4154

Experimental Food Poisoning in White Mice with Heat Stabile Paratyphoid Poisons.

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A study of human outbreaks of food poisoning indicates that a severely irritant substance, probably produced by representatives of the paratyphoid-enteritidis group and other bacteria when growing on foods rich in protein, exerts its action on the alimentary tract. A number of workers (Savage and White,[1] Branham, Robey and Day[2] and others) have sought for experimental evidence of such an irritant. Most of the experiments were inconclusive or merely suggestive on account of the apparent insensitiveness of the animal in contrast to the human intestinal tube. Following the oral administration of living or dead paratyphoid bacilli a definite pathological reaction was either absent or unobtrusive; and delayed (5 to 10-14 days, Branham and Day) symptoms were produced unless a general infection was eventually set up. However, in this connection it must be recalled that Gärtner[3] as early as 1888 observed significant clinical and pathological manifestations in mice fed with meat previously contaminated with *B. enteritidis* and heated for 1 hour at 100°. A casual perusal of the literature indicates that the experiments of Gärtner have never been repeated on a large scale or with strains which have been recently isolated from outbreaks of food poisoning. The toxicity of these organisms is usually tested by parenteral injections of filtrates or boiled cultures and not by systematic feeding experiments (Bahr and Dyssegaard[4]). These considerations suggested a renewed investigation. Although the studies are still in progress a number of interesting observations deserve wider recognition.

Under suitable experimental conditions which will be detailed elsewhere certain strains of *B. aertrycke* produce after an incubation time of 3 to 4 days at 37° C. a highly potent enterotropic poison. The active principle is present in filtrates in very potent concentra-

[1] Savage and White, Med. Res. Council, Special Rep., Series 91, 1925, 111.

[2] Branham, Robey and Day, *Arch. Path.*, 1928, v, 742; *J. Bacteriol.*, 1928, xv, 36.

[3] Gärtner, *Correspondenz-Blatter d. allg. arztl. Vereins v. Thüringen*, 1888, xvii, 590.

[4] Bahr and Dyssegaard, *Centralbl. f. Bakteriol.*, 1927, cii, 268.

tions, in heated whole fluid cultures. It acts both by intraperitoneal injection and by feeding with the aid of a catheter, or when mixed with bread. The production of symptoms and characteristic anatomical changes was practically universal when a particular strain in a special medium was heated for 10 to 60 minutes at 100° C. or subjected to a temperature of 240° for 10 minutes in the autoclave. Administered by catheter the sterile, heated poison was fatal to mice weighing approximately 20 gm. in some instances in 0.05 cc. and usually in 0.1, 0.2 and 0.5 cc. amounts. The heated media treated in an identical manner as the cultures are not poisonous.

TABLE I.

Fed 0.5 cc. of fluid culture of *B. aertrycke* grown 4 days—then sterilized by	No. of mice fed	No. of deaths	Elapse of time from feeding to death
1. 10 minutes at 100°	5	5	10-13 hours.
2. 60 minutes at 100°	5	3	3-13 hours.
3. Autoclaved 10 min. at 240°	5	5	1 in 7 and 4 in less than 24 hours.

Approximately 30 minutes after oral administration, the mice exhibit a quiet attitude; in from 60 to 180 minutes they may show uneasiness, excitement and spasms, roughened coat, labored and accelerated respiration Later, the eyes are closed by a crusty exudate. Shortly before death, which occurs in from 6 to 12 to 24 hours, general weakness is not uncommon and the motionless animals are flattened out on the bottom of the cage. In approximately 50% of the poisoned animals the anus is soiled with fluid intestinal content or a plug of glassy mucous. On autopsy the distended abdomen is soft, and, on opening reveals a markedly distended duodenal loop and deeply injected moist but empty coils of the small intestines. The stomach, filled with a small amount of food, is frequently distended by the same bile tinged or some blood streaked mucous which is present in the ballooned duodenal loop. The mucosa is always injected and sometimes covered with petechia and small erosions. Soft or fluid chyme is found in the large intestines; the jejunum and ileum contain as a rule flakes of clear yellowish mucous. The spleen may be slightly enlarged and the liver is hyperaemic. In some instances both pleural cavities contain a blood tinged or straw colored fluid (0.2-0.5 cc.); the lungs are bright red and collapsed. Cultures from the heart blood, spleen and liver remain sterile, while those from the intestinal content fail to reveal representatives of the paratyphoid group. The distended duodenum, the hyperaemic jejunum and ileum and the pleural effusion are

pathognomonic for experimental food poisoning in white mice. In the experience of the writers deaths occurring later than 48 hours after feeding are probably due to other causes than the paratyphoid poison which acts primarily on the duodenum and stomach but may extend its reaction down the intestines beyond the duodenum. Rabbits, guinea pigs and cats fed double lethal mouse doses by weight of the poison may present transitory and indefinite symptoms from which they rapidly recover. Their blood collected 2 weeks after the feeding of the poison usually agglutinates the paratyphoid bacilli in low dilutions.

Symptoms of food poisoning have been produced in a macacus monkey by feeding 10 cc. of a potent poison and its blood had an agglutination titre of 1/640 2 weeks later.

4155

Electrolytes of Saliva Under Normal and Pathological Conditions.

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The growing perception of the close relations of saliva to the teeth and the surrounding tissues led to systematic analyses of the mixed saliva in order to obtain normal or standard values for the electrolytes and thus a foundation for the study of this secretion under pathological conditions. The examinations of the physiological resting saliva were made on persons with absolutely intact teeth and normal gum tissues, and, who were known not to have been sick within the last 3 or 4 years. In all cases the saliva has been analyzed as to its content of cations and anions, namely Cations: K, Ca, Mg, Na; Anions: Cl, P, (*i. e.*, PO_4), CNS, as well as the H-ion concentration (pH). The CO_2 capacity and viscosity.

1. It was found that under physiological conditions the excretion of cations and anions diminishes, with the exception of potassium (between 20 and 40 years) but noticeably increases with an advance in age.

2. By an arithmetical average for the different saliva components the following normal standard values have been determined: