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APPRECIATION OF CONCENTRATION OF LIPOPROTEINS AND APOLIPOPROTEINS IN SERUM OF MALE RATS UNDER THE INFLUENCE OF DIET CHANGE COMPOSITION AND ITS SUPPLEMENTATION WITH GROUP B VITAMINS

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Background. This study was aimed at exploring, on animal model, how the diet changes, which results in exceeding 5 times the amount of deficit of group B vitamins after diet change, which up to a certain extent imitates supplementation method in people, influences the concentration of apolipoprotein A-I and apolipoprotein B – the components of lipoprotein HDL-C and LDL-C.
Material and methods. The research was conducted on 24 WISTAR male rats, aged ca 5 months. The animals were divided into 3 feeding groups: I was fed with basic compound which contained among others full wheat grain and corn grain, group II and III with modified compound in which part of the full wheat grain, from basic compound, was substituted for wheat flour, and 50% of corn with saccharose. Group I and II animals were drinking pure tap water which was left to stand for some time beforehand, group III animals vitamins dissolved in water: B_1, B_2, B_6, and PP – five times exceeded the difference between the amount of basic and modified feed, which in a certain way imitated the supplementation in human food. After one week of animals conditioning, the experiment was conducted for 6 weeks. In their blood serum were determined concentration of glucose (GL), triacyloglycerols (TG), total cholesterol (TC), fraction of HDL-cholesterol (HDL-C), fraction of LDL-cholesterol (LDL-C) and apolipoproteins A-I (apo A-I) and apolipoproteins B (apoB). In the dissected muscles and in the animals' livers the amount of fat was determined with Soxhlet's method. The obtained results were analysed with one factor variance by use of statistic computer program Statistica® with application of Duncan test.
Results. Analysing the influence of diet change and its supplementation with chosen group B vitamins on the amount of consumed feed, it was ascertained that in spite of the same calorific value of the used feed, significantly less, compared to other groups, was

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consumed by the animals from the supplemented group. However, there was no significant gain of body mass in male rats and higher accumulation of pericardial and perintestinal fat tissue. Significantly lower amount of fat, in comparison to animals fed with basic feed, was observed in muscles of animals fed with modified and supplemented feed, however significantly higher amount of fat was found in liver. In animals fed with modified feed compared with animals fed with basic feed higher GL, TG, TC its LDL-C fraction and apoB and decrease of fraction HDL-C concentration was noticed. The applied supplementation with group B vitamins statistically significantly lowered concentration of GL, TG, LDL-C fraction, apoB and increased concentration of TC. Observed decrease concentration of HDL-C fraction, apoA-I, apoB and increased TC in serum of supplemented animals it was statistically insignificant.

Conclusions. Analysis of the obtained results allowed stating that supplementation of diet with chosen group B vitamins in which full grains were exchanged for wheat flour and saccharose, was favourable to returning to original state of disadvantageous effects brought by change of diet content. It was demonstrated by decrease of glucose, triacyloglycerols, lipoprotein LDL-C and apoB concentration while lipoproteins HDL-C and apoA-I were decreased and increase of total cholesterol in blood of rats under research, although not all changes were statistically significant.

Key words: supplementation, vitamins B groups, lipids, lipoproteins, apolipoproteins, rats

INTRODUCTION

As numerous studies show, the method of modern society nutrition is characterised in a substantial imbalance of consumption of basic food components including vitamins and minerals. Almost 25-75% of society [Kunachowicz et al. 2004] applies, without clear medical indication, often as a result of aggressive media advertisement, diet supplementation with, among others group B vitamins. One of the methods of preventing insufficient consumption of vitamins and mineral components, directed on realisation of feeding norms for these components, is enriching consumption products with them. Only these groups of consumption products, which are the natural source of vitamins which were lost during the applied technological processes, should be enriched. Wheat flour is often enriched with group B vitamins (vitamins are lost during grinding of the grain to obtain flour), as well as breakfast cereal products [Pietruszka and Brzozowska 1999]. Although group B vitamins are recognised as non-toxic, and when overdosed being excreted in urine, nevertheless the period of their inhabitation in the body leads to numerous substantial changes in protein, fat and carbohydrates metabolism [Friedrich 2004, Friedrich and Goluch-Koniuszy 2009]. It appears in author's own research [Friedrich and Goluch-Koniuszy 2007, 2009] that changing diet content in which whole products (full wheat grain and corn) are replaced with wheat flour and saccharose of the same calorific value and supplementing such a diet with chosen group B vitamins, causes substantial changes, among others, in lipids metabolism. In this domain substantial increase in tricyloglycerols, total cholesterol, lipoproteins VLDL-C, LDL-C concentration was ascertained, while decrease of lipoprotein HDL-C concentration was observed.

