NATURAL DEHYDRATION OF CULL POTATOES BY ALTERNATE FREEZING AND THAWING

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Drying of potatoes by alternate freezing and thawing was apparently originated nearly 2,000 years ago by inhabitants of the highland country of western South America. (5) Archeological proof is available in the existence of ornamental pots shaped in the form of dehydrated potatoes and in the recovery of dried potatoes that are well preserved after many centuries. Pots unearthed in the northern, coastal area of Peru are believed to date back to approximately 200 A.D. Dried potatoes are frequently found in the pre-Columbian graves of the arid coastal zone.

In dehydrating these potatoes, tubers were spread on the ground of high plateaus where they froze during the night and thawed during the day. Much of the juice was lost during the thaws. After four or five days of freezing and thawing, the natives trampled on the potatoes to expel most of the remaining juice. Following this treatment, the potatoes were left 15 to 20 days longer to undergo further dehydration by action of sunlight and frosts. This product, called chuño, consisted of hard, dark, shrivelled potatoes that had been greatly reduced in volume and weight as a result of natural dehydration. It was used, as such, for animal feed.

For food use, preparation of the dehydrated potatoes was modified to give a nearly white product called tuna or "moray." After partial dehydration by freezing and thawing, the potatoes were placed in a pool or stream of cold water and allowed to remain for one to two months. They were then dried in the sun about one week. Extraction of the dark substances gave an attractive product that could be ground into flour for baking or reconstituted in water to be cooked and served in various forms instead of fresh potatoes. Preparation of chuño and tuna continue up to the present time in the plateau region of western South America.

This dehydration practice of the early South Americans seems to have been largely forgotten in the United States until 1946 when a group of North Dakota potato growers, led by William M. Case, tried the idea there. Cull potatoes were spread on pasture and allowed to freeze and thaw during the winter and spring. Late in the spring, livestock were let out to pasture to eat the dried potatoes. Both dairy and beef cattle did well in the North Dakota demonstration, with dried potatoes supplying an important part of their rations. The grass stand where the potatoes had been placed improved noticeably as the result of nutrients that had drained onto the soil.

Despite the facts that natural freeze drying of potatoes had been

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4The terms "freeze drying" and "freeze dried" as used in this paper refer, respectively, to a method of dehydrating potatoes by alternately freezing and thawing them, and to the resulting product.
practiced for several centuries in South America and in recent times has been demonstrated to be successful in northern North Dakota — where winters are severe, humidity low, and annual precipitation averages only about 20 inches — there is still a need for more information. Of particular importance are such questions as the following: What quantities of the various nutrients are lost from the tubers during freeze dehydration? What is the nature of freeze and thaw dehydration? What are the most feasible conditions for carrying out the natural freeze dehydration of potatoes?

Hence, the Eastern Utilization Research Branch in cooperation with the Maine Agricultural Experiment Station initiated a series of trials at Presque Isle, Maine, in February 1950 which continued until the summer of 1952. Data were obtained on the optimum method of exposing the potatoes and certain observations made on the mechanism of freeze drying and on the nutrient loss.

**Feeding of Freeze-Dried Potatoes**

Although we have not been directly connected with controlled experiments in the feeding of freeze-dried potatoes, all available evidence points to the conclusion that the product is palatable to livestock and without any accompanying bad effects. Following the initiation of our experiments in Maine, several potato growers there conducted satisfactory demonstrations. One grower spread five carloads of potatoes on grassland near Presque Isle, Maine, in February 1950. The partially-dried product was fed successfully the following spring to beef and dairy cattle. (3) The same grower continued trials the following year, this time feeding the product to swine. Another grower near Presque Isle experienced favorable results in feeding freeze-dried potatoes; in the fall of 1951, he put out 30,000 bushels of culls for conversion to dry feed.

More recently, controlled experiments in feeding freeze-dried potatoes have been conducted by T. M. McCall, Superintendent of the Northwest School and Experiment Station, University of Minnesota, at Crookston, Minnesota. (2) McCall and associates observed that steers ate the field-dried potatoes readily and that grass growth was greater where the potatoes had been spread. Homer D. Fausch of the Northwest School and Experiment Station has summarized the results of recent potato feeding trials in Minnesota. (1) In two out of three trials conducted with freeze-dried potatoes in 1951, 1953, and 1954, definitely better weight gains were obtained on the lot of steers fed on potatoes plus pasture than on the control lot fed on pasture alone.

**Experiments at Presque Isle, Maine**

On February 1, 1950, potatoes were placed in the open at Aroostook Farm of the Maine Agricultural Experiment Station under several sets of conditions. Some were spread in layers 4, 8, and 12 inches deep on the ground, and others were placed in well-ventilated structures above ground. One of these structures was cylindrical, about eight feet in diameter and four feet high. It was constructed of snow fence reinforced with wire. The cylinder was mounted on a base 1½ feet above the ground and fitted with a slatted bottom to permit drainage and aeration. An inner cylinder about two feet in diameter was fixed at the center