Online Journal of Animal and Feed Research

Volume 1, Issue 6: 434-438 (2011) ISSN 2228-7701

THE USE OF ORGANIC ACIDS IN RABBIT FARMING

V.G. PAPATSIROS* and G. CHRISTODOULOPOULOS*

Clinic of Medicine, School of Veterinary Medicine, University of Thessaly, Karditsa, Greece

*E-mail: vpapatsiros@yahoo.com / vpapatsiros@yahoo.com

ORIGINAL ARTICLE

ABSTRACT: *During the last decades, organic acids (acidifiers) have been used as potential alternative to antibiotics in non monogastric animals' diets in order to improve growth performance and prevent diseases. Their beneficial effects include enhancement of growth rate by improving gut health through the reduction of pH, promoting of beneficial bacterial growth and increasing the digestibility of nutrients through the improvement of pancreatic secretions. Furthermore, acidifiers appear antimicrobial activity, by controlling the bacterial populations in the gut, increasing activity of proteolytic enzymes, and inhibiting the proliferation of pathogenic bacteria. Dietary organic acids can actually become an alternative solution to antibiotics, in order to improve health status and performance in rabbit farming. The purpose of this study is to summarize the beneficial effects of using organic acids in rabbit diet*.

Keywords: *Acidifiers, organic acids, effect, growth performance, health status, rabbit*

INTRODUCTION

Organic acids and salts have a long-history in the food and the feed industries, which commonly use them as preservatives. Organic acids are routinely included in diets for monogastric animals in Europe in order to replace antibiotics as growth promoters.

As a group of chemicals, organic acids are considered to be any organic carboxylic acid of the general structure R-COOH (including fatty acids and amino acids). Not all of these acids have effects on gut microflora. Organic acids (C1-C7) with specific antimicrobial activity are short-chain acids (C1–C7) and they are widely distributed in nature as normal constituents of plants or animal tissues. They are also formed through microbial fermentation of carbohydrates mainly in the large intestine. They are sometimes found in their sodium, potassium or calcium form. Most organic acids with antimicrobial activity have a pKa—the pH at which the acid is half dissociated-between 3 and 5. Table 1 shows the common name, chemical name, formula, molecular weight, and first pKa of organic acids that are commonly used as dietary acidifiers for pigs or poultry (Dibner and Buttin, 2002).

Table 1 - List of acids and their properties

Acid	Chemical name	Formula	pKa
Formic	Formic Acid	HCOOH	3.75
Acetic	Acetic Acid	CH3COOH	4.76
Propionic	2-Propanoic Acid	CH3CH2COOH	4.88
Butyric	Butanoic Acid	CH3CH2CH2COOH	4.82
Lactic	2-Hydroxypropanoic Acid	CH3CH(OH)COOH	3.83
Sorbic	2,4-Hexandienoic Acid	CH3CH:CHCH:CHCOOH	4.76
Fumaric	2-Butenedioic Acid	COOHCH:CHCOOH	3.02
Malic	Hydroxybutanedioic Acid	COOHCH2CH(OH)COOH	3.40
Tartaric	2,3-Dihydroxy- Butanedioic Acid	COOHCH(OH)CH(OH)COOH	2.93
Citric	2-Hydroxy-1,2,3- Propanetricarboxylic Acid	COOHCH2C(OH)(COOH)CH2COOH	3.13
Benzoic	Benzenecarboxylic acid	C_6H_5COOH	4.19

To cite this paper: Papatsiros, V.G. and Christodoulopoulos, G. 2011. The use of organic acids in rabbit farming. *Online J. Anim. Feed Res.*, 1(6): 434-438.

Journal homepage: http://www.ojafr.ir

Organic acids in monogastic animals' diet

Several organic acids have been reported to improve growth performance (eg. increased palatability, feed efficiency, mineral absorption, phytate-P utilization) when they are supplemented in non-ruminant diets (Partanen and Mroz, 1999; Dibner and Buttin, 2002; Boling et al., 2000). In addition, organic acids are believed to have antimicrobial activity and they have suggested for the control intestinal microbial growth (Partanen and Mroz 1999; Davidson, 2001). The antimicrobial activity of organic acids is basically the same, irrespective of acting in food, feed, or gut lumen (Diebold and Eidelsburger, 2006). Most available information about the use of acidifiers in animal feeding is focused on swine and poultry (Partanen and Mroz 1999; Michi et al., 2001; Dibner and Buttin, 2002; Papatsiros et al., 2011).

