Report of the Technical Commercialization Subsidy Program (Patent)

Wen-Ling Shi
Professor
Department of Biological Science and Technology
08-7703202#5192 wlshih@mail.npust.edu.tw

1. Introduction

Shampoo is an essential component of routine hair cleansing and care. In order to attract consumers, manufacturers often add a variety of chemicals and botanical extracts to enrich the appearance, fragrance and function of products; however, this also leads to the composition of shampoo becoming very complex, and may increase the risk of adverse effects on the hair and scalp.

Therefore, this innovative research aimed to develop shampoo products that do not contain chemical preservatives, synthetic surfactants, or other chemical constituents. By using a blend of a formula of camellia oil and other plant oils with a formula of essential oils, we developed a series of natural and healthy shampoos that have a pleasant scent and can clean the scalp as well as beautify the hair as part of a normal hair care routine.

2. Concept of Design

Choosing an appropriate shampoo that is suitable for the individual characteristics of hair is key to obtaining beautiful hair. In order to improve the manageability and glossiness of the hair, most shampoo manufacturers add synthetic oily substances, such as polydimethylsiloxane. Although polydimethylsiloxane is a legal ingredient of shampoos, long-term use may lead to blocked follicles and cause overproduction of sebum. Chemical fragrances and pigments are often added into shampoos to confer an appealing smell and consistency, as well as to improve the texture of shampoo products, and in order to claim certain positive effects, a variety of extracts is often used in shampoo.

Synthetic surfactants are normally used as the cleansing components of the vehicle base of shampoo, such as anionic surfactants, the type of surfactant most commonly used in shampoo. Although it is known that most anionic surfactants can cause skin irritation, they are present in almost all commercially-available shampoo products. These surfactants include sodium lauryl sulfate (SLS), sodium lauryl ether sulfate (SLES), ammonium lauryl sulfate (ALS), and ammonium lauryl ether sulfate (ALES). In addition, almost all commercially-available shampoos add derivatives of p-hydroxybenzoates as preservatives, such as methyl paraben, ethyl paraben, propyl paraben, isopropyl paraben, butyl paraben and isobutyl paraben. Although they are widely-used in shampoo, the addition of preservatives of this group is controversial due to safety concerns. For example, some of these preservatives have been reported to be endocrine disruptors and/or possess possible carcinogenicity. Therefore, while the use of these ingredients in shampoo is in line with regulations, consumers may avoid their use if alternative safe products exist.

The cosmetics market has undergone a dramatic transformation in recent years, and more cosmetic products are required to have simple, mild and safe formulations. As the appeal of simplicity and safety is a current trend in the shampoo market, products of this type are now mainstream. Currently, due to considerations of cost and stability, very few shampoo products on the market contain natural essential oils. Although some do claim to contain monomer essential oils, most also add synthetic fragrances, a number of foaming agents, chemical pigments and even glimmer and pearling agents.

Therefore, this research aimed to develop shampoo products that do not contain silicon substances, that use vegetable oil formulas as the vehicle base, that combine natural hair nutrients and anti-microbial agents, and to which essential oils that benefit hair care are added. Using this green biotechnology approach, a series of healthy natural shampoo products with natural fragrances was created.

3. Technical Development

(1) As most customers are used to the conventional cleansing property of shampoo, our formulated shampoo combines plant-based surfactants and soap ingredients prepared from vegetable oils, which can reduce the amount of synthetic chemical surfactant used, but still create a foaming effect and possess the conventional characteristics of shampoo. Using different ratios of the two ingredients, different types of shampoo base for normal, oily and other hair types were created.

(2) Blending fragrance: our formulas do not use chemical fragrance, and only contain compound essential oils

that can stimulate healthy hair, control frizz, nourish the scalp and balance the sebum based on our aromatherapy studies. In addition, using supplements including natural moisturizers and vitamins B5, we developed several new essential oil shampoo products. Furthermore, the compound essential oil used in the innovative product contains compounds that possess antibacterial activities based on gas chromatography-mass spectrometer (GC/MS) analysis. These compounds include high ratios of natural aldehydes, terpene alcohols, phenols and cyclic monoterpenes, which have been scientifically proven to inhibit the growth of a variety of bacteria.

