FOOD PROTEIN LEVEL DURING SOWS PREGNANCY

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SUMMARY

The aim of this experiment is to see how many days before the end of pregnancy there is a need for more energy intake and for a higher content of protein in the sows diets.
Using two different diets in the two groups of pregnant sows the results show that we can feed the sows according to a corrected diet of 30 days before parturition and during the first 3 months of pregnancy an 11% level of protein in the diet is high enough to sustain a normal growth of the fetuses.

Keywords: gilt, corrected diet, deficient diet

INTRODUCTION

In pregnant sows the protein of the diet must cover sows needs for maintenance, for placenta formation and for the fetuses' growth. Protein is essential for life. Animal body gain is done of proteins, sows milk contents proteins. Surplus of protein in the diet is used as an energy source, in which case the cost of feeding becomes very high. At the same time protein surplus can cause kidney disease. Deficit of protein in the diet determines low performances and when it's under the maintenance needs it becomes dangerous for the health and the life of the animals.

From a practical point of view the most important hypothesis is that a special diet for pregnant sows in the second part of gestation can solve both requirements: supplementation of protein and more metabolic energy, as well. This way of acting is convenient especially for gilts.

Based on data concerning development and growth of fetuses it is possible to think that at the end of pregnancy there is need for more energy intake and for a higher content of protein in the sows' diets. That is the hypothesis of the present research.

MATERIALS AND METHODS

In order to test the former hypothesis I proposed to make an experiment with pregnant sows using two diets differing in their protein content. The first diet, the control one, called corrected (C), should have a 13% level of protein, as much as it is recommended by the literature. For the second diet, called deficient, (D), I decided to keep the 11% protein level as I met in a commercial pig reproduction farm. The reason of using in experiment a lesser percent of protein than recommended at the experimental diet is justified by the action of Mitsherliech's low of growth. According to this low the growing process follows a logistic curve and has to be expressed up to specific limits. Using a lower than recommended percent of protein in the experimental diet there is more chance to provoke a difference of the weight of piglets between the corrected and the uncorrected diets of the experiment.

So I have used for the two experimental lots the following receipts of powder combined feed:

Table 1. Structures of the corrected (C) diet and deficient (D) diet

Feed stuffs	Corrected diet (C)				Deficient, uncorrected diet (D)			
	%	TDN	M cal.	Protein	%	TDN	M cal.	Protein
Corn meal	55	44.0	189.4	440	55	44.0	189.4	440
Barley meal	30	22.8	89.8	300	30	22.8	89.8	300
Soya bean cake	10	7.8	31.5	440	5	3.9	15.8	220
Wheat bran	–	–	–	–	5	3.3	11.6	70
Meat meal	3	2.7	8.8	135	2	1.8	5.9	90
Minerals	2	–	–	–	3	–	–	–
TOTAL	100	77.3	319.5	1315	100	75.8	312.5	1120

In fact in this experiment I corrected feeding of sows by increasing the protein level of the diet from 11% to 13%. Food was given twice a day weighing 2kg of combined food per sow each time which means 4 kg of food per day. Straws were renewed twice a week in the sow's pen.

The experiment was located in a pig reproduction farm of 200 heads. Sows having the last mating in less than 21 days when the different feeding was implemented were not included in the experiment. The rest of the sows were grouped for 10 days interval from the last mating dividing each group in to parts, half of them received a correct 13% protein diet, the other half, i called the deficient lot, continued to receive the 11% protein diet. Altogether there were 10 groups of sows for each diet. Thus the time each group was fed in the experiment was different. The longest term was, as a mean, 100 days and the shortest one was of 10 days. The sows with less than 5 days of experimental feeding before farrowing were excluded from result evaluation. In order to have for each tens the same number of sows in the deficient and in the corrected feed lot one or two sows were excluded, just in case of data treatment, from one lot of the same ten. Finally, it has resulted the experimental design presented in Figure 1.

Days from mating

0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90	90–100	100–110	110–120	>120
x	***x***	***C*** ***5***	***D*** ***4***	***C*** ***8***	***D*** ***8***	***C*** ***8***	***D*** ***3***	***C*** ***3***	***D*** ***4***	***C*** ***6***	***D*** ***8***	***C*** ***x***
x	***x***	***D*** ***5***	***C*** ***4***	***D*** ***8***	***C*** ***8***	***D*** ***8***	***C*** ***3***	***D*** ***3***	***C*** ***4***	***D*** ***6***	***C*** ***8***	
		100	***90***	***80***	***70***	***60***	***50***	***40***	***30***	***20***	***10***	***<10***

Figure 1. Experimental design concerning effect of two different levels of protein during pregnancy in sow

Mean number of controlled feeding days

This experimental design gave me the possibility to appreciate: the effect of the two different levels of the protein in the diet and the term this effect takes place after. So the model must be treated as polyfactorial experimental design. It permitted to have equal number of cases in the both experimental groups of sows. That helps to apply statistical interpretation of data using analysis of variance.

