DIET INDUCED CHANGES IN ORGAN WEIGHTS AND UNCOUPLING PROTEIN GENE EXPRESSION IN PIGLETS

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Miller and Payne (1962) reported poor energy efficiency of piglets fed a low protein diet when compared to piglets fed restricted amounts of a high protein diet. Subsequent studies have established that the poor efficiency of energy utilization is due to increased metabolic rate of pigs fed low protein diets. In this study we examined the role of uncoupling proteins (UCPs) and of internal organ mass in the poor energy efficiency of piglets fed low protein diets. Increased expression of UCPs as well as increased internal organ mass have been speculated to play important roles in metabolic rate of animals.

Eight male piglets weighing approximately 6 kg were randomly assigned to one of two groups. The high protein group was fed a restricted amount of a high protein diet (267 g crude protein / kg DM) to achieve weight maintenance. The low protein group was fed *ad libitum* a diet containing 26.5 g crude protein / kg DM. During the first two weeks faeces was collected for measurement of digestible energy intake. After three weeks, whole body oxygen consumption by each piglet was determined before and 1.5 h after feeding. Piglets were killed at the end of week 4 and organ weights measured. Samples of liver, skeletal muscle, adipose tissue and other tissues were taken for measurement of UCP mRNA expression. A fragment of approximately 300 base pairs of a pig UCP2 was used as a probe in Northern blot analyses to measure UCP2 mRNA expression.

Table1. Protein and energy intake, body weight, whole body oxygen consumption and organ weights of pigs (mean ± SEM) fed high protein and low protein diets

	High Protein		Low Protein	
Initial live weight, kg	5.93 ± 0.42		5.95 ± 0.34	
Final live weight, kg	6.18 ± 0.42		7.35 ± 0.32**	
Feed intake, g/d	138 ± 2.3		260 ± 7.6**	
Digestible Energy intake, MJ/d	2.08 ± 0.03		4.43 ± 0.12**	
Protein intake, g/d	37 ± 0.7		6.9 ± 0.56**	
Oxygen consumption before feeding, ml/min	48 ± 19		127 ± 49*	
Oxygen consumption 1.5 h after feeding, ml/min	104 ± 20		213 ± 66*	
Organ weights, g (% of final live weight)				
Liver	145 ± 8	(2.4 ± 0.07)	199 ± 30**	(2.9 ± 0.13)**
Heart	56 ± 5	(0.9 ± 0.09)	62 ± 6.6	(0.8 ± 0.12)
Large Intestine	111 ± 19.7	(1.8 ± 0.30)	100 ± 19.8	(1.3 ± 0.29)
Small Intestine	231 ± 31.0	(3.8 ± 1.50)	355 ± 84.6*	(4.7 ± 0.51)

Significant difference between groups are indicated by * P< 0.05; ** P< 0.01

Despite a two-fold increase in energy intake, live weights of piglets fed the low protein increased by only about 1 kg. Piglets fed the low protein diet showed increased oxygen consumption before feeding as well as 1.5 h after feeding, indicating increased metabolic rate. Liver and small intestine weights were significantly higher in piglets fed the low protein diet. UCP2 expression in the liver, spleen and especially adipose tissue of pigs fed the low protein diet was up regulated.

From the results it may be concluded that increased liver mass and increased expression of UCPs are involved in the regulation of energy efficiency of piglets.

MILLER, D.S. and PAYNE, P.R. (1962). *J. Nutr.* **78**, 255-62.

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