

# Rethinking of Preventive Effect of Hair Loss in Environment and Food Factors

Ji Ahn Han<sup>1</sup>, Ki Han Kwon<sup>2,\*</sup>

<sup>1</sup>Major of Rice Cake Manufacturing Management, Department of Business Administration, Graduate School, Sungkyul University, Republic of Korea

<sup>2</sup>College of General Education, Kookmin University, Republic of Korea

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**Abstract** The hair loss patients appear in all age groups, regardless of gender, and the number and severity are increasing every year. The causes of hair loss include not only genetic factors, but also environmental factors, lifestyle habits, and eating habits. This paper aims to introduce the goodness of black soybeans (*Phaseolus vulgaris*) rich in estrogen and white ferula mushroom (*Pleurotus nebrodensis*) with high antioxidant effect and protein content. Keywords such as hair loss, nutrition, and food ingredients were searched in Pubmed, Scopus, Google Scholar, and Riss electronic databases, and the relevant information and research were reviewed. It is critical to maintain good care of hair to prevent hair loss, but it is often overlooked. Accordingly, as people are interested in foods that help prevent hair loss, black beans and white ferula mushroom are suggested to be used in various recipes so that they can be consumed regularly. Black soybeans (*Phaseolus vulgaris*) and white ferula mushroom (*Pleurotus nebrodensis*) in this review are foods with many potential health benefits and are expected to have great importance and potential for future food applications. In addition, interest in hair loss continues to this day, so it is believed that continued research is needed to find many food ingredients that can help prevent hair loss. Therefore, it is hoped that the importance of ingredients that are effective in preventing hair loss will be promoted and that it will be in the spotlight as a health functional food.

**Keywords** Alopecia, Hair Loss, Black Soybean (*Phaseolus vulgaris*), White Ferula Mushroom (*Pleurotus nebrodensis*)

## 1. Introduction

With the advancement of science and medical technology in modern society, daily life has become more convenient and the average lifespan of human beings has also been extended. This has been shown to have a significant impact on the changes in eating habits of busy modern society. There are many side effects from this, and one of them is that the number of patients suffering from alopecia is increasing rapidly. Therefore, we would like to introduce foods that help prevent hair loss by studying the cause of hair loss.

A healthy person generally has 80,000 to 120,000 hairs on the scalp and it grows about 1-2cm per month [1]. There is a hair matrix in the area in contact with the hair papilla, so that hair is created. Hair papilla contains capillaries and nerves that help the hair follicle grow by supplying nutrients and oxygen [2, 3]. All hair follicles go through repeated cycles of Anagen, Catagen, and Telogen. It may be said that it is common to lose about 50 to 100 hairs a day, but if more than 100 hairs are missing, it is likely to be hair loss [1, 4, 5]. Alopecia is largely classified into alopecia areata, androgen alopecia, other non-scarring hair loss, and scar alopecia. Hair falls out naturally with age, but hair loss symptoms include M-shaped hair loss, in which the hair becomes thinner, the hair falls out a lot, or the border of the forehead is pushed back [6, 7]. Androgenic alopecia (AGA) is the most common alopecia in both men and women. It is

characterized by the fact that the growth stage of the hair follicle cycle occurs repeatedly due to male hormones and genetic predisposition, so that the hair becomes thinner [8]. Among the factors of hair loss, oxidative stress can be called inflammation. It has been reported that when melanin synthesis causes mutations in the nucleus and mitochondrial DNA of melanocytes, symptoms of white hair and hair loss appear [9, 10]. Currently, the cause of hair loss, one of the concerns of modern people, cannot be clearly defined. However, several factors have been identified as contributing to hair loss, including genetics, age, hormonal changes, immune system dysfunction, stress, malnutrition, and dietary habits. Other causes include frequent application of shampoo, mousse, spray, dyeing and perm. There are also environmental factors including sulfuric acid in the air, smoke, and smoking.

Lastly, modern medical treatments have been identified as potential triggers for hair loss, including minoxidil and immunosuppressive agents such as diphenylcyclopropenone (DPCP), corticosteroids, and cyclosporine. There is no direct prevention method, but it is a part that pays attention to lifestyle. Frequent shampooing and irritating the scalp by perms and dyes should be avoided, and nutrients should be consumed evenly during meals, and adequate sleep is required. And it is recommended not to have a sudden diet and or stress [7]. The incidence of hair loss appears regardless of gender, and hair loss symptoms are also seen in younger age groups than in the past.

