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Postweaning anorexia in pigs at very early weaning

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Abstract: *This study aimed to compare the zoo technical parameters of pigs subjected to early (31 days) and very early weaning (24 days) and to identify challenges associated with very early weaning, proposing potential solutions. The experiment was conducted on 24 pigs per group (12 gilts and 12 boars) of the large white × landrace breed on the DONA Ltd. farm (Slovak Republic). Pigs were fed two commercial pelleted feed mixtures: the first for 7 days post-weaning, and the second until pre-fattening (27 days post-weaning). Weight gains and feed conversion ratios were measured, and the nutrient content of feeds was analyzed. Statistically significant differences in initial weights (8.44 ± 0.45 vs. 7.05 ± 0.27 kg at 24 days, $p<0.01$) and daily weight gains were observed between the control and experimental groups. The experimental group exhibited lower daily weight gains from days 31–38, 38–45, and 45–52 ($p<0.01$). Feed conversion at the end of the experiment (days 45–52) was identical in both groups (1.26 kg kg^{-1}). Results highlight the significant impact of weaning age on production parameters, with very early weaning adversely affecting growth performance. Findings suggest that optimizing weaning age is crucial for improving growth efficiency and minimizing performance setbacks.*

I. INTRODUCTION

The segregated early weaning of pigs began to be applied on farms in North America about 12 years ago. Weaning at the age of 14-17 days, with the intention of using it for disease prevention, gradually gained popularity. The management of this method of breeding has evolved and changed gradually as knowledge about the rather dramatic transition of young animals from milk nutrition in the sow to dry feed has increased.
Researchers together with breeders have tried to find the best alternative for the nutrition of weaned pigs [1].
Weaning and the transition from milk to dry feed causes stress in pigs and consequently a reduction in feed intake. This results in increased susceptibility to gastrointestinal diseases and prolonged growth. Lower growth parameters can cause problems in the growing and finishing phases, a longer fattening period, and inhomogeneous growth rates in groups.

It is very important to increase feed intake during the post-weaning period in order to support the development of the small intestine and subsequently increase growth performance [1].

Very early weaning causes many problems that arise from strictly adhering to the maximum age at weaning regardless of the weight of the pigs. This type of weaning is carried out to prevent disease transmission and to achieve eradication of some endemic infections during the growth of pigs (e.g. *Actinobacillus pleuropneumoniae*). Farmers may sometimes have inadequate expectations of complete pathogen elimination.

This is partly true in farms where pigs are purchased from multiple sources and also in the case of different ages of pigs placed in a nursery after weaning [2].

In the case of very early weaning, pigs are usually at a disadvantage because their gastrointestinal tract is not adequately developed for the digestion and absorption of a typical post-weaning diet, which is composed of grains and vegetable proteins. On the other hand, the digestive tract has a good ability to digest milk components such as milk fat, protein and lactose. A comparison of the nutrients in sow milk and in a conventional weaning diet is shown in Table 1. The main difference between these two sources is the level of fat and therefore the level of energy available to the pigs for growth. This high level of fat cannot be achieved in conventional feed mixtures. Also, the fat contained in sow milk is very well digestible by pigs compared to fat added to diets [3].

Table 1. Comparison of the composition of sow milk and diets for early weaned pigs

Nutrients in dry matter (%)	Sow's milk	Diet of early weaned pigs
Fat	45	11
Lactose	25	23
Proteins	27.5	27
Lysine	2.22	2
Ca	1.05	0.9
P	0.75	0.8

[4]

A certain time is needed to increase the secretion of digestive enzymes that break down sugars, starch and proteins, which is not the same for all individuals. Subsequently, insufficient enzyme production is manifested by growth retardation [1].

The ability of the digestive tract of pigs to secrete enzymes (lactase, lipase, amylase, trypsin, chymotrypsin) varies with age and can be dramatically reduced after weaning (Fig. 1). According to [5], the development of enzymatic activity is dependent on feed intake. Higher feed intake results in higher enzymatic activities. This observation is in accordance with the results of [6], who found that enzymatic activity increases during milk intake, drops sharply during weaning when feed intake decreases, and increases after a period of post-weaning lag.

