Effects of Gonadectomy on the Histological Structure of the Mandibular Glands in Male Mice

II. On the Immature Mice

Junichi OTSUKA, Koichi NAGANO* and Hayao NISHINAKAGAWA

(Laboratory of Veterinary Anatomy)

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INTRODUCTION

It was re-affirmed in the previous paper[1] that gonadectomy brought about an atrophy of the granular tubules in the mice mandibular glands, namely, there was a close connection between the testes and the development of the granular tubules. However, the relationship between the testes and the post-natal development of the mandibular glands has been left uncharted in mice.

The post-natal development of the rodent mandibular gland was described by JACOBY (1959)[2] and ICHIKAWA et al. (1961)[3] in mice, by JACOBY and LEESON (1959)[4], LEESON and JACOBY (1959)[5] and KIM et al. (1970)[6] in rats and by DEVI and JACOBY (1966)[7] in golden hamsters. These observations suggested that there was an intimate relationship between the structure of the granular tubules in the mandibular gland and the puberty, but the effect of sex hormone to the post-natal development of the granular tubules has not been examined.

In the present experiment, to examine the effect of hormone secreted out of the testes on to the post-natal development of the mice mandibular glands, the changes in the structure of the mandibular glands were observed, using the male mice gonadectomized during the period from 30~80 days after birth.

MATERIALS AND METHODS

104 male ICR-JCL mice were gonadectomized by the method described in the previous paper on the 30th, 40th, 50th, 60th, 70th and 80th day after birth, and the animals of 90 days old were sacrificed, then the mandibular glands were examined. As the controls, 44 intact male mice were sacrificed on the 30th, 40th, 50th, 60th, 70th, 80th and 90th day after birth.

The rearing and the methods of observations were the same as those described in the previous paper.

The body-weight of the animals used in this experiment is shown in figure 1.

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* Present adress: Institute of Research Otsuka Pharmaceutical Co., Ltd.

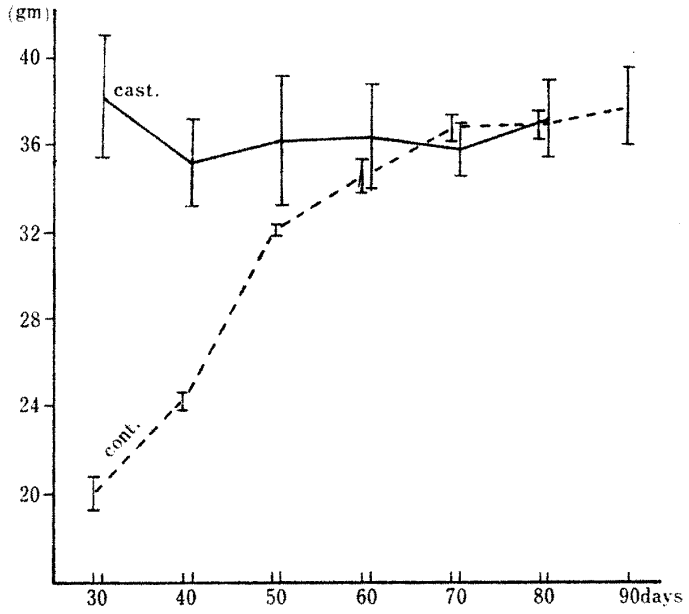

Fig. 1. Body-weight

cont. Body-weight of intact control mice.
cast. Body-weight of 90 days old mice gonadectomized on the 30th~80th day after birth. In this case, the graduation in the transverse shows the day when gonadectomy was carried out.

means±standard deviation.

OBSERVATIONS

1) **gland-weight** (Fig. 2, 3)

The mandibular gland-weight of the intact control mice increased rapidly as mice grew older during the period from 30~60 days after birth, but after that time the curve of increase began to show a gentle slope.

The mandibular gland-weight of the 90 days old mice gonadectomized during the period from 30~80 days after birth was smaller than that of the 90 days old intact control mice by about 60 mg.

The gland-weight-percentage per the body-weight of the 90 days old mice gonadectomized on the 30th, 40th, 50th, 60th, 70th and 80th day after birth was almost constant.

The mandibular gland-weight of the 90 days old mice gonadectomized at the 30th and 40th day after birth was greater than that of the intact control mice 30 and 40 days of age respectively. The gland-weight of the mice gonadectomized on the 50th day after birth was the same as that of the 50 days old intact control mice, eventually the mandibular glands showed no growth for 40 days in those mice from 50 to 90 days old.

