International Journal of Veterinary Science and Agriculture Research
Volume 7 Issue 5, November-December 2025
ISSN: 2582-4112, Available at www.ijvsar.com

Essential Oils from Sage and Oregano – Positive Effects on Production and Health Parameters of Weaned Pigs

Andrej Marcin[1], Lukáš Bujňák[1]

[1]*Department of Animal Nutrition and Husbandry, University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, 04181 Košice, Slovak Republic*

***For Correspondence**

Correspondence Author
Department of Animal Nutrition and Husbandry, University of Veterinary Medicine and Pharmacy in Košice, Slovak Republic

andrej.marcin@uvlf.sk

Keywords: *pig nutrition, digestion, aromatic oils, Salvia officinalis, Origanum vulgare.*

Abstract: *The aim of the feeding experiment performed in the pig fattening farm was to study the influence of essential oils from oregano and sage and probiotic bacteria Enterococcus faecium on basic production parameters, incidence of intestinal disorders, digestibility of nutrients, and the metabolic profile of weaned pigs on day 28. The experimental (Exp, n = 30) and the control group (Co, n = 30) were used in the trial. Essential oils isolated from Origanum vulgare L. (Lamiaceae; carvacrol 60%) or Salvia officinalis L. (Labiateae; cineole 15%, thujone 24%, borneol 18%) were added to feed mixtures of Exp (0.067%, 0.133%) from day 29 to 55 of age. Enterococcus faecium M-74 (20 x 10^6 CFU/g) was also added to the feed mixture of the experimental group (20g/kg DM). Commercial phytogenic feed additive 0.02% was added into the feed of Co (carvacrol 5.1%, cinamaldehyde 3.06%, extract from Capsicum spp. 2.04%). The average daily weight gain and the feed conversion ratio increased by 60 g/day and 0.15 kg/kg in Exp. The digestibility of crude protein increased in Exp by 4.95%, 3.06% ($p<0.05$) in weeks 2 and 3. The digestibility of ash increased in Exp by 7.25%, 5.17% ($p<0.05$) in weeks 3 and 4. The decrease in the incidence of diarrhoeal diseases was observed in Exp by 88.89% compared to Co. Concentration of urea in the blood serum was higher in Co by 0.92 g/l ($p<0.05$).*

I. INTRODUCTION

The application of growth-promoting antibiotics in the feeds of food animals is prohibited in the European Union by the EU directive since January 1, 2006. Their advantage was a reduction in energy costs associated with a low incidence of inflammatory changes caused by bacteria in the gastrointestinal tract [1].

In pig breeding, it is very important from an economic point of view to increase the reproductive parameters of sows and production parameters in fattening, as well as to reduce morbidity during the weaning period. The activities of several research centers have long been focused on the search for alternatives and natural methods for maintaining the growth ability, improving the product quality, as well as the health of pigs. They managed to develop several approaches for maintaining the balance of the gastrointestinal microflora in production animals. One of them was the oral application of acidifiers in order to control the pH and suppress the development of pathogenic microflora, further the incorporation of nutritional substances, such as specific types of fructooligosaccharides (FOS) or mannan oligosaccharides (MOS) into feed mixtures, and also the use of plant extracts and essential oils in nutrition. Some additives selectively destroy pathogenic bacteria, others can support the growth of beneficial bacteria (commensal and symbiotic), and others adhere to pathogenic bacteria and prevent them from acting. The last of the alternatives, which uses the metabolic products of medicinal and aromatic plants, represents a natural way of solving the given problem.

Over 3,000 essential oils have now been identified, derived from plants within approximately 87 angiosperm families—significantly expanding upon earlier estimates of essential oil-producing plant diversity [2].

The use of essential oil-producing plants for therapeutic purposes dates back to ancient civilizations. Their antimicrobial properties stemming from volatile, bioactive mixtures have been documented for decades. With the advent of advanced analytical techniques such as GC–MS and NMR over the past 20 years, researchers have been able to chemically profile and biologically evaluate these oils in detail, confirming their efficacy and enabling structure-activity studies [3].

The antimicrobial efficacy of essential oils is not only dose-dependent but also hinges on their precise chemical compositions. For example, a 2025 in vitro study evaluated clove, cinnamon bark, black seed, and citronella oils against 19 human pathogens (including both Gram-positive and Gram-negative strains). Cinnamon, clove, and black seed oils showed the strongest antibacterial action—cinnamon bark oil achieved up to a 32 mm zone of inhibition, while clove bud oil exhibited a 20 mm zone against *Staphylococcus epidermidis* at 10 µl/disc—demonstrating clear concentration-dependent effects [4].

