Attempt to Preserve Freshness of Whale Meat With Germicides. II.

By
SHICHIRO AKIYA, OTOMATSU HOSHINO
and
NOBUO MOTOHASHI

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In recent years, ground for coastal whaling have been getting further and further away from the land and, consequently, the time elapsed between catching and dissection has become larger. This in turn has posed the question of the lowering of the freshness of whale meat.

Some experiments have previously been made for the preservation of freshness of whale meat but they seemed to have been rather ineffective.

Attempts have recently been made to charge the harpoon with a germicide so as to allow the drug to penetrate into whale meat on harpooning and thereby prevent decaying of meat. In three occasions during 1950 and 1951, Guanofuracin (5-nitrofurfurylidene-aminoguanidine hydrochloride), was used as such a germicide.

The results were described in the first paper of this series[1], which showed some effect in successful examples but due to the small number of examples obtained, the same experiments had to be carried out further. Fourth occasion was the experiments carried out during July and August, 1953, during which harpoon charged with Guanofuracin was used with fairly effective results, which are described herein.

Experimental

I. *Methods*

Methods used were based on previous experiments with numerous modifications and revisions which will chiefly be described.

1) Improvement on the Harpoon: Ordinary harpoon had been used in the previous experiments, but it was modified with a screwed cover so as to facilitate insertion of Guanofuracin can from the head, and a partition was placed between the can and an explosive. This improved harpoon, shown in Fig. 1, is slightly larger than the ordinary harpoons used.

2) Amount of Guanofuracin used and its Container: Ordinary can-

ning cans of about 300cc. capacity were used as the containter for Guanofuracin*. At first, fairly good results were obtained by the use of a 20 gm. can. Later, 40 gm. cans were prepared but owing to unfavorable weather conditions and moving of catcher boats, sufficient use of the larger cans could not be made.

3) pH-Measurement of Whale Meat: pH of the meat was measured with Guanofuracin-injected whales and control whales. Dorsal meat was taken up at first but later, ventral and tale meat were also measured for comparison.

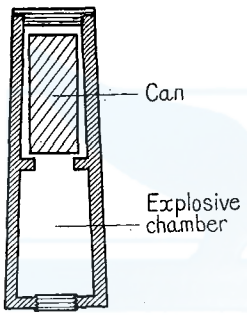

Fig. 1

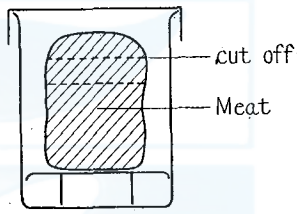

Fig. 2

Fig. 1. Improved Harpoon for Guanofuracin
Fig. 2. Meat Beaker

The meat was handled as aseptic as possible, cut into portions of 100–200 gm. size, and placed in a beaker with raised bottom (Fig. 2). The beaker was covered with a petrie dish so as not to make the beaker air-tight, and placed in a thermostat of 30° temperature. The meat was cut from the top at intervals of several hours or over ten hours, and variation in pH values of the meat was measured.

pH measurement was carried out with the glass electrode pH-Meter and pH test paper, as in the previous experiments, but the glass electrode used was the one for muscle measurement.

4) Measurement of Guanofuracin Concentration in Blood: The measurement was carried out as in the previous experiments. Guanofuracin was added in various proportion to the blood of control whale, acidified with acetic acid, heated, and filtered. The filtrate was made

* The cans used were treated with paint on the innerside and presented no problem but during the course of these experiments, there was shortage of cans and change in the content of Guanofuracin. Galvanized iron was used for the cans in which aqueous solution of Guanofuracin was placed but Guanofuracin was found to undergo change by reacting with zinc and iron in the can material. It is therefore advisable to avoid using cans in which the metal is exposed on the inside.

alkaline and this was used as the standard for colorimetric determination[2].

II. *Results*

1) In the earlier part of experiments, about dozen sperm whales were obtained and the period was extended to include a few examples of sei whales. One each of fin whale was obtained for Guanofuracin injected and control cases.