The gland-weights of the mice gonadectomized at 60th, 70th and 80th day after birth were smaller than those of the intact control mice 60, 70 and 80 days old. This fact

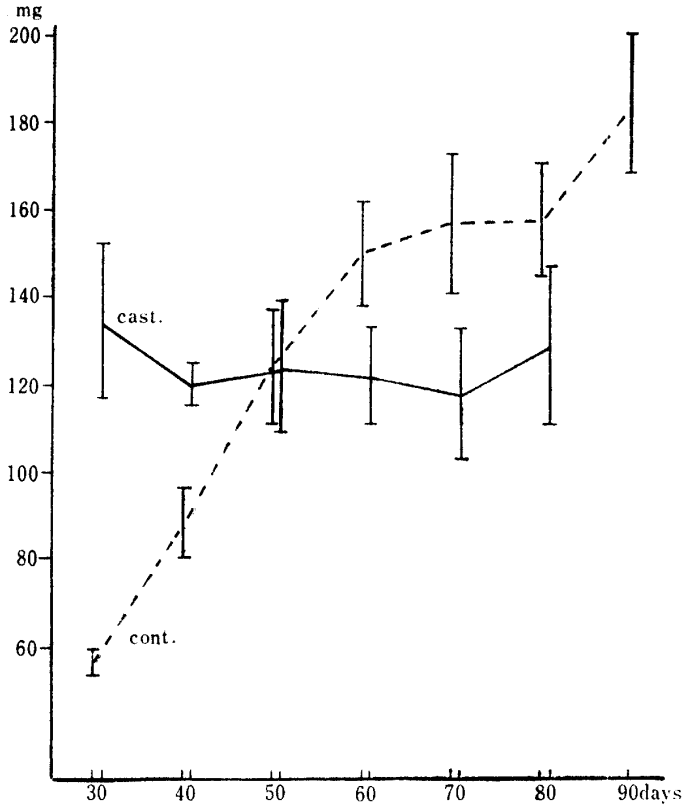

Fig. 2. Gland-weight

The form of the graphs in Fig. 2~Fig. 10 is the same as that in Fig. 1.

shows that the mandibular glands of these mice were rendered to be atrophied after gonadectomy.

The gland-weight-percentage per the body-weight of the 90 days old mice gonadectomized on the 40th day after birth was smaller than that of the 40 days old intact control mice as shown in figure 3.

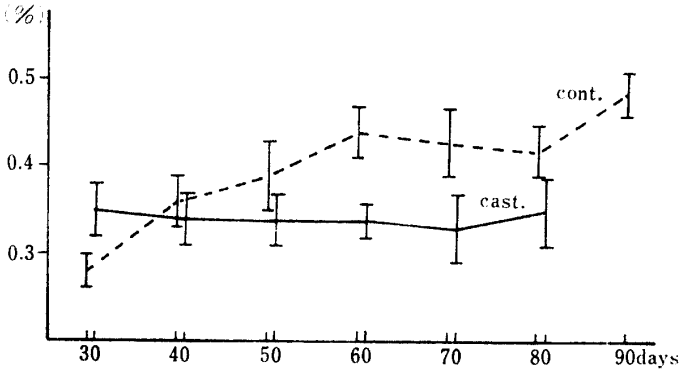

Fig. 3. Gland-weight-percentage per body-weight.

2) **histological observations**

As described in the previous paper, the secretory ducts were developed well in the mandibular glands in the 90 days old intact control mice.

The most portion of the secretory ducts was composed of the granular tubules; while the smaller portion near the intercalated ducts was composed of the striated tubules.

With the exception of the granular tubules of the mandibular glands, the histoiogical structure of the acini and others, in the mice gonadectomized at the early age showed no difference as compared with that in the 90 days old intact control mice. On the contrary, the granular tubules in the mice treated on the 30th and 40th day after birth showed quite undeveloped features, the area of those tubules in a lobulus was the same as or the lesser than the area of the acini. The length of the granular tubules consisting of the epithelial cells having a very small amount of granules was shorter than that in the 90 days old intact controls; while the length of the striated tubules became longer. Moreover, the diameters of the granular tubules and lumens were small, showing rectilinear features in their direction.

