Effect of a phytogenic additive on blood serum indicator levels and fatty acids profile in fattening turkeys meat

Vplyv fytogénneho aditíva na ukazovatele krvného séra a profilu mastných kyselín v mäse výkrmových moriek

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Abstract

The aim of the study was to determine the effect of a phytogenic additive on blood serum indicator levels and fatty acids profile of breast, leg muscles and liver in fattening turkeys. The experiment was realized in private turkey farm and in the Department of Animal Nutrition, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra. A total of 300 clinically healthy female turkeys (broad-breasted white turkey, hybrid XL) were used in the experiment. Female turkeys were randomly divided into two groups (150 pcs per each). In the control group, turkey were fed with standard complete feed mixtures for fattening, in the experimental group, standard diets from the beginning to 12th week were supplemented with the a blend of essential oils from origanum, anise and citrus fruits as well as a prebiotic rich fructooligosaccharides in dosage 1kg per 1000 kg of feed mixture. Fattening lasted 18 weeks. Blood serum was collected at the end of the experiment, during the slaughter of birds. Samples of breast and leg muscles, and liver for fatty acids composition evaluation were collected during birds dissection (10 samples per each group). After the 12 weeks of phytoadditive supplementation, a tendency of lower activity of serum alanine aminotransferase (53.963 vs. 3.499 U/L) and aspartate aminotransferase (6.238 vs. 1.012 U/L) in experimental group of turkeys was found ($P<0.01$). The same tendency was analyzed in content of phosphorus ($P<0.05$). Compare to the control group, in the experimental group have been detected significantly ($P<0.01$) lower concentration of capric acid in leg muscle, lauric and myristic acid in both evaluated muscles, palmitoleic acid and stearic acid in the liver. Additionally, the phytoadditive supplementation markedly (P<

0.01) increased content of following SFA: lauric, myristic and palmitic acids in the liver, pentadecanoic, heptadecanoic and stearic in both evaluated muscles. In the case of unsaturated fatty acids have been detected that the phytogenic feed additive in breast and leg muscles of birds markedly increase the content of cis-11,14-eicosadienoic acid (0.209 vs 0.276 and 0.242 vs 0.298 % of crude fat, respectively); compare to control group, leg muscle of individuals from experimental group have higher (P>0.01) content of cis-8,11,14-eicosadienoic and arachidonic acids. The phytoadditive supplementation significantly (P<0.01) decreased content of some unsaturated fatty acids in turkeys tissues, as well. In experimental group of turkey have been recorded lower level of elaidic and oleic acids in the breast muscle and cis-11,14-eicosadienoic and arachidonic acids in the liver, compare to birds from control group.

