

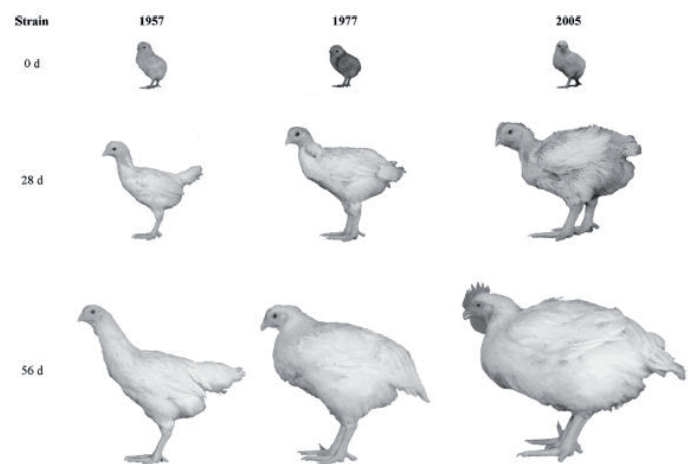
# Improved broiler performance with a combination of protected sodium butyrate and zinc bacitracin

Mónica Puyalto Juan José Mallo  
Norel SA, Spain

## INTRODUCTION

Since the early 1950's antibiotics have been widely used in poultry feeds, first primarily to control disease and more recently to promote growth and improve feed conversion. Legislative developments in the European Union and USA, recommendations by the World Health Organisation, initiatives taken by the food chain, and consumer concerns, all point to a widespread removal of antibiotic feed additives for animal growth promotion.

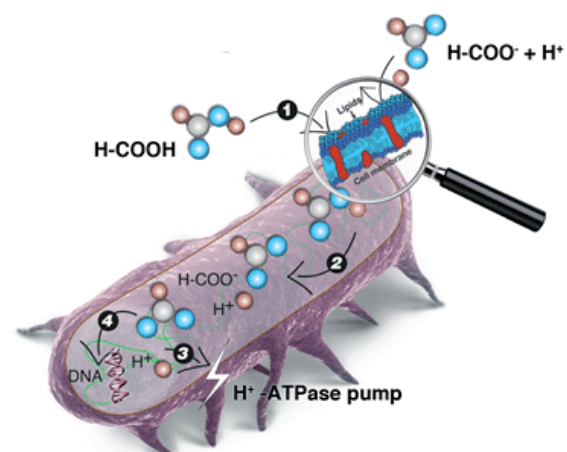
Essentially, the main way in which we can reduce our dependence on antibiotic use in animals is the development of alternatives to antibiotics that work via similar mechanisms, promoting growth whilst enhancing the efficiency of feed conversion. However, the mode of action of AGPs is not yet fully understood. Different potential mechanisms have been proposed to explain AGP-mediated growth enhancement (Gaskins et al., 2002; Dibner and Richards, 2005; Page, 2006). The most accepted mechanism would be through modulation of the gut microbiota, which plays a critical role in maintaining the host health (Tuohy et al., 2005). Microbiota composition influences the intestinal environment and the development and responses of the host immune system against pathogenic and non-pathogenic antigens (Cebra, 1999; Kelly and Conway, 2005).



In evaluating the possible alternatives to subtherapeutic use of antibiotics, it must be considered not only their relative short- and long-term costs but also their ability to produce the same positive effects as the antibiotics. The focus of alternative strategies has been to prevent proliferation of pathogenic bacteria and modulation of indigenous bacteria so that the health, immune status and performance are improved (Ravindran, 2006). It may well be necessary to adopt changes in the management of livestock and also introduce different feed components in order to compensate for the antibiotics effects and maximize production. Genetic improvements in animals and vaccinations may also be useful. Therefore, some of the alternatives described below may be part of the solution even though they do not reproduce all the beneficial effects of antibiotics.

## ORGANIC ACIDS

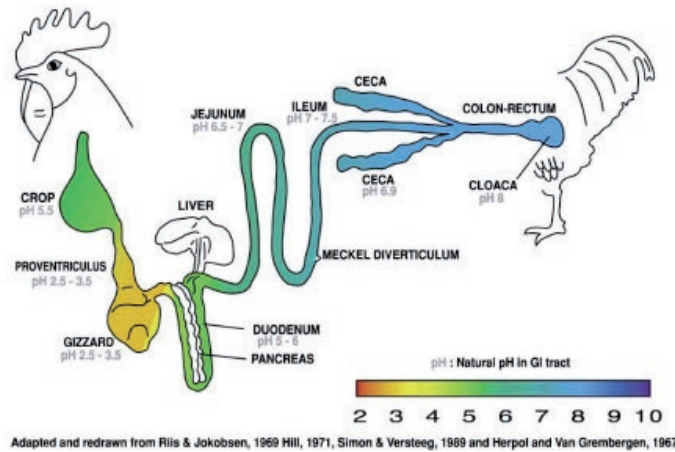
Organic acids are not antibiotics but, if used correctly along with nutritional, management and biosecurity measures, they can be a powerful tool in maintaining the health of the GI tract of poultry, thus improving their zootechnical performances (Abdel-Fatah et al., 2008). Organic acids in poultry might be a meaningful tool of controlling enteric bacteria, both pathogenic and non-pathogenic (Naidu, 2000; Wolfenden et al., 2007). Due to their antimicrobial effect, organic acids result in inhibition of intestinal bacteria leading to the reduced bacterial competition with the host for available nutrients and diminution in the level of toxic bacterial metabolites. As a result of the decreased bacterial fermentation, protein and energy digestibility might be improved and thereby ameliorate the performance of bird. Acids also decrease the pH value in different segments of gastrointestinal tract which is conducive for the growth of favourable bacteria, hampering the growth of pathogenic bacteria which grow at relatively higher pH.



