Neutron Absorption of Boron and Cadmium at Low Temperatures

In the same arrangement as used for silver absorption[1], we have measured the influence of temperature on the absorption of neutrons in Fermi's group 'C' by boron and cadmium, using the 2·3 min. silver activity as detector.

Absorption curves were taken with detector, source and absorber kept at room temperature in the centre of a large vessel containing liquid hydrogen (20·4° K.) or water (300° K.). The ratio of thickness giving equal absorption at different temperatures, $\sqrt{(300)}/\sqrt{(20{\cdot}4)}$, was found to be fairly independent of the absorption itself, its value being $1{\cdot}65 \pm 0{\cdot}20$ for boron and $1{\cdot}4 \pm 0{\cdot}25$ for cadmium.

The theoretical value to be expected from a $1/v$ law of absorption, assuming a Maxwell distribution, would be 3·84. Preliminary results on cadmium absorption in paraffin cooled by liquid nitrogen (77° K.) gave, for $\sqrt{(300)}/\sqrt{(77)}$, a value less than 1·1 in agreement with the results of Rasetti, Segre, Fink, Dunning and Pegram[2] with the mechanical selector, and those of Dunning and others[3], obtained at 85° K. We therefore conclude that the absorption curve of cadmium has a selective character, though comparison with 20·4° K. shows that an increase of cross-section certainly exists at the lowest energies, presumably due to overlapping of a selective band with the usual increase obtained with most elements at very low energies.

The results with boron cannot be explained on the assumption of a $1/v$ law for both boron and silver, but it is not possible to decide whether this is not due to the deviation of the silver detector alone from the $1/v$ law, since experiments have not yet been made with a boron chamber as detector.

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[1] *Sow. Phys.*, **10**, 170 (1936); NATURE, [**138**, 326 (1936)].
[2] *Phys. Rev.*, **49**, 104 (1936).
[3] *Phys. Rev.*, **49**, 650 (1936).

The State of Ascorbic Acid in Plant Tissues

During the last two years, considerable discussion has arisen over the state in which ascorbic acid occurs in natural food materials. It is an experimental fact that some vegetables after being heated in boiling water exhibit an apparent increase in the amount of titratable ascorbic acid, which can then be extracted from the plant tissues.

Three explanations for this anomalous increase have been advanced:

(1) Heating breaks up the cellular tissue and allows a more complete extraction of ascorbic acid[1].

(2) A part of the ascorbic acid exists in a combined or esterified form which is hydrolyzed by heat or acid[2,3].

(3) Heating inactivates the oxidizing enzymes, thus preventing the oxidation of ascorbic acid[4].

The first explanation has been discarded, but the (2) and (3) have provided the basis for the present controversy. As a matter of fact, all the phenomena were noted by Tillmans and his associates[5] several years ago. They state that with certain vegetables the proposed titrametric method agreed with the biological assay method only if the oxidized ascorbic acid were reduced with hydrogen sulphide. The oxidation of ascorbic acid occurred during the extraction and might be prevented by heating before extraction or by extracting with stronger acid.

These facts have been insufficiently realized by later workers. Thus, Ahmad[2] considers that no oxidase was concerned, since raw cabbage extracted with cold 20 per cent trichloracetic acid gave a lower titre than boiled cabbage extracted with the same acid. The assumption that 20 per cent trichloracetic acid completely inhibits the enzyme action in cabbage is erroneous. In a forthcoming communication from this laboratory, it is shown that while the optimum *p*H for the reaction of ascorbic acid oxidase is about 5·5, a considerable activity persists at very much lower *p*H values. Although an oxidizing enzyme has been found in every one of nine vegetables investigated, its activity varies greatly. The oxidase in cabbage is barely inhibited by extraction with 1 *N* sulphuric acid, in which case the *p*H of the extract is 0·8. Furthermore, it should be realized that while the final concentration of an extract may be 20 per cent trichloracetic acid, it is very much less than that in the crushed plant cells during the first few moments of grinding up the vegetable.

Recently, Guha and Pal[6] have reported experiments which are claimed to demonstrate almost conclusively that the increase in ascorbic acid content of certain foodstuffs on boiling cannot be accounted for on the oxidase theory. Alcoholic and ethereal extracts of cabbage are claimed to give an increase in ascorbic acid after heating. It should be pointed out that ascorbic acid oxidase is completely inactivated by both absolute alcohol and ether. Therefore any increase in ascorbic acid on heating these extracts has no bearing whatever on the oxidase theory, but must be explained by other means.

Experimental Procedure

Treatment	Ascorbic acid (mgm. per gm. of vegetable) Before Reduction with H_2S	After Reduction with H_2S
1. 20 gm. cabbage extracted with 100 ml. cold water	0·003	0·50
2. 20 gm. cabbage covered with 40 ml. cold water and heated 4 min. at 100° C. under CO_2. Extracted with 60 ml. additional water	0·47	0·48
3. 20 gm. cabbage extracted with 100 ml. cold 1*N* H_2SO_4 containing 2 per cent HPO_3	0·50	0·51
4. 20 gm. cabbage + excess Na_2SO_4 extracted with 100 ml. cold anhydrous ethanol	0·51	0·54
5. 20 gm. cabbage + excess Na_2SO_4 extracted with 100 ml. cold anhydrous ethyl ether	0·004	0·03
6. Extract (1) heated 4 min. at 100° C. under CO_2	0·04	0·47
7. Extract (1) made 0·2 per cent with resp. to HCl, let stand 1 hour ...	0·006	0·43
8. Extract (1) made 1 per cent with resp. to HCl, let stand 1 hour ...	0·008	—
9. Extract (4) heated 4 min. at 100° C. under CO_2	0·50	—
10. Extract (4) heated 10 min. at 36° C. under CO_2	0·47	—
11. Extract (5) air dried, then heated in 50 ml. water 4 min. at 100° C. under CO_2	0·004	—

I have carefully repeated the experiments of Guha and Pal and failed to observe any increase in ascorbic acid content on heating. Instead, the results show that the samples of cabbage examined in this laboratory did not contain appreciable amounts of ascorbic acid in a combined state. If the enzyme is inactivated by heat or alcohol, or inhibited by