

(b) From these data it is shown that widely divergent curves of acidity may be plotted which depend entirely upon the experimental error of the method and not upon the subject's gastric condition.

(c) The inadequacy of the titration method and the importance of hydrogen ions and buffer salts in measuring gastric acidity is indicated.

3. A subject who could regurgitate his total gastric contents at will, was given the test meal on different days and the total contents were regurgitated at different intervals from the time of ingestion to the test meal. The curve of acidity plotted in this manner differed radically from the curve obtained in the usual manner. Furthermore, discrepancies were noted between the acidity of an aliquot removed immediately prior to regurgitation and the acidity of the total gastric contents.

Results obtained by the Rehfuess method may be more validly interpreted if: (a) the analysis is repeated until a satisfactory agreement in curves is obtained; (b) the tube is kept at a constant level; (c) aliquot fractions are large; (d) little saliva is swallowed; (e) acidity is measured in terms of hydrogen ions and buffer salts.

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The effect of cooking upon the antiscorbutic vitamin in cabbage.

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The present report is one of a series of studies undertaken to determine the effect of the new cooking implement known as the pressure cooker upon the vitamin content of such foods as are adapted to preparation in that device. The cooker also affords in its manipulation an opportunity to throw light on the response of vitamins to certain combinations of destructive influences that are absent or different from those met in older methods of cookery. The present study is confined to a comparison of the effects of pressure versus open kettle cooking on the vitamin C content of cabbage.

In open kettle cooking the routine involves immersing a given wt. of cabbage in a kettle containing one cup of boiling water and continuing the boiling until the cabbage is in a condition suitable for the table. This required from 45 to 90 minutes according to the weight of cabbage used. In bringing the cabbage to the same condition with the pressure cooker the following procedure was necessary: One cup of water was placed in the cooker and brought to boiling. Cabbage was then added, the cover clamped on and the cooker placed over the flame. The valve was left open until dry steam issued, then closed and heating continued until a pressure of 15 lbs. was reached and a temperature of 121° C. From the time of adding the cabbage to this point required 3-5 minutes. The flame was then regulated to maintain this pressure and temperature for thirteen minutes. At the end of that time the cooker was removed from the flame and allowed to cool until the pressure had dropped to 5 lbs. The valve was then opened, cover removed, and the cabbage drained. The contrasts in cooking conditions are summarized as follows (the P_H was determined on the drained-off liquor):

COOKING CONDITIONS.

	Pressure Cooker.	Open Kettle.
Time of cooking	20 minutes in all 13 minutes at 15 lbs.	45-90 minutes total
Temperatures maintained	3-5 minutes at 100-121° C. 13 minutes at 121° C. 2 minutes at 121-100° C.	45-90 min. at 100° C.
Reaction: Exp. II and I	P_H 5.6-5.8	P_H 5.6-5.8
Exp. III	P_H 4.6-4.8	
Contact with atmos. oxygen	In atmosphere of steam throughout cooking period.	Practically immersed in boiling water throughout cooking period.

Guinea pigs were used as experimental animals throughout the experiments and in all cases the pigs were fed for a preliminary period of at least two weeks on the basal diet plus raw cabbage ad lib. Only those which gained consistently on this diet were selected for the experiment and those which approximated 350 gms. so far as possible. For basal diet the LaMer-Sherman combination was selected:

LAMER-SHERMAN BASAL DIET.

	Per Cent.
Skim milk powder (Krystallak) heated two hours at 107° C.....	30
Butter fat.....	10
Ground whole oats.....	59
NaCl.....	1
	100

The cabbage was fed separately by hand and complete consumption observed of the daily allowance. The amounts used were 1 gram raw to control pigs and 5 or 10 grams cooked to experimental pigs. 5 grams cooked cabbage is equivalent to 5.4 grams raw. 10 grams pressure cooked is equivalent to 10.7 gms. raw and 10 grams open kettle cooked to 10.8 gms. raw.