2) Table 1 gives the species and sex of whales in which Guanofuracin harpoon was used, time elapsed until dissection, pH value of meat, and presumptive blood level of Guanofuracin. The term "putrefaction inhibition rate" used in Table 1 was calculated by taking pH of the control whale meat as 0% inhibition rate and pH of toluene-added meat as 100%. The summarized judgement was arrived at by examining the state of harpooning, location of harpooning, observations at the time of dissection, presumptive blood level of Guanofuracin, external apparent change of meat, and pH curve, the order given being A, A', B, C, and D.

3) Table 2 gives the kind and sex of whales and pH value of meat in control whales and in whales caught just prior to experiments and on which Guanofuracin harpoon was not used.

4) Figs. 3–8 give summarized results of representative pH curves obtained on experimental whale meat. They give pH curve of meat in whales in which Guanofuracin was comparatively well circulated and that of control. In these figures, the time of catching, and therefore of death, was taken as zero, and the shaded portion shows the time spent in landing and dissection, and the rest is the time during which the sample meat was kept in a theromostat at 30° and pH of the meat measured at certain intervals. pH values of tail and ventral meat are also gived for comparison.

III. *Discussions*

1) Freshness and pH of Meat at the Time of Dissection: From the determination of pH of Whale meat under various conditions, it has been observed that there is a close relationship between freshness and pH of the meat at the time of dissection. During 30–40 hours after catching, when the meat is fresh, pH value is quite high and pH value is low when the freshness is impared (cf. Table 1). Owing to the extremely small number of experimental animals, however, this point needs further investigation.

2) pH value of Dorsal, Ventral, and Tail Meat: pH value of tail and ventral meat seems to be generally higher than that of dorsal meat

Table

No.	Species	Sex	Body length (ft.)	Date of captured	Duration (hrs.) a)	Freshness (%) b)	No. of G.F.-harpoon used	No. of G.F.-harpoon hit c)
2	Sperm	Female	37	July 20	26.00	70	1	1
3	〃	〃	35	20	25.30	80	2	1
4	〃	〃	39	22	25.00	60	1	1 (missed)
6	〃	〃	36	22	25.00	70	1	1
8	〃	〃	38	24	29.00	70	1	1
9	〃	〃	35	24	28.15	70	1	1
10	〃	〃	37	24	28.15	70	1	1 (can unexploded)
11	〃	〃	35	24	27.30	70	1	1
12	〃	Male	48	26	31.20	65	1	1
13	〃	〃	36	26	32.00	70	1	1
14	〃	Female	35	26	32.00	75	1	1
15	〃	〃	36	26	32.00	60	1	1
17	Sei	〃	46	27	25.00	60	1	1
18	〃	Male	44	Aug. 4	14.00	65	1	1 (40 gm.)
19	〃	〃	42	6	6.10	85	2	1 (missed) 1 (hit)
20	Sperm	Female	36	9	20.40	75	1	1 (can unexploded)
21	Fin	Male	60	12	26.00	60	1	1
22	Sei	Female	41	16	27.00	70	1	1 (40 gm.)

G.F.=Guanofuracin (5-Nitrofurfurylideneaminoguanidine hydrochloride)

a) Duration of time between catching until dissection.

b) Freshness gives the degree of freshness at the time of dissection as designated

c) Unless otherwise noted as 40 gm., the 20 gm. can of guanofuracin was used.

at the time of dissection but the rate of putrefaction is the most rapid in tail meat. pH values of dorsal and ventral meat are varied under different conditions (cf. Figs. 6-8).

3) Relationship between Freshness and Guanofuracined Whale Meat: It has been observed that the freshness of whale meat depends on the location of harpooning, time elapsed between harpooning and death, duration towing, atmospheric and sea-water temperature, and nutritional condition of the whale. Since the autolysis of the meat and rate of putrefaction are dependent on the foregoing factors, the freshness of the meat is not necessarily maintained until the time of dissection by Guanofuracin injection. As long as a fairly reasonable amount of the drug is in circtlation, the freshness is naturally maintained (cf. Table 1).

