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Effectiveness of kidney bean lectin preparation in improving pig performance – field study

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Summary

Most of the strategies developed to reduce weaning diarrhea and to improve the health and performance of pigs are targeted at the post-weaning period and concern modifications of feed composition and/or supplementation with a variety of feed additives. Studies on the physiology of gastrointestinal tract development, however, clearly demonstrated a conflict between the immaturity of the gut mucosa and early weaning. A kidney bean lectin preparation (Suilectin™, Biolek, Poland) was designed to speed up the maturation of the pig gastrointestinal mucosa before weaning. The aim of the present study was to examine the effectiveness of Suilectin™ under practical conditions. The study was performed in a single farm on the total of 3575 piglets, some of which orally received a single dose of Suilectin™ when they were 10-12 d of age (3.27 ± 0.04 kg body weight, BW). Piglets were weaned when they were 25-26 d of life. Their body weight, food intake, clinical health, and veterinary costs were calculated. Suilectin™-treated pigs were characterized by a higher BW at weaning, a lower incidence of post-weaning diarrhea, lower costs of veterinary treatment, and lower mortality as compared to control.

Keywords: kidney bean lectin, precocious maturation, weaning diarrhea

Most of the strategies developed to reduce weaning problems in pigs are targeted at the post-weaning period and concern modifications of feed composition and feed supplementation with a variety of additives (acidifiers, pre- and probiotics, enzymes, herb blends, etc). Their aim is to reduce negative consequences of early and abrupt weaning, such as lowered performance and weaning diarrhea. Studies on the postnatal development of the gastrointestinal (GI) tract in pigs, however, revealed a number of essential conflicts between early weaning and gut mucosa function, and a relative immaturity of the gut epithelium is considered to be a major problem (11). In order to solve it, a novel approach, involving a provoked stimulation of gut development before weaning, was proposed (8). As a stimulus, the oral administration of a single dose of a kidney bean lectin extract (Suilectin™, Biolek, Poland) was developed within Eureka Initiative nr E!2675 (10). Suilectin™ is a natural product containing standardized lectin isolated from the red kidney bean (*Phaseolus vulgaris*) which contains five lectin isoforms, PHA-E_4, PHA-E_3L, PHA-E_2L_2, PHA-EL_3, and PHA-L_4 of phytohaemagglutinin (PHA) activity i.e., erythro- and leucoagglutinating. Red kidney bean lectin is relatively well researched, since kidney beans are one of the most commonly used leguminous plants in human and farm animal nutrition. Problems of poisoning by the consumption of high amounts of kidney bean lectin present in raw or improperly cooked kidney beans were recognized well over half a century ago and prompted a number of extensive studies on animals (6, 9). In contrast, low doses of kidney bean lectin extracts are not poisonous and show a number of physiological effects in the gastrointestinal tract, in particular in the small intestine and the pancreas (1, 4, 5, 7, 8). The effects can be mediated by cholecystokinin released from the intestinal endocrine I-cells (3). The tissues behind the gastrointestinal tract are much less affected and seem to be influenced indirectly, since kidney bean lectin is not absorbed from the gut (4, 5). Kidney bean lectin readily binds with the gut epithelium, enhances enterocyte turnover

(1, 8), and is subsequently entirely excreted in an undigested form (4). Previous rat and pig studies demonstrated that small doses of kidney bean lectin induce a precocious maturation of the gut as well as have a number of positive effects on the GI tract structure and function, involving the modification of brush border enzymes, stimulation of the exocrine pancreas and improved gut epithelium integrity (5, 8). In contrast to accumulated theoretical knowledge, farm studies on the health and performance of piglets supplemented with kidney bean lectin are lacking.

The aim of the present study was to examine the influence of a kidney bean lectin preparation on the health and performance of weaned piglets in commercial pig farm conditions.

