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Short communication

Toltrazuril and sulphonamide treatment against naturally *Isospora suis* infected suckling piglets: Is there an actual profit?

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ABSTRACT

A study was carried out to assess the efficacy and the economic profit of prophylactic treatment against *Isopsora suis* with toltrazuril or with a sulfamethazine/trimethoprim combination in piglets from an intensive pig farm. Thirty-one litters were included in study. Eight litters were treated once with toltrazuril (20 mg/kg b.w.) at 3 days of age (Toltra group); 8 litters were treated with the sulphonamide combination (sodium sulfamethazine 35 mg and trimethoprim 7 mg/kg b.w.) for 3 consecutive days starting at 3 days of age (Sulfa group), and 15 litters were untreated (control group). Counts of oocyst per gram on pooled feces sampled from each litter were carried out on Days 7, 14, 21 and 28 and diarrhea was registered daily from pooled samples. Piglets were weighed on Days 1, 7 and 28 and mean weight gain (WG) and daily weight gain (DWG) were evaluated. The economic profit of treatment was evaluated comparing the WG of piglets of each treatment group from the day of birth to Day 28. On Days 14, 21 and 28, toltrazuril showed a better efficacy in controlling fecal oocyst output, diarrhea and weight gain compared with sulphamidic treatment ($P < 0.001$). The budgeting analysis showed a return of economic benefit of € 0.915 per toltrazuril-treated piglets and an additional cost of € 1.155 per sulphonamide-treated piglets.

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1. Introduction

Isospora suis infection of suckling piglets is a condition reported worldwide (Chae et al., 1998; Meyer et al., 1999; Mundt et al., 2005). Recent investigations have shown that *I. suis* is the most frequent parasite found in piglets aged 7–14 days and that the presence of the parasite is associated with diarrhea in over 50% of naturally infected animals (Meyer et al., 1999; Sanna et al., 2002; Gualdi et al., 2003a). The infection has an important negative impact on the swine industry. Mortality is usually low, but high morbidity leads to negative effects on the economic performance of farms (Lindsay et al., 1992; Torres, 2004; Maes et al., 2007). In addition, isosporosis seems to predispose the piglet to other secondary infectious agents such as *E. coli*, *Clostridium* sp. and rotavirus, which could considerably increase morbidity, mortality and management costs (Chae et al., 1998).

The economic loss from isosporosis is mainly due to the growth retardation which can reach 20% in terms of weight loss and decreased daily weight gain, and which can be extended into the post-weaning phase (Del Castillo et al., 1996; Gherpelli and Barbieri, 1997). Presently, metaphylaxis against isosporosis with toltrazuril is recommended,

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as well as specific therapy in overt clinical forms, since toltrazuril is an anticoccidial triazin derivative that significantly reduces the shedding of oocysts and diarrheic symptoms in infected piglets (Gualdi et al., 2003b; Busse, 2004; Mundt et al., 2007). The aim of this study was to assess the efficacy of toltrazuril and of a sulfamethazine/trimethoprim combination given to suckling piglets 3 days after birth and if there is an actual economic benefit in such a metaphylactic treatment in piglets from intensive breeding farms.

2. Materials and methods

The study was carried out throughout 2006 on an intensive swine farm located in Sardinia (approximately 1200 sows), where preliminary analyses showed the presence of *I. suis* oocysts in the feces of suckling piglets. Thirty-one litters of 11–13 piglets were monitored starting from birth. The litters were bred in delivery cages with grid floors. The litters were randomly divided into 3 groups: Toltra group, consisting of 8 litters (98 piglets) treated at 3 days of age with an oral suspension of toltrazuril at the dosage of 20 mg/kg b.w. (Baycox® 5%, Bayer, 0.4 ml/kg b.w. oral suspension); Sulpha group, consisting of 8 litters (96 piglets) injected intra-muscle at 3, 4 and 5 days of age with 2 ml/animal of a combination of 25 g sodium sulfamethazine and 5 g trimethoprim suspended in 100 ml of water for injections (corresponding to 250 mg/kg b.w. and 50 mg/kg b.w.). Control group, consisting of 15 litters (191 piglets) was left untreated throughout the study. Fecal samples were collected on Days 7, 14, 21 and 28 after birth in single pools for each litter containing at least 4 different individual stools. Fecal examinations were carried out as suggested by Mundt et al. (2006) and the number of oocysts per gram (opg) was assessed in 2 McMaster chambers (sensitivity 15 opg). Fecal consistency (normal or diarrhea) was registered daily within pools collected from each litter of Toltra group and Sulpha group and from 8 litters of control group, randomly chosen at the start of the study. Each animal was weighed on the day of birth (Day 1) and then on Days 7 and 28 to assess the individual weight (kg, BW) and the daily weight gain (kg, DWG). The mean BW (±SE), and the mean WG from Day 1 to Day 28 were calculated. The economic profit of both treatments was evaluated comparing the mean WG of piglets of each treatment group from the day of birth (Day 1) to Day 28. The treatment cost of Toltra was € 0.20/piglet and of € 0.36/piglet of Sulpha. The time needed for treating 1 piglet was estimated at 15 s (about 5 min/litter) with a labor cost of € 18/h.