This study was aimed at exploring, on animal model, how the diet changes, which results in exceeding 5 times the amount of deficit of group B vitamins after diet change,

which up to a certain extent imitates supplementation method in people, influences the concentration of apolipoprotein A-I and apolipoprotein B – the components of lipoprotein HDL-C and LDL-C.

MATERIAL AND METHODS

The research, after obtaining the approval of Local Ethical Commission (agreement no 17/2009), was conducted on 24 Wistar male rats, aged ca 5 months, with initial body mass 434.9 g ±29.1 g, which stayed in separate cages in air conditioned vivarium, in temperature 21 ±1°C, cycle of light light/dark 12 h/12 h.

The animals were divided into 3 feeding groups with the same number of animals in each and were fed *ad libitum* with granulated compounds, produced by Wytwórnia Pasz in Kcynia. Group I was fed with basic compound which contained among others full wheat grain and corn grain, group II and III with modified compound in which part of the full wheat grain, from basic compound, was substituted for wheat flour, and 50% of corn with saccharose (Table 1). The feed was of the same calorific value (Table 2).

Table 1. Percentage of components of fodders

Component	Basic fodder, %	Modified fodder, %
Wheat	36.4	6
Corn grain	20	10
Wheat bran	20	20
Dray whey	3.0	3.0
Fodder salt	0.3	0.3
Soy-bean grain 48%	18	18
Fodder chalk	1.5	1.5
Fosforan 2-CA	0.8	0.8
Wheat flour (type 500)	–	30.4
Saccharose	–	10

Feed and Concentrate Manufactures in Kcynia, Poland, following implementation of Procedure 5.14.5 (Cleaning of Machinery and Equipment).

Group I and II animals were drinking pure tap water which was left to stand for some time beforehand. Group III animals, during the period of increased activity, received 30 ml of vitamins dissolved in water: B_1 – 0.560 mg (Teva Pharmaceuticals), B_2 – 0.130 mg (Pliva Kraków), B_6 – 0.490 mg (Pliva Kraków), PP – 5.25 mg (Glaxo-SmithKline Pharmaceuticals) for each 100 g of feed. The amount of vitamins, calculated for the amount of feed eaten by the animals feed, five times exceeded the difference between the amount of basic and modified, which in a certain way imitated the supplementation in human food. The animals, after drinking the vitamin solution were given clean, tap water which was left to stand for sometime beforehand.

Table 2. Chemical composition of fodders used in the experiment

Component	Basic fodder	Modified fodder (Mf)
Total protein, %	19.1	18.5
Crude fat, %	2.8	2.3
Carbohydrates, %	63.8	65.5
Dry matter, %	91.8	92.3
Total ash, %	6.1	6.0
Brutto energy		
$kcal \cdot g^{-1}$	3.99	3.98
$kJ \cdot g^{-1}$	16.73	16.67
Metabolic energy		
$kcal \cdot g^{-1}$	3.57	3.57
$kJ \cdot g^{-1}$	14.95	14.94

After one week of animals conditioning, the experiment was conducted for 6 weeks during which the amount of consumed feed and in the supplemented group also the amount of taken vitamins, was calculated. The body mass of the animals was checked once a week.