4) Location of Guanofuracined Harpooning and State of Guanofuracin Circulation: In general, the freshness of meat is maintained

1.

pH of dorsal meat		Presumed Blood Level of G.F. (mg. %)	Putretaction inhibition rate (%)	Elapsed Time until death (min.)	Summarized judgement
At dissection	40 hrs. later (30°C)				
5.85	7.10	0.1~0.2	10	0~1	D
5.90	6.70	0.4~0.5	40	4	A′
5.80	7.25	0 (control)	0	3	—
5.75	6.85	0.2~0.3	25	0~1	C
5.80	6.50	0.3~0.5	50	3	A′
5.65	6.40	0.6~0.7	60	1	A
5.60	7.40	0 (control)	0	8	—
5.70	6.60	0.3~0.4	40	2	A′
5.55	6.85	0.4~0.5	35	16	B
5.60	6.65	0.7~0.9	55	5	A
5.70	6.95	0.3~0.4	30	0~1	B
5.50	7.00	0.2~0.3	20	2	C
5.70	6.85	0.2~0.4	25	—	C
5.75	6.70	0.3~0.5	35	—	B
5.90	6.75	0.3~0.4	30	15	B
5.80	7.00	0 (control)	0	3	—
5.80	6.95	0.3~0.5	25	—	C
5.80	6.65	1.0~1.2	50	—	A

by fishery workers by experience and does not give a chemically determined data.

when ordinary harpoon strikes the head or chest portion, and freshness is extremely lowered when the harpoon strikes the ventral side. With harpoons charged with Guanofuracin, the best result was obtained when it struck the chest portion.

5) Relationship between Guanofuracined Whale Meat and Rate of Putrefaction: As long as certain amount of Guanofuracin is circulating through the body, the rate of putrefaction is suppressed in accordance with the amount as compared with the control whale (cf. Figs. 3-8). In some outstanding examples, no putrefying odor was detected even after a few days at 30°. This fact was also observed in few successful cases described in the previous report and was confirmed in the present series of experiments by larger number of successful cases. (especially Nos. 3, 8, 9, 11, 13, and 22) in which Guanofuracin was effective in preventing putrefaction.

Table 2

No.	Species	Sex	Body length (ft.)	Date of captured	Duration (hrs)	Freshness (%)	pH of dorsal meat		Weather	Water temparature (°C)
							At dissection	40 hrs later (30°C)		
1	Sei	Male	41	July 13	32.35	50			B	13.0
2	Fin	〃	51	15	15.50	75			F	13.0
3	Sei	〃	40	16	9.00	80	5.80	7.10	B	14.0
4	Sperm	〃	35	23	29.10	60			O	18.5
5	〃	〃	36	23	28.35	65			〃	〃
6	〃	〃	36	23	28.27	60			〃	〃
7	〃	〃	44	Aug. 2	14.40	60			RF	21.0
8	〃	〃	46	2	14.25	60			〃	〃
9	Sei	〃	37	5	12.55	70	5.70	7.05	C	15.5
10	〃	Female	45	11	26.25	65			BC	26.0
11	〃	〃	48	12	27.05	60			C	20.5
12	Sperm	Male	54	14	10.50	80			CF	16.0
13	Sei	〃	43	15	21.30	70	5.85	7.30	FC	20.5
14	Fin	〃	54	15	24.55	70	5.80	7.40	FC	21.5
15	Sei	Female	43	16	28.25	70	5.80	7.20	B	20.0
16	〃	〃	44	16	29.40	65	5.70	7.30	B	〃
17	〃	Male	37	16	30.45	60			B	〃
18	Sperm	Female	36	18	25.00	70	5.70		BC	〃
19	〃	〃	35	18	26.45	60			C	〃
20*	〃	Male	36	18	34.29	60	5.80	6.80	B	〃

* No. 20 is injected with 60 gm. Boakinin.

