets are often used as a quick and easy way to achieve weight loss in those who are overweight or obese. People using for a long time this type of diet are not aware that it can cause serious health problems, therefore it is very important to monitor the effects of long-term use of high-protein diets. *Aim.* The aim of this study was to evaluate the high–protein diet (Dukan Diet) and after its completion, as well as to assess the nutritional status of women on the basis of biochemical parameters of blood: morphology, blood sugar, lipid profile and hepatic profile, in order to determine the health consequences of the high-protein diet. *Material and Methods.* The study included 32 women aged 19 to 56, who had followed the Dukan Diet in the past (2 year ago). A 7-day nutrition diary was used to assess nutrition after the Dukan Diet, where 5 days were working days and 2 days were non-working days. Nutritional status was assessed on the basis of anthropometric measurements and the morphological and biochemical parameters of blood: blood count, fasting blood glucose levels, lipid profile, the profile of the hepatic were analyzed in an accredited analytical laboratory, and these values were determined using haematological and biochemical indicators measured on an Analyzer at Sysmex K-1000 and Vitalab Flexor, respectively. *Results.* The resulting analysis shows that women did not receive adequate amounts of energy from the diets. Diets were deficient in terms of most nutrients, while in other cases the values exceeded the recommended standards. Analysis has shown that the Dukan Diet is deficient in many vitamins, including vitamins C and B, nor does this diet provide a sufficient amount of dietary fiber. It has been observed of minerals deficiency (iron, magnesium, copper) both during and after the protein diet. Moreover, subjects revealed an increased concentration of eosinophils, basophils, monocytes, triglycerides, LDL cholesterol, glucose in the blood. *Conclusions.* The diet of women after the end of high-protein diet is still abnormal as evidenced by improper blood chemistry markers. Women should be under the control of a dietitian.

**Key words**: diet, vitamins, minerals, nutritional status, lipid profile, glucose

## Introduction

High-protein diets are often used as a quick and easy way to achieve weight loss in those who are overweight or obese (1). People using this type of diet are not aware that it can cause serious health problems (2-6).

A high–protein diet is characterized by an increase in the supply of protein and contains from 30% to 40% protein (6, 7). A high–protein, weight-loss diet is also characterized by a reduced carbohydrate content and lower energy value. The increased protein content contributes to reduced feelings of hunger, as a result of the lower concentration of ghrelin, a hormone produced by the cells lining the stomach (8-11). Moreover, low-carb diets lead to dehydration, as a result of the loss of glycogen. The use of glycogen as energy material by

the body, in the course of high-protein and low-carb diets, causes a loss of 2 – 3 g of water for each gram of glycogen, hence weight loss also results from the loss of water (1). Weight loss during high-protein diets is also explained by an increase in the metabolic rate, as well as increased energy expenditure, associated with the digestion of large amounts of protein, as a result of increased thermogenesis, among other factors (9, 12).

The Dukan Diet is a high-protein diet which is very popular in Poland (6, 13). It is divided into 4 stages. The first phase is a very high-protein phase (the attack phase), where the supply of proteins exceeds even the characteristic values for a typical high-protein diet. In the subsequent phases - the second phase – the cruise phase, the third phase – the consolidation phase and the fourth phase – the stabilization phase, the proportions of protein are reduced, though still remain at a high level. In these phases new products are introduced into the diet. Each stage has a specified duration, which depends on individual preferences related to weight loss (6).

