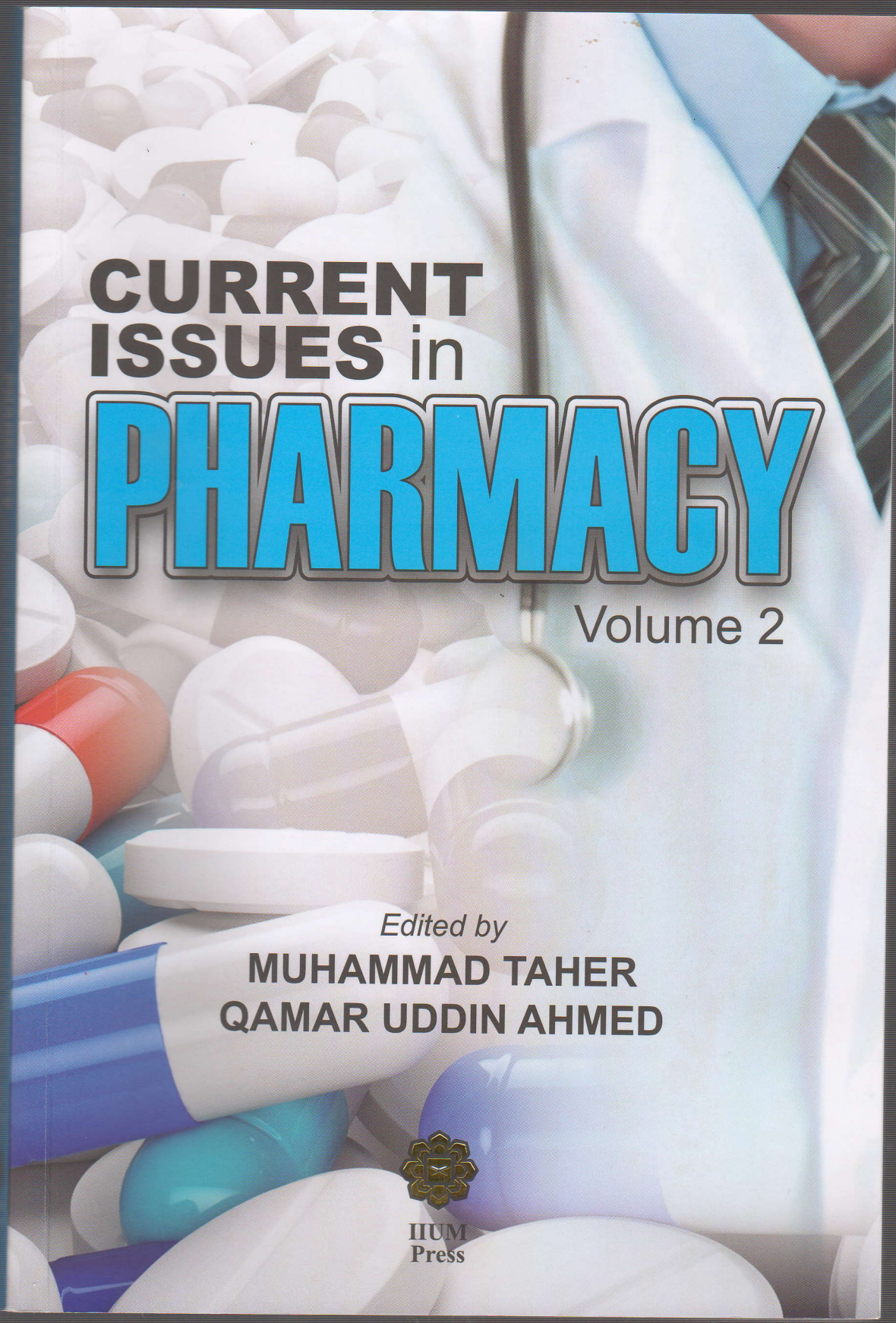

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MUHAMMAD TAHER
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Contents

