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Utah Agricultural College
EXPERIMENT STATION

Circular No. 26

Storing Vegetables for Winter

By

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Storing Vegetables for Winter

M. C. MERRILL

The storing of vegetables for winter use has come to be important. The joys of having a large variety of choice garden produce available for the table at any time are no longer confined to the growing season. Because we are thrifty today and plan for the morrow, we gather our crops in the fall and store them for winter use.

In spite of its importance, comparatively little research work has been done on the problems of storage. As a result we are still employing many of the same methods that were devised by our forefathers, except in the case of cold storage, which is strictly a modern institution. The fact that we continue to use old methods, however, speaks well for them; otherwise, they would be abandoned.

Underlying the practice of storing vegetables are some fundamental principles which are easily understood and which are also helpful, for they tell us the "why" in our storage operations.

A. FUNDAMENTAL PRINCIPLES

1. RETARDING PLANT ACTIVITIES

To store vegetables under the proper conditions has the desirable effect of retarding the processes which are being carried on in every living plant cell. Vegetables are not dead when harvested, unless they have been killed by frost or other agents, in which case they soon begin to spoil; neither are they completely mature in the chemical sense. The cells continue their work of transforming the substances until the plant is entirely mature. When that time comes,—which may be a question of days, weeks, months, or years, after harvesting, depending upon the kind of vegetable and the conditions under which it is kept, the cells die, and decay sets in at once. The maturing processes are carried on more rapidly at high temperatures than at low. In the storage cellar the temperature should be sufficiently low to retard the plant activities and thereby prolong the life of the vegetable, thus making it possible to keep it for a longer period.

2. RESPIRATION

Every living plant cell takes in oxygen and gives off carbon dioxide the same as animals do. This process goes on day and night until the cell dies. If oxygen is not available or if carbon dioxide accumulates in quantity within the tissues, the breathing is interfered with and the plant is injured. As with the other plant activities, respiration is retarded by low temperatures. For example, experiments by Morse of New Hampshire with apples stored at different temperatures for four and five months showed the following interesting results:
STORING VEGETABLES FOR WINTER

At a Temperature of | No. Milligrams of Carbon Dioxide Exhaled Each Hour by 1 kilogram of apples
-------------------|--------------------------------------
65-77° Fahrenheit | 18.0
40-50° Fahrenheit | 8.1
32° Fahrenheit | 2.7

Slowing down the respiration process prolongs the life of the produce in storage, for during respiration deep-seated changes occur in the plant, by means of which complete chemical maturity is reached. It would cause death, however, if the respiration were stopped altogether.

3. AGENCIES PRODUCING DECAY

Were it not for the destructive work of bacteria and fungi our plant products could be stored without much loss arising from decay and putrefaction. These agents cause the rotting and the molding so commonly seen on the fruits and vegetables in our cellars. The spores, or seeds, of these tiny plants are produced by the billions every day and are distributed widely by wind and other means. They are in the air we breathe, in the water we drink, in the food we eat. They are everywhere present, though they are so small we cannot see them, and are merely awaiting favorable conditions of temperature, moisture, and food to germinate and grow.

It is our business, therefore, to prevent or retard as much as possible the growth of these organisms. By so doing we will greatly prolong the period during which vegetables will remain usable. This growth is retarded by a low temperature and a dry atmosphere. Furthermore, if the vegetables are sound, mature, and uninjured when they are placed in the cellar, the spores of bacteria and fungi will find it more difficult to gain entrance and start growth. Bruised fruits and vegetables invite speedy infection and rapid decay, and hence the greatest care should be exercised in the handling of our garden products if we wish to store them for any length of time.

B. STORAGE REQUIREMENTS

1. PURPOSE AND EXPENSE

The purpose for which the facilities are intended should be clearly kept in mind in making plans for storage places. Since various types of vegetables require different conditions, the aim should be to provide those conditions as nearly as possible. This question is closely related to that of expense, which is worthy of careful consideration. Places for storage range in price from an hour’s labor for a pit to thousands of dollars for a large permanent storage house. The conditions on each farm should determine the character of the facilities provided to care for the surplus. If one’s needs require the storing away of some produce every fall, it would be economy in the long run to have permanent facilities, thus avoiding waste in material and time.
2. CLEANLINESS

One of the first requisites for a storage cellar is that it should be clean and sanitary. Yet how often is that essential ignored! The house itself may be kept scrupulously clean and the cellar underneath it be entirely overlooked. Rubbish and decaying matter hold filthy sway in the dark, damp corners, and disorder rules supreme. Bacteria and fungi flourish in such places, causing heavy losses that might have been avoided. The cellar should be cleaned out in the fall and again in the spring and kept that way. Especially should decaying fruit and vegetables be removed at once.

3. EASE OF ACCESS

Another requirement, which should be heralded from the housetops, is that of easy access. One of the disagreeable jobs of life is to carry produce in or out of a cellar that has a low, dingy, winding, rickety entrance. Comfort and convenience in such matters should be considered, even though this increases the expense somewhat.