Acid effect in Gram- bacteria

In this respect, Sofos *et al.* (1985) reported that sorbic acid supplemented broilers had lower coliform counts in the *duodenum* and lower yeast and mold counts, but higher bacteroides counts in the *caeca*. Also, Alp *et al.* (1999) reported that inclusion of an antibiotic and an organic acid mixture (lactic, fumaric, propionic, citric and formic acids), separately or in combination, reduced the Enterobacteriaceae count in the *ileum* of broilers. Moharrery and Mahzoneh (2005) described that malic acid had the potential to reduce *E. coli* population in the intestines of broiler chicken. Gunal *et al.* (2006) found that both a mixture of propionic and formic acid salts and the inclusion of flavomycin significantly decreased total bacterial and gram negative bacterial counts compared to the basal diet. Organic acids also have demonstrated to increased villus height in the small intestines (Senkoğlu *et al.*, 2007; Paul *et al.*, 2007; Garcia *et al.*, 2007; Abdel-Fattah *et al.*, 2008; Mallo *et al.*, 2010) which increases the absorptive intestinal surface and might facilitate the nutrient absorption and growth performance.

Regarding performance, Maiorka *et al.* (2004) reported that a mixture of fumaric, lactic, citric and ascorbic acids, as a substitutive of AGPs improved performance of broilers even in absence of antibiotic. Benedetto (2003) also observed that a commercial mix of organic acids used as a replacer of AGPs improved production performance in breeding hens along with other beneficial effects. Roy *et al.* (2012) evaluating the pathomorphological effect of different combinations of formic, propionic and lactic acids in their salt forms as a replacer of AGPs (virginiamycin) in broilers, suggested that the combination of organic acids instead of using only one acid may be used in broilers diets as a replacer of AGPs.



Adapted and redrawn from Riis & Jakobsen, 1969 Hill, 1971, Simon & Versteeg, 1989 and Herpol and Van Grembergen, 1967

Other researchers found that both the supplementation with virginiamycin and a commercial mixture of propionate and formicine significantly improved body weight, average daily gain, and feed:gain ratio of broilers when compared to a control diet (Ziaie *et al.*, 2009).

As a result of a possible increase in digestibility, Ziaie *et al.* (2011) found that both a commercial mixture of organic acids based on propionic acid or a virginiamycin supplemented diet improved weight and tibia length, tibiotarsi index, thickness of the medial and lateral wall of the tibia, tibiotarsal index, mechanical parameters and tibia ash, Ca and P over a negative control diet.

Sodium butyrate has demonstrated to control pathogenic bacteria (Fernández Rubio *et al.*, 2009), increase diet digestibility (Mallo *et al.*, 2011) and improve animal performance (Mallo *et al.*, 2010). Chamba *et al.* (2014) demonstrated that the addition of protected sodium butyrate to the diet improved animal performance when compared with colistine or a control (blank) group, because of a better villi development in the intestine. He concluded that it is a possible substitute to AGPs.

## TRIALS

The objective of the present study, presented in the APPC (Puyalto *et al.*, 2014), was to evaluate the effect in broiler productive parameters and gut health of sodium butyrate protected with PFAD sodium salt (GUSTOR N'RGY), Zn Bacitracin and their combination, when added to a control diet without any other additive.

A total of 160 Cobb one day old chickens were randomly allocated to 4 treatments (Table 1).

Every treatment was replicated 4 times and each replicate consisted of 10 chickens. Mash feeds and water were offered *ad libitum*.

Body weight (BW), average daily gain (ADG), average daily feed intake (ADFI) and feed conversion rate (FCR) were recorded for the 0-42 d fattening period. At the end of each period (21 days and 42 days) one chicken per replicate was euthanized and samples from the ileum and caecum were taken to analyze gut microflora. Besides, samples of duodenum, jejunum and ileum epitheliums were obtained in order to determine their development status.

Data were analyzed as a completely randomized design by GLM of SPSS v. 19.0.