RESULTS AND DISCUSSION

According to the primarily results, I have appreciated the body weight of piglets at birth and the suckling capacity of sows by the weight of the piglet lot at 21st day since birth. In this respect I have to say that after the farrowing all of the sows received the same diet containing 16% of protein and 77 TDN. Piglet weights at birth are shown in table 2.

Table 2. Body weight of piglets at birth

Time under exp.	Lot	Statistics				
		n	$\bar{x}$	s^2	s	V%
10	**C**	77	1.092	0.0202	0.142	13.0
	D	75	1.080	0.0232	0.152	14.0
20	**C**	63	1.358	0.0276	0.166	12.0
	D	58	1.174	0.0352	0.188	16.0
30	**C**	34	1.785	0.0837	0.289	16.0
	D	41	1.176	0.0359	0.189	16.0
40	**C**	23	1.587	0.0293	0.171	10.7
	D	20	1.425	0.0409	0.202	14.1
50	**C**	26	1.688	0.0522	0.228	13.5
	D	28	1.317	0.0593	0.243	18.5
60	**C**	103	1,502	0.1156	0.340	22.6
	E	97	1.205	0.0553	0.235	19.5
70	**C**	82	1.580	0.1040	0.323	20.4
	E	80	1.217	0.0609	0.246	20.2
80	**C**	81	1.508	0.0418	0.204	13.5
	E	74	1.266	0.0420	0.205	16.2
90	**C**	38	1.582	0.1026	0.320	20.2
	D	40	1.390	0.0578	0.240	17.2
100	**C**	39	1.682	0.1125	0.335	19.9
	D	39	1.230	0.1269	0.356	28.9

Sows fed on 11% protein level diet have born 552 piglets and the sows fed on a 13% protein level have born 566 piglets

Statistical analysis of data looks like that: Corrected feeding lot (C):

n_C = 566; =1.505; s_C^2 = 0.07096; s_C= 0.266; v%=17.7 Deficient, uncorrected feeding lot (D):

n_D =552; =1.266; s_D^2 =0.05134; s_D=0.227; v%=17.9

The difference of means measures 0.239 kg, about 16% from the weight of piglets obtained from corrected feeding. In order to establish if such a difference is significant or not, I must apply Student's "*t*" test. In this case:

$$\sigma_t = \frac{552x0.05134 + 566x0.07096}{552+566-2} = \frac{68.5026}{1116} = 0.0613 \qquad \hat{\sigma} = \sqrt{0.0613} = 0.248$$

$$\hat{\sigma}_T = 0.248\sqrt{\frac{1}{552}+\frac{1}{566}} = 0.248x0.06 = 0.0185 \qquad t = \frac{0.239}{0.0185} = 12.92$$

Looking for this value of "*t*" on the Graphic of Student's at the site of over 100 degrees of freedom (in our case there are 1116 degrees of freedom) I noticed it is placed much higher the line of highly significant level. I can conclude for sure that an 11% protein level will determine that the body weight piglets to be born will be under the normal one.

Now, if I am looking at the differences in weight of piglets whose mothers were fed differently for the same length of time before parturition, (see table 2.), I notice the values of differences differ. But I have to find which of these differences are significant and which ones are not. In order to answer this question I formed a table of variance, presented as Table 3.

In this way I had the opportunity to judge the rate of contribution of the experimental factor to the total variance of the items and also to evaluate the significance of differences between different groups of piglets. It is possible to compare every group to any other group created by the experimental design (Table 3.).

The difference of means of body weight between the two groups of piglets whose mothers were fed differently for 10 days has no significance because 10 days is a too short term to show its influence on the corrected feeding.

Table 3. Analysis of variance table

Differences between groups of piglets within the same length of different feeding of their mothers

Days to part.	Number of piglets		s^2		Difference of $\bar{x}$	Counted t	Degrees of freedom	Tabulated t value			Significance
	C	D	C	D				.05	.01	.001	
10	77	75	.0202	.0232	0.012	0.50	150	1,96	2.576	3.291	–
20	63	58	.0276	.0352	0.184	5.73	119	1.98	2.617	3.373	+++
30	34	41	.0837	.0359	0.609	10.95	73	2.00	2.660	3.460	+++
40	23	20	.0293	.0409	0.162	2.85	41	2.02	2.704	3.551	++
50	26	28	.0522	.0593	0.371	5.76	52	2.00	2.617	3.375	+++
60	103	97	.1156	.0553	0.297	7.14	198	1.96	2.576	3.291	+++
70	82	80	.1040	.0609	0.363	8.01	160	1.96	2.576	3.291	+++
80	81	74	.0418	.0420	0.242	7.33	153	1.96	2.576	3.291	+++
90	38	40	.1026	.0578	0.192	3.00	76	2.00	2.660	3.460	+++
100	39	39	.1125	.1269	0.452	5.79	76	2.00	2.660	3.460	+++

For all other length of action the difference of means of similar groups in the two lots are highly significant, excepting the pair of groups with a 40 days action of the corrected feed where the difference of means was only significant.

