

The Effect of Low Temperature in the Preservation of *Petasites japonicus* Miq. (Fuki) and *Phyllostachys pubescens* Mazel (Mōsōchiku, Bamboo Shoot)

Sachiye HIRAHARA

The application of food preservation by freezing has recently increased and there are detailed publications¹⁾²⁾³⁾ concerning the preparation of frozen foods. However, *Petasites japonicus* Miq. (fuki) and *Phyllostachys pubescens* (mōsōchiku, bamboo shoot), vegetables used in Japanese cookery, have not been reported as to the method of freezing. These vegetables have a very short season and thus, if freezing is possible it would be of value. Whether these vegetables are not listed due to unfavourable results is not known, although Kato⁴⁾ has reported that the recommended time for blanching is 15–55 mins. at 100°C for bamboo shoots. Thus, a report will be given on the effect of freezing on these vegetables.

Materials and Methods

Petasites japonicus Miz. (fuki) and *Phyllostachys pubescens* Mazel (mōsōchiku) were used as materials and for comparison *Phaseolus vulgaris* (green beans) was also used as it is recommended for freezing. They were blanched for 2 mins., 20 mins. and 2 mins. respectively, and frozen and stored at –15°C for three months in a R5430FB Hitachi freezer.

Each sample was fixed in CRAF III⁵⁾, dehydrated in TBA series, embedded in paraffin, cut at 10 μ , and stained with iron haematoxylin.

Results and Discussion

To make comparisons, green beans were studied histologically. Fig. 1 shows transverse sections of green beans. Perhaps due to blanching as reported previously⁶⁾ chloroplasts can be seen slightly coagulated and the epidermal cells slightly loosened. However, no cellular breakdown could be observed, which may contribute to the production of an acceptable product.

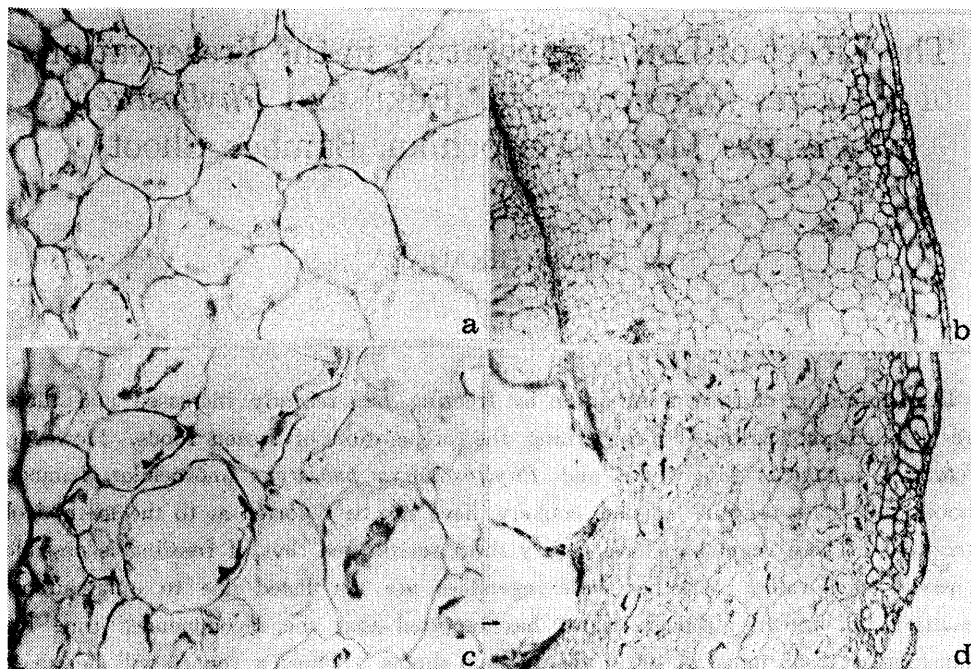


Fig. 1 Transverse section of *Phaseolus vulgaris* (green beans). a. and b. Fresh. Cells are intact. Chloroplasts are distributed around the periphery of the palisade cells. c. and d. Frozen for 3 months at -15°C . Coagulation of chloroplasts and separation of the epidermal cells. a. and c. $\times 800$. b. and d. $\times 180$.

Table 1 Moisture Content of the Vegetables

Vegetables	Average Moisture (%)	
	Fresh	After 3 mons. storage at -15°C
<i>Phaseolus vulgaris</i> (green beans)	96.1	91.3
<i>Petasites japonicus</i> Miq. (fuki) unpeeled	93.4	93.0
peeled	94.6	94.5
<i>Phyllostachys pubescens</i> Mazel (mōsōchiku, bamboo shoot)	93.1	89.3

Petasites japonicus Miq. (fuki) (Fig. 2).