4. KEEPING PRODUCE IN A NORMAL CONDITION

The ultimate aim of all storage operations is to keep the produce in a condition as nearly normal as possible. To do this, there are three essentials that must be given attention.

The first of these is protection from freezing. Before most vegetables will freeze, a temperature several degrees lower than the freezing point of water (32°F Fahrenheit) must be reached. To prevent injury and speedy decay, the storage conditions should be such that the danger point is never attained. Ordinarily, the best temperature for the purpose is slightly above 32°F Fahrenheit.

The second essential pertains to moisture. Some vegetables require a dry atmosphere, others keep better where the humidity is higher. In general, both extremes of humidity are to be avoided. In addition to the atmospheric moisture, the drainage conditions must be satisfactory. Excess water should not accumulate in the pit or cellar to the detriment of the stored materials.

Good ventilation constitutes the third requirement. This is probably more important than either of the other two, since by ventilation both temperature and humidity can to an extent be controlled. Furthermore, ventilation has a direct relation to the respiration of the vegetable matter and to the sanitation of the cellar.

In arranging the ventilating system it is desirable to have one flue open into the cellar near the floor and another open out near the ceiling. During the warm days and cold nights of autumn the ventilating shafts should be opened at night to allow the cool air to enter and the warm air to escape. In the morning, when the cellar is filled with cold air, the shafts should be closed. When there is danger of the cellar tempera-
ture becoming too low in the winter, the process should be reversed and the warm air of the daytime allowed to enter, thereby raising the temperature.

C. TYPES OF STORAGE

Four different types of farm storage are in use throughout the country. These are (1) the pit, (2) the outside cellar, (3) the storage house, and (4) the house cellar. In addition, there is the cold storage, a commercial industry of the cities which has developed to enormous proportions in recent years.

1. THE STORAGE PIT

This is the simplest and least expensive method of storing vegetables where no permanent facilities are available. By this method the vegetables are piled in a conical or ridge shape, and are covered by straw, soil, and sometimes manure. The bottom of the pit may be at the surface of the ground or it may be excavated to a depth of 6, 12, or more inches. For either case the location should be well drained, because standing water or a damp soil about the pit is conducive to decay.

On the bottom of the pit a bed of dry straw or leaves should be spread, on which the vegetables are placed. The pile should then be covered with straw to the depth of about a foot; when this is pressed down by the soil it will be 3 or 4 inches thick. The thickness of the soil is increased as winter approaches until finally it is several inches thick. If the severity of the winter demands it, a layer of straw or strawy manure should be placed over the pile.

For ventilation, a bundle of straw extending from the vegetables through the soil at the peak of the pile will be all that is needed for a small heap. For larger piles a board flue about 4 inches in diameter open at both ends and extending down into the center of the heap will give satisfactory results. It will be desirable to have a peaked cap over the upper end of the flue.

A point that should be kept in mind is the ease in getting at the produce in the winter when it is wanted. For this reason, several small pits are better than one large one, there being fewer vegetables to expose to the freezing weather on opening the pit. Furthermore, when the bulk of vegetables piled together is too great, the pile tends to heat and the vegetables to decay. In the small piles, however, it is a great convenience to have several kinds of vegetables piled together in order that when the pit is opened a variety of products may be obtained with little trouble.

2. THE OUTSIDE CELLAR

Various types of outside cellars are in use, ranging from the triangularly topped kind for temporary use to the arched-roof concrete cellar that is built as a permanent structure. The farmer should consider his needs in deciding whether to build a cheap, temporary cellar or a good, permanent one, remembering that what is cheapest at first may not be so in the end.
The outside cellar is built either partly or entirely under ground, depending largely upon the location. If the home is near a hillside, it would facilitate entrance to the cellar and be very desirable from many other standpoints to build the cellar in the side of the hill. If the region is subject to cold winds, the cellar should be built behind a protecting shelter if compatible with the other requisite conditions. Where exposure to the wind cannot be avoided, it is well to build the cellar parallel to the prevailing winds.

The location should be well drained. If this is the case, a dirt floor is satisfactory and has the advantage of being inexpensive and of being a means of supplying moisture to the air by evaporation from the soil.

3. THE STORAGE HOUSE

In certain parts of the country one finds large, well-equipped houses for the storage of tubers or vegetable crops. Where this is the case, the soil or climate is especially suited to the production of those particular crops, and the farmer makes a specialty of growing one crop on a large scale, as do the Maine and Colorado potato growers. For the ordinary farm, however, the conditions do not justify the erection of a large, specialized, and expensive house for any particular crop. Most farmers must be prepared to store smaller amounts of several crops, and under those conditions the outside cellar rather than the large storage house best meets their needs.

4. THE HOUSE CELLAR

A very common place for storing vegetables is the house cellar. Where the conditions are right, this makes a desirable and convenient place. Often, however, there are so many unfavorable conditions in the actual arrangement and use of the cellar under the living rooms that it is frequently much better to have an outside cellar in spite of the somewhat greater inconvenience of getting at the supplies in winter.

