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Original article

Response of pregnant and lactating sows to reduced protein content in complete compound feed

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Abstract

The experimental material consisted of 42 sows divided into 3 feeding groups, each containing 14 sows fed complete compound feed varying in protein content. Protein and amino acid content of the feed fed to the control group was in compliance with Polish standards. Protein content in the experimental groups was reduced by 10% and 20%, respectively. At the same time, lysine, methionine, threonine and tryptophane content was supplemented to the level of the control group. All pregnant and lactating sows were fed individually. The condition of the sows was determined by measuring the thickness of backfat at the P2 position on days 30 and 105 of pregnancy and on day 25 of lactation. The data analyzed in the study included: the total number of piglets born, their body weight gain, milk composition, weaning-to-estrus interval and the farrowing rate. Protein content of the compound feed did not have a significant impact on the increment in backfat during pregnancy and losses during lactation. The sows fed compound feed with reduced protein content gave birth to 0.7 and 0.6 less piglets per litter than the control animals. However, due to lower losses, they bred 0.3 and 0.4 more piglets than the control sows. Average body weight of a piglet on day 21 was 0.5 kg lower in the experimental than in the control group. Dry matter, protein, fat and lactose content of the sow's milk did not depend on protein content of the feed. The weaning-to-estrus interval in the experimental groups was one day longer than in the control group. The reproductive rate accounted for 86% and was comparable in all the groups.

Key words: sows, feed, protein, milk composition, piglets

Introduction

A major factor determining profitability of pig production is the reproductive efficiency of sows, i.e. the number of weaners per year and the number of weaners in total lifetime of a sow. The reproductive efficiency is significantly affected by feeding. Cereal ingredients are major protein and energy sources of complete compound feed for pigs. The deficiency in protein and exogenous amino acids is commonly supplemented by valuable, but expensive post-extraction soya meal. However, the amounts of high-protein

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feed have to be optimized for economical, physiological and ecological reasons. As reported by many authors (Reynolds and O'Doherty 2006, Htoo et al. 2007, Korniewicz et al. 2007a,b), nitrogen retained in the body of pigs, in relation to nitrogen intake, accounts for 39.5 – 57.8%, depending on age, quality (amino acids) and content of total protein in diet for swine. The remaining about 50% is excreted in faeces and urine, being a serious threat to the environment. In finishing pigs with crude protein content in mixture on the level of 20%, total ammonical nitrogen content in the slurry was 4.32 gN kg^{-1}, while when reducing CP to 12% it may be decreased to 1.92 gN kg^{-1} that means the reduction of ammonia emission of 63% (Portejoie et al. 2004).

Protein and amino acid content in the feed for sows was also studied by many authors. Canh et al. (1998) found that a reduction of total protein from 16.5% to 12.5% and parallel supplementation with exogenous amino acids did not affect body weight gain, but markedly limited excretion of nitrogen with urine and increased its retention in relation to uptake. According to Johnston et al. (1993), increased daily protein intake did not affect the backfat of lactating sows. Revell et al. (1998) reported that high-protein diets during gestation and lactation minimized body weight losses and reductions in the fat tissue in primiparous sows. According to other authors (Anderson et al. 1990, Aňuez and Patterson 1998, Tritton et al. 1996), *ad libitum* feeding of lactating sows prevented them from a decline in physical condition.

No data in the literature are available on the effects of reduced protein content of compound feed for sows on their reproductive efficiency and the amounts of nitrogen in faecal.

The aim of the present study was to determine the productive efficiency of pregnant and lactating sows fed complete compound feed, the protein content of which was reduced by10% and 20%, respectively, but the concentration of exogenous amino acids was maintained at the same level.