Keywords: additives, aromatic plants, blood serum, fatty acids profile, turkey

Abstrakt

Cieľom práce bolo determinovanie vplyvu fytogénneho aditíva na ukazovatele krvného sera a profil mastných kyselín v prsnom, stehennom svale a pečeni výrkmových moriek. Experiment bol realizovaný na privátnej farme moriek a Katedre výživy zvierat, Fakulta agrobiológie a potravinových zdrojov, Slovenská poľnohospodárska univerzita v Nitre. Celkom bolo v pokuse sledovaných 300 klinicky zdravých samíc moriek (morka biela širokoprsá, hybrid XL). Samice moriek boli rozdelené do dvoch skupín (150 ks v každej skupine). V kontrolnej skupine boli morky kŕmené štandardnými kompletnými kŕmnymi zmesami pre výkrm moriek, v pokusnej skupine boli morky kŕmené identicky, avšak prvých 12 týždňov s kŕmnymi zmesami obohatenými o zmes esenciálnych olejov z oregano, anízu, citrusových plodov a prebioticky obohatenými fruktooligosacharidmi v koncentrácii 1 kg na 1000 kg kŕmnej zmesi. Výkrm trval 18 týždňov. Krv bolo odobratá na konci experimentu po porážke moriek. Vzorky prsných a stehených svalov, ako aj pečene pre stanovenie profilu mastných kyselín boli odobraté počas jatočnej rozrábky (10 vzoriek z každej skupiny). Po 12 týždňovej suplementácii fytogénnym aditívom bola zistená tendencia nižšej aktivity sérovej alanín aminotransferázy (53,963 vs. 3,499 U/L) a aspartát aminotransferázy (6,238 vs. 1,012 U/L) v pokusnej skupine moriek (P<0,01). Rovnaká tendencia bola zistená v obsahu fosforu (P<0,05). V porovnaní s kontrolnou skupinou bol v pokusnej skupine detekovaný preukazne (P<0,01) nižšia koncentrácia kyseliny kaprylovej v stehennom svale, laurovej a myristovej v oboch svaloch, palmitoolejovej a steárovej kyseliny v pečeni. Suplementácia fytoaditívom výrazne (P<0,01) zvýšila obsah nasýtených mastných kyselín: kyseliny laurovej, myristovej a palmitovej v pečeni, pentadekánovej, heptadekánovej a steárovej v oboch svaloch. Z pohľadu zastúpenia nenasýtených mastných kyselín bolo zistené, že fytogénne kŕmne aditívum výrazne zvýšilo obsah cis-11,14-eikosadiénovej kyseliny (0,209 vs. 0,276 a 0,242 vs. 0,298 % v tuku). V porovnaní s kontrolnou skupinou, individuálne vzorky stehenných svalov z pokusnej skupiny mali vyšší (P>0,01) obsah cis-8,11,14 kyseliny eikosadiénovej a arachidónovej. Fytogénne aditívum preukazne (P<0,01) znížilo obsah niektorých nenasýtených mastných kyselín u moriek. V pokusnej skupine moriek sa zistil

nižší obsah kyseliny elaidovej a olejovej v prsnom svale a cis-11,14-eikosadiénovej a arachidónovej kyseliny v pečeni v porovnaní s kontrolnou skupinou.

Kľúčové slová: aditíva, aromatické rastliny, krvné serum, morky, profil mastných kyselín

Detailný abstrakt

Cieľom práce bolo analyzovanie vplyvu fytogénneho aditíva na ukazovatele krvného sera a profil mastných kyselín v stehennom a prsnom svale a pečeni výkrmových moriek. Experiment bol realizovaný v spolupráci s privátnou farmou výkrmu moriek a Katedry výživy zvierat, Fakulta agrobiológie a potravinových zdrojov, Slovenská poľnohospodárska univerzita v Nitre. Do pokusu bolo zaradených celkom 300 klinicky zdravých 1-dňových vysexovaných samíc moriek (mäsový medzilínový úžitkový kríženec morka širokoprsá biela, hybrid XL). Samice moriek boli rozdelené do dvoch skupín (každá skupina 150 ks). V kontrolnej skupine moriek boli skrmované štandardné výkrmové kompletné kŕmne zmesi, v pokusnej skupine boli kŕmne zmesi od začiatku výkrmu do veku moriek 12 týždňov obohatené o zmes esenciálnych olejov z oregano, anízu a citrusových plodov a prebioticky obohatené fruktooligosacharidy v dávke 1 kg na 1000 kg kŕmnej zmesi. Výkrm trval 18 týždňov. Krv bola odobraná na konci experimentu počas porážky. Vzorky prsného svalu, stehenného svalu a pečene na analyzovanie obsahu mastných kyselín boli odobrané počas jatočnej rozrábky (10 vzoriek z každej skupiny). Po 12 týždňov trvajúcom skrmovaní fytogénneho aditíva, sme zistili tendenciu nižšej sérovej aktivity alanín aminotransferázy (53,963 vs. 3,499 U/L) a aspartat animotransferázy (6,238 vs. 1,012 U/L) v pokusnej skupine moriek ($P<0.01$). Rovnaká tendencia bola zistené v sérovom obsahu fosforu ($P<0.05$). V porovnaní s kontrolnou skupinou, sme v pokusnej skupine moriek zistili preukazne ($P<0.01$) nižší obsah kyseliny kaprylovej v stehennom svale, laurovej a myristovej aj v prsnom svale, palmitoolejovej a steárovej v pečeni. Vplyvom použitého fytogénneho aditíva, sme zaznamenali výrazné zvýšenie obsahu viacerých nasýtených mastných kyselín: laurovej, myristovej a palmitovej v pečeni, pentadekánovej, heptadekánovej a steárovej v prsnom aj stehennom svale. V obsahu nenasýtených mastných kyselín sme zistili, že fytogénne aditívum výrazne zvýšilo v prsnom a stehennom svale obsah cis-11,14-eikosadiénovej kyseliny (0,209 vs. 0,276 a 0,242 vs. 0,298 % v tuku), v porovnaní s kontrolnou skupinou, stehenný sval pokusnej skupiny sa vyznačoval v priemere vyšším ($P>0,01$) obsahom cis-8,11,14 eikosadiénovej a arachidónovej kyseliny. Suplementácia kŕmnych zmesí fytogénnym aditívum preukazne ($P<0,01$) znížila obsah niektorých nenasýtených mastných kyselín v mäsa moriek. V pokusnej skupine moriek sme zaznamenali nižší obsah kyseliny elaidovej a olejovej v prsnom svale a cis-11,14-eikosadiénovej a arachidónovej kyseliny v pečeni v porovnaní s kontrolnou skupinou.