The incorporation of plant-based additives into animal feed emerged in the mid-20th century, with their use as growth and health promoters gaining momentum in the 1990s. The phytogenic feed additives encompassing herbs, spices, essential oils, and other botanicals are widely applied in the nutrition of broilers, pigs, and ruminants as natural alternatives to antibiotic growth promoters [5].

The aim of the feeding experiment performed in the commercial pig fattening farm was to study the influence of essential oils from oregano and sage and probiotic bacteria Enterococcus faecium on basic production parameters, incidence of intestinal disorders, digestibility of nutrients, and the metabolic profile of weaned pigs.

II. Materials and Methods

A feeding trial was performed with weaned pigs (large white x landrace, weaned on day 28 of age) on the farm of the agricultural company DONA, Ltd., Veľké Revištia (Slovak Republic), aged from 29 to 55. days. A combination of oregano (*Origanum vulgare* L.*, Lamiaceae*) and sage (*Salvia officinalis* L.*, Labiateae*) essential oil (Calendula, joint-stock company, Slovak Republic) and also a commercial preparation containing the probiotic bacteria *Enterococcus faecium* M-74 (20.10^6 KTJ/g) were added to the feed mixture (Table 1) of the experimental group.

Table 1: Analyzed nutrients in the feed mixtures

Parameter	**Groups**	
	Experimental	**Control**
DM[1] (g/kg)	907.1	896.1
Crude protein (g/kg DM)	200.7	184.6
Crude fibre (g/kg DM)	21.1	22.9
Ash (g/kg DM)	42.2	42.3
Fat (g/kg DM)	5.5	5.5
ME[2] (MJ/kg DM)	14.0	14.0

[1] – Dry matter, [2] – Metabolizable energy

The control group of weaned pigs (Table 2) received a feed mixture with the same parameters, with the addition of a commercial phytogenic feed additive (carvacrol 5.1%, cinnamaldehyde 3.06%, *Capsicum* spp. extract 2.04%).

Table 2: Application of feed additives to feed mixtures

Groups	**Number of animals**	**Age (day)**	**Oregano essential oil (g/kg)**	**Sage essential oil (g/kg)**	***E. faecium* M-74; 10^9 CFU/g (g)**	**Phytogenic feed additive[1] (g/kg)**
Experimental	30	29 – 55	0.67	1.33	20	0
Control	30	29 – 55	0	0	0	0.2

[1] – Commercial phytogenic feed additive - carvacrol 5.1%, cinnamaldehyde 3.06%, extract from *Capsicum* spp. 2.04%

The composition of essential oils isolated from oregano and sage was analyzed by gas chromatography (GC) [6]. (Table 3). The following parameters were analyzed in weaned pigs during the experiment: a) production parameters: weight, average daily weight gain (ADWG), feed conversion ratio (FCR), b) digestibility of crude protein (CP) and mineral substances, c) incidence of intestinal diseases: diarrhea score, occurrence of pathogenic *Escherichia coli* (haemolytic, K88 antigen positive) in rectal swabs of animals with the incidence of diarrhea), d) metabolic profile: total protein, albumin, urea, total cholesterol, total lipids.

Table 3: Main components of oregano and sage essential oils analyzed by GC[1]

Essential oil	Components	Content in essential oil (%)
Oregano	Carvacrol	60.0 ± 3.0
Sage	Cineol	15.0 ± 1.0
	Thujone	24.0 ± 1.0
	Borneol	18.0 ± 1.0

[1] - gas chromatography (GC)

III. Results and Discussion

The achieved production parameters of weaned pigs in the operational trial are shown in Table 4.

In the analytical evaluation of digestibility, a statistically significant increase in the digestibility of CP ($p<0.05$) was observed in the 2nd and 3rd week with an improvement index of 106.03% and 103.52% and of mineral substances ($p<0.05$) in the 3rd and 4th week of the experiment in the experimental group compared to the control group with an improvement index of 112.88% and 108.27% (Table 5).

During the experiment, a decrease in the number of days with diarrhea (diarrhea score) was observed in the experimental group by 88.88% (Table 6) and in the rectal swabs of diarrheic pigs, the presence of hemolytic and K88 antigen positive Escherichia coli decreased in the experimental group compared to the control group by 100% by 66.66% and 100% (Table 7), respectively.

