

## THE EFFECT OF FOOD DEPRIVATION ON MATERNAL BEHAVIOUR AND PUP DEVELOPMENT IN ALBINO NORWAY RATS

BY

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### SUMMARY

*The effect of food deprivation on maternal behaviour and pups development in albino Norway rats was carried out. Females rats were divided into three groups, subjected to: Group I: severe deprived food, Group II, medium deprived food and Group III, no deprivation of food (well-nourished). The different reproduction and behavioural measurements were studied :*

- Gestation length, litter size and viability of pups.
- Still births and post-natal mortalities.
- Nest building.
- Retrieving.
- Physical contact.
- Percentage of suckling.
- Cannibalism.

*The results revealed that , maternal feed deprivation affect the viability and survival of rat pups and also some reproductive performance.*

*Maternal starvation altered the maternal behaviour of the dams.*

### INTRODUCTION

Animals which are kept under conditions of artificial environment usually undergoing to what is called suffering (Behavioural and managerial problems of economic impact), and this will badly affect animal performance.

Stress is defined biologically as the force producing or tending to produce deformation in a body (Lee, 1966). Stress may be climatic;nutritional, due to feed or water deprivation (Scott, 1981) or; due to pathogens and toxins (Hafez, 1968).

Maternal behaviour of rats had been extensively studied by Calhoun, 1962; Rosenblatt and Lehrman, 1963; McIver and Jeffrey, 1967, Denenberg et al. 1969, Grotta and Ader 1979; Siegel and Rosenblatt, 1975 and Jakubowski & Ter-

kel, 1986.

Effects of maternal starvation on blood metabolites and survival of the neonates had been studied (Ojamea et al. 1980 and Ezekwe, 1981). Limiting the amount of feed given to gestating sows or limiting the energy intake of dams in late gestation significantly reduced hepatic glycogen levels and tended to decrease skeletal muscle glycogen in the progeny at birth and could decrease the newborn chances of survival.

Liver glycogen is the primary source of energy available to the newborn. Muscle glycogen concentration decreases more gradually and is probably utilized primarily for shivering thermogenesis and physical activity. PCO<sub>2</sub>, PO<sub>2</sub> and glucose, blood pH and lactate could be affected due to metabolic alterations of the offspring associated



with the dietary intake restriction of the dam. Few studies have been done on the effect of starvation on maternal behaviour of some species of animals, yet have provided less than definitive data.

So, the present work is dealing with the effect of feed deprivation during the last two-thirds of gestation on some aspects of reproductive behaviour, anomalies and survival rate of pups.

## MATERIAL AND METHODS

### Animals:

1- Sixty primiparous, 4 month old albino Norway rats (*Rattus Norvegicus*), of good selected breeds, were used in this experiment. Their weight ranged from 250-300 g. Dams were bred and maintained in a controlled environmental condition as well as a formalized balanced diet. Controlled lighting, with 14 h. light and 10 h. dark. Room temperature was kept at 24°C.

2- Dams were randomly arranged in cages, each female was housed overnight with a male, and mating was verified by detection of sperms in the vaginal smear or presence of vaginal plug in the nest (Jakubowski and Terkel, 1986).

3- Dam cages carried identity cards, which show number of each animal, weight, date of service, in addition to the amount of food will consume daily.

This study was performed at College of Veterinary Medicine, Auburn-Alabama.

**Animals and Nutritional treatment:** (Tonkiss and Smart, 1983). Female rats were randomly divided into three groups. Each group consisted of 20 females and the groups were designed as follows:-

### Group I (severe deprived food):

Received daily rations of food equal to about 50% of the amounts consumed by the control one.

### Group II (medium deprived food):

Received rations equal to about 75 % of the amount consumed by the control one.

**Group III (control group):** no deprivation of food, the normal amount consumed 5 gm feed per 100 gm body weight.

### Reproduction & Behavioural measurements:

= Litter size and the viability of pups (neonates) were recorded (number of alive pups at birth).

= The maternal behaviour was tested by:

(1) Recording the presence or absence of nest (Numan, 1978).

(2) Measuring retrieving: females living with their pups were separated from the pups 30 minutes prior to the test and then reunited with their young (Jakubowski & Terkel; 1986). The test began by placing the pups across from the mothers nest and the dam was observed continuously for 30 minutes. Pup retrieval is scored if the dam carried at least two pups to the nest site.

(3) Recording the physical contact: the dam considered good, if she was in contact with all pups or in contact with all except one or two pups. The dam scored bad, if she was in contact with only one or two pups.

(4) Percentage of suckling: percentage of suckled pups at the first day post-partum.

(5) Cannibalism was measured by counting the number of dams cannibalized their pups and also the number of cannibalized pups.

### Statistics:

The data were analysed by using analysis of variance test.

## RESULTS

The experiment utilized three groups of dams, the group (1) (N=20): severe deprived food and group II (N=20) medium deprived food. While group III (N=20) was the control group and the dams consumed the normal amount of food (5 gm/100gm body weight). The groups were tested on the basis of maternal ability and its anomalies.

The results are summarized in Table (1) and (2)



The results declared that the control does showed good mothering ability, while the other two groups I and group II failed to express good maternity toward their young and showed some varieties of abnormal maternal behaviour. In addition, four females from group I (severe deprived food) failed to give birth and died after the end of gestation period.

