Original paper

INFLUENCE OF ENERGY AND PROTEIN LEVEL IN LACTATING SOWS DIET ON THE MOBILIZATION OF RESERVES FROM INTERNAL ORGANS

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Abstract

The aim of this paper was to investigate the effect of feeding sows in lactation, in diets with different levels of energy and protein to mobilization of reserves from internal organs. The experiment was conducted on 240 sows divided into two groups of 120 sows each, with two sub-groups of 60 sows. Experimental period lasted 65 days, and during the last 30 days of pregnancy and lactation, until weaning. For sows feeding a mixture of the standard composition and the quality, with the 15% crude protein, and 14 to 12 MJ ME / kg and 19% crude protein, and 14 to 12 MJ ME / kg of the mixture were used. Sows were divided into two groups and four subgroups consumed 2.20 and 3.30 kg of food per day. Based on the statistical analysis of the data it can be concluded that the different amounts of feeds with different levels of protein and energy in the diet resulted in the mobilization of the reserves from the internal organs of lactating sows. When we talk about the content of protein in the liver of lactating sows, statistically significant effect ($P>0.05$) to diets with 15% crude protein (19.04%) and 19% crude protein (19%) was not recorded. The same trend in the content of crude protein in the kidney (14.61 and 14.84%) was also observed, but with no statistically significant difference ($P>0.05$). Analysis of variance was established as statistically significant effects ($P<0.01$) protein content in the diet on protein content in the muscle of the heart muscle (17.59 and 18.71%). Effect of different energy level in mixture used for the diet of lactating sows, the protein content in the liver, kidneys and heart was missing.

Key words: *energy, nutrition, protein, sows*

Introduction

In intensive pig production important place takes the nutrition of sows, whose main goal is the cost-effective production. This set of goals is not easy to achieve because sow reproductive efficiency is influenced by many factors of which diet take a significant role. Success in the modern conditions of pig production greatly depends on the efficiency of the breeding herd (Rupić et al., 2005; Rosendo et al., 2007). It is believed that during the exploitation, sows should raise a total of 70-75 piglets (Smits 2003; Close and Turnley, 2004). Achieving this goal can be defined only if the optimal housing conditions and adequate nutrition of sows were in all phases of the reproductive cycle. The problem of optimal nutrition of sows is complex due to the very different needs of sows in the food and nutrients in different stages of the reproductive cycle (Kovčin et al., 2005). In

pregnancy, the needs of sows in nutrients are not great and come down primarily to meet basic maintenance requirements, which are the largest item in the structure needs. In addition to their maintenance requirements necessary to provide part of the nutrients for the development and creation of reserves, then the intrauterine development of piglets and to prepare the mammary glands for milk secretion, this begins immediately after farrowing (Beuković, 1999). Needs of lactating sows are extremely high which can be a serious problem when it comes to feed consumption, namely, insufficient consumption of sowing order, the secretion of milk will be satisfactory (Kim and Wu, 2008), and at the same time, should not lose too much reserves of nutrients from the body, in order to avoid delayed estrus after weaning piglets (Whittemore, 1998; Trottier and Johnston, 2000, Boyd et al. 2000; Kongsted, 2005). The secretion of milk requires an appropriate amount of protein in the diet, so it is necessary to increase the participation of protein nutrients of plant or animal origin (Trottier and Johnston, 2005; Dean, 2005). The protein needs for sows, during lactation depends mainly of milk secretion amount, and much less of the weight of the sows (Beuković, 1999, McNamara and Pettigrew, 2002). In order to satisfy the needs in nutrients during lactation via feed which sows consumed during this stage, it would be necessary to consume 6-7 kg of feed, which is much higher than the actual consumption (Beuković, 1999). Engagement body reserves of nutrients from the body during the period of lactation is a regular occurrence (Foxcroft et al., 1997; Eissen et al., 2000), which is hard to miss and is not a big problem if it is not too long and big (Eissen et al., 2003; Thaker and Bilkei, 2005). In the body there are reserves of protein, so it comes to engaging body protein from muscle and vital internal organs (Aherne and Williams, 1992, Yang et al., 2000; Clowes et al., 2003). Previous studies have indicated that increasing the amount of protein and energy in pregnancy has a negative effect on embryonic survival (Whittemore, 1987), and recent studies point to the positive effect of increasing amounts of protein and energy on litter size, especially when it comes to young sows (Wu et al., 2006). Increasing amounts of protein and energy in pregnancy aims to provide the best possible preparation for the next lactation sows and possibly increase the body weight of newborn piglets.

