On an Attempt to Preserve Whale Meat Freshness with 5-Nitrofurfuriden Aminoguanidine from Decay

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With latest improvement of food situation the demand for whale meat is decreasing in Japan. It seems chiefly due to the easy decay of freshness of whale meat that this tend is seen, in spite of high nutritive value of it which is practically equal to that of general edible meats.

Freshness decay is inevitable in coastal whaling, particularly in summer, for the reasons of air injection into whale body to float it after death and of tugging whales to land stations for a considerably long time. The purpose of our present study is to preserve whale meat freshness from decay by injection and circulation of a germicide which is attached at the head of the harpoon. As a germicide, 5-nitrofurfuriden aminoguanidine hydrochloride (Guanofracin in commercial name, abbreviated G.F. in this report), one of nitrofuran group, which was lately discovered, was adopted for our experiment, from the following view points: 1. mighty sterilizing power 2. harmless as food and 3. very soluble in water etc. This is yellow powder, soluble in about 100 parts of cold water and in about 30 parts of warm water (60°C). Although sterilizing power depends upon species of bacteria, G.F. is thought sufficiently effective at the concentration of 1/10,000–100,000 for our purpose. If whales caught in the adjacent waters to Japan are assumed to be 20 tons in average body weight and quantity of their blood is assumed to be 1/13 of body weight, viz., 1.5 tons, about 15 gr. of G.F. would be necessary for keeping G.F. at a concentration of 1/100,000 in such a quantity of blood. On the basis of this assumption 10–20 gr. of G.F. per whale was used in the present experiments. The experiments were carried on at Akkeshi, Hokkaido in September 1950 and in August 1951 and at Ayukawa, Miyagi prefecture, in November 1950. Successful injection on sei whales and sperm whales could be at Akkeshi but no successful results could be obtained at Ayukawa due to bad weather and end of the whaling season.

In order to compare the freshness change between G.F. injected whales and a control whale, pH of aqueous extract of their meat and G.F. concentration in their blood were measured. In 1951, a glass

Table 1. Results of Experiments in 1950.

No.	Sp.	Sex	Body length in feet	Lapse of time between capture and flensing	G.F. quantity used	G.F. attached harpoon	Estimated concentration of G.F. in blood
No. 1	Sperm	Female	40	23.00 hrs.	13 g/340 cc physiological salt solution	hit	0.5 mg%
No. 2	〃	Male	37	22.00 〃	5 g/300 cc* water	〃	trace
No. 3	〃	〃	38	22.00 〃	—	—	—
No. 4	Sei	〃	44	24.00 〃	15 g/300 cc water	pierced	—
No. 5	〃	〃	43	24.00 〃	20 g/300 cc water	〃	—

* $^2/_3$ of G.F. quantity was lost due to the shock of the failed first harpooning.

Table 2. Results of

No.	Sp.	Sex	Body length in feet	Date of captured		Date of treatment		Lapse of time between capture and flensing	Water temperature °C	Weather	Locality of capture	G.F. attached harpoon
				Day	Time	Day	Time					
No. 6	Sei	Male	44	Aug. 7	6.30	Aug. 8	14.00	31.30 hrs.	20.3	B	SSE135° Akkeshi	not used
No. 7	〃	〃	44	10	12.00	10	9.30	21.30 〃	22.0	C	SE/S 118°	used
No. 8	〃	〃	48	〃	18.00	〃	10.00	16.00 〃	22.0	C	SSE 107°	〃
No. 9	〃	Female	47	15	10.00	16	0.30	14.30 〃	21.0	F	SSE 85°	〃
No. 10	〃	Male	44	〃	11.00	〃	1.00	14.00 〃	21.0	F	SSE 85°	〃
No. 11	Sperm	Female	37	19	16.00	20	15.00	23.00 〃	23.5	B	SE $^1/_2$ E 110°	〃
No. 12	〃	〃	37	〃	14.00	〃	16.00	26.00 〃	24.0	B	SE $^1/_2$ E 105°	〃

** The 2nd harpoon which had seemed misfired, was found fired when the whale

electrode pH meter which was carried as far as to Akkeshi was used, as well as pH test paper.