Materials and Methods

Animals and feeding

The experiment was conducted on a pig farm located in Łosice (POL-LEAN Ltd., Poland). The experimental material consisted of 42 sows (Polish Large White x Polish Landrace), inseminated with semen of Hampshire x Pietrain boars, twice within 5 days. The semen contained 4-5 billion sperm cells in one portion. After insemination, the sows were divided into 3 groups, each containing 14 animals, with respect to the number of parities and reproductive efficiency to the date:

– Group I – control, protein and amino acid content – in compliance with Polish standards.

– Group II – protein content reduced by 10%, supplemented with lysine, methionine, threonine and tryptophane to the level recommended in Polish standards.

– Group III – protein content reduced by 20%, supplemented with lysine, methionine, threonine and tryptophane to the level recommended in Polish standards.

Complete compound feed fed to each group contained the same components and was manufactured by a Feed Company PIAST Ltd. (Poland), according to its own recipe. The basic ingredients of the feed were: ground barley and wheat, dried sugar beet pulp, wheat bran, post extraction soya bean meal and rapeseed oil. Total protein content of the feed in experimental groups was reduced by decreasing the percentage of soya bean meal. Optimized amino acids, such as: lysine, methionine, threonine and tryptophane were balanced to the level recommended in Polish Norm (Normy... 1993), by adding these substances to the feed in crystalline form. Supplementation of minerals and vitamins to the recommended level was done by the addition of 0.3% premix, manufactured by the LNB Poland Ltd., according to their own procedure.

The components used for the production of complete compound feed were subjected to chemical analyses in which the content of basic nutrients was determined. The analyses were made according to standard methods (AOAC 1990) in a laboratory of the Cargill Poland Ltd. Amino acid composition of feed ingredients was determined using chromatograph in a Degus AG Hanem-Wolfgang laboratory (Germany). The results of the analyses were used for optimization of nutrient contents of the feed fed to each experimental group.

The energy value of the feed was calculated by analyzing its components, digestibility coefficients and formula of Polish Norm (Normy... 1993) and Dutch (CVB 2004) standards.

Tables 1 and 2 show composition of complete compound feed for pregnant and lactating sows and nutrient content per kg of feed.

The sows were kept in individual pens until day 105 of gestation and then put in a farrowing stall, where they were kept until day 28 of lactation. After weaning, the sows were kept in grouped pens, close to the pens with boars, so as to induce the heat. When estrus symptoms occurred, they were placed in individual pens and inseminated. The farrowing pens were equipped with nipple drinkers, separate for sows and piglets. Ultrared radiators placed above mats were used as a heating source for piglets. One-day-old boars were castrated. The weaners were moved to group pens. Litters were adjusted to 11 pigs per sow in each groups.

Table 1. Percentage composition and feeding value of complete feed for low gestation sows (%).

Ingredients	Groups		
	I control	II reduced protein – 10%	III reduced protein – 20%
Ground barley	32.16	36.26	40.37
Ground oat	25.00	25.00	25.00
Dried sugar beet pulp	25.00	25.00	25.00
Soya bean meal	8.50	4.30	0.00
Wheat bran	5.00	5.00	5.00
Rapeseed oil	2.30	2.10	2.00
Limestone	1.05	1.05	1.06
Monocalcium phosphate	0.45	0.49	0.52
Salt	0.23	0.23	0.23
Premix	0.30	0.30	0.30
Phytase	0.01	0.01	0.01
L-lysine	–	0.15	0.29
L-threonine	–	0.06	0.12
Dl-methionine	–	0.03	0.06
L-tryptophane	–	0.02	0.04
Total	100.00	100.00	100.00
In 1 kg mixture:			
Nett energy (kcal)	2101	2096	2102
Metabolic energy (MJ)	12.20	12.18	12.21
Crude protein (%)	13.01	11.74	10.40
Crude fibre (%)	9.63	9.69	9.74
Crude fat (%)	4.76	4.58	4.49
Crude ash (%)	5.56	5.42	5.27
Ca (%)	0.80	0.80	0.80
P (%)	0.44	0.44	0.43
Na (%)	0.15	0.15	0.15
Lysine (%)	0.64	0.64	0.64
Methionine (%)	0.20	0.21	0.22
Methionine and cystine (%)	0.46	0.45	0.45
Threonine (%)	0.48	0.48	0.48
Tryptophane (%)	0.15	0.15	0.15
Izoleucin (%)	0.49	0.42	0.35
Valine (%)	0.65	0.58	0.51