(3) Thickening technology: most commercially-available shampoo products contain hydroxyethyl cellulose (HEC) and carboxy methyl cellulose (CMC) as thickening agents. Although the use of these agents is in compliance with safety regulations, they are synthetic materials. In our innovative product, natural polysaccharide is used as a thickening agent, rendering the nature of the product less synthetic.

(4) Preservatives/antimicrobial agents: as shampoo has a high water content, in order to increase product stability and avoid microbial growth, the addition of a preservative or antimicrobial agent is necessary. Therefore, in addition to the antimicrobial activity of essential oils, a natural bactericidal agent prepared from lecithin was also used as a supplementary antimicrobial and antifungal agent in the shampoo. This natural bactericidal and fungicidal agent is extra mild and suitable for use on sensitive skin and scalps.

(5) Product stability: the stability of the shampoo products was tested using instruments set up in a standard laboratory. Stability testing was performed in a testing chamber under a constant temperature and humidity. The test conditions were 12 hours daily for a 14-day cycle, at 50°C and 85% RH, and 5°C at 25% RH. At the end of the test cycle, the products were examined in terms of their appearance and viscosity, and were put to actual use to verify their stability.

(6) Product viscosity: measurement of viscosity was performed using a Brookfield viscometer. With a suitable type of spindle, the viscometer motor rotated the spindle at a constant speed to measure the resistance to the flow, and calculated the torque necessary to overcome the viscous resistance to the induced movement.

(7) Microbial testing: according to the regulations of the Ministry of Health and Welfare, Taiwan, no Escherichia coli, Pseudomonas aeruginosa or Staphylococcus aureus should be detected in cosmetic products, and the total number of bacteria detected should be under 1000 CFU/g. Testing for bacteria in the shampoo products was performed using Rapid Bacterial Test Strips. In addition, 28-day Challenge Testing for Cosmetics as recommended by the United States Cosmetics Association (The Cosmetic, Toiletry, and Fragrance Association (CTFA)) was used to test microbial growth in the products. The test was performed by adding the test preservative into the culture medium. After inoculating a number of microorganisms at a fixed amount, the test samples were then incubated at an appropriate temperature. The numbers of residual microorganisms were counted after certain periods of time in order to evaluate the antimicrobial effect of the preservative.

4. Technological Competitiveness

Shampoo is necessity of life today in the arena of personal care. Many people use it every day, and the shampoo market is extremely competitive. In the report "Global Shampoo Market 2014-2019: Trends, Forecast, and Opportunity Analysis", it was said that the global market for shampoo is expected to grow to US$25.73 billion by 2019. Product innovation and increasing demands for natural raw materials for the production of shampoo are the main factors that will promote growth.

As the current shampoo market is very competitive, and due to shampoo being a necessity of life in terms of personal care, this innovative research led to the design of a series of shampoo products that are formulated with natural plant materials and essential oils to give the products a natural fragrance and confer a safe preservative effect, yet still provide amazing results in terms of hair care. These products are unique, and are more advanced than other shampoo products currently on the market.

5. R & D Results

Four shampoo products containing compound essential oils have been formulated, and their index and active ingredients, antibacterial and antioxidation activities, product stability and viscosity have been identified and established.

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Figure 1. Dried flowers and plants as materials. Extraction of the bioactive components and aroma according to plants characteristics. (Upper left) Lemon grass, (Upper right) Pot marigold, (Lower left) Lavender, (Lower middle) Jasmine, (Lower right) Rose.

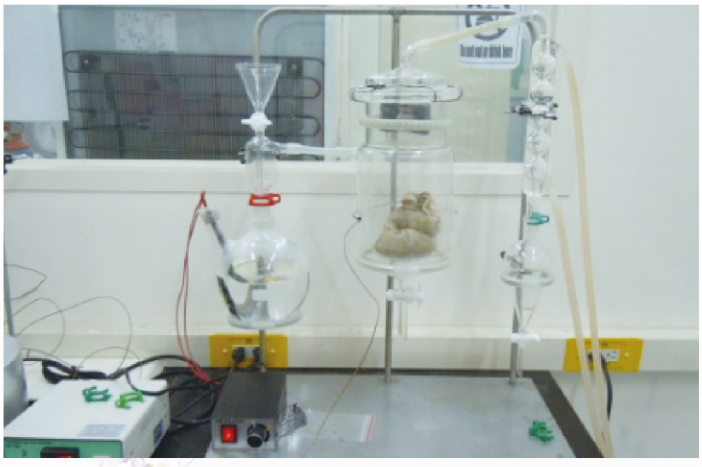

Figure 2. Essential oil extraction by steam distillation. Plant sample and water in different container, steam passed the plant, the steam-containing essential oil then cooling-down within condensing tube. The essential oil on the upper layer will be collected.

