

HISTOLOGICAL STUDIES OF ENDOCRINE ORGANS AFTER
THE INJECTION OF GARLIC EXTRACT
(ROCAMBOLE)

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INTRODUCTION

Both garlic and red pepper are commonly used in Korean cooking. However few studies on the physiological effects of garlic on the human body have ever been made. There are also very few studies on the histological changes in endocrine organs brought about by any kind of condiments and none on garlic which is so freely used here.

Mitoma (4) investigated the changes in bones of the young rabbit after the ingestion of red pepper, ginger or eutrema and found in such ani-

mals acidosis and partial or complete atrophy of osteoblasts. At the same time there was hypertrophy of the periosteum, and the formation of fatty marrow. Suematsu (6) (7) (8) studied and reported on the effect of mustard oil, pepper and the Japanese pepper on the endocrine organs. He noted decrease of eosinophils and basophils, in hypophysis and hypertrophy of main cells in the hypophysis; also evidence of early hyperfunctional change at early stages and hypofunctional change at later stages in thyroid, active hyperemia of thymus probably due to mustard oil, early evidences of hyperfunctional change and later degenerative changes in thyroid. He further noted maldevelopment of seminiferous tubules in testis, after pepper extract injection; early evidences of hyperfunctional change followed by degenerative changes at a later stage in thyroid after Japanese pepper extract injection.

Zeckwer (10) fed animals with cabbage and noted hyperplasia of the thyroid gland in them.

Choi (11) of our department studied the effect of the oral administration of red pepper powder on various organs of the rabbit and found very interesting results in endocrine organs. He noted evidence of hyperfunctional change in the thyroid at an early stage followed by hypofunctional change or degeneration at later stages. There was also active hyperemia of the parathyroid; hyperplasia of the medulla of the thymus gland and hyaline degeneration of the thymus gland. Decrease of eosinophils in the anterior lobe of hypophysis, hyperemia of the suprarenal gland, hyperemia with partial or complete atrophy of follicles and parenchyma of spleen, hyaline degeneration of the walls of the capillaries of the Malpighian corpuscles, were noted. Of special interest was the hyperplasia of the reticulo-endothelial cells in the spleen. Lee and Hiraoka (14) noted acceleration of gastric secretion at an early stage followed by decrease at later stages in Koreans after the oral administration of red pepper powder.

Arima (13) found catarrhal changes of the stomach wall with hemorrhages from the mucous membranes after the experimental oral administration of red pepper powder or extract to rabbits. Sato (12) also found chronic hypertrophic gastritis in rabbits after the oral or the rectal administration of red pepper powder or its watery extract.

Bergsma (15) found many cases of gastric and duodenal ulcer in the black races of Abyssinia who commonly use the African pepper in cooking.

So, it is quite evident that so far as we know few have studied the effects of garlic on the endocrine organs. Yet garlic is an essential item of our Korean diet. We have therefore attempted the investigation and found some interesting results which are presented in this paper.

MATERIAL AND EXPERIMENTAL METHODS

In these experiments healthy white rabbits, weighing from 1750 to 3550 g were used and 0.5 cc to 1.0 cc per kilogram of body weight of 20% garlic extract was injected intravenously daily for from one to four weeks.

Sections were fixed in 10% formalin solution, imbedded in paraffin and stained with hematoxylin-eosin.

EXPERIMENTAL PROCEDURE

I. EFFECTS OF GARLIC EXTRACT INJECTION FOR ONE WEEK

In this experiment, rabbits received garlic extract intravenously for one week and endocrine organs were examined histologically.

1. SMALL DOSES ONLY WERE USED

Rabbits received intravenous injections of garlic extract at the rate of 0.5 cc per kilogram of body weight daily for one week.

Case No. 1. Female 2400 g.

Thyroid: Most acini large, colloid pale showing granules and vacuoles. Epithelium flat. Congestion of blood vessels was noted in the interstitial tissue.

Parathyroid: Congestion of blood vessels.

Thymus: Eosinophils abundant in medulla. Congestion of blood vessels in the interstitial tissue.

Hypophysis: Increase of eosinophil cells in anterior lobe.

Spleen: The lymph follicles were atrophied. There was decrease of lymphocytes, hyperplasia of reticular cells, increase of eosinophils and passive congestion of the spleen pulp.

Suprarenal gland: Congestion of capillaries in capsule. Acute congestion in all three zones of cortex.

Ovary: Graafian follicles abundant. Interstitial cells appear hypertrophic and hyperplastic.

Pancreas: Hyperemia was noted.

Case No. 2. Male 2250 g.

Thyroid: Most acini were medium sized or small. Colloid was pale with few vacuoles. Epithelium was flat or cuboidal. Active congestion of capillaries was noted.

Parathyroid: Principal cells were decreased and most of them showed fat droplets. Active congestion was noted.

Thymus: The connective tissues of the interstitial tissue seemed slightly hyperplastic. Hyperemia was noticeable.

Hypophysis: Eosinophils were decreased and there was congestion in the anterior lobe.

Spleen: Lymph follicles showed atrophy. Slight hyperplasia and passive hyperemia were noted in pulp.

Suprarenal gland: Active hyperemia of zona reticularis in cortex. Cells were cloudy and nuclei of the medulla pyknotic.

Testicle: Spermatogenesis appears to be diminished. Hyperemia of capillaries in interstitial tissue was noted.

Pancreas: This organ showed congestion.

Case No. 3. Female 2000 g.

Thyroid: Hyperemia. Acini mostly medium sized. Colloid pale. Epithelium flat, some cells show fat droplets.

Parathyroid: Hyperemia present, principal cells increased but show fatty degeneration.

Thymus: Marked congestion.