Experts from the Dietary Guidelines for Americans 2010 indicate that diets with a protein content of more than 35% and a carbohydrate level reduced below 45% do not demonstrate greater efficiency than diets with a controlled amount of energy (6, 14). In the systematic review article, the high-protein diets have been shown to reduce weight by 3,7 kg – 11,3 kg, compared conventional diets, that reduced weight by 2,2 kg – 9,4 kg. The average weight loss was 6,3 kg for high-protein diet and 5 kg for standard diet (15-23). It was observed that effect of the high-protein diet is not clear (15). The greater part of the analyzed research indicates better effectiveness of high-protein diet (15-23), but three out of longest intervention of four studies hadn't statistical power (15, 16, 22, 23). Moreover the author stresses that well designed and conducted standard diet might be better for reduction body mass then the high-protein diet (15). Furthermore, diets with an increased protein content cause serious health problems and should not be used as an alternative treatment for those who are overweight/obese (6, 14). The health consequences associated with the use of this diet are: constipation, colon cancer, osteoporosis, liver and kidney damage. High-protein diets are deficient in many nutrients, including calcium. A diet with an increased protein content reduces the absorption of this component in the gut. In addition, the increased renal filtration results in the removal of calcium through urine. Excess protein is associated with an increased nitrogen balance and excessive production of ammonia and urea. It heavily burdens both kidneys and liver and can lead to damage and failure. This situation can be especially in patients with impaired liver and kidneys, but also in people with overweight or obesity. A high-protein diet is associated with increased mortality due to cardiovascular diseases (6, 24), and also leads to the deterioration in the functioning of the nervous system. Protein diets are mainly characterized by a deficiency of calcium, vitamin B, vitamins C, A, E and selenium, manganese and fiber (6). Therefore, it is very important to monitor the effects of long-term use of high-protein diets because they can lead to serious health consequences in the case of using for a long time.

The aim of this study was to evaluate the high–protein diet (Dukan Diet) and after its completion, as well as to assess the nutritional status of women on the basis of biochemical parameters of blood: morphology, blood glucose concentration, lipid profile and hepatic profile, in order to determine the health consequences of the high-protein diet.

## Material and Methods

The research comprised 32 women aged 19 to 56, who had followed the Dukan Diet (for 7 months) in the past (2 year ago). Before the study, BMI of these women were as follows: 47% overweight (BMI = 25,00 – 29,90), 47% class I obesity (BMI = 34,00 – 34,90), 6% class II obesity (BMI = 35,00 – 39,90). The average weight reduction was 15 kilograms, the average body weight was 76,59 ± 8,50 kg. The characteristics of the women are presented in table 1. BMI of women was: 15,6% normal weight, 53,1% overweight and 31,3% obesity. A 7-day nutrition diary was used to assess nutrition after the Dukan Diet, where 5 days were working days and 2 days were non-working days. Women received a printed questionnaire, and notation and a serving size was also verified during an interview. Additionally, women filled in a questionnaire containing basic information: body weight, height, BMI. Body

**Table 1.** Characteristics of women

| Women | X±SD | minimum value | maximum value |
|---|---|---|---|
| Age [years] | 36.96±13.07 | 19 | 56 |
| Body weight [kg] | 76.59± 8.50 | 56 | 89 |
| Body height [cm] | 165±0.06 | 150 | 176 |

mass and height was measured by researcher. Measurements were made in the morning, on an empty stomach and in light clothes. Always at the same time of the day. BMI was also calculated by researchers. To assess serving size 'The Photograph album of foodstuffs and dishes' was used (25). The morphological and biochemical parameters of blood: blood count, fasting blood glucose levels, lipid profile, the profile of the hepatic were analyzed in an accredited analytical laboratory and these values were determined using haematological and biochemical indicators measured on an Analyzer at Sysmex K-1000 and Vitalab Flexor, respectively.

The protocol of the study was approved by the Research Ethics Committee of Poznan University of Medical Sciences (no. 1016/13).

The qualitative dietary assessment was made using the 'Dietetyk' program produced by 'JuMaR', and also 'Microsoft Excel 2003' to estimate the average value of a daily ration. This doesn't make sense. Assessments of the level of each macro- and micronutrient include 10% for losses in technology in most nutrients and in the case of vitamin C, they were determined at the level of 50% and vitamin $B_2$ at the level of 20%. The percentage of implementation of nutrition standards was defined on the basis of the 'Standards of nutrition for the Polish population – amendment to 2012, edited by M. Jarosz (26). The Recommended Dietary Allowances (RDA) and the Adequate Intake (AI) were used as nutrition standards. To evaluate the statistical significance for contents of nutritional ingredients in the diet the analysis of variance for randomized block designs was used at the significance level $p < 0.05$. The statistical analysis was conducted using the T-test for dependent samples in the 'StatSoft' 'STATISTICA' program.