In the 90 days old mcie gonadectomized on the 50th and 60th day after birth, the majority of the epithelial cells of the granular tubules contained a small quantity of granules. The height of the epithelial cells and the diameters of the tubules and lumens were larger than those in the mice treated on the 30th and 40th day after birth. Furthermore, the direction of the granular tubules showed zigzag line and the boundary lines between the intralobular striated ducts and the tubules were distinct, the striated tubules becoming shorter.

The granular tubules of the mandibular glands in the 90 days old mice gonadectomized on the 70th and 80th day after birth were more developed than those in the mice treated before they were 60 days of age. However, the content of the granules in the epithelial cells of the granular tubules was less, and the diameters of the tubules and lumens were smaller than those in the 90 days old intact control mice.

The histological features of the granular tubules in the 90 days old mice gonadectomized on the 30th day after birth were almost the same as those in the 30 days old intact control mice. The granular tubules in the animals gonadectomized on the 40th day after birth decreased in the contents of the granules, and the diameters of the tubules and lumens became shorter than those in the 40 days old intact controls. Moreover, the granular tubules in the mice gonadectomized on the 50th, 60th, and 70th day after birth showed a distinguished atrophy in comparison with those in 50, 60 and 70 days old intact control mice respectively. But in the granular tubules in the mice treated on the 80th day after birth, the atrophy of the tubules was less distinct than that in the mice gonadectomized on the 50th, 60th and 70th day after birth.

3) **quantitative assessments**

a) acini (Fig. 4, 5)

As shown in figure 4, the number of the acini in 335 square microns in a lobulus in all the mice gonadectomized during the period from 30~80 days after birth was ascertained to be significantly greater than that in the 90 days old intact control mice.

The number of the acini in the gonadectomized mice was compared with that in the

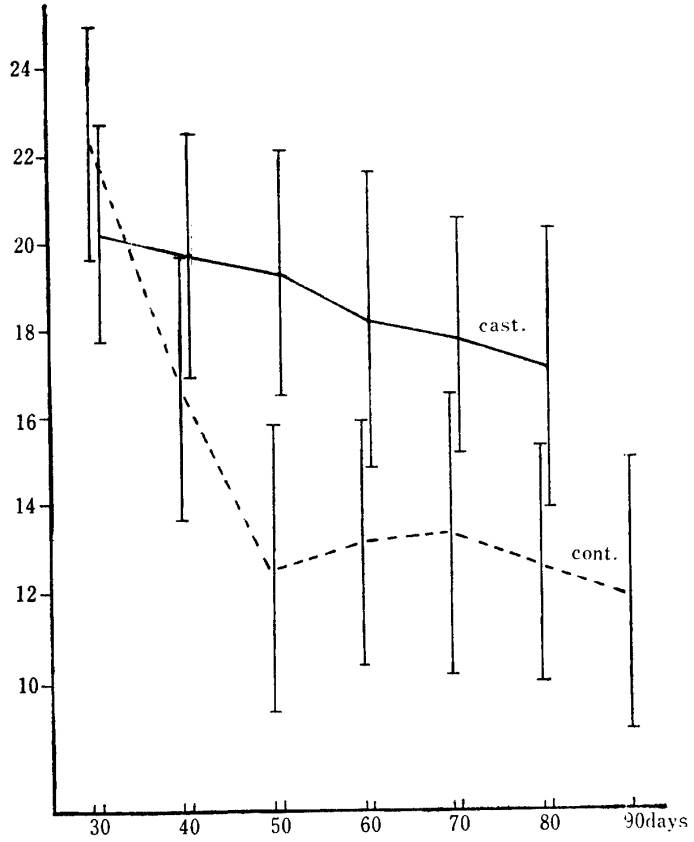

Fig. 4. Number of acini in 335 μ^2.

intact control mice, sacrificed on the respective days of age when gonadectomy was carried out in the experimental mice, with the following result that in the mice gonadectomized on the 30th day after birth the number was less and that in the animals treated on the 40th day or beyond that after birth it was more than that of the control mice.

The changing-type of the area of the acini of 335 square microns was almost similar to that of the number of the acini as shown in figure 5.