Hypophysis: Eosinophils were increased in anterior lobe.

Spleen: Lymph follicles were slightly atrophic. There was hyperemia and hyperplasia of reticular cells in the pulp. The wall of central arteries of splenic follicles show hyaline degeneration.

Suprarenal gland: Hyperemia of capsules present. Capillaries congested in zona glomerulosa, fasciculata and reticularis of cortex.

Ovary: Graafian follicles were numerous. Corpora lutea were scarce. Interstitial cells seem hyperplastic. Connective tissue fibers showed hyaline degeneration.

Pancreas: Blood vessels were congested.

Resumé: Active hyperemia was found in thyroid, cortex of suprarenal gland, testicles and pancreas. Principal cells in parathyroid were increased and showed fatty degeneration. Eosinophil cells of the anterior lobe in hypophysis were increased. Lymph-follicles were atrophic, reticular cells were hyperplastic, the wall of central arteries of the spleen showed hyaline degeneration and the spleen pulp showed hyperemia. The ovary has numerous Graafian follicles and the ovarian interstitial cells were hypertrophic and hyperplastic. Spermatogenesis was lessened in testicle.

2. LARGE DOSES WERE USED THROUGHOUT

Rabbits were injected intravenously with garlic extract at the rate of 1.0 cc per kilogram of body weight.

Case No. 4. Female 2200 g.

Thyroid: Acini are mostly large. Colloid dense and vacuolated. Epithelium is flat.

Parathyroid: Principal cells are mostly vacuolated and show fat droplets. Hyperemia of blood vessels was noted.

Thymus: Shows active hyperemia.

Spleen: Lymph follicles were atrophic. Passive congestion is evident in the pulp. The reticular cells were hyperplastic.

Suprarenal gland: Congestion was noted in the zona fasciculata. Marked hyperemia and hemorrhage were present in the zona reticularis.

Ovary: Graafian follicles were diminished in number. The connective tissue showed hyaline degenerated in the cortex.

Pancreas: Hyperemia was noted.

Case No. 5. Male 2250 g.

Thyroid: Most acini were small in size. Epithelium was flat. Colloid was pale and vacuolated and with Sudan III gave a positive reaction.

Parathyroid: Principal cells increased marked congestion present.

Thymus: Hyperemia present.

Hypophysis: Eosinophils increased in anterior lobe. Congestion of the posterior lobe.

Spleen: Reticulum cells hyperplastic. Passive congestion of the whole organ.

Suprarenal gland: Congestion present in zona reticularis. Cloudy swelling of epithelial cells of the medulla.

Testicle: No marked changes.

Pancreas: Congestion of capillaries.

Case No. 6. Male 2700 g.

Thyroid: Acini are mostly large. Colloids stains well and is vacuolated. Epithelium flat. Blood vessels show congestion.

Parathyroid: Principal cells increased in number and show fatty degeneration. Congestion present.

Thymus: Parenchyma shows atrophy and is replaced by fat tissue. Hassall's corpuscles are calcified and there is some congestion.

Hypophysis: Eosinophil cells increased and congestion present in anterior lobe.

Spleen: Eosinophils increased and passive congestion of the pulp.

Suprarenal gland: Capillaries of the cortex are congested.

Testicle: Interstitial tissue is hyperplastic and congestion is present.

Pancreas: Blood vessels show congestion.

Resumé: In the thyroid there is congestion and the acini are mostly large. Epithelium cells are flat, colloid is mostly heavily staining and vacuolated with fat droplets. The principal cells of the parathyroid are hyperplastic and show fatty degeneration. There is congestion in both parathyroid and thymus. In the anterior lobe of hypophysis eosinophils are increased. In the spleen reticular cells are increased and there is passive congestion. In the ovary Graafian follicles are diminished in number and the stroma shows hyaline degeneration. In the testicle there is congestion and the stroma appears hyperplastic. The pancreas shows congestion.

The above experiments show the presence of congestion in thyroid, parathyroid, adrenal cortex, pancreas, hypophyseal anterior lobe, thymus, and testicle, also increase of principal cells and fatty degeneration in the parathyroid; passive congestion and hyperplasia of reticular cells and atrophy of lymph-nodules in spleen; hyperplasia of eosinophils in the anterior lobe of hypophysis; hyperplasia of stroma in ovary and testicle; Since these findings were noted in animals after the injection of garlic extract in small or large doses the garlic may be the cause of these changes.

II. EFFECT OF GARLIC EXTRACT INJECTION FOR TWO WEEKS

In this experiment, rabbits received garlic extract intravenously for two weeks and the endocrine organs were examined histologically.

1. USING SMALL DOSES

Rabbits were given intravenously doses of garlic extract at the rate of 0.5 cc per kilogram of body weight.

Case No. 7. Female 3250 g.

Thyroid: Acini are mostly moderate sized. Colloid is pale. The epithelium is flat and cuboidal. Congestion is present.

Parathyroid: Principal cells are markedly hyperplastic and a majority show fatty infiltration. Congestion and hemorrhage were marked.

Thymus: Reticular cells are increased in medulla. Congestion is present.

Hypophysis: Eosinophils are hypertrophic and hyperplastic. Chief cells show fatty degeneration in anterior lobe.

Spleen: Passive congestion of the splenic pulp is present.

Suprarenal gland: There is congestion of the zona fasciculata and reticularis.

Ovary: Graafian follicles are abundant. Congestion is present.

Pancreas: Congestion is present.

Case No. 8. Female 3000 g.

Thyroid: Acini are comparatively small. Colloid is pale. Epithelium is flat and cuboidal. Congestion present.

Parathyroid: Many principal cells show fat droplets, and their number is increased. Congestion present.

Thymus: Congestion is present.

