# Palatable Dry Whole Milk

## of good keeping quality assured by correct preparation and proper packaging

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**Dry whole milk** and dry ice cream mix of acceptable quality and with good storage properties can be manufactured if proper precautions are observed.

The main problem of processing is to manufacture a product that will rehydrate easily and completely.

Drying under the spray process without excessive heating of either the liquid or dry milk will give a dry milk that will rehydrate completely without settling out.

Dry milk that will rehydrate easily by simple mixing with water without considerable stirring or mixing is not yet available. Much experimental work remains to be done along this line.

### Off-Flavors

Deterioration of dry whole milk, and dry ice cream mix, too, takes usually one of three forms: development of oxidized flavor, development of stale flavor and development of hydrolytic rancidity.

Oxidized flavor develops rapidly in the presence of air resulting in an unplatable product. This defect was serious in the early part of the war, but adoption of processing methods revealed by research soon overcame the major part of this difficulty.

The first requisite is a supply of high quality milk produced under sanitary conditions. Secondly, prompt processing to avoid storage deterioration of the liquid milk is important. The processing should be done in stainless steel equipment. Copper and iron contamination catalyze the oxidation reaction and promote the development of off-flavors.

### Procedure

Processing is carried out in four steps: preheating the liquid milk, precondensing, spray drying and packaging.

Preheating is used to destroy the bacteria and to inactivate the enzymes present in the milk. Temperatures from 175° F to 190°F flash are sufficient to accomplish most of the desired results although some oxidizing enzymes and lipases are not inactivated at 200°F.

Some manufacturers have preferred to preheat under pressure at temperatures in excess of 210°F with the objective of developing compounds in the milk which act as antioxidants. Such antioxidants are developed but an objectionable cooked flavor frequently accompanies this treatment.

Precondensing and homogenization usually follow the preheating. The milk should be precondensed to as great a degree as practical before drying. A total solids content of 40–45% should be attained if possible.

The degree of condensation, in addition to affecting the economy of the operation, affects also the particle size of the powder; the greater the concentration the larger the size of the particles. Large size particles are more desirable than small ones both from the standpoint of ease of rehydration and the amount of occluded oxygen.

Homogenization usually is desirable to insure that the fat globules are uniformly broken up; some homogenization is accomplished by the spraying process but often this is not sufficient to prevent oiling off in the rehydrated milk.

### Low Moisture

The drying operation should reduce the moisture to 2% or lower. Most deteriorative changes take place more rapidly at higher moisture contents. Staling, and even browning, may occur at higher moisture percentages.

Proper packaging will prevent the development of oxidized flavor, and will retard the development of stale flavor.

The dry product should be packaged as free from oxygen as is possible. This may be accomplished either by vacuum packaging or by packing under nitrogen.

In either case it is necessary to remove the occluded air from the inside of the dry milk particle. This can be done by storing under vacuum for 48 hours before vacuum packing. Most commonly it is done by drawing a vacuum on the dry milk in bulk and thus releasing the vacuum with nitrogen and allowing this gas to remain for 24–48 hours. This should be done as promptly as possible after removal from the dryer.

### Second Gassing

A second gassing is then performed after the product is put into the final container by drawing a vacuum and releasing it with nitrogen once again. If this second gassing is not performed a considerable amount of oxygen will be left inside the milk particles and will diffuse throughout the package on standing.

The oxygen content of the atmosphere surrounding the product is not critical at the first gassing, but should be as low as practicable after the second one, and in no case should exceed 3% and preferably should be below 1%.

It has been found that where the oxygen content was kept to 2% oxidized flavor did not develop in 12 months storage at 98°F, but some staleness was evident. If the oxygen content was kept below 1% no staleness was evident after 12 months storage at 98°F. Slight staleness was noticed at 16 months. At 72°F the samples were still good after 16 months.

### Rancidity

Packaging will not prevent the development of hydrolytic rancidity. This usually occurs from the action of naturally active lipase that is frequently present in winter milk.

Present knowledge indicates that measures must be taken to prevent any hydrolytic action prior to and during processing. First, the lipase milk may be mixed in proportions of 1:4 with normal milk at the ranch. Second, any unnecessary agitation of raw milk must be avoided, and third, preheating temperatures as high as practical should be used where lipolytic activity is apt to occur. While it has been found that temperatures as high as 200°F flash will not completely inactivate the enzyme, they do retard its action materially.

If the above precautions are observed, dry whole milk can be manufactured which will be an acceptable beverage when rehydrated. The flavor and physical characteristics of the rehydrated milk will not be identical with those of fresh whole milk, but this product is palatable and highly nutritious.

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