In order to illustrate better the probable effect of the corrected feeding I applied the Analysis of Variance test.

Total variance = Σs^2 (all groups of both lots) = 0.7+0.5374=1.2374

Variance between groups $= \dfrac{o.7x566 + 0.5374}{566 + 552 - 2} = \dfrac{692.8448}{1116} = 0.62$ Variance inside groups = 1.2374–0.62=0.6174

It resulted that 50.1% of the total variance of the piglets' weight at birth was due to the corrected diet.

The same test applied to the last pair of groups' shows: **Total variance = 0.1125+0.1269=0.2394**

Between groups variance $= \dfrac{39x0.1125 + 39x0.1269}{39 + 39 - 2} = \dfrac{9.3366}{76} = 0.12$ Within groups variance = 0.2394–0.12=0.1194

The same result was obtained: 50.1% of the variance of the pair of groups receiving different feeding along all the gestation period pertains to these groups of variance.

There is no doubt than 11% of protein in the diet of the pregnant sows determines a significantly lower piglet weight at birth.

However how long the corrected diet must act before parturition in order to produce a significant difference between the mean body weight of piglets born after 100 days of corrected feeding and shorter terms.

Applying the Student's *t* test to appreciate the difference between the mean body weight of piglets born after a corrected feeding of pregnant sows during al pregnancy and the mean body weight of piglets born after 10 days corrected feeding before parturition I found:

$$\sigma^2 = \frac{39x0.1125 + 77x0.0202}{39 + 77 - 2} = \frac{4.3875 + 16.5627}{114} = 0.1838 \qquad \sigma = \sqrt{0.1838} = 0.4287$$

$$\hat{\sigma}_T = 0.4287\sqrt{\frac{1}{39} + \frac{1}{77}} = 0.4287\sqrt{0.0376} = 0.4287x0.1965 = 0.0842 \quad \bar{x}_{100} - \bar{x}_{10} = 1.682 - 1.092 = 0.59$$

$$t = \frac{0.59}{0.0842} = 7.00$$ **Degrees of freedom=39+77–2= 114**

The value of "*t*" for 114 degrees of freedom indicates a highly significant difference between the two means explained by the short term of action of the corrected diet.

Comparing in the same way the effect of a 100 days action of corrected feeding with the effect of 20 days corrected feeding I found:

$$\hat{\sigma}^2 = \frac{39x0.1125 + 63x0.0276}{39 + 63 - 2} = \frac{4.3875 + 1.7388}{100} = 0.0613 \quad \hat{\sigma} = \sqrt{0.0613} = 0.2475$$

$$\hat{\sigma}_T = 0.2475\sqrt{\frac{1}{39} + \frac{1}{63}} = 0.2475x\sqrt{0.0415} = 0.2475x0.2037 = 0.0504$$

$$\bar{x}_{100} - \bar{x}_{20} = 1.682 - 1.358 = 0.324 \quad t = \frac{0.324}{0.0504} = 6.429$$

The value of "*t*" for 100 degrees of freedom shows a highly significant difference between the mean body weights of these two groups of piglets. It means this term is also too short for corrected diet to show its effect.

When I compared the same group of 100 days corrected feeding piglets with the group of piglets whose mothers received corrected food for 30 days I found:

$$\hat{\sigma}^2 = \frac{39x0.1125 + 34x0.0837}{39+34-2} = \frac{4.3857+2.8458}{71} = \frac{7.233}{71} = 0.1019 \; \hat{\sigma} = \sqrt{0.1019} = 0.3192$$

$$\hat{\sigma}_T = 0.3192\sqrt{\frac{1}{39}+\frac{1}{34}} = 0.3192x\sqrt{0.0534} = 0.3192x0.2311 = 0.074$$

$$\bar{x}_{30} - \bar{x}_{100} = 1.785 - 1.682 = 0.103 \; t = \frac{0.103}{0.074} = 1.39$$ Degrees of freedom = 71

This time the value of *t* indicates, for 71 degrees of freedom, no significance of the difference between the mean body weights of the two groups of piglets.

It means that feeding sows on a corrected diet for 30 days before parturition I can have the same effect as feeding sows on corrected feeding along all the pregnancy. During the first 3 months of pregnancy 11% level of protein in the diet is high enough to sustain a normal growth of the fetuses. The same diet can be used both for adult sows and for gilts. Gilt growth doesn't claim higher level of protein.

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