Introduction

During the past few decades production of poultry products has grown faster than that of any other major food in the developing countries. This is as a result of increasing population income, urbanization and westernization of diet (Yassin, et al., 2013). Have been reported that consumption of turkey broilers as white meat was rising worldwide and that a similar trend existed in developing countries (Karki, 2005). Turkeys have tremendous versatility in local marketing and can be sold or traded in small units at any age when large enough to be butchered. Moreover, unlike chickens, turkeys can be herded much the same as sheep (Yassin, et al., 2013). In the past, turkey was regarded as a once a year treat but nowadays more and more people are aware of turkey's low cost and low fat (10% fat) compared to red meat and are making it a part of their regular diet (Castro Ferreira, et al., 2000). Moreover, meat obtained from turkeys is an excellent protein source and has a good price-quality ratio (Roberson, et al., 2003). In addition, in modern dietary trends, consumption of turkey meat is indicated as an adequate source of essential unsaturated fatty acids (Antony, et al., 2000). It is an important fact, taking into account that research results show that the consumption of PUFAs, especially n-3 PUFAs plays an important role in cardiovascular disease prevention (Jankowski, et al., 2012). The undeniable influence on performance of birds have wide range of factors, e.g. health state. Valuable information on the health status provide the biochemical blood parameters (Piotrowska, et al., 2011), which in case of birds have been performed much less often in comparison to large animals (Talebi, 2006). The evaluation of blood biochemistry in birds allows for the identification of metabolic alterations of organs and tissues due to many endo- and exogenous factors (Piotrowska, et al., 2011). The biochemical values of bird's serum may be influenced by the following agents: diseases (Burnham, et al., 2003; Koinarski, et al., 2001; Kumar, et al., 2003), housing systems (Gunes, et al., 2002), environmental temperature (Vecerek, et al., 2002) and water limitations (Iheukwumere and Herbert, 2003). Moreover, it is well established that the biochemical blood parameters as well as performance of birds can be affected by some dietary nutrients (Capcarová, Kolesárová, 2010; Al-Homidan, et al., 2002; Eroksuz, et al., 2001; Kurtoglu, et al., 2005; Odunsi, et al., 1999) and feed additives (Oğuz, et al., 2000). Mentioned observations are due to the fact that feed is probably the most important entity in the poultry industry. It is a critical determinant in the functional development and growth of the gastrointestinal tract, which structure is influenced by the route of nutrient administration, dietary composition of the meal, and availability in it of specific nutrients (Domeneghini, et al., 2006). Furthermore, proper diet has significantly positive effect on the immune status, but also it is one of the tools used to increase the breeding productivity of birds, with positive effects on the carcass and meat quality (Ohimain, et al., 2012; Safaeikatouli, et al., 2010). The substantial role in poultry nutrition play a natural alternatives of antibiotic growth promoters, which were banned in UE since 2006. A relatively new class of feed additives are phytogenic feed additives (often also called phytobiotics or botanicals) commonly defined as plant-derived compounds incorporated into diets to stabilize the feed hygiene, improve the productivity of livestock through amelioration of feed properties, promotion of the animals' production performance, and improving the quality of food derived from those animals (Roth and Kirchgessner, 1998, Windisch, et al., 2008). The phytogenic products can potentially be implemented as interesting feed additives; however, the knowledge of their efficacy, the

