Mammary Growth and Plasma Progesterone Level during Pregnancy in the House Musk Shrew, *Suncus murinus* LINNAEUS.1)

KEIKO FURUMURA, KATUAKI ŌTA, AKIRA YOKOYAMA AND SEN-ICHI ODA*

Faculty of Agriculture and *Research Institute of Environmental Medicine, Nagoya University, Chikusa-ku, Nagoya 464

Abstract

The process of growth of the mammary gland and change in the plasma concentration of progesterone were investigated throughout the course of pregnancy (30 days) in the house musk shrew, *Suncus murinus* L.

Development of the mammary gland of the musk shrew was limited during the first half of pregnancy. Extensive branching of ducts and conspicuous alveolar formation and a marked increase in the DNA content of the gland started between day 15 and 20 of pregnancy, and continued until term. Milk synthesis indicated by accumulation of the secretory fluid in the alveolar lumen and a sudden rise in the RNA/DNA ratio of the gland tissue seemed to be initiated 1 or 2 days before parturition. No lactose was detected in either the mammary tissue or milk of the house musk shrew.

Plasma concentration of progesterone was very low until mid-pregnancy and began to rise after day 15, reaching a peak of 10–13 ng/ml around day 25. The steroid level started to fall shortly before parturition and returned to the basal level in post-parturient animals.

Ovariectomy interrupted pregnancy in some animals, but not in others. When pregnancy was maintained, the mammary development and the plasma level of progesterone were normal.

House musk shrews, *Suncus murinus*, a species of Insectivora, captured in parts of southern Japan have been domesticated as a new experimental animal (Oda, 1973; Oda and Kondo, 1976; Kondo *et al.*, 1978). In addition to being a non-spontaneous ovulator with no breeding season (Morita, 1964a; Dryden, 1969), animals of this species seem to have some unique and interesting features in their reproduction and its endocrine control; for instance, a lack of uterine response to estrogen was reported (Dryden and Anderson, 1977a).

Although a considerable number of papers have been published on the reproductive traits of the house musk shrew originating from Japan (Morita, 1964b) and from Guam island (e.g., Hasler *et al.*, 1977; Hasler and Nalbandov, 1978, 1980), our knowledge of lactation and mammary growth in this species is still very scanty. As far as we know, there has been only one report on the lactation curve and milk composition in the species (Dryden and Anderson, 1977b).

In the present study, the pattern of mammary growth during pregnancy in the house musk shrew was followed by both morphological examination and the measurement of nucleic acid content of the gland tissue. The plasma concentration of progesterone (P) of the animal used was also

Received May 2, 1983

1) This paper is dedicated to the late Prof. M. Kawakami. Reprint requests should be addressed to Dr. K. Ōta, Faculty of Agriculture, Nagoya University, Nagoya 464, Japan.
measured to obtain some information on the endocrine control of the mammary growth. A part of the results was reported previously in an abstract form (Yokoyama et al., 1980).

Materials and Methods

Animals

Animals used were derived from stock originating in Nagasaki city and in several islands in Kagoshima and Okinawa prefectures (Kondo et al., 1978). They have been maintained for several generations either as a local strain or a mixed colony. In the present study, although the animals were randomly taken from these heterogeneous populations, the breeding data and all results on mammary development and plasma hormone levels did not differ appreciably among them and, therefore, the results obtained were combined irrespective of the original populations.

The age of musk shrews used ranged from 3 to 18 months, mainly from 4 to 14 months. About two thirds of them had not conceived in the past (nulliparous and primigravid animals in Table 1). The remaining animals that had delivered young previously from 1 to 8 times were used for the experiment after being isolated for more than 3 months from the last lactation (multigravid). The mean weight of the animals used was 38.05 ± 0.57 (S.E.) g (N=31).

