THE EFFECT OF DIETARY PROTEIN AND ENERGY LEVEL TO PROTEIN LOSS IN HAM MUSCLE OF SOWS

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Abstract: *In a trial with lactating sows, examined the effects of using a meal with different levels of protein and energy. In an experiment involving 240 sows and gilts last 30 days before farrowing, all animals involved in the experiment were divided into two groups of 120 sows in the group, and by 60 in subgroups. Sows in the experiment were 65 days, and during the last 30 days of pregnancy and lactation and the experiment ended with with the weaning of piglets. The sows were fed diets during lactation. Results were as follows. Sows that were fed into the model food diet with 15% protein and 12 MJ ME / kg of diet, had a protein content of 21.00% round muscles. Consuming foods sows in the model diet with 15% protein and 14 MJ ME / kg diet, there was an increase in the protein content of ham muscle to 21.75%. In sows that were fed into the model food diet with 19% protein and 12 MJ ME / kg diet, the protein content in the ham muscles was 22.24%. Dietary feeding of sows with a model of 19% protein and 14 MJ ME / kg diet, there is a change in the protein content of ham muscles, and then it was 22.72%.*

Key words: sow, protein, energy, lactation, ham muscle

INTRODUCTION

The relationship of protein and energy supplements are an important measure of control activation of the body's reserves.

Increasing these parameters sows need daily food consumption of 6-7 kg, which is higher than the actual consumption (Beuković 1999), while we know that the milk malnutrition, caused 50% mortality before weaning (Kertiles and Anderson 1979). The biggest problem in lactating sows is to satisfy nutritional needs, and this can be achieved only through quality nutrition.

Feeding lactating sows is an area that is not enough, especially from the standpoint of energy and protein source in the diet. Sow's protein needs, depend primarily on the amount of milk secreted (Beuković 1999), and it is very important to provide the appropriate level of protein in the diet, in order to have adequate milk production in quantity and quality.

Under nutritional needs is not enough to provide the proper amount of nutrients, it is necessary to ensure that sows can use those nutrients.

Sows during lactation usually has a negative balance of nutrients, and puts part of its reserves to produce milk. In this period it is important to provide as much nutrient intake during lactation, in order to minimize loss of body weight of sows. This is particularly useful for the development and productivity of the next litter reproductive cycle. Appetite sows in early lactation was lower than in the subsequent lactation. Food consumption gradually increases until the third week.

Although many farms have adopted a nutrition program that gradually increases sows off feed during the first 5-7 days of lactation. This diet will further reduce food intake by 15% in the first week of lactation compared to the aggressive diet.

This limited diet, due to the widespread view that overeating sows in early lactation can cause inflammation of the udder, and lead to reduced milk production for pigs, sows to constipation, and decreased appetite sows in the later stages of lactation. Kotetsu et al. (1996a) concluded that 10-30% of sows show a strong entry of food for 2-3 days in the second week of lactation.

This food intake is more to do with weaning-estrus interval, farrowing rate reduction, reduced litter size in sows.

Deen (2005) observed that sows a day during lactation consume less than 4 kg of food will increase the chances of expulsion from the herd by 50%. Limiting food intake in any week of lactation, either because of poor appetite, or imposed conservative nutrition program will increase the weight loss of sows, and can reduce the reproductive efficiency after weaning (Kotetsu et al. 1996b).

The nutritional needs instead of protein lysine often referred to only as the primary limiting amino acid, so the code attaches the greatest importance (Kim et al. 2001). Very important role in determining the protein requirement has current condition of the sow, and predicted protein mobilization from body reserves.

Kim et al. (2004) have shown that the above model diet has a positive effect on the growth of litter, but has no effect on weight, and loss at partus. Ji et al. (2004) found that sows in the second parity leads to reduced activation of the body's reserves.