Hypophysis: Eosinophils are increased and hyperplastic. A majority of the chief cells show fatty degeneration and there is congestion of the anterior lobe.

Spleen: There is marked congestion. Reticular cells are increased in number. Some lymph follicles are hypertrophic.

Suprarenal gland: Capillaries show congestion in zona fasciculata.

Ovary: Congestion present. Graafian follicles are present in moderate number.

Pancreas: No marked change.

Resumé: Acini were small or moderate sized, colloid was pale, epithelium was flat and cuboidal, capillaries were congested in the thyroid. Principal cells were increased markedly and showed fatty degeneration. Congestion was noted in the parathyroid. The thymus showed congestion. Eosinophils were increased and hypertrophic, chief cells for the most part were degenerated, and there was congestion of the anterior lobe of hypophysis. Congestion of the spleen was noted. The cortex of suprarenal gland, ovary and pancreas were congested.

2. USING LARGE DOSES

Rabbits received intravenous injections of garlic extract at the rate of 1.0 cc per kilogram of body weight.

Case No. 9. Female 2400 g.

Thyroid: Acini are mostly large sized. Colloid is pale. Epithelium is flat. Capillaries are congested.

Parathyroid: Principal cells show fatty degeneration. Congestion is present.

Thymus: Eosinophils are increased. Reticular cells are hyperplastic in medulla. Congestion present.

Hypophysis: Eosinophils are increased and show marked hypertrophy in the anterior lobe.

Spleen: Lymph follicles are hypertrophic. Passive congestion is marked and reticular fibers and cells are increased. Markedly hemosiderin bearing cells are present in large numbers in the splenic pulp.

Suprarenal gland: Capillaries are congested in zona reticularis.

Testicle: Congestion present.

Pancreas: There is marked congestion.

Case No. 10. Male 2500 g.

Thyroid: Acini are generally small sized. Colloid is pale. Epithelium is flat and cuboidal.

Thymus: Eosinophils are increased in medulla. Congestion is present.

Hypophysis: Eosinophils are increased in the anterior lobe. Capillaries are congested in the intermediate lobe.

Spleen: Lymph-follicles hypertrophic. Reticular cells hyperplastic in pulp and some passive hyperemia.

Suprarenal gland: Capillaries of cortex are congested and hemorrhage in medulla.

Testicle: Blood vessels show marked congestion.

Pancreas: Congestion in stroma.

Case No. 11. Male 2000 g.

Thyroid: Acini are small. Colloid is pale with many fat droplets. Epithelium is hyperplastic and cuboidal. There is congestion.

Parathyroid: Principal cells mostly show fatty degeneration. There is congestion of the tissues.

Thymus: Eosinophils are increased in medulla. Blood vessels show congestion.

Hypophysis: Eosinophils are increased and capillaries are congested in anterior lobe. Capillaries of the intermediate lobe show congestion.

Spleen: Lymph-follicles are hypertrophic. Reticular cells are increased and the pulp shows passive congestion.

Suprarenal gland: Capillaries in zona reticularis and in medulla show congestion.

Testicle and pancreas: Congestion present.

Case No. 12. Male 2000 g.

Thyroid: Acini are mostly large sized. Colloid is pale with vacuoles. Epithelium is flat. Congestion is present.

Hypophysis: Eosinophils are hyperplastic and hypertrophic. Capillaries show congestion and chief cells show fatty degeneration in the anterior lobe.

Spleen: Lymph-follicles are atrophic. Eosinophils are increased.

Suprarenal gland: Medulla shows congestion.

Ovary: Graafian follicles are abundant. Corpora lutea are few in number.

Pancreas: Congestion is evident.

Resumé: In the thyroid acini were either large or small sized. Colloid was usually pale. Epithelium was flat and cuboidal and somewhat hyperplastic. Congestion was marked. In the parathyroid the principal cells for the most part showed fatty degeneration and showed congestion. In the thymus eosinophils were increased and congestion was noted. In the anterior lobe of the hypophysis, eosino-

phils were increase and hypertrophic, chief cells showed fatty degeneration and there was congestion throughout the organ except in the posterior lobe. Lymph-follicles of the spleen were hypertrophic as were the reticular cells and fibers. Passive congestion was noted in the pulp of spleen. There was congestion in the cortex of the adrenal especially in zona reticularis and hyperemia or even hemorrhage was found in the medulla. The testicle showed marked congestion. The Graafian follicles of the ovary were abundant and corpora lutea rare. The pancreas showed congestion.

Thus congestion of blood vessels was found in thyroid, parathyroid, adrenal cortex, pancreas, anterior and intermediate lobe of hypophysis, thymus, ovary and in testicle. Epithelium was hyperplastic in some thyroids. Parathyroid principal cells for the most part showed fatty degeneration and were increased in number. In the spleen passive congestion and hyperplasia of reticular tissue and hypertrophy of lymph follicles were noted especially in the cases of large doses. In the anterior lobe of the hypophysis eosinophils were increased and hypertrophic and chief cells showed fatty degeneration. These changes were found after both small and large doses.

III. EFFECTS OF GARLIC EXTRACT INJECTION KEPT UP FOR THREE WEEKS

In this experiment, rabbits received intravenous injections of garlic extracts for three weeks after which endocrine organs were examined.

1. USING SMALL DOSES

Rabbits received doses of garlic extract at the rate of 0.5 cc per kilogram of body weight.

Case No. 13. Female 3100 g.

Thyroid: Acini are mostly large sized. Colloid is pale. Epithelium is flat. There is congestion.

Parathyroid: Principal cells for the most part show fatty degeneration. Blood vessels show congestion.

Thymus: Reticular cells are hyperplastic.