Daily rations of complete compound feed in a given physiological period were as follows:

– 2.5 kg – at low gestation, from day 1 to 90 of gestation

– 3.5 kg – at high gestation, from day 91 to 110 of gestation

– 2.0 kg – from day 111 of gestation until 2 days before farrowing

– 1.0 kg – 2 days before farrowing until farrowing

– wheat bran with warm water on farrowing day

– 1.0 kg – day 1 after farrowing

– 2.0 kg – day 2 after farrowing

– mixture fed on further days of lactation *ad libitum*

– 2 kg – on weaning day

– 4 kg – from weaning to mating

The sows at early pregnancy (from mating to day 90 of gestation) were fed individually on mash form feed poured to troughs by hand once a day. The sows at late gestation (from day 91 to 105 of gestation) were fed individually on granulated feed poured to troughs by hand twice a day. Lactating sows in the farrowing pens were fed granulated feed from autofeeders *ad libitum*.

Supplementary feeding of the piglets began on day 7 after birth – granulated "Prestarter" was given *ad libitum* for 28 days.

Data collection

The impact of reduced protein content of complete compound feed on the body condition of sows

Table 2. Percentage composition and feeding value of complete feed for high gestation and lactation sows (%).

Ingredients	Groups		
	I control	II reduced protein – 10%	III reduced protein – 20%
Ground barley	40.00	40.00	40.00
Ground wheat	32.65	37.58	39.93
Soya bean meal	16.95	11.30	8.60
Wheat bran	4.00	4.50	4.70
Rapeseed oil	2.80	2.65	2.60
Limestone	1.62	1.62	1.62
Monocalcium phosphate	0.95	1.00	1.05
Salt	0.46	0.46	0.46
Premix	0.30	0.30	0.30
Phytase	0.01	0.01	0.01
L-lysine	0.19	0.37	0.46
L-threonine	0.03	0.11	0.15
Dl-methionine	0.04	0.07	0.08
L-tryptophane	0.00	0.03	0.04
Total	100.00	100.00	100.00
In 1 kg mixture:			
Nett energy (kcal)	2301	2301	2302
Metabolic energy (MJ)	13.37	13.37	13.37
Crude protein (%)	17.00	15.33	14.53
Crude fibre (%)	3.52	3.51	3.50
Crude fat (%)	4.55	4.40	4.35
Crude ash (%)	5.60	5.42	5.35
Ca (%)	0.95	0.95	0.95
P (%)	0.64	0.64	0.64
Na (%)	0.20	0.20	0.20
Lysine (%)	0.94	0.94	0.94
Methionine (%)	0.30	0.30	0.30
Methionine and cystine (%)	0.62	0.60	0.59
Threonine (%)	0.63	0.63	0.63
Tryptophane (%)	0.22	0.22	0.22
Izoleucin (%)	0.68	0.59	0.54
Valine (%)	0.80	0.70	0.66

was determined by measuring backfat at the P2 position behind the last rib, on days 30 and 105 after parturition and on day 25 of lactation. The thickness of backfat was measured using a PIGLOG 105 (Carometec, Denmark) device.

The impact of reduced protein content of complete compound feed for pregnant and lactating sows on physiological effects was calculated, based on chemical analysis of milk on day 14 of lactation. Milk of 10 sows in each group was collected by hand-milking from the first three teats, after injecting 2 ml of oxitocin to the marginal ear vein. The milk samples were analyzed in a Laboratory for Milk Assessment and Analysis at the Institute of Animal Breeding, Wroclaw University of Environmental and Life Sciences (Poland), using an Infrared Milk Analyzer (Bentley, USA). The measurements included: dry matter, non-fat dry matter, protein, fat and lactose.

