Effects of Hydrogen-ion Concentration upon the Decomposition of Fish Muscle by Bacteria.

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Effects of hydrogen-ion concentration upon the physiology of bacteria have been studied along two main paths, namely, on the growth rate of bacteria, and on the other physiological activities of them. The first has attracted much more attention of the bacteriologists than the second, but much is left to be desired in the technique. The second mostly concerns with the influence of initial pH of the medium on the fermentation by lactic acid bacteria, *Bact. coli*, etc. Such investigations as carried out by MEYERHOF⁽¹⁾ into the oxidation of ammonia and nitrite, or by ITANO⁽²⁾ into the decomposition of broth media in relation to the afore-mentioned conditions are not many. Still fewer are the papers which have dealt with the decomposition of the fish muscle under such conditions.

The present paper embodies my observations on the effects of pH on the rate of the decomposition as well as the rate of growth of bacteria in the fish muscle suspensions.

EXPERIMENT

1. **Cultural media:**—One hundred c. c. of the fish muscle suspension were made by means of the previously reported method⁽³⁾, pipetted into sterilized flask of 300 c. c. and added with an equal volume of sterilized distilled water and then added with a certain volume of sterilized N NaOH or N HCl and kept in a definite hydrogen ion concentration.

2. **Organisms employed:**—*Pseudomonas fluorescens*, *Serratia marcescens*, *Achromobacter multistriatum*, *Proteus vulgaris*, *Staphylococcus aureus*.

The first three water bacteria are known to be particularly concerned with fish muscle decomposition.

3. **Procedure:**—It is the same as the previously reported method⁽⁴⁾.

RESULTS

Various in hydrogen ion concentration may have markedly different influences upon rates of growth of bacteria, and upon rates of production of

(1) MEYERHOF, O.:—Arch. Physiol. 164, 165, 166, 1916, 353, 229, 240.

(2) ITANO, A.:—Mass. Agr. Expt. Sta. Bull., 117, 1916, 139.

(3) KIMATA, M.:—Bull. Jap. Soc. Sci. Fish. 4, 1936, 294.

(4) KIMATA, M.:—Bull. Jap. Soc. Sci. Fish., 5, 1936, 77.

formol titrating nitrogen and of volatile basic nitrogen from decomposed fish muscle by them.

1. *Pseudomonas fluorescens*:—The growth rate of bacteria remains unchanged at about $pH=6.0\sim 8.0$, and velocity constant (k) is about 5.3. But it decreases when hydrogen-ion concentration of the medium shifts a little to acid or alkaline side, the decrease being more remarkable in the acid one than in alkaline.

The rate of formation of formol titrating nitrogen and volatile basic nitrogen from the fish muscle is the greatest at about $pH=6.0$ (Fig. 1, B).

2. *Serratia marcescens*:—The maximum growth rate is reached at about $pH=6.5$, the curve coming down more steeply in acid side than in alkaline one.

The rate of formation of the decomposition products of fish muscle is the greatest at about $pH=7.0$ (Fig. 1, A).

3. *Achromobacter multistriatum*:—The growth rate does not so much change within the range of pH from 6.0 to 8.0, but its peak appears to lie at about $pH=6.5$.

The decomposition of fish muscle is nearly the same when pH ranges $6.5\sim 8.5$, but it suddenly falls down in the acid reaction (Fig. 1, E).

4. *Proteus vulgaris*:—The growth rate is the greatest in about $pH=7.0\sim 8.5$.

The rate of the decomposition of the fish muscle appears to be the greatest at about $pH=8.0$ (Fig. 1, D).

5. *Staphylococcus aureus*:—It has a maximum in the growth rate at about $pH=7.0$.

The rate of the decomposition seems to reach its culmination at about $pH=6.5$, although decomposing activity of the fish muscle by this bacteria is generally very weak (Fig. 1, C).

Fig. 1. The-velocity constant (k) of the growth rates of bacteria, and the formol titrating nitrogen and the volatile basic nitrogen produced in relation to hydrogen-ion concentration.

A....*Serratia marcescens*

B....*Pseudomonas fluorescens*

C....*Staphylococcus aureus*

D....*Proteus vulgaris*

E....*Achromobacter multistriatum*

●....Velocity constant of the growth rate of bacteria.

○....Formol titrating nitrogen produced in five days.

×....Formol titrating nitrogen produced in seven days.

+....Volatile basic nitrogen produced in five days.

△....Volatile basic nitrogen produced in seven day.