Hypophysis: Eosinophils are increased and hypertrophic, there is congestion of the anterior lobe and in the intermediate lobe.

Spleen: Reticular cells are more or less hyperplastic. There is passive hyperemia of the pulp.

Suprarenal gland: Capillaries of the zona fasciculata are congested and hemorrhage is noted in the zona reticularis, where there is also necrosis of cells and infiltration of small round cells. The medulla is congested.

Ovary: Ovarian follicles are decreased and atrophic. Interstitial cells are hyperplastic.

Case No. 14. Female 3100 g.

Thyroid: Acini are mostly small. Colloids are pale. Epithelium is flat. There is some congestion.

Parathyroid: Principal cells for the most part show fatty degeneration. There is congestion.

Thymus: Congestion is present.

Hypophysis: Eosinophils are more or less hyperplastic.

Spleen: Reticular cells are more or less increased and the pulp shows hyperemia.

Suprarenal gland: Shows congestion of the zona fasciculata, and medulla.

Ovary: Ovarian follicles are absent. Stroma has increased markedly and in places show fatty degeneration. There is congestion.

Pancreas: Congestion is present.

Case No. 15. Male 2000 g.

Parathyroid: Principal cells for the most part show fatty degeneration. There is congestion.

Hypophysis: Eosinophils are hyperplastic and the anterior lobe shows congestion.

Spleen: Lymph-follicles are atrophic. Reticular cells are increased and passive congestion is present in pulp.

Suprarenal gland: No marked change is evident.

Ovary: Follicles are mostly atrophic. Stroma cells are hyperplastic.

Pancreas: No marked change.

Case No. 16. Female 2000 g.

Spleen: Lymph-nodules are markedly atrophic. Reticular cells are hyperplastic and there is passive congestion of the splenic pulp.

Suprarenal gland: With the exception of the zona glomerulosa and fasciculata the tissues are necrotic.

Testicle: Seminiferous epithelium is degenerated and spermatogenesis is decreased. Interstitial tissues, especially the interstitial cells are hyperplastic. There is congestion.

Pancreas: No marked change.

Case No. 17. Male 2000 g.

Hypophysis: In the anterior lobe eosinophils are hyperplastic and hypertrophic.

Spleen: The capsule is thickened, the lymph-follicles are atrophic. Reticular cells and fibers in pulp are hyperplastic.

Pancreas: No marked change.

Resumé: The thyroid showed congestion. The acini were mostly small, epithelium was flat or cuboidal and hyperplastic, colloid was pale. In the parathyroid many principal cells showed fatty degeneration and there was congestion. In the thymus reticular cells were increased and there was congestion. There was congestion in the anterior lobe of the hypophysis and eosinophils were increased in size and number. There also was congestion of the intermediate lobe. In the spleen the lymph-follicles were mostly atrophic. In the pulp reticular cells and fibers were hyperplastic and there was passive congestion. In the suprarenal gland there was congestion of the cortex and medulla. Hemorrhage or necrosis was to be found in either cortex or medulla and at times there was small round cell infiltration. Ovarian follicles were atrophic or absent

while the interstitial cells were hyperplastic or showed fatty degeneration. The ovary was definitely congested. Seminiferous epithelium was degenerated and the stroma tissues especially the interstitial cells were hyperplastic and showed fatty degeneration. Congestion was noted and spermatogenesis appeared to be slow. The pancreas showed congestion.

2. USING LARGE DOSES

Rabbits received intravenous injections of garlic extract at the rate of 0.5 cc per kilogram of body weight.

Case No. 18. Male 2500 g.

Thyroid: The acini are mostly small. Colloid is pale. Hyperplastic epithelium was flat or cuboidal. There was congestion and some evidence of hemorrhage. Interstitial connective tissue is hyperplastic.

Parathyroid: Congestion is present.

Thymus: Marked congestion was present.

Hypophysis: Eosinophils increased in anterior lobe.

Spleen: Reticular cells and lymph-follicles are hypertrophic.

Suprarenal gland: Hemorrhages appear in zona fasciculata and reticularis of cortex. The capsule shows congestion.

Testicle: Seminiferous epithelium is degenerated and spermatogenesis appears to be decreased. Interstitial tissue especially interstitial cells are increased. Congestion is present.

Pancreas: No marked change.

Case No. 19. Female 2600 g.

Thyroid: Acini are mostly large. Colloid is pale. Epithelium is flat. Congestion is present.

Parathyroid: Principal cells show fatty degeneration. Eosinophil cells are rare. Congestion is present.

Thymus: Reticular cells are slightly increased.

Hypophysis: In the anterior lobe eosinophils are increased, chief cells show fatty degeneration. Both lobes are congested and basophil cells are increased in posterior lobe.

Spleen: Lymph-follicles show some hypertrophy. Passive congestion is noticeable in pulp.

Suprarenal gland: Capillaries show marked congestion in the zona reticularis.

Ovary: Follicles are mostly atrophic. Stroma cells are markedly hyperplastic.

Pancreas: Congestion is present.

Resumé: In the thyroid acini are either small or large. Colloid is pale, epithelium is flat or cuboidal and hyperplastic. There are both congestion and hemorrhagic areas, connective tissues are hyperplastic. In the parathyroids principal cells show fatty degeneration. There is congestion. In thymus blood vessels show congestion and reticular cells are slightly increased. In the anterior lobe of the pituitary eosinophils are increased, chief cells show fatty degeneration. There is congestion in both lobes and basophils are increased in the posterior lobe. In the spleen lymph-follicles are hyperplastic. Hemorrhage or congestion is found in the cortex of the suprarenal

gland. In the testicle parenchyma degenerated and interstitial tissues are increased, and there is congestion. Ovarian follicles are atrophic and the stroma of the ovary is hyperplastic.

