

# FORMULATION OF SHAMPOO FROM KERATIN PROTEIN

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## **FORMULATION OF SHAMPOO FROM KERATIN PROTEIN**

### **ABSTRACT**

Keratin protein is a protein which is extracted from chicken feather which consists of about 91% keratin, 1.3% fat and 7.9% water. Keratin protein is a hard protein that is also found in hair, skin and nails. From this research keratin protein is extracted from chicken feathers and the keratin protein will be used in formulating shampoo. Human's hair is mainly of keratin and the shampoo with harsh chemical is used, basic structures of hair will get damage. The purpose of the research is to produce shampoo, that contains keratin protein from chicken feathers and to add natural products as additives into shampoo to avoid harmful effect to human hair. In this study, the process begins with extracted keratin protein from chicken feather and natural additives were added into shampoo formulation. At the end of this project, we will be able to produce shampoo containing keratin that will help to improve the structure of hair.

## **PERUMUSAN SYAMPU DARIPADA PROTEIN KERATIN**

### **ABSTRAK**

Keratin adalah protein yang diekstrak daripada bulu ayam yang terdiri daripada kira-kira 91% keratin, 1.3% lemak dan 7.9% air. Keratin protein juga ditemui dalam kulit, rambut, dan kuku. Dari penyelidikan, keratin protein diekstrak daripada bulu ayam dan protein ini akan digunakan dalam bahan pembuatan syampu. Rambut manusia adalah terdiri daripada sumber keratin dan jika syampu yang mengandungi bahan kimia yang merbahaya digunakan, struktur asas rambut manusia akan rosak. Objektif kajian adalah untuk menghasilkan syampu, yang mengandungi protein keratin daripada bulu ayam dan untuk menambah bahan semulajadi sebagai aditif ke dalam syampu untuk mengelakkan kesan berbahaya kepada rambut manusia. Dalam kajian ini, proses bermula dengan protein keratin diekstrak daripada bulu ayam dan aditif semula jadi telah ditambah ke dalam rumusan syampu. Pada akhir projek ini, kita akan dapat menghasilkan syampu yang mengandungi keratin yang akan membantu untuk memperbaiki struktur rambut manusia.

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## **LIST OF ABBREVIATIONS**

FTIR	-	Fourier Transform Infrared Spectrometer
SEM	-	Scanning Electron Microscopy
SLS	-	Sodium Lauryl Sulphate

## **CHAPTER ONE**

### **INTRODUCTION**

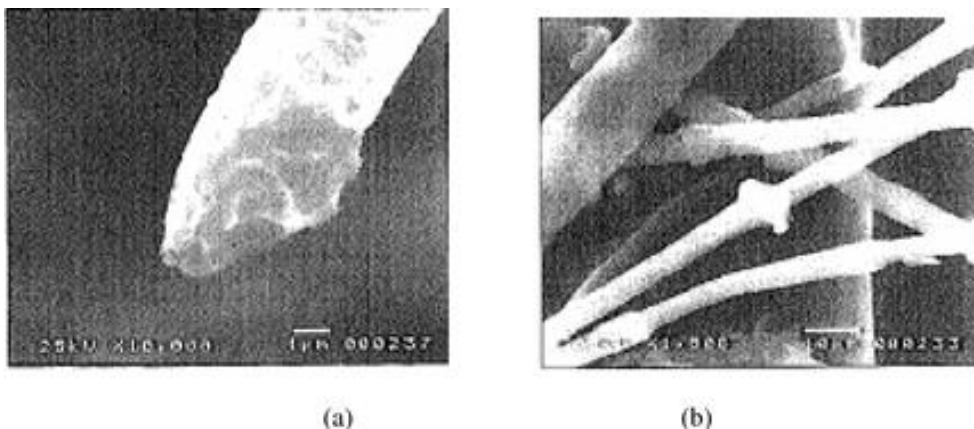
#### **1.1 Background of Study**

Keratin protein is a protein which is extracted from chicken feather. Chicken feathers consist of about 91% keratin, 1.3% fat and 7.9% water. Keratin protein is a hard protein that is also found in hair, skin and nails. Chickens, birds and other reptiles have their own keratins that are not same with the  $\alpha$ -keratins in mammals. Chickens feathers are composites made up from both fibrous and matrix components. Keratin protein is same just like other protein which has large molecule made up of smaller unit called amino acid and joined together in chain like beads on a string.