(Addeddum)

At a later stages of the present series of experiments, comparison of antiseptic effect of Guanofuracin and that of butyl p-hydroxybenzoate, one of the antiseptics used for foodstuff, against whale meat showed no great difference and, therefore, cans containing 60 gm. of Boakinin B (butyl p-hydroxybenzoate) were prepared and their use in harpoon was requested. Only one example was obtained but it could not be said to have been successful. The effect of this antiseptic is therefore, still unknown and further examinations are scheduled to be made.

The writers take this opportunity in expressing their deep gratitude to the members of the Technical Department and Akkeshi Office of Taiyo Fisheries Co., Ltd. for giving them facilities and extending them many valuable assistances during the course of this study. The writers are also grateful for valuable advices extended them by Messrs. H. Okuda and T. Nakai of the whales Research Institute, and to Messrs. T. Ohsawa, Y. Kuno, and Y. Nakaji for their cooperations in this work.

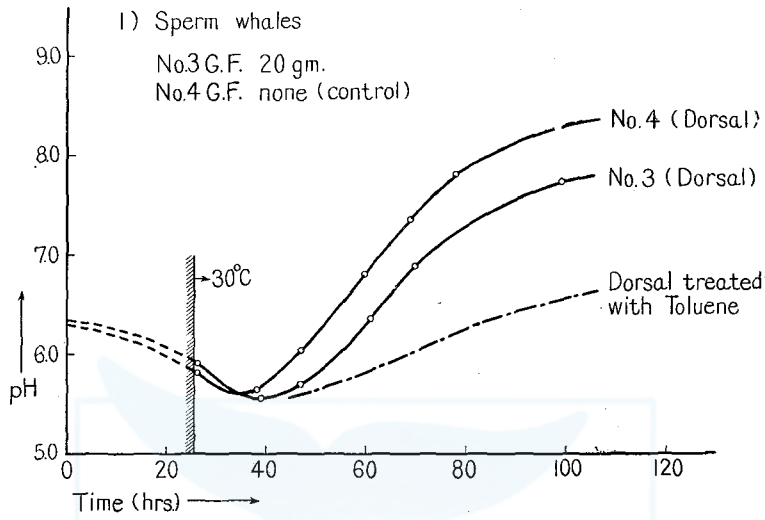
1) Sperm whales
No.3 G.F. 20 gm.
No.4 G.F. none (control)
No.4 (Dorsal)
No.3 (Dorsal)
Dorsal treated with Toluene
30°C
pH
9.0
8.0
7.0
6.0
5.0
0
20
40
60
80
100
120
Time (hrs.)

Fig. 3

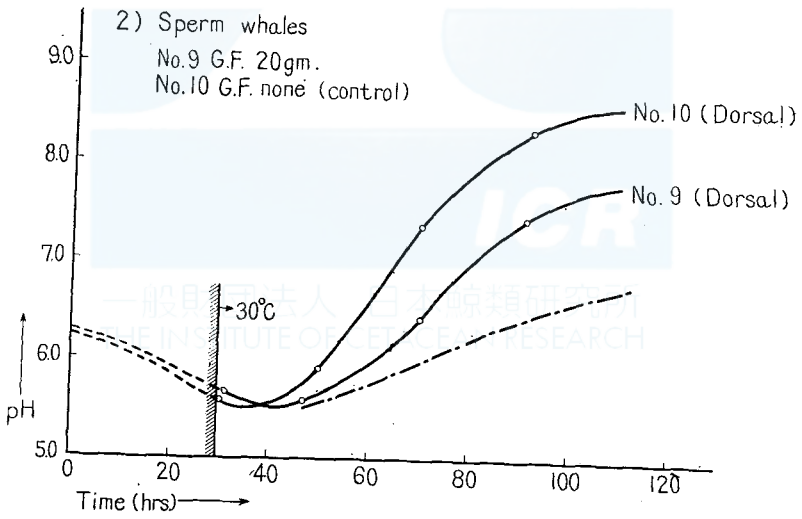
2) Sperm whales
No.9 G.F. 20gm.
No.10 G.F. none (control)
No.10 (Dorsal)
No.9 (Dorsal)
30°C
pH
9.0
8.0
7.0
6.0
5.0
0
20
40
60
80
100
120
Time (hrs)