The impact of reduced protein content of complete compound feed for pregnant and lactating sows on productive efficiency was determined by taking into account the following factors:

– the total number of piglets born (alive an dead)
– the number of piglets aged 1, 21 and 28 days
– body weight of piglets on days 1, 21 and 28 after birth
– daily body weight gain of piglets within days 1-21; 21-28; 1-28 after birth
– losses of piglets and their causes
– weaning-to-estrus interval
– farrowing rate

Statistical analyses

The data obtained were analyzed statistically using one-way analysis of variance. Significant differences between the groups were determined using Duncan's multiple-range test (computer program STATGRAPHICS v. 5.0).

Results

Quality assessment of complete compound feed. As has been described earlier in this paper, the samples of ingredients selected for manufacturing complete compound feed were collected in appropriate quantities and subjected to chemical analyses. The results of the analyses were the basis for optimized concentrations of the nutrients. After the manufacturing process, chemical analysis of the finished product was conducted. The results of the analyses confirmed that protein and exogenous amino acid concentrations in each feeding group were in agreement with the experimental hypothesis.

The content of macro and microelements and vitamins was the same in all the animal groups. The content of minerals and vitamins per kg of complete compound feed for the pregnant and lactating sows was the same in all the groups and it was in agreement with the upper limit recommended in Polish (Normy... 1993) and Dutch (CVB 2004) standards for pig feeding. Daily portions for pregnant pigs were fully consumed in all the groups, therefore, they must have had an impact on the productive and technological results.

Backfat thickness. One of the indices showing the condition of the pregnant and lactating sows is body weight gain or loss. In our study, it was backfat thickness that was used as the indicator. The first and second measurements were made on days 30 and 105 of gestation, and then, on day 25 of lactation. The results of the measurements allowed us to find changes in the fat storage and condition of the sows. The backfat thickness in the control sows on day 30 of gestation averaged 16.5 mm, while in group II it was 18.6 mm (Table 3). The differences were insignificant and they resulted from great individual variability. On day 105 of gestation, the thickness of the backfat in the control group increased on average by 4.2 mm (25.4%) as compared to day 30 of gestation. A similar increase (26.8%) was observed in group III. The smallest increase in backfat thickness (3.8 mm, 20.4%) was observed in group II. This was due to the fact that the backfat of sows in this group was thicker at the beginning of the experiment (day 30 of gestation).

The backfat thickness of lactating sows in the control group decreased by 4.4 mm (21.7%) in relation to the measurements on day 105 of gestation. Similar reductions in backfat thickness (20.9-20.1%) were observed in the experimental groups. It can, therefore, be concluded that 10 and 20% reductions in protein content of the feed for lactating sows did not higher reduce body condition of the sows than in the control group.

In the control group, the number of piglets in a litter averaged 12.1, of which 11.2 were born alive and 0.9 dead. An average number of piglets born in group II was 11.7 (10.5 alive and 1.2 dead). The lowest number of piglets born (11.2, including 0.6 dead) was in group III. The differences between the groups were insignificant.

On average, body weight of the piglets born by the sows in all the groups was similar, i.e. 1.54 – 1.60 – 1.54 kg. However, it is worth noting that the litters in the control group had more piglets with low body weight. Hence, the losses in this group accounted for 16.4%. On the other hand, the losses in the litters of groups II and III were markedly lower (8.7 and 8.5%, respectively). In total, the number of piglets bred in the control group averaged 9.3, while the number of piglets bred in the experimental groups was 9.6 and 9.7.

Parturition length in the control group was 114.2 days, whereas in the experimental groups it was longer, i.e. 114.4 and 114.9 days.