Genetic selection for increased productivity of sows, including the number of piglets born alive, weaned weight, and number of weaned pigs, and results in increasing milk production (Bergsma et al. 2008). Shurson and Irvin (1992), and Bergsma et al. (2008) found that increasing the productivity of sows leads to an increase in milk production during lactation and in major losses of body mass sows.

Selection of sows on the higher feed consumption during lactation is the only possible solution to improve the performance of sows, physical fitness and reducing days of weaning and estrus (Bergsma et al. 2008).

MATERIAL AND METHODS

The experiment was conducted with sows in pig farms "ZP Commerce" Vrsani-Bijeljina, Bosnia and Herzegovina, in the spring-autumn 2010. Necessary analysis in this paper were performed at the Veterinary Institute "Dr Vaso Butozan" Banja Luka, Bosnia and Herzegovina, and the Laboratory for feed and animal products, the Department of Animal Science, Faculty of Agriculture in Novi Sad, Serbia

In an experiment involving 240 sows and gilts last 30 days before farrowing, all animals involved in the experiment were divided into two groups by 120 sows.

Sows were marked with and measured the body weight and backfat thickness. When forming groups of animals were not uniform in weight, age and thickness of the back fat after the experiment switched sows of different ages and with approximate average weight. Sows in the experiment were 65 days, (during the last 30 days of pregnancy and lactation).

Sows and gilts in experiment were „Naima" breed. All sows in the experiment were divided by farowwing times, (two to four).

Sows in the mating room were feed twice, in quantities of 1 kg of feed per feeding, or 2 pounds of feed per day. Pregnant sows and gilts are kept in separate groups of 5 animals. About 5 to 7 days before the farrowing, sows were move in forowing room.

Microclimate in pens for sows and gilts were computer-controlled (ventilation and temperature).

After forming groups, sows were fed with standard diets (composition used for feeding of all sows on the farm) (Table 1). The table below shows the composition of feeding in pregnancy and lactation. During the last 30 days of gestation, sows and gilts were fed a standard diets with same composition, 13% CP and 12 MJ ME per kg. The difference between these two experimental groups consisted in the daily amount of consumed feed (first and second feeding model).

The first model: Sows and gilts are daily consumed 2.20 kg of feed, so that the average daily consumption amounted to 286 g of protein and 26.4 MJ ME per day.

The second model: Sows and gilts are consumed daily 3.30 kg of food, so that the average daily consumption amounted to 426 g of crude protein and 39.6 MJ ME energy, which is about 50% more protein and ME, compared to the first model.

Table 1

Mixture composition for sows in the experiment

	% in mixture				
	Gestation sows	Lactating sows			
		15% CP / 12 M.J. ME	15% CP / 14 M.J. ME	19% CP / 12 M.J. ME	19% CP / 14 M.J. ME
Maze	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
Full fat soybean meal		1,00	5,00		5,00
Sunflower bean	5,00	10,00		10,00	
Vegetable oil			3,30		3,80
Lysine	0,06	0,17	0,03		
Limestone	1,17	1,70	1,42	2,02	1,44
MCP		0,07	0,60	0,50	0,43
Salt	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**

CP – Crude Protein; ME – Metabolic energy

Sows in the first model of diet during the last 30 days of gestation, fed 2.20 kg of feed during lactation were divided into 4 groups: the first group with 15% protein and 12 MJ ME, second group with 15% protein and 14 MJ ME, third group with 19% protein and 12 MJ ME, and the fourth group with 19% protein and 14 MJ ME. Sows in the second model of diet during the last 30 days of gestation, consumed 50% more crude protein and MJ ME in diet than sows in firt model. Its mean that sows consumed a daily average of 426 g of crude protein and 39 , 6 MJ ME.

