Effect of the use of organic acids in drinking water during the last two weeks prior to slaughter on *salmonella* shedding

E.V. De Busser[1,2*], J. Dewulf[1], N. Nollet[4], K. Houf[2], K. Schwarzer[5], L. De Sadeleer[3], L. De Zutter[2], D. Maes[1]

[1] Department of Reproduction Obstetrics and Herd Health, Faculty of Veterinary Medicine, Ghent University, Belgium
[2] Department of Veterinary Public Health and Food Safety, Faculty of Veterinary Medicine, Ghent University, Belgium
[3] Animal Management, Ghent Highschool, Belgium
[4] INVE België NV, Oeverstraat 7, 9200 Baasrode, Belgium
[5] Nutri-Ad International NV, Kloosterstraat 1/7, 2460 Kasterlee, Belgium
Corresponding author: Emily.DeBusser@UGent.be

Abstract

In this study we investigated the effect of adding organic acids to the drinking water of finishing pigs two weeks prior to slaughter on the shedding and prevalence rate of *Salmonella* at slaughter. One hundred animals from 4 Belgian pig herds infected with *Salmonella* were included. Fifty of these animals received drinking water supplemented with a mixture of different organic acids during 14 days prior to slaughter. Non-treated animals served as controls. Different samples were taken: contents of ileum and rectum, mesenteric lymph nodes and carcass swabs. All samples were submitted to *Salmonella* isolation using standard procedures. The results could not reveal a significant difference between both groups. This may be due to the limited power of the study (only 50 animals sampled in each group) or due to the fact that the treatment duration was insufficient to prove the benefit of the used organic acids.

Introduction

Salmonella is known as one of the most important zoonotic pathogens and the consumption of pork meat is a major source of infection. Seventy-five percent of all pig farms in Belgium are infected and it is known that the amount of animals shedding *Salmonella* increases at times of stress (Nollet et al., 2004). Transport to the slaughterhouse and waiting in the lairage room is a stress moment for the pigs (Berends et al., 1996). Acidifying the feed and/or drinking water during a long period seems to be useful to control *Salmonella* (Van der Wolf et al., 1997; Van der Wolf et al., 1998). In this study we assessed the effect of the addition of organic acids to the drinking water in finisher pigs for two weeks prior to slaughter to specifically target the expected increase of shedding during transport and lairage.

Materials and Methods

This study was conducted in 5 groups of fattening pigs on 4 different Belgian pig farms with a high *Salmonella* infection status as determined by serology in the *Salmonella* Surveillance Programme (Animal Health Care Flanders, personal communication, 2006). The farmers had not taken any *Salmonella* reducing measures before.
Two weeks prior to the expected slaughter date, the pigs were randomly divided into two groups (treatment and control group) each containing on average fifty animals. The treatment group received from this day onwards acidified drinking water. A mixture of different organic acids were added until a pH of 4 was achieved. The control group received the normal, untreated drinking water. Housing and feeding were identical in both groups. At the time of loading, the animals of each group were held separated during transport and in the lairage room. Ten randomly selected pigs of each group were sampled in the slaughterhouse. After evisceration, contents of ileum and rectum, as well as samples of the mesenteric lymph nodes and swabs of the carcasses were collected.
All samples were submitted to *Salmonella* isolation using standard procedures.

Results

Table 1 shows the pH of the drinking water in the treatment and control groups of the different herds.

The results of this study are summarized in Table 2. In herd B, no *Salmonella* organisms were detected despite of the fact that the serological screening results suggested a high *Salmonella* infection level in the herd. For some pigs there was not enough content of ileum or rectum, so isolation of *Salmonella* was not possible.

In the herds where *Salmonella* was isolated (herd A, C, D and E), the differences between the treatment and control groups were variable and small (Fisher's Exact Test, $p>0.1$). No significant differences in the number of *Salmonella* positive samples were found between the treatment and control groups.