Thus active hyperemia was found in thyroid, parathyroid, thymus, the anterior, intermediate and posterior lobe of hypophysis, suprarenal cortex, ovary, testicle and pancreas. Epithelium was hyperplastic in certain thyroids, and connective tissue was often hyperplastic. Hemorrhage was present in thyroid and suprarenal cortex. Principal cells showed fatty degeneration in the parathyroid. Reticular cells were increased in thymus. Necrosis was found in the cortex and medulla of the suprarenal cortex, especially after small doses. Eosinophils were increased in the anterior lobe of hypophysis and chief cells showed fatty degeneration after large doses. Basophils increased in posterior lobe after large doses. Lymph-follicles were atrophic and reticular tissues of the spleen were increased after small doses and lymph-follicles were hypertrophic after large doses. Passive hyperemia was found in spleen pulp after small doses. Ovarian follicles were atrophic and stroma increased in ovaries after either small or large doses. In the testicle the parenchyma was degenerated and interstitial tissues increased after either small or large doses.

IV. EFFECT OF GARLIC EXTRACT INJECTION FOR FOUR WEEKS

In this experiment rabbits received intravenous injection during four weeks of garlic extract and endocrine organs were examined histologically.

1. USING SMALL DOSES

Rabbits received intravenous injection of garlic extract at the rate of 0.5 cc per kilogram of body weight.

Case No. 20. Female 2700 g.

Thyroid: Acini are mostly small. Epithelium is flat. Colloid is pale. Congestion is present.

Parathyroid: Principal cells show fatty degeneration. Reticular cells and fibers are hyperplastic. There is congestion.

Thymus: Reticular cells are markedly increased in number. Parenchyma is atrophic. Congestion is present and there are hemorrhagic areas. Eosinophils were noted.

Hypophysis: Eosinophils are markedly increased and hypertrophic and there is congestion in the anterior lobe. Glia cells are increased and there is congestion in posterior lobe.

Spleen: Lymph-follicles are hypertrophic. Passive hyperemia is present and reticular cells are increased, eosinophils in pulp are increased.

Suprarenal gland: There is congestion in zona glomerulosa and reticularis.

Ovary: Follicles are mostly atrophic. Stroma cells are increased in size and vacuolated. There is congestion.

Pancreas: No marked change.

Case No. 21. Male 3550 g.

Thyroid: Acini are mostly small. Colloid is pale. Epithelium is flat. Interstitial tissues are increased. Congestion is present.

Parathyroid: Principal cells show fatty degeneration. Reticular cells are increased. There is congestion.

Thymus: Parenchyma is atrophic. Connective tissues are hyperplastic. There is congestion. The walls of the blood vessels and connective tissue fibers often show hyaline degeneration.

Hypophysis: In the anterior lobe eosinophils are increased and hypertrophic, and congestion is present.

Spleen: Lymph-follicles hypertrophic. The walls of central arteries show hyaline degeneration. Reticular cells are increased, passive hyperemic congestion is present and eosinophils are increased in the spleen.

Suprarenal gland: There is congestion in the zona fasciculata and reticularis of cortex. Medullary cells are necrobiotic and swollen.

Testicle: Seminiferous epithelium is for the most part degenerated or absent. Interstitial tissues, especially the interstitial cells are hyperplastic. Interstitial tissues show hyaline degeneration. There is general congestion.

Pancreas: This organ shows congestion.

Case No. 22. Female 1750 g.

Thyroid: Acini are mostly moderate in size. Colloid is pale. Epithelium is flat, cuboidal or ovoid, and is hyperplastic. There is congestion.

Parathyroid: Capillaries are congested. Reticular cells are hyperplastic.

Thymus: Parenchymatous lymphoid cells are almost absent. Reticular cells are increased. There is congestion.

Hypophysis: In the anterior lobe eosinophils are increased and hypertrophic; reticular cells are increased. Both anterior and posterior lobe are congested.

Spleen: Lymph-follicles are hypertrophic. The wall of the central arteries shows hyaline degeneration. There is passive hyperemia and reticular cells and fibers are increased.

Suprarenal gland: Medullary cells show karyolytic nuclei, capillaries of the medulla are congested.

Ovary: Follicles are atrophic or absent. Interstitial cells are hyperplastic. There are a few hemorrhages.

Pancreas: There is general congestion.

Case No. 23. Male 2000 g.

Thyroid: Acini are mostly small. Colloid is pale and vacuolated. Epithelium is flat or cuboidal and hyperplastic. There is congestion.

Hypophysis: Eosinophils are decreased. Chief cells mostly show fatty degeneration. There is congestion.

Spleen: Lymph-follicles are hypertrophic. The walls of central arteries show slight evidences of hyaline degeneration. Reticular cells of the pulp are hyperplastic.

Suprarenal gland: Congestion is noted in zona fasciculata and reticularis.

Testicle: Seminiferous tubules are vacuolated and there is degeneration of the cells which have often disappeared altogether. Interstitial tissue, especially interstitial cells are hyperplastic. There is general congestion.

Pancreas: There is general congestion.

Case No. 24. Male 2000 g.

Hypophysis: In anterior lobe eosinophils are atrophic and chief cells show fatty degeneration. There is congestion.

Spleen : Lymph-follicles are hypertrophic. The wall of the central arteries show hyaline degeneration. Reticular cells and eosinophils of the pulp are increased.

Suprarenal gland : In medulla there is some congestion.

Testicle : Seminiferous epithelium is for the most part degenerated or absent and there cells show vacuolation. The interstitial tissue, especially the interstitial cells are hyperplastic. There is congestion.

Pancreas : There is general congestion.

Case No. 25. Male 2000 g.