## Results

Table 3 shows the estimated values of selected nutrients during and after the Dukan Diet. During the diet, women provided their organism with energy below the basal metabolism (BMR) per day. This energy value was deficient compared to the norm at a low PAL (physical activity level). The Dukan Diet is characterized by a high protein content and a low fat and carbohydrate content. The average percentages of energy were about 40% protein, approximately 30% fat, and 30% carbohydrates. The protein content of the diet stood at the level of 139.17% of the standard, fat at the level of 48.62%, and carbohydrates at 25.96% of the standard. After the protein diet in women had increased slightly, the energy value of the diet, as compared to the energy requirement of 2000 kcal/day, was still low, at a level of 64.79% of the recommendations. Starting body weight was classified for 47% as overweight and for 53% as obesity (47% class I obesity and 6% class II obesity). After the Dukan Diet, their body weight dropped on average for 15 kg and the average body weight was 76,59 ± 8,50 kg. BMI ranged from 34,85 kg/m$^2$ to 20,9 kg/m$^2$. After the Dukan Diet, 15% of these women had normal body weight, 53,1% had overweight and 31,3% had obesity.

After the Dukan Diet, the proportion of energy from macronutrients in the women's diet was as follows: from protein 20%, from fat 30%, from carbohydrates 50%. It indicates that protein intake is decreased, while carbohydrates content increased. In accordance with the IŻŻ (Institute of Food and Nutrition) in Warsaw's recommendations, the percentage of specific macronutrients in the diet should be as follows: 15% (protein), 30% (fat), 55% (carbohydrates). In the Dukan Diet, protein intake significantly exceeds these standards, and after this protein diet, macronutrient percentages were close to the recommended values. Despite

this, the amount of protein, fat and carbohydrates in the diet was below standard and was as follows: 76%, 73.10% and 62.30%, which derives from the energy-reduced diet.

The standards of the IŻŻ (Institute of Food and Nutrition) do not specify the desired content of SFA (Saturated Fatty Acid). This amount has been defined thus: "as low, as possible to achieve in the diet to ensure adequate nutritional value" (26). In this analysis the value of <10% Of GDA (Guideline Daily Amounts = 2000 kcal/day) was assumed. Both during and after the Dukan Diet, SFA content was within the limits adopted for valid values.

After the protein diet the amount of EFA (Essential Fatty Acid) in women's diets increased. The MUFA (Monounsaturated Fatty Acids) content was 19.33±13.37 g, and PUFA (Polyunsaturated Fatty Acids) 7.24±4.92 g, and during the diet the levels of EFA and PUFA were lower, standing at 11.14±8.42 g and 4.74±3.36 g. The cholesterol values during the protein diet were significantly higher than after the diet, and the amount of fiber was reduced both during the diet and after its completion, constituting only half of AI (Adequate Intake).

There were no significant differences in the supply of sodium and potassium during and after the diet. In both cases, sodium values were close to normal, or slightly above it, and the amount of potassium was significantly reduced in relation to the value desired. A lower potassium content in EAR (Estimated Average Requirement) (45.62% of standards) was observed after diet than during the diet (59.54% of standards).

It has been observed of minerals deficiency (iron, magnesium, copper) both during and after the protein diet. In the case of zinc content, a deficiency was noted after the diet, while during the course of the diet, the zinc content was slightly above the desirable value at 119%.

Vitamin contents also differ depending on the type of diet. During the Dukan Diet thiamine and vitamin C were in deficiency, while riboflavin (200.90%) and piridoxine (166.92%) were slightly above the recommended values. In turn, after the diet there was a deficiency in thiamine and vitamin D.

The average age of the women participating was 36.9±13.00. Most had increased body weight (overweight / obese). A small number of women had a normal body weight, while none were underweight (table 2).