Table 2: pH values of the drinking water in treatment and control groups of the different herds

Study Group	Herd	pH	
		Treatment group	Control group
1	A	3.9	8.4
2	B	4.0	8.5
3	C	3.8	7.8
4	D	3.6	8.4
5	A	3.7	8.4

Table 3: Number of *Salmonella* positive samples in the treatment and control groups of the different herds

Study Group	Herd	Group	IL	R	LN	CS	Total*
1	A	Treatm	2/10	0/10	3/10	3/10	6/10
		Contr	4/10	1/10	5/10	0/10	6/10
2	B	Treatm	0/10	0/10	0/10	0/10	0/10
		Contr	0/10	0/10	0/10	0/10	0/10
3	C	Treatm	1/10	2/10	1/10	1/10	3/10
		Contr	2/9	0/8	3/10	0/10	4/10
4	D	Treatm	3/10	1/10	1/10	0/10	3/10
		Contr	2/10	0/9	1/10	0/10	3/10
5	A	Treatm	2/10	4/10	6/10	0/10	8/10
		Contr	3/10	2/10	5/10	0/8	8/10
	Total	Treatm	8/50	7/50	11/50	4/50	20/50
		Contr	11/49	3/47	14/50	0/48	21/50

IL: content of ileum (12g)
R: content of rectum (10g)
LN: mesenteric lymph nodes (10g)
CS: carcass swabs
Total*: amount of animals tested positive in at least one sample / amount of animals tested

Discussion

Different studies (Van der Wolf et al., 1997; Van der Wolf et al., 1998) revealed the benefit of acidifying feed and/or drinking water during a long period in the reduction of the *Salmonella* prevalence. However, it is not yet known whether the strategically administration of acidified drinking water during a limited period of time is also able to reduce the *Salmonella* prevalence. To reduce the costs for the farmer, it might be enough to acidify the drinking water only the last 14 days before slaughter.

The present study could not demonstrate a significant reduction of *Salmonella* positive samples in finishing pigs receiving acidified drinking water. This may be due to the fact that only 100 animals (50 per group) from 4 different herds were examined in the present study. This number might not be enough to demonstrate the benefit of the used organic acids in the drinking water.

It has been proven before that acidifying the drinking water is a useful tool to reduce the number of *Salmonella* shedding animals at herd level (Van der Wolf et al., 2001). However, one of the problems in the control of *Salmonella* is the existence of carriers, hiding the pathogen in the mesenteric lymph nodes (Schwartz, 1999). Organic acids are killing bacteria in the intestinal lumen (Van Immerseel et al., 2006), but can probably not reach the mesenteric lymph nodes. When these *Salmonella* carriers are transported to the slaughterhouse, shedding is reactivated due to stress, leading to the equal number of positive samples in the treatment and the control group.

Further research is necessary to investigate the optimal strategies to control *Salmonella*.

References

Berends, B.R., Urlings, H.A., Snijders, J.M., et al., 1996. Identification and quantification of risk factors in animal managment and transport regarding *Salmonella* spp. in pigs. International Journal of Food Microbiology 30, 37-53

Nollet, N., Maes, D.,.De Zutter, L., et al., 2004. Risk factors for the herd-level bacteriologic prevalence of *Salmonella* in Belgian slaughter pigs. Preventive Veterinary Medicine 65, 63-75.

Schwartz, K.J., 1999. Salmonellosis. In Straw B.E. et al. (Ed.), Diseases of Swine, Iowa State University Press, Ames, Iowa, USA, 535-551

Van der Wolf, P.J., Wolbers, W.B., Elbers, A.R.W., et al.,1997. Blood sampling at two slaughterhouses and serological screening of *Salmonella* infections in swine using an indirect ELISA. 2nd International Symposium on Epidemiology and Control of Salmonella in Pork, Copenhagen, Denmark, 199-202.

Van der Wolf, P.J., Elbers, A.R.W., Wolbers, W.B., et al., 1998. Risk factors for *Salmonella* in slaughter-pigs in the Netherlands. 15th IPVS Congres, Birmingham, England, 98.

Van der Wolf, P.J., van Schie, F.W., Elbers, A.R.W., et al., 2001. Administration of acidified drinking water to finishing pigs in order to prevent *Salmonella* infections. The Veterinary Quarterly 23, 121-125

Van Immerseel, F;, Russell, J.B., Flythe, M.D., et al., 2006. The use of organic acids to combat *Salmonella* in poultry: a mechanistic explanation of the efficacy. Avian Pathology 35, 182-188