DOI: 10.1515/FV-2016-0028

FOLIA VETERINARIA, 60, 3: 43—46, 2016

THE INFLUENCE OF PROBIOTICS ON REPRODUCTIVE PARAMETERS OF SOWS AND HEALTH OF THEIR SUCKLINGS

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ABSTRACT

Thirtytwo sows were included in the trial. They were divided into the experimental group (n = 16) and a control group (n = 16). The experimental group received 1.28 × 10^6 *Bacillus subtilis* and *Bacillus licheniformis* per gram of feed (400 ppm BioPlus 2B, Chr. Hansen, Denmark). The trial started 2 weeks before farrowing and lasted until weaning. No significant differences were revealed in the number of piglets born alive, stillborn or the number of weaned pigs between the two groups of sows. The wean-to-first service interval was not significantly different between the groups, but sows in the experimental group had earlier first services. The conception rate did not differ. Sows in the experimental group suffered from postpartum dysgalactia syndrome (PDS) less than sows in the control group. The suckling piglets in the experimental group of sows reached better weight on day 14 of the trial and this state persisted up to the end of the experiment. The differences in the weights of the experimental group and the control group were significant at the end of the trial (P < 0.01). The experimental piglets had significantly lower incidence of diarrhoea than those in the control group (P < 0.05).

Key words: piglets; probiotics; sows

INTRODUCTION

The prosperity of sow farms depends upon the number of weaned pigs per sow per year. It is connected with other parameters, e.g. number of pigs born alive, time to the first service after weaning, the need to re-mate sows, incidence of diseases and mortality of pigs.

Farmers use various supplements to feed to gain good results. For example, probiotics have received considerable attention as a suitable growth promoter in the pig industry for many years [12]. For optimal use in a farm setting, probiotics administration should be cost-effective, stable to moisture (or portion packed) and temperature. These criteria are difficult to meet reliably for most bacteria. Nevertheless, a number of commercial preparations are available to pig farmers and have been tested relatively rigorously.

In biological terms, the easiest microbes to manipulate are those that produce spores; spores are extremely stable under normal storage conditions. Several spore-forming species of the genus *Bacillus* (*B. subtilis*, *B. licheniformis*, *B. cereus* var *toyoi*) have been used in the pig industry. Interestingly, these organisms are not usually part of the indigenous porcine gut microbiota; they are, however common soil bacteria, which are likely to be transient passengers through the guts of most outdoor reared pigs [3].

Different lactic acid bacteria, and also *Bacillus* sp., are widely used as probiotics and their use has reportedly led to health benefits against gastrointestinal disorders including diarrhoea [7]. The most critical periods in which the probiotics have been tested are the period around farrowing, the first week of life and the post-weaning period.

The treatment of sows and their litters with feed supplemented with *B. cereus* var *toyoi* reduced carriage of pathogenic *E. coli* strains and resulted in altered absolute numbers and distributions of immune cells in the piglets [10]. Piglets from the group given the microbial supplement had a reduced incidence of diarrhoea and liquid faeces; they also had higher average daily gains and feed : gain ratios [11]. Another study described a large-scale study (nearly 22 000 piglets) comparing the production characteristics when sows were fed the same diet with either a proprietary mix of *B. licheniformis* and *B. subtilis* or a standard mixture of anti-microbial growth promoters [5]. The cost of producing each kilogram of pork and all other production parameters were statistically the same showing that the probiotic supplementation was effective at replacing the non-specific chemical inhibition traditionally used in the pig industry.

A study also has been conducted to evaluate the effects of probiotic preparation, containing *Bacillus subtilis* and *Bacillus licheniformis* spores, on sows and their litters. The results of the study have shown improved sow and piglet performance [1].

The aim of our study was to observe the influence of probiotic preparation, based on *Bacillus* sp., on selected reproductive and production parameters of sows and health of sucklings.

MATERIALS AND METHODS

There were 32 sows, all with the same genetic background (Landrace, and cross-bred, Landrace x Slovak White) included into the trial. Both the control (n = 16) and the experimental group (n = 16) were balanced according to the sows parity number. Both groups consisted of 8 primiparae and 8 pluriparae.

From about 14 days before the anticipated farrowing date, the sows were housed in conventional farrowing crates. The trial lasted from 2 weeks before farrowing until weaning at 4 weeks after farrowing.

The control group was fed with the standard feed for lactating sows (OŠ-09, the farm's feed mill). The experimental group was fed with the control feed supplemented with 1.28×10^6 CFU.g^{-1} of feed (400 ppm BioPlus 2B, Chr. Hansen, Denmark). The preparation, BioPlus 2B contained equally *Bacillus subtilis* and *Bacillus licheniformis*, at the dose of 3.2×10^9 per gram of powder. In both groups the piglets received the same creep feed without additives until weaning. All piglets were given an iron preparation Ferribion (Bioveta, Czech Republic) for the prevention of anaemia on the 3rd day of life.

During the experiment, the following parameters were investigated: number born alive, number stillborn, number weaned pigs, individual weight of piglets at birth, on day 14, and at weaning. Days to first service after weaning and mated sows were also determined in the experiment. We also monitored the occurrence of diarrhoea in the suckling pigs daily. The scale for the intensity of diarrhoea was 0–3 (0 = no diarrhoea; 1 = slight; 2 = watery faeces; 3 = smelling faeces with a change of colour). The diarrhoea score for groups of piglets was calculated as follows: the diarrhoea score = sum of partial scores per pen for all days : days of monitoring

The data were used for the calculation of the average value and the standard deviation. The results between the groups were compared by the unpaired Student t-test using $P < 0.05$ as the level of significance.