In the first place, the house cellar in many cases has so many other uses that it is difficult to secure the proper conditions for vegetable storage. This applies particularly to cellars containing a furnace, coal room, kindling room, laundry, junk room for trunks, clothes boxes, tools, and miscellaneous materials, and an awkward entrance through the house. Provided a separate room—or better, two rooms, one for vegetables requiring high humidity and one for those which do better in a dry atmosphere—could be well partitioned off from the rest of the cellar and with a convenient entrance, the house cellar answers the purpose very satisfactorily. One of the chief advantages of a vegetable cellar under the house is its accessibility whereby the supplies can be obtained when needed without the discomfort of going outdoors. The house cellar should be especially well ventilated and the decaying matter removed as soon as it forms, since the odors from putrefying vegetation
are injurious to the health of the occupants of the house. For sanitary reasons also the sunlight should have some access to the cellar.

D. STORAGE CONDITIONS FOR DIFFERENT TYPES OF VEGETABLES

For storage purposes, vegetables may be classified in different groups depending largely upon their types or their growth requirements. The factors concerned most directly in this grouping are the humidity and the temperature. For instance, some vegetables of a more succulent condition than others require a higher humidity in order to prevent their drying out, whereas those with a comparatively low water content keep better in a drier atmosphere. Again, some vegetables keep better at a temperature only slightly above the freezing point; others require a higher temperature. Furthermore, some are injured by being frozen, while others are not.

1. REQUIRING A MOIST ATMOSPHERE

In this class are placed the root crops: beets, carrots, rutabagas, and turnips. Since these contain approximately 90 per cent of water, it is well to keep them from drying out if possible during winter storage. To accomplish this, some growers pack them in slightly moistened sand or sawdust, if those materials are easily available. When kept in a cellar, there should be vessels of evaporating water in the room to keep the atmosphere moist. In the outdoor pit the moisture conditions are fairly favorable for the root crops.

Because cabbage heads also contain about 90 per cent of water, they require conditions somewhat similar to those for root crops, except that they are not ordinarily stored in the house cellar, on account of their disagreeable odor. Cabbage is usually stored in outside pits which are shallow, narrow, and long enough to care for the crop. It is desirable to have the pit no wider than is sufficient for two or three heads placed side by side. A common method is to place the heads down with the stalks and roots up and cover the whole with soil. Another method is to place the plants upright in a long, shallow trench of the size needed, to cover the roots with soil, and then to construct a slight framework of rough lumber or poles over the cabbage heads. The sides of the framework are banked up with soil and the top is covered with straw or manure. To open up the pit in the easiest way, access should be had at one end, and thus avoid exposing the whole pit, though cabbage can withstand some freezing without injury.

The best storage temperature for this group of vegetables is slightly above the freezing point of water.

The Irish potato is another vegetable that fits fairly well into this group. Containing only about 75 per cent of water, however, it would naturally be supposed that potatoees would do very well in a somewhat drier atmosphere than the root
crops mentioned. Altho little definite information is known regarding this point, some maintain that the humidity for the potato in storage should be high. The temperature factor has been investigated with the result that 38° Fahrenheit may be recommended as approximately the best temperature at which to store the potato. If lower than that temperature, the starch is converted into sugar; if higher, the powdery dry-rot is liable to be injurious.

The potato should not be piled in large piles because of the danger of heating, especially if the center of the pile is not well ventilated. Potatoes in storage should not be subjected to strong light, for sunlight injures their quality for table use. For seed purposes, however, it has been found that subjecting the potato to the light in the spring before planting time is advantageous.

2. REQUIRING A DRY ATMOSPHERE

Beans, peas, and other seeds keep much better in a dry, than in a moist, atmosphere. The temperature should be sufficiently low to prevent decay or growth processes.

Onions are kept best in dry, cool, well-ventilated places. They should be dry and mature when harvested. If these conditions are fulfilled the onion will keep easily and well.

Sweet potatoes, pumpkins, and squashes require a dry place that is comparatively warm. If sweet potatoes are well matured, well cured, and dry at the time of being placed in storage, they keep best at a temperature of about 55° F. Pumpkins and squashes may be kept at a temperature of about 40° F.

3. IN A GROWING CONDITION DURING STORAGE

Some plants such as celery, Brussels sprouts, parsley, and leeks are frequently kept in a growing or semi-growing condition during storage. If the celery has not already been blanched, this process may be beautifully done in the storage cellar if the light is withheld. The plants are simply transplanted from the field to the earth floor of the cellar which is kept moist enough to keep the plants from wilting. A slight growth is thus continued which increases the quality of the celery for table purposes. The planting may also be done in protected cold frames.

The same principle also applies to Brussels sprouts and to leeks, though they are usually planted in cold frames out-of-doors before freezing weather and then protected by a covering of straw or similar material.

Parsley is also grown during the winter, but the usual way is to grow it in a flower pot in the living room for the dual purpose of ornament and table use.

IN THE GARDEN OVER WINTER

Parsnips, salsify, and horseradish are frequently left in the garden during the winter and used in the early spring. At that time they are delicious. For winter use, however, some may be gathered and stored as recommended for root crops.

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