By the results of qualitative and quantitative analysis applied to fracin group, it was found that G.F. turns reddish orange with caustic alkali like some of 5-nitrofran derivatives. On the basis of the result of the preliminary test, therefore, colorimetric determination of G.F. in whale blood was made. In the same concentration, colorimetric value of G.F. in blood was considerably smaller than that of G.F. in water. This may be due to the loss in the treatment to remove protein from blood. Injected G.F. presented in blood at an extremely small concentration, so sample had to be concentrated if necessary.

Table 1 shows the results of the five cases at Akkeshi in 1950 (2 sei whales and 3 sperm whales). Among them, one was for control and the successful G.F. injection was seen only in 2 cases (on sperm whales)

Experiments in 1951.

1st harpoon	G.F. amount	2nd harpoon	G.F. amount	3rd harpoon	G.F. amount	Amount of G.F. injected to whale	Estimated concentration of G.F. in whale blood	Note
hit	0	hit	20 gr	hit	20 gr	40 gr	1.2 mg%	G.F. sufficiently circulated during 10 or so minutes between 3rd harpooning and death of the whale.
〃	0	misfired	20 〃	pierced	15 〃	0	0	
〃	0	pierced	20 〃			0	0	
〃	0	hit	20 〃			20 gr	0.4 mg%	G.F. did not circulated so well due to a short interval between 2nd harpooning and death of the whale.
〃	20					20 〃	trace	G.F. concentration in blood was very small due to instant death of the whale.
pierced	20					0	0	

was flensed.

and the rest were failed due to misfire or piercing of harpoon and instant death of whale.

Table 2 shows the results of the seven cases at Akkeshi in 1951 (5 sei whales and 2 sperm whales). Among them, one was for control and successful G.F. injection was seen in 2 cases (sei whales) and the rest was not successful. pH curves for each experiment in Tables 1 and 2 are shown in Figs. 1–4. Fig. 1 indicates pH values which were measured with pH test paper (Toyo Filter Paper Co. Ltd., made) on a control whale and two G.F. injected whales in 1950. Figs. 2–4 indicate those which were measured with a glass electrode pH meter on a control whale and two G.F. injected whales in 1951. Time when the whale was completely caught is shown by 0 and the oblique lined part covers time when the whale was being flensed on the land stations. After flensing was finished, the sample meat was kept at 30°C in the thermostat.

In 1950, both of the two successfully injected whales were sperm whales. The whale No. 1 was injected 13 gr. of G.F., which was acknowledged to preserve freshness a little from decay on the basis of pH curve and odor and appearance of meat. The concentration of G.F. in blood was at a level of 1/200,000. The remarkable difference in pH curve was not seen between the whale No. 2 and the control whale, because 2/3 parts of G.F. prepared were lost due to the shock of the failed first harpooning and the rest was injected with the second harpoon. In this case, a trace of G.F. was only seen in blood.

In 1951 successfully injected whales were both sei whales and the whale No. 7 was injected twice 20 gr. of G.F. each, 40 gr. in total,

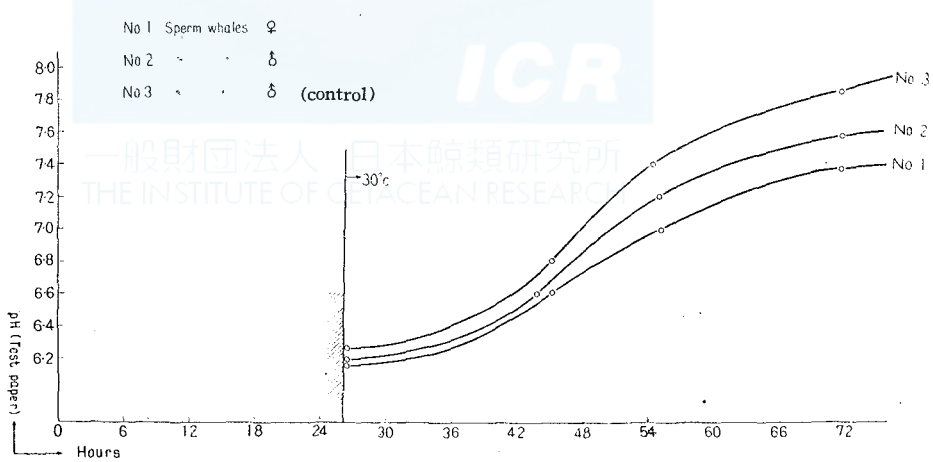

Fig. 1.

which indicated the concentration of G.F. in blood enough to restrain the growth of bacteria. pH curve in this case showed that G.F. injection could preserve freshness of meat from decay. The whale No. 10 was injected 20 gr. of G.F. but died immediately after hit, so the concentration of G.F. in blood was less than 1/200,000, which seemed to preserve freshness from decay to some extent.