As a result of analyzing alopecia (L63-66, alopecia) using the 2015-2019 health insurance and medical benefit review decision data of the Korea Health Insurance Review and Assessment Service, the number of patients with alopecia in 2015 was 208,534, 212,916 in 2016, 215,025 in 2017, 224,688 in 2018, and it can be seen that the number continued to surge to 233,628 in 2019. In addition, it was found that women accounted for about 45% of all hair loss patients in 2019. In 2015, 24,889 men aged 20-29 and 32,318 men aged 30-39. There were 16,920 women aged 20-29 and 19,127 aged 30-39, but in 2019, 30,387 men aged 20-29, 35,245 men aged 30-39, 18,357 women aged 20-29, 18,823 aged 30-39, increasing every year. The total amount of medical care benefit expenses was calculated as 19,810,608,000 won in 2015, 21,738,702,000 won in 2016, 23,447,907,000 won in 2017, 26,788,739,000 won in 2018, 30,281,826,000 won as reported by Health Insurance Review and Assessment Service, 2019 [7]. Every year, the number of hair loss patients, including children and adolescents, is increasing, and all age groups are increasingly concerned about hair loss.

## 2. Research Progress and Product Status Due to Hair Loss

As the economy develops and social life increases, modern people have increased their interest in appearance,

but the number of hair loss patients is increasing even in the younger generation due to problems such as stress, drinking, and smoking. Hair maintains body temperature and protects the scalp from external stimuli. However, due to alopecia, the role of body functions can be lost, and external image changes are causing loss of self-esteem, lack of self-confidence, shame, depression, psychological atrophy, social disconnection due to interpersonal issues, and problems with the relationship with the opposite sex. Since alopecia has a large psychological effect, it is becoming more serious as a disease that negatively affects stress and quality of life [11, 12, 13]. Accordingly, this trend is expected to continue with the rapid growth of the hair loss market every year due to the increase in the hair loss population.

Hair loss prevention, development of hair care products that help with hair loss, and research on treatments are being conducted, but there are many areas that are insufficient. Hair loss treatments approved by the U.S. Food and Drug Administration (FDA) are prescribed with minoxidil, a topical application, and finasteride, an oral treatment, but there are side effects. Finasteride causes side effects such as decreased sexual function, unwanted hair growth, swollen hands and feet, and birth defects, and minoxidil causes dermatitis with erythema, peeling of the epidermis and dryness. In other cases, it is said to cause allergic contact dermatitis and seborrheic dermatitis. In addition, it is known to cause side effects such as recurrence of hair loss if discontinuation of use due to itchiness, showing a limitation. The World Health Organization's Adverse Drug Adverse Events VigiBase confirmed Propecia-related adverse reactions. As a result of the survey, it was reported that the suicide rate was 356 cases and psychological adverse reactions were 2,926 cases. The side effects of finasteride were confirmed that there were suicidal thoughts and attempts due to depression and anxiety from using finasteride. Although interest in hair loss has increased as the number of patients with alopecia increases every year, treatment methods are very limited [14-19]. Therefore, it is necessary to develop treatments and products that can have an effect on preventing hair loss and strengthening hair growth, and minimizing the side effects and disadvantages of hair loss treatments [20]. In Korea, due to this problem, food ingredients are being used to develop products that can have an effect on preventing hair loss.

A study conducted by JUNG and CHO (2014) [21] found that products using jujube fermented with *Saccharomyces cerevisiae* have antioxidant effects, hair growth promotion, and hair loss prevention effects. Another study proved its value by manufacturing a hair loss prevention product using a natural material, *Platycodon grandiflorus* [22]. However, although it continues to develop hair loss shampoos, hair products that help with hair loss, and hair loss treatment drugs, it has not yet seen a clear treatment method and great effect. Considering that the number of patients with alopecia is increasing every year and the

initial onset age is gradually decreasing, research and development of foods that help hair loss and promote hair growth are very important [11, 23].

### 3. Physiological Problems Caused by Hair Loss

In 2019, the rate of high stress from hair loss by age group was 98.5% in their 20s, 75.6% in their 30s, 62.7% in their 40s, and 61.2% in their 50s. What can you give up in a year for healthy, rich hair? 37% can give up drinking, 15% can give up sex, 11% can give up a year in the life, 11% can give up internet, 8% can give up cell phone use, 17% others had a response [7]. Compared to the West, Asians have a lower rate of hair loss, so it seems that it has a lot of influence on the stress of hair loss and the surrounding gaze.

