

CHEMICAL STUDIES ON CANNED MEATS.
III. CARBON DIOXIDE AND HYDROGEN GASES
PRODUCED AT CANNING AND IN STORAGE.

By Yuzuru OKUDA and Kitaro KATAI.

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For the purpose of knowing the changes of canned meat and the state of corrosion of can-materials, we determined oxygen, nitrogen, carbon dioxide and hydrogen gases in commercial cans as described in the preceding paper.⁽¹⁾ In the experiment recorded in the present paper, carbon dioxide was again determined as a means of knowing some chemical changes which occurred in canned meat, and hydrogen gas to know the state of the corrosion of can-material. But in the present case, instead of commercial cans, sealed glass tubes containing a certain meat, tin and iron powders, and solutions of different hydrogen ion concentrations were used for the sake of more exact comparison. The tubes were heated at 130° for different hours, to know the influence of heat and pressure upon canned meat and can-material at canning, and preserved at 50° for different periods to know the effect of storage.

The experiments were performed with three kinds of meats, but only the data with beef are described below, as the results with other meats were analogous.

Table 1. Carbon Dioxide (c.c.)

(a) Sulphuric acid was added.

Meat powder	Fresh meat				Somewhat spoiled meat			
pH, before and after heating	4.0—4.5				4.0—4.3			
Hours of heating	1			3	1			3
Days of storage	0	30	60	0	0	30	60	0
Fe added	2.1	2.6	2.1	3.1	2.2	2.1	1.8	2.7
Sn added	1.4	2.6	2.9	2.2	1.1	1.9	2.5	1.8
Fe and Sn added	2.2	2.2	1.9	3.1	2.0	2.1	1.5	2.8

(1) This Bulletin, **11** (1936), 715.

(b) Water was added.

Meat powder	Fresh meat				Somewhat spoiled meat			
pH, before and after heating	5.5—5.7				5.5—5.7			
Hours of heating	1			3	1			3
Days of storage	0	30	60	0	0	30	60	0
Fe added	1.7	1.2	0.8	2.6	1.7	1.1	1.2	2.5
Sn added	1.5	2.4	2.8	2.3	1.2	2.0	2.4	2.0
Fe and Sn added	1.5	0.5	0.9	2.4	1.4	0.8	0.8	2.4

(c) Sodium hydroxide was added.

Meat powder	Fresh meat				Somewhat spoiled meat			
pH, before and after heating	8.5—7.9				8.2—7.9			
Hours of heating	1			3	1			3
Days of storage	0	30	60	0	0	30	60	0
Fe added	0.9	0.5	0.2	1.8	1.1	0.3	0.2	2.0
Sn added	0.9	1.2	1.3	1.6	1.0	1.4	1.8	1.8
Fe and Sn added	0.9	0.3	0.2	1.4	1.2	0.5	0.2	2.0

Table 2. Hydrogen (c.c.)

(a) Sulphuric acid was added.

Meat powder	Fresh meat				Somewhat spoiled meat			
pH, before and after heating	4.0—4.5				4.0—4.3			
Hours of heating	1			3	1			3
Days of storage	0	30	60	0	0	30	60	0
Fe added	18.6	48.2	57.7	32.5	19.9	55.0	60.1	30.2
Sn added	0.3	0.2	0.2	0.3	0.3	0.3	0.1	0.3
Fe and Sn added	19.7	49.3	57.8	32.8	23.7	54.1	63.3	27.8

(b) Water was added.

Meat powder	Fresh meat				Somewhat spoiled meat			
pH, before and after heating	5.5—5.7				5.5—5.7			
Hours of heating	1			3	1			3
Days of storage	0	30	60	0	0	30	60	0
Fe added	5.2	32.1	36.0	7.4	5.9	34.9	41.1	8.1
Sn added	0.2	0.2	1.2	0.3	0.2	0.1	0.5	0.2
Fe and Sn added	5.2	33.4	33.0	8.7	5.6	40.0	41.6	9.6

(c) Sodium hydroxide was added.

Meat powder	Fresh meat				Somewhat spoiled meat			
pH, before and after heating	8.5—7.9				8.2—7.9			
Hours of heating	1			3	1			3
Days of storage	0	30	60	0	0	30	60	0
Fe added	0.5	16.4	21.5	1.2	1.8	22.9	27.1	5.2
Sn added	0.2	0.1	0	0.2	0	0	0.1	0.2
Fe and Sn added	0.9	17.2	21.2	0.8	1.4	22.1	27.8	5.1

The results of experiments performed with beef and fish were as follows:

(1) The production of carbon dioxide at canning increased a little more, as a rule, in the presence of iron than in the presence of tin alone. And also the longer the time of heating the more was the increase.

(2) The production of carbon dioxide during storage, gradually increased in the presence of tin alone, but decreased in the presence of iron. The decrease seem to be due to the fact that carbon dioxide produced by gradual oxidation acts on iron to make iron carbonate and hydrogen.

(3) The production of carbon dioxide seems to have some relation with the hydrogen ion concentration of meat juice and the kind of meats, but the relation with the freshness of the meat is not definite.

(4) The production of hydrogen is chiefly due to the presence of iron but only slightly to that of tin. In the presence of iron, the production had an

intimate relation with the hydrogen ion concentration of meat juice, the stronger being the concentration the more the production. The production increased proportionally to the length of time of heating at canning, and to the period of storage of cans.

(5) The kind and freshness of meats have more or less influence upon the production of hydrogen from can-material.

(6) The quantity of carbon dioxide produced was generally very small as compared to that of hydrogen.

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*Laboratory of Agricultural Chemistry,
Kyushu Imperial University, Fukuoka.*
