the number of discrete particles of solute present in the solution. Therefore, the drug release rate mainly depends on solubility, molecular weight, osmogen, and activity coefficient of the solute [55, 56]. The formulation components of osmotic drug delivery system are listed in Table 3.

6.1. Mechanism Involved in Drug Release From Osmotic Drug Delivery Systems

In ODDS, the release of drug through the semipermeable membrane is controlled by the difference between osmotic pressure in the drug containing core and the external fluid. This system generally consists of a core-containing drug, surrounded by a semipermeable membrane that is impermeable to solutes and other additives and only permeable to water [58]. The mechanism of drug release from this system is as shown in Fig. 4 [53, 57, 58].

6.2. Factors Affecting the Osmotic Drug Delivery Systems [54, 55, 59]

Various factors affecting the rate of drug release from the ODDS are:

6.2.1. Solubility

One of the most essential factors in the osmotic drug delivery system is the solubility of the drug as it has direct relation with the release kinetics of the drug from the system. The kinetics of drug release from the system is directly proportional to the solubility of the drug within the core. The fraction of drug release by zero-order kinetics can be given in terms of:

TABLE 3
Formulation components of typical osmotic drug delivery systems [53, 54, 57, 58].

Ingredients	Purpose
Drug	• Active pharmaceutical ingredient • Suitable drugs with short half-life, high potency, and prolonged treatment
Semipermeable membrane	• Defines the permeability characteristics of the system • Should be a stable membrane, biocompatible, and impermeable to dispenser content so that osmogen can cross the membrane
Hydrophilic and hydrophobic polymers	• Drug release controlling • Nonswellable polymers are used to prevent the increase in hydrostatic pressure caused due to swelling properties of polymers • For example hydrophilic polyethylene glycol and hydrophobic ethyl cellulose
Wicking agent	• It has the ability to draw water into the porous network of a delivery device • Allows drug to increase the contact surface area with the incoming aqueous fluid • For example silicon dioxide, kaolin, and titanium dioxide
Surfactant	• They act by modifying the surface energy of the particles • They produce an integral composite so useful when added to wall-forming materials • For example carboxylic acid salts and phosphoric acid esters
Osmogen	• They are used to create and protect the concentration gradient across the membranes • Drugs that are less soluble show zero-order release at a slow rate that can be enhanced by osmogen by increasing the release rate • For example magnesium chloride, lithium, and magnesium succinate
Coating solvents	• To dissolve or disperse the polymer used in manufacturing the wall of the osmotic device • For example methylene chloride, acetone, methanol, and ethanol
Plasticizer	• Changes the viscoelastic behavior of membrane • Lowers the temperature of the second-order phase transition of the wall and also increases workability • For example triethyl citrate, acetates, propionates, and glycolates
Pore-forming agents	• Used in the development of controlled porosity of pumps • They are useful in the development of poorly water-soluble drugs • For example sodium chloride, calcium chloride, and sucrose