Twelve hours before the end of the research animals stopped to be fed. Next the animals were put to sleep with an anesthetic (Ketanest), blood was taken from their hearts and after centrifugation concentration of glucose (GL) determined with the enzymatic colorimetric technique of Trinder [1969] by using BioMaxima diagnostic set, tricyloglycerols (TG) determined with the enzymatic colorimetric technique of McGowan et al. [1983] by using Biolabo diagnostic set, total cholesterol (TC) determined with the enzymatic colorimetric technique of Stein [1987] with by using BioMaxima diagnostic set, fraction HDL-cholesterol (HDL-C) following precipitation technique of Burstein at al. [1970] by using Aqua-Med diagnostic set, fraction of LDL-cholesterol (LDL-C) following precipitation technique of Assmann et al. [1984] by using BioSystems diagnostic set and apolipoproteins A-I (apo A-I) and apolipoproteins B (apoB) method a liquid-phase immunoprecipitation assay with nephelometric end-point detection [Fruchart et al. 1982] by using Orion Diagnostica set were determined in their blood serum.

In the dissected muscles (in *m. quadriceps femoris*, *m. biceps femoris*, *m. semimembranosus*, *m. superficialis glutenus*) and in the animals' livers the amount of fat was determined with Soxhlet's method according to PN-ISO 1444-2000. Pericardial and peri-intestinal fat was dissected currently and weighted exactly to 0.001 g.

The obtained results were analysed with one factor variance by use of statistic computer program Statistica® with application of Duncan test.

RESULTS

Analysing the influence of diet change and its supplementation with chosen group B vitamins on the amount of consumed feed, it was ascertained that in spite of the same

calorific value of the used feed, significantly less, compared to other groups, was consumed by the animals from the supplemented group (Table 3). However, there was no significant gain of body mass in male rats under the research. There was also no, under the influence of the applied research factors, higher accumulation of epicardiac and perienterc fat tissue calculated both on 100 g of body mass and on 100 g of consumed feed. Significantly lower amount of fat, in comparison to animals fed with basic feed, was observed in muscles of animals fed with modified and supplemented feed, however significantly higher amount of fat was found in liver (Table 3).

Table 3. The effect type of diet and supplementation vitamin with B group on body weight, fodder consumption and lipids contents in male rats (x ±SD, n = 24)

Trait	Basic fodder (a)	Modified fodder (Mf) (b)	Mf + supplementation (c)	Statistical significant
Feed consumption $g \cdot 100\ g^{-1}$ body weight	163.2 ±14.4	158.0 ±5.9	144.8 ±14.6	a-c*
Body weight gain $g \cdot 100\ g^{-1}$ feed	5.3 ±1.0	4.8 ±1.2	5.4 ±1.9	–
Pericardial fat $g \cdot 100\ g^{-1}$ body weight	0.019 ±0.008	0.018 ±0.005	0.015 ±0.003	–
Pericardial fat $g \cdot 100\ g^{-1}$ feed	0.012 ±0.005	0.011 ±0.003	0.010 ±0.002	–
Peri-intestinal fat $g \cdot 100\ g^{-1}$ body weight	0.98 ±0.1	1.07 ±0.2	1.07 ±0.1	–
Peri-intestinal fat $g \cdot 100\ g^{-1}$ feed	0.61 ±0.09	0.67 ±0.09	0.70 ±0.12	–
Intramuscular fat, %	2.89 ±0.5	2.25 ±0.3	2.87 ±0.4	a-b** b-c*
Hepatic fat, %	2.24 ±0.4	2.53 ±0.4	2.68 ±0.2	a-c**

*Statistically significant difference $p \leq 0.05$.
**Statistically significant difference $p \leq 0.01$.

Significant influence of the diet change and its supplementation with group B vitamins on the content of glucose, lipoproteins, and apolipoproteins in blood serum of the animals under research was noticed (Table 4). In animals fed with modified feed compared with animals fed with basic feed higher glucose, triacyloglycerols, total cholesterol its LDL-cholesterol fraction and apolipoprotein B and decrease of fraction HDL--cholesterol concentration was noticed.

The applied supplementation with group B vitamins statistically significantly lowered concentration of GL, TG, LDL-C fraction, apoB and increased concentration of TC. Observed decrease concentration of HDL-C fraction, apoA-I, apoB and increased TC in serum of supplemented animals it was statistically insignificant.