Hypophysis : Eosinophils are enlarged and capillaries show congestion in the anterior lobe.

Spleen : Lymph-follicles are hypertrophic. Reticular cells in pulp are hyperplastic.

Suprarenal gland : In zona fasciculata and reticularies and in medulla there is marked congestion.

Testicle and *Pancreas* : These organs show congestion.

Case No. 26. Male 2000 g.

The anterior lobe of hypophysis : Eosinophils are decreased and atrophic. The chief cells show fatty degeneration. There is congestion.

Spleen : Lymph-follicles are hypertrophic. The walls of the central arteries show hyaline degeneration. There is passive hyperemia in the pulp and the reticular cells are increased in number.

Suprarenal gland : The medulla shows congestion.

Testicle : Seminiferous epithelium is markedly degenerated and shows vacuolation. Interstitial tissues, especially the interstitial cells are increased. There is congestion of all the tissues.

Pancreas : There is congestion.

Resumé : In the thyroid acini were mostly small, epithelium was flat and cuboidal and at times hyperplastic, colloid was pale. There was congestion and at times interstitial fibrous tissue was increased. In parathyroids the principal cells showed fatty degeneration. Reticular cells were increased in number. In thymus reticular tissues were markedly increased and there was congestion. In the anterior lobe of hypophysis eosinophils were increased and at times hypertrophic. At other times they were decreased and atrophic. There was congestion of the anterior lobe and the chief cells showed fatty degeneration. In the posterior lobe of hypophysis glia cells were increased and capillaries showed some congestion. In the spleen lymph-follicles were hypertrophic and in the pulp reticular cells and fibers were increased in number and the wall of central arteries and some connective tissues cells showed hyaline degeneration. There was also increase of eosinophils and passive congestion was noted. In both cortex and medulla of the suprarenal congestion was quite marked and cells of the medulla were necrotic. In the testicles seminiferous epithelium showed some degeneration, the cells were vacuolated. The interstitial tissues especially interstitial cells were hyperplastic and there was general

congestion. There was congestion of the ovary and follicles were atrophied and stroma increased in number. In the pancreas there was congestion.

2. USING LARGE DOSES

Rabbits received intravenous injections of garlic extract at the rate of 1.0 cc per kilogram of body weight.

Case No. 27. Male 2950 g.

Thyroid: Acini are mostly large. Colloid is pale. Epithelium is flat. Hemorrhagic areas are noted and general congestion.

Parathyroid: Principal cells show some fatty degeneration. There is both congestion and hemorrhage. Reticular cells and fibers are hyperplastic.

Thymus: Congestion is noted.

Hypophysis: Eosinophils are atrophic and decreased, chief cells are fatty degenerated and there is congestion of the anterior lobe.

Spleen: Lymph-follicles are hypertrophic. There is chronic passive congestion and some hemorrhage in the pulp. Reticular cells and connective tissues are hyperplastic and hyaline degenerated fibers were noted in pulp.

Suprarenal gland: Capillaries are congested in both zona fasciculata and reticularis.

Testicle: Seminiferous tubules are mostly destroyed and cells show vacuolation. Interstitial connective tissue and especially interstitial cells are increased. There is general congestion of the organ.

Pancreas: Pancreas also shows general congestion.

Case No. 28. Male 2600 g.

Thyroid: Acini are mostly small-sized. Colloid is pale. Epithelium is cuboidal and hyperplastic. Connective tissues in the stroma are hyperplastic and there is general congestion.

Parathyroid: Principal cells show much fatty degeneration. There is congestion.

Thymus: Reticular cells are increased and the wall of blood vessels show hyaline degeneration. There is general congestion.

Hypophysis: In the anterior lobe eosinophils are atrophic and decreased. The chief cells show fatty degeneration and all capillaries are distended. Reticular cells are more or less hyperplastic.

Spleen: Lymph-follicles are hypertrophic. The wall of central arteries show some hyaline degeneration. There is passive hyperemia and the reticular cells in the pulp are increased in number.

Suprarenal gland: There is marked congestion in capsule, zona fasciculata and in medulla.

Testicle: The seminiferous tubules are for the most part destroyed and the cells remaining are vacuolated. Interstitial tissue is markedly hyperplastic and show some hyaline degeneration. Interstitial cells are notably hyperplastic and hypertrophic. There is general congestion.

Pancreas: There is congestion of the whole organ.

Resumé: In the thyroid acini were either large or small, colloid was pale, epithelium was flat or cuboidal and often hyperplastic, hemorrhage and congestion were found in the interstitium, and the interstitial connective tissues in general were hyperplastic. In the

parathyroid principal cells usually showed fatty degeneration and congestion and hemorrhage were noted. Reticular tissues were usually hyperplastic. In the thymus general congestion was found, reticular cells were increased and hyperplastic and the wall of blood vessels showed hyaline degeneration. In the anterior lobe of the hypophysis eosinophils were atrophic and decreased and the chief cells showed fatty degeneration and there was general congestion. In the spleen lymph-follicles were hypertrophic, the wall of central arteries and connective fibers show hyaline degeneration and passive hyperemia or hemorrhage and increase of reticular cells and fibers were noted in the pulp. In capsule, cortex and medulla of suprarenal gland there was marked congestion. Seminiferous tubules were for the most part destroyed and vacuolated. Interstitial tissue especially interstitial cells were hyperplastic and the testicular tissues were all congested. The tissues of the pancreas were all congested.