**Figure 1.1** Chicken feather

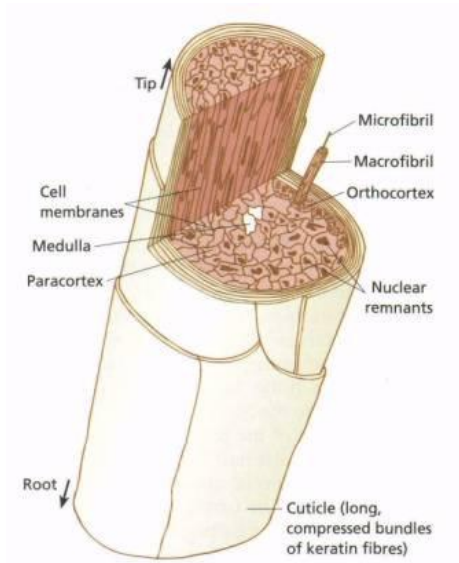
(Source: <http://www.sciencedirect.com/science/article/pii/S0266353804001745>)



**Figure 1.2** Chicken feather keratin fiber structures (a) and its surface structure (b)

(Source: <http://www.sciencedirect.com/science/article/pii/S0266353804001745>)

Keratin protein is same just like the protein in human hair. Human hair is composed primarily of proteins. These proteins are of a hard fibrous type known as keratin. Keratin protein is comprised of what we call "polypeptide chains." The word, polypeptide, comes from the Greek word "poly" meaning many and "peptos" meaning digested or broken down.



**Figure 1.3** Structure of the hair bulb

(Source: <http://pgbeautyscience.com/hair-structure.php>)

The extracted of keratin protein will be used as one of the ingredients in shampoo. Therefore, the development of shampoo from keratin protein will strengthen human hair, rebuild damaged hair and keep it from further breakage. As a component of personal care formulation, keratin protein performs many functions including conditioning, firm forming, as a humectants and an emollient (Kelly and Roddick-Lanzilotta 2006). Other products that use keratin protein as one of the ingredients are anti-aging cream, shower gel, hair straightening and for medicinal purposes.

## **1.2 Problem Statement**

- It's hard to find shampoos in markets that contain keratin protein in their formulation. Almost of shampoos in markets contain high chemical quantity used in it.
- The chemical ingredients in many shampoos can cause damage to hair and be potentially harmful, from skin irritation to systemic illness and cancer.
- The formulation of shampoo in this study will use extraction of keratin protein and suitable chemical compound that will not harm for users.
- Analysis on the protein that contain in shampoo obtained.

## **1.3 Research Objectives**

This study is guided by the following research objectives:

- 1.3.1 To produce shampoo contains keratin protein from chicken feather.
- 1.3.2 To add natural product as additive into shampoo to avoid harmful to human hair.
- 1.3.3 To analyze the shampoo product.

## **1.4 Scope of Study**

- 1.4.1 This research is focus on development of shampoo from keratin protein that is extracted from chicken feathers
- 1.4.2 Addition of natural product in the formulation of shampoo.
- 1.4.3 Different amount of keratin protein are used in different formulation.
- 1.4.4 Analysis of structure of hair after applied shampoo obtained.

## **1.5 Expected Outcomes**

From this research keratin protein is extracted from chicken feathers and the keratin protein will be used in formulating of shampoo. Human's hair is mainly of keratin and when the of shampoo with harsh chemical is used, basic structures of hair will damage and these type of harmful chemical can lead to the development of cancer and other serious illness for human. All type of hair can be improved by using keratin shampoo. Therefore if people use keratin protein in shampoo, it will help bring the hair back to normal, will remain softer, more manageable and make healthier.

## **1.6 Significance of Study**

The study about development of shampoo from keratin protein is quiet useful. In this research, the chicken feathers are used and they are widely available in Malaysia and the thing is this feather creates an environment problem as they are waste product. The base material was used to make some useful keratin protein to develop the shampoo. Therefore one way this research are helping the environment and other way is trying to commercialize and people can use the shampoo that develop from keratin protein. Besides that, usage of natural product like aloe vera oil, virgin coconut oil, grape seed oil and hibiscus leaves extract in formulation of shampoo as additive can help to revive human hair and scalp from years of using chemical treatment. In addition, it will help produce new hair growth by naturally stimulating the hair follicles. Moreover, it is better receiving the benefits of natural oil and protein instead of using harsh chemicals that harmful for hair. Therefore, using of formulation of shampoo with natural product also will help environment by letting bio-degradable substances go down the drain and not dangerous chemicals.



## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Review of literature of this research consists of three sections that are related to the research. The first section is keratin protein, the second section is development of shampoo, the third section is extraction method and the last section is conclusion.