The animals were housed singly in wooden or polycarbonate cages kept in a temperature (20 ± 3°C)- and light (14L-10D, lights on at 0500 h)-controlled animal room. Dry cat chow (CLEA C.F.E.-1 : Nihon CLEA Ltd., Tokyo) and commercial canned food for cats (Cat Lunch : Nippon Haigo Shiryo Co. Ltd., Tokyo) were mixed and fed as the basal diet every day. About a quarter of a boiled egg, once a week, and sometimes a portion of a fresh corpse of a young mouse was also fed as additional diet.

Females were mated by placing in the cage of an experienced male overnight, and the following day was designated day 0 of pregnancy. Parturition occurred on day 30 or 31 of pregnancy in most cases. The average duration of pregnancy in our laboratory was 30.5 ± 0.1 (S.E.) days (N=116).

The animals were bled to death by heart puncture under light ether anesthesia between 1000 and 1300 h. All of three pairs of mammary glands were quickly removed and 3 unilateral glands were fixed with Bouin’s fluid for morphological studies. The three glands from the other side were stored at -20°C until use for the steroid assay. The numbers of fetuses and/or corpora lutea in both sides of the ovaries were counted. Weights of ovaries and adrenal glands were also recorded at autopsy.

In another series of experiments, bilateral ovariectomy was performed in 14 musk shrews under ether anesthesia on days 15-16 of pregnancy. Animals operated on were killed on either day 20 or 25 of pregnancy, and blood and mammary glands were collected. Sham operation was carried out in another 6 animals, but they were not killed until the delivery of young was confirmed.

Chemical analyses of the mammary gland

Mammary glands for determination of nucleic acids were lyophilized in toto and then defatted by ether extraction for 16–20 hrs using a Soxhlet apparatus. Extraction and fractionation of nucleic acids from dried fat-free tissues (DFFT) were carried out by the method of Munro and Fleck (1966). DNA and RNA were determined by the diphenylamine method of Burton (1956) and the modified orcinol method (Munro and Fleck, 1966), using salmon DNA (Type III ; Sigma Chemical Co., St. Louis) and yeast RNA (do.) as reference standards, respectively. The determination was performed in duplicate, as a rule.

For the detection of lactose in the mammary tissue, 10% aqueous homogenate of the tissue was deproteinized with Ba(OH)₂ and ZnSO₄. The aqueous extract was then washed with chloroform, and lactose in it was split into glucose and galactose moieties with β-galactosidase (Ota and Peaker, 1979).

Glucose thus liberated was assayed by the glucose oxidase method using a commercial kit for blood sugar determination (Blood Sugar GOD Perid Test : Boehringer Mannheim GmbH, W. Germany).

Measurement of plasma progesterone

The steroid in the plasma sample was measured by the radioimmunounassay described by Nakamura, Shodono and Tanabe (1974) with slight modifications. The rabbit antisera to progesterone-3-(o-carboxymethyl)-oxime-bovine serum albumin (Teikoku Hormone Mfg., Co. Ltd., Kawasaki) and 1, 2, 6, 7-3H-progesterone (New England Nuclear Co.) were used. Triplicate assays were performed for each plasma sample.

Statistical treatment

The Mann-Whitney test and χ²-test were used at the 5% significance level.
Table 1. Changes in nucleic acid contents of the mammary gland and the plasma concentration of progesterone during pregnancy in the house musk shrew.

