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Acidifiers and their application as growth promoters

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SUMMARY – The use of organic acids that are able to control the growth of pathogenic microorganisms both in the feed and in the animal digestive tract is evaluated. The results indicate that the antibiotics, previously used but now banned in the EU as standard feed additives, can be substituted by synergetic formulations of such acids without losing animal production yields. *In vitro* studies were followed by in vivo evaluations and the results were tabulated.

Key words: Organic acids, feed additives, synergetic, production yields.

RESUME – *"Les acidifiants et leur application comme promoteurs de croissance". L'utilisation des acides organiques, capables de contrôler la croissance des micro-organismes pathogènes, non seulement dans l'aliment mais aussi dans l'appareil digestif, est évaluée. Les résultats indiquent que les antibiotiques, employés auparavant comme des additifs standard de l'aliment bétail, mais actuellement interdits dans l'UE, peuvent être substitués par des formulations synergiques de ces acides sans perte de rendement en production animale. Des études* in vitro *suivies par des évaluations in vivo sont rapportées et leurs résultats sont présentés.*

Mots-clés : *Acides organiques, additifs, synergique, rendement en production animale.*

Introduction

The use of anbiotics at intensive animal production, not only intended as therapeutics but also as common additives of continuous use in animal feeding started approximately 50 years ago. During decades these treatments were maintained as they exerted a positive effect, not only as a prevention of enteric infections, but also allowing an improved feed utilization.

One of the most important benefits of this antibiotic use, is the decrease of microbial intestinal fermentation. It is known that this intestinal fermentation reduces the nutritive value of the feed considering, in addition, the risk of endotoxin formation.

Before arriving to the year 2000, the animal food industry has been obliged to abandon the use of these antibiotics and look for alternatives to accomplish the new food regulations, that each time are more severe, in benefit of human health, however the animal production yield became seriously affected.

In this publication, the results of *in vitro* and *in vivo* trials are shown using different organic acids to evaluate their effect on the pathogenic enteric flora and their benefits for animal production.

In vitro studies

The antibacterial properties of different acids, accepted as feed additives, vary between each other, being the organic acids more effective than the mineral acids. These latter do only exert an acidifying function however they lack the capacity to penetrate into the bacterial wall. Figure 1 compares the activity of different acids: (i) formic; (ii) acetic; (iii) lactic; (iv) fumaric; and (v) phosphoric acid against a pathogen *Escherichia coli* at different pH (Reports Lab. CCL, 1997, 1998).

Several studies were developed to balance synergic mixtures of organic acids with a high antimicrobial capacity, not only in the feed but also passing the gastric barrier acidifying a large part of the intestine.

Summary of results
Strain: *E. coli* pathogen - K88, K87
Acid concentration: 50 mmol/l
Log decrease of bacteria count according to pH
Contact time 4 hours

	pH 5	pH 6	pH 7
Formic Ac.	7.0	6.0	2.0
Acetic Ac.	6.0	6.0	0.1
Lactic Ac.	6.8	3.0	0.3
Fumaric Ac.	0.1	0.0	0.2
Phosphoric Ac.	1.2	0.7	0.0

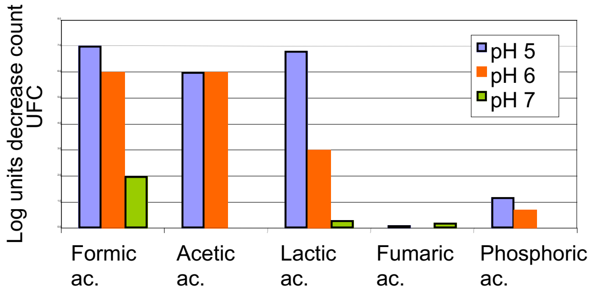

Fig. 1. Bactericidal activity according to pH.

In Fig. 2, the activity of acid is again compared: (i) formic, (ii) formic + Na-butirate, (iii) phosphoric, and (iv) a syngergic combination lactic + formic acid to control growth of *Clostridium* (Reports Lab. CCL, 1997, 1998). It was observed that a concentration of 0.4% of this synergic combination may control growth of *Clostridium campylobacter* and reduce the contamination rate with minimum 3 logaritmic units at pH 5 as well as at pH 6.