Table 4. The effect of diet type and supplementation with vitamin B group on selected lipids, lipoproteins and apolipoproteins levels in male rat serum (x ±SD, n = 24)

Trait	Basic fodder (a)	Modified fodder (Mf) (b)	Mf + supplementation (c)	Statistical significant
Glucose, mmol·l^{-1}	7.29 ±1.52	7.65 ±1.0	6.72 ±1.6	b-c*
Triacylglicerols mmol·l^{-1}	0.44 ±0.04	0.60 ±0.07	0.45 ±0.09	a-b** a-c** b-c**
Total cholesterol mmol·l^{-1}	1.71 ±0.2	2.06 ±0.1	2.19 ±0.1	a-b** a-c**
HDL-cholesterol mmol·l^{-1}	1.05 ±0.1	0.87 ±0.1	0.80 ±0.2	a-b** a-c**
LDL-cholesterol mmol·l^{-1}	0.76 ±0.2	0.99 ±0.1	0.83 ±0.1	a-b** b-c*
Apolipoprotein A-I g·l^{-1}	0.53 ±0.2	0.57 ±0.2	0.50 ±0.1	–
Apolipoprotein B, g·l^{-1}	0.21 ±0.1	0.57 ±0.02	0.50 ±0.2	a-b** a-c**
Total cholesterol//HDL--cholesterol	1.64 ±0.3	2.38 ±0.2	2.84 ±0.7	a-b** a-c** b-c*

*Statistically significant difference $p \leq 0.05$.
**Statistically significant difference $p \leq 0.01$.

DISCUSSION

Analysing the obtained results it was found that in spite of significant decrease of feed consumption calculated on 100 g of body mass, under the influence of diet content change and its supplementation with chosen group B vitamins, no significant changes in body mass in animals under research were observed. The observed lower consumption of feed by animals fed with modified feed and modified and supplemented feed, containing easily accessible starch and saccharose resulting from diet content change (full grain wheat was replaced for wheat flour and 50% of corn grain for saccharose) could be the cause of deepening deficiency of components controlling carbohydrate – lipid metabolism e.g. Ca, Mg, Cr, Zn [Busserolles et al. 2003, Parikh and Yanowski 2003, Zemel 2002].

The change of diet content and applied supplementation brought about significant changes in lipid accumulation. Significant decrease of lipid accumulation in muscle tissue of animals fed with modified feed compared with animals in other groups was observed. The noticed changes can be explained by found in earlier research [Friedrich 2004] decrease of insulin concentration, because the result of increased release of free

fatty acids from adypocytes under the influence of hormone-dependant lipoprotein lipase (LPL), is their lower transportation to skeleton muscles and higher intake by hepatocytes. What is more the skeleton muscles do not release lipids but play significant role in removing not esterified fatty acids (NEFA) from blood during rest, hunger and after food consumption. During the period of higher NEFA inflow and increased intensity of fatty acids burning, glucose oxidation in skeleton muscles is suppressed by acetyl-CoA (in Randle's glucose-fatty acids cycle) deriving from lipids. It leads to decrease of glucose intake by muscles and intensifies insulin resistance [Randle 1998].

The content of fat in liver is the resultant of uptake speed of free and esterified fatty acids, lipid synthesis from carbohydrates and amino acids and lipoprotein release speed and lipids exploitation. In the conducted research a substantially higher accumulation of lipids in livers of animals under research, being the effect of application of experiment factors, was found. Morral et al. [2007] showed that rich in carbohydrates diet, applied to rats, independent of insulin, caused over expression of genes responsible for enzyme activity responsible for intensifying conversion of glucose into fatty acids such as: liver type-pyruvate kinase (L-PK), malic enzyme, fatty acid synthase (FAS) and stearoyl-CoA desaturase 1 (SCD-1), and also over expression of genes reducing activity of enzymes engaged in mitochondrial β-oxidation of fatty acid oxidation and citric acid cycle. This diet, because of the increased expression of genes induced by glucose metabolism was favourable to fatty degeneration of liver.

