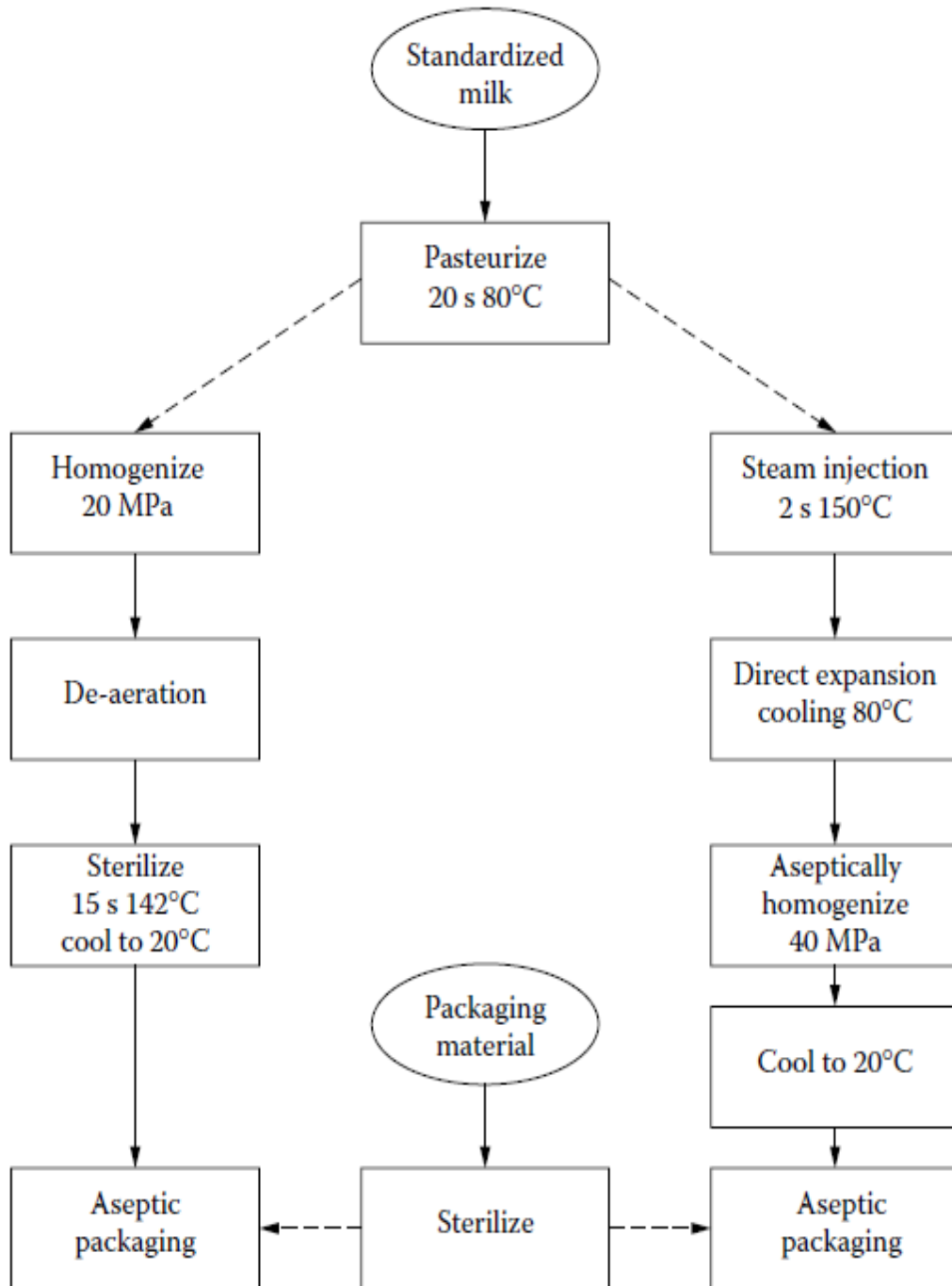


## **STERILIZED MILK**

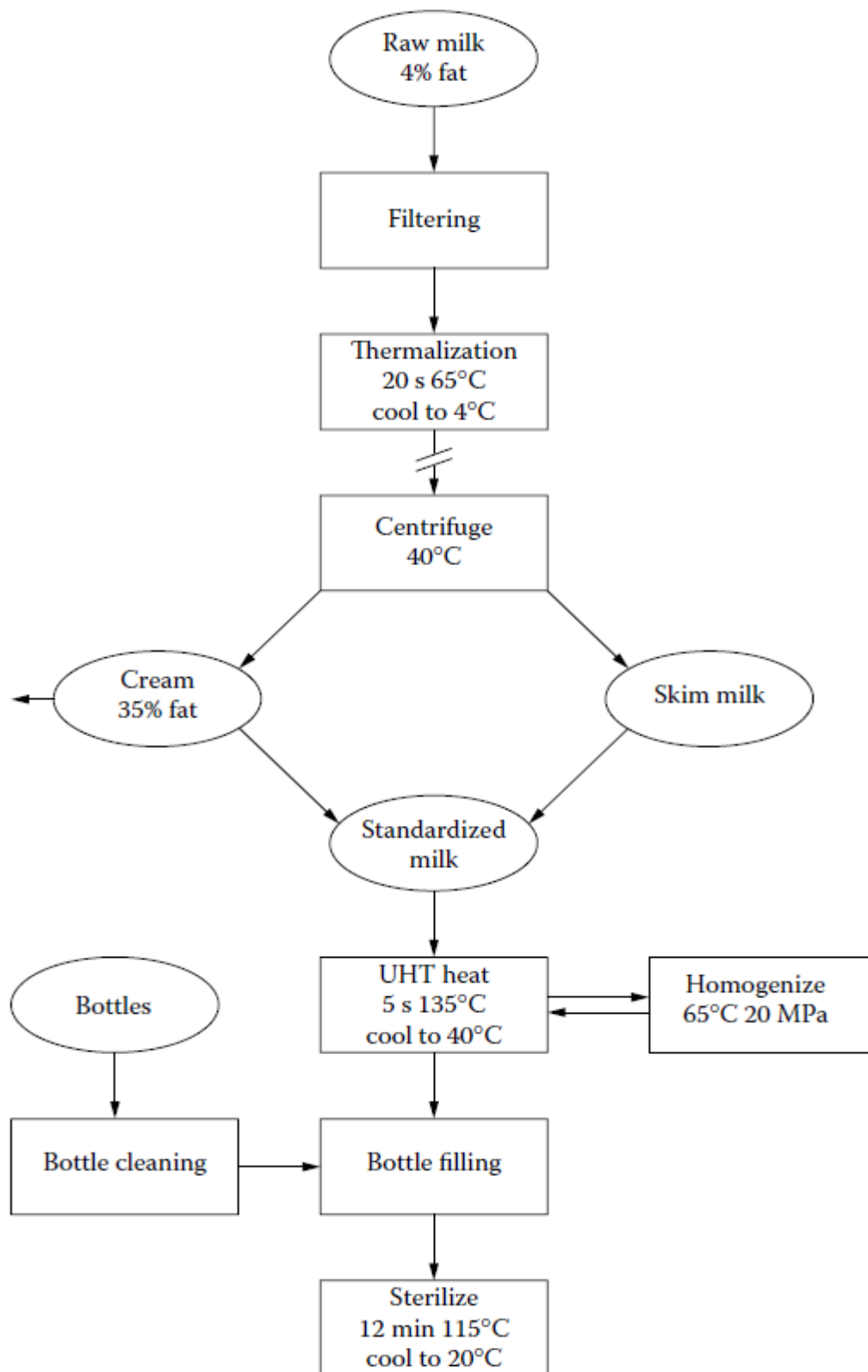
Sterilization of milk is aimed at killing all microorganisms present, including bacterial spores, so that the packaged product can be stored for a long period at ambient temperature, without spoilage by microorganisms. Since molds and yeasts are readily killed, we are only concerned about bacteria. The undesirable secondary effects of in-bottle sterilization like browning, sterilization flavor, and losses of vitamins can be diminished by UHT sterilization. During packaging of UHT-sterilized milk, contamination by bacteria has to be rigorously prevented. After UHT sterilization, certain enzymatic reactions and physicochemical changes still may occur.

### **OBJECTIVES / CHARACTERISTIC REQUIREMENTS**

- The count of microorganisms, including spores, is reduced to less than  $10^{-5}$  per liter.
- The original milk does not contain enzymes of bacterial origin that cannot be fully inactivated by the heat treatment.
- Enzymes naturally present in milk are sufficiently inactivated.
- Chemical reactions during storage are minimal.
- Physical properties of the milk change as little as possible during treatment and storage.
- The flavor of the milk remains acceptable.
- The nutritive value of the milk decreases only slightly.



**FLOW SHEET FOR MANUFACTURING OF UHT-STERILIZED (TETRAED) MILK**



**FLOW SHEET FOR MANUFACTURING OF IN-BOTTLE STERILIZED MILK**

## CHANGES DURING SHELF LIFE / STORAGE

Spoilage of in-bottle sterilized milk can be caused by insufficient heat treatment, due to which spores of, for instance, *Bacillus subtilis*, *B. circulans*, *B. coagulans*, or *B. stearothermophilus* have survived sterilization. *B. subtilis* has relatively