

EFFECTS OF A DIETARY PLANT MIX ON MICROBIOLOGICAL FAECES ANALYSES OF PIGLETS

Gabriela Maria Cornescu^{1*}, T. Gavriss¹, Tatiana Panaite¹, Cristina Tabuc¹,
Margareta Olteanu¹, Rodica Diana Criste¹

¹National Research-Development Institute for Animal Biology and Nutrition, Balotesti, Romania

Abstract

The purpose of this experiment was to investigate a plant mix effects with antibacterial properties on the microbiological faeces load of piglets. During the 28 days period, 8 hybrid Topigs castrated males, aged 68 days (average initial weight 17.4±0.58 kg) were divided in 2 groups (C, E). Two balance studies were conducted for 5 days (weeks 2 and 4). The feed consumed and excreta were weighted, recorded and sampled. Microbiological analyses of faeces were performed for *Escherichia coli* (*E. coli*), *Salmonella* spp., *Staphylococcus* spp, *Lactobacillus* spp. Microbial populations were determined by counting the colonies on selected media for each microorganism using a Scan® 300 automatic colony counter. The results were expressed as a logarithm (base 10) of colony-forming units per gram of sample. The microbiological faeces analyses of balance 1 showed a very significant statistically ($P < 0.0001$) lower concentration of *E. coli* (\log_{10} CFU/g) and a statistically significant ($P < 0.05$) decreasing *Staphylococci* spp. concentration, while balance 2 showed a very significant statistically ($P < 0.0001$) lower concentration of *E. coli* and *Staphylococci* spp. (\log_{10} CFU/g) and a very significant statistically ($P < 0.0001$) increasing concentration of *Lactobacilli* spp (\log_{10} CFU/g) for E group compared to C group. The plants mix had the best results concerning the microbiological faeces load, therefore their antibacterial properties had a real effect during the experimental period.

Key words: piglet, antibacterial, microbiological, faeces, plant mix

INTRODUCTION

The benefits of herbals and their extracts is well recognized and have been related to the modulation of gut microbiota in addition to improvement of digestibility, stimulation of the immune system, antimicrobial activities and anti-inflammatory and antioxidant properties [3].

Essential oils increase the mucus secretion in the intestine, which protects the surface of villi, reduces the feed microbial load and improve the microbial hygiene of the carcass [6].

The wide antimicrobial spectrum of several plant extracts has been clearly demonstrated in different in vitro studies [14].

Plant extracts may directly kill pathogens due to their hydrophobicity and due to the high percentage of phenolic compounds [5].

Plant extracts and essential oils possess antifungal, antibacterial, and antiviral properties and have been screened on a global scale as potential sources of novel antimicrobial compounds, agents promoting food preservation, and alternatives to treat infectious diseases [1].

The microbiota plays an essential role not only for the well-being of the animal, but also for animal nutrition and performance and for the quality of animal products [13].

It is known that there is a competition between the dietary plants added to a diet with the other major nutrients.

The present study aimed to assess the changes in microbiological faeces load of piglets in response to the supplementation of a plant mix with antimicrobial activities.

MATERIAL AND METHODS

The experiment (28 days length) has been carried out 8 hybrid Topigs castrated males [(Large White×Pietrain)-female × (Talent)-male], divided into 2 homogenous groups (C,

*Corresponding author:
gabriela_cornescu@yahoo.com
The manuscript was received: 15.08.2018
Accepted for publication: 15.09.2018

E). The piglets had an average initial bodyweight of 18.69 ± 1.2 kg. The piglets were housed in individual metabolic cages with its own feeder and nipple drinker. Two dietary treatments (isoenergetic and isoprotein) characterized by metabolisable energy 3214 kcal/kg and crude protein 18% were fed. The feed formulation was based on corn, wheat, rice, soybean meal, rapeseed meal, gluten, powder milk, sunflower oil, choline premix, Zoofort (a vitamin-mineral premix IBNA's brand) in agreement with TOPIGS requirements. Group E diet was made distinctive by virtue of a plant mixture of bilberry dried fruits, black currant dried fruits, quince dried fruits, peppermint and fennel essential oil inclusion (789 mg/kg feed).

Pigs were individually weighed at the beginning, weekly and at the end of trial.

The production parameters: average daily gain (ADG), average daily feed intake (ADFI), gain-feed ratio (G:F) and feed consumption were recorded and calculated.

The microclimate parameters (temperature and humidity) were monitored. During two periods (5 days/week) samples of

excreta were collected daily from each animal and average weekly samples were formed.

Microbial populations (*Escherichia coli*, *Salmonella*, *Staphylococcus* spp., *Lactobacillus* spp.) from faeces samples were determined by counting the colonies on selected media for each microorganism using a Scan® 300 automatic colony counter. The results were expressed as the number of each population analysed/1 g of product. All microbiological concentrations were subjected to base-10 logarithm transformation before analysis.