The increase of lipids accumulation in supplemented animals' liver can be explained by administration of niacin which is substrate for coenzyme NAD^+ and its phosphorylated form of $NADP^+$ [Packard et al. 1980]. NAD^+ exists most often in carbohydrates, lipids, and proteins katabolic reactions and $NADP^+$ for instance in synthesis of fatty acids and cholesterol in biosynthesis reactions. It was shown that excess administration of nicotinic acid has negative influence, among others, on liver metabolism [Henderson 1983] because it is responsible for such an increase of glucose which the speed of its transformation in tissues can not compensate, which leads to incorporating it in fat tissue [Wahlberg et al. 1992]. The excess amount of thiamine, which forces glucose metabolism through pentose cycle supplying pentose for NADPH synthesis, could play substantial role in fatty acids synthesis in livers of supplemented animals.

Disadvantageous influence of diet content change and its supplementation with chosen group B vitamins appeared also in significant changes in glucose, lipids and lipoproteins content in animals under research. Saccharose present in modified diet could have influenced the observed decrease of glucose concentration and increase of tricyloglycerols and total cholesterol concentration in blood serum of the animals under research in two ways: by supplying glucose used for triacyloglycerols synthesis *de novo* and supplying fructose, which stimulates metabolic paths in liver leading to intensification of fatty acids synthesis and their esterification and thereby increase of TG concentration [Busserolles et al. 2003]

Intensification of TG synthesis in liver could have been also the result of direct supplying of unesterefied fatty acids (NEFA) to portal circulation by acceleration of lypolysis in the increased accumulated visceral fat tissue [Friedrich and Goluch-Koniuszy 2007]. This is bound to be the result of losing insulin activity suppression on the hormone-sensitive lipase of fat tissue, thus accumulation of free fatty acids in liver, taking part in synthesis of TG incorporated into VLDL-C fraction. VLDL-C fractions released from liver to circulation could be slowly metabolized by endothelial lipoprotein lipase (LDL), which led to the observed in the research, increase of TG level in blood serum of

animals fed with modified feed. However, the observed decrease of TG concentration in blood serum of animals fed with modified and supplemented feed can be explained by application of niacin, which suppresses DAGT2 (diacylglycerol acyltransferase 1) responsible for TG synthesis in liver assigned to produce VLDL-C [Ganji et al. 2004].

Found in the conducted research significant increase of total cholesterol concentration in blood serum of animals fed with modified feed was the result of changes of carbohydrates in glycolytic path associated with citric acid cycle, in supplied feed. Acetyl-CoA, which arose in these process, was the initial substrate to cholesterol synthesis in liver, because the advantageous correlation between the amount of its synthesis and hypertrigliceridemic rate, which is conditioned by increased production of acetyl-CoA and increase of reductase HMG-CoA activity, was already shown. However, substantially higher TC concentration in blood serum of the animals fed with the modified and supplemented feed could have arisen from its defective degradation in liver or the increase of fraction of IDL-C remnants, which concentration was not determined in these experiments and which removal might have been reduced by conversion into derivative compounds e.g. steroid hormones.

Level increase of LDL-C fraction in blood serum of animals fed with modified feed allows assumption that this fraction was not metabolized in a physiological way in tissues containing apoB100 (LDL-R) receptor, but was subject to recirculation in circulation. High level of this fraction in blood serum could have been also caused by, found by Friedrich [2004], decreased insulin concentration responsible for increase of liver endothelial lipase (HLP) activity, which hydrolyzes phospholipids present in LDL-C and HDL-C thus leading to formation of LDL-C and concentration of fraction HDL-C [Krauss 2004] decrease. However the observed significant LDL-C concentration decrease in the group of supplemented animals, in comparison to animals fed with modified feed could be the result of niacin supplementation [Tavintharan and Kashyap 2001] which suppresses TG by suppressing synthesis and esterification of fatty acids by suppressing DGAT, the key enzyme in TG synthesis incorporated in LDL-C fraction.