<table>
<thead>
<tr>
<th>Day of pregnancy</th>
<th>Previous experience of pregnancy</th>
<th>No. of shrews</th>
<th>Age at autopsy (month)</th>
<th>No. of fetuses</th>
<th>Mammary gland</th>
<th>Plasma progesterone&lt;sup&gt;4&lt;/sup&gt; (ng/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DFFT&lt;sup&gt;2&lt;/sup&gt; (mg/3 glands&lt;sup&gt;3&lt;/sup&gt;)</td>
<td>DNA (mg/3 glands)</td>
</tr>
<tr>
<td>0</td>
<td>N</td>
<td>10</td>
<td>4.4±0.5</td>
<td>—</td>
<td>38.3±1.6&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>0.37±0.04&lt;sup&gt;3b&lt;/sup&gt;</td>
</tr>
<tr>
<td>1—5</td>
<td>P</td>
<td>4</td>
<td>4.4±0.9</td>
<td>3.5 (3, 4)</td>
<td>38.7±2.1&lt;sup&gt;3ab&lt;/sup&gt;</td>
<td>0.30±0.03&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>3</td>
<td>6.6±0.7</td>
<td>4.0±0.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>49.3±8.4&lt;sup&gt;3bed&lt;/sup&gt;</td>
<td>0.47±0.12&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td>6—15</td>
<td>P</td>
<td>10</td>
<td>6.0±0.9</td>
<td>3.6±0.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>44.6±2.5&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>0.49±0.06&lt;sup&gt;3ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>4</td>
<td>7.6±1.1</td>
<td>4.0±0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>54.3±2.9&lt;sup&gt;3ef&lt;/sup&gt;</td>
<td>0.77±0.06&lt;sup&gt;3ef&lt;/sup&gt;</td>
</tr>
<tr>
<td>16—21</td>
<td>P</td>
<td>7</td>
<td>8.5±0.7</td>
<td>3.0±0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>45.4±3.7&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>0.61±0.12&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>4</td>
<td>9.8±2.3</td>
<td>3.5±0.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>61.1±4.9&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>0.96±0.18&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td>22—24</td>
<td>P</td>
<td>6</td>
<td>8.0±0.7</td>
<td>3.3±0.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>53.3±6.3&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>0.90±0.27&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>6</td>
<td>10.2±0.9</td>
<td>3.3±0.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>82.7±13.1&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>1.61±0.32&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td>25—26</td>
<td>P</td>
<td>6</td>
<td>7.5±0.5</td>
<td>2.8±0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>75.6±8.2&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>1.70±0.39&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>3</td>
<td>12.8±1.1</td>
<td>2.5 (1, 4)</td>
<td>106.6±15.3&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>2.79±0.42&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td>27—28</td>
<td>M</td>
<td>4</td>
<td>12.9±2.2</td>
<td>2.8±0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>96.1±19.1&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>2.50±0.53&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td>29</td>
<td>P</td>
<td>3</td>
<td>7.8±1.1</td>
<td>3.7±0.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>180.1±38.9&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>2.82±0.53&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>4</td>
<td>10.4±1.8</td>
<td>3.5±0.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>184.6±77.0&lt;sup&gt;3a&lt;/sup&gt;</td>
<td>3.09±0.68&lt;sup&gt;3a&lt;/sup&gt;</td>
</tr>
<tr>
<td>L0&lt;sup&gt;5&lt;/sup&gt;</td>
<td>P</td>
<td>2</td>
<td>5.7 (5.0, 6.3)</td>
<td>4.5 (4, 5)</td>
<td>180.3 (136.1, 224.5)</td>
<td>3.15 (2.76, 3.54)</td>
</tr>
</tbody>
</table>

2) Dried fat free tissue.
3) Total of 3 glands of unilateral side.
4) Combined data of primi- and multigravid animals. Figures in parenthesis represent number of shrews in which assay of plasma progesterone was performed.
5) Mean±S.E. No significant differences (5% level) were found in Mann-Whitney test between the means having the same letter in the superscript in each column.
6) Day 0 of lactation: day of parturition.
Mammary gland development of the house musk shrew during pregnancy

Female house musk shrews have 3 pairs of teats and mammary glands in the inguinal region (Fig. 1) and there is a well-defined areola mammae around the teat. When fully developed, the 3 pairs of mammary gland extended from the inguinal region to the flank (the 1st gland), to rostral on the abdomen (the 2nd) and to the thigh and the buttocks (the 3rd), respectively.

The mammary glands of the non-gravid female musk shrews consisted of only 2 bare ducts that opened independently to the teat. Ducts having branches were rare and no end buds were found. In the first pregnancy, the gland remained in this primitive stage until day 5 (Fig. 2-1). The development of the gland was still restricted on day 13. Although the formation of end buds and ramifications of ducts had begun, the number of them was still small and the extension of ducts could hardly be recognized (Fig. 2-2). The mammary gland of multigravid animals occupied a large area even during the first half of pregnancy and consisted of a well branched duct system (Fig. 2-4). However, the duct was slender and the pattern of mammary growth until mid-pregnancy was principally the same as in the primigravid ones. No eminent increase in the number of branches and no lobulo-alveolar structure were found in the glands of multigravid animals until day 15 of pregnancy (Fig. 2-5).