The data obtained were analysed using StatView software, one-way analysis of variance (ANOVA). The results are given as means and standard error of the mean (SEM). Differences were considered significant at $P < 0.05$.

RESULTS AND DISCUSSIONS

Figure 1 shows no significant differences ($P > 0.05$) between the two groups concerning the production parameters: ADG and ADFI.

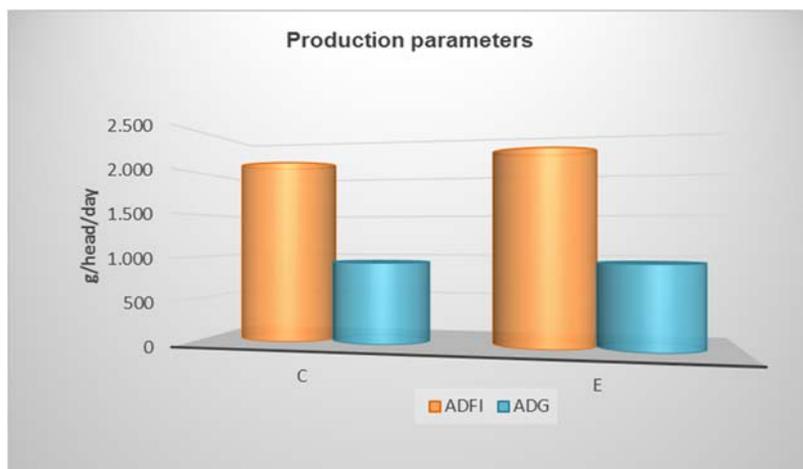


Fig. 1 Production parameters (ADFI and ADG) of piglets

Different levels and sources of plant extracts also show benefits on growth performances [13]. Also, the researches Cullen [4] and Janz [12] observed a higher ADG and ADFI in pigs' diets fed with garlic compared with the pigs fed with the control

diets. A significant improvement in ADG was observed by Grela [7] using an herb mixture (great nettle, garlic, wheat grass) in the diet of pigs from 25 to 105 kg.

In other experiments where peppermint was fed to pigs it was noticed a reduced

ADG and ADFI compared with pigs fed a medicated control diet [8].

There were no significant differences ($P>0.05$) between the two groups regarding the final body weight of the piglets.

Table 1 The effect of plants mixture from pigs' diet on faeces microflora collected during period 1

Specification	Control	Experimental	SEM	<i>P</i> -value
<i>E. coli</i> (log ₁₀)	11.364 ^a	11.321 ^b	0.008	<0.0001
<i>Salmonella</i> (log ₁₀)	absent	absent	absent	absent
<i>Staphylococcus</i> spp. (log ₁₀)	7.732 ^a	7.675 ^b	0.014	0.0219
<i>Lactobacillus</i> spp. (log ₁₀)	10.335	10.347	0.003	0.0635

Note: *Values with the different superscript in the same row are significantly different ($P<0.05$)

The results of Table 1 show significant statistically ($P<0.0001$) lower concentration of *E. coli* in E group compared with C group, starting with the second experimental week. Also, statistically significant ($P<0.05$) lower value of *Staphylococcus* spp concentration could be noticed on E group compared with C group, concomitant with a slighty increase of *Lactobacillus* spp concentration in E group.

It was demonstrated in vitro studies that oils as peppermint, lemon balm and coriander seed exhibited highly antibacterial activity in several assays against *E. coli* [15].

It could be said with certainty that a synergic antibacterial activity of the plant extract composition influenced the significant reduction of *E. coli*. concentration even from the beginning of the experiment.

Table 2 The effect of plants mixture from pigs' diet on faeces microflora collected during period 2

Specification	Control	Experimental	SEM	<i>P</i> -value
<i>E. coli</i> (log ₁₀)	11.450 ^a	11.380 ^b	0.013	<0.0001
<i>Salmonella</i> (log ₁₀)	absent	absent	absent	absent
<i>Staphylococcus</i> spp. (log ₁₀)	8.177 ^a	8.110 ^b	0.013	<0.0001
<i>Lactobacillus</i> spp. (log ₁₀)	11.964 ^b	12.155 ^a	0.037	<0.0001

Note: *Values with the different superscript in the same row are significantly different ($P<0.05$)

Within table 2, the data obtained during period 2 show a very significant statistically ($P<0.0001$) lower concentration of *E. coli* and *Staphylococcus* spp in E group compared with C group. A very significant statistically ($P<0.0001$) higher concentration of *Lactobacillus* spp. was registered in favour of group E.

Taking into consideration that since the first period we had a very significant reduction of *E.coli* concentration, during the second period the concentration of *Staphylococcus* spp. was decreasing considerably. The results are in accordance with Jamroz [11] studies who noticed that the plant extract (carvacrol, cinnamaldehyde and

capsaicin) reduced the total *E. coli* and *Clostridium perfringes* numbers in the intestines of broiler chickens, therefore in droppings.

