



Title	STUDIES ON SHARK MUSCLE : PART 4. ON HISTAMINE IN SHARK MEAT
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Citation	北海道大學水産學部研究彙報, 4(2), 119-122
Issue Date	1953-08
Doc URL	http://hdl.handle.net/2115/22801
Type	bulletin (article)
File Information	4(2)_P119-122.pdf



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STUDIES ON SHARK MUSCLE

PART 4. ON HISTAMINE IN SHARK MEAT

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Introduction

Cases of poisoning by fish meat have been frequently reported the cause of which may be considered to be ptomaine, especially some amines. Actually several amines have been separated from putrefactive meat⁽¹⁾. Histamine is one of those amines; it is seriously toxic. One cause of the saying "mackerel stinks alive" may be the rapid decomposition of the meat; in the decomposed mackerel meat the formation of histamine is used to recognized. The mechanism of the histamine formation in mackerel meat may be explained as follows:

- (1) Fresh fish meat indicates acidic reaction.
- (2) The decomposition of amino acids by bacteria in acidic medium is dominant in decarboxylation, so the amines corresponding to those amino acids are obtained⁽²⁾.
- (3) A large amount of histidine is contained in the extractive matter of mackerel meat in comparison with other fish having white meat⁽³⁾.

In accordance with the above three items, the mackerel meat, looking rather quite fresh, may contain a large amount of histamine, of which the quantity is enough to cause poisoning.

The other hand, it has been already said that shark meat having a large amount of ammonia shows several features of good freshness except for developing ammonia⁽⁴⁾. Actually such meat containing ammonia is customarily eaten after cooking with vinegar or manufacturing as "kamaboko" (a sort of fish paste). Taking consideration of such cases, studies on histamine poisoning by shark meat are necessary from the viewpoint of food hygiene. So, the author has studied the changes in the quantities of both histidine and imidazol compounds in shark meat comparing with that of mackerel meat which is the most perishable meat among the blue-skin fish. These investigations were carried on by following experimental schedule:

(1st experiment) The following combinations of samples were employed: the mackerel meat antiseptized with toluene (1% for the fish meat) and thymol (1%), and the non-antiseptized meat as the control. In the former sample, the autolytic action will occur, in the latter sample both bacterial and autolytic actions.

(2nd experiment) Two gm. of urea was added to 100 gm. of mackerel meat as the model of shark meat, and to the other samples none was added. From the results of studies in this combination the effect of the urea upon the histidine decomposition has become known.

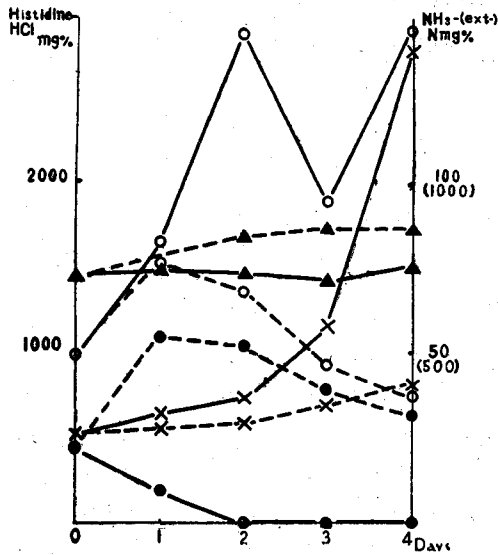


Fig. 1

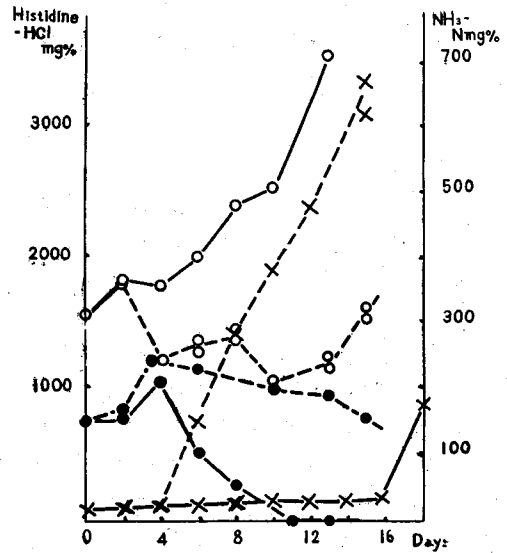


Fig. 2

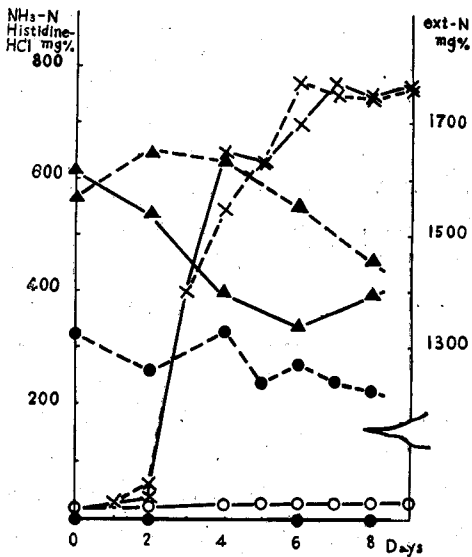


Fig. 3

Figures

-x- ammonia, -▲- extractive nitrogen,
 -●- histidine, -○- imidazol compounds

1. Changes in the amounts of ammonia, extractive nitrogen, histidine and imidazol compounds in both antiseptized mackerel meat and the non antiseptized. Those were preserved at 21° to 24.5°C. ----- antiseptized meat, — non-antiseptized.
2. The same changes. Mackerel meat to which urea is added and non-added. Preserved at 7°C. ----- meat added with urea, — non added.
3. The same changes. Shark meat added with histidine and non added. Preserved at 7° to 18°C. ----- meat added with histidine, — non-added.