Several mechanisms through which dietary organic acids may produce beneficial effects on health status and growth performance have been proposed (Partanen and Mroz, 1999; Partanen 2001; Knarreborg et al., 2002, Diebold and Eidelsburger, 2006, Tung et al., 2006) the following appear to be the most prominent:

-Reduction of gastric pH
-Reduction of buffering capacity of diets
-Increase of proteolytic enzymes activity / Improvement of pancreatic secretions
-Stimulating the activity of digestive enzymes
-Increase of nutrient digestibility
-Promotion of beneficial bacterial growth
-Reduced survival of pathogens through the stomach / balancing the microbial population
-Direct killing of bacteria
-Alterations in the nutrient transport and synthesis within the bacterium
-Depolarization of the bacterial membrane

Considerable variations in the results of their response due to possible dietary and other factors such as (Partanen and Mroz, 1999; Strauss and Hayler, 2001; Decuypere and Dierick, 2003; Morz 2005):

-type and pKa of acid
-inclusion rate and dose of supplemented acids
-type / composition of diets and their acid-base or buffering capacity
-level of intraluminal production of acids in GI tract by inhabiting microflora
-feed palatability
-intrinsic acid activity
-receptors for bacterial colonization on the epithelial villi
-maternal immunity by vaccinations against pathogens
-hygiene and welfare standards
-age of animals

Beneficial effects of organic acids on rabbits

The mucosa of the small intestine has a major role in the digestion and absorption of nutrients and represents an important area of defence against antigenic aggressions in young rabbits (Gallois et al., 2005). The use of organic acids appears interesting, even if scientific data concerning their effect on microflora population, mucosal immunity and growth performance are few and often contradictory in rabbits (Falcao et al., 2007). Also the mode of action of these products on caecal microflora is not completely understood, although it is demonstrated that organic acids play a direct action on the bacterial cell integrity (Maertens et al., 2006).

The effects in digestibility and productive performances of the inclusion of organic acids in rabbit nutrition are not clear. Improvements in daily gain have been reported in many studies (Table 2), but no effects were recorded by others (Hollister et al., 1990, Scapinello et al., 2001). In addition, antimicrobial activity of organic acids in rabbits has also been reported (Skřivanová and Marounek, 2002), reducing the damage caused by both Gram– and Gram+ pathogen bacteria (Gardinali et al 2008). In contrast, in other studies testing sodium butyrate (Carraro et al., 2005) and fumaric acid (Scapinello et al., 2001) or formic acid (Skřivanová and Marounek, 2007) no antimicrobial activity was indicated. Combining organic acids with prebiotics (Scapinello et al., 2001) or with probiotics (Michelan et al., 2002) did not significantly improve performances, though mortality was significantly reduced in trial by Hollister et al. (1990).

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Table 2 - Review of trials' results with organic acids in rabbits

Trial	Organic acids	Results
Castrovilli, 1991	fumaric acid (1.5 g/kg)	Improvements in daily gain
ZiLin et al., 1996	fumaric acid (1.25 g/kg)	Improvements in daily gain
Hullar et al., 1996	fumaric acid (3 g/kg)	Improvements in daily gain
El-Kerdawy, 1996	fumaric acid (0.5%)	Increase of digestibility of crude protein and crude fibre
Hullar et al., 1996	sodium butyrate	Increase of diet digestibility
Skřivanová and Marounek, 2002	caprylic acid (5 g/kg)	Decreased mortality due mainly to *Pasteurella multocida*, *Clostridium perfringens, Bordetella bronchiseptica* No significant effect on the growth rate
Abecia et al., 2005	fumaric acid (5 g/kg and 10 g/kg)	No significant effect affect the caecal environment, except for a higher concentration of amylolytic bacteria
Scapinello et al., 2001 Michelan et al., 2002	fumaric acid (1,5%)	tended to improve both the daily gain and the feed efficiency, but the differences were not statistically significant
Skøivanová and Marounek, 2006	Oil containing caprylic, capric and lauric acid at 60.8, 38.7 and 0.3 g per 100 g of fatty acid methylesters, respectively at 10 g/kg	Decreased mortality post-weaning mortality no effect on No significant effect on zootechnical parameters (growth rate, feed intake, daily gain, or carcass yield)
Cesari et al., 2008	-a blend of formic acid, lactic acid and essential oil originating from rosemary, thyme and cinnamon (4 g/kg) -formic and lactic acid (5 g/kg)	stimulated weight gain, increasing also feed conversion rate in the second phase of fattening,
Gardinali et al., 2008	0.4% mixture of microencapsulated formic and citric acids and essential oil	Reduction of the damage of both Gram– and Gram+ pathogen bacteria permitting to obtain a better serum innate response in experimentally infected rabbits

CONCLUSIONS

During last decades there is growing increase in public awareness about the relationship between the feed medication with antimicrobials in farm animals' diets and the risk of developing cross-resistance of pathogens to antibiotics used in human medicine (Corpet, 1996, Mathew et al., 2007, Hunter et al., 2010). Digestive disorders constitute the main health problem in weaned rabbits and antibiotics are widely used for prevention of infections and as a growth promoter, altering the gut flora, suppressing bacterial catabolism and reducing bacterial fermentation (Pinheiro et al., 2004). Due to consumers' concern about the possibility of drug resistance of pathogenic bacteria, dietary acidifiers can actually become the most common and efficacious alternative solution to antibiotics, in order to improve health status and growth performance of rabbits.

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To cite this paper: Papatsiros, V.G. and Christodoulopoulos, G. 2011. The use of organic acids in rabbit farming. *Online J. Anim. Feed Res.,* 1(6): 434-438.
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