It is likely due to production of antimicrobial compounds of the plant extract composition together with the production of antimicrobial compounds by lactobacilli to increase the prevention of pathogenic microorganisms such as *Salmonella* spp., *E. coli* and *Staphylococcus* spp.. It is known that an increased number of lactobacilli have the potential to reduce the *E. coli*. and aerobic bacteria in jejunum, ileum, cecum and colon mucosa [9], [2].

CONCLUSIONS

The plants mix had real antibacterial effects against *E.coli* and *Staphylococcus* spp., decreasing significantly their concentration in faeces concomitant with an increasing concentration of *Lactobacillus* spp. It can be assumed that the synergic antibacterial activity of the plant extract composition influenced these effects during the experimental trial.

ACKNOWLEDGEMENTS

This work was supported by a grant of the Romanian Ministry for Scientific Research and Innovation, project number PN 18200102.

REFERENCES

[1] Astani A., Reichling J., Schnitzler P., 2010: Comparative study on the antiviral activity of selected monoterpenes derived from essential oils. *Phytother. Res.* 24, p.673–679. doi: 10.1002/ptr.2955.

[2] Chiang M.L., Chen H.C., Chen K.N., Lin Y.C., Lin Y.T., Chen M.J., 2015: Optimizing production of two potential probiotic *Lactobacilli* strains isolated from piglet feces as feed additives for weaned piglets. *Asian Australas J Anim Sci.* 28(8):1163–1170

[3] Costa L.B., Luciano F.B., Miyada V.S., Gois F.D., 2013: Herbal extracts and organic acids as natural feed additives in pig diets, *S Afr J Anim Sci.*, vol 43, p.181–193.

[4] Cullen S.P., Monahan F.J., Callan J.J., O'Doherty J.V., 2005: The effect of dietary garlic and rosemary on grower-finisher pig performance and sensory characteristics of pork, *Ir J Agric Food Res.* 44, pp. 57-67.

[5] Dorman H. J. D. and Deans S. G., 2000: Antimicrobial agents from plants: antibacterial activity of plant volatile oils, *Journal of Applied Microbiology*, vol. 88, no. 2, p. 308–316.

[6] Franz C., Baser K.H.C., Windisch W. 2010: Essential oils and aromatic plants in animal feeding – a European perspective. A review. *Flavour Fragr J.* 25:327–340. doi: 10.1002/ffj.1967

[7] Grela E.R., Krusiński R., Matras J. 1998: Efficacy of diets with antibiotic and herb mixture additives in feeding of growing-finishing pigs, *J Anim Feed Sci.* 7 (Suppl. 1), p. 171-175.

[8] Holden P. J., and McKean J., 2000: Botanicals for pigs-Peppermint II (ASLR649). 2000: Iowa State University, Ames, IA.Swine Research Report.

[9] Huang C.H., Qiao S.Y., Li D.F., Piao X.S., Ren J.P., 2004: Effects of *Lactobacilli* on the performance diarrhea incidence VFA concentration and gastrointestinal microbial flora of weaning pigs. *Asian Aust J Anim Sci.* 17: p.401–409.

[10] Jamroz D., Wertelecki T., Houszka M., Kamel C., 2006: *J. Anim. Physiol. Anim Nutrition*, 90, p.255

[11] Jamroz, D., Wertelecki T.J., Orda J., Wiliczkievics A. and Skoropinska J., 2003: Influence of photogenic extracts on gut microbial status in chickens. In: *Proc. 14th European Symp. on Poultry Nutrition*, August, pp. 176. Lillehammer, Norway.

[12] Janz J.A., Morel P.C., Wilkinson B.H., Purchas R.W., 2007: Preliminary investigation of the effects of low-level dietary inclusion of fragrant essential oils and oleoresins on pig performance and pork quality, *Meat Sci.* 75, p. 350-355.

[13] Jensen B.B., 1998: The impact of feed additives on the microbial ecology of the gut in young pigs, *Journal of Animal and Feed Sciences*, no. 7, p. 45 – 64.

[14] Liu Y., Espinosa C. D., Abelilla J. J., Casas G.A., Lagos V., Lee S.A., Know W. B., Mhatai J.K., Navarro D.M.L., Jaworski N.W., Stein, H. H. 2018: Non-antibiotic feed additives in diets for pigs, *Animal Nutrition*, vol. 4, no.2, p.113-125.

[15] Thompson A., Meah D., Ahmed N., Conniff-Jenkins R., Chileshe E., Phillips C.O., Claypole T. C., Forman D.W., Row P.E., 2013: Comparison of the antibacterial activity of essential oils and extracts of medicinal and culinary herbs to investigate potential new treatments for irritable bowel syndrome. *BMC Complementary and Alternative Medicine.* 2013; 13:338. doi: 10.1186/1472-6882-13-338.