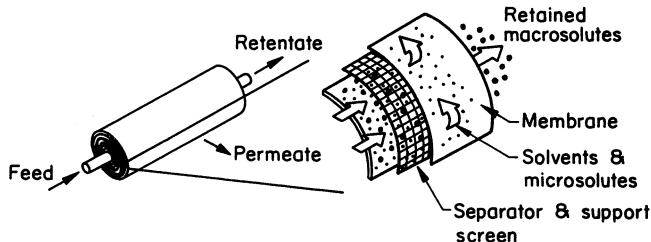
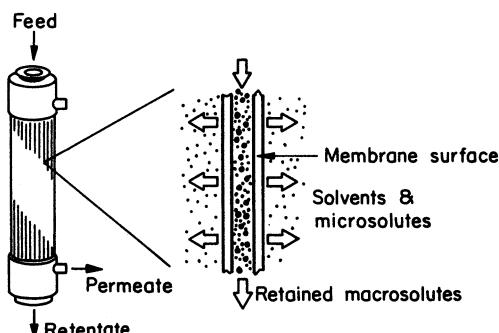


PLATE & FRAME DEVICE



SPIRAL CARTRIDGE



HOLLOW FIBER CARTRIDGE

Figure 11.26. Examples of different membrane configurations. (Adapted with permission, from R. S. Tutunjian in M. Moo-Young, ed., *Comprehensive Biotechnology*, Vol. 2, Elsevier Science, London, 1985.)

Three major applications of ultrafiltration are concentration, purification, and diafiltration. In concentration, water is removed from the aqueous solution of solute using an UF membrane, and solute is concentrated. In purification, solvent and low-MW products are separated from high-MW compounds using a UF membrane. The product contains low-MW compounds and the solvent. In diafiltration, low-MW solutes such as salts, sugars, and alcohols pass through the filter, and the retained stream contains the product. The permeate that leaves the system is replaced with deionized water.

Ultrafiltration membranes are used for the separation of proteins, enzymes, pyrogens (lipopolysaccharides from bacterial cell wall), cell debris, and viruses from fermentation media. Ultrafiltration is usually the second step in protein recovery after protein