

## INFLUENCE OF DIETARY FIBER ON MATERNAL BEHAVIOUR IN RABBITS

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(Received 27. 9. 1993.)

### SUMMARY

An experiment was performed to determine the influence of low fiber diet on the maternal behaviour in New Zealand white rabbits. Two groups of does; an experimental group fed low fiber diet (7%) and a control group fed an adequate fiber diet (18%). The does were randomly arranged under controlled environmental conditions. Pre and postparturient behaviour (time of nest lining, location of nest, nest uncleanliness, quantity of plucked hair, litter size born alive, percent of young suckled and site of delivery) were noticed and recorded.

In addition, maternal anomalies (nest lined post-partum, plucking of hair outside the nest, no plucking of hair, eating bedding material, fouling the nest, inadequate nest lining, eating plucked hair, cannibalism, scattering young, failure of suckling and delivery outside the nest) were observed and recorded in the two groups.

The results indicated that, does fed low fiber diet had scanty maternal performance and high incidence of different varieties of maternal anomalies. The performance and a number of anomalies of the control does were significantly differ than those of experimental ones ( $P < 0.05$ ). It was concluded that fiber content of diet has a strong influence on maternal patterns especially nest quality & its anomalies and consequently the survival of the neonates.

The implications of these results for maternal anomalies are discussed.

### INTRODUCTION

Maternal behaviour is one of the significant elements in the reproductive complex of the mammals (Zarrow et al., 1961). It is obvious that a disturbance in the homeostasis of the mother during gestation or an irregularity in the normal pattern of maternal behaviour can induce maternal anomalies or failure in the proper care of the young and result in the death or injury of the neonates (Denenberg et al., 1969, Anderson et al., 1972 and Maurer & Chenault; 1983).

Maternal behaviour and its anomalies in rabbit has been extensively studied (Zarrow et al., 1963, Hafez et al., 1966 Hudson & Distel 1981, Franceshii; 1983 and Kamel, 1989). Investigators found different kinds of maternal anomalies with different causes. Some anomalies resulted from different environments, others influenced by genetics and hormonal imbalance. There are few studies on the effect of dietary insufficient and maternal behaviour in rabbits. Other studies by Brozek & Voets (1961) and Worden (1968) on other animals demonstrated gross effect from nutritional deficiency and malnutrition on the behaviour of animals.

The rabbit possesses maternal behavioural patterns which differ from most animals (Denenberg et al., 1973). The nest building and lining is one of specific component of maternal behaviour concerning with the care and life of the neonate (Denenberg et al., 1958 and Sawin et al.; 1960). Nest building requires a sufficient amount of nesting material to be mixed with the plucked hair.

The present work was designed to determine the influence of insufficient fiber content in the diet, on the change and level of maternity in one hand, and its effect on survival of the neonates, on the other hand.

## MATERIAL AND METHODS

### Animals and Housing:

Forty adult female New-Zealand white rabbits were used in this study. Their weight ranged from 8 to 10 Lbs.

The rabbits were obtained from DLAH (Final Source, USA).

This study was performed at the Institute for Biological detection System, department of Physiology and Pharmacology, College of Veterinary Medicine, Auburn University; Alabama.

Rabbits were housed individually in rabbit cages in a controlled environment. Controlled lighting with equal periods of light and dark. The temperature of the room was maintained at 70-72 degrees Fahrenheit. Relative humidity was between 50-60%. Rabbit cages carried identity cards, which showed the number of each animal, date of service and weight of each female.

The forty bred females were divided into 2 groups: a Control group (20 females) and an experimental group (20 females). Six females from the control group and three from the experimental group were debited from the study when it was seen that they were not impregnate. Both groups were randomly housed in three rooms.

### Feeding and Watering:

Two planes of nutrition were offered during this investigation, one for the control group and the other for the experimental group.

The control food contained the following nutrients:

Crude protein	15.0%
Crude fat	2.5%
Crude fiber	18.00%

The experimental food contained the following nutrients:

Crude protein	15.0%
Crude fat	2.5%
Crude fiber	7.00%

The experimental group fed the low fiber ration (experimental food about one week before parturition).

The process of feeding was done in the morning after observation and recording the data to avoid any noise or interference.

Water was offered in water bottles ad-libitum.

### Behavioural measurements

Nest boxes and nesting material (cotton seed balls) were provided inside the cage of pregnant does before parturition.

Recording the data and observations were performed daily in the morning between 9-10 a.m.

The behaviour of does before parturition for both groups was observed to determine the following parameters:

#### \* Nest lining (Maternal nest):

- Location of nest:-

The female before parturition begins to pluck hair from her body to line the nest. Observation was done to record if the does pluck their hair outside the nest box on the floor of cage or inside the provided nest box.

- Time of nest lining

A score of zero was given, if no fur was lined the nest when the pups were born. Score one, the fur was only found when the young were born. A point was added to the score, for each day prior to parturition. Does of score zero or one were considered abnormal. (Sawin and Cray, 1953).

#### \* Nesting Material: (Bedding of nest).

Observation was done to record if the does used the bedding material (cotton seed ball) or kept as it was for preparing the nest for pups.