The blood chemistry showed reduced neutrophil levels [%], as well as increased monocyte [%; a thousand/μl], increased glucose, LDL cholesterol and triglycerides in the blood. There were no negative changes in the liver panel (table 4).

## Discussion

In this study the nutritional values of the Dukan Diet and nutrition were evaluated. The resulting analysis shows that women did not receive adequate amounts of energy from the diet, and in both diets there was a deficiency in terms of most nutrients, while in other cases the values exceeded the recommended standards. The reduced energy values of the diet in relation to energy needs promote a reduction in the body weight. However, this may result from muscle mass loss, which as a result, leads to a reduction in the pace of the basal metabolism and a yo-yo effect (28, 29).

The Dukan Diet's first phase lasts about 7 days. In this phase is allowed an unlimited consumption of products such as poultry, rabbit, veal, beef, horsemeat, offal, other meats, seafood, fish, lean dairy and eggs. In addition, it is recommended to drink 1.5 l of water per day (6, 13, 30).

The current recommendations propose consumption of unsweetened drinks during the day, and water consumption for adult women of about 2 l (26). During the Dukan Diet, this recommendation of 1.5 l of water per day is therefore insufficient. According to Canadian and USA recommendations, water consumption for women should be about 2.7 l per day, and for men about 3.7 l per day (31, 32).

**Table 2.** Classification of women by BMI

| BMI classification | BMI ranges [kg/m$^2$] | Percentage distribution of BMI |
|---|---|---|
| Obesity | 30.00 – 34.90 | 31.3% |
| Overweight | 25.00 – 29.90 | 53.1% |
| Normal weight | 18.50 – 24.90 | 15.6% |
| Underweight | < 18.5 | 0.0% |

**Table 3.** Estimated mean values of nutrients during the Dukan Diet, as well as after its completion

| Content of nutrients | During the Dukan Diet | After the Dukan Diet | Nutritional standards |
|---|---|---|---|
| Energy [kcal] | 948±306[a] | 1295.87±561.73[b] | 2000 kcal |
| Protein [g] | 104.38±26.39[a] | 57.01 ±24.45[b] | 75 g [15%] |
| Fat [g] | 32.41 ±20.1[a] | 48.47 ±29.50[b] | 66,66 g |
| Carbohydrate [g] | 71.38±49.40[a] | 171.35±75.33[b] | 275 g [55%] |
| SFA[g] | 12.27±5.64[a] | 18.31±11.53[b] | 22,22 g [<10%] |
| MUFA [g] | 11.14±8.42[a] | 19.33±13.37[b] | N/A |
| PUFA [g] | 4.74±3.36[a] | 7.24±4.92[b] | N/A |
| Cholesterol [mg] | 462±275.25[a] | 239.63±165.01[b] | N/A |
| Fiber [g] | 12.52±8.38[a] | 13.84 ±7.58g[a] | >25 |
| Sodium [mg] | 1651.18±911.19[a] | 1546.49± 972.09[a] | 1500 |
| Potassium [mg] | 2798.19±1006.08[a] | 2144.22± 925.34[a] | 4700 |
| Magnesium [mg] | 282.67±95.28[a] | 194.85± 88.72[b] | 320 |
| Iron [mg] | 9.27±4.59[a] | 7.97±3.50[a] | 18 |
| Zinc [mg] | 9.52±3.30[a] | 7.10±3.09[a] | 8 |
| Copper [mg] | 0.74±0.33[a] | 0.80±0.35[a] | 0,9 |
| $B_1$ [mg] | 0.79 ±0.28[a] | 0.79±0.40[a] | 1,1 |
| $B_2$ [mg] | 2.21±1.10[a] | 1.17±0.63[a] | 1,1 |
| $B_6$ [mg] | 2.17±0.67[a] | 1.27±0.60[a] | 1,3 |
| Vitamin C [mg] | 37.6±42.16[a] | 77.37±72.43[b] | 75 |
| Vitamin D [mg] | 5.46±7.30[a] | 3.19±5.47[a] | 5 |

