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ORIGINAL ARTICLE

Biochemical response in piglets after application of essential oils from Sage (*Salvia officinalis* L.) and Oregano (*Origanum vulgare* L.)

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ABSTRACT

In order to find out the growth stimulators, essential oils from Sage (cineol 15%, thujone 24%, borneol 18%) and Oregano (carvacrol 65%, thymol 16%) were applied to feed (ČOS 1 and ČOS 2) of Slovak white noble breed x Pietrain at the age of 28 days) at a concentration of 0.05%/ kg. To determine the lipid metabolic pathway (cholesterol, triacylglycerides, HDL), blood samples were collected from both the control (CG = 6) and treated group (TG = 7) of piglets. Present study demonstrated a statistically significant decrease ($p<0.05$) in concentration of triacylglycerides (CG = 0.79 – 1.59 mmol.l^{-1}, TG 0.79 – 1.25 mmol.l^{-1}, $P<0.05$) and HDL (CG = 1.33-2.33 mmol.l^{-1}, TG = 1.48-1.85 mmol.l^{-1}, $P < 0.01$) and total cholesterol in treated animals with respect to the control during 28th days of experiment. It is concluded that essential oils from Sage and Oregano have the potential to decrease triacyglycerides levels in the blood of piglets important to enhance body weight and livestock productivity of animal.

Key words: Sage, Oregano, triacylglycerides, HDL, Piglets

Introduction

The health and productivity of livestock are important economic factors influencing pig production worldwide. Although many factors might influence the overall productivity of the pig herd. It has been suggested that non-specific activation of the immune system [17] as well as stimulation of some biochemical parameters are responsible for the well being of animals [11,26,22] and subsequently leading to productivity.

Plant extract is a source of different molecules which have intrinsic bio-activities on animal physiology and metabolism [12].

Plant secondary metabolites, including a wide variety of phytochemicals, have always been constituents of the diets of man and animals. Their effects depend to a great extent on the chemistry of the compounds, their concentration in the diet and the amount consumed, and are further depend on the health status of the animals [1]. The importance of the plant secondary metabolites in human and animal feeds, and as pharmaceuticals with chemical and biochemical influences has already been described in some details [2,18,7]. Bile acids are essential for the efficient digestion and absorption of lipid and lipid-soluble nutrients. Bile acids are synthesized from cholesterol by a pathway regulated by the microsomal cytochrome P450 enzyme cholesterol 7α-hydroxylase (EC 1.14.13.17, CYP7A; Shefer et al., 1969) and by an alternate pathway starting with 27-hydroxycholesterol [3,4,16,15] measured hepatic cholesterol 7α-hydroxylase and sterol 27 hydroxylase activities in fetal, newborn, suckling, and weaned piglets. Their results suggest that developmental regulation of 7α-hydroxylase activity is the result of

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a pretranslational mechanism. The specific role of dietary lipids in brain development has been widely studied [20]. Cholesterol is an essential constituent of all animal cells [6], the brain has the highest cholesterol concentration of any organ [8]. Myelin contains 20–25% C (dry basis) and the nerve growth cones responsible for establishing brain neuroarchitecture are as much as 30% C. The relationship between nutrition of the neonate and development of the central nervous system is well recognized. Pond *et al.* [21] measured neonatal dietary cholesterol and alleles of cholesterol 7-hydroxylase affect on piglet cerebrum weight, cholesterol concentration and behavior. In light of the above discussion objective of the present study was to find out the biochemical response (cholesterol, triacylglycerides, HDL, LDL in blood serum of piglets) in piglets after application of essential oils from Sage (*Salvia officinalis* L.) and Oregano (*Origanum vulgare* L.)