The size of an acinus (area of acini/number of acini) in the gonadectomized mice treated at the early age was a little larger than that in the 90 days old intact control mice.

b) granular tubules (Fig. 6, 7, 8, 9, 10)

The number of the granular tubules of 335 square microns in a lobulus in the histological sections showed no difference between the gonadectmized mice and the controls statistically. The area of the granular tubules in the above-stated field in the gonadectomized mice showed a distinct decreasing in comparison with that in the 90 days old intact control mice as shown in figure 7. There was no significant difference between the area of the granular tubules in the 90 days old mice gonadectomized on the 30th day after birth and that in the 30 days old intact control mice, while that in the mice treated on the 40th day after birth or beyond that date was smaller than that in the intact control mice sacrificed on the respective day when the gonadectomy was carried

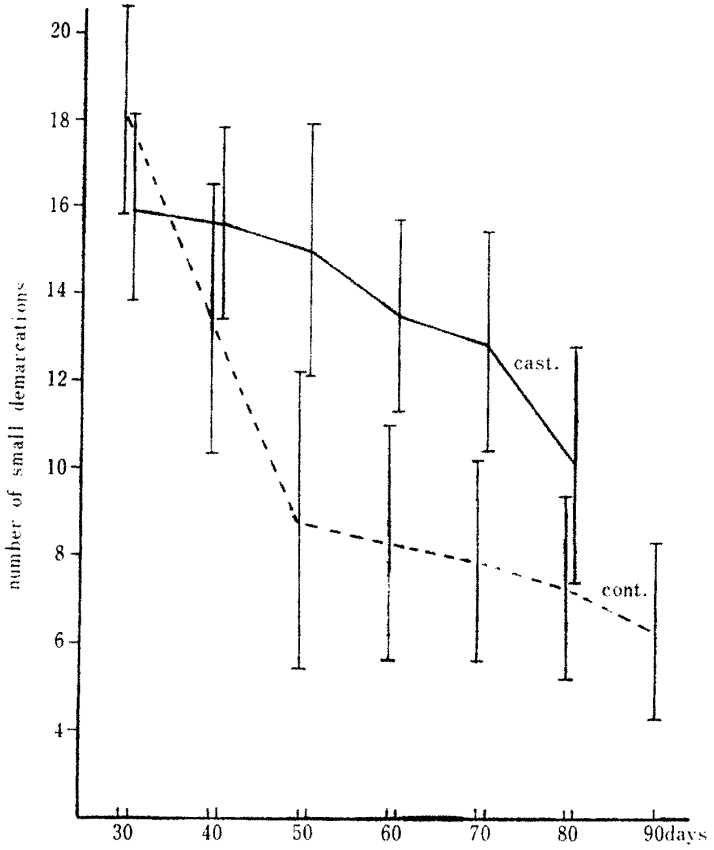

Fig. 5. Area of acini in 335 μ^2.

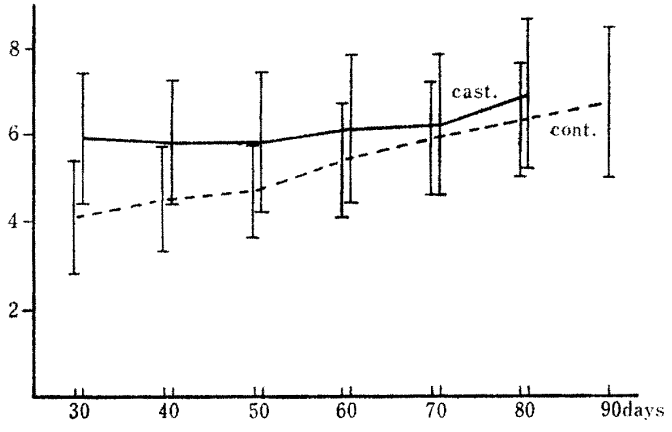

Fig. 6. Number of granular tubules in 335 μ^2.

out in the experimental mice.