Table 4: Production parameters of weaned pigs

Groups		Individual weight (kg)					ADWG[1] (kg/day)	FCR[2] (kg/kg)
	Age (day)	29	36	44	51	55	29 - 55	29 - 55
	n							
Experimental	30	8.1 ± 1.05	9.25 ± 0.72	11.57 ± 1.37	14.02 ± 1.83	15.8 ± 2.47	0.36 ± 0.17	1.39
Control	30	8.15 ± 0.69	9.24 ± 0.24	11.28 ± 1.68	13.20 ± 2.31	13.77 ± 2.65	0.30 ± 0.14	1.54

[1] – average daily weight gain, [2] – feed conversion ratio, *- p<0,05

Table 5: Evaluation of the digestibility of nitrogenous and mineral substances of weaned pigs

Digestibility coefficient (%)	**Groups**		**Index of improvement (c = 100%)**
	Experimental	**Control**	
week 2			
CP[1]	87.09* ± 0.701	82.14 ± 3.669	106.0
Ash	60.35 ± 3.414	59.12 ± 5.402	102.1
week 3			
CP[1]	89.92*± 0.9	86.86± 1.770	103.5
Ash	63.56* ± 2.39	56.31 ± 4.374	112.9
week 4			
CP[1]	91.53 ± 0.701	87.2 ± 2.555	104.9
Ash	67.66*± 0.138	62.49 ± 2.138	108.3

[1] – crude protein, *- p<0,05

Similar results were achieved by Marcin et al. [7] with weaned pigs when a statisticaly non-significant decrease of the incidence of diarrhoeal diseases was observed in the experimental groups of both trials as follows: in the 1st trial by 43.41%, whereas in the 2nd trial by 20.03% (1st exp. group) and 6.72% (2nd exp. group) in comparison with the control groups. The daily weight gains increased in the 1st trial by 42.95 g/day, while in the 2nd trial by 69.52 g/day (1st experimental group) and 105.23 g/day (2nd experimental group; $p < 0.05$) compared with controls.

Table 6: Diarrhea score[1] of weaned pigs

Groups	**n**	**Age (day)**				
		29 – 35	**36 - 43**	**44 - 50**	**51 - 55**	**29 - 55**
		Diarrhea score (day/pig)				
Experimental	30	0	1	0	0	1
Control	30	6	0	0	0	9

[1] – diarrhea score – number of days with diarrhea

Table 7: Occurence of pathogenic *Escherichia coli* in rectal swabs of weaned pigs with diarrhea

Groups	**n**	***E.coli***	
		haemolytic	**K88 antigen positive**
Experimental	8	2	0
Control	8	6	1

Statistically significant decrease in serum urea concentration by 0.92 g/l ($p<0.05$) was observed in the analyses of the metabolic profile in weaned pigs. This parameter is related to protein metabolism and complements previous results showing reduced digestibility of CP in the control group (Table 8).

Table 8: Metabolic profile of weaned pigs

Groups	**Total protein (g/l)**	**Albumin (g/l)**	**Urea (g/l)**	**Total cholesterol (g/l)**	**Total lipids (g/l)**
Experimental	66.91 ± 5.541	39.76 ± 2.833	3.38 ± 0.653	2.3 ± 0.128	3.36 ± 0.644
Control	70.55 ± 9.658	40.88 ± 3.24	4.3* ± 0.77	2,06 ± 0,295	3.42 ± 0.562

*- p<0,05

Phytogenic feed additives (derived from herbs, spices, essential oils, and botanical extracts) exert multiple beneficial effects in pigs. Reported benefits include enhanced feed intake, improved weight gain and feed conversion, reduced incidence of diarrhea—particularly in weaned piglets—lower mortality rates, heightened palatability, reduced use of chemotherapeutic agents, improved meat characteristics (texture, taste, color), no harmful residues, enhanced overall health indicators, and improved animal viability [5].

A 2024 trial using a Delacon phytogenic additive in nursery pigs showed increased average daily gain (ADG), average daily feed intake (ADFI), and gain-to-feed ratio during early phases, with quadratic responses at higher inclusion levels, and a numerical reduction in mortality. A 2025 comprehensive review reported that phytogenic additives can modulate gut function, bolster immunity, and improve meat quality, making them effective, natural alternatives to antibiotic growth promoters especially under stress or disease conditions [5].

A 2024 study in Korea investigated finishing pigs under crowded conditions and found that dietary supplementation with microencapsulated thymol and carvacrol at 0.01% (equivalent to 100 ppm) significantly improved growth and health parameters. Treated pigs showed higher average daily gain, better average daily feed intake, and an improved feed conversion ratio. Additionally, stress-related biomarkers including cortisol and TNF-α were markedly reduced. Although mortality rates were not explicitly reported, the enhanced health and lowered stress indicators suggest a positive impact on overall pig viability [8].