Chapter 14

Cosmeceutical Applications of Clay Minerals: A Review

Hazrina Hadi, Muhammad 'Izzuddin Zamery and Ahmad Zaiter

14.1 Introduction

Clay refers to a group of fine-grained materials originating from the earth that have a plastic property when wet and harden after drying or burning (Guggenheim et al., 2006). Regarding its chemical properties, clay has the crystal structure of phyllosilicates (Meunier, 2005). However, in broader terms, the phyllosilicate-derived aluminosilicate phases include sepiolite, polygorskite, imogolite and allophane (Guggenheim and Martin, 1995; Velde and Meunier, 2008). Clay minerals, which are phyllosilicates, are composed of two types of layer structures (structural units): magnesium or aluminium octahedron and silicon tetrahedron (Mitchell and Soga, 2005). These layers are made from a combination of oxygen anions with various cations (Velde and Meunier, 2008). The foundation of the crystal structure of all phyllosilicates determines whether the clay minerals are 1:1 or 2:1 layer type. The former is composed of a single tetrahedral sheet attached to a single octahedral sheet, while the latter consists of a single octahedral sheet packed in and covalently coordinated between two tetrahedral sheets (Guggenheim et al., 2006; Velde and Meunier, 2008). The group of clay minerals is characterised by the stacking behaviour of either one of the two layer types (Pant, 2013). For instance, smectite possesses the basic structural unit of a 2:1 layer type, and the layers are stacked by a weak bond, leaving a prominent cleavage that allows water molecules and cations to reside between the layers (Mitchell and Soga, 2005). There are four major well-known groups of clay minerals: kaolinite, smectite/montmorillonite, illite and chlorite.

Clay minerals have a distinguishing property, whereby their sizes range by only a few micrometres (often less than 1 micron) (Meunier, 2005). They are difficult to view through a light microscope, yet they can be clearly observed through transmission electron microscopy (Meunier, 2005; Velde and Meunier, 2008).

14.1.1 History of the Use of Clay in Cosmetics

The use of clay as a cosmetic is not new in the cosmetics world; clay has been used extensively as a cosmetic to make the skin look more beautiful, radiant and healthy. There is evidence that Homo neanderthalensis and Homo erectus (human species that existed millions of years ago) utilised ochre (natural clay) combined with water and various kinds of clay to treat lesions, soothe skin irritations and to cleanse the skin (Carretero, 2002). For example, red clay from ancient deposits in the fertile Atlas Mountains of Morocco (also known as Rhassoul clay) has been utilised for the last 1,400 years as a soap, shampoo and skin conditioner. The history of using red clay as a cosmetic has been recorded in ancient Rome and Egypt, where it was used by the nobility to tone and enrich the skin. Today, Rhassoul clay has been proven to be effective for skin conditions and other cosmetic purposes (Xing and Garland, 2011).

14.1.2 Classification of Clay Minerals

Clay minerals have many kinds of classification systems; for example, in a spa setting, they are classified according to their colour and the action they may exert when applied (Matike et al., 2011). However, the well-known and worldwide grouping system of clay minerals is based on the stacking behaviour of their basic structural unit (layer type), as was previously mentioned (Pant, 2013). The four major groups of clay minerals are kaolinite, smectite, illite and chlorite. These groups can be found, either mixed or in their original forms, mostly in the deep-sea ocean floor (Burk and Drake, 1974; Seibold and Berger, 1996).

Kaolinite can be sourced from the resilication of materials that are rich in aluminium by means of hydrothermal alteration and by precipitation of solutions or gels of alumina and silica (Dixon et al., 1977; Mcafee,

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The field of pharmacy consists of many disciplines of pharmaceutical sciences particularly pharmacy practice, pharmaceutics, pharmacology, molecular biology, pharmacognosy and medicinal chemistry. Pharmacy is involved in a wide array of pharmaceutical research and education, too. Pharmacy practice research focuses on the areas of pharmacogenetics, pharmacokinetics and pharmacodynamics. It also covers the inter-relationship between these areas in different ethnic groups, as well as methodological issues on pharmacoeconomics. Clinical and applied research is conducted on studies that are supposed to improve patient outcomes and could have a favourable impact on pharmacy practice and service. Pharmaceutics research is concerned with drug formulation, stability, and delivery science, and also works on medical devices. Medicinal chemistry research is mainly focused on pharmaceutical chemistry, drug discovery and compound library, and receptor biology. Pharmacology research works on molecular and cellular mechanisms of disease states and associated pharmacology, as well as a range of toxicology research.

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