Fig. 4

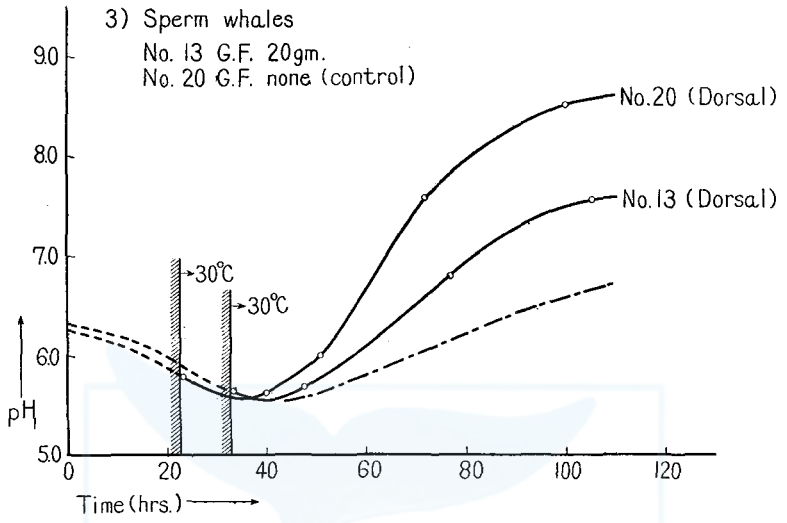
3) Sperm whales
No. 13 G.F. 20gm.
No. 20 G.F. none (control)
No.20 (Dorsal)
No.13 (Dorsal)
30℃
30℃
pH
9.0
8.0
7.0
6.0
5.0
0
20
40
60
80
100
120
Time (hrs.)

Fig. 5

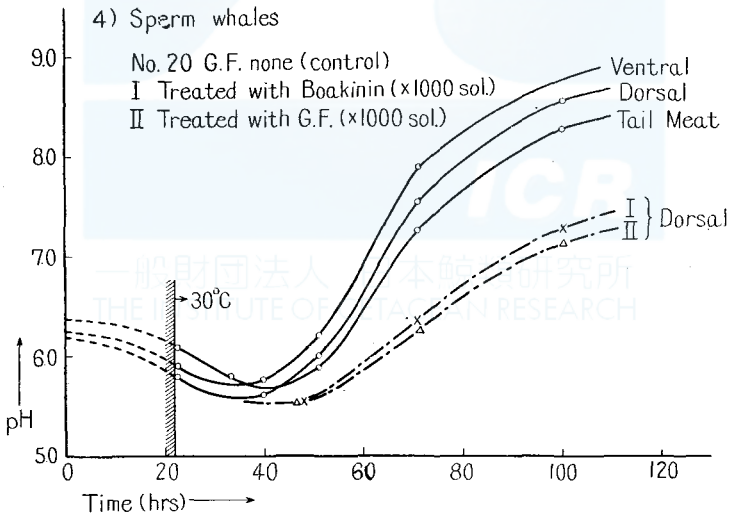
4) Sperm whales
No. 20 G.F. none (control)
I Treated with Boakinin (×1000 sol.)
II Treated with G.F. (×1000 sol.)
Ventral
Dorsal
Tail Meat
I
II
Dorsal
30℃
pH
9.0
8.0
7.0
6.0
5.0
0
20
40
60
80
100
120
Time (hrs)