Therefore, the size of a granular tubule in the histological sections (area of granular tubules/number of granular tubules) in the gonadectomized mice was smaller than that in the control mice with the exception of the 30 days old intact control mice. The so-called tubular/acinar ratio (T/A)in the gonadectomized mice showed quite a small

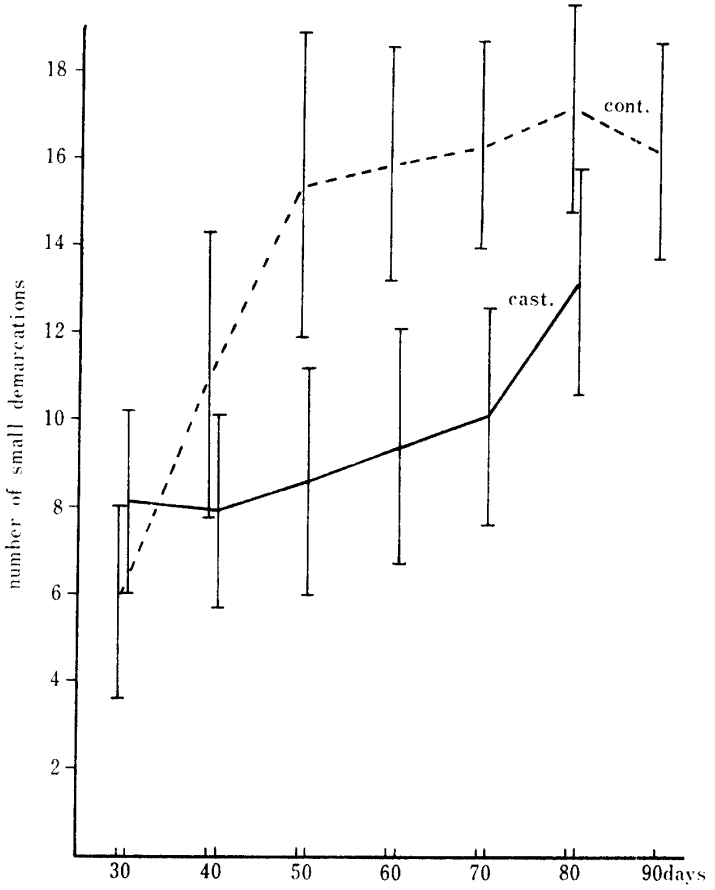

Fig. 7. Area of granular tubules in 335 μ^2.

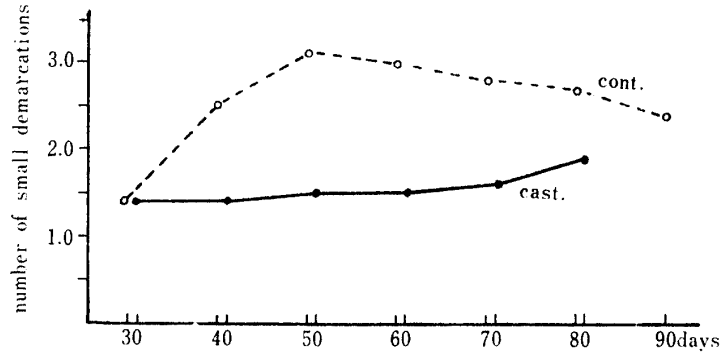

Fig. 8. Size of a granular tubule.

value in contrast to the characteristic value in the adult male mice (e. g. 90 days old intact control mice). The tubular/acinar ratios in the mice gonadectomized on the 30th and 40th day after birth were nearly similar to that in the 30 and 40 days old intact control mice as shown in figure 9.

The diameter of the granular tubules, the height of their epithelia and the diameter of their lumens are recorded in figure 10. The diameter of the granular tubules in the

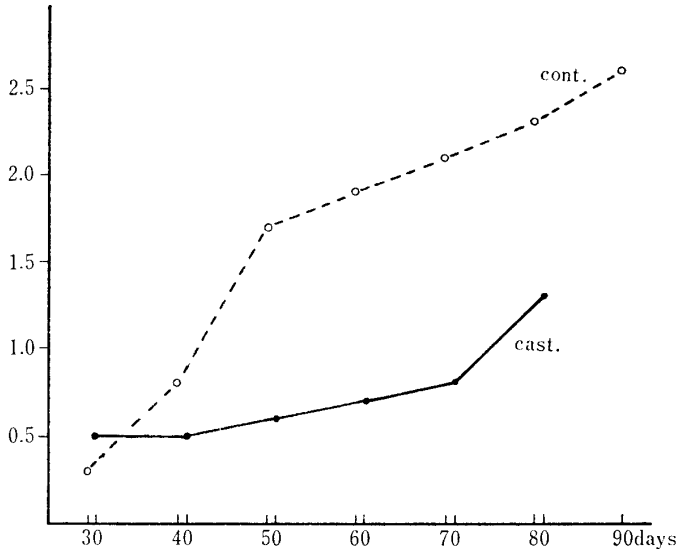

Fig. 9. Tubular/acinar ratio (T/A).