potential modes of action must be constantly deepened. Consequently, the aim of this study was to examine the effects of a commercial phytogenic feed additive substance on selected biochemical blood parameters and fatty acids profile of turkey muscles and liver.

Material and Methods

Animals and feeding

The experiment was realized in cooperation with privat turkey farm (Morky Petránek, s.r.o., Čremošné, Slovak Republic). Trial lasted 18 weeks, 1-day old broad-breasted female white turkeys hybrid XL were used. A total 300 turkeys were randomly divided into two groups, control and experimental (150 pcs per each group). In the control group, standard fattening complete feed mixtures were used, in the experimental group from the 1st to the 12th week of turkeys age feed mixtures were supplemented with a blend of essential oils from origanum, anise and citrus fruits as well as a prebiotic rich fructooligosaccharides in dosage 1kg per 1000 kg of feed mixture.

Samples and laboratory analysis

Blood samples after slaughter were collected. Blood samples were centrifuged for 30 min at 3000 x g and blood serum was obtained. In the blood serum, biochemical indicators as triglycerides, cholesterol, glucose, total proteins, chlorides, aspartate aminotransferase, alanine aminotransferase, magnesium and phosphorus were analysed. The samples were analyzed by apparatus Abacus Junior Vet (Diatron Ltd., Vienna, Austria). Samples of breast and leg muscles, and liver for fatty acids profile analysis were collected during turkey's dissection.

For the characteristics of lipid fraction were triglycerides hydrolyzed to glycerol and free fatty acids. Fatty acids were then derivated to methylesters. After their preparation were separated on the basis of carbon number and level of unsaturation by using gas chromatography fitted with a flame-ionization detector (FID). For the identification column was used 37 components mixture (Supleco 47885-U). Standard solution was diluted with 10 ml of hexane with 1 ml supplementation of 2 N potassium hydroxide in methanol. Analytic tube was heated 30 seconds at 60 °C in a water bath. After 1 minute was added 2 ml of 1 N hydrochloric acid. The top layer was transferred in an amount 2 ml to autosampler vial with inhydrin (Na_2SO_4). Injection of samples was performed by injection autosampler Agilent.

The content of fatty acids was determined on machine Agilent 6890A GC (Agilent Technologies, USA) as a percentage in crude fat.

Laboratory analyses of fatty acids were carried out in the Laboratory of Quality and Nutritional Value of Feed at the Department of Animal Nutrition in Slovak University of Agriculture.

Statistic analysis

The data used for statistical analyses represents means of values obtained from 10 animals from each group. To calculate basic statistic characteristics, to determine significance of differences and to compare results, one-way ANOVA and t-test were performed at $P<0.05$ level.

The SAS statistical package was used (SAS Inc., New York City, USA).

