CHEMICAL STUDIES ON CANNED MEATS. II. ON THE CONTENTS OF GASES AND METALS IN STORED CANS.

By Yuzuru OKUDA and Kitaro KATAI.

Received August 20th, 1936. Published November 28th, 1936.

In the first paper[1] on some chemical changes of muscle proteins in canning, we described the changes of *p*H, of the forms of nitrogen and sulphur, of elementary composition, of the contents of arginine, histidine, lysine, cystine, cysteine, tyrosine, tryptophane and proline. The present communication deals with the contents of gases and metals in the cans which have endured long storage.

(1) This Bulletin, **9** (1934), 75.

As a means to know the changes of canned meats and the state of corrosion of can-materials, gases, such as carbon dioxide, hydrogen, oxygen and nitrogen, sometimes ammonia and hydrogen sulphide, together with metals, such as iron and tin, dissolved from cans were determined with the results shown in Tables 1, 2 and 3.

Table 1. Beef. +: present; —: absent

Age of cans (years)	15	7	5	1
No. of analysis	6	7	3	3
Blown cans	+	—	—	—
Corrosion of cans	+++	++	++	+
Putrid odor	—	—	—	—
Appearance of meat	Normal	Normal	Normal	Normal
Contents (g.)	156	159	450	459
Water (%)	61.0	60.5	60.2	59.7
Dry matter ,,	39.0	39.5	39.8	40.3
Gas (c.c.)	79.5	25.9	15.9	10.4
CO_2 (%)	3.4	4.9	3.6	2.8
O_2 ,,	1.3	1.8	3.0	4.7
H_2 ,,	82.2	22.3	22.3	12.2
N_2 ,,	13.2	71.0	71.2	80.4
Fe (mg. %)	191.5	15.6	14.2	13.7
Sn ,,	375.0	219.5	104.5	78.3
*p*H	5.8	5.6	5.8	5.8

Table 2. Crab.

Age of cans (years)	5	3	1
No. of analysis	6	4	6
Contents (g.)	231	221	224
Water (%)	79.2	78.5	80.0
Dry matter ,,	20.8	21.5	20.0
Gas (c.c.)	9.5	7.0	11.0
CO_2 (%)	0.3	0.6	0.4
O_2 ,,	9.6	7.2	10.1
H_2 ,,	11.6	11.9	8.7
N_2 ,,	78.5	80.4	80.8
Fe (mg. %)	10.6	11.3	9.7
Sn ,,	19.9	17.9	15.0
*p*H	6.9	6.9	7.0

Table 3. Salmon and Tunny.

	Salmon		Tunny	
Age of cans (years)	1	7	1	7
Contents (g.)	452	480	404	422
Water (%)	73.7	75.2	62.4	61.1
Dry matter ,,	26.3	24.8	37.6	38.9
Gas (c.c.)	1.5	5.0	21.5	102.0
CO_2 (%)	0	1.8	13.1	5.5
O_2 ,,	6.7	10.2	0.7	0.3
H_2 ,,	35.3	25.0	20.8	73.8
N_2 ,,	58.0	63.0	65.4	20.4
Fe (mg. %)	13.8	15.9	12.7	49.9
Sn ,,	24.2	108.7	87.0	214.8

The results of the experiments carried out with canned meats of different ages of storage, from 1 to 15 years, were as follows:

(1) Among gases contained in cans examined, the quantity of nitrogen was the largest in the majority of the cans, but in some old cans the amount of hydrogen was frequently more than that of nitrogen.

(2) The proportion of oxygen as compared to that of nitrogen was much smaller than it is in the air.

(3) The content of carbon dioxide in cans was larger than that in the air, but it did not increase appreciably during the storage of the cans.

(4) Free ammonia and hydrogen sulphide showed only traces.

(5) The concentration of hydrogen ion of the canned meats showed almost no change in storage.

(6) The contents of iron and tin in both canned beef and fish were nearly proportional to that of hydrogen in the cans which was produced by corrosion of can-materials. But in the case of crab meat packed in the cans which are covered inside with lacquer, almost no increase of the contents of iron, tin and hydrogen was observed.

(7) Unusual increase of hydrogen gas in some very long-stored beef-cans sometimes gave rise to the so-called "blown" cans, in which the ends become convex, and are apparently analogous to the spoiled cans dilated by the pressure of carbon dioxide produced by the action of bacteria upon the contents.

A part of the expense of this investigation was defrayed by a research grant from the "Hattori-Hokokwai", to whom our thanks are due.

Laboratory of Agricultural Chemistry,
Kyushu Imperial University, Fukuoka.