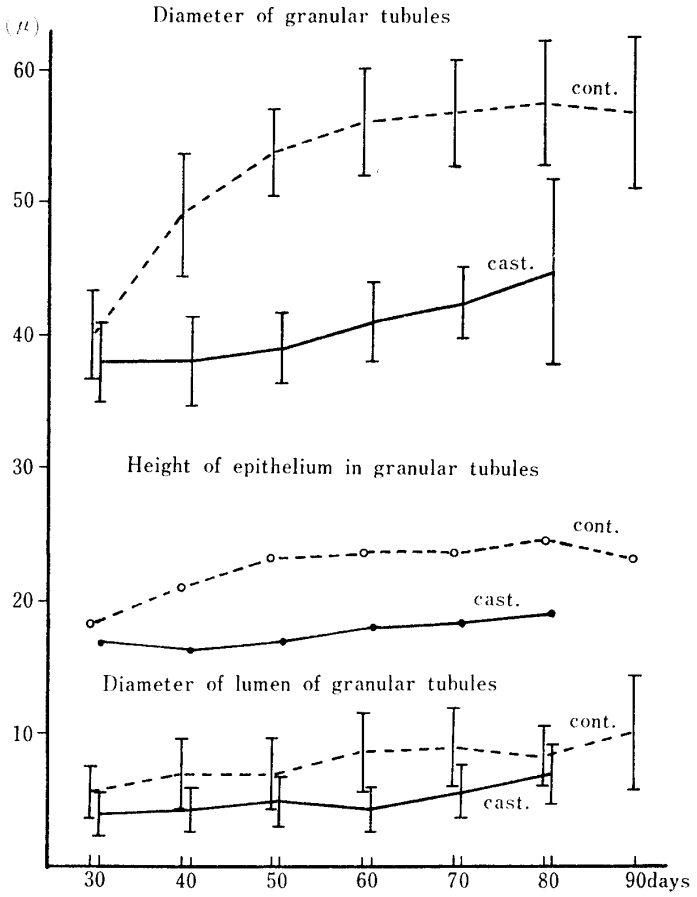

Fig. 10. Diameter of granular tubules.

* Height of epithelium in granular tubules. Diameter of lumen of granular tubules.

* The value is $\frac{\text{Diameter of granular tubules—Diameter of lumen of granular tubules}}{2}$

gonadectomized mice was smaller than that in the 90 days old intact control mice distinctly. However, that in the mice gonadectomized on the 60th day after birth or beyond that date was larger to some extent than that in the mice treated on the 30th, 40th and 50th day after birth. On the other hand, the tubular diameter in the mice gonadectomized on the 40th day after birth or beyond that decreased in comparison with the value in the control mice, sacrificed on the respective day when gonadectomy was carried out in the experimental mice.

The diameter of the lumens of the granular tubules in the gonadectomized mice was smaller than that in the 90 days old intact control mice.

The height of the tubular epithelia ((diameter of granular tubule−diameter of lumen)/2) in the gonadectomized mice was smaller than that in the control animals excepting the case of 30 days old mice.

The number of the nuclei in the granular tubules in the mice gonadectomized on the 30th day after birth was less than in the 90 days old controls, but among the other groups there were no significant differences.

DISCUSSION

Using the mice from birth to 6 months of age JACOBY (1959)[2] reported that the acini of the mandibular glands developed immediately after birth out of the terminal tubules, and the development was practically finished at the period between the 4th and 5th weeks. Moreover, he described that granulation of the intralobular striated ducts began in the mice 24 days of age, and this duct transformation was well advanced at 4th week after birth. ICHIKAWA et al. (1961)[3] indicated, in the light- and electron-microscopic studies, that the epithelia of the granular tubules were of pseudstratified type in fetus, and immediately after birth came to be changed into the simple epithelia, then grnulation began on the 15th day after birth, which resembles the epithelia in the adult mice about 45 days old.

In the present experiment, it was observed that the acini contained scanty stainable substance on the 30th day after birth, showing structures similar to those of the adult mice about 60 days of age. On the other hand, it was revealed that granulation in the granular tubules was recognized in those less than 30 days old, rapid development of the tubules being observed in those 40～50 days old, after that developing slowly. Such a development of the mandibular gland was ascertained to be slightly slower than that observable in the description by JACOBY. It is supposed that this difference was caused by the discrepancy in mice-strain used in the experiments.