## 2.2 Keratin Protein

Keratin protein is a protein which is extracted from chicken feather. Chicken feathers have high percentage of keratin protein content and can be a suitable protein source (Wrześniewska-Tosik and Adamiec 2007). According to Wrześniewska-Tosik and Adamiec (2007), keratin protein from chicken feather is a by-product which is available in great amounts. Besides that, the keratin included in chicken feathers is a very inconvenient and troublesome waste product of the poultry-farming industry (Wrześniewska-Tosik and Adamiec 2007). Barone and Schmidt (2005) found that keratin is a hierarchical structure, consisting of subnanometer-sized amino acid that polymerize in a known sequence into a large molecular weight protein molecule that is on the order of  $10^1$ - $10^2$  nm in size. Feather keratin protein has a molecular weight of approximately 10500 and a cysteine/cystine content in the amino acid sequence of 7% allowing for sulfur-sulfur bonding or cross-linking in the keratin (Arai et al., 1983)

In Malaysia especially, chicken feather is available as a waste product in a large quantity. The extracted of keratin protein can be used as one of the ingredients in hair care and skin care. Keratin protein is the same like protein in human hair and people can use it for multiple purposes. Based on Wrześniewska-Tosik and Adamiec (2007) application of keratin preparations in the cosmetic are the best known and described in literature. Similarly with Schrooyen (2000) the keratin from the poultry feathers can be decreased and then solubilised so that it can be used in cosmetics or pressed into films for biodegradable coatings or for cell culturing substrates. However, opportunities to use this interesting protein in other fields have arisen, for

example as component of various kinds of composites, as a component of biodegradable nonwovens, and in biotechnology (Wrześniewska-Tosik and Adamiec 2007). Besides that, the keratin feather fiber has many possible uses including short-fiber reinforcement for polymer (Barone and Schmidt, 2005). According to Wrześniewska-Tosik and Adamiec (2007), considering the hydrophilic properties of keratin, it would be appropriate to use it for manufacturing fibres with increased sorption features, that would in turn be useful for producing textile products dedicated to sanitary and medical application, also as a technical sorption material. For the properties of keratin protein, based on Wrześniewska-Tosik and Adamiec (2007), keratin is insoluble in water, weak acids and bases, as well as in organic solvents. In addition, keratin also very reactive, as cystine can easily be reduced, oxidised, and hydrolysed (Wrześniewska-Tosik and Adamiec 2007). Barone and Schmidt (2005) mention that keratin is a biologically produced polyamide that is also semi-crystalline with a fair amount of hydrogen bonding. It is therefore possible that formic acid also has a similar effect on the keratin feather fiber for example amorphous and crystalline fractions will dissolve in formic acid. The other products that keratin protein can be used as one of the ingredients are anti-aging cream, hair straightening and for medicinal purposes.

### **2.3 Shampoo**

Shampoos are cleaning formulations used for a wide range of applications, including personal care, pet use, and carpets. Besides that, it is a hair care product

used for the removal of oils, dirt, skin particles, dandruff, and environment pollutants. Most are manufactured in roughly the same manner. They are composed primarily of chemicals called surfactants that have the special ability to surround oily materials on surfaces and allow them to be rinsed away by water. Most commonly, shampoos are used for personal care, especially for washing the hair. According to Kelly and Roddick-Lanzilotta (2006) a range of personal care products that include a keratin protein fraction. The fraction may be intact or hydrolysed. In addition, keratin protein and their derivatives are used in a wide range of personal care formulation, including those intended for use on the hair (Kelly and Roddick-Lanzilotta 2006). Based on Kelly and Roddick-Lanzilotta (2006), the formulation of keratin protein in shampoo will protect human hair from the insults of environmental and chemical damage. Kamiya (2001) showed that shampoo compositions are for cleaning the head and body, softening the hair, giving a rinsing effect and improving atopic dermatitis.

According to Dowell et al. (1996), many people buy and use a hair shampoo for its cleansing properties. The consumer always desire a hair shampoo that can give other desirable properties to human hair or scalp such as conditioning, antidandruff and set retention properties. In this case, the consumers often desire sufficiently-conditioned hair that can holds a present configuration.

### **2.3.1 Surfactant**

In formulation of shampoo, surfactant is function as cleaning, wetting, and foaming. Characteristics of final product of shampoo are depending on the mixture of

various types of surfactants (Pena et al. 1990). Pena et al, (1990) points out that in general, a shampoo contains a base surfactants for cleansing at 10-15%(w/w) and the base surfactant is mostly a salt of C<sub>12</sub>-C<sub>14</sub> alkyl sulphate, alkyl ether sulphate, or alkyl olefin sulfonate, base on the mildness and foaming characteristics required. In addition, typical sample of surfactant based conditioning agent are cocamidopropyl betaine and coconut oil derived amine oxides. Kamiya (2001) mentions that diaklyldimethylammonium chloride that is quaternary ammonium surfactants used for softening the hair promotes skin roughening.