Material and Methods

Model Schedule Experiment:

Suckling piglets of crossbred piglets Slovak White x Pietrain were divided into two groups: control group (n=6) and treated group (n=7). Extracted essential oils from sage and oregano were applied to treated group along with the feed at a concentration of 0.05%. During the experiment pigs were fed complete feed mixture for lactating sows. Suckling piglets had free access to adult pigs and from 5th day of their age they had free access to feed mixture. Weaning of piglets were done at the age 28 days. During weaning and postweaning the piglets were fed feed mixture ČSO1 and ČSO2. Feed intake was 0.5 kg/day. Water was adminitrated *ad libitum*. Data for the body weight, health status, excrementa and mortality of pigs were recorded through out the experimental duration. Blood samples were collected and production parameters were monitored at the age of 21st, 28th, 35th and 42nd days of Suckling piglets. The samples of feed were analyzed in the following way – sensory, microbial and physico-chemical examination.

Essential oil and its analysis

Dry raw materials of the sage and oregano herbs were collected from the commercial growers of the Eastern part of Slovakia for essential oils isolation.

Total composition of sage and oregano essential oil was carried out using a HEWLETT – PACKARD 5890/5970 GC/MSD system.

In model experiment sage essential oil were applied with optical rotation +8±10, refraction index 1.469 – 0.001, content of cineol 15±1%, thujone 24±1%, borneol 18±1% and oregano essential oil with optical rotation 0 ± 1^0, refraction index 1.513 ± 0.001, with content of carvacol 65 ± 3.0%, thymol 16 ± 1,5.

Statistical Analysis:

The experimental values were tabulated as mean ± standard deviation (S.D.) of three replicates. Datas of the biochemical parameters were statistically analysed by Mann-Whitney U test within control and treated group. Significant test was further performed by one-way ANOVA between groups within specific duration of treatment considering $P<0.05$. Statistical analysis was performed using the UNISTAT 4.53 system.

Results and Discussion

Table.1 and 2 recorded the concentrations of cholesterol, triacylglycerides, HDL (High Density Lipoproteins) and LDL (Low Density Lipoproteins) in blood serum of piglets from control and treated groups subsequently after the application of sage and oregano essential oils into feed.

Table.1 and 2 showed the statistically significant difference between biochemical parameters between control (CG) and treated animals (TG). A highly significant difference in triglycerides level was noted in Sage and Oregano treated group (TG=1.25±0.255) with respect to control group (CG=0.797±0.322) (1st collection of blood – 21st day of age).

Gudev et al. [9] studied effect of the probiotic on some biological parameters and nonspecific resistence in neonatal pigs. Supplemental probiotic (Lactina) decreased plasma cholesterol level ($P<0.05$) at 35 days of age in treated group of piglets.

Several investigators reported the effects of different natural and chemical compounds in animals [10,13]. Śliwa et al. [23] monitored the impact of chemical substances in piglets and recorded the blood serum level of total cholesteol, glucose and electrolytes. Result of the present investigation is substentiated by the earlier investigators [24] that herbal extracts could be successfully used as growth stimulators, replacing nutritive antibiotics in pig diets. Bindas [5] studied the effects of low protein diets supplemented with crystalline amino acids on biochemical parameters and performance of crossbred piglets weaned at 28 days of age. The decrease in the diet crude protein was manifested by significant decrease in blood urea. The observed biochemical parameters in blood serum of weaned piglets varied in relatively wide ranges of physiological values for piglets, presented by earlier investigators [14,25]. The mean values of biochemical parameters, such as cholesterol, total proteins, urea, some enzymes AST, ALP did not differ significantly within the groups.

The effect of feeding sows conjugated linolei acid in late pregnancy on blood thyroid hormone, total cholesterol and cholesterol fraction (LDL, HDL) levels in piglets was observed by Pietras et al. [19]. Lower total cholesterol and HDL ($P<0.05$) and LDL ($P<0.01$) levels were found in the blood plasma of piglets in the treated group in comparison with those in the control group. The obtained results show that conjugated linoleic acid contained in the colostrum of sows increases plasma thyroid hormone levels in the blood of piglets and lowers the levels of total cholesterol and cholesterol fractions.