RESULTS AND DISCUSSIONS

Ham muscles are a significant source of protein who cover the deficit. The protein content in the ham muscles is directly related to the amount of protein in diet. The protein content in the ham is shown in (Table 2) and Figure 1. When is protein diet 720g, (15%) level of protein in muscle of ham is 21.37%. With an increase in protein in the diet at levels of 950 (19%) g, there is an increase in the protein content of the leg muscles 22.69%. (Table 2)

Table 2

Protein level in ham muscle

Protein Level (%)	15		19		Mean
ME Level (MJ)	12	14	12	14	
2.20	20.97	21.00	23.05	23.55	22.14
3.30	21.02	22.50	21.4325	22.72	21.92
Mean	21.00	21.75	22.24	23.14	
Protein effect	21.37		22.69		
ME effect	21.62		22.44		

Because of the high protein and energy requirement during sows lactation, it's lead to deficit of feed nutrients (protein and energy). Needs in this stage are often greater than the amount of consumed nutrient Kovčin et al. (1992), King and Dunkin (1986), King and Wiliamas (1984). Protein and energy in that situation mobilized from body reserves, which it agrees with that of other scholars Tokachi et al. (1992), Pettigrew et al. (1993), Brendemuhl et al. (1987), Brendemuhl et al. (1989), Everts et al. (1995), Kemp et al. (1996).

The content of protein and energy levels in the ham muscles is influenced by the level of protein and energy in sows fed. At the level of protein and energy in the diet with 15% protein and 12 MJ ME / kg diet, the protein content in the ham muscles is the smallest, with the same level of protein but with increasing levels of energy to 14 MJ ME / kg of diet increases the level of protein in ham muscles.

Table 3

The statistical significance of protein levels in ham muscle

Gestation sows feed consummation (Kg)			2.20				3.30			
Protein level (%)			15		19		15		19	
ME Level (MJ)			12	14	12	14	12	14	12	14
2.20	15	12								
		14	0.035							
	19	12	2.080*	2.045*						
		14	2.582*	2.547*	0.502					
3.30	15	12	0.055	0.020	2.025*	2.527*				
		14	1.530	1.495	0.550	1.052	1.475			
	19	12	0.462	0.427	1.617	2.120*	0.407	1.067		
		14	1.750	1.715	0.330	0.832	1.695	0.220	1.287	

** - Significant at the 1% level, * - significant at the 5% level

Increasing levels of protein and energy in the diet (19% protein and 12 MJ ME / kg), the protein content in the ham muscles is increased, also and with increasing levels of energy to 14 MJ ME / kg. Which indicated that with increasing energy and protein in the food, it reduces the involvement of ham muscle protein. The protein and energy had a statistically significant impact on the average protein content of leg muscles.

Table 4

Anova and relation protein level in musculature of ham

	sum of squares	degrees of freedom	mean of sum squares	F	p level
Consummation	0.41	1	0.41	0.222	0.641445
Protein	13.81	1	13.81	7.584	0.011049*
ME	5.45	1	5.45	2.991	0.096592
Interaction					
Consummation vs protein	8.00	1	8.00	4.394	0.046790*
Consummation vs ME	2.48	1	2.48	1.360	0.255074
Protein vs ME	0.04	1	0.04	0.022	0.884569
Consummation vs protein vs energy	0.21	1	0.21	0.118	0.734401
Error	43.70	24	1.82		
Total	74.08	31.00			