Hair loss may be partially removed from the scalp, but the area may also spread widely. Also, hair loss usually falls off the scalp, but can occur in any part of the body. A skin biopsy at the area of alopecia may show multiple lymphocytes and supports the theory of autoimmune causes. Alopecia is associated with autoimmune diseases such as vitiligo, thyroid disease, rheumatoid arthritis and diabetes, discus lupus erythema. In addition, patients with atopic disease are also at an increased risk of developing alopecia [24]. Among them, early-onset alopecia has been reported to be associated with fatal ischemic heart disease in addition to myocardial infarction. Hence through medical examination is required when treating hair loss disease [25]. It has been reported that hair loss and diabetes may be related, and type 2 diabetes is associated with an increased risk of severe scalp hair loss [26, 27, 28]. Furthermore, as a result of a survey of the long-term effects of 40 domestic COVID-19 patients, conducted by Korea Centers for Disease Control and Prevention, hair loss is one of the sequelae problems of COVID-19 and was 3rd common symptoms of post-COVID-19 patients accounting for 23%, which was followed by chest tightness [29].

### 4. Introduction and Efficacy of Ingredients That Are Good for Hair Loss

Factors influencing hair growth include acute telogen hair loss and sudden weight loss resulting from decreased carbohydrate and protein intake, and alopecia spreading due to niacin deficiency [30, 31, 32]. In addition, excessive supplementation of certain nutrients, including selenium is associated with hair loss [33]. Particularly, people suffering from hair loss disease should always be careful and pay attention when ingesting nutrients. Accordingly, in China, alopecia is gradually increasing even in the younger age group, and the demand for health functional foods among

young people in their 20s and 30s who care for health has increased significantly, and has emerged as the main consumers. According to China's National Health Survey Report (2019), 20s and 30s are most concerned about factors that affect their appearance, such as hair loss, skin problems, and obesity. As a result, an increasing number of people are seeking foods that help maintain and improve overall health. In particular, in the health food market, products suitable for the elderly were emphasized, but now it is understood that the younger generation is taking care of themselves, so health functional food companies are identifying the needs of the younger generation and developing, promoting, and marketing targeted products [34].

### 5. Black Soybean (*Phaseolus vulgaris*)

Soybeans are widely cultivated all over the world, imported and exported, and foods using soybeans include tofu and soy milk, and are diversified as beverages as well as food [35]. Soybeans contain phytochemicals as a natural physiologically active ingredient [36]. Black beans have been used in folk medicine in China, India, Japan, and Korea for hundreds of years [37]. Black beans contain more isoflavones than soybeans, which are a kind of plant estrogen. It is a compound that occurs naturally in plants and is similar to the 17- $\beta$  estradiol in mammals. It binds to the estrogen receptor(ER) and shows an activity similar to that of estrogen [38, 39]. Therefore, it showed excellent effects in preventing diseases related to hormones such as menopausal syndrome, osteoporosis, colon cancer and heart disease [40, 41]. The isoflavone substances abundantly contained in soybeans include daidzein, glycitein, and genistein. It has been reported that genistein, an isoflavone glycoside, is effective in breast and ovarian cancer, prostate cancer, and cardiovascular disease [42-45]. Daidzein is a physiologically active substance that is expected to play a pivotal role in the prevention and treatment of various chronic diseases [46]. Black beans are rich in vitamin B1 [47, 48], riboflavin (B2), and vitamin B12, the latter of which has been reported to promote hair growth [49, 50]. However, a deficiency in vitamin B12 may impair DNA synthesis and cell division within hair follicles, potentially leading to hair loss [51].

In the skin of black beans, anthocyanins, which belong to phenolic compounds, are red, purple, and blue, and are water-soluble flavonoid pigments. Due to this, it facilitates blood circulation of the scalp, so it is widely used for preventing and treating hair loss [52, 53]. In addition, it was found to be effective in preventing hair loss because it contains a large amount of cysteine, an essential ingredient for hair growth [54]. According to Jeon et al. [55], black bean extract was found to promote hair growth by stimulating the proliferation of dermal papilla cells and dilating capillaries, thereby improving blood circulation in the scalp. Accordingly, black beans were found to be highly

effective in inhibiting the progression of hair loss and in improving hair health. In addition, in the clinical trial results of Sung and Kim [56], when black bean extract was applied to the scalps of adults for 12 weeks, the average number of hairs lost per day decreased from approximately 140 to fewer than 40. It was also proven that the diameter of the hair increased, which in turn improved the satisfaction of the experimental participants. A recent study found that when finasteride and black bean extract were mixed in a 6:4 ratio and applied to human hair papilla cells stimulated with DHT (dihydrotestosterone), the protective effect on cells significantly increased. Therefore, it is expected that black beans have the potential to improve the therapeutic effect of androgenetic alopecia [57]. These research results suggest that black beans may be effective not only for those suffering from hair loss, but also for those who want to prevent it. In particular, shampoos and hair products containing black bean extract, a natural substance, are worth considering for promoting hair health as they can be beneficial in promoting hair health.