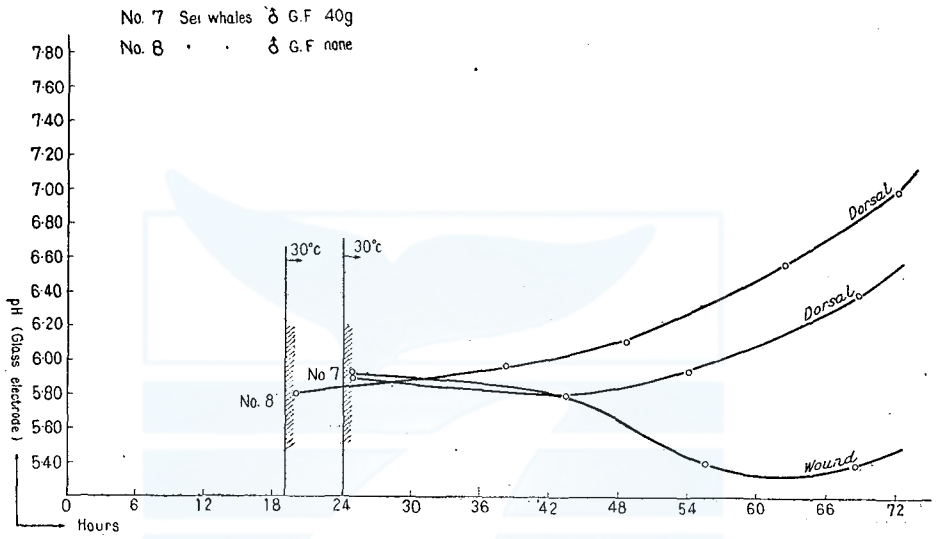

Fig. 2.

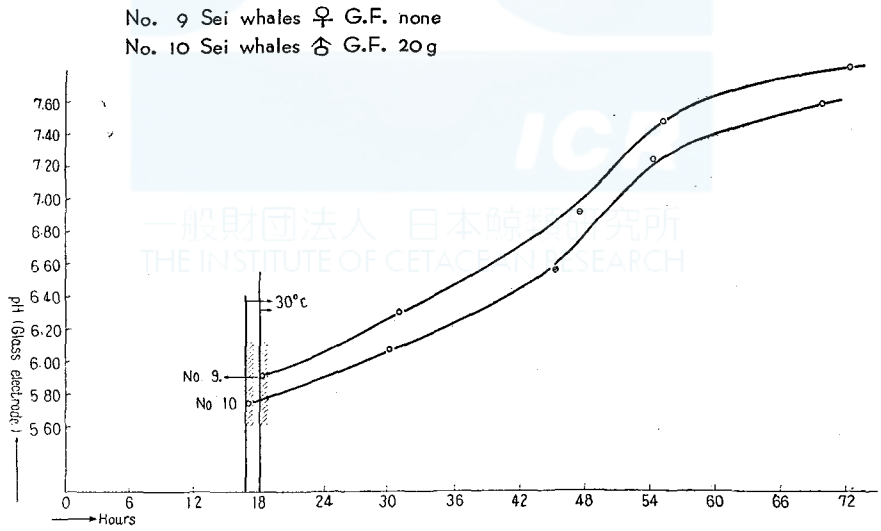

Fig. 3.