** - Significant at the 1% level, * - significant at the 5% level

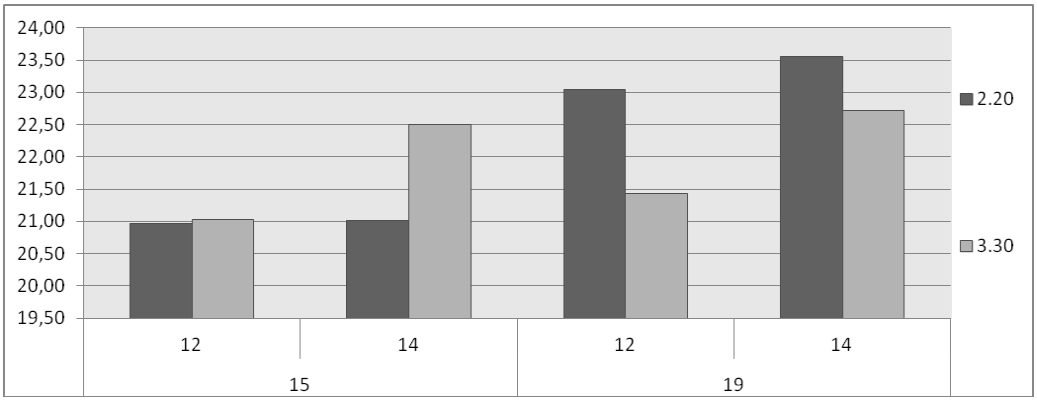

Figure 1: protein levels in muscles leg muscle

Everything mentioned above indicates that with increasing levels of protein, especially to increase the level of energy in sows fed leads to less involvement of body reserves, or that there is a small loss in weight.

Protein loss in muscle mass, which are shown in our experiment are consistent with the stated losses of other researchers Ravell et al. (1998), Brendmuhl et al. (1989), Mullan and Williams (1989), Tokachi et al. (1992a), Everts et al. (1995), Kemp et al. (1996), King and Williams (1984), King and Williams (1984b), King and Dunkin (1986), King and Dunkin (1986b), Clowes et al. (1998., 2003), Ravell et al. (1998a), King and Martin (1989),

CONCLUSIONS

The results obtained in our experiment indicate that the amounts of protein and energy in the diet of sows had a significant effect on the protein content of the muscle.

With increasing levels of energy and protein in the diet of sows increases the protein content in muscles and leads to less involvement of muscle protein for milk production. Increasing the

amount of feed in the last stage of gestation had no significant impact on the content of protein levels in musculature.

BIBLIOGRAPHY

1. BERGSMA, R., KANIS, E., VERSTEGEN M. AND KNOL, E., 2008. Genetic parameters and predicted selection results for maternal traits related to lactation efficiency in sows, J ANIM SCI May 2008 vol. 86 no. 5 1067-1080
2. BEUKOVIĆ, M., 1999. Efekat nivoa proteina u ishrani mladih krmača tokom laktacije. Doktorska disertacija. Univerzitet u Novom Sadu, Poljoprivredni fakultet.
3. BRENDEMUHL, J.H., LEWIS, A.J., PEO, E.R., 1987. Effect protein and energy intake by primaparous sows during lactation on sows and litter performance and serum thyroxine and urea concentrations. J.Anim. Sci., 64, 1060-1069.
4. BRENDEMUHL, J.P., A. J. LEWIS AND E.R. PEO., 1989. Influence of energy and protein intake during lactation on body composition of primaparous sows. J. Anim. Sci. 67, 6, 1478.
5. CLOWES, E. J., I. H. WILLIAMS, V. E. BARACOS, J. R. PLUSKE, A. C. CEGIELSKI, L. J. ZAK, AND F. X. AHERNE, 1998. Feeding lactating primiparous sows to establish three divergent metabolic states: II. Effect of nitrogen partitioning and skeletal muscle composition. J. Anim. Sci. 76:1154–1164.
6. CLOWES, E. J., F. X. AHERNE, G. R., FOXCROFT, AND V. E. BARACOS., 2003. Selective protein loss in lactating sows is associated with reduced litter growth and ovarian function. J. Anim. Sci. 81:753–764
7. DEEN, J., ANIL, S., ANIL, S. 2005. Sow housing: opportunities, constraints, and unknowns. J. Am. Vet. Med. Assoc, (226) 1331-1334
8. EVERTS, H., PLAGGE, J. G., SEBEK, L. B. J., 1991. Het effect van het lysine/ewit gehalt in het voer voor lacterende zeugen op de prestaties van de zeugen en hun biggen. Proefverslag-Varkenspoefbedrif Noord en Oost- Nederland. P 1.67, 32.
9. JI, F., Y. G. KIM, AND S. W. KIM. 2004. Ideal protein to improve lactation performance of multiparous sows. J. Anim. Sci. 82(Suppl. 1.331.
10. KEMP, B. 1998. Lactational učinke na endokrinologije reprodukcije. U: laktaciji krmača (ur. MWA Verstegen, PJ Moughan i JW Schrama). Wageningen University Press, Nizozemska, str 241-257.
11. KERTILES, L. P., AND L. L. ANDERSON. 1979. Effect of relaxin on cervical dilation, parturition and lactation in pig, Biol. Reprod., 21:57.
12. KIM, S. W., D. H. BAKER, AND R. A. EASTER. 2001. Dynamic ideal protein and limiting amino acids for lactating sows: The impact of amino acid mobilization. J. Anim. Sci. 79:2356–2366
13. KIM, S. W., AND G. WU. 2004. Dietary arginine supplementation enhances the growth of milk-fed young piglets. J. Nutr. 134:625–630.
14. KING R.H., DUNKIN, A.C., (1986 a. The effect of nutrition on the reproductive performance of first-litter sows. 3. The responce to graded increases in food intake during lactation. Animal Production, 42, 119-125.
15. KING R.H., DUNKIN, A.C., (1986 b. The effect of nutrition on the reproductive performance of first-litter sows. 4. The relative effects of energy and protein intakes during lactation on the performance of sows and their piglets. Animal Production, 42, 319-325.
16. KING, R. H., AND G. B. MARTIN. 1989. Relationship between protein intake during lactation, LH levels and oestrus activity in first-litter sows. Anim. Reprod. Sci. 19:283–292.
17. KING R.H., WILLIAMS, I. H., (1984 a. The effect of nutrition on the reproductive performance of first litter sows. 1. Feeding level during lactation and between weaning and mating. Animal Production, 38 241-272.
18. KING R.H., WILLIAMS, I. H., (1984 b. The effect of nutrition on the reproductive performance of first litter sows. 2. Protein and energy intake during lactation. Animal Production 38, 249-256.
19. KOKETSU, Y., G. D. DIAL, J. E. PETTIGREW, W. E. MARSH, AND V. L. KING. 1996.

