Others were injected with an equal amount of the saline solution alone. They were then returned to the manometer vessels, and the O_2 uptake was measured for another period of 2–2½ hrs. Because of the time consumed in injections and setting up and equilibrating the vessels, measurements began about 30 min after the treatment. This delay prevents measurement of the initial rise. Subsequently the O_2 consumption of the animals was measured after longer periods, up to 80 hrs.

A definite increase in O_2 consumption was recorded after injection of the Ryanodine. Table 1 shows that the mean rate of 4.97 $mm^3/O_2/gm/min$ for normal animals increased to 13.54 $mm^3/O_2/gm/min$, or 222%, while for those animals injected with saline solution the rate changed only from 6.22 to 8.62 $mm^3/O_2/gm/min$, or 48.8%.

The high O_2 consumption was maintained for a considerable time, as shown in Fig. 1. By the end of the first 24 hrs it had dropped to the normal level, and later, between 30 and 40 hrs, it decreased to a constant level at 2 $mm^3/O_2/gm/min$. Measurements made between 40 and 80 hrs showed no further change, and this level probably indicates the onset of death. Because of the total lack of movement after the Ryanodine injections, the time of death was otherwise indeterminate.

A New Method of Reporting Data on Reproduction and Lactation in the Mouse[1]

LEONORA MIRONE, FRANK P. PANZARELLA, and LEOPOLD R. CERECEDO

Department of Biochemistry, Fordham University

In studying the nutritive requirements of the mouse for reproduction and lactation, it was the practice in this laboratory, in common with that observed in other laboratories, to consider all survival failures as being due to an inability of the mothers to nurse the young, and, consequently, as indicative of the inadequacy of the diet to provide normal lactation. However, the persistency with which newborn mice died during the first 4 days of life cast suspicion on the reproduction rather than the lactation performance.

The idea that the maternal diet exerts a great influence on the health of the newborn is not new. In fact, a host of data has been accumulated concerning the role of the diet of the mother with regard to the welfare of the unborn child. For example, Burke, *et al.* (*1*) have observed a statistically significant relationship between the quality of the diet consumed by the mother during pregnancy and the health of the infant at birth. Every stillborn infant, every infant dying within a few days after birth, the majority of babies with marked congenital defects, and all premature and "functionally immature" infants were born to mothers whose diets were inadequate. At the prenatal clinic in Toronto, Ebbs and Moyle (*2*) found that the number of miscarriages, stillbirths, premature births, and infant deaths was greatest in the case of mothers receiving a poor diet. Lastly, in spite of inevitable suffering and hardships endured by women in England during the war years, babies born in that country have been heavier and longer in their first year of life. According to Garry and Wood (*4*), nutrition was the only factor which improved in England during the recent war.

Yet, various investigators who have studied the effect of purified diets on experimental animals are of the opinion that the problem of reproduction has been solved, whereas that of lactation still awaits solution. Spitzer

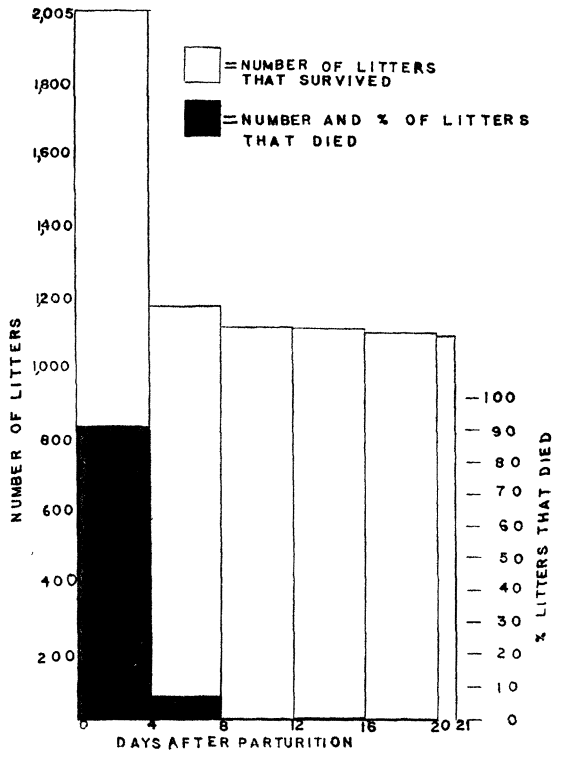

FIG. 1

and Phillips (*6*) state: "Young that were born alive appeared normal at birth, but did not live more than 1 or 2 days after parturition. Although the young attempted to nurse, no milk could be found in their stomachs. When this condition was observed in these experiments it was considered to be due to lactation failure." A similar conclusion was drawn by Fenton and Cowgill (*3*): "Reproduction and lactation have been studied in highly inbred strains of mice fed purified diets. . . . The problem appears to be one of lactation."