Three experiments are reported herewith. Experiment I was a qualitative experiment over a twenty-day period. During this period 4 pigs were fed the basal diet plus 1 gram raw cabbage daily and two were put on basal diet without supplement. Two others were given basal diet plus 5 grams pressure cooked cabbage daily. At the end of 20 days the animals were chloroformed and autopsied. The result seemed to indicate that 5 grams cooked cabbage was very little protective as the animals showed marked scurvy symptoms. It also demonstrated the efficiency of the control diets. (See Chart, Exp. I.)

In the second experiment the control diets were repeated and four groups of experimental animals followed. These received 5 grams or ten grams daily of pressure cooked or open kettle cooked cabbage. They were kept on this diet until death ensued from scurvy and were then autopsied and the symptoms of scurvy verified. The controls on 1 gram raw cabbage per day were continued 82 days to make sure of the protection and then chloroformed and autopsied to confirm this point. (See Chart, Exp. II.)

In the third experiment three animals were placed on 10 grams pressure cooked cabbage per day plus basal diet but in this case the water in which cooking took place was acidified by diluting 40 c.c. of vinegar to 234 c.c. with water. The liquor drained from the cabbage at the end of the cooking period registered a P_H of 4.6-4.8. All of these animals died of scurvy. (See Chart, Exp. III.)

A summary of the significant data connected with these three experiments is given in the following table. The growth curves are shown in the chart.

TABLE.

Diets (Symbols).

- A. Basal diet plus one gram raw cabbage daily.
 B. Basal diet without cabbage.
 C. Basal diet plus 5 grams pressure cooked cabbage daily.
 D. Basal diet plus 5 grams open kettle cooked cabbage daily.
 E. Basal diet plus 10 grams pressure cooked cabbage daily.
 F. Basal diet plus 10 grams open kettle cooked cabbage daily.
 G. Basal diet plus 10 grams pressure cooked acidified cabbage daily.

Experiment I.

	Diet.		
	A.	B.	C.
Pigs.....	Ave. of 4	Ave. of 2	Ave. of 2
Days on diet.....	20	20	20
Wt. at beginning.....	250	225	225
Wt. at end.....	350	185	220
Autopsy findings.....	No scurvy	Scurvy	Scurvy

Experiment II.

	Diet.											
	A.		B.		C.		D.		E.		F.	
Pig No.....	6	12	3	8	4	10	5	7	1	11	2	9
Days on diet...	82	82	32	32	46	41	44	48	45	59	52	48
Wt. at beg.	400	358	378	387	364	376	411	339	362	396	351	384
Wt. at end.....	300	498	220	207	212	272	235	235	252	207	200	244
Gain or loss.....	100	+140	158	180	152	104	176	104	110	189	151	140
Autopsy.....	N ¹	N	S ¹	S	S	S	S	S	S	S	S	S
Adrenals.....	—	640	410	453	439	302	509	481	350	—	389	324 mgms.

Experiment III.

	Diet G.		
Pig No.....	23	24	25
Days on diet.....	41	26	37
Wt. at beg.....	469	315	395
Wt. at end.....	300	230	225
Loss.....	169	85	170
Autopsy.....	S	S	S
Adrenals.....	697	412	496 mgms.

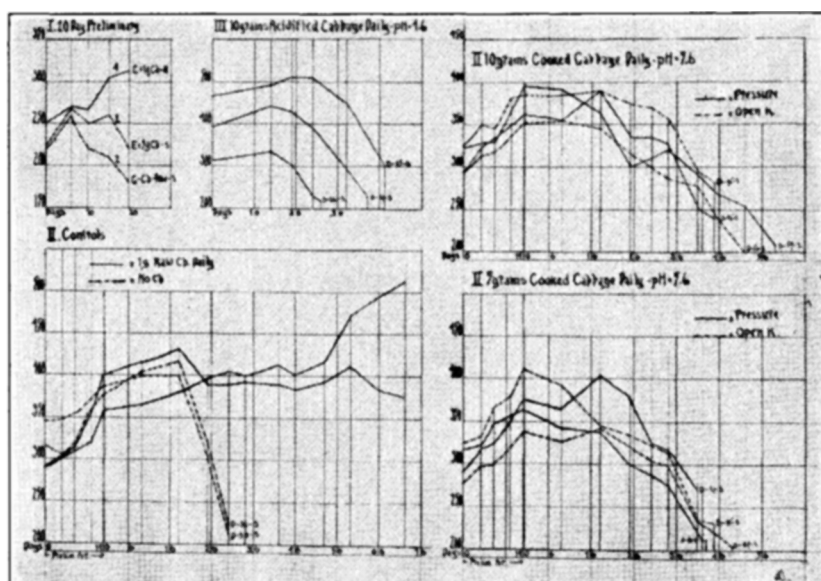
SUMMARY.