Important indicators of the reproductive efficiency of sows are: the weaning-to-estrus interval and the farrowing rate. In the control group, the weaning-to-estrus interval averaged 4.7 days, and in the experimental groups, it was 5.5 and 5.7 days, respectively. The farrowing rate was the same in all groups and it accounted for 86%. The farrowing frequency, calculated with regard to the length of parturition and lactation and the weaning-to-estrus interval, was practically the same (2.47 litter/sow/year) in all the groups under investigation.

Generally, in the control group, the number of piglets born alive by a sow per year averaged 27.78 and the number of weaners was 23.06. The sows in the experimental groups gave birth to a smaller number of piglets per litter, but lower losses of piglets during lactation resulted in the increased number of weaners (by 0.65 and 0.80 pigs).

Another indicator of the reproductive efficiency of sows is body weight of piglets on day 21 after birth, mainly attributed to the lactation performance of sows. Table 5 shows that average body weight of piglets in the control group was the highest (7.0 kg). In the experimental groups, the body weight of piglets was 0.5 kg lower. In the control group, daily body weight gain of piglets, aged 1 to 21 days, averaged 256 g, which confirmed high lactation performance of the sows. Body weight gain of the piglets in the experimental groups was about 10% lower than that found in the control.

Table 3. The backfat thickness (mm) in sows during gestation and lactation ($\bar{x}$ ± SD).

Specification	Groups		
	I control	II reduced protein – 10%	III reduced protein – 20%
Backfat thickness during gestation:			
– 30 day	16.5 ± 3.67	18.6 ± 3.63	14.9 ± 4.36
– 105 day	20.7 ± 4.75	22.4 ±3.32	18.9 ± 4.97
Increase of backfat thickness	4.2 ± 1.76	3.8 ± 1.91	4.0 ± 2.63
– in %	25.4	20.4	26.8
Backfat thickness at 25 day of lactation	16.3 ± 4.10	17.7 ± 3.12	15.1 ± 4.07
Decrease of backfat thickness during lactation	4.4 ± 2.68	4.7 ± 2.72	3.8 ± 2.41
– in %	21.7	20.9	20.1

Table 4. The litter size, rearing losses of piglets in rearing period and effectiveness of insemination in sows ($\bar{x}$ ± SD)

Specification	Groups		
	I control	II reduced protein – 10%	III reduced protein – 20%
Litter size:			
Total	12.1 ± 2.61	11.7 ± 3.05	11.2 ± 2.73
Born alive	11.2 ± 2.29	10.5 ± 2.11	10.6 ± 2.46
Born dead	0.9	1.2	0.6
Litter size in rearing period:			
1 day	11.2	10.5	10.6
21 day	9.3 ± 1.37	9.6 ± 1.62	9.7 ± 1.65
28 day	9.3	9.6	9.7
Losses of piglets aged 1 to 28 days	16.4	8.7	8.5
Duration of gestation (days)	114.2	114.4	114.9
Duration of lactation (days)	28.0	28.0	28.0
Interval between weaning and effective insemination (days)	4.7	5.5	5.7
Farrowing rate per sow per year	2.48	2.47	2.46
Farrowing rate (%)	86	86	86
Piglets per sow per year:			
– born alive	27.78	25.93	26.07
– weaned	23.06	23.71	23.86

Table 5. The body weights and daily gains of piglets in rearing period ($\bar{x}$ ± SD)

Specification	Groups		
	I control	II reduced protein – 10%	III reduced protein – 20%
Body weight of piglets on day:			
1	1.54 ± 0.15	1.60 ± 0.17	1.55 ± 0.15
21	7.00^{a} ± 0.62	6.46^{b} ± 0.95	6.52^{b} ± 0.71
28	8.36^{a} ± 0.94	7.67^{b} ± 1.10	7.67^{b} ± 0.83
%	100.0	91.7	91.7
Daily gains of piglets (g) within:			
1-21 days	256^{a} ± 31	231^{b} ± 33	237^{b} ± 38
%	100.0	90.2	92.6
21-28 days	194^{a} ± 40	173^{b} ± 45	164^{b} ± 47
%	100.0	89.2	84.5
1-28 days	243^{a} ± 29	217^{b} ± 35	218^{b} ± 30
%	100.0	89.3	89.7