Fig. 6

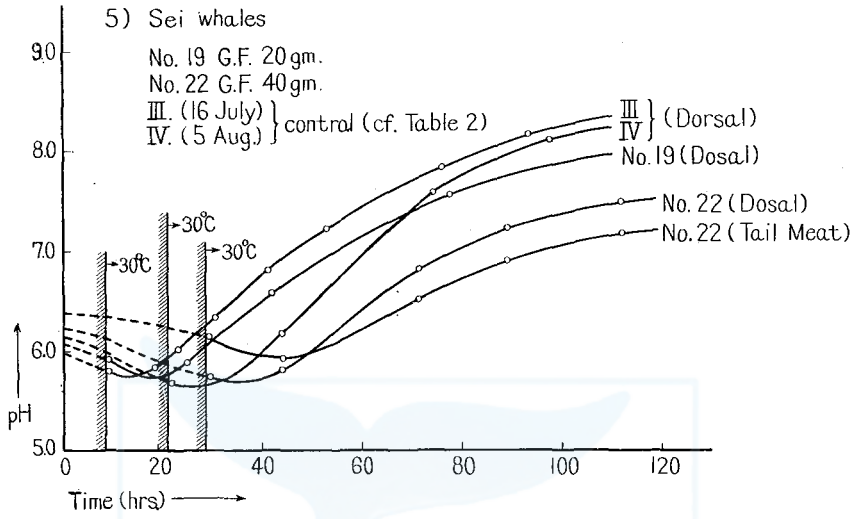
5) Sei whales
No. 19 G.F. 20 gm.
No. 22 G.F. 40 gm.
III. (16 July)
IV. (5 Aug.)
control (cf. Table 2)
III
IV
(Dorsal)
No. 19 (Dosal)
No. 22 (Dosal)
No. 22 (Tail Meat)
30℃
30℃
30℃
pH
9.0
8.0
7.0
6.0
5.0
0
20
40
60
80
100
120
Time (hrs)

Fig. 7

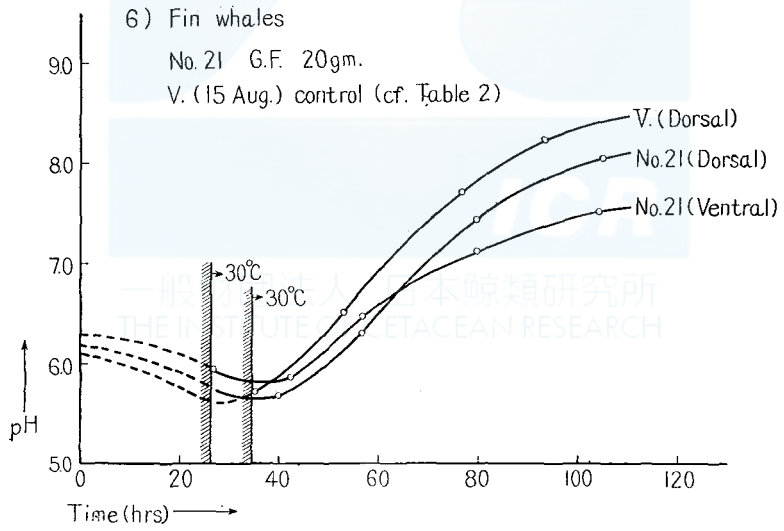
6) Fin whales
No. 21 G.F. 20 gm.
V. (15 Aug.) control (cf. Table 2)
V. (Dorsal)
No. 21 (Dorsal)
No. 21 (Ventral)
30℃
30℃
pH
9.0
8.0
7.0
6.0
5.0
0
20
40
60
80
100
120
Time (hrs)

Fig. 8

Summary

Experiments on the preservation of freshness in whale meat with Guanofuracin (5-nitrofurfurylideneaminoguanidine hydrochloride) were carried out as 4th series of the these experiments at Akkeshi in the Hokkaido during July and August, 1953. Twenty-two cases, including 16 sperm whales, 5 sei whales, and one fin whale, were obtained of which about two-thirds were successful cases. Determination of pH value of the meat and blood level of Guanofuracin was carried out on the successful cases and on control whales and it was reconfirmed that the freshness of meat in Guanofuracin-injected whales was preserved to some extent compared to control whales.

Reference

1) S. Akiya, O. Hoshino, N. Motohashi: Sci. Rep. Whales Res. Inst., No. 7, 23 (1952).
2) S. Akiya, R. Sawamura: Sci. Rep. Whales Res. Inst., No. 7, 31 (1952).

(Pharmaceutical Institute, Medical Faculty, University of Tokyo)