The aim of this study was to investigate the effect of feeding sows in lactation diets with different levels of energy and protein to mobilization of reserves from internal organs.

Materials and methods

The experiment was conducted on 240 sows, divided into two groups of 120 sows each, with two sub-groups of 60 sows. Experimental period with sows lasted 65 days, respectively during the last 30 days of pregnancy and lactation, until weaning. The sows were fed a mixture with a standard composition and the quality of the 15% crude protein, and 14 to 12 MJ ME / kg and 19% crude protein, and 14 to 12 MJ ME / kg of feed (Table 1 and 2). Sows were divided into two groups and four subgroups consumed 2.20 and 3.30 kg of food per day. In the last thirty days of experiment sows were housed in group pens. Feed is performed automatically, twice a day. Water supply was from automatic drinkers. Micro-climatic conditions, the relative humidity and temperature were automatically controlled. Fresh air flow was enabled by perforated ceiling, while drawing air was through a vertically mounted vent with running on the roof. During the experimental period sow body mass was controlled 30 days before farrowing and immediately before farrowing and weaning. The results regarding gain of sows in gestation and weight loss in lactation were also accompanied in the trial. After farrowing the sows in all groups were fed diets for lactating sows, which differed by the amount of crude protein and energy levels. At this stage, feeding is performed on two occasions in an amount of 5 kg. Amount

of consumed food in this phase of the experiment was not registered. Piglets were weaned in 28 days age. After the end of the experimental period, sows were sacrificed, and analysis of nutrients in the liver, kidney and heart was determined. The results obtained in this experiment are shown in the tables as well as an average or relative value. Statistical significance was determined by measurement obtained by using analysis of variance (ANOVA) and t-test. The level of statistical significance of differences between groups was expressed as a statistically highly significant, statistically significant or the difference that is not statistically significant. Software package Statistica for Windows ver. 8.0 (StatSoft Inc., USA) was used for statistical data processing.

Table 1. *Structure of diet mixtures used in experiment, %*

Feedstuffs	In mixture, %				
	Sows	Lactating sows			
		15/12 (CP/ME)	15/14 (CP/ME)	19/12 (CP/ME)	19/14 (CP/ME)
Corn	48.38	23.56	56.62	26.56	44.50
Soybean meal	3.48	6.20	13.70	19.58	25.50
Wheat bran	30.00	15.00	8.00	15.00	8.00
Barley	10.00	41.00	10.00	25.00	10.00
Soybean grits		1.00	5.00		5.00
Sunflower meal	5.00	10.00		10.00	
Vegetable oil			3.30		3.80
Lysine	0.06	0.17	0.03		
Lime stone	1.17	1.70	1.42	2.02	1.44
Monocalcium phosphate		0.07	0.60	0.50	0.43
Salt (NaCl)	0.31	0.30	0.33	0.30	0.33
Premix	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00

Table 2. *Structure of diet mixtures used in experiment, %*

	Sows		Lactating sows							
			15/12 (CP/ME)		15/14 (CP/ME)		19/12 (CP/ME)		19/14 (CP/ME)	
Nutrients	ND	DM	ND	DM	ND	DM	ND	DM	ND	DM
Dry matter	88.93	100.00	88.01	100.00	88.14	100.00	87.31	100.00	87.60	100.00
Moisture	11.07	-	11.99	-	11.86	-	12.69	-	12.40	-
Crude proteins	13.47	15.15	15.56	17.68	15.47	17.55	19.11	21.89	19.15	21.86
Crude fat	2.87	3.23	2.71	3.08	3.60	4.08	2.49	2.85	6.85	7.82
Crude fiber	3.92	4.41	3.65	4.15	3.39	3.85	3.49	4.00	3.69	4.21
Ash	4.16	4.68	4.82	5.48	4.88	5.54	5.87	6.72	5.19	5.92
NEM	64.51	72.53	61.27	69.62	60.80	68.98	56.35	64.54	52.72	60.18
Ca	0.67	0.75	0.73	0.83	0.80	0.91	1.00	1.15	0.79	0.90
P	0.47	0.53	0.45	0.51	0.50	0.57	0.58	0.66	0.49	0.56