Rapid growth of the duct system seemed to start after day 15 in the primigravid shrews. There was a big difference in the area covered by mammary glands between day 13 and day 20 (Figs. 2-2 and -3). No increase in the mammary gland area due to the extension of ducts was conspicuous in the multigravid animals, but thickening and branching of ducts started to occur after...
Fig. 2.
day 15 in these animals (Fig. 2–6). The first sign of alveolar formation was found on days 19–20 of pregnancy both in the primi- and the multigravid house musk shrews. Mammary glands at this stage were composed of very thick ducts with poorly developed lobulo-alveolar like structures (Figs. 2–3 and -6). Alveolar formation became evident and the duct extended further after day 20 (Figs. 2–7 and -8). The degree of the mammary gland development no longer differed between the primi-and multigravid animals in the last third of pregnancy. Although the alveolar lumen was extended in the gland on days 20–24, no milk was found in the lumen (Fig. 2–8). Extended alveolar lumen with secretory substances and fat droplets in the epithelial cells could be observed in the glands of some animals after day 26, and after day 28 almost all alveoli of all shrews contained milk-like substances in the lumen and many fat droplets in both the lumen and the cells (Fig. 2–9).

Changes in nucleic acid content of mammary glands during pregnancy

Results obtained on different days of pregnancy were pooled at intervals of 5 or 10 days during the first and of 2 or 3 days during the latter halves of pregnancy, except for those on day 29 of pregnancy and on the day of parturition on which DFFT content and the RNA/DNA ratio rose rapidly (Table 1). The number of fetuses ranged from 1 to 6 in the animals killed. Most of the dams killed in the early stage of pregnancy had 3 to 5 fetuses and those in the later stage had 2 to 4. Differences in the number of fetuses, however, were not statistically significant between groups at different stages.

The increase in the DFFT and DNA content was very gradual during the first half of pregnancy and, though DNA content increased to about double during the period, no significant difference in the content was found between groups until day 15 in either the primi- or the multigravid animals. A steep increase in both DFFT and DNA content started between days 15 and 20, and continued thereafter until the end of pregnancy. When DFFT and DNA content of the primi- and the multigravid shrews at the same stage of pregnancy was compared, the content was always higher in the multigravid animals through the entire period of pregnancy, though significant differences could be detected only in DFFT on days 16–21 and in DNA on days 6–15. There was no difference in the pattern of changes in DFFT and DNA content between animals of the primi- and the multigravid groups. The ratio of RNA to DNA remained low throughout pregnancy and rose abruptly on the last day of the period in either the primi- or the multigravid animals. A slightly higher ratio was recorded at the earliest stage of pregnancy in both groups than at other stages, except for day 29.

No lactose could be detected in the mammary gland tissue of the house musk shrew by the method employed.

Changes in plasma concentration of progesterone (P) and weight of adrenal gland during pregnancy

Since no difference was found in the circulating level of P between the primi- and the multigravid animals, data were combined (Table 1). No significant elevation of plasma P level was found during the first half of pregnancy. A steep increase in the steroid concentration started after day 15 and peaked around day 25. The level of circulating P remained high until the end of pregnancy, and returned to the low level observed in the non-gravid stage after parturition. A large variation in the steroid concentration on day 29 was due to the extremely low concentration obtained in some shrews. Pregnancy seemed to be nearly terminated and the fall in the plasma P level starting shortly before parturition might begin in these animals.
There was no appreciable change in the weight of the adrenal glands throughout the pregnancy. The mean gland weight was 10.06 ± 0.28 mg (N = 29) during the first half (day 0–15) and 9.53 ± 0.24 (40) during the latter half (days 16–29) of pregnancy. No change in ovarian weight could be detected.