Material and methods

The study protocol was approved by the Local Ethics Committee. Study was performed in a commercial pig farm (Agroduda, Nowy Świat, Poland) on 3575 male and female piglets (Naima × Neckar) born in May 2008. Entire litters of neonatal piglets (10-12 d old) were randomly allocated to 4 groups (tab. 1), and checked for their body weight (BW). Groups A and B received a single dose of Suilectin™ (1.0 g in 2 ml of 0.9% NaCl, *per os*), and groups C and D received vehicle alone (2 ml of 0.9% NaCl). All animals were weaned when they were 25 d old. After weaning, piglets were kept in pens, 19 to 22 piglets in each, located in two adjacent buildings of similar cubature and equipped with identical automatic ventilation and water supply systems. The animals received a commercial starter diet for weanling piglets, Skrzat PT418 (ME 13.55 MJ/kg, CP 21.0%, CF 4.0%, fat 6.4%, Provimi, Poland). The feedingstuff for groups B and C was supplemented with premixes for medicated feed: Suibicol® premix (Zincum oxydatum 300.0 g, Sulfaguanidinum 200.0 g, dose: 8 kg/1000 kg feedingstuff, Vetoquinol Biowet Sp. z o.o. Gorzów Wlkp., Poland) and Concentrate PW (ME 12.7 MJ/kg, CP 17.5%, lysine 1.05%; dose: 5 kg/1000 kg feedingstuff, Super Feedmix sp. z o.o., Czołowo, Poland). For each group the study was completed when the piglets' average BW exceeded 20 kg, and the piglets were transported to a piggery. In all groups of animals the feed intake per pen, health and direct costs of veterinary service (materials and labour) were recorded daily. Sick piglets were routinely treated; dead piglets were examined by a veterinary clinician. According to results of the autopsy, dead animals were classified into four groups (colibacteriosis, edematous disease, meningitis and others, unrelated to the GI function). Results were calculated as means and SD. One-way ANOVA with Tukey-Kramer multiple comparisons test was performed using GraphPad InStat version 3.10 for Windows (GraphPad Software, San Diego, CA, USA) to evaluate statistical differences between groups. A value of $P < 0.05$ was considered statistically significant.

Results and discussion

At the day of weaning the BW of piglets receiving Suilectin™ (group A and B) was significantly higher (tab. 2) as compared to the other two groups, C and D ($P < 0.01$). In contrast, piglets from group C showed the highest BW at the end of study. Piglets from group D, did not reach the average BW/pen > 20 kg during 33-34 days after weaning (tab. 2).

Owing to a sharp increase in post-weaning diarrhea incidence and an augmented mortality of piglets from groups C and D, at day 7 and 8 post-weaning, a decision was made to immediately start antibiotic treatment. All piglets from groups C and D received antibiotics (Linco-Spectin, Medivet, Śrem, Poland) administered for 4 days in drinking water. The piglets from group D were also switched from the regular to a medicated feedingstuff from the 13th day after weaning until the end of study. In contrast to groups C and D, the number of sick and dead animals in groups A and

Tab. 1. Study protocol, number and BW (mean ± SD) of pigs at the beginning of study (10-12 d of life)

Group	Number of pigs/group	Suilectin™	Medicated feed	Initial BW (kg)
A	990	+	–	3.32 ± 0.66
B	1010	+	+	3.22 ± 0.72
C	525	–	+	3.38 ± 0.71
D	1050	–	–	3.19 ± 0.72

Tab. 2. Average BW at weaning and at the end of study (mean ± SD), number of days spent in the weaning facility, and starter feed intake/piglet (kg)

Group	BW at weaning (kg)	BW at the end of study (kg)	Days from weaning to the end of study	Starter feed intake/piglet (kg)
A	7.38 ± 1.47[a]	20.26 ± 4.97[a]	34	35.75
B	7.54 ± 1.69[a]	20.22 ± 4.66[a]	33	34.15
C*	7.11 ± 1.49[b]	21.27 ± 5.38[b]	33	36.55
D*, **	7.19 ± 1.62[b]	20.88 ± 5.49[b]	39	33.39
P	0.0001	0.002	–	–

Explanations: * – piglets were treated with antibiotics added to drinking water during 8-11 post-weaning days; ** – from the 13th day post-weaning piglets from group D received the medicated feedingstuff; a, b – different letters when red in columns depict statistical difference

Tab. 3. The percentage (%) of dead piglets after weaning

Groups	Colibacteriosis	Edematous disease	Meningitis	Other	Total died
A	1.31	0.20	0.40	0.71	2.63
B	0.00	0.00	0.10	0.50	0.59
C*	0.19	0.19	0.19	0.57	1.14
D*, **	0.76	1.52	0.57	0.48	4.57

Explanations: *, ** as in tab. 2.