Table 1. Nutritive value of complete feed mixture during the experiment
Tabuľka 1. Výživná hodnota kompletných kŕmnych zmesí počas experimentu

	DM	CP	F	CF	NFE	Starch	T.s.	ME_N
	$g.kg^{-1}$			$g.kg^{-1}$ of dry matter				$MJ.kg^{-1}$
				Control group				
KR1	906.3	297.7	56.9	37.4	541.8	343.5	54.1	11.79
KR2	903.9	271.9	51.8	40.5	557.7	362.8	46.7	11.40
KR3	895.9	252.3	70.1	40.7	564.8	357.7	46.1	11.55
				Experimental group				
KR1	902.9	294.1	49.6	41.0	549.1	346.6	52.1	11.49
KR2	907.5	260.6	63.4	35.9	578.6	400.4	47.6	11.60
KR3	903.5	245.2	59.7	31.9	601.0	434.1	47.8	12.39
				Both groups				
KR4	915.0	211.4	82.5	42.1	601.9	417.5	42.0	12.47
KR5	905.4	193.8	70.5	41.7	630.9	471.6	39.2	12.50
KR6	908.3	183.4	93.6	42.3	631.2	464.3	37.0	12.98
Wheat	896.3	146.5	15.2	26.9	792.9	667.5	33.2	12.88

DM: dry matter, CP: crude protein, F: crude fat, CF: crude fibre, NFE: nitrogen free extract, T.s.: total sugars, ME_N: metabolisable energy, KR1-KR6: complete feed mixtures for turkeys fattening.

DM: sušina, CP: dusíkaté látky, F: tuk, CF: hrubá vláknina, NFE: bezdusíkaté látky výťažkové, T.s.: celkové cukry, ME_N: metabolizovateľná energia, KR1-KR6: kompletné kŕmne zmesi pre výkrm moriek.

Results and Discussion

In the experiment, there was analysing the effect of phytogenic additive on selected blood serum parameters in turkeys. The concentrations of those blood plasma indicators are shown in the Table 2.

The majority of performance traits of livestock species is determined by maintaining a dynamic equilibrium between the extent of anabolic and catabolic changes in the body and by effective metabolism. The intensity of metabolic changes, mainly of protein, is also reflected in the concentration of other biochemical indicators of blood, e.g. alanine aminotransferase (ALT) and aspartate aminotransferase (AST) (Kapelański, et al., 2004). Those marker enzymes, are normally localised within the cells of the liver, heart, gill, kidney, muscles and other organs (Yakubu, et al., 2005). Moreover, mentioned "adaptive enzymes" are of importance for diagnosis of diseases (Beňová, et al., 2003). In our study, significantly higher ($P <0.01$) concentration of ALT as well as AST was found in turkey of control group (53.963 and 6.238 U/l), while lower concentration was found in birds from experimental group (3.499 and 1.012 U/l). The lowest activities for

plasma ALT and AST recorded for individuals fed diets supplemented with phytoadditive indicate that the used treatment did not negatively alter liver enzyme activity but also had a non-toxic effect on the kidneys and liver (Saleh, 2014). Furthermore, no increase in serum concentration of ALT and AST may provide evidence to protect of liver against hepatocellular degeneration (Al-Jaff, 2011). The presented study confirmed previous results (Habibi, et al., 2014; Saleh, 2014; Zhu, et al., 2014) on the decreasing effect of phytoadditives on the activities of plasma ALT and AST in animals. Meanwhile, Abd El-Ghang and Ismail (2013) who used oregano essential oil in broiler feed, observed increase in the activity of ALT and AST. Presented finding does not agree also with the results of Traesel, et al. (2010), who reported that the serum AST levels in the group supplemented with essential oils from oregano, sage, rosemary, and pepper crude extract at 150 mg/kg were significantly higher than in the control group.