According to Grute et al. (1994), surfactant is an essential component of the present compositions. It will be selected from any of many varieties of synthetic anionic, amphoteric, zwitterionic and nonionic surfactants that is present at a level of from about 5% to about 70%, preferably from about 10% to about 30%, and most preferably from about 10% to about 22%. Murray (2002) mentions that, the type of surfactant that should be consider in formulation of shampoo are anionic, nonionic, zwitterionic or amphoteric surfactant.

In addition, according to Karsheva, Georgieva and Handjieva (2007), surfactant also is essential to provide long term stability to emulsion, since they prevent droplet coalescence by adsorbing at the interface and increasing the repulsive interactions among droplets according to two main mechanisms that are steric and electrostatic.

Karsheva, Georgieva and Birov (2005) mention that there are two types of surfactants those are primary and secondary surfactant. Primary surfactant is main cleansing agent of the formulation of shampoo. Sodium lauryl sulphate (SLS) is one of the most popular primary surfactant. Meanwhile for secondary surfactant, the

function is to reduce the drying effect of the primary surfactant and change the aesthetic properties of the shampoo. Ether sulfate is the most popular secondary surfactant (Karsheva, Georgieva and Birov, 2005).

### **2.3.1.1 Anionic Surfactant**

According to Dowell et al. (1996), anionic surfactants not only can eliminate the dirt and soil from human hair, it also eliminate essentially all of the sebum naturally present on the surface of the hair fibers. The anionic surfactants also make the hair in a cosmetically-unsatisfactory condition instead of effectively deterge the human hair (Dowell et al. 1996). Murray (2002) identifies example of commonly anionic surfactants include sodium oleyl succinate, ammonium lauryl sulphosuccinate, ammonium lauryl sulphate, and sodium dodecylbenzene. In addition, Murray (2002) lists most preferred anionic surfactants that are sodium lauryl sulphate, triethanolamine lauryl sulphate, triethanolamine monolauryl phosphate, and sodium lauryl ether sulphate and ammonium lauryl sulfate. According to Grute et al. (1994), the alkali metal salts of organic sulphuric reaction products is the example for synthetic anionic surfactants having in the molecular structure an alkyl radical containing from 8-22 carbon atoms and a sulfonic acid or sulphuric acid ester radical.

### **2.3.1.2 Nonionic Surfactant**

According to Murray (2002), nonionic surfactants suitable for use in compositions of the invention may include condensation products of aliphatic primary or secondary linear or branched chain alcohols or phenol with alkylene oxides and generally having from 6 to 30 ethylene oxide group. Grute et al. 1994 claims that nonionic surfactants is a compound produced by the condensation of alkylene oxide groups with an organic hydrophobic compound, which may be aliphatic or alkyl aromatic in nature. One of example of nonionic surfactants is the polyethylene oxide condensates of alkyl phenols.

### **2.3.1.3 Amphoteric Surfactant**

Those which can be described as derivatives of aliphatic secondary and tertiary amines in which the aliphatic radical can be straight chain or branched is the example of amphoteric surfactants (Grute et al. 1994).

### **2.3.1.4 Zwitterionic Surfactant**

Grute et al. (1994) points out that those which can be broadly described as derivatives of aliphatic quaternary ammonium, phosphonium and sulfonium compounds in which the aliphatic radicals can be straight chain or branched is the

Zwitterionic surfactants and wherein one of the aliphatic substituent contain from about 8 to 18 carbon atoms and one contains an anionic water-solubilizing group as example carboxyl, sulfonate, sulphate, phosphate or phosphonate.

## **2.4 Formulation Strategy of Shampoo**

### **2.4.1 Choice of detergent**

Almost shampoo contains a mixture of two or more surfactant in a concentration range from 25 to 30%. But, such a high concentration of detergents is not really required in a shampoo because it can make harsher to human hair ( Mainkar and Jolly 2001). Besides that, according to Moldovan and Paraun (2012), type of detergent which is characteristics who may appreciate the cleansing ability of a shampoo, scalp tolerance and also a great detergence is responsible of drying effect, irritation and may lead to a scalp condition.

### **2.4.2 Additives**

According to Mainkar and Jolly (2001) citric acid was used by biofermentation for this dual purpose, as well as to reduce the pH to the desired level. Therefore, in this formulation of shampoo, the suitable pH is 6 – 7. Besides, additives give an important role in any cosmetic formulation. Besides that, a good