SWEETENED CONDENSED MILK

Sweetened condensed milk is milk that is concentrated by evaporation, to which sucrose is added to form an almost saturated sugar solution, after which it is canned. The high sugar concentration is primarily responsible for the keeping quality of the product and for its fairly long shelf life, even after the can has been opened, although it then will eventually become moldy.

Approximate Compositions of Two Kinds of Sweetened Condensed Milk

	American Standard	British Standard
Fat content (%)	8	9
Milk solids-not-fat (%)	20	22
Lactose (%)	10.3	11.4
Sucrose (%)	45	43.5
Water (%)	27	25.5
Lactose/100 g water (g)	38.3	44.6
Sucrose/100 g water (g)	167	171

IMPORTANT MANUFACTURING STEPS

Heating: Pathogens and potential spoilage organisms must be killed. Among the enzymes, milk lipase should primarily be inactivated; bacterial lipases are not inactivated and, if present, can cause severe rancidity. Deterioration caused by proteinases has not been reported. The heating intensity considerably affects viscosity and also age thickening and gelation of the product, so the actual heat treatment must be adjusted to these properties. UHT heating at about 130 to 140°C is commonly applied.

Homogenization: Creaming is often not a major problem, and therefore homogenization is not always done. Currently, however, sweetened condensed milk is made less viscous (and exhibits less thickening) than previously. The density difference between fat globules and continuous phase is large, over 400 $kg \cdot m^{-3}$; for a viscosity of the continuous phase of 1 Pa·s, the creaming rate would be about 1% of the fat

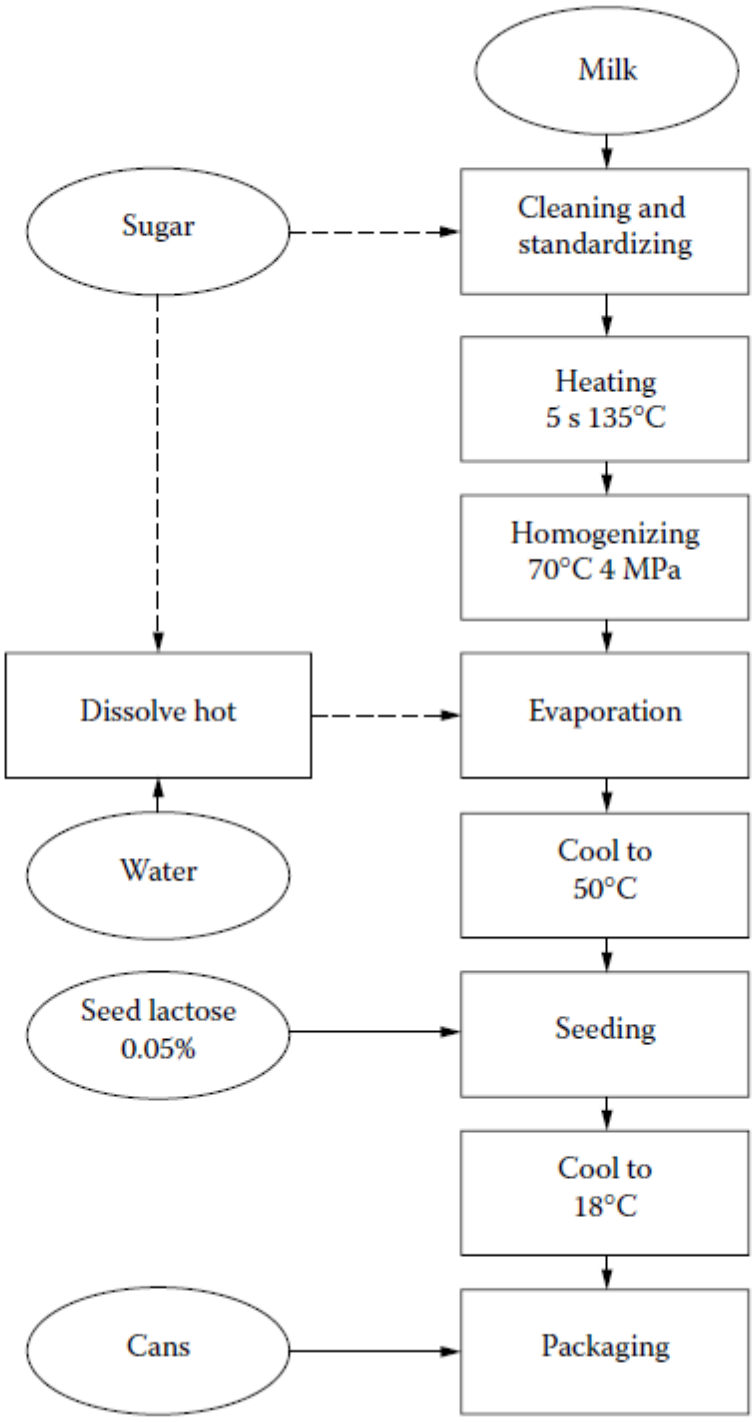
Sugar: This can simply be added to the original milk. The amount added can be adjusted readily, and the sugar is pasteurized along with the milk.

However, this procedure causes fairly extensive Maillard reactions during heating and evaporation, and above all, a faster age thickening. Alternatively, a concentrated sugar solution, which should be sufficiently heat-treated to kill any osmophilic yeasts, is added at the end of the evaporation step. The sugar should be refined and be devoid of invert sugar to prevent excessive Maillard reactions.

Concentration: This is usually done by evaporation. A falling-film evaporator is generally used to remove the bulk of the water and a circulation evaporator to remove the remainder. Relatively high temperatures (up to 80°C) are often applied, which implies a lower viscosity in the evaporator but a higher initial viscosity of the final cooled product. The low water content of the sweetened condensed milk implies a high viscosity and boiling point. Evaporation in continuously operating equipment with many effects is, therefore, not easy. Fouling, thus, readily occurs. It is difficult to accurately adjust the desired water content, which is mostly monitored by means of refractive index.

Cooling and seeding: In these steps, formation of large lactose crystals must be avoided. Consequently, seed lactose is added. Before that, the condensed milk must be cooled to a temperature at which lactose is supersaturated so that the seed lactose does not dissolve. However, the temperature must not be so low that spontaneous nucleation can occur before the seed crystals are mixed in. After seeding, cooling should be continued to crystallize the lactose.

Packaging: Packaging in cans is common. The cans are then covered with a lid and the seams are sealed. Cans and lids are first sterilized, e.g., by flaming. The packaging room is supplied with air purified through bacterial filters.



Flow sheet for manufacturing of sweetened condensed milk