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Lactation Studies at Different Planes of Protein Intake.*

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This is a preliminary report of part of an extensive study of the comparative effects of different planes of protein intake upon female rats with respect to the production of young, lactation, and the resulting condition of both mothers and offspring. Table I shows the rations employed in the present experiments, the dietary adjustments being such as to keep the yield of energy and the content of calcium and phosphorus constant while the protein in one mixture was increased through substitution for part of the carbohydrate in the other.

TABLE I. Rations Used.

Ingredients	Amounts	
	18% protein	50% protein
	gm.	gm.
Ground wheat	25.	25.
Dried skim milk	20.	20.
Dried yeast	3.	3.
Cod liver oil	3.	3.
Starch	38.	0.
Casein	8.	48.
NaCl	0.5	0.5
$Ca(H_2PO_4)_2 .2H_2O$	2.	0.
$CaCO_3$	0.5	0.5

TABLE II. Reproduction and Lactation Records.

Ration	No. of mothers		Lactations						Averages for 6 lactations
			1st	2nd	3rd	4th	5th	6th	
50% protein	4	Av. No. in litter	8.	8.	8.	5.8	5.8	8.	7.1
		Av. birth wt. (gm.)	5.2	5.4	5.1	5.4	5.2	5.3	5.3
		% reared	97.	71.	82.	50.0	86.0	95.0	80.2
		Av. wt. 20 days (gm.)	31.6	26.0	28.5	28.3	28.8	29.2	28.7
18% protein	4	Av. No. in litter	7.8	8.	7.6	8.	5.6	6.3	7.1
		Av. birth wt. (gm.)	5.2	5.3	5.4	5.3	4.9	5.8	5.3
		% reared	97.0	97.0	40.0	75.	94.	90.	82.2
		Av. wt. 20 days (gm.)	34.2	35.5	25.6	28.7	32.4	30.3	32.2

* These studies were begun by the senior author in the Laboratory of Physiological Chemistry, Yale University, under the direction of Dr. Lafayette B. Mendel.

Rats, under 100 days of age, weighing at least 160 gm. and previously fed alike on the stock ration, were placed on the 2 rations and mated. The male was removed when pregnancy was apparent. When the young were born, they were counted, weighed, and reduced to 6 (3 males and 3 females when possible). The mother and litter were weighed every 3 days until the 20th day, which was chosen as the period during which the weight of the young was a measure of the milk secretion of the mother. On the 22nd day the young were removed from the mother and the latter was remated for a second pregnancy and lactation. In this way each of the females was carried through at least 6 lactations, so that the possible cumulative effects of the diets could be noted.

Table II summarizes significant data for the first 6 lactation periods. The 2 rations have yielded identical averages for the birth weights and litter size. Though the figures for litter size and birth weights vary considerably from one lactation to another there is no certain trend either up or down with succeeding lactations. The records for the average time elapsing between successive lactations (not shown in the table) show no certain differences among the 3 groups. It may be concluded that a 50% protein ration is as effective for reproduction over a period comprising 6 lactations as is an 18% protein ration.

The records of the periodic weights of the mothers (not included in the table) show that in almost every lactation all the mothers maintained their own weights. This constitutes further evidence for the adequacy of the experimental rations over a series of lactations.

On examination of the kidneys of a few rats on both rations, all the kidneys from the high-protein group showed marked enlargements compared to those from the other groups, and also considerable degeneration. Large amounts of hyaline material were found distending the convoluting and collecting tubules, there was a multiplication of connective tissue with a decreased number of tubules, and coagulum was present in the lumen of the tubules. In contrast, the kidneys from the rats on the lower-protein ration showed little or no hyaline material and no connective tissue present, but did show some degeneration of the tubules. Though results thus far indicate increased kidney damage as a result of the high-protein ration, the recognized large margin of safety in kidney tissue is shown in the history of rat 902 on the high-protein ration. After the 10th lactation one kidney was removed from this rat. She recovered from the operation and remains in good health and condition 50 days after the operation and is now nursing another litter.