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Oil-Gelling Ability of the Mixture of Plant-Derived Highly Purified Paraffin Wax and Botanical Waxes

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Abstract

Oil gels composed of oils and waxes are used in stick cosmetics. Recently, modification of petroleum-derived waxes to botanical waxes has become desirable; however, the gel hardness of these gels is insufficient. Therefore, to improve the gel hardness of rice paraffin wax (RP-wax), a highly purified botanical wax, the mixing effect with other botanical waxes, namely carnauba wax and rice bran wax, was investigated. RP-wax has a lower gel hardness than petroleum-derived paraffin waxes because of the formation of large plate crystals in the gel. The gel hardness of carnauba wax is very low owing to the existence of spherical clusters composed of small crystallites in the gel. However, when RP-wax was mixed with 20% carnauba wax, its gel hardness significantly improved. This was due to the size reduction of plate crystals in the gel and the disappearance of the spherical clusters derived from carnauba wax. However, rice bran wax did not produce a similar effect.

Key-words: *Rice paraffin wax, Carnauba wax, Oil gel, Gel hardness, Wax crystal*

1. Introduction

Oil gels are obtained by heating and mixing oils and solid waxes, followed by cooling. They are mainly used in stick cosmetics, such as lipsticks, foundations, and antiperspirants[1]. Hydrocarbon waxes, such as paraffin waxes and synthetic waxes, are mainly used as gelling agents for oil gels[2,3]. However, the replacement of hydrocarbon waxes by botanical waxes from the point of view of substitution by renewable resources and regulation of petroleum- or mineral-derived ingredients in the cosmetic industry is desired.

However, the oil gel hardness of botanical waxes (such as rice bran wax, carnauba wax, and candelilla wax) is much lower than that of petroleum-derived waxes[4]. Many studies have been conducted to improve the gel hardness of botanical wax. Mixing different types of waxes sometimes causes gel hardness to vary. For example, a mixture of higher alcohols and fatty acids[5], a mixture of candelilla wax and carnauba wax[4], the addition of high-purity esters to candelilla wax[6], and the addition of high-melting-point alcohols to rice bran wax[7], can improve gel hardness.

Gel hardness can be increased by removing impurities from the botanical waxes and obtaining only the main component. Currently, highly purified botanical waxes, such as hydrocarbon and ester mixture extracted from candelilla wax, and hydrocarbon extracted from rice bran wax are commercially available. However, the gel hardness of these highly purified waxes is still lower than that of commercial hydrocarbon waxes.

In this study, we investigated the effect of rice paraffin wax, a highly purified botanical wax, on gel hardness when mixed with other botanical waxes. Rice paraffin wax is a solid hydrocarbon obtained from the portion discarded during rice oil production by using liquid-phase chromatography.

2. Materials and Methods

Rice paraffin wax (Phytochemical Products Inc., RP-wax) was used as the highly purified wax. Rice bran wax (Rice bran wax S-110, Yokozeki Oil & Fat Industries Co., Ltd.) and carnauba wax (TOWAX-1F3, Cerarika Noda Co., Ltd.) were used as the typical botanical waxes. Paraffin wax (HNP-9, Nippon Seiro Co., Ltd.) was used for comparison. Caprylic/capric triglyceride (O.D.O, The Nisshin Oillio Group, Ltd.) was used as a plant-derived oil. The wax and oil were mixed at a weight ratio of 15/85.

Wax (1.5 g) and 8.5 g of oil were placed in a 100 mL glass beaker and stirred on a hot plate at 90 °C for 30 min. The mixture was poured into a polycarbonate cylindrical container with a diameter of 3 cm and a height of 1 cm and allowed to stand at 25 ℃ for 24 h.

The hardness of the obtained oil wax gel was measured using a gel hardness meter (Rheotex SD 700, Sun Scientific Co., Ltd.) equipped with a spherical plunger of 5 mm in diameter. The plunger was inserted 2.5 mm into the gel with a speed of 30 mm/min, and the maximum stress was measured.

The wax crystals in the gel were observed by scanning electron microscopy (SEM, JSM-6060LV, JEOL Ltd.)