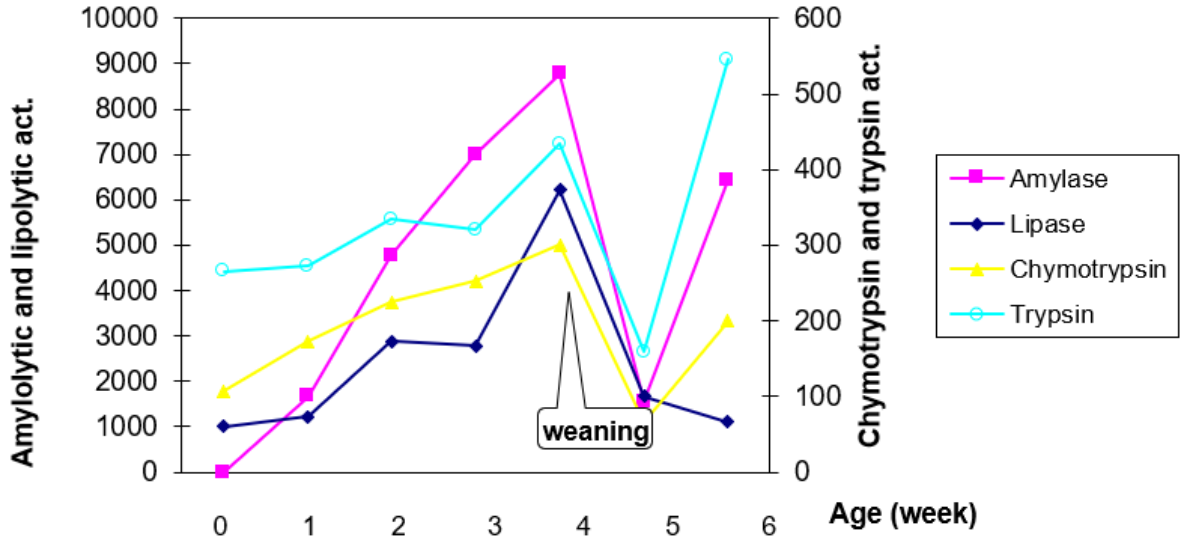

Figure 1. Development of enzymatic activities in the digestive tract of pigs [4]

II. Material and Methods

A feeding experiment was conducted with pigs (large white x landrace) that were weaned on the 31st (control group) and 24th day of age (experimental group) on the farm of the agricultural enterprise DONA Ltd. (Slovak Republic). Each group contained 24 animals (12 gilts and 12 boars). Feeding was carried out with two commercial pelleted feed mixtures (Table 2). The first was administered for 7 days after weaning and the second in the following days until transfer to pre-fattening (27th day after weaning). During the operational experiment, weight gains and feed conversion were measured and analyzed in the pigs. An analysis of the nutrient content of the feed mixtures used was performed (Table 3).

Table 2. Analysed nutrient content in feed mixtures

Parameter	Feed mixture 1, intake day 1 – 7	Feed mixture 2, intake day 8 - 27
Dry matter (g kg^{-1})	931.7	920.0
CP (g kg^{-1})	188.6	208.7
Fibre (g kg^{-1})	35.6	32.7
Ash (g kg^{-1})	60.4	56.0
Ash insoluble in HCl (g kg^{-1})	4.9	3.3
Fat (g kg^{-1})	67.69	77.04
Ca (g kg^{-1})	6,9	6.6
P (g kg^{-1})	5.2	5.12

Na (g kg^{-1})	2.9	2.7
K (g kg^{-1})	1.03	0.82

CP – crude protein

III. Results and Discussion

During the analytical evaluation of production parameters (Table 4) between the control and experimental groups, statistically significant differences were observed on the 31st and 24th day of age, respectively (8.44 ± 0.45 versus 7.05 ± 0.27 kg pig^{-1}, p<0,01). Subsequently, the average daily weight gains were statistically significantly lower in the experimental group compared to the control group on the days 31-38 and 24-31 (83.11 ± 46.79 versus -82.92 ± 57.98 kg pig^{-1} day^{-1}, p<0,01), on 38-45 and 31-38 day of age (251.85 ± 86.43 versus 126.88 ± 73.90 kg pig^{-1} day^{-1}, p<0,01) and on 45-52 and 38-45 day of age (377.56 ± 128.23 versus 258,33 ± 87,28 kg pig^{-1} day^{-1}, p<0,01). Feed conversion reached the same value of 1.26 kg kg^{-1} at the end of the experiment in the time period 45-52, or 38-45 days of age in both groups. In our experiment, the results of zootechnical parameters were significantly influenced by the age of weaned pigs.

Feeding a high-quality post-weaning diet is very important to improve the transition of pigs from highly digestible milk to less digestible diets consisting of plant components. One option for maximizing growth is to use a more economically demanding diet containing milk and plasma proteins.

From an economic point of view, a diet that reduces the adaptation time of the pig to the post-weaning diet is advantageous not only for the farmer but also for the animal [7].