Values with the same letters and with no letters do not differ significantly (a,b at $P \leq 0.05$)

Table 6. The content of nutrients (%) in sow's milk ($\bar{x} \pm SD$)

Nutrients	Groups		
	I control	II reduced protein – 10%	III reduced protein – 20%
Dry matter	17.02 2.01	16.75 1.24	17.63 0.86
Non-fat dry matter	10.42 0.79	10.24 0.47	10.65 0.33
Crude fat	6.60 1.42	6.51 0.99	6.98 0.95
Crude protein	4.78 0.14	4.73 0.45	4.75 0.26
Lactose	5.12 0.78	5.22 0.63	5.50 0.30

Reproductive efficiency of sows. Table 4 shows reproductive efficiency of 42 sows under investigation. In each feeding group, 12 sows, including 4 one-parity sows, gave birth to offspring.

Further rearing (21-28 days) resulted in decreasing daily body weight gain of piglets in all the groups under investigation (194-173-164 g), which was due to lower lactation performance of the sows and reduced feed intake by the piglets.

Average body weight of piglets weaned on day 28 was 8.36 kg and can be considered satisfactory. In contrast, body weight gain of the piglets in the experimental groups was 0.5 kg (8%) lower than that found in the control.

Composition of sow's milk. Table 6 shows the content of basic nutrients present in sow's milk. The results of the study show that reduced protein content of complete compound feed for sows did not have a significant impact on milk composition. Dry matter content of the milk in the control group was 17.02% and were similar in experimental groups (16.75 and 17.63%). Non-fat dry matter content was similar (10.42 – 10.24 – 10.65%) in all the groups.

Fat content of the sow's milk in the control group was 6.60%, while in the experimental groups it was 6.51 and 6.98%, respectively. A slight increase in fat content of the sow's milk in group III was mainly due to the individual variability, not feeding. Total protein content was similar (about 4.75%) in all the groups under investigation and did not depend on protein content of the feed. Lactose of the milk in the control sows accounted for 5.12%. Slightly greater quantities of lactose (5.22 and 5.50%) were found in the experimental groups. The differences between the groups were insignificant.

Discussion

Complete compound feed given to sows in the control group (from day 1 to day 90 of gestation) contained 13% of protein, while the feed fed to the experimental groups contained 11.7 and 10.4% of protein, respectively. The protein level was reduced by the removal of soya meal from the feed. A major ingredient of the feed was dried sugar beet pulp (25%), which was the main source of crude fiber (9.6%), indispensable for preparing the sows to high feed intake during gestation. Loose feed, rich in beet pulp, was completely consumed by sows in all the groups under investigation. Granulated feed administered to the sows before parturition and during lactation did not contain sugar beet pulp, so crude fiber content consequently decreased to 3.5%. This guaranteed high intake of the feed and digestibility of the nutrients. Raj et al. (1997) studied digestibility of fiber by sows at fiber content of 2.8% and found that the digestion rate was 65.5%. An increase in the fiber content to 10.6% resulted in 41.7% reduction in fiber digestion, whereas digestibility of protein decreased from 80.5 do 59.4%.

Reduced protein content in the feed for pregnant sows decreased nitrogen content of the faeces, which suggests optimal use of this element by the sows. Korniewicz et al. (2010) analyzed sow faeces and urine and found that pregnant sows fed feed with reduced protein content by 10 and 20% excreted 7 and 10% less nitrogen in the faeces and 18 and 23% less nitrogen in urine, respectively.

The level of exogenous amino acids was the same in the feed fed to all the groups. Pampuch (2003) reported that increasing tryptophan concentrations from 0.9 to 2.1 g per kg of feed for lactating sows resulted in a three-fold reduction in body weight losses and two-fold increase in feed intake. This relationship is particularly important in feeding of lactating sows, which need high amounts of feed for milk production.