It is our contention, supported by observations on 2,005 litters, that the problem is primarily one of reproduction and not of lactation. If a diet is qualitatively adequate for reproduction, it will also be, according to our findings, adequate for lactation. However, the converse does not necessarily follow. Fig. 1 shows that, of a total of 900

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litter deaths, 91% succumbed during the first 4 days of life and 9% during the remaining 17 days of the lactation period. The deaths which occurred during the first 4 days were a consequence of the poor maternal diet, for in all instances the young were puny, undersized, and weak. Thus, whereas the first month is critical for the human infant, in the case of the mouse the first 4 days are decisive, and the outcome depends on the quality of the maternal diet. This is supported by observations that have been made in this laboratory on 127 mothers whose litters succumbed during the first 4 days of life. Fifty-seven of these were able to rear foster litters born to females kept on stock or good experimental diets. The conclusion seems to be justified, therefore, that the deaths of the natural litters were not due to a poor lactation performance.

In the light of the aforementioned observations, it appeared to us that the prevailing system of reporting data on reproduction and lactation in the mouse was inadequate and misleading, for it placed the brunt of the survival failures on lactation rather than on gestation performance.

In Table 1, the results of this investigation are recorded according to the old and new systems of reporting data. The experiments were carried out on mice belonging to the following strains: Rockland albino, C 57 Black, Swiss Webster, and our own albino strain which we have been inbreeding for the last 12 years.

By way of illustration, we have included in the table the data obtained with two of our good rations, diets RL-5 and RB²S-20. These are modifications of our basal diet R-5a, which consisted of casein (Labco or GBI) (30%), sucrose (48%), salt mixture (5%), lard (5%), hydrogenated vegetable oil (10%), Ruffex (2%), and contained the following supplements per kilo of diet: thiamin, 20 mg; riboflavin, 20 mg; pyridoxin, 20 mg; calcium pantothenate, 40 mg; α-tocopherol, 20 mg; vitamin A concentrate, 67.5 mg (67,500 I.U.); vitamin D (Drisdol), 5,000 units; and choline chloride, 500 mg. Diet RL-5 consisted of diet R-5a, to which was added an aqueous extract of liver (3 gm/100 gm of diet). Diet RB²S-20 consisted of diet R-5a, to which was added 200 γ of biotin and 20 mg of pteroylglutamic acid per kilo.

TABLE 1

COMPARISON OF THE OLD AND NEW SYSTEMS OF REPORTING DATA ON REPRODUCTION AND LACTATION

Diet	Old system			New system			
	No. of litters	Lactation success (%)	Gestation success (%)	Gestation index	Viability index	Over-all reproduction index	Lactation index
Stock (3)*	250	90	96	96	92	88	95
Basal (3)*	239	42	62	62	49	30	86
Experimental (36)*	1,376	71	80	80	72	58	91
RL-5	104	70	84	84	72	60	95
RB²S-20	36	80	97	97	80	78	100

* The figure in parentheses denotes the number of diets used.

We found that a more reliable picture of the adequacy of a diet may be gained by expressing the data as follows:

$$\text{Gestation Index} = \frac{\text{No. of litters born alive}}{\text{No. of pregnant animals}} \times 100$$

$$\text{Viability Index} = \frac{\text{No. of litters alive on 4th day}}{\text{No. of litters born alive}} \times 100$$

$$\text{Over-all Reproduction Index} = \frac{\text{No. of litters alive on 4th day}}{\text{No. of pregnant animals}} \times 100$$

$$\text{Lactation Index} = \frac{\text{No. of litters weaned}}{\text{No. of litters alive on 4th day}} \times 100$$

The 'Over-all Reproduction Index' has been added to the other three indices, which were discussed in the preliminary report of this investigation. Addition of this index is based on our findings that if a litter survives the first 4 days of life, its chance of reaching the end of the suckling period is close to 90%. Now then, if we are correct in assuming that the nutritional condition of the mother before and during gestation is decisive with regard to the ability of the young to survive, of the four indices, the 'Over-all Reproduction Index' would seem to be the most important for evaluating the adequacy of a diet for reproduction and lactation in the mouse.

It is interesting to note that, according to the old system of recording data, the lack of viability was considered a lactation failure. The new system indicates, on the other hand, that whereas a purified diet may be inadequate for the production of viable young, it can be adequate for normal lactation performance. In fact, as shown in the table, the lactation index is high, even for the basal diets.

On the evidence of the results obtained, we may therefore conclude that in the case of the mouse, as in that of the rat (*5*), the nutritional requirements for a normal gestation leading to the birth of viable young are more stringent than those for lactation.

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