Some components commonly used in diets for early weaned pigs are listed in Table 5. All of them are highly digestible with high palatability. A typical feed mixture for early weaned pigs usually contains carbohydrate sources that provide 20 to 25% lactose. Protein sources used include soybean meal, fish meal (3-8%), plasma protein (3-8%), synthetic amino acids and skimmed milk. Plasma protein stimulates feed intake in weaned pigs. In general, these diets contain approximately 1.6-1.8% lysine. Most of them are supplemented with copper sulphate (200-240 ppm copper) and zinc oxide (1500-3000 ppm zinc) for their growth-promoting and antibacterial properties. If a pelleted diet is fed to early weaned pigs, then smaller pellets may be more suitable for young pigs. When the pellet size was reduced from 2.4 to 2 mm, an improvement in feed intake of 5% was observed [4]. The work aimed to compare the zootechnical parameters of pigs in an operational experiment after early and very early weaning and to point out the problems of very early weaning with the proposal of some solutions.

Table 3. Declared nutrient content and composition of compound feeds

Parameter	Feed mixture 1, intake day 1 - 7	Feed mixture 2, intake day 8 - 27
CP (g kg^{-1})	176	183
Fibre (g kg^{-1})	31	24
Ash (g kg^{-1})	57	46
Lysine (L-lysine HCl) (g kg^{-1})	12	12.8
Fat (g kg^{-1})	71	61
Vitamin A (u.i.)	16 000	16 000

Vitamin D3 (E671) (u.i.)	2 000	2 000
Vitamin E (alpha-tocopherol) (mg)	75	180
Cu ($CuSO_4$ x $5H_2O$) (mg)	160	164
Zn (ZnO) (mg)	2515	2 515
3-phytase (EC 3.1.3.8.) (FTU)	500	500
Components (%)	Barley 30, thermal treated maize 20, dried whey 15, soy protein concentrate 10, wheat feed flour 6, soybean meal 5, sugar 4, vegetable oil 4 (coconut, palm, soy), yeast 1, dicalcium phosphate, NaCl 0.2, premix of additives 4.6.	Barley 20, thermal treated maize 20, dried whey 10, soy protein concentrate 4, full-fat toasted soy 4, fish meal 10, vegetable oil 4 (coconut, palm, soy), yeast 1, wheat flour feed 5, CaCO3 0.5, mono- and dicalcium phosphate, NaCl 0.1, premix of additives 1.2.

Kim et al. [1] published the results of an experiment, that focused on the potential of a liquid diet to promote growth in very early weaned pigs. They used 240 pigs weaned at 11 days of age with an initial weight of 3.93 kg. There was a significant effect of the physical form of the feed on growth. At 14 days after weaning (day 25 of age), the pigs were 21% heavier and their average daily weight gain was 44% higher than that of pigs fed a nutritionally identical dry diet. Liquid feeding was most beneficial during the first three days after weaning. During this period, pigs fed liquid feed gained almost four times as much as the control (248 versus 64 g day^{-1}). However, the difference in average daily weight gain between liquid and dry feed rapidly decreased with age. The result was a 2.4 kg higher live weight of pigs when transferred from nursery to pre-finisher. They required a shorter time (150.9 vs. 154.6 days) to reach a slaughter weight of 110 kg.

A decrease in production parameters of weaned pigs after their transition to a dry diet was observed [8]. Diarrhoea, 6% mortality and a 2-week growth depression occurred.

There are several reasons why pigs may have a lower than desired target weaning weight. These are younger age, low birth weight, increased number of live births in the group, nutritional deficiencies (lack of milk) and diseases (diarrhoea, PRRS, associated infections).

Table 4. Zootechnical parameters of weaned pigs

	Individual weight (kg)		Individual average daily weight gain ($kg\ day^{-1}$)			Feed conversion ratio ($kg\ kg^{-1}$)		
Age (day)	31	52	31 - 38	38 - 45	45 - 52	31 - 38	38 - 45	45 - 52
Control group (n = 24)	8.44 ± 0.45[a]	13.18 ± 1.73[a]	83.11 ± 46.79[a]	251.85 ± 86.43[a]	377.56 ± 128.23[a]	1.55	1.3	1.26
Age (day)	24	45	24 - 31	31 - 38	38 - 45	24 - 31	31 - 38	38 - 45

Control group (n = 24)	7.05 ± 0.27[c]	9.53 ± 1.32[c]	-82.92 ± 57.98[c]	126.88 ± 73.90[c]	258.33 ± 87.28[c]	-0.78	1.0	1.26
Index (c = 100%)	83.53	72.31	-99.77	50.38	68.42	50.32	76.92	100.0

a-c ($p<0,01$)