(3rd experiment) Three hundred and fifty mg. of histidine hydrochloride was added to 100 gm. of shark meat as the model of mackerel meat, and to the other samples none was added as the control. From this combination the same effect of urea as seen in the 2nd experiment will be obtained, too.

Experimental

The meats employed as the samples were fine meats prepared strictly from mackerel (*Scomber japonicus HOUTTUYN*) in the 1st and 2nd experiments, and from "yoshikirizame" (a species of shark fish, *Prionace glauca (LINNE)*) in the 3rd experiment. Those sample meats after mincing, were placed in ERLENMYER's flasks, closed tightly, then stored respectively at room temperatures. At certain definite intervals, some parts of the samples were taken out to estimate the contents of ammonia, extractive nitrogen, histidine and imidazol compounds. The estimations were carried out as follows: i.e. the meat was extracted with 10% of trichloroacetic acid 4 to 5 times repeatedly, then the extract was evaporated on a water bath, whereby the trichloroacetic acid was removed completely. The concentrated extract was dissolved with water again to bring it to a definite volume. Histidine and imidazol compounds were estimated by SERA's method⁽⁵⁾, using aliquot volume of this sample, and the extractive nitrogen was by "KJELDAHL method." Ammonia was determined immediately from the meat by the usual aeration method. The results of 1st to 3rd experiments are illustrated in Figs. 1 to 3 respectively.

Results

As the preservation time elapsed, histidine decreased and imidazol compounds increased in the non-antiseptized mackerel meat; however, in the antiseptized mackerel meat both histidine and imidazol compounds increased at first and then turned to the decrease (Fig.1). Therefore it is known that imidazol radical in mackerel meat extract is hard to be decomposed by the attack of bacteria, while histidine is decomposed easily. So, it will be obvious that the histamine which was formed from histidine tends to accumulate in mackerel meat so far as the reaction of meat is acidic in the initial stage of preservation. The same tendency which has been seen in the antiseptized mackerel meat was also obtained from both the mackerel meat to which urea is added and from the shark meat added with histidine, i.e. histidine and imidazol compounds increased at first, and thereafter decreased. In the non added shark meat, only a trace of histidine and imidazol compounds were found, and they did not increase during the experimental periods. At the beginning of the 2nd experiment, there was a slight amount of histidine increase in the non antiseptized mackerel meat. This phenomenon which has been seen similarly in the antiseptized mackerel meat, perhaps is due to the comparatively lower storing temperature, 7°C. and it is restricted to a shorter period (Figs. 2 and 3).

According to those experimental results, a small amount of histidine is present in shark meat extract and also there is no increase by its autolytic action. Moreover even if

histidine was added, this amino acid was hard to be decomposed. From another viewpoint, the increasing alkalinity of meat due to the decomposition of urea to ammonium carbonate also inhibited the decarboxylation. Therefore it may be concluded as follows: as to the histamine poisoning by shark meat, it seldom occurs.

KONDO and his colleague⁽⁶⁾ showed in their studies of shark muscle protein that 0.680% of histidine form nitrogen are contained in the muscle protein of "yoshikirizame." Accordingly, histidine or imidazol radical may increase in the meat of that shark fish, if the meat is decomposed by proteolytic action of bacteria. As in the above experiment concerning shark meat, such radical did not increase for 9 days in preserving at 7° to 18°C., it is obvious that the protein of shark meat was hard to be decomposed, in comparison with the mackerel meat in which imidazol compounds increased remarkably.

Even the shark meat protein will be decomposed after the elapsing of a considerable longer time of preservation, e.g. in the previous histochemical studies of shark meat⁽⁴⁾, the degradation of tissue was seen after 17 to 32 days preservation at 6° to 17°C. From such shark meat, the tissues degraded and the proteins decomposed, histidine may be liberated and also imidazol compounds may increase. But, it is not necessary to consider such distinctly decomposed shark meat to be edible or not, because such meat is already seldom eaten.

The above discussion may be summarized as follows: histamine poisoning by shark meat does not occur. But, as to the idea of poisoning by other amines besides histamine the present author can not argue here.

Summary

No considerable amount of histidine was found, moreover imidazol compounds were not observed in shark meat extract within the above described experimental period, while the both were distinctly presents in mackerel meat. From those results it will be presumed that histamine poisoning does not occur from shark meat regarded usually to be in an edible state.

This experiment was carried out at the Laboratory of Technological Fisheries directed by Prof. SHIMIZU, Department of Fisheries, Kyoto University, with the kind help of Mr. T. ISHIKAWA, supported in part by a grant in Aid for Fundamental Scientific Research from Ministry of Education. The author wishes to express his hearty thanks to them.

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(水産科学研究所業績 第175号)