Tab. 4. Treatment costs per one piglet in PLN (1 PLN = 0.31 EUR, June, 2008)

Groups	Suilectin™	Premixes for medicated feed	Veterinary treatment	Total costs/piglet
A	3.00	–	1.30	4.30
B	3.00	4.45	0.76	8.21
C*	–	4.45	1.81	6.26
D*, **	–	3.57	2.57	6.14

Explanations: *, ** as in tab. 2.

B did not show sharp peaks during the study. Antibiotic treatment and the switch to the medicated feed markedly reduced the mortality in group D, from 3.81% (from weaning until day 12 post-weaning) to 4.57% (from weaning until the end of study, tab. 3). The lowest number of treated and dead piglets was observed in group B (tab. 3 and 4), and in most cases they were not related to GI problems. In group A, however, the percentage of animals suffering from edematous disease was low, and colibacteriosis was the main cause of the piglets' mortality (tab. 3).

The calculation of costs, involving Suilectin™, premixes for medicated feed and veterinary treatment expenditures (total cost of materials and labour), is summarized in tab. 4. The costs were lowest in group A, and the highest in group B. In group B, the combined costs of Suilectin™ and premixes contributed to the high overall cost, though the costs of veterinary treatment were the lowest.

The aim of the study was to test the effectiveness of a kidney bean preparation in farm conditions against two controls: a positive control (group C) treated with a medicated feedingstuff from weaning to the end of study, and a negative control (group D) fed with a commercial feedingstuff lacking zinc oxide and sulfonamide premixes. The size of the farm enabled us to study all 4 experimental groups (3575 piglets) at the same time, thereby minimizing the impact of environmental factors (same buildings, ambient temperature and humidity); on the other hand, however, our study protocol had to be altered owing to economic considerations. Our study failed in terms of the negative control on account of a sharp increase in the number of sick and dead piglets at days 7 and 8 post-weaning. Clinical and autopsy examinations indicated edematous disease and colibacteriosis as main reasons of deaths (tab. 3). Without the intervention into the protocol, the BW gain, food consumption, number of sick and dead animals and veterinary expenses in group D would obviously be higher but exact numbers are not known. Similar reasons (an increased number of pigs with post-weaning diarrhea) led us to treat with antibiotics all piglets from group C. In contrast, groups treated with Suilectin™ before weaning (A and B) did not show a peak in the number of post-weaning GI disorders as the control groups did.

The Suilectin™ pre-treated piglets were heavier at weaning, but afterwards gained less BW and showed higher mortality as compared to group C. On the other hand, they had a lower feed intake, and much less money was spent on their veterinary treatment. These differences can be explained by the fact that kidney bean lectin induced the maturation of the gut mucosa, in particular by speeding up the modification of brush border enzyme activity, and enhanced the integrity of the epithelium (4, 8). Direct effects on tissues behind the GI tract are excluded by lack of the absorption of kidney bean lectin from the GI tract in neonatal pigs (5). Piglets treated with Suilectin™ and fed with a medicated feedingstuff (group B) showed the best performance and health. However, this practice conflicts, like the excessive use of medicated feed, with the conditions of use of medicated feedingstuffs (2, 10).

Concluding, our study shows for the first time that the induction of precocious maturation in suckling piglets with a kidney bean lectin preparation (Suilectin™) can be considered as an economically viable alternative to medicated feedingstuffs in preventing post-weaning disorders and improving animal performance.

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