Inspecting the nest:

Nest boxes of pregnant females were inspected daily to detect any foulness Verga et al. (1978) considered urination inside the nest anomalies of behaviour.

Location of delivery:

Litters were delivered inside the nest or on the floor of the cage. Dams were checked daily for litters and the days on which a litter was found was called day one. The following parameters were recorded daily for the first 10 days post-partum. (Post-partum behaviour).

Quantity of nest lining:

The quantity of hair plucked from the dam's body was estimated according to these scores: (Sawin and Curran 1952)

None or poor (0):

No hair or trace amount of hair in the nest box, bare pups.

Fair (1): Small amount of hair, doesn't cover the pups.

Good (2): Large amount of hair, enough to cover the pups.

Excellent (3): Huge amount of hair, filled the nest, covered the young completely.

Eating (consuming) the plucked hair:

The doe which consumed plucked hair after parturition was considered bad maternally and given a positive (+) score. A negative score was given for normal behaviour.

Litter size and suckling:

Litter size was estimated by counting alive and dead pups for each doe, daily, till the end of observation.

Nursing scores were obtained from examination of the abdomen of the young, daily, till the end of observation (Denenberg et al., 1958).

A neonate was scored as nursed if the belly was distended and the white milk could be seen through the skin.

$$\text{Percent of young Fed} = \frac{\text{filled stomach neonates}}{\text{No. of young alive at birth}} \times 100$$

\*Cannibalism: (I) Nature of cannibalism:

According to Hafez et al. (1966), cannibalism was observed in three degree.

- . Mild cases: cannibalism of neonates ear, extremities and tail.
- . Intermediate cases: Cannibalism of limbs & parts of body.
- . Severe Cases: Most of the body, head and limbs.

(II) Time of cannibalism:

The day post-partum in which the doe cannibalized the pups.

Does which never cannibalized any pups were given negative (-) score.

\* Scattering of pups:

The doe which scattered her pups after delivery on the floor of the cage rather than grouped them in the nest box is considered abnormal doe. (Hafez et al., 1966) and (Verga et al., 1978), and gave a positive (+) score.

- + 1: More than one pup scattered inside nest box.
- + 2: All the pups were scattered inside nest box.
- + 3: All the pups on the floor of the cage.

The doe which grouped her pups inside the nest box and showed no scattering was, recorded as negative score.

Statistics:

The PROC CATMOD system of the statistical analysis system (SAS, Carey, N.C.) was used to generate the chi-square statistics for each data category.

RESULTS

The experiment utilized two groups of does, experimental (N= 17) and control group (N=14). The experimental group was fed a low fiber diet

(7%), while the control group was fed a diet of adequate fiber (18%). The groups were tested on the basis of maternal performance and its anomalies. The results are summarized in Table (1) and (2). The results indicated that, the control does were more active in expression of maternal patterns, while the experimental does failed to express maternal patterns toward their young and showed different varieties of maternal anomalies.

dependable in locating their nests within the nest box. Regarding, nest unfouling, a small proportion of experimental does, 3 out of 17 (17.65%) kept their nests clean in comparison with 11 out of 14 (78.57%) of the control does (The statistical analysis indicated a significant difference at  $P < 0.05$ ).

\* Post-parturient behaviour:- concerning the quantity of plucked hair, the results (Table 1) show that, control does were the most abundant

Table (1): Effect of low fiber diet on the performance of maternal behaviour in female rabbits

Maternal Parameters	Experimental Dams			Control Dams		
	Total number	Dams showed Maternal parameters		Total number	Dams showed Maternal parameters	
		number	%		number	%
<b>Pre-partum behaviour:</b>						
. Time of nest lining (score + 2 and above)	17	2	11.76	14	10	71.43
. Location of nest (Lining inside the provided nest)	17	5	29.41	14	11	78.57
. No fouling of nest	17	3	17.65	14	11	48.57
<b>Post-partum behaviour:</b>						
. Quantity of hair (score + 2, + 3)	17	3	17.65	14	10	72.43
. Litter size (number of young alive at birth)	17	7	41.18	14	10	71.43
. Percent of young suckled at (1st day [more than 50%])	17	10	58.82	14	13	92.86
. Delivery inside the provided nest	17	5	29.41	14	12	85.71

### Maternal performance

\* Pre-parturient behaviour: The recorded maternal patterns are shown in Table (1), where 2 out of 17 of experimental does (11.76%) lined their nest at the pre-partum period, while most of the control does (71.43%) lined the nests at that period. The analyzed data showed a significant difference ( $P < 0.05$ ) between the two groups.

Also, there was a significant difference ( $P < 0.05$ ), in the location of the nest within the provided nest box between the two groups, where 5 out of 17 (29.41%) of experimental does were considered dependable while 11 out of 14 (78.57%) of the control does were

hair pluckers where, 10 out of 14 plucked abundant hair (71.43%), in contrast to the experimental does where 3 out of 17 (17.65%). Plucked abundant hair with a significant difference of 0.05. Furthermore a significant difference was found between the two groups ( $P < 0.05$ ) concerning the number of young born alive. Seven out of 17 (41.18%) of the experimental does born alive young in comparison with 10 out of 14 (71.43%) of control does. In addition all the young of the experimental does had succumbed 10 days post-partum. The results declare also that, significant differences ( $P < 0.05$ ) in suckling percent at birth and site of delivery. Ten out of 17 (58.82) and 5 out of 17 (29.41%) of

Table (2): Incidence of maternal anomalies in the experimental and control does.