Backfat thickness at the P2 position in sows on days 30 and 105 of gestation shows that it did not depend on protein content of the feed. Whittemore (1996) and Sinclair et al. (1998) suggest that the opti-

mum thickness of the fat tissue at the P2 position in sows at mating should be within the range of 15-17 mm, and at parturition from 20 mm in first-parity sows to 25 mm in multiparous females. In our studies, the thickness of backfat at the P2 position ranged from 14.9 to 18.6 mm on day 30 of gestation and from 18.9 to 22.4 mm before parturition. Comparing the data obtained in our studies and those reported by other authors, it can be concluded that physical condition of the sows under investigation was normal. The thickness of the backfat in lactating sows was decreased by about 20%. A similar relationship was reported by Boldaun and Morgenthum (1989). They found that the backfat thickness was decreased from 25 mm on parturition to 18 mm after breeding of the first litter, and was reduced to 15 mm after several reproductive cycles.

An important indicator of the reproductive efficiency of sows is the number of piglets born alive and weaners and their body weight gain before weaning. The results of our studies show that the number of piglets per litter was 0.7 and 0.6 lower when the sows were fed compound feed with reduced protein content. The weight of piglets in a litter was comparable, hence, the losses before weaning were half lower than in the control group. Greater uniformity in the weight of piglets born in the experimental groups was likely due to a better use of pure amino acids, especially L-lysine and L-threonine. The amount of L-lysine added to the feed was almost two-fold higher in group II and 2.4-fold higher in group III, while that of L-threonine was 3.7-fold higher in group II and as much as 5-fold higher in group III, as compared with the control. Hence, on average, the sows in the experimental groups bred 0.3 and 0.4 more piglets in a litter than the sows in the control group.

It is worth noting that body weight gain in the experimental groups was 10% lower as compared to the control, which was likely due to larger sizes of litters at that stage of breeding. A lower number of piglets born in the experimental groups might have been due to a reduced content of amino acids, such as isoleucine and valine, not supplemented to the level of the control group. On average, the number of piglets born by the sows in all the groups as well as their body weight were similar to those observed on pig farms (Rekiel 2002) and the results were comparable with those reported for reproductive efficiency of sows in Poland (Whittemore 1996).

Protein digestibility by lactating sows can be enhanced by such feed additives as: enzymes, acidifiers, zeolites, yeast and herbal substances (Korniewicz 2004, Krasucki et al. 2004, Tatara et al. 2005, Korniewicz et al. 2006, Wang et al. 2008, Svoboda et al. 2009).

Protein content of the feed for lactating sows did not have a significant impact on basic milk nutrients. Migdał et al. (2003) reported that sows exhibiting high reproductive efficiency, fed compound feed containing 15% of protein, produced milk containing 5.26% of protein, 6.72% of fat and 5.36% of lactose. An increase in sunflower oil content of the feed from 2 to 4% increased the fat content of milk by 6.72-7.59%. Korniewicz (2004) reported that addition of vegetable extract to the feed markedly increased protein content of sow's colostrum and milk. Schöne et al. (1998) claim in turn, that the composition of colostrum and milk of sows is quite stable, and fatty acids profile may only be changed by an increase in dietary fat.

Annual reproductive efficiency of sows is also affected by the weaning-to-estrus interval. Reduced protein content of the feed did not affect the weaning-to-estrus interval, which took 6 days in the control and 5 days in the experimental groups. Rekiel (2002) conducted studies on sows in 3 consecutive reproduction cycles and found that the weaning-to-estrus interval was 11 days long. Korniewicz (2004) studied 150 sows in the conditions of an industrial farm and found that the weaning-to-estrus interval was 7 days long.

In summary, it should be stated that the reduction of protein content to 20% in pregnant and lactating sows with simultaneous maintenance of the same level of exogenous amino acids does not influence negatively the condition and indices of reproductive performance of the animals.

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