Results and discussion

The results shown in Table 3 indicate that the protein content in the liver was under the influence of the protein level in the diet for sows. When the level of protein in the diet was 750 g, the protein content in the liver was 19.04%, while the increase of protein to 950 g in diet leads to an increase in the protein content of 19.31% in the liver. Statistical analysis of the results shows that the level of protein in the liver was not significantly (P>0.05) different between groups fed with different levels of protein in the diet.

Table 3. *Protein level in liver*

Protein level (%)	15		19		Mean:
Energy level (MJ)	12	14	12	14	
2.20	18.85	18.89	19.1	19.66	19.12
3.30	18.87	19.54	18.96	19.5	19.22
Mean:	18.86	19.22	19.03	19.58	
Protein effect	19.04^{ns}		19.31^{ns}		
Energy effect	18.94		19.4		

In contrast to the liver, changes in the protein content in the kidney are not affected by the protein in a meal, and it can be concluded that the protein from the kidneys is less involved in the mobilization of protein to meet the needs of the protein during lactation. The content of protein in the kidneys of affected levels of protein in the diet is shown in Table 4 in addition to the protein content of kidney which marked a significant difference (P>0.05).

Table 4. *The level of protein in kidneys*

Protein level (%)	15		19		Mean:
Energy level (MJ)	12	14	12	14	
2.20	14.01	14.49	15.1	15.22	14.71
3.30	14.37	15.57	14.41	14.61	14.74
Mean:	14.19	15.03	14.755	14.915	
Protein effect	14.61		14.84		
Energy effect	14.48		14.97		

Table 5. *Level of protein in the hearth muscle*

Protein level (%)	15		19		Mean:
Energy level (MJ)	12	14	12	14	
2.20	17.49	17.61	18.5	19.07	18.14
3.30	17.50	17.78	18.38	18.90	18.17
Mean:	17.50	17.70	18.44	18.99	
Protein effect	17.59^{B}		18.71^{A}		
Energy effect	17.97		18.34		

The protein content in the heart muscle was not affected by protein meals so it can be concluded that the protein of the body was less involved in the mobilization of protein to

meet the needs of the protein during lactation. The protein content in the heart muscle is shown in Table 5. To the basis of Statistical analysis of results it can be noted that the level of protein in the muscle of the heart had a significant effect ($P<0.01$) to the levels of protein in sows feed while the energy levels in sow feed had no significant effect ($P> 0.05$).

Conclusion

On the basis of the tests and the results it can be concluded that the level of protein and energy in the diet of lactating sows can influence the mobilization of protein from vital internal organs, especially the liver. The content of protein level in the liver was higher in sows fed with high levels of protein and energy. Sows that were fed diet with 750 g of protein and 60 MJ ME had a protein content in the liver of 18.86%, 14.19% in the kidney, and 17.50%. in the heart. Increasing the energy level of the food with 70 MJ ME causes increase of the protein content in vital internal organs, the liver 19.22%, kidney 15.03% and heart 17.70%. The content of protein in the internal organs was increased in diet with increased protein in the diet. At the protein level of 950 g and 60 MJ ME protein content amounts to 19.03% in liver, 14.41% in kidney and 18.44%. in the heart. With the increase of the energy level to 70 MJ ME the same level of protein leads to an increase of protein in internal organs, in the liver 19.58%, in the kidney 14.91% and 18.99% in the heart. Increasing the amount of food in the last stage of pregnancy had no significant impact on the content of protein levels of vital internal organs.

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