**Litter size:**

As shown in Table (1), severe under nutrition affected litter size, where the mean litter size in the severe deprived group was  $2.5 \pm 0.2$ , while it was  $4 \pm 0.3$  and  $5 \pm 0.02$  in the medium deprived and well nourished groups respectively ( $P < 0.05$ ).

dams (20% and 30% respectively) than the medium deprived dams (5% and 15%) in comparison with 100% viability and 0% stillbirths in the well-nourished group.

**Retrieving:**

Table (2), shows the mean percent of retrieving, where, 80%, 60% and 10% respectively of the well nourished, medium deprived and severely deprived dams retrieved their young. The statistical analysis indicated a significant difference between the severe deprived group and the well nourished group at level 0.005.

Table (1): Effect of under nutrition on litter size and viability of neonates in rats

Group No.	Litter size		Viability of young		
	Range	Mean $\pm$ SD	% viable	% still birth	% of postnatal mortality
I	2-7	$2.5 \pm 0.2^*$	50*	20*	30*
II	3-8	$4 \pm 0.3$	80*	5*	15*
III	4-8	$5 \pm 0.02$	100	-	-

\* Significant at level 5 %

In group I four dams died

**Viability of the neonates:**

The results declared that, undernutrition severely affected the viability of the neonates where  $P < 0.05$  (the viability was 50 % in severe deprived group and 80 % in medium deprived dams, while it was 100 % in well nourished group).

**Still births and post-natal mortalities :**

Still births and post-natal mortalities were significantly higher ( $P < 0.05$ ) in the severe deprived

**Nest building and physical contact:**

Nest building and physical contact were affected with severe food deprivation, where 30% and 70% respectively of the dams of the severe deprived group failed to build their nests and crouching their young.

While 100% of the medium deprived and well nourished dams were built their nests. In addition 90% and 80% of the medium deprived and well nourished dams respectively showed physical



Table (2): Effect of under nutrition on maternal performances in rats

Group No.	Nest building			Retrieving			Physical contact			Suckling %	Cannibalism	
	Good	Bad	No	Good	Bad	No	Good	Bad	No		% of Dams	% of pups
I	40 <sup>*</sup>	30	30 <sup>*</sup>	10 <sup>**</sup>	40	60 <sup>*</sup>	10 <sup>*</sup>	70	70 <sup>*</sup>	15 <sup>*</sup>	18/40	75 <sup>*</sup>
II	70	30	-	60 <sup>*</sup>	30	10 <sup>*</sup>	70	70	10	70	9/60	10 <sup>*</sup>
III	80	20	-	80	70	-	70	10	70	100	-	-

\* Significant at level 5 %

\*\* Significant at level 0.5 %

contact towards their young.

The statistical analysis indicated a significant difference between the severe deprived group and the other two groups ( $P < 0.05$ ), towards their young.

**Suckling:**

It was found a significant differences ( $P < 0.05$ ) concerning suckling after delivery, it was affected with the level of nutrition as shown in Table (2) where 15%, 70% and 100% of the total number of delivered young respectively suckled by the severe deprived, medium deprived and well nourished dams.

**Cannibalism:**

The statistical analysis indicated a significant difference ( $P < 0.05$ ) between the under-nourished groups and the well nourished one. Cannibalism was showed in high percentage among severely deprived dams (25%) and medium deprived dams (10%), without any recorded cases in the well-nourished dams.

**DISCUSSION**

This study revealed some aspects of the relation-

ship between behaviour and nutritional level at the effect of under-nutrition on maternal performance of rats.

Maternal feed intake, is of great practical importance, it affects the viability and survival rates of rabbits (Hafez et al., 1966).

High mortalities of young and high incidence of still births were showed in the swine dams of severely food deprived. Anderson et al., (1979) and Ezekwe (1981) found that maternal starvation severely affect foetal growth, where pigs were subjected to under-nutrition. Also, Hauptet al. (1983), observed that foals of mares, on a high plane of nutrition, were more active than foals of mares on maintenance or less adequate diets even though there were no differences in weight gain among the foals.

It is interesting that behavioural differences were detected among dams whose received under-nourished diet. The present experiment indicated that under-nutrition of rat dams had an effect on the incidence of cannibalism, retrieving, suckling, physical contact and nest building. Apparently, suckling behaviour is a more sensitive measurement of nutritional well being. Other studies have demonstrated the direct effect of feed deprivation on



male activities. For example, white tail deer fawns respond to partial food deprivation by decreasing their play activity (Muller-Schwarze et al., 1982). In primates, under-nutrition reduces all activities (Baldwin, 1976).

Spencer et al. (1980) reported and stated that, although the dam has a considerable capacity to supply nutrients to the fetus at her own expense, the severity of food restriction significantly reduce birth weight, decreased liver and muscle glycogen concentrations and altered blood pH and glucose concentration at birth.

Winters et al. (1977) found that maternal behaviour was different toward malnourished rat pups than toward normal rat pups. Also, the finding reported is confirmed with that from the study of Girard et al. (1977) with mice.

In conclusion, maternal feed deprivation affect the viability and survival of rat pups and also some reproductive performance. Maternal starvation altered the maternal behaviour of the dams.

Our findings support the idea that deficiencies in environment and/or management usually lead to abnormal or behavioural disorders, which consequently affect the performance and health of animal.

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