In the next phase (the cruise phase) are allowed a small amount of vegetables, which are added to the protein diet. During the consolidation phase (phase 3) some fruits are included in small amounts, as well as full-fat cheese, whole meal bread in quantities of 40 g per day and other starch products consumed twice a week in a maximum amount of 200 g. The stabilization phase, which should last until the end of one's life, assumes that for one day per week, the user must adhere to the recommendations of the first phase of the diet by using a high-protein diet (1, 13, 30). When used for a long time, alongside the previously mentioned health consequences, such a diet might also contribute to an increased risk of gout. The Dukan Diet is characterized by excessive consumption of products of animals origin. High meat and/or seafood consumption increases the risk of gout (33). Such a diet is also a source of purines. As a result, the concentration of uric acid in the blood increases. If used in the long term, a high-protein diet will therefore result in an acid-alkaline imbalance in the body, and might also contribute to increased instances of high blood pressure, coronary heart disease (34-37), osteoporosis (38, 39), kidney stones (40, 41), and other disorders related to the kidney function (34-37). In this study, the high-protein diet resulted in the average weight loss of 15 kg in seven months. Comparing these values to other authors we observe similar results. According to other

**Table 4.** The average value of the biochemical parameters of blood after the protein diet

| Biochemical Parameter | Score | Reference range (27) |
|---|---|---|
| **COMPLETE BLOOD COUNT (CBC)** | | |
| White Blood Cells (WBC) [tys/µl] | 7.33±2.35 | 4.0-10.00 |
| Red Blood Cells (RBC) [mln/ µl] | 4.43±0.70 | 3.5-5.2 |
| Hemoglobin [g/dl] | 13.41±1.69 | 12.00-16.00 |
| Hematocrit [%] | 38.84±5.61 | 37.00-47.00 |
| MCV [fl] | 88.15±5.88 | 82.00-92.00 |
| MCH [pg] | 30.05±2.63 | 23.00-31.00 |
| MCHC [g/dl] | 33.27±2.15 | 32.00-36.00 |
| Thrompocytes [tys/µl] | 205.56±72.18 | 150-400 |
| Neutrophils [tys/µl] | 3.54±0.97 | 1.8-8.00 |
| Lymphocytes [tys/µl] | 2.70±0.57 | 1.00-5.00 |
| **Monocytes [tys/µl]** | **1.01±1.44** | **0.03-0.8** |
| **Eozynophils [tys/µl]** | **0.45±0.34** | **0.05-0.4** |
| **Bazophils** [tys/µl] | 0.02±0.01 | 0.00-0.30 |
| **Neutrophils [%]** | **51.10±9.77** | **60.00-70-00** |
| Lymphocytes [%] | 32.77±3.58 | 20.00-45.00 |
| **Monocytes [%]** | **17.14±14.51** | **4.0-8.00** |
| **Eozynophils** [%] | 3.08±1.09 | 2.0-4.0 |
| **Bazophils [%]** | **0.35±0.20** | **0.0-1.0** |
| **GLUCOSE (mg/dl)** | | |
| **Glucose [mg/dl]** | **105.92±24.90** | **61.00-99.00** |
| **LIVER PANEL** | | |
| AST [U/l] | 22.29±5.29 | <40.00 |
| ALT [U/l] | 27.07±6.04 | <40.00 |
| Total bilirubin [mg/dl] | 0.43±0.09 | 0.30-1.20 |
| Alkaline phosphatase [IU/l] | 56.96±5.20 | <270.00 |
| GGTP [IU/l] | 27.88±6.54 | <35.00 |
| **LIPIDOGRAM** | | |
| Total cholesterol (TC) [mg/dl] | 194.39±41.75 | 114.00-200.00 |
| HDL cholesterol [mg/dl] | 60.67±13.74 | >50.00 |
| **LDL cholesterol [mg/dl]** | **134.57±22.74** | **<100.00** |
| **Triglycerides [mg/dl]** | **152±48.32** | **<150** |

authors the average high-protein diet caused body weight loss of 6,3 kg per six months (15-23).