Figures 1-4 show dynamic changes of the measured biomarkers in the blood serum of piglets. After the application of both essential oils decrease in the levels of total cholesterol, HDL and LDL in blood serum of piglest was performed in control and experimental groups. Statistically significant changes ($p<0.05$) were observed in concentration of triacylglycerides when the decrease was monitored in the treated group comparing to the control one on 28th day of experiment.

Table 1: Values of lipid metabolism in blood serum of piglets – control group

Age	Cholesterol *(mmol . l^{-1})*	Triacylglycerides *(mmol . l^{-1})*	HDL *(mmol . l^{-1})*	LDL *(mmol . l^{-1})*
21. day				
x	4.26	0.79	2.33	1.65
±SD	0.801	0.179	0.264	0.380
28. day				
x	3.59	1.03	1.52	1.76
±SD	0.761	0.575	0.240	0.374
35. day				
x	3.64	1.59	1.48	1.69
±SD	0.294	0.332	0.140	0.118
42. day				
x	2.97	0.87	1.33	1.49
±SD	0.219	0.182	0.226	0,207
n	6	6	6	6

Table 2: Values of lipid metabolism in blood serum of piglets – treated group (sage and oregano)

Age	Cholesterol *(mmol . l^{-1})*	Triacylglyceride *(mmol . l^{-1})*	HDL *(mmol . l^{-1})*	LDL *(mmol . l^{-1})*
21. day				
x	4.25	1.25	1.85	2.08
±SD	0.904	0.255	0.294	0.572
28. day				
x	3.48	1.01	1.63	1.67
±SD	0.317	0.254	0.083	0.214
35. day				
x	3.73	1.21	1.71	1.82
±SD	0.530	0.243	0.253	0.311
42. day				
x	2.96	0.79	1.48	1.46
±SD	0.241	0.161	0.114	0.172
n	7	7	7	7

Note:
n – number of animal
x – average value
s – standard deviatio

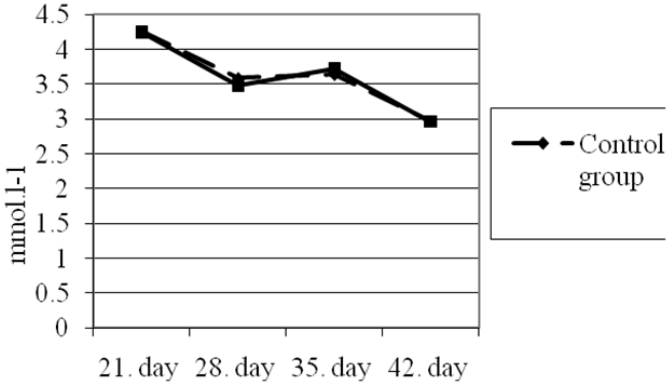

Fig. 1: Dynamics of changes of total cholesterol concentration in blood serum of piglets