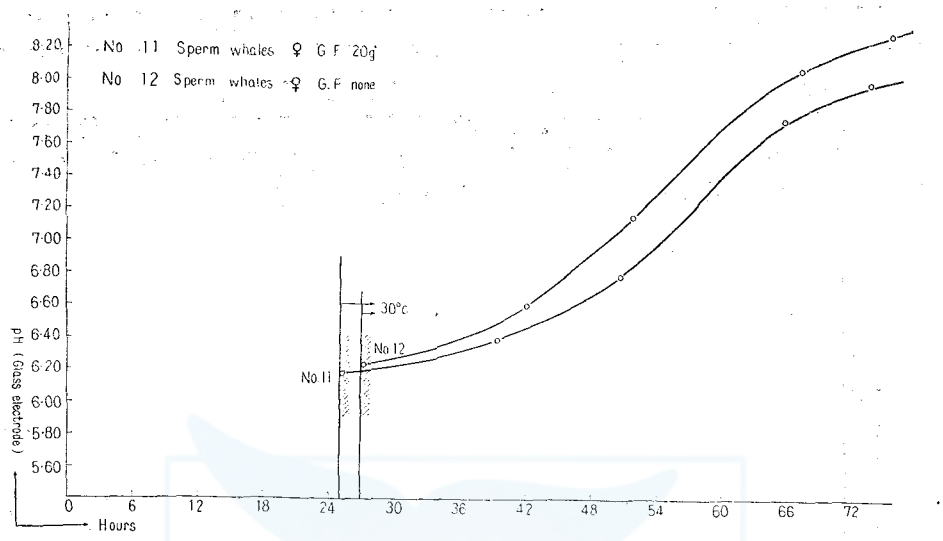

Fig. 4.

As these experiments depend much upon the external conditions, such as sea condition and whaling technique etc., we could not obtain only a few successful results. Nevertheless G.F. injected whale showed slow spoilage and injected G.F. was completely circulated although it was diluted to less than calculated value in concentration with permeated sea water and oozed humours in the course of tugging.

The conclusion might be therefore that G. F. can presserve freshness of whale meat from decay to some extent, if more than 20–40 gr. of G. F. are injected to a suitable point and G. F. is absorbed over 1/5–100,000 in concentration in blood.

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Experimental part

1. Attachment of G. F.

A grenade of the whaling harpoon is cylindrical and has a space of about 900 cc in it. An explosive compound and a fuse occupy most of the space, leaving about 300 cc for G. F. attachment. So, a tin or a

gum made ice bag, in which 15–20 gr of G. F. and about 300 cc of water or physiological salt solution were mixed, was prepared.

In the beginning, the ice bag was used as a container, which was broken due to the shock of discharge and wet powder led often to misfire. In the later stage of the experiments, therefore, the tin was used instead of it. As any of the authors did not get aboard the catcher boat in 1950, detailed information on harpoon hitting was regretably not obtained. In 1951, they could get a chance to observe hitting of the harpoon on whales by aboarding the catcher boat.

2. Measurement of pH[1)]

Some 5 gr. blocks of meat taken from dorsal part of the whale by possible germ free operation were left at 30°C in the sterilized Petri's scale in the thermostat.

At intervals of a certain hours they were ground well with qualtz sand in the mortar. To those which were placed in a 150–200 cc flask, 100 cc of distilled water was added and stirred well for ten minutes. After standing, pH of the supernatant was measured with pH test paper (Toyo Filter Paper Co. Ltd. made) and with the glass electrode pH meter.

3. Measurement of G. F. concentration in blood

As the blood of the whale was diluted with sea water and humours, a certain quantity of comparatively dense blood was prefered, and after acidifying it with acetic acid, protein in it was coagulated by boiling. The filtrate was condensed again if necessary and cooled and filtered to remove the precipitate. G. F. concentration of this filtrate after alkalizing it with caustic alkali, were determined (Presence of G. F. turns the color to yellowish orange) with Duboscq colorimeter in 1950 and with Beckmann's spectrophotometer at 400–410 mμ in 1951 (cf. Akiya and Sawamura: reported separately).

For control a fundamental experiment was preliminary made with G. F. aqueous solution.

Summary

An attempt to preserve the whale meat freshness from decay by circulation of G.F. in whale blood which was attached in the head of the whaling harpoon, before its death, was tried in 1950 and 1951 at Akkeshi, Hokkaido. Successful injection was made on 2 sperm whales and 2 sei whales. The results of the measurement of pH of the meat

extract from them and concentration of G. F. in their blood showed that G. F. injected whales could preserve their freshness from decay, when compared with a control whale.

Literature

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