Analysis has shown that the Dukan Diet is deficient in many vitamins, including vitamins C and B, nor does this diet provide a sufficient amount of dietary fiber. Korean research has shown that people with hyperuricemia have a reduced intake of vitamin C in comparison with healthy people (42, 43). In addition, in patients with hyperuricemia, reduced consumption of other nutrients such as vitamin A, folic acid, calcium and fiber, is also reported (42), which can be considered a potential prevalence factor for gout. In addition, other studies confirm that increased vitamin C in the diet can reduce both uric acid levels ( 44) and also the risk of gout (45). The diet of people with hyperuricemia is not well balanced and is associated with reduced consumption of vegetables and dairy products in comparison with the increased consumption of alcohol in the control group (42).

When comparing a percentage coverage standard for nutrients during and after the Dukan Diet, it was found that the diet of women was not balanced. The Dukan Diet does not shape correct eating habits. Moreover, in the food rations of women on this diet, and who had finished the diet, deficiency in many nutrients in the diet was demonstrated, including: fiber, potassium, magnesium, iron, zinc, copper, vitamin B1 and vitamin D. Moreover, subjects revealed an increased concentration of eosinophils, basophils, monocytes in the blood, and also decreased percentage values of neutrophils. An excess of eosinophils can result from allergy, aspirin-induced asthma, infections (above all, from parasites), myelodysplastic syndrome, connective tissue diseases, tumoral diseases, and also Churg-Strauss' syndrome and Löffler's syndrome. In turn, there may be a too high level of basophils, because of hyperplastic processes (e.g. chronic myelomonocytic leukemia, chronic myleoid leukemia, acute basophilic leukemia, polycythemia vera). Increased concentrations of monocytes in the blood also relate to tumoral diseases, but may also refer to different kind of infections, non-specific inflammation of the bowel, systemic diseases of connective tissue, alcoholic liver disease, and granulomatous (27). In this instance, increased percentage of monocytes suggests, first of all, the presence of inflammation, which may result from the presence of type 2 diabetes (increased blood sugar levels), or atherosclerosis (46) (a diet rich in animal products and increased levels of total cholesterol). Many authors claim that when used for extended periods of time a high-protein diet may have a negative effect on the liver (2, 5, 6). The lack of negative changes in the liver panel may result from a short period of the high-protein diet in the group of investigated women.

## Refrences


1. Wyka J, Malczyk E, Misiarz M, Zołoteńka-Synowiec M, Całyniuk B, Baczyńska S. Assessment of food intakes for women adopting the high protein Dukan diet. Rocz Panstw Zakl Hig 2015;66(2):137-142
2. Knight EL, Stampfer MJ, Hankinson SE, Spiegelman D, Curhan DC. The impact of protein intake on renal function decline in women with normal renal function or mild renal insufficiency. Ann Intern Med 2003;138:460-467
3. Veldhorst M, Smeets A, Soenen S, et al. Protein-induced satiety: effects and mechanisms of different proteins. Physiol Behav 2008;94(2):300-7
4. Campbell WW, Tang M. Protein intake, weight loss, and bone mineral density in postmenopausal women. J Gerontol A Biol Med Sci 2010;65(10):1115-22
5. Busett L, Marangan M, de Stefano F. High-protein low-carbohydrate diets: what is the rationale. Diabetes Metab Res Rev 2011;27:230-232
6. Kłosiewicz – Latoszek L., Szostak W.L. Controversy concerning weight reducing diets, Post N Med 2011;9:790-794
7. Reguła J. Description and the evaluation of chosen alternative diets. Forum Zab Metabol 2013;4(3):115-121
8. Bowen J, Noakes M, Trenerzy C, Clofton PM. Energy intake, ghrelin, and cholecystokinin and protein preloads in overweight men. J Clin Endocrinol Metab 2006;91(4):1477-1483
9. Lejeune M, Westerterp KR, Adam TCM, Luscombe-Marsh ND, Westerterp-Plantenga MS. Ghrelin and glucagon-like peptide 1 concentrations, 24-h satiety, and energy and substrate metabolism during a high-protein diet and measured in a respiration chamber. Am J Clin Nutr 2006;83(1):89-94
10. Gil – Campos M, Aguiler CM, Canete R, Gil A. Ghrelin: a hormone regulating food intake and energy homeostasis. Br J Nutr 2006;96:201 – 226
11. Polińska B, Matowicka-Karna J, Kemona H. The role of ghrelin in the organism. Post Hig Med Dośw 2011;65:1-7
12. Weigle DS, Breen PA, Matthys CC, et al. A high-protein diet induces sustained reductions in appetite, ad libitum caloric intake, and body weight despite compensatory changes in diurnal plasma leptin and ghrelin concentrations. Am J Clin Nutr 2005;82(1):41-8
13. Dukan P. The Dukan Method. Wydawnictwo Otwarte. Kraków 2009
14. Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans 2010
15. Lepe M, Bacardí Gascón M, Jiménez Cruz A. Long-term