The granular tubules of all the gonadectomized mice showed un-developed structures. The granular tubules in the 90 days old mice gonadectomized when 30 days old showed an aspect similar to those in the 30 days old intact control mice, while those in the mice treated when 40 days old or older than that were found to be atrophied than those in the intact control mice sacrificed on the respective day when gonadectomy was carried out in the experimental mice. These observations may be looked upon as indicating that the effects of the hormone secreted from testes on the development of the mice mandibular glands are to be brought forth when they are about 40 days of age.

On the mandibular glands, in the gonadectomized mice treated when 50 days old or older than that, the diameter of the granular tubules and contents of granules contained in their epithelial cells, diminished markedly in accordance with the lengthened lapse of time after gonadectomy.

This fact indicates that the above-mentioned atrophic process is a change reverse to the developmental process of the granular tubules taking place in the same manner as the case of the adult mice reported in the previous paper[1].

SUMMARY

The mandibular glands in the 90 days old mice gonadectomized on the 30th, 40th, 50th, 60th, 70th and 80th day after birth were observed histologically in comparison with those in the intact control mice 30, 40, 50, 60, 70, 80 and 90 days of age.

1) The mandibular gland-weight and gland-weight-percentage per body-weight of all the gonadectomized mice were smaller distinctly than those of the 90 days intact control mice.

2) The granular tubules in all the gonadectomized mice showed undeveloped structures as compared with those in the 90 days old intact control mice, but the difference in the extent of development was recognized in accordance with the lapse of days when the gonadectomy was carried out.

3) The granular tubules in the 90 days old mice gonadectomized when 40 days old or older than that showed atrophy higher than those in the intact control mices sacrificed on the respective day when the gonadectomy was carried out in the experimental mice, while in the mice gonadectomized when 30 days old showed structures similar to those in the 30 days old intact control mice.

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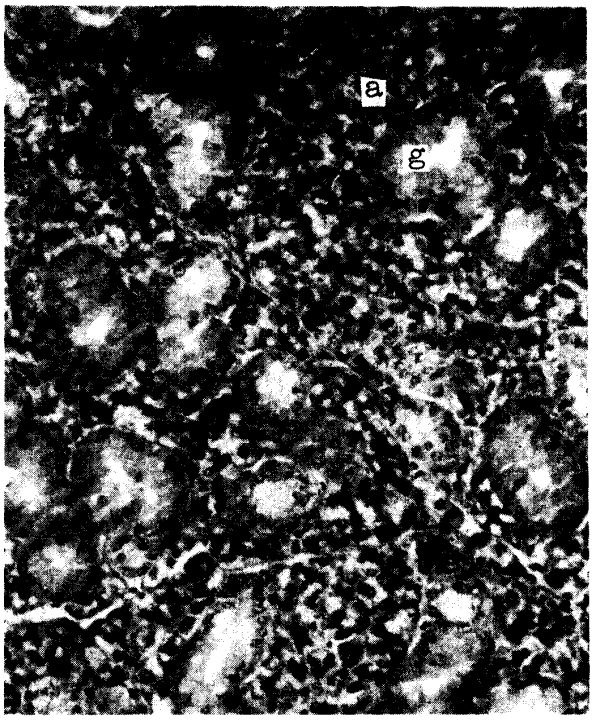
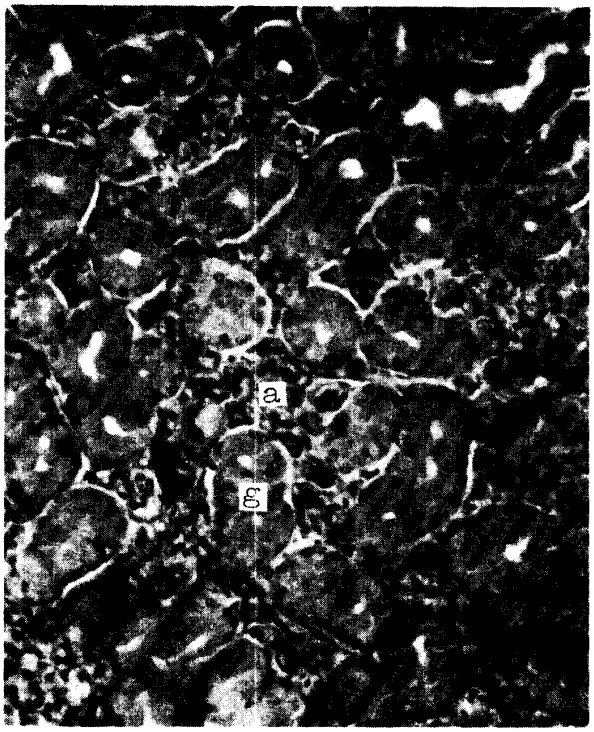


