SLNs and NLCs are colloidal dispersions composed of lipids that are solid (SLN) or liquid (NLC) at room temperature and stabilized as a nanodispersion by a surface covering of surfactant(s) [113]. They increase the solubility and stability of lipophilic compounds such as retinol that are prone to decomposition in the presence of light and oxygen [114] and increase the delivery into the stratum cornuem [115]. The NLC lipids' spatial structure allows greater drug loading and better stability compared to SLN, resulting in greater skin deposition [116–118]. Their mechanism of permeation enhancement is attributed to (1) prolonged contact with the skin surface; (2) their occlusive nature due to formation of a film on the skin surface that combines with the skin lipid film to reduce water loss, thus hydrating the skin [119]; and (3) interaction between the formulation lipids and stratum corneum lipids, facilitating permeation of lipid-soluble compounds [120].

17.8 CONTROLLED/PROLONGED DELIVERY: TRANSDERMAL PATCHES

Whereas most topical formulations (creams, gels, ointments, foams, etc.) are applied to the skin, often with rubbing or massage, for delivery to the skin layers or deeper tissues, transdermal patches are intended to deliver drug via the cutaneous circulation for a systemic effect and may remain in place for a prolonged period of up to seven days. There are three main types of transdermal patches: drug in adhesive, drug in a matrix, and drug in a reservoir, with the latter being the original patch design but largely superseded due to a greater risk of product failure and dose dumping. There are currently about 20 drugs available as transdermal patches used in the management of a wide range of conditions, including angina, hormone replacement, smoking cessation, attention deficit hyperactivity disorder, depression, Alzheimer disease, and Parkinson disease [121]. A detailed history of the development of transdermal patches and their formulation design principles was provided by Pastore and co-authors [121]. Patches benefit from occlusion and may incorporate permeation enhancers such as alcohols, glycols, surfactants, pyrrolidones, and fatty acids that also function to solubilize the drug present. However, as seen from the currently marketed patches, the drugs included are typically potent and have physicochemical properties that make them favorable for percutaneous absorption.

17.9 CONCLUSION

It is clear that the formulation in which a permeant is applied to the skin can profoundly affect the percutaneous absorption of both hydrophilic and lipophilic permeants. Indeed, it is important to note that the wide range of components in a formulation often work in combination to influence skin delivery. This is particularly the case with components that act by different mechanisms; thus, the rational design of a topical formulation must apply this knowledge to optimize a topical formulation for efficacy, stability, cosmetic elegance, and patient acceptance.

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