The effect of treatments on opg output was evaluated throughout generalized linear model (GLM) taking into account the difference between groups and between sampling times. In order to consider the aggregated distribution of opg, the GLM was fitted with a log link function and negative binomial error structure. For each treatment, opg count geometric mean (GM) and range were calculated for each sampling time. The effect of treatments on body weight was analyzed by ANOVA. All statistical analyses were performed using Genstat 6th edition and the cut off for statistical significance was fixed at a probability $P < 0.05$.

3. Results and discussion

No difference was found with regard to mortality between litters ($P > 0.05$). Both Toltra- and Sulpha-treatment were well tolerated by piglets. On Day 7 after treatment, *I. suis* oocysts were found in 2 of 8 fecal pools of Toltra group (opg GM 1.36, range 0–30), in 1 of 8 fecal pools of Sulpha group (opg GM 0.67, range 0–60) and in 6 of 15 fecal pools of control group (opg GM 3.99, range 0–145). On Day 14, oocysts were found in 1 of 8 fecal pools of Toltra group (opg GM 0.45, range 0–15), in 6 of 8 fecal pools of Sulpha group (opg GM 25.31, range 0–240) and in 14 of 15 fecal pools of control group (opg GM 543.33, range 0–13,400). On Day 21, no oocyst was found in any fecal pool from Toltra group, while 5 pools of Sulpha group (opg GM 10.36, range 0–390) and 12 pools of control group (opg GM 63.43, range 0–4285) were positive. On Day 28, 5 fecal pools of Toltra group (opg GM 11.19, range 0–165), 7 of Sulpha group (opg GM 72.25, range 0–845) and 9 of control group (opg GM 9.59, 0–150) were positive. The differences between treatments were significant on Days 14, 21 and 28 ($P < 0.001$).

Diarrhea was found in 4, 3 and 7 of 64 fecal pools of Toltra group (respectively 6.3%, 4.7% and 10.9%) collected daily from Day 5 to Day 12, from Day 13 to Day 20 and from Day 21 to Day 28, respectively. At the same time intervals,

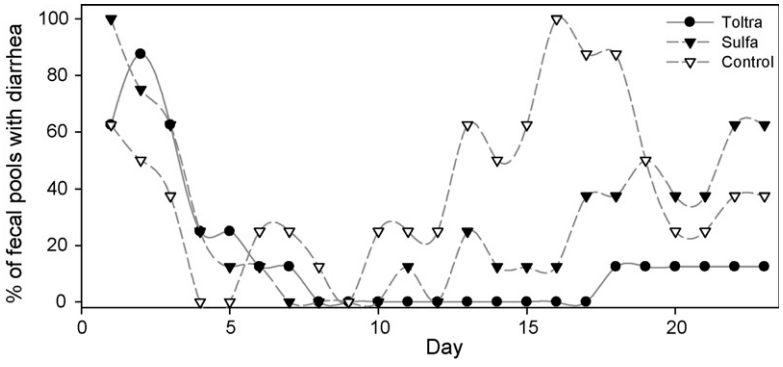

Fig. 1. Prevalence of diarrhea in the different treatment groups of piglets.

Table 1
Mean body weight and daily body gain (±standard error) of treated piglets and untreated piglets.

	Day 1	Day 7	Day 28
Group Toltra			
A.m. b.w./piglet (kg)	1.599 ± 0.072	2.101 ± 0.105	7.056 ± 0.172[a]
Daily body gain (kg)		0.101 ± 0.013	0.225 ± 0.008[1]
Group Sulfa			
A.m. b.w./piglet (kg)	1.409 ± 0.111	1.956 ± 0.191	5.985 ± 0.412[b]
Daily body gain (kg)		0.170 ± 0.052	0.198 ± 0.213[2]
Control group			
A.m. b.w./piglet (kg)	1.528 ± 0.057	2.270 ± 0.059	6.386 ± 0.167[b]
Daily body gain (kg)		0.147 ± 0.009	0.188 ± 0.007[2]