Active hyperemia was thus found in thyroid, parathyroid, thymus, the anterior and posterior lobe of hypophysis, suprarenal gland, ovary, testicle and pancreas. Epithelium and connective tissues were hyperplastic in the thyroid. Principal cells showed fatty degeneration, reticular cells were increased, and hemorrhage was noted especially after large doses in parathyroid. In the thymus reticular cells were markedly increased and blood vessels walls showed hyaline degeneration after large doses. Eosinophils in the anterior lobe were hypertrophic and hyperplastic after small doses but were atrophic and decreased after large doses. In the anterior lobe, the chief cells showed fatty degeneration and glia cells were increased in the posterior lobe of hypophysis. Lymph-follicles of the spleen were generally hypertrophic, reticular cells and fibers were increased and the walls of blood vessels and connective tissues both showed hyaline degeneration. Eosinophils were increased and passive congestion was noted in spleen. In the testicles seminiferous tubules were mostly damaged or vacuolated and interstitial tissues and interstitial cells were hyperplastic. Ovarian follicles of the ovary were atrophied and stroma cells were hyperplastic after the small doses.

DISCUSSION

The following changes were found in each series as above reported. That is, after small or large doses of garlic extract during one, two, three or four weeks.

Active hyperemia of blood vessels in thyroid, parathyroid, adrenal cortex, thymus, pancreas, the anterior lobe of hypophysis, testicle and ovary were seen and passive hyperemia of spleen was noted. Thus, garlic extract intravenously administered to the rabbit causes blood circulatory disturbances throughout the endocrine glands in all my experiments. In the same way fatty degeneration of principal cells in parathyroid, and hyperplasia of reticular cells in spleen were also found throughout in all my experiments. Lymph-follicles of the spleen at first appeared atrophic, but later became hypertrophic. That is, long continued injection of garlic extract stimulates growth of the lymph-follicles of the spleen. The eosinophils of the anterior lobe of the hypophysis increase and are hypertrophic at first, but later decrease and are atrophic. The chief cells also showed fatty degeneration later. Thus, garlic extract accelerates the function of the anterior lobe, but later inhibits it. In the thyroid, the acinar epithelium was at first hyperplastic and the function was accelerated, but later the interstitial tissue increased and the thyroid function was definitely interfered with. The reticular cells of the thymus showed slow hyperplasia. Seminiferous tubules of the testicle were destroyed at a late stage of the injections by the garlic extract and at the same time interstitial tissue, especially the interstitial cells increased. The ovarian follicles of the ovary finally became atrophic and the interstitial cells increased. Thus marked and various histological changes occurred in various endocrine organs of rabbits after injections of garlic extract, a substance which is used daily in the diet of Korean people.

Garlic extract which at first stimulates the blood vascular system later accelerates or inhibits various endocrine organs as described above. These findings are similar to those of Suematsu's (6) (7) (8) with mustard or pepper.

SUMMARY AND CONCLUSIONS

(1) The injection daily into rabbits of 0.5 cc of rocambole extract per kilogram of body weight during one week was followed by a series of marked changes. Thus eosinophils increased in the anterior lobe of hypophysis, lymph-follicles of the spleen became atrophic and reticular cells were hyperplastic in splenic pulp. In the ovary interstitial cells were hyperplastic and spermatogenesis was decreased in testicle. Congestion was noted in thyroid, parathyroid, thymus, anterior lobe of hypophysis, adrenal cortex, testicle, pancreas and spleen, and the principal cells of parathyroid showed fatty degeneration.

(2) In rabbits receiving 1 cc of rocambole extract per kilogram of body weight daily for one week, the interstitial tissues were hyperplastic in the testicle only while others changes were as previously described (1).

(3) In rabbits receiving 0.5 cc of rocambole extract per kilogram of body weight for two weeks, the changes seen were almost the same as in (1) except that the thyroid showed evidences of hyperactivity.

(4) In rabbits, receiving 1 cc of rocambole extract per kilogram of body weight daily for two weeks, the thyroid gland showed the picture of hyperactivity and the chief cells of the anterior lobe of hypophysis showed fatty degeneration. Other changes were as described in (1).

(5) In rabbits receiving 0.5 cc of rocambole extract per kilogram of body weight daily for three weeks, hemorrhage and necrosis were noted in adrenal cortex, and the seminiferous epithelium of the testicles was almost destroyed and the interstitial cells were markedly hyperplastic. Other changes were as described in (4).

(6) In rabbits, receiving 1 cc of rocambole extract per kilogram of body weight daily for three weeks the thyroid still showed the picture of hyperactivity, but the interstitial tissues showed more or less hyperplasia. In thymus the reticular cells were increased, in anterior lobe of hypophysis the chief cells showed fatty degeneration, while basophils were increased in the posterior lobe of hypophysis. The lymph-follicles of the spleen showed hypertrophy. In the other organs, the same changes were found as described in (5).

(7) In rabbits, receiving 0.5 cc of rocambole extract per kilogram of body weight daily during four weeks, atrophy of thyroid acini and hyperplasia of connective tissue were noted, which indicates hypofunction. Eosinophils of anterior lobe of hypophysis in certain cases began to decrease and to be atrophic. In the spleen the walls of central arteries and connective tissues often showed hyaline degeneration. In other organs the changes were as in (6).

(8) In rabbits, receiving 1 cc of rocambole extract per kilogram of body weight daily during four weeks, the picture of hypofunction was found in the thyroid gland, with more marked fatty degeneration in the parathyroid. Eosinophils were decreased and markedly atrophic in the anterior lobe of the hypophysis. The thymus showed hyaline degeneration of blood vessels walls. In other organs the changes were as in (7).

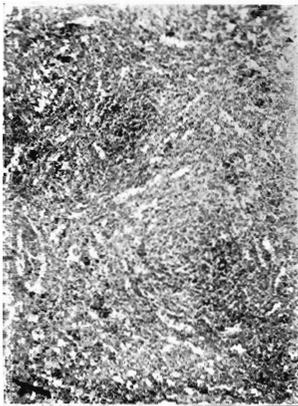
(9) Thus, marked changes were found in thyroid, parathyroid, anterior lobe of hypophysis, spleen, testicle and ovary after injections of rocambole extract for from one to four weeks the daily dose being 0.5 to 1.0 cc per kilogram of body weight.