In the frozen state the epidermal cells have loosened and the cortical cells are ruptured. By blanching such rupture could not be seen. Sterling⁷⁾ has also found

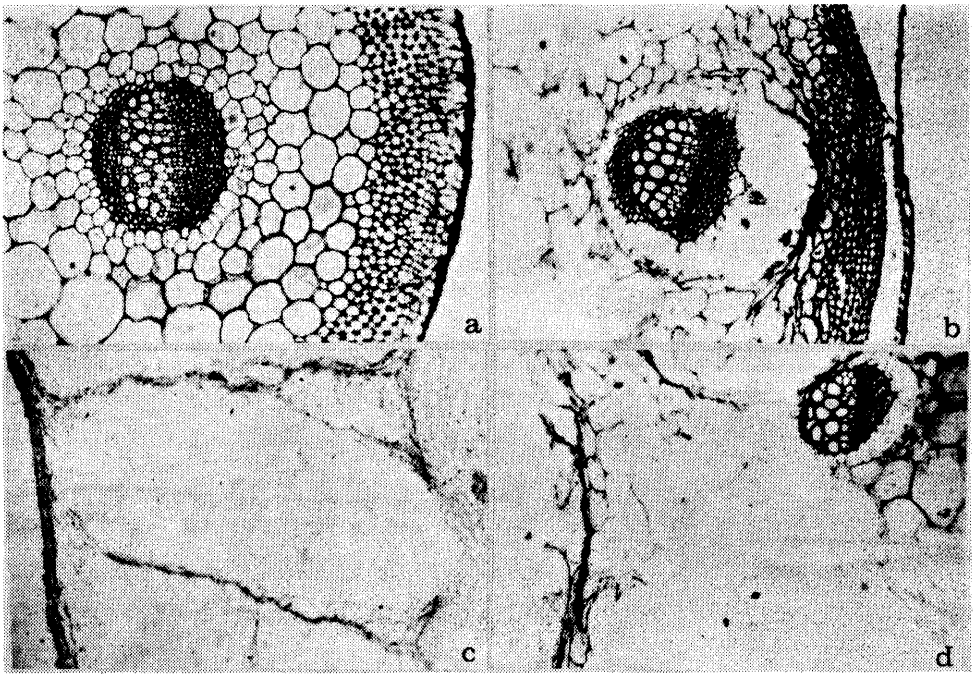


Fig. 2 Cross section of *Petasites japonicus* Miq. (fuki). a. Control. b. and d. Frozen for 3 months at -15°C . c. *Phaselus vulgaris* (green beans) frozen for 3 months. Epidermal cells slightly distorted but still holding its shape. d. Ruptured epidermal cells and cellular breakdown of the cortical cells of *Petasites japonicus* Miq. (fuki). $\times 180$.

that by steaming even as long as 60 mins. resulted only in the separation of the cells and no breakdown of the cell walls. Thus, it can be said that due to the formation of ice crystals the cell walls have been punctured and these cells no longer are able to reabsorb the water. This condition in turn causes flabbiness, which is observed on thawing.

As shown clearly in Fig. 2 c and d, a distinct difference can be seen between the two cell structures. In the case with string beans the epidermal cells are slightly distorted but still holding its shape. On the other hand, with *Petasites japonicus* Miq. (fuki) the thin cellular walls are distorted, which makes it difficult to keep its original structure.

There are objective methods⁸⁾ in measuring the effect of freezing, however, in the present study the moisture content was measured. From Table 1 no difference in the moisture content between fresh and frozen is observed. This may have resulted from