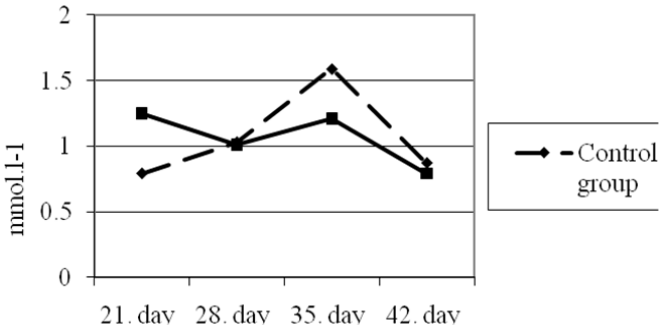

Fig. 2: Dynamics of changes of triacylglycerides in blood serum of piglets

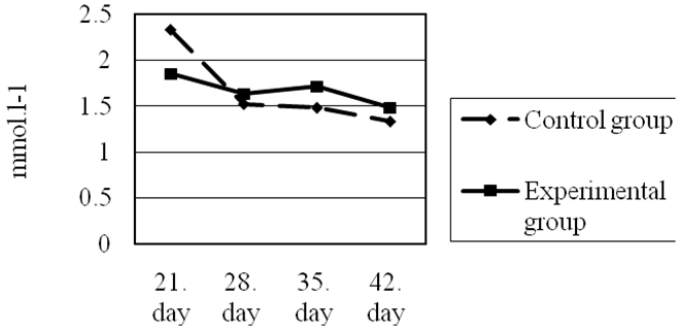

Fig. 3: Dynamics of changes of HDL in blood serum of piglets

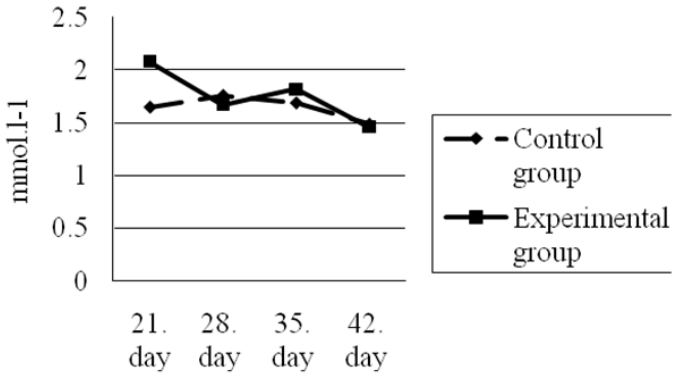

Fig. 4: Dynamics of changes of LDL in blood serum of piglets

It is concluded that essential oils from Sage and Oregano have the potential to decrease triacyglycerides levels in the blood of piglets important to enhance body weight and livestock productivity of animal.

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References

1. Acamovic, T., J.D. Brooker, 2005. Biochemistry of plant secondary metabolities and their effects in animals. Proceedings of the Nutrition Society, 64: 403-412.
2. Acamovic, T., C.S. Stewart, T.W. Pennycott, 2004. Poisonous Plants and Related Toxins. Wallingford, Oxon.:CAB International.
3. Axelson, M., J. Sjovall, 1990. Potential bile acid precursors in plasma-possible indicators of biosynthetic pathways to cholic and chenodeoxycholic acids in man. J. Steroid Biochem, 36: 631- 640.
4. Axelson, M., J. Shoda, J. Sjovall, A. Toll, W. Kikvall, 1992. Cholesterol is converted to 7*α*-hydroxy-3-oxo-4-cholestenoic acid in liver mitochondria: evidence for a mitochondrial sterol 7*α*-hydroxylase. J. Biol. Chem., 267: 1701-1704.
5. Bindas, L., 2009. Biochemical responses and performance of early-weaned piglets fed different protein level diets. Folia Veterinaria, 53(3): 154-156.