Table 5. Components used in diets for early weaned pigs [4]

Energy sources		Protein sources	Additives
Lactose sources	Other sources	Soybean meal	Vitamins
Whey	Oat protein	Soy protein concentrate	Minerals
Ultrafiltered whey sediment	Maize	Fish meal	Copper sulfate
Lactose	Soybean oil	Plasma proteins	Zinc oxide
	High quality white fat	Skimmed milk	Acidifiers
		Aminoacids	Additives

In a sow, an individual in a group of suckling pigs may receive a mother's milk 16 to 20 times a day. This implies two facts. On the one hand, pigs behave socially when feeding and therefore the rearing environment must allow for group feeding. On the other hand, pigs are adapted to consume frequently and therefore the intake of small amounts throughout the day can stimulate feed intake [4]. Feeding a diet adapted to the average pig results in underfeeding the lighter pig and overfeeding the heavier pig. This can be solved by a phase feeding program, which aims to match the diet composition to the nutritional needs of the pig at the lowest cost and to minimize post-weaning growth depression for the fastest adaptation of the pigs to a plant-based diet.

Table 6 presents a proposal for nutritionally balanced pre-starter diets for the three phases of the feeding program for early weaned pigs. The data are adapted from [9]. The feed mixture for the first phase is fed for 7 to 10 days if the pigs are weaned at 16 to 21 days of age. However, this depends on how early the pigs start to consume plant-based feed and overcome post-weaning depression. The individual components required for the preparation of this diet are more demanding in terms of storage conditions compared to commercial pre-starter diets. After starting with the first diet, the second diet is switched as quickly as possible, which is fed from the 4th to the 10th day after weaning. This should be fed to pigs weighing 6.8 to 11.4 kg, which is usually one to two weeks. The diets for the first and second phases are quite complex and many farmers may have problems with their purchase and subsequent storage. Another option is to purchase a basic mixture containing all the nutritional components. The feed mixture intended for the third phase is fed to pigs weighing at least 11.4 kg up to a weight of 20.5 kg.

Table 6. Suggested pre-starter diets for the three phases of the weaning pig feeding program

Components (%)	Phase 1	Phase 2	Phase 3
Maize	29.25	51.7	57.6
Oat protein	10	0	0
Soybean oil	4	2	0
Soybean meal	6.5	16.75	29.25
Fish meal	4.5	7.5	0

Lactose	10	0	0
Dried skimmed milk	7	0	0
Whey protein	20	20	10
Dried plasma protein	6	0	0
L-lysine, 78%	0.15	0.2	0.1
Calcium carbonate	0	0.05	0.65
Dicalcium phosphate	2	1.2	1.7
Copper sulfate	0.1	0.1	0.1
Salt (NaCl)	0.25	0.25	0.35
Vitamins and trace elements	0.25	0.25	0.25
Total	100	100	100
ZnO	up to 3000 ppm	up to 3000 ppm	0
Calculated parameters (%)	Phase 1	Phase 2	Phase 3
Protein	19.92	18.94	19.07
Lysine	1.50	1.30	1.15
Tryptophan	0.28	0.23	0.25
Threonine	0.93	0.80	0.76
Methionine and cystine	0.71	0.68	0.62
Ca	0.96	0.90	0.81
P	0.86	0.81	0.70

IV. Conclusion

In conclusion, we would like to summarize several principles for solving post-weaning anorexia in pigs aimed at improving changes in the feeding regimen, zoohygiene and zootechnics. Post-weaning problems are usually a combination of disease, nutrition, management and zoohygiene. From the point of view of the feeding program, the pre-starter diet must contain a high concentration of nutrients. During the 1st, or 1st - 3rd day after weaning, it is economically advantageous to feed a mash diet. In the subsequent period, it is better to feed a pelleted feed mixture in smaller doses. This improves the feed turnover, which contributes to its sensory stability. From the zoo hygiene and zootechnics aspect, it is necessary to design nurseries with a controlled microclimate, respecting the principles of welfare. Additional drinkers should be placed in the housing areas in order to always ensure enough clean water, as dirty drinkers can discourage drinking. The housing areas should be illuminated with additional mobile lighting. Additional lighting should be 24 hours a day for at least 5 days. This helps the pigs to familiarize themselves with the environment after being placed in the nursery. Gastrointestinal and respiratory diseases have a major impact on weight variability in pigs. The prevention must use the usual prophylactic procedures on the farm. The influence of genotype on the growth potential of individuals is significant, which should be taken into account when choosing the breed of the basic herd of sows and insemination biological material. Post-weaning problems are usually a combination of disease, nutrition, management and zoohygiene.

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