Figure 4. Centrifugation of the essential oil hair-care lotion at 3000rpm for 30minutes. The outward appearance didn't alter before and after (left and right) centrifugation, indicated the good stability of product.

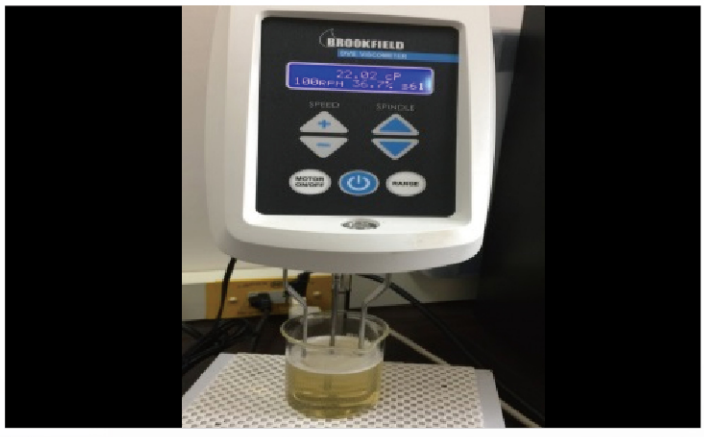

Figure 5. Essential oil shampoo product prototype. The viscosity measurement by a Brookfield viscometer. Using a specific spindle, the viscosity was 22.08cp. The precise product viscosity and product production standard procedure will be established.

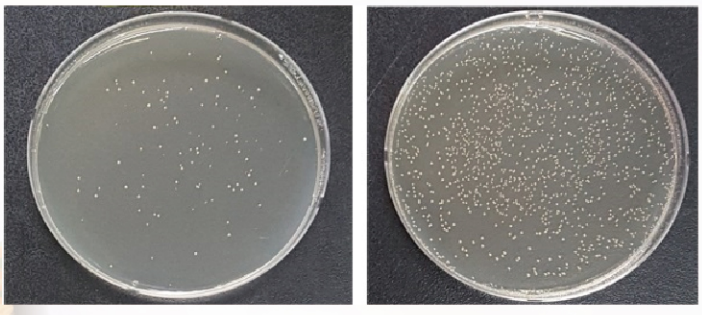

Figure 6. Figure 7. (Left) 0.2% essential oil against common skin pathogen efficiently. (Right) Bacterial colonies of control group.

Figure 3. (Left) High-quality camellia oil as raw material, performing the saponification and producing the natural cleaning reagent-potassium aliphatat. (Middle) Mix the cleaning reagent base with active components and thickener to produce shampoo. (Right) Performing the emulsion reaction by using camellia oil combined with emulsifier and auxiliary emulsifier, adding the essential oil and nutrients to produce the hair-care lotion.

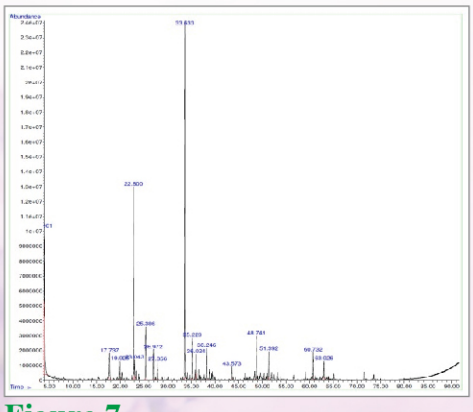

Figure 7.

Essential oil composition analysis by Gas chromatography–massspectrometry. Several major compounds and some minor compounds were revealed at specific retention time. Confirmation of the identical major compound with literatures.