**Effect of ovariectomy on the maintenance of pregnancy, the rate of mammary growth and the plasma progesterone concentration**

Bilateral ovariectomy on day 15 or 16 of pregnancy caused abortion by day 20 or 25 in 7 out of 14 animals operated (Table 2). However, abortion by day 25 also occurred in one of 6 sham operated control animals and only half of them could maintain pregnancy until term. The difference in the rate of maintenance of pregnancy on day 25 between ovariectomized and sham operated animals was not statistically significant.

No significant differences were found in the DFFT and DNA content, the RNA/DNA ratio of the mammary gland or in the plasma

<table>
<thead>
<tr>
<th>Operations</th>
<th>Date of examination (Day of pregnancy)</th>
<th>No. of shrews operated</th>
<th>No. of shrews in which pregnancy was maintained (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovariectomy</td>
<td>20</td>
<td>5</td>
<td>3(^b) (60.0)</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>9</td>
<td>4(^b)* (44.4)</td>
</tr>
<tr>
<td>Sham-operation</td>
<td>25</td>
<td>6</td>
<td>5(^c)* (83.3)</td>
</tr>
</tbody>
</table>

a) Operations were performed bilaterally on day 15 or 16 of pregnancy.
b) Survival of fetuses was checked at autopsy.
c) Pregnancy was ascertained by palpation and the increase in body weight. Three out of 5 animals delivered living young on day 28, 30 or 32 of pregnancy, respectively.

* No significant difference was present between 4/9 and 5/6 (X² = 3.78).

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**Table 3. Effect of ovariectomy on nucleic acid contents of the mammary gland and the plasma concentration of progesterone in the pregnant house musk shrew.**

<table>
<thead>
<tr>
<th>Animals</th>
<th>Date of autopsy (Day of pregnancy)</th>
<th>Maintenance of pregnancy</th>
<th>No. of Shrews</th>
<th>Mammary gland DNA (mg/3 glands(^1))</th>
<th>RNA DNA</th>
<th>Plasma progesterone (ng/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovariectomized(^1)</td>
<td>20</td>
<td>+</td>
<td>3</td>
<td>50.8 ± 2.1 (^{a,b,d})</td>
<td>0.79 ± 0.23 (^{a,b,e})</td>
<td>1.22 ± 0.12 (^{a,b,e})</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>+</td>
<td>4</td>
<td>74.2 ± 7.0 (^{b,e})</td>
<td>2.01 ± 0.28 (^{d})</td>
<td>1.40 ± 0.09 (^{b,e})</td>
</tr>
<tr>
<td>Intact(^2)</td>
<td>13–17</td>
<td>+</td>
<td>7</td>
<td>40.8 ± 2.3 (^a)</td>
<td>0.53 ± 0.07 (^a)</td>
<td>1.18 ± 0.09 (^{b,a})</td>
</tr>
<tr>
<td></td>
<td>19–21</td>
<td>+</td>
<td>7</td>
<td>56.7 ± 4.0 (^{b,e})</td>
<td>0.89 ± 0.13 (^{b,e})</td>
<td>1.20 ± 0.06 (^e)</td>
</tr>
<tr>
<td></td>
<td>24–26</td>
<td>+</td>
<td>14</td>
<td>79.5 ± 6.9 (^{d,e})</td>
<td>1.83 ± 0.27 (^d)</td>
<td>1.42 ± 0.06 (^{b,e})</td>
</tr>
</tbody>
</table>

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1) Operation was performed on day 15 or 16 of pregnancy, 2) Combined data of primi- and multigravid animals, extracted from the results shown in Table 1, 3) Dried fat free tissue, 4) Total of 3 glands of unilateral side, 5) Mean ± S.E. No significant differences (5% level) were found in Mann-Whitney test between the means having the same letter in the superscript in each column.