efficacy of high-protein diets: a systematic review. Nutr Hosp. 2011;26(6):1256-1259
16. Due A, Toubro S, Skov AR, Astrup A. Effect of normal-fat diets, either medium or high in protein, on body weight in overweight subjects: a randomised 1-year trial. Int J Obes Relat Metab Disord 2004;28(10):1283-90
17. Keogh JB, Luscombe-Marsh ND, Noakes M, Wittert GA, Clifton PM. Long-term weight maintenance and cardiovascular risk factors are not different following weight loss on carbohydrate-restricted diets high in either monounsaturated fat or protein in obese hyperinsulinaemic men and women. British Journal of Nutrition 2007;97(02):405-10
18. Brinkworth GD, Noakes M, Keogh JB, Luscombe ND, Wittert GA, Clifton PM. Long-term effects of a high-protein, low-carbohydrate diet on weight control and cardiovascular risk markers in obese hyperinsulinemic subjects. Int J Obes Relat Metab Disord 2004;28(5):661-70
19. Brinkworth GD, Noakes M, Buckley JD, Keogh JB, Clifton PM. Long-term effects of a very-low-carbohydrate weight loss diet compared with an isocaloric low-fat diet after 12 mo. Am J Clin Nutr 2009;90(1):23-32
20. McAuley KA, Smith KJ, Taylor RW, McLay RT, Williams SM, Mann JI. Long-term effects of popular dietary approaches on weight loss and features of insulin resistance. Int J Obes Relat Metab Disord 2005;30(2):342-9
21. Skov AR, Toubro SRB, Holm L, Astrup A. Randomized trial on protein vs carbohydrate in ad libitum fat reduced diet for the treatment of obesity. Int J Obes 1999; 23(5):528-36
22. Clifton PM, Keogh JB, Noakes M. Long-term effects of a highprotein weight-loss diet. The American Journal of Clinical Nutrition 2008;87(1):23-9
23. Brinkworth GD, Noakes M, Parker B, Foster P, Clifton PM. Long-term effects of advice to consume a high-protein, low-fat diet, rather than a conventional weight-loss diet, in obese adults with Type 2 diabetes: one-year follow-up of a randomised trial. Diabetol 2004; 47(10):1677-86
24. Fung TT, van Dam RM, Hankinson SE, Stampfer R, Willett WC, Hu FB. Low-carbohydrate diets and all-cause and cause-specific mortality, The cohort studies. Ann Intern Med 2010;153:289-298
25. Szponar L, Wolnicka K, Rychlik E. Album of photographs of food products and dishes. Instytut Żywności i Żywienia. Warszawa 2000
26. Jarosz M., (editor). Normy żywienia dla populacji polskiej – nowelizacja. Instytut Żywności i Żywienia. Warszawa 2012
27. Dittfeld A. Diagnostyka dla dietetyka. Podręcznik diagnostyki dla studentów dietetyki. Śląskie Centrum Zdrowia 2015
28. Woźniewicz M, Jeszka J. Diety odchudzające i skuteczność ich stosowania. Energia w żywności i żywieniu. Gawęcki J, Jeszka J. (editor). UP Poznań 2010:115 – 122
29. Łagowska K, Woźniewicz M, Jeszka J. Estimation of nutritional value of hypocaloric diets published on Internet portals. Probl Hig Epidemiol 2011;92(4):824-827
30. Dukan P. Nie potrafie schudnąć. Wydawnictwo Otwarte. Kraków 2008