1. The LaMer-Sherman basal diet proved quantitatively accurate in producing death by scurvy within the periods predicted by the authors.

¹ "S" sign. scurvy. "N" sign. no scurvy.

2. One gram raw cabbage daily, added to the basal diet, proved completely protective against scurvy; no symptoms appearing in 82 days on the diet and the absence of symptoms in this case was confirmed by autopsy on the chloroformed survivor.

3. The methods of cookery were such as to indicate that in spite of acid reaction and exclusion of oxygen the temperatures used were sufficient to destroy enough vitamin C to make an intake of 10 grams daily inadequate for protection against the disease. In this respect the cabbage vitamin seems to be much

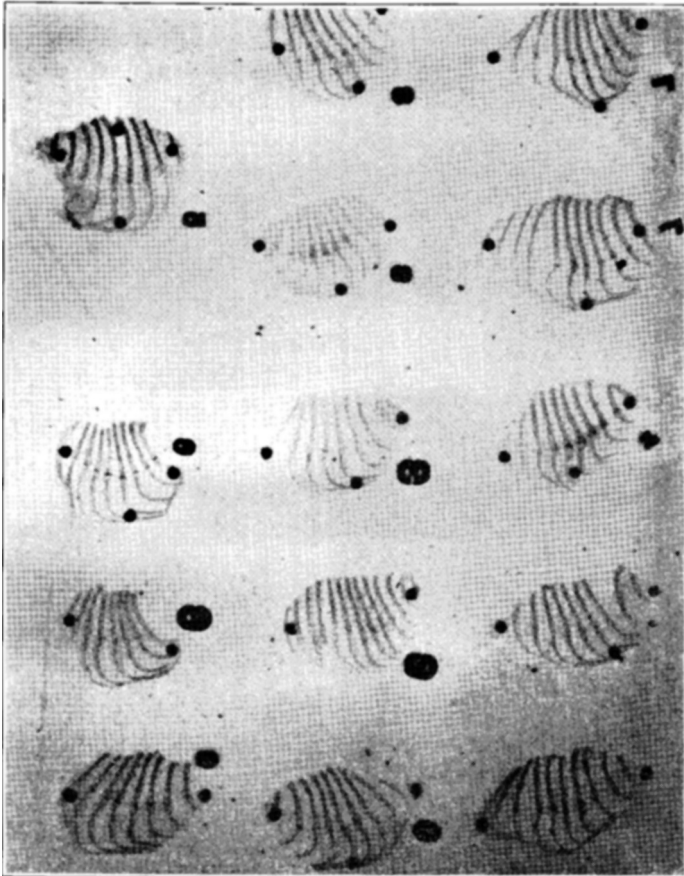


Growth curves expressed in grams. *D* indicates death by scurvy and the numeral following indicates days elapsed on diet.

less resistant than the orange juice or tomato juice carried form. It is of course possible that the intra-cellular oxygen of the cabbage is a factor in this difference. The results however harmonize with those of Ellis, Steenbock and Hart,¹ who showed that drying for 35 hours in an atmosphere of CO_2 at a temperature of 65°C . proved extremely destructive to the cabbage vitamin.

¹ *J. Biol. Chem.*, 1921, xlii, 367.

4. At the maximum intake used, no difference was observable between the pressure cooker and the open kettle as a destructive agent.



X-rays of excised ribs of the animals of Experiment II. The numerals on the photograph have the following significance: 5 is pig 12, 82 days on basal diet plus 1 gram raw cabbage daily; 6, pigs 3 and 8, no cabbage in diet; 4, 5 grams pressure cooked cabbage and 3, 5 grams open kettle cooked cabbage; 7, 10 grams pressure cooked cabbage and 8, 10 grams open kettle cooked cabbage daily.