* Steroid assay was missed in two samples.
Discussion

Results of the present study clearly indicate that growth of the mammary gland in dams of the house musk shrew occurs very rapidly in the last third of the pregnancy period. This pattern of mammary growth is quite different from that in rats, mice and hamsters in which the gland developed throughout the entire period of pregnancy (Yokoyama et al., 1980). However, restriction of the period of intensive mammary growth to the latter half or one third of pregnancy seems to be common to many species other than those of Myomorpha. By the quantitative assessment of the mammary development using the measurement of nucleic acid content of the gland, it was revealed that a majority of mammary growth occurred only after mid-pregnancy in guinea pigs, rabbits, pigs, goats and cattle (see Cowie et al., 1980 for review).

It is difficult to make any assumption on the hormonal control of mammary growth in the house musk shrew at present, because information about hormones other than P in this species is still completely lacking. The present results strongly suggest the stimulating effect of P on the lobulo-alveolar development in the musk shrew as in other species of laboratory and domestic animals. Both the rapid increase in circulating P and the burst of lobulo-alveolar formation started at almost the same time in mid-pregnancy. However, in addition, extensive branching and extension of the mammary duct system also began at mid-pregnancy, coinciding with the onset of rise in plasma P level. The role of P in the musk shrew may not be restricted to the promotion of lobulo-alveolar development. The mammogenic action of P in this species, in comparison with that in other species, offers an interesting subject for future studies.

Dispensability of ovaries for the maintenance of pregnancy in the house musk shrew has been already mentioned by Hasler and Nalbandov (1978). The present result confirmed their finding and further clarified that even the enhanced level of plasma P similar to that observed at the later stage of normal pregnancy could be maintained in the absence of ovaries. The concentration of P in the ovarian tissue increased in the latter half of pregnancy (Hasler and Nalbandov, 1978). However, the present results in the ovariectomized animals throw doubt on how much the increase contributes to the enhancement of the total amount of circulating P during the second half of normal pregnancy.

Possible candidates for the source of extraovarian P are placenta and maternal and fetal adrenal glands. Concerning the adrenal gland of mother animals, no increase in the weight was found throughout the whole period of pregnancy, and histological studies revealed that eminent alteration of the adrenal function did not occur during pregnancy and even after ovariectomy during the period (Fujioka et al., 1980). Hasler and Nalbandov (1978) demonstrated that the adrenal P concentration was elevated in pregnant shrews, but the change was only slight and the concentration was almost constant through pregnancy. Of all candidates, the contribution of placenta seems to be the most likely. However, a preliminary survey failed to detect histochemically the activity of 3β-hydroxysteroid dehydrogenase in the placental tissue of the musk shrew after day 15.
A more concentrated investigation would be required.

In the present study, no lactose could be detected in the mammary gland of musk shrews on day 29 of pregnancy or on the day of parturition, despite the fact that the glands of most animals were filled with milk. Preliminary trials also failed to find sugar in milk collected by hand milking from lactating dams, though the method employed could detect lactose in milk at a minimum concentration of 0.001% (w/w, 10 μg/g). Dryden and Anderson (1977b) reported that milk of the house musk shrew contained lactose at a concentration of 0.8%. The difference, however, seems to be due to the difference in the method used for the sugar detection between by these workers and us. The phenolsulfuric method used by them was not necessarily specific for lactose. Therefore, the presence of unidentified carbohydrate(s) seems to cause an overestimation of lactose in the musk shrew's milk. Considering the fact that α-lactalbumin, a common milk whey protein, is a component of lactose synthetase (Ebner and Schanbacher, 1974), deficiency of lactose in milk of the house musk shrew may be worth further study.

Acknowledgements

We are grateful to Mr. R. Ogawa for his assistance in the management of the animals and to Mrs. Y. Niwa for her secretarial help. Our thanks are also due to Mrs. R. Izeki of the Laboratory of Animal Genetics (Present address: School of Medicine, Nagoya University) for her valuable advice on the feeding of house musk shrews. The work was supported in part by Grant-in-aid for Cancer Research (No. 501040) and for Co-operative Research (No. 56360024), Ministry of Education, Science and Culture, Japan.

References