Concentration of HDL-C fraction shows that both higher removal of cholesterol from cells, which is transferred to LDL-C / VLDL-C and returned to liver after joining LDL-C with receptor for LDL, and is an expression of efficiency of metabolic changes of lipoproteins rich in TG [Frederich and Bayer 2003]. Cholesterol in rats is transported mainly by HDL-C [Hassan 1987]. The decreased concentration of HDL-C found in conducted research could have been the result of decreased apoA-I synthesis, but it could have been also the result of intracellular defect of cholesterol transportation, LCAT lower activity (lecithin-cholesterol acyltransferase) and lipoprotein lipase (LPL) or increased activity of liver lipase (HLP) [Goldberg et al. 1990, Jansen et al. 2002] however, it requires further research. Influence on concentration of HDL-C has also activity of CETP (cholesteryl ester transfer protein) [de Grooth et al. 2004] despite the fact that rats are deprived of it [Tall 1995] the research conducted on rabbits where diet rich in cholesterol was applied, showed change of genes expression (increase of mRNA--CETP in liver) and finally increased concentration of CETP activity in circulation [Quinet et al. 1990]. That is the reason why further research in this field, in the aspect of applying in rats, for research, such as these, experimental factors.

Liver takes part in synthesis and release of apolipoproteins sending direct signal to metabolize lipoprotein [Davis 1999]. Apolipoprotein A-I, the main protein component HDL-C [Eisenberg 1984, Frank and Marcel 2000] plays fundamental role in reversible cholesterol transportation because it is a strong physiological activator of LCAT [Rogers

et al. 1998]. That is why the concentration of apoA-I determines the dependence between synthesis and catabolism of HDL-C particles. Despite the fact that in the conducted research, under the influence of diet change and its supplementation with group B vitamins, statistically significant differences in concentration of apoA-I between groups of animals under research were not found, its decrease along with the decrease of concentration of HDL-C fraction could be noticed.

The reason of apoA-I concentration decrease might be suspected in its decreased synthesis or in increased catabolism [Brinton et al. 1989]. Negative correlation was found [Bigazzi et al. 2004] between high concentration of TG and TC observed in those animals under research, which were fed with modified feed, and catabolism of apoA-I. The increase of TG concentration itself evokes increase of apoA-I catabolism [Brinton et al. 1991] by increasing uptake and removing of apoA-I by kidneys [Goldberg et al. 1990]. In the group of animals fed with modified and supplemented feed low level of HDL-C and apoA-I which was not accompanied by TG increase could have been caused by decrease of synthesis and/or secretion of apoA-I [Le and Ginsberg 1988]. Supplementation with niacin could also have lowered the rate of apoA-I catabolism not influencing its synthesis [Ganji et al. 2003]. What is more, it was also shown [Sorci-Thomas et al. 1989] that feeding factors can also evoke changes in mRNA concentration and thus have influence on the decrease of secretion and concentration of apoA-I, which also makes further research necessary.

ApoB, main structural protein produced in liver, bound with lipoproteins VLDL-C and LDL-C [Davis 1999] is indispensable to bundle LDL-C to LDL-R receptor on the surface of hepatocyte enabling internalization and intake of cholesterol. Substantial increase of concentration of apoB in blood serum of animals fed with modified feed was found during the conducted research, which is bound to found by Friedrich research [2004] decrease of insulin concentration, which is favourable to decreased synthesis of apoB and its higher degradation [Sparks and Sparks 1990]. In the research conducted on hamsters which were on diet rich in fructose [Carpentier et al. 2002, Taghibiglou et al. 2000] or rats [Zago et al. 2010] was shown that such a diet causes insulin resistance, induction of lipogenesis *de novo* and stimulates liver to produce apoB and VLDL-C. However, the found decreased concentration of apoB in blood serum of supplemented animals can also be caused by application of niacin, which has influence on its efficient decrease [Tavintharan and Kashyap 2001]

CONCLUSIONS

Analysis of the obtained results allowed stating that supplementation of diet with chosen group B vitamins in which full grains were exchanged for wheat flour and saccharose, was favourable to returning to original state of disadvantageous effects brought by change of diet content. It was demonstrated by decrease of glucose, tiacyloglycerols, lipoprotein LDL-C and apoB concentration while lipoproteins HDL-C and apoA-I were decreased and increase of TC in blood of rats under research.