Treatment	Period (days)	BZn (kg/t)	GUSTOR N'RGY (kg/t)
Control	0-42	-	-
BZn	0-42	0.5	-
NRGY	0-21	-	1
	22-42	-	0.5
NRGY + BZn	0-21	0.5	1
	22-42	0.5	0.5

Table 1. Trial treatments

### Productive Parameters

The use of the combination of sodium butyrate protected with PFAD sodium salt (GUSTOR N'RGY) and BZn resulted in a statistically improvement in the FCR when compared to the control treatment (Figure 1).

The final body weight was numerically higher for BZn but the animals that received the combination presented the highest FBW (Figure 2).

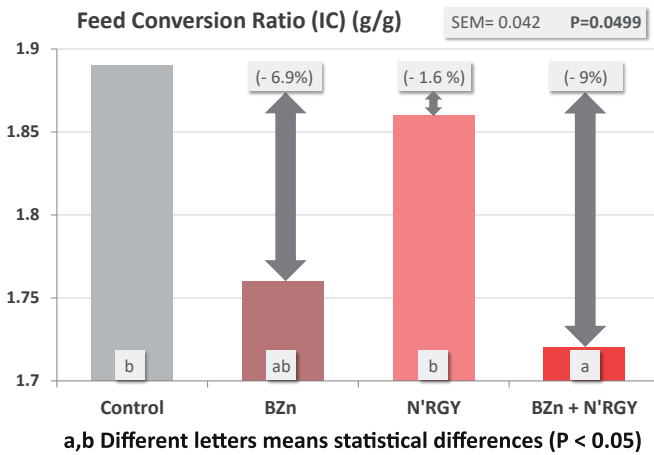


Figure 1. Effects of dietary sodium butyrate protected with palm fatty acids salts and zinc bacitracin on broilers feed conversion ratio

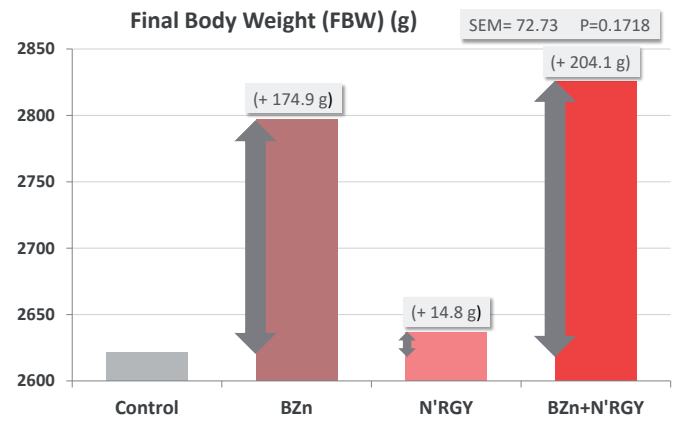


Figure 2. Effects of dietary sodium butyrate protected with palm fatty acids salts and zinc bacitracin on broilers final body weight

### Gut health

The use of butyrate alone and in combination with BZn tended to reduce the count of *E. coli* in ileum at 21 days (Control=5.02x10<sup>6</sup> vs. N'RGY=4.63x10<sup>5</sup>; P=0.0932).

BZn was also able to reduce the count of *E. coli* but when evaluating the epithelium variables a thinner mucosa was observed both in jejunum and ileum at 42 days. This effect was not observed in the combination of BZn+butyrate. Also the longest ileum villi corresponded to the butyrate supplemented group (N'RGY) (Table 2).

	Jejunum 42 days		Ileum 42 days	
	Mucosa thickness	Villi length	Mucosa thickness	Villi length
<b>Control</b>	760 <sup>xy</sup>	546	670 <sup>b</sup>	487 <sup>b</sup>
<b>BZn</b>	683 <sup>y</sup>	485	627 <sup>b</sup>	464 <sup>b</sup>
<b>N'RGY</b>	<b>985<sup>x</sup></b>	717	<b>922<sup>b</sup></b>	<b>720<sup>a</sup></b>
<b>BZn+N'RGY</b>	959 <sup>xy</sup>	753	809 <sup>ab</sup>	589 <sup>ab</sup>
SEM	83.3	78.8	60.4	57.1
P	0.0813	0.1057	<b>0.0182</b>	<b>0.0306</b>

a,b Different letters means statistical differences (P < 0.05)  
x, y Different letters means tendency (P < 0.1)

Table 2. Effects of dietary sodium butyrate protected with palm fatty acids salts (N'RGY) and zinc bacitracin (BZn) on histomorphology in jejunum and ileum of broilers

### CONCLUSIONS

It can be concluded that the use of combination of **Zn Bacitracin (BZn)** and **sodium butyrate protected with PFAD sodium salts ( GUSTOR N'RGY)** is able to **improve productive parameters in broiler chickens** compared to the control treatment and numerically when compared to the antibiotic alone. Also, **GUSTOR N'RGY** is able to **modify gut microflora** without affecting mucosa thickness and villi length when combined with Zn Bacitracin. **GUSTOR N'RGY, used alone, improves GIT development.**