31. Jarosz M, Bułhak-Jachymczyk B. Normy żywienia człowieka. Podstawy prewencji otyłości i chorób niezakaźnych. Wydawnictwo Lekarskie PZWL. Warszawa 2008
32. Brzozowska A, Gawęcki J. Woda w żywieniu i jej źródła. Wyd. II. Wydawnictwo Uniwersytetu Przyrodniczego w Poznaniu 2015;15-47
33. Choi HK, Atkinson K, Karlson EW, Willett W, Curhan G. Purine-Rich Foods, Dairy and Protein Intake, and the Risk of Gout in Men. N Engl J Med 2004;350:1093-1103
34. Perlstein TS, Gumieniak O, Hopkins PN, Murphey LJ, Brown NJ, Williams GH, Hollenberg NK, Fisher ND. Uric acid and the state of the intrarenal renin-angiotensin system in humans. Kidney Int 2005;67:1739-1742
35. Zoccali C, Maio R, Mallamaci F, Sesti G, Perticone F. Uric acid and endothelial dysfunction in essential hypertension. Am Soc Nephrol 2006;17:1466-1471
36. Viazzi F, Leoncini G, Ratto E, et al. Mild hyperuricemia and subclinical renal damage in untreated primary hypertension. Am J Hypertens 2007;20:1276-1282
37. Brinkworth G.D, Buckley JD, Noakes M, Clifton PM. Renal Function Following Long-Term Weight Loss in Individuals with Abdominal Obesity on a Very-Low-Carbohydrate Diet vs High Carbohydrate Diet. J Am Diet Assoc 2010;110:633-638
38. Lutz J. Calcium balance and acid-base status of women as affected by increased protein and by sodium bicarbonate ingestion. Am J Clin Nutr 1984;39:281-288
39. Sellmeyer DE, Stone KL, Sebastian A, Cummings SR. A high ratio of dietary animal to vegetable protein increases the rate of bone loss and the risk of fracture in postmentopausal women. Am J Clin Nutr 2001;73:118-122
40. Poortmans JR, Dellalieux O. Do regular high-protein diets have potential health risks on kidney function in athletes? Int J Sports Nutr 2000;10:28-38
41. Reddy ST, Wang CY, Sakhaee K, Brinkley L, Pak CY. Effect of low carbohydrate highprotein diets on acid-base balance, stone forming propensity, and calcium metabolism. Am J Kidney Dis 2002;40(2):265-274
42. Ryu KA, Kang HH, Kim SY, et al. Comparison of nutrient intake and diet quality between hyperuricemia subjects and controls in Korea. Clin Nutr Res 2014;3(1):56-63
43. Towiwat P, Li ZG. The association of vitamin C, alcohol, coffee, tea, milk and yogurt with uric acid and gout. Int J Rheum Dis 2015;18(5):495-501
44. Huang HY, Appel LJ, Choi MJ, et al. The effects of vitamin C supplementation on serum concentrations of uric acid: results of a randomized controlled trial. Arthritis Rheum 2005;52(6):1843-7
45. Choi HK, Gao X, Curhan G. Vitamin C intake and the risk of gout in men: a prospective study. Arch Intern Med 2009;169(5):502-7
46. Winiarska H, Bobkiewicz – Kozłowska T, Jagodziński PP, Kempisty B, Dworacka M. Aktywacja prozapalna monocytów krwi obwodowej u chorych na cukrzycę typu 2. Prz Kardiodiabetol 2009;4(3):125-132

Correspondence:
Julita Regula
Institute of Human Nutrition and Dietetics,
Poznan University of Life Sciences, Wojska Polskiego
Str. 31, 60-624 Poznan, Poland
E-mail: julita.regula@up.poznan.pl