heat-resistant spores, and this bacterium may cause deterioration of in-bottle sterilized milk. If the milk is stored under tropical conditions, it may spoil due to *B. stearothermophilus*, which has very heat-resistant spores. Both a low count of these spores in the original milk and a UHT preheating step can help. *B. stearothermophilus* does not grow below about 35°C. A mild in-bottle sterilization after a UHT presterilization is only possible if during filling not more than a very slight contamination by bacterial spores occurs. If the package is not completely tight (for example, due to an ill-fitting crown cork), then the milk can be recontaminated and so becomes spoiled. Enzymic or oxidative deterioration occurs hardly, if at all, because of the very intense heat treatment.

Deterioration of UHT milk by bacterial growth is usually caused by recontamination. Obviously, the type of deterioration is determined by the species of the recontaminating bacteria. Recontamination by pathogens may even occur, possibly without marked deterioration. Up to now some (rare) cases of food poisoning due to UHT milk contaminated by staphylococci have been reported.

Enzymatic deterioration of UHT milk due to the presence of heat-resistant bacterial enzymes, such as gelation or development of bitter, rancid, or putrid flavors, can only be prevented by a good-quality raw material. Deterioration by plasmin, causing a bitter flavor, will mainly occur in those cases where it is desirable to store UHT milk for a long time (e.g., up to 6 months) and at higher temperature, as in tropical countries. A more intense heat treatment can partially prevent this. Nonenzymatic deterioration of UHT milk during storage may concern: oxidation, influence of light, and Maillard reactions.