Abnormal parameters	Experimental Dams			Control Dams		
	Total Number	Dams showed Maternal parameters		Total Number	Dams showed Maternal parameters	
		Number	%		Number	%
- Nest lined post-partum	17	7	41.18	14	3	21.43
- Plucking of hair outside the nest (on the floor of cage)	9	4	44.44	14	1	8.33
- No plucking of hair	17	8	47.05	14	2	14.28
- Eating of bedding material	17	17	100.00	14	0	00.00
- Fouling the nest (either defecation or urination)	17	14	82.35	14	3	21.43
- In adequate nest lining	9	6	66.66	14	2	17.66
- Eating of plucked hair	9	8	88.89	14	0	00.00
- Dam cannibalized her pups	17	12	70.59	14	2	14.28
- Dam scattered her pups.	17	16	94.12	14	0	00.00
- Dam failed to suckle her pups.	17	7	41.18	14	1	7.14
- Delivery outside the nest (on the floor of the cage).	17	12	70.59	14	2	14.28

experimental does respectively suckled their young and clivered inside the nest in comparison with 13 out of 14 (92.86%) and 12 out of 14 (85.71%) respectively of control does.

Maternal anomalies.

Table (2), indicates a significant difference between the experimental and control does ( $P < 0.05$ ), where nest lined post partum and hair plucked outside nest were 41.18% (7 out of 17), 44.44% (4 out of 9) respectively of experimental group and 21.43% (3 out of 14), 8.33% (1 out of 12) respectively in the control does.

Regarding other anomalies (No plucking of hair, eating of bedding material, fouling nest, inadequate nest lining, eating of plucked hair, cannibalism, scattering, failure suckling and delivery outside the nest) were showed in high percentages of experimental does respectively 47.05 (8 out of 17), 100 (17 out of 17), 82.35 (14 out of 17), 66.66 (6 out of 9), 88.89 (8 out of 9) 70.59 (12 out of 17), 94.12 (16 out of 17), 41.18 (7 out of 17) and 70.59 (12 out of 17). In comparison with the control does; plucking of hair, fouling nest, inadequate nest lining, cannibalism, failure suckling and delivery outside nest, were reported in small percentage

respectively; 14.28 (2 out of 14), 21.43 (3 out of 14) 16.66 (2 out of 12), 14.28 (2 out of 14), 7.14 (1 out of 14), and 14.28 (2 out of 14). The statistical analysis of data indicated significant differences between the two groups (Table, 2). No cases of eating bedding material, eating plucked hair, and scattering of young, were observed in the control does.

**DISCUSSION**

The effect of insufficient crude fiber of diet on maternal behaviour in the rabbit seemed to be strong, especially in its influence on nest quality (nest building and nest lining).

The statistical analysis of the results showed significant differences between the experimental does which were fed low fiber diet and those of the control does which were fed diet containing adequate fiber.

These findings support those of Denenberg et al. (1958) and Savin et al. (1960), who reported that, nest building and lining were important components for care and life of the neonates.

The results of this work declared that, a poor or

inadequate nest resulted in higher mortalities of the pups produced by experimental does. Denenberg et al. (1958) and Kamel (1989) observed a positive correlation between nest quality and the viability of young during the first week of life. Worden & Leahy (1962) and Wishaw et al. (1979) suggested that adequate nesting material, plucked hair and nest quality might maintain an adequate body temperature of the neonates.

Abnormal maternity or poor maternity of the does consuming diets of low fiber content might be explained in the light of "nutritional wisdom" where the experimental does presumably tried to compensate the shortage of fiber in their diets by eating their bedding material and their plucked hair. "Nutritional wisdom" has been reported in cattle and sheep (Hafez; 1962 and Denton; 1967) as well as in rat (Rozin and Kalat, 1971). Furthermore Davidson and Spreadbury (1975) stated that, rabbits need a higher requirement of fiber and they were able to adjust food intake.

Cannibalism and Scattering might be influenced by genetic makeup and environmental factors or a compile event (Ross et al., 1963 and Denenberg et al., 1969). On the other hand, Kamel (1989) failed to find a correlation between cannibalism and hormonal constitution of rabbit does. However, Denenberg et al. (1959), Ross et al. (1963) and Kamel (1989) found a significant correlation between cannibalism and Scattering, and a high correlation between nest quality and both cannibalism and scattering, but they failed to explain the physiological mechanisms which contribute to cannibalism.

Our conclusions from the work reported here are that the neonate rabbits are highly dependent on maternal care, on one hand and nest quality on the other hand, which is considered one specific component of the maternal behaviour complex in rabbits. In addition fiber content of diet has a stronger influence on the quality of nest and maternal behavior as well as it could act as a negative stimuli against normal maternity in the rabbit and, consequently the viability and survival of the neonates.

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