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DESCRIPTION OF PLATE

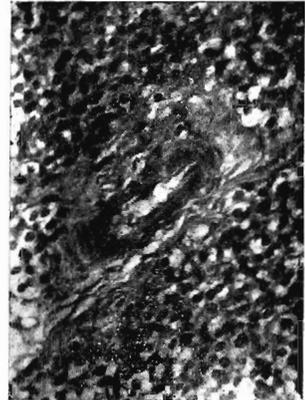
- Fig. 1. Case No. 17. Spleen, follicles atrophic, $\times 103$.
- Fig. 2. Case No. 23. Spleen, follicles hypertrophic, $\times 103$.
- Fig. 3. Case No. 11. Parathyroid, principal cells show fatty degeneration capillaries congested, $\times 480$.
- Fig. 4. Case No. 27. Parathyroid, principal cells show fatty degeneration, reticular cells and fibers are increased, congestion present, $\times 480$.
- Fig. 5. Case No. 11. Thyroid, epithelium cuboidal and hyperplastic, acini small, $\times 103$.
- Fig. 6. Case No. 27. Thyroid, epithelium flat, acini large, $\times 103$.
- Fig. 7. Case No. 7. Hypophysis, anterior lobe, eosinophils increased and hypertrophic, $\times 480$.
- Fig. 8. Case No. 27. Hypophysis, anterior lobe, eosinophils decreased and atrophic, chief cells show fatty degeneration, $\times 480$.
- Fig. 9. Case No. 27. Testicle, seminiferous tubules destroyed, congestion present, interstitial tissue hyperplastic, $\times 103$.
- Fig. 10. Case No. 21. Testicle, seminiferous epithelium degenerated or absent, interstitial tissue, interstitial cells are hyperplastic, $\times 480$.
- Fig. 11. Case No. 14. Ovary, follicles absent, interstitial cells are markedly hyperplastic, $\times 103$.
- Fig. 12. Case No. 12. Suprarenal gland, medullary cells show cloudy swelling, $\times 103$.



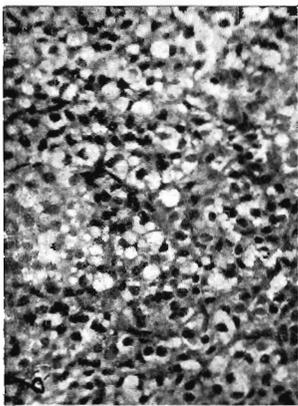
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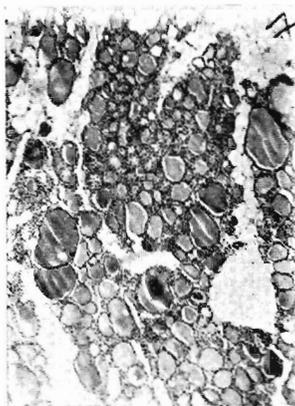
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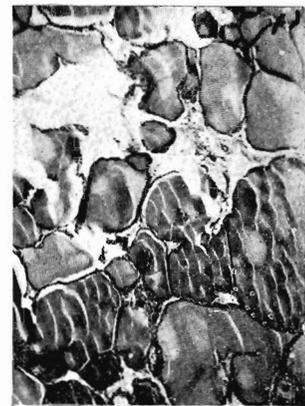
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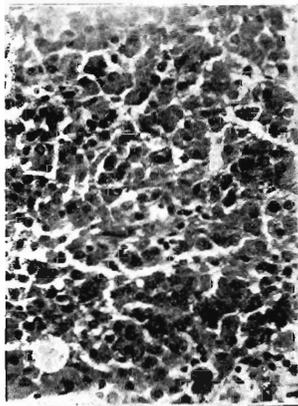
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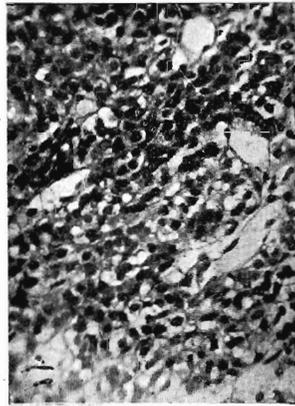
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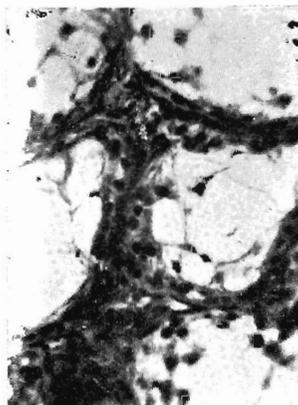
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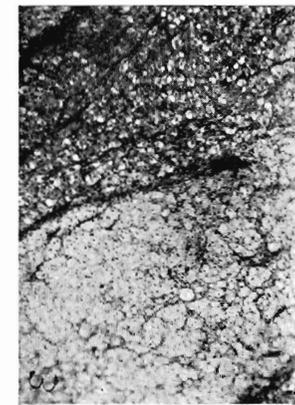
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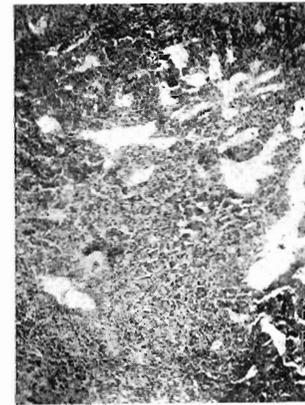
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