Concentration: 0,4% pH: 5

Treatment group	Count log (UFC)/ml
Control O	4.8
Control T=4	4.2
LF2 Form.	1.3
Formic ac.	2.9
Phosphoric ac.	3.9
Formic ac. + Na-butiric	2.8

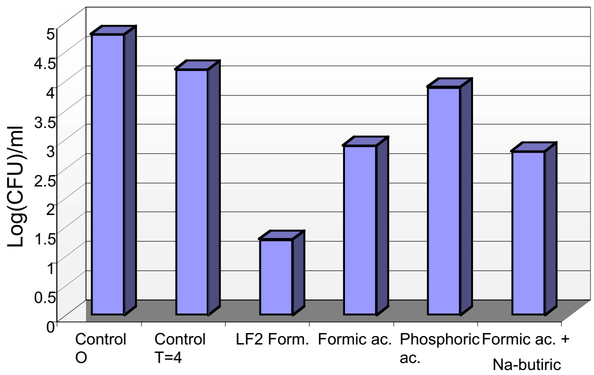

Fig. 2. *Clostridium* growth after addition of sifferent additives.

In vivo studies

The first study evaluates the effect of the synergic combination Formula LF2 (similar to LFP: Lactic + Formic + Propionic) against two mono-organic acids. 480 pigs at finishing stage were fed from 50 kg weight to 100-110 kg. The feed did not contain any anitbiotic growth promoter. The parameters controled are body weight and feed consumption. The results are shown in Table 1 (Reports Lab. CCL, 1997, 1998).

Comments

(i) Between 50 and 75 kg, all groups that were fed with feed treated with organic acids, showed a better feed conversion and a tendency to increase feed intake. The growth rate is higher for the group that received lactic acid 1.1%.

(ii) From 75 kg to final weight, the group fed with the synergic mixture LF2 improved significantly daily weight gain, the best feed conversion rate was also obtained in this group.

(iii) Analysing all parameters of both phases, we see the results in all groups are very similar, however the major growth rate is found in groups treated with lactic acid and the synergic mixture LF2 (similar to LFP).

Table 1. Evaluation of the effects of LF2 Formula against two mono-organic acids

Animal weight	Parameters	Treatment groups			
		Control 0	Lactic acid (1.1%)	Formic acid (0.5787%)	LF2 Form. (0.5%)
50-75 kg	Feed intake	2.10	2.17	2.13	2.15
	Daily gain	764	793	787	781
	Conversion ratio	2.76	2.74	2.71	2.75
75-105 kg	Feed intake	2.49	2.54	2.53	2.57
	Daily gain	730	754	740	772
	Conversion ratio	3.43	3.38	3.42	3.33
50-105 kg	Feed intake	2.27	2.34	2.31	2.34
	Daily gain	754	782	772	783
	Conversion ratio	3.02	2.99	2.99	2.99

The second test was conducted in pigs during fattening, once again to substitute antibiotic growth promoter.

The effect in feed is: (i) acidifier; (ii) antimicrobial and fungistatic; and (iii) improves feed palatability. The effects required at gastrointestinal level are: (i) acidifier; (ii) antimicrobial against Gram– pathogen flora and *Clostridium e.o;* and (iii) mineral chelating action, improving its bioavailability.

The test was performed at the Cooperative San Miguel, Tauste, Zaragoza (Spain). It was conducted with a total of 881 pigs at a fattening stage, separated into lots of 421 and 460 animals. As for the parameters evaluated, they were twofold: (i) feed quality parameters (a bacteriologic and mycologic control was performed); and (ii) productive parameters as shown in Table 2.

Table 2. Field trial registered data

No. total of animals at entrance	881	Average days fattening control lot	118.25
No. of defectuous animals	7	Average days fattening LF2 lot	113.20
Mortality before trial start	5	Feed conversion control lot	2.89
Mortality at control lot	6	Feed conversion LF2 lot	2.67
Mortality at experimental lot LF2	3	Daily growth rate – control lot (g/d)	724
No. total animals at slaughter	867	Daily growth rate – LF2 lot (g/d)	744
No. finishing control lot	409	Saving feed consumption per animal (kg)	22.43
No. finishing treated lot LF2	451	Net savings /animal /cyclus (€)	3.20

Results

(i) The best feed quality was found with the synergic combination, being comparable with a high dosed antibacterial treatment + mould inhibitor.

(ii) The productive parameters registered at 60 kg BW showed a difference between both groups of 2.7 kg benefit for the group treated with LF2 (LFP).

References

Reports Lab. CCL (1997, 1998). Franklin Products BV, The Netherlands.