A.m.: arithmetical mean; within column, figures with different superscripts are significant to at least 5% level of probability.

the pools with diarrheic feces were 3, 21 and 31 in Sulpha group (respectively 4.7%, 32.8% and 48.4%) and 8, 44 and 18 in the control group respectively 12.5%, 68.8% and 28.1%) (Fig. 1). *I. suis* opg counts and diarrhoea increased significantly from the Day 7 to Day 28 in Sulpha groups ($P < 0.001$) while the differences were not significant in Toltra group. In the control group, the highest opg counts were found on Day 14 and most of diarrheic faecal samples were found between Day 16 and Day 18 (Fig. 1). It seems to confirm that piglets both acquire immunity and developed age resistance on the course of natural infections that were able to decrease oocyst output and control clinical signs of infection, as previously observed (Stuart et al., 1982; Koudela and Kučerová, 1999; Worliczek et al., 2007).

On Day 1 the BW and was 1.599 kg, 1.409 kg and 1.528 in Toltra group, Sulpha group and control group, respectively ($P > 0.05$). On Day 7, the mean BW and DWG of piglets in Toltra group were 2.101 kg and 0.102 kg, respectively (Table 1). In Sulpha group, the mean BW and DWG were 1.956 kg and 0.170 kg, respectively, and 2.270 kg and 0.147 kg in piglets from control group. On Day 28, both the mean BW (7.056 kg) and the DWG (0.225 kg) of piglets in Toltra group were significantly higher than in the other groups (Sulpha group, mean BW 5.985 kg; DWG 0.281 kg); control group, mean BW 6.386 kg, DWG 0.188 kg) ($P < 0.05$). The variations (SE) in BW and DWG were very high in piglets of Sulpha group on Day 28 (Table 1). The economic outcome of growth performance was expressed by additional net return/piglet to medicinal and labor costs per piglet (Table 2). The budgeting analysis showed a return of economic benefit of € 0.915 per Toltra-treated piglet and an additional cost of € 1.155 per Sulpha-treated piglet.

In this study, the anticoccidial treatment was done at 3 days of age with toltrazuril and from Day 3 to Day 5 with sulphonamides, during the prepatent period of infection (Mundt et al., 2006). The choice to extend the observations throughout the clinical disease period (6–9 days from infection, Mundt et al., 2006) was done to evaluate how long early treatment would be able to control oocyst excretion by piglets and diarrhea. Although a variety of factors influence isosporosis in piglets, not last the immunity and the pressure of infection in the different litters, it is of interest to note that from Day 10 to Day 28 the number of fecal pools with diarrheic feces in Toltra group was significantly lower both versus Sulpha group and control group ($P < 0.001$). Furthermore, the infection pressure in the different litters and the poor efficacy of the sulphonamides in restoring the normal morphology of intestinal surface after experimental infection, as demonstrated by Mundt et al. (2007), have apparently influenced the growth performances of piglets and the high variations in WG of piglets in Sulpha group.

Table 2
Economic profit based on mean weight gain following toltrazurin and sulfamethazine/trimethoprim treatment of piglets.

	Group Toltra	Group Sulfa	Control
Mean weight gain in kg/piglets Days 1–28	5.457	4.576	4.858
Piglet value (€/kg)	2.00	2.00	2.00
Total piglet value in Euro based on mean weight gain Days 1–28	10.91	9.15	9.72
Cost treatment per piglet: medicinal (€)	0.20	0.36	0
Cost treatment per piglet: labor (€)	0.075	0.225	0
Returns/piglet (€)	10.635	8.565	9.72
Difference in returns/piglet in comparison with controls (€)	+0.915	−1.155	–
Percent difference in cost/profit ratio/piglet between animal of treated and control group	+8.60%	−11.9%	–

Mortality rate was not included because this parameter was not statistically modified by anticoccidial treatments ($P > 0.05$).

Different approaches have been recommended to decrease the survival of *I. suis* oocysts in the environment and the risk of infection, mainly changing microclimatic conditions in the farrowing pens (Longkiæer and Roepstorff, 2008). However, in large pig farms it is difficult to increase the days between litters and, to some extent, to maintain microclimatic conditions able to significantly decrease oocyst survival. Our results confirms that prophylactic treatment of piglets with toltrazuril is the best option to control isosporosis in suckling piglets, confirming Mundt et al. (2007) findings in experimental infections. The use of sulphonamide drugs is not advisable. In this study on *I. suis*-infected piglets, no efficacy against the parasite and no economic benefit were found.

Conflict of interest

All authors declare no financial or personal relationship with individuals or organizations that could inappropriately influence this work.

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