The comparison of biochemical blood parameters of turkey received diet with phytogenic feed additive and from control group demonstrated that the latter had only slightly lower ($P>0.05$) concentration of glucose (-4.11%), which is a substance that in animals directly oxidises to provide energy. Presented findings concur with the results of Mansoub (2011) who showed that using oregano oil in chickens diet had not significant effects on plasma glucose level. Our findings are similar also to those presented by Ghasemi (2014). They observed that black cumin seed had no significant effect on plasma glucose concentration in chicken males. Differently, Saleh, et al. (2014) noted lower plasma concentration of glucose in chicken broilers fed by summer shield (the mixture of seven herbs) than in those without this supplementation in the diet.

As shown in Table 2, experimental treatments did not significantly affect the plasma cholesterol concentration as well. Our results were in agreement with the findings of a research work conducted by Soltan, et al. (2008) who noted that dietary anise seeds supplementation in broiler diet not significantly affected serum cholesterol level. No differences on serum cholesterol levels observed also Bampidis, et al. (2005) and Sarica, et al. (2005) who evaluated the effect of dietary supplementation with oregano essential oil. Meanwhile, Ghazalah and Ali (2008) noted that addition of dried *Rosmarinus officinalis* L. in the broiler diet lowered plasma content of total cholesterol levels.

In presented study, also no difference ($P>0.05$) was observed in plasma total protein concentration between control and experimental groups. Obtained stability in total protein values in the control and treatment groups irrespective of the phytogenic feed additive inclusion suggest that the diet is adequate for the turkeys. These findings concur with the results of Al-Harthi (2006) who reported that a mixture of cardamom, cumin, and red and black pepper at 2 or 4 g/kg did not have any significant effects on plasma total protein. Also Corduk, et al. (2013), showed that supplementation of phytoadditives (oil of oregano or red pepper) did not markedly affect the serum total protein. However, in some another studies carried out in poultry, the increase in the plasma total protein resulted from the phytoadditives supplementation has been observed (Amad, et al., 2013; Elagib, et al. 2012; Nanjundaiah, et al., 2009; Tollba, et al., 2010; Zhang, et al., 2009).

Moreover, the conducted analysis showed only slightly higher ($P > 0.05$) concentration of triglycerides in turkeys of control group compare to birds from experimental group. The decreasing effect of phytoadditives on serum triglycerides level observed also Abou-elkhair, et al. (2014), Gerzilov, et al. (2011), Puvača, et al. (2015), Rahimi, et al.

(2011) and Saki, et al. (2014). Have been suggested that the lower serum concentrations of triglycerides and cholesterol in birds who received phytogenic feed additive could be related to the complex antistress, antioxidant and antimicrobial effect of herbs included in the feed supplement.
The current experiment demonstrated that the experimental treatments did not markedly (P>0.05) affect the plasma chlorides and magnesium concentration. However, in case of phosphorus have been observed that the individuals from control group in comparison with turkeys of experimental group were distinguished by higher (P < 0.05) concentration of this macroelement in the blood serum. Our findings are not in agreement with those presented by Levkut, et al. (2011). They observed that chickens fed oregano oil supplemented diet had significantly higher serum magnesium concentration and only slightly lower serum phosphorus level compare to birds from control group.

Table 2. The effect of phytoadditives on turkey blood serum indicators during the experiment
Tabuľka 2. Vplyv fytogénneho aditíva na krvné ukazovatele moriek počas experimentu

Blood Parameter (unit)	Control group	Experimental group	P-value
	Mean±SD		
Alanine Aminotransferase (U/L)	53.963±18.89	3.499±3.12	< 0.01
Aspartate Aminotransferase (U/L)	6.238±2.91	1.012±0.72	< 0.01
Glucose (mmol/l)	16.577±2.41	17.288±3.56	ns
Cholesterol (mmol/l)	2.776±1.13	3.447±0.94	ns
Triglycerides (mmol/l)	2.198±2.69	1.524±0.36	ns
Total protein (g/l)	38.996±7.05	44.886±8.26	ns
Chlorides (mmol/l)	99.164±7.53	90.955±14.58	ns
Magnesium (mmol/l)	0.944±0.22	0.782±0.35	ns
Phosphorus (mmol/l)	1.698±0.71	1.251±0.29	< 0.05