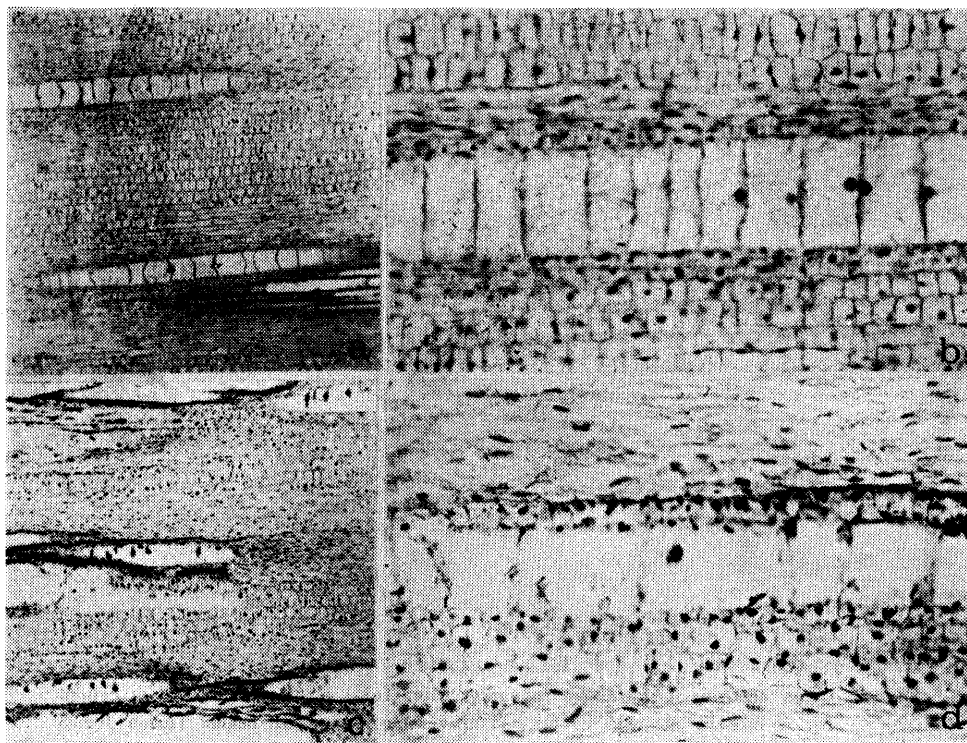


Fig. 3 Tangential sections of *Phyllostachys pubescens* Mazel (mōsōchiku, bamboo shoot). a. and b. Control. c. and d. Frozen for 3 months at -15°C . Ruptured cell walls due to ice-crystal formation. a. and c. $\times 180$. b. and d. $\times 800$.

water left in the large holes formed by the ice-crystals and the thicker surrounding walls keeping the water intact. On cooking the water is withdrawn almost entirely and therefore, a very dry and tough product is obtained.

***Phyllostachys pubescens* Mazel** (mōsōchiku, bamboo shoot) (Fig. 3).

This vegetable is composed of two kinds of cells, those tightly arranged compact small cells and large thin walled cells. It is these large thin walled cells which are pushed out of position and sometimes turned on edge or crosswise the original position. The cell nucleus has retained very nearly its original position and size but slightly irregular in outline. At the septa, breakage of the cellular wall was also observed but the shape of cells are round and in bundles rather than longitudinal. The sogginess which is obtained after thawing may be due in part to these cells still absorbing water but since the walls are broken a sponge-like tissue is obtained.

No significant difference could be seen between the moisture content of fresh and frozen samples (Table 1). This may have been caused by the water still intact between the cells.

An acceptable product from these two vegetables may be obtained by thawing in a seasoned solution and in so doing may retain its fresh structure as in the cases with fruits⁹⁾ or by a quick freezing method as suggested by Woodroof¹⁰⁾. Further studies concerning these methods are now under investigation.

Summary

Petasites japonicus Miq. (fuki) and *Phyllostachys pubescens* Mazel (mōsōchiku, bamboo shoot) were studied concerning its possibility as a frozen product. It was found that after thawing the vegetables were extremely flabby and soggy, resulting in an undesirable food for cookery. Histological findings revealed that the delicate thin walls were ruptured in comparison to the fresh or blanched samples, resulting in excess amount of water leakage.

References

- 1) Simpson, J. I., 1962. The Frozen Food Cookbook. The Avi Publishing Co. Ltd. Westport, Conn. pp. 483.
- 2) Tressler, D. K., C. F. Evers and B. H. Evers, 1953. Into the Freezer—and Out. The Avi Publishing Co. Inc. New York pp. 246.
- 3) Tressler, D. K. and C. F. Evers, 1957. The Freezing Preservation of Foods. The Avi Publishing Co. Inc. Westport, Conn. pp. 1214.
- 4) Kato, S., 1967. Shokuhin reito no riron to oyo. Korin Publishing Co. pp. 1001.
- 5) Hirahara, S., 1962. The Effect of Several Fixing Solutions on the Fixation Image and Staining of the Lilac Leaf (*Syringa Vulgaris*). Bull. Hiroshima Jogakuin College **12**:169-176.
- 6) Hirahara, S., 1963. Histological Findings in String Beans during Cooking in Relation to its Change in Color Pigment. Bull. Hiroshima Jogakuin College **13**:145-152.
- 7) Sterling, C., 1955. Effect of Moisture and High Temperature on Cell Walls in Plant Tissues. Food Research **20**:474-479.
- 8) Lee, F. A. and G. A. Johannessen, 1951. An Objective Method for Measuring the Effect of Freezing Rate on Asparagus. Food Technology **5**:263-265.
- 9) Cox, M. J. and M. M. MacMasters, 1942. Microscopic Studies of Tissue of Frozen Fruits and Vegetables. Food Research **7**:135-139.
- 10) Woodroof, J. G., 1938. Microscopic Studies of Frozen Fruits and Vegetables. Geo. Expt. Sta. Bull. 201.