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Effect of Caffeine on Basal Metabolism.

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In a recent report we called attention to the fact that when certain of the methylated purines were fed or injected into dogs morphological evidence of increased activity of the thyroid gland was obtained.[1, 2, 3, 4] Toxic and frequently fatal doses of these substances were often required to produce such changes. These studies have been extended with especial reference to the calorigenic action of one of these purines, namely, caffeine citrate.

It has been realized for some time that caffeine possesses the ability to increase the oxygen consumption in the organism.[2] The mechanism has been vague although the adrenal glands, the skeletal muscle and the central nervous system have all been suggested as playing some part in this process. The present report has to do with the relation of the thyroid gland to this phenomenon.

Young guinea pigs weighing between 350 and 450 gm. were used. The basal metabolic rate was determined by a method previously described by us in which a closed circuit is used and direct oxygen consumption measured. A normal rate of oxygen consumption was established for each animal before the experiment was begun. These animals were placed on a basal diet of lettuce, oats and alfalfa. Basal metabolism determinations were made on alternate days for 2 weeks before the normal rate of oxygen consumption was considered established. Unless the animal showed 5 successive readings of the same rate the basal rate was not considered established. Each animal was fed 70 mg. of caffeine citrate by mouth per kilo of body weight. Apparently the method of administering the caffeine was of little importance. Determinations were made one hour later. A progressive rise in the basal metabolic rate was noticed which reached a peak at about the end of 2 weeks. At this time the increase was generally from 40%-75%. There was then a gradual decline until by the end of the fourth week the increase was more or less constant at a level of about 20%-25% increase. When the basal

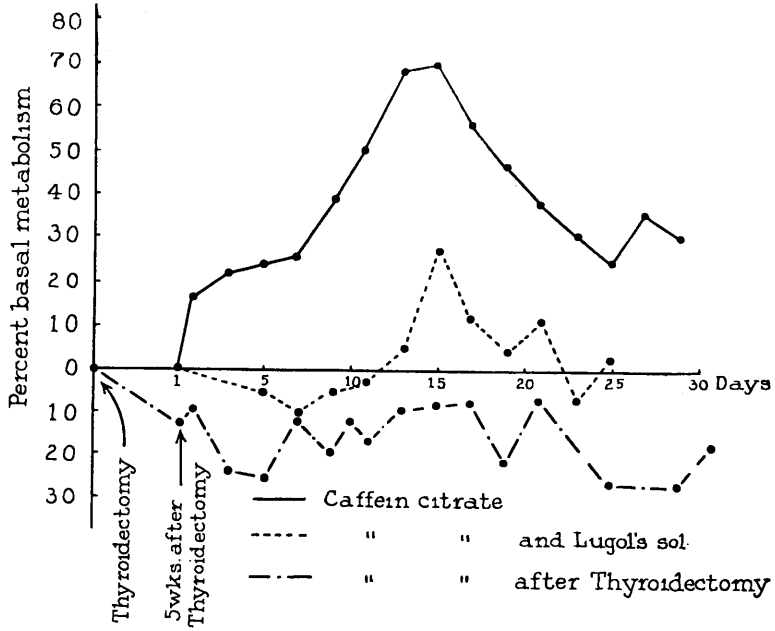
1 Cole, Womack, and Ellett, *Arch. Surg.*, 1931, **22**, 926.

2 Edsall and Means, *Arch. Int. Med.*, 1914, **14**, 897.

3 Higgins and Means, *J. Pharm. and Exp. Med.*, 1915, **7**, 1.

4 Means, Aubard DuBois, *Arch. Int. Med.*, 1917, **19**, 832.

metabolism determinations were made 24 hours after caffeine feeding the rise was still seen to be present but not quite so marked. Animals sacrificed at the end of 4 weeks showed little evidence of hyperactivity of the thyroid gland.



Another series of animals was studied under similar conditions with the exception that they were fed one minim of Lugol's solution daily beginning 2 days before the feeding of caffeine citrate and continued throughout the experiment. Very little rise in the oxygen consumption was noticed. When this did occur it was generally most prominent at about the end of the second week and was rarely over 20%-25%. Apparently, therefore, iodine is capable of preventing the calorigenic action of caffeine to a large extent.

A third series of animals in which thyroidectomy had been done was studied. At the end of 5 weeks it was found that the oxygen consumption had fallen from 9%-13% below normal. Caffeine citrate was then fed and basal metabolism determinations made as in series one. A slight rise was seen usually about 10% above the thyroidectomized level but rarely reaching the level of oxygen consumption previous to the thyroidectomy. The animals were sacrificed and serial sections made of the neck. In every case a small amount of accessory thyroid tissue was found although at times this consisted of only several acini. However, none of these animals can be considered totally thyroidectomized.

Conclusions. Caffeine citrate increases the basal metabolic rate of guinea pigs. This increase is present 24 hours after feeding caffeine though not quite so marked. Lugol's solution or thyroidectomy tends to prevent this calorigenic action.

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Effect of Supersonic Waves on Bacteria.

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Destruction of living organisms by supersonic waves has recently been observed.[1] The mechanism of the destruction is, however, unknown. The present communication extends the observation to a number of pathogenic and nonpathogenic bacteria and the results seem to indicate that the destruction is due to the dissolution of the bacterial cells.

The oscillating circuit was similar to that described by Wu and Liu,[2] and the quartz was adjusted to vibrate at the rate of 1.5×10^6 times per second. Bacterial suspensions to be exposed were placed in a thin test tube, 15 mm. in diameter. Inside the test tube was placed a glass cooling coil through which cold water circulated. The temperature of the bacterial suspension was never over 20° C. The possibility of destruction by heat was therefore eliminated.

Saline suspensions of the following 10 strains of bacteria were used: *Bacillus subtilis, Bacillus anthracis, Bacillus proteus X* 19, *Bacillus coli communis, Bacillus typhosus, Bacillus dysenteriae Shiga, Staphylococcus aureus, Micrococcus catarrhalis, Bacillus influenzae,* and *Streptococcus hemolyticus.* The number of surviving bacteria per cc. before and after exposure was determined by counting the colonies in poured plates. In the case of *Bacillus influenzae* streak plating was used. Control experiments with bacterial suspension standing at room temperature without exposure showed no significant change in the number of surviving bacteria. Results are shown in Fig. 1.

[1] Wood, R. W., and Loomis, A. L., *Phil. Mag.*, 1927, **4**, 417. Harvey, S. N., and Loomis, A. L., *J. Bact.*, 1929, **17**, 373. Beckwith, T. D., and Olson, A. R., PROC. SOC. EXP. BIOL. AND MED., 1931, **29**, 362. Williams, O. B., and Gaines, N., *J. Inf. Dis.*, 1930, **47**, 485.

[2] Wu, H., and Liu, S. C., PROC. SOC. EXP. BIOL. AND MED., 1931, **28**, 782.