6. Boleman, S.L., T.L. Graf, H.J. Mersmann, D.R. Su, L.P. Krok, J.W. Šavelů, Y.W. Park, W.G. Pond, 1998. Pigs fed cholesterol neonatally have increased cerebral cholesterol as young adults. J Nutr., 128: 2498–504.
7. Broker, J.D., 2000. Tannins in Livestock and Human Nutrition. Canberra, ACT: ACIAR.
8. Dietschy, J.M., S.D. Turley, 2004. Cholesterol metabolism in the central nervous system during early development and in the mature animal. J Lipid Res., 45: 1375–97.
9. Gudev, D., S. Popova-Ralcheva, P. Moneva, M. Ignatova, 2008. Effect of the probiotic „LACTINA“ on some biological parameters and nonspecific rsistance in neonatal pigs. Biotechnology in Animal Husbandry, 24(1-2): 87-96.
10. Holovská, K., V. Cigánková, V. Almášiová, A. Sobeková, P. Naď, M. Skalická, 2009. Ultrastructural and biochemical changes in the turkeys liver after the chronic kadmium exposure. Acta Vet. Beograd, 59: 167-175.
11. Cheng, B.J., A. Moritomo, Y. Yamasaki, L.X. Wu, J. Poracova, H. Takabayashi, K. Tanishima, 2004. Blood lipoprotein cholesterolnlevels and hepatic telomerase activities in eperimental hypercholesterolemic rats and choleretic effect of administered chinese herbarium formulae. Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, FHPV PU, Prešov. Prírodné vedy, biológia – ekológia, XL, 56-62.
12. Kamel, C., 2001. Natural plant extracts: Classical remedies bring modern animal production solutions. Cahiers Options Méditerranéennes, 54(3): 31-38.
13. Kimáková, T., 2008. Some informations about PCB (Polychlorinated Biphenyls). Medicínsky monitor, 4: 16-18.
14. Kraft, W., M.U. Durr, 2001. Clinical laboratory Diagnostics in Veterinary Medicine (In Slovak/Czech). Hajko, Hajková (ed.), Bratislava, 365.
15. Lewis, D.S., S. Oren, X. Wang, M.L. Moyer, D.C. Beitz, T.J. Knight, G.E. Mott, 2000. Developmental changes in cholesterol 7α- and 27-hydroxylases in the piglet. J Anim Sci., 78: 943-951.
16. Lund, E., I. Bjorkhem, C. Furster, K. Wikvall, 1993. 24-, 25-and 27-hydroxylation of cholesterol by a purified preparation of 27-hydroxylase from pig liver. Biochim. Biophys. Acta., 1166: 177-182.
17. Markowska-Daniel, I., Z. Pejsak, 2006. Imunological and production parameters in pigs fed spray-dried aimal plasma. Bull Vet Inst Pulawy, 50: 455-59.
18. Nash, R.J., 2004. Remedies from nature. Chemistry World, 7: 20-23.
19. Pietras, M., T. Barowicz, M. Pieszka, 2002. The effect of feeding sows conjugated linoleic acid (CLA) in late pregnancy on blood thyroid hormone and cholesterol levels in piglets. Journal of Animal and Feed Science, 11(4): 651-659.
20. Pond, W.G., H.J. Mersmann, D. Su, J.J. McGlone, M.B. Wheeler, E. O'Brian Smith, 2008. Neonatal Dietary Cholesterol and Alleles of Cholesterol 7- Hydroxylase Affect Piglet Cerebrum Weight, Cholesterol Concentration, and Behavior.
21. Pond, W.G., 2003. Dietary fatty acids and cholesterol in normal brain development. Comments Theor Biol., 8: 37-68.
22. Poracova, J., M. Blascakova, M. Zahatnanska, M. Takacsova, 2009. Therapeutical Influence of Cowslip (*Primula veris* L.), Sweet Flag (*Acorus calamus* L.) and Ephedra (*Ephedra distachya* L.) on Human and Animal Health. The Fourth International Conference of Pharmaceutical and Drug Industries Research Division. March, 3-5: Cairo, Egypt, pp: 65.
23. Śliwa, E., M.R. Tatara, S.G. Pierzynowski, 2006. Total cholesterol, lucose, and electrolytes in piglets serum after α- ketoglutarate (AKG) and dexamethasone treatment dutiny prenatal and neonatal life. Bull Vet Indy Pulawy, 50: 561-566.
24. Valchev, G., S. Popova-Ralcheva, M. Bonovska, I. Zaprianova, D. Gudev, 2009. Effect of dietary supplements of herb extracts on performance in growing pigs. Biotechnology in Animal Husbandry, 25(5-6): 859-870.
25. Vrzgula, L., 1990. Metabolic Disorders in Farm Animals and their Prevention (In Slovak), Publ. House Príroda, Bratislava.
26. Wu, L.X., K. Tanishima, J. Poracova, H. Inoue, M. Torii, S. Hasegawa, S. Kojima, 2004. Biochemical study of a thermostable lactate dehydrogenase from the extreme thermophilic diptera larva in a spa. Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, FHPV PU, Prešov. Prírodné vedy, biológia – ekológia, XL: 73-79.