Plant extracts belong to combinations of different chemical groups (e.g., essential oils, tannic acids, phenols). This is one of the reasons that very little is known about their mode of action. The standardization of plant products is also a problem because many plants are collected in the wild, and the content of several plant components varies depending on the vegetation conditions in individual years, the weather, and the origin. Their expected effects are also different. They affect the palatability of the feed, the intestinal microflora, stimulate the excretion of digestive enzymes and the immune system, i.e. the health of farm animals, as well as antioxidant and sedative properties.

A detailed 2024 review on essential oils highlighted safety concerns: their volatile bioactive compounds may disrupt gut microbiota balance, cause mucosal irritation, or provoke systemic toxicity if used without careful dose optimization [9].

IV. Conclusion

Our results confirmed that the growth parameters, the incidence of diarrheal diseases caused by pathogenic *E. coli*, the digestibility of nitrogenous and mineral substances, as well as the metabolic profile of urea of experimental weaned pigs were positively influenced by the intake of plant essential oils isolated from sage (*Salvia officinalis* L., *Lauraceae*) and oregano (*Origanum vulgare* L., *Lamiaceae*). The used plant extracts appeared as potentially promising additives positively affecting the production growth parameters and the protection of the intestinal health of weaned pigs.

V. Acknowledgements

The evaluation of the experimental study was funded by the Scientific Grant Agency of the Ministry of Education, Research, Development and Youth of the Slovak Republic with the contract VEGA 1/0698/24 - Monitoring the effect of feed additives of natural origin and alternative feed components on the production and health of monogastric animals.

References

[1] D.M. Anderson, V.J. McCracken, R.I. Aminov, J.M. Simpson, R.I. Mackie, W.A. Verstegen, H.R. Gaskins, Gut microbiology and growth-promoting antibiotics in swine. *Nutrition, Abstracts and Reviews. Series B: Livest. Feeds and Feeding, 70,* 2000, 101-108.

[2] S.L. Kochhar, Essential Oil Yielding Plants, *Economic Botany, A Comprehensive Study* (Cambridge University Press; 2016) 576-614. DOI: 10.1017/9781316286098.019

[3] M. Abers, S. Schroeder, L. Goelz, A. Sulser, T. St. Rose, K. Puchalski, J. Langland, Antimicrobial activity of the volatile substances from essential oils., *BMC-Complementary Medicine and Therapies, 21,* 2021, 124. DOI: 10.1186/s12906-021-03285-3

[4] K.A. Qureshi, A. Parvez, H. Ismatullah, H. Almahasheer, O. Al Rugaie, Exploring the antimicrobial and antibiofilm potency of four essential oils against selected human pathogens using in vitro and in silico approaches, *PLOS ONE, 20(4),* 2025, e0315663. DOI: 10.1371/journal.pone.0315663

[5] M. Madesh, J. Yan, G. Jinan, P. Hu, I.H. Kim, H.-Y. Liu, W. Ennab, R. Jha, D. Cai, Phytogenics in swine nutrition and their effects on growth performance, nutrient utilization, gut health, and meat quality: a review, *Stress Biology, 5,* 2025, 11. DOI: 10.1007/s44154-024-00209-2

[6] A. Pavlišinová, I. Danielovič, The content of essential oil and major effective components of essential oil monitored in sage (Salvia officinalis L.), *Proc. Slovak Centre of Agricultural Research – Institute of Agroecology,* Michalovce, Slovak Republic, 2007, 205-212. ISBN 978-80-88872-70-2.

[7] A. Marcin, A. Lauková, R. Mati, Comparison of the effects of Enterococcus faecium and aromatic oils from sage and oregano on growth performance and diarrhoeal diseases of weaned pigs, *Biologia, Bratislava, 61(6),* 2006, 789—795. DOI: 10.2478/s11756-006-0159-9

[8] H.A. Cho, M.H. Song., J.H. Lee, H.J. Oh, J.W. An, S.Y. Chang, D.C. Song, S.Y. Cho, D.J. Kim, M.S. Kim, H.B. Kim, J.H. Cho, Effects of phytogenic feed additives in growing and finishing pigs under different stocking density, *Journal of Animal Science and Technology, 66(5),* 2024, 981-998. DOI: 10.5187/jast.2023.e124

[9] B.S. Sivamaruthi, P. Kesika, N. Daungchana, N. Sisubalan, C. Chaiyasut, Composition, bioactivities, microbiome, safety concerns and impact of essential oils on the health status of domestic animals, *Journal of Applied Science, 14,* 2024, 6882. DOI: 10.3390/app14166882

..