SD = Standard Deviation, p-value: ns (not significant)

SD = smerodajná odchýlka, p-hodnota:ns (nepreukazné)

The influence of phytoadditive on fatty acids profile in muscles and liver of turkeys is shown in Table 3. Results of the analyses of saturated fatty acids content of meat in turkeys did not demonstrate any significant differences in the concentration of myristoleic acid in all evaluated tissues, palmitic and palmitoleic acids in the breast and leg muscles, heptadecanoic acid in the liver. Compare to the control group, in the experimental group have been observed significantly (0.05>P <0.01) lower concentration of some saturated fatty acids (SFA): capric acid in leg muscle, lauric and myristic acid in both evaluated muscles, palmitoleic acid and stearic acid in the liver. The fact that in the experimental group the share of mentioned SFA was lower, compare to the control group, is beneficial in the terms of dietetics. SFA contained in animal fat increase the blood cholesterol level and they are to a greater extent responsible for occurrence of obesity, diabetes type II, cardio-vascular diseases and cancer as well (Maślanko and Pisarski, 2009). Unfortunately, in the current study the phytoadditive

supplementation markedly (0.05>P <0.01) increased content of some SFA as well. In experimental group of turkey have been reported higher level of lauric, myristic and palmitic acids in the liver, pentadecanoic, heptadecanoic and stearic in both evaluated muscles, compare to birds from control group.
In the case of unsaturated fatty acids no significant differences were found in the content of elaidic and oleic acid in leg muscle and liver, linoleic, γ-linolenic, α-linolenic, arachidic, cis-11-eicosenoic acids in both muscles evaluated and in the liver, cis-8,11,14-eicosadienoic and arachidonic in breast and leg muscles. Results of the analyses of fatty acids profile of meat in turkeys demonstrated that the breast muscles of birds from group received phytoadditive in the diet characterized by markedly (P<0.05) higher content of cis-11,14-eicosadienoic acid. The same increasing tendency (P <0.01) observed in leg muscles for mentioned cis-11,14-eicosadienoic acid, and additionally for cis-8,11,14-eicosadienoic and arachidonic acids. Moreover, in the presented study the phytoadditive supplementation significantly (P <0.01) decreased content of some unsaturated fatty acids as well. In experimental group of turkeys have been recorded lower level of elaidic and oleic acids in the breast muscle and cis-11,14-eicosadienoic and arachidonic acids in the liver, compare to birds from control group. The effect of phytoadditives had been investigated in poultry species in previous studies. Zuidhof, et al. (2009) observed an improvement in the fatty acid profile (an increase in PUFA and a decrease in SFA level) after the addition of 17% of linseed to a standard feed mixture for poultry. The administration of a lower dose (10%) affected the fatty acid profile only to a negligible extent. The effect of the phytoadditive supplementation confirmed also Eleroğlu, et al. (2013). They observed higher concentrations of linoleic acid and the lower concentrations of linolenic acid in genotypes fed with supplemented dry oregano or lemon balm leaves diet.

Tabuľka 3. Vplyv fytoaditíva na profil mastných kyselín v prsnom svale, stehennom svale a pečeni moriek