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OCENA STĘŻENIA LIPOPROTEIN I APOLIPOPROTEIN WE KRWI SAMCÓW SZCZURA POD WPŁYWEM ZMIANY SKŁADU DIETY I JEJ SUPLEMENTACJI WYBRANYMI WITAMINAMI Z GRUPY B

Wstęp. Celem pracy było zbadanie na modelu zwierzęcym wpływu zmiany składu diety – w ilościach pięciokrotnie przekraczających powstałe po zamianie składników diety niedobory witamin z grupy B, co do pewnego stopnia imituje sposób suplementacji u ludzi – na stężenie wybranych parametrów gospodarki lipidowej.

Materiał i metody. Badania przeprowadzono na 24 samcach szczura rasy Wistar, w wieku około 5 miesięcy. Zwierzęta podzielono na trzy grupy żywieniowe: I otrzymywała mieszankę podstawową, zawierającą m.in. pełne ziarna pszenicy i kukurydzy, natomiast grupy II oraz III – mieszankę zmodyfikowaną, w której część pełnych ziaren pszenicy zastąpiono mąką pszenną, a 50% kukurydzy – sacharozą. Zwierzęta z grupy I i II otrzymywały do picia czystą, odstaną wodę wodociągową, a z grupy III – wodny roztwór witamin: B_1, B_2, B_6 i PP – przewyższał on pięciokrotnie różnicę pomiędzy zawartością tych składników w paszy podstawowej i zmodyfikowanej, co do pewnego stopnia imitowało sposób suplementacji u ludzi. Doświadczenie trwało sześć tygodni po jednotygodniowym okresie kondycjonowania. W surowicy zwierząt oznaczono stężenia: glukozy (GL), triacylogliceroli (TG), cholesterolu całkowitego (TC); frakcji HDL-cholesterolu (HDL-C); frakcji LDL-cholesterolu (LDL-C), apoA-I oraz apoB. W wypreparowanych mięśniach oraz w wątrobach zwierząt oznaczono zawartość tłuszczu metodą Soxhleta. Wypreparowano tłuszcz okołojelitowy i nasierdziowy. Wyniki poddano jednoczynnikowej analizie wariancji, z użyciem komputerowego programu statystycznego Statistica®, z zastosowaniem testu Duncana.

Wyniki. Analizując wpływ zmiany składu diety i jej suplementacji wybranymi witaminami z grupy B na wielkość spożycia paszy, stwierdzono, że pomimo izokaloryczności zastosowanych pasz, istotnie mniej spożywały zwierzęta z grupy suplementowanej, w porównaniu z pozostałymi grupami. Nie towarzyszyły temu jednak: istotny przyrost masy ciała badanych samców szczura oraz zwiększone gromadzenie tkanki tłuszczowej nasierdziowej i okołojelitowej. Istotnie mniejszą zawartość tłuszczu, w stosunku do szczurów żywionych paszą podstawową, obserwowano w mięśniach szczurów żywionych paszą zmodyfikowaną i suplementowaną, natomiast w wątrobach stwierdzono istotnie większą jego zawartość. U zwierząt żywionych paszą zmodyfikowaną, w stosunku do żywionych paszą podstawową, zaobserwowano w surowicy wzrost stężenia GL, TG, TC i jego frakcji LDL-C oraz apoB, oraz zmniejszenie stężenia frakcji HDL-C. Zastosowana suplementacja witaminami z grupy B statystycznie istotnie zmniejszyła stężenie GL, TG oraz LDL-C. Natomiast nieistotne statystycznie okazało się obserwowane zmniejszenie stężenia HDL-C, apoB, apoA-I oraz wzrost TC w surowicy zwierząt suplementowanych.

Wnioski. Suplementacja wybranymi witaminami z grupy B diety, w której pełne ziarna zbóż zastąpiono mąką pszenną i sacharozą, sprzyjała powrotowi do stanu pierwotnego

po niekorzystnych efektach wywołanych zmianą składu diety. Manifestowało się to zmniejszeniem stężenia glukozy, triacylogliceroli, lipoprotein LDL-C i apoB, przy równoczesnym zmniejszeniu lipoprotein HDL-C i apoA-I, oraz podwyższeniem TC we krwi badanych szczurów, choć nie wszystkie zmiany były statystycznie istotne.

Słowa kluczowe: suplementacja, witaminy z grupy B, lipidy, lipoproteiny, apolipoproteiny, szczury

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