RESULTS

The number of weaned piglets in the control group was higher because the number of piglets born alive was higher in that group. As only one suckling piglet died on average per every experimental and control sow, the number of born alive piglets seems to be the only reason that there was a better number of weaned pigs in the control group. The number of stillborn piglets was approximately the same in both the control and experimental groups.

No significant differences were revealed in the number of piglets born alive, stillborn and number of weaned pigs between the two groups of sows (Table 1).

Table 1. Numbers of born and weaned piglets
(mean ± SD)

Group	Live born piglets	Stillborn piglets	Weaned piglets
Experimental	9.88 ± 2.28	0.63 ± 0.81	8.88 ± 1.89
Control	10.25 ± 3.51	0.50 ± 0.73	9.56 ± 3.22

Sows in the experimental group had earlier oestrus after weaning, consequently the control group needed more time to the first service. Although there were no significant differences between the groups, as time to the first service was short in both groups, sows in the experimental group had earlier first services compared with the control group. The conception rate was approximately the same in the experimental and control groups.

The experimental piglets did not suffer as much from their diarrhoea as those in the control group ($P < 0.05$) (Table 2).

Table 2. Reproduction parameters of sows and diarrhoea score of the suckling piglets

Group	Days to first service	Conception rate	Diarrhoea score
Experimental	5.69 ± 2.18	85 %	0.35 ± 0.28*
Control	5.93 ± 2.31	87 %	0.62 ± 0.42*

* — P < 0.05

In the control group, two sows suffered with clinical signs of postpartum dysgalactia syndrome (PDS) which included loss of appetite, reddening and swelling of mammary glands after parturition and the production of little milk. In the experimental group, only one sow had mastitis (reddening and swelling of mammary gland). All sows with PDS syndrome had to be treated with antibiotic.

All litters that suffered from diarrhoea with scores of 2 or 3, were treated with antibiotics to manage the bacterial diarrhoea. All piglets which needed to be treated with antibiotics, were given tetracycline (Tetravet, Sanofi, France). Five litters from the experimental group had to be treated with antibiotics. However, antibiotics needed to be administrated in 8 litters from control group.

The suckling piglets in the experimental group reached higher weight on day 14 of the trial and this state persisted up until the end of the experiment. The differences in the weight of the experimental group and the control group were significant at the end of the trial ($P < 0.01$) (Table 3).

Table 3. Weight of suckling pigs in kg
(mean ± SD)

Group	Day 0	14th day	28th day
Experimental	1.50 ± 0.36	4.10 ± 0.85	7.46 ± 1.61*
Control	1.57 ± 0.39	3.97 ± 0.91	6.88 ± 1.67*

* — P < 0.01

DISCUSSION

The weighing showed that the mean weight of the experimental pigs at weaning were significantly higher than that in the control group. Our results are similar to other researchers who supplemented the diet of pigs from weaning to slaughter with *B. subtilis* and *B. licheniformis* (400 ppm BioPlus 2B). They demonstrated improvement in average daily gains (ADG) and average daily feed intake (ADFI) during both the prestarter period and the overall prestarter-finishing period [2]. On the contrary, the addition of *B. subtilis* and *B. licheniformis* (500 ppm BioPlus 2B) to the diet of finishing pigs improved the ADFI, but had no effect on ADG or the G : F ratio [8]. The variation in the results of these studies can be ascribed to several factors, e. g. the age of the pigs and the BioPlus 2B dose.

It is becoming clear that the gut microbiota of animals is critically determined at the very earliest stages after birth, the so called "microbial imprinting" [4]. Organisms that are abundant in the piglet's environment at this time have a high chance of forming a permanent association with the piglet's intestinal mucosa (true "colonisation"). It may transpire that this is the most efficient time to deliver probiotics to ensure the establishment of life-long health benefits and to produce a robust microbiota, resistant to adverse ecological shifts at times like weaning. The most efficient way to deliver probiotics to piglets may be to dose sows before and during farrowing so that she, and her environment, is saturated with desirable organisms in a form whereby the piglet can acquire them as part of its natural development [3].

One of the reason why higher weights were found in the experimental group may be because of better utilisation of the feed. For example, chickens fed dried *Bacillus subtilis* var. *natto* for 28 days had significantly lower blood ammonia concentrations in the experimental group [9]. That means better utilisation of proteins and higher weight in the experimental group. The reported effects of *Bacillus* probiotics on the incidence of diarrhoea in weaned piglets were similar to ours [6].

It can be concluded that the administration of *Bacillus subtilis* and *Bacillus licheniformis* (BioPlus 2B) to sows 2 weeks before farrowing until weaning, significantly decreased diarrhoea in piglets, increased piglet weight at weaning, and shortened the time to the first service of sow after weaning.

CONCLUSIONS

The aim of this research was to document the efficacy of probiotic preparations which contained *Bacillus subtilis* and *Bacillus licheniformis* in sows. After the administration of probiotics to sows 2 weeks before farrowing until weaning it can be concluded:

1) The experimental piglets did not suffer such diarrhoea as the control piglets ($P < 0.05$). Antibiotics for the therapy of diarrhoea had to be used more often in the control group than in the experimental group.
2) The piglets in the experimental group had higher weights at the end of trial, i.e. at the time of weaning. The differences in weight between groups were significant ($P < 0.01$).
3) Sows in the experimental group suffered from PDS syndrome less than sows in the control group.
4) Sows in the experimental group had a tendency to have shorter wean-to-first service intervals compared with the control group.

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Received June 27, 2016