Fatty acid	Breast muscle (in % of FA)		Leg muscle (in % of FA)		Liver (in % of FA)	
	Control	Experimental	Control	Experimental	Control	Experimental
Capric acid	0.113±0.02	n.d.	0.123^{A}±0.02	0.47^{B}±0.01	n.d.	0.035±0.04
Lauric acid	1.995^{A}±0.33	0.476^{B}±0.08	1.878^{A}±0.25	0.697^{B}±0.14	0.134^{A}±0.11	0.613^{B}±0.71
Myristic acid	1.959^{A}±0.27	1.494^{B}±0.07	1.998^{A}±0.19	1.526^{B}±0.10	0.210^{A}±0.17	1.035^{B}±0.62
Myristoleic acid	0.352±0.09	0.310±0.01	0.365±0.08	0.275±0.01	n.d.	0.276±0.01
Pentadecanoic acid	0.147^{A}±0.02	0.217^{B}±0.02	0.147^{A}±0.01	0.205^{B}±0.02	n.d.	0.084±0.10
Palmitic acid	23.842±0.70	24.989±1.36	24.509±0.44	24.520±1.05	22.411^{a}±2.09	25.492^{b}±0.64
Palmitoleic acid	6.415±2.52	6.289±0.52	6.395±1.92	5.295±0.69	4.334^{a}±1.13	7.133^{b}±1.20
Heptadecanoic acid	0.212^{A}±0.04	0.337^{B}±0.02	0.219^{A}±0.03	0.352^{B}±0.03	0.094±0.08	0.163±0.11
Stearic acid	6.466^{a}±1.01	7.828^{b}±0.20	6.880^{A}±0.58	8.650^{B}±0.07	18.763^{A}±2.81	8.070^{B}±1.00
Elaidic acid	0.186^{A}±0.01	0.164^{B}±0.01	0.150±0.04	0.176±0.01	0.317±0.11	0.222±0.04
Oleic acid	33.402^{A}±1.61	32.680^{B}±0.09	31.439±0.94	30.807±0.54	26.464±4.99	39.652±4.50
Linoleic acid	18.643±2.79	17.957±1.87	18.942±2.22	19.198±1.89	12.277±2.90	10.677±7.32
γ-Linolenic acid	0.053±0.05	0.079±0.06	0.098±0.02	0.109±0.03	0.067±0.09	0.039±0.04
α-Linolenic acid	1.136±0.05	1.215±0.13	1.226±0.04	1.227±0.12	0.328±0.06	0.796±0.48
Arachidic acid	0.082±0.02	0.092±0.01	0.081±0.01	0.091±0.01	n.d.	0.076±0.01
cis-11-Eicosenoic acid	0.324±0.04	0.356±0.02	0.305±0.04	0.325±0.01	0.192±0.06	0.288±0.04
cis-11,14-Eicosadienoic acid	0.209^{a}±0.04	0.276^{b}±0.01	0.242^{A}±0.01	0.298^{B}±0.01	0.907^{A}±0.16	0.214^{B}±0.08
cis-8,11,14-Eicosadienoic acid	0.105±0.02	0.114±0.01	0.143^{A}±0.01	0.151^{B}±0.01	0.594±0.16	n.d.
Arachidonic acid	0.583±0.24	0.690±0.03	0.741^{A}±0.06	1.053^{B}±0.07	6.936^{A}±1.72	0.928^{B}±0.83

n.d.- not detected, SD = Standard Deviation, ^{ABC} Values within a row followed by different letters differ significantly (P<0.01),

^{abc} Values within a row followed by different letters differ significantly (P<0.05).

n.d.- nedetekovné, SD = smerodajná odchýlka, ^{ABC} Hodnoty v riadku s rôznymi indexami sú preukazné (P<0,01), ^{abc} Hodnoty v riadku s rôznymi indexami sú preukazné (P<0,05).

Conclusion

The main goal of the study was to find the influence of phytogenic additive on blood serum indicators and fatty acids profile of breast, leg muscles and the liver in turkeys. In experiment, we used additive rich in origanum, anise and citrus fruits essential oils as well as prebiotics. Results of the present study showed an decrease in serum alanine aminotransferase, aspartate aminotransferase and serum phosphorus content, when phytoadditive was added in turkey diets. Moreover, we found inconclusive effect of the phythoaddive on the fatty acid profile; it was observed both increase and decrease in the levels of selected fatty acids in tissues collected from birds received phytogenic feed additive. However, the obtained results may be helpful in the evaluation of changes in the metabolic profile, health condition and production patterns in broiler turkeys after the phytoadditive supplementation.

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