Characterization of feed intake patterns during lactation on commercial swine herds. J. Anim. Sci. 74:1202

20. KOVČIN, S., VARNJU VALERIJA, BEUKOVIĆ, M., RAKIĆ, I., 1992. Uticaj konzumacije hrane na gubitke tjelesne mase krmača i veličinu legla. V - Savjetovanje veterinara Srbije, Kopaonik.
21. MULLAN, B. P., AND I. H. WILLIAMS. 1989. The effect of body reserves at farrowing on the reproductive performance of first litter sows. Anim. Prod. 48 (2) 449–457
22. PETTIGREW, J. E. BIOKYOWA NUTRITION (1993. Update. Lactation requirements for the sow. Biokyowa, Inc, Chesterfield, MO.
23. RAVELL, D. K., I. H. WILLIAMS, B. P. MULLAN, J. L. RANFORD, AND R. J. SMITS. 1998(a).Body comp ositio n at farrowing and nutrition during lactation affect the performance of primipar ous sows: I. Voluntary feed intake, weight loss, and plasma metabolites. Journal of Animal Science 76:1729-1737.
24. RAVELL, D. K., I. H. WILLIAMS, B. P. MULLAN, J. L. RANFORD, AND R. J. SMITS. 1998(b). Body comp ositio n at farrowing and nutrition during lactation affect the performance of primiparous sows: II.Milk composition, milk yield, and pig growth. Journal of Animal Science 76:1738-1743.
25. TOKACH, M.D, PETTIGREW, J.E., DIAL, G.D., WHEATON, J.E, CROOKER, B.A., JOHNSTON, L. J. (1992 a). Characterization of luteinizing hormone secretion in the primaparous, lactating sow: relationship to blood metabolites and return-to-estrus interval. Journal of Animal Science. 70, 2195-2201.text