Plate. 1.



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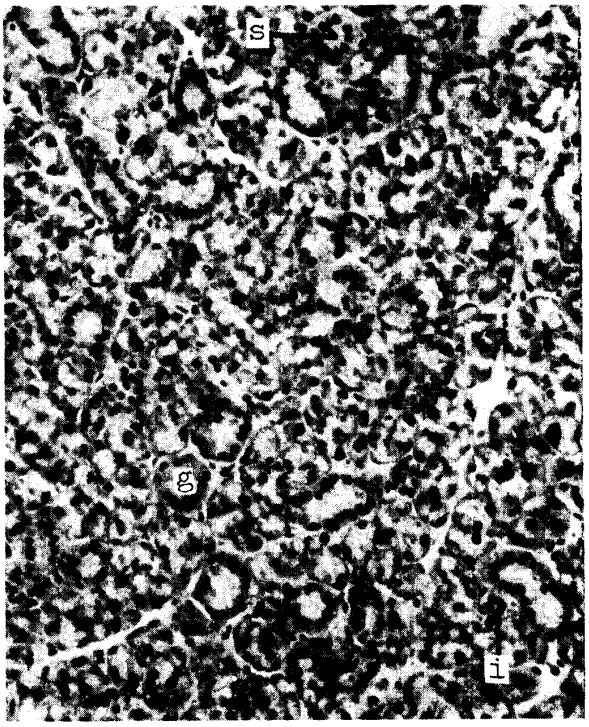

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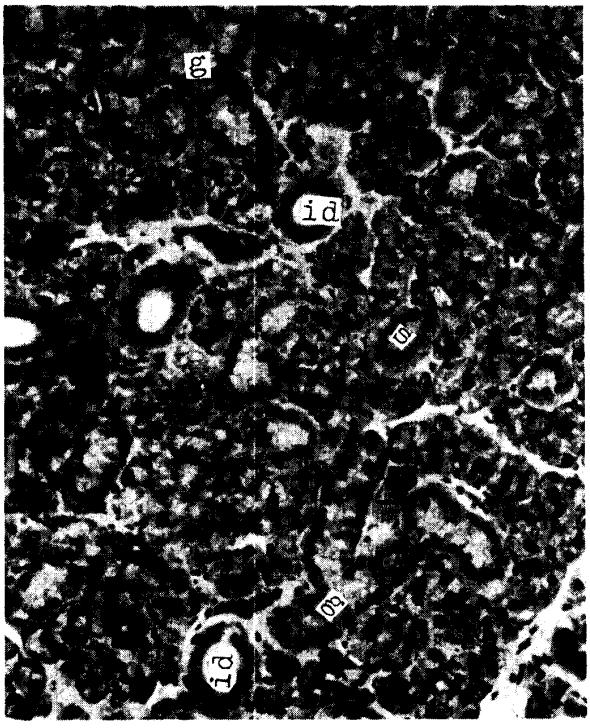

Plate. 4.

Explanation of Plates

Abbreviations

a ..... acinus
g ..... granular tubule
s ..... striated tubule
i ..... intercalated duct
id ..... intralobular striated duct

Plate 1. Mandibular gland of the 40 days old intact control mouse. × 100.

Plate 2. Mandibular gland of the 90 days old intact control mouse, showing granular tubules developed more than those in Plate 1. × 100.

Plate 3. Mandibular gland of the 90 days old mouse gonadectomized when 30 days old, showing undeveloped granular tubules. × 100.

Plate 4. Mandibular gland of the 90 days old mouse gonadectomized when 60 days old. The cells containing a numerous granules are located in the granular tubule near the striated tubules (arrows). × 100.