Research on cooking methods to minimize nutrient loss in black beans showed that when black beans were soaked in water and then cooked, vitamins E and K remained relatively stable against heat. In particular, the nutrient preservation rate of vitamin K was the highest in black beans at 107.2% compared to kidney beans, soybeans, mung beans, and red beans, showing that black beans were superior in terms of nutrient preservation rate [58]. In addition, in an experiment where dried black beans were fed to rats, protein oxidation in plasma was significantly inhibited, and lipofuscin production in heart and eye tissues was also inhibited [59]. In a study on roasted black bean powder, it was confirmed that the content of phenolic compounds and radical scavenging activity increased together as the roasting temperature and time increased [60]. In summary, black beans are a food that can be cooked and consumed in a variety of ways to provide sufficient health benefits. In Korea, there are many foods that use black beans, which are high in protein. Black bean *Gangjeong*, black bean rice, black bean porridge, black bean milk, black bean smoothie, black bean ice cream, and black bean rice cake are often consumed. Therefore, it is considered that there are fewer hair loss patients in Korea than in the West. It is difficult to expect a significant change in a short period of time, however it is best to constantly consume health functional foods and ingredients that are effective in preventing hair loss.

## 6. White Ferula Mushroom (*Pleurotus nebrodensis*)

The first documentary and botanist of mushrooms, Giuseppe Inzenga, discovered the white ferula mushroom (*Pleurotus nebrodensis*) in 1866, and according to the study by Hawksworth [61], there are 22,000 mushroom species. White ferula mushroom (*Pleurotus nebrodensis*) is

a type of mushroom belonging to Pleurotaceae and Pleurotus, and is a variant of *Pleurotus eryngii* [61, 62].

This mushroom has been described as the most delicious mushroom in the world, and white ferula mushroom (*Pleurotus nebrodensis*) is called the Angel's Mushroom in Xinjig region of China. White ferula mushroom (*Pleurotus nebrodensis*) is very white in color and is the largest among edible mushrooms, and its chewy texture is excellent [62, 63, 64]. As a source of dietary fiber and natural antioxidants, white ferula mushroom (*Pleurotus nebrodensis*), which contains nutrients appropriately due to its high protein content and high mineral content, has characteristics that can be used in various ways for nutrition and medicinal purposes [65]. In Korea, it is eaten grilled or fried, fried, Shabu-Shabu, or fried. The powder form is eaten by adding it to seasonings, drinks, yogurt, or adding it to rice cakes. In Italy, it is eaten with meat, grills, risotto, gratin, and salad. In China, it is used in soup or used as a medicinal plant.

White ferula mushroom (*Pleurotus nebrodensis*) contains 46.2% carbohydrates, 27.7% crude protein, 15.7% crude fiber, 7.35% crude fat, and 3.84% ash, so its nutritional value is very high [64]. As a result of mineral content test in dry white ferula mushroom, K, P, Mg, Na were the highest as the main constituents, followed by Ca, Fe, Zn, Cu, and Mn. It is believed to have higher antioxidant and antibacterial activity due to its higher Fe, Zn, and Mn content than *Pleurotus ferulae* and *Pleurotus ostreatus*, and it is considered to be in the spotlight as an excellent source of minerals and health functional food [66, 67]. Among minerals, zinc plays an important role in hair growth and is classified as an essential nutrient. Zinc deficiency can impair hair follicle function, potentially leading to hair loss. In fact, there have been reports of zinc having a positive effect on patients with alopecia areata. Additionally, it has been shown that abnormalities in zinc metabolism can also affect hair loss [68]. It has the highest content of tryptophan, an essential amino acid, and contains isoleucine, valine, threonine, phenylalanine, lysine, methionine, and leucine, and vitamin D3, which helps supplement calcium, is found to have a higher content than other mushrooms [67]. It is rich in nutrients, including dietary fiber, oleic acid, unsaturated fatty acids, calcium, zinc, and manganese. In addition, it contains various biologically active compounds that strengthen immunity by regulating the immune system. It has the effect of tumor growth, inhibition of inflammation, hypoglycemia, the reduction of antithrombotic activity, blood lipid concentration, atherosclerosis treatment, and prevention and improvement of hypertension. Polysaccharides extracted from *Pleurotus nebrodensis* have strong anticancer effects and can help in many ways [64, 69, 70, 71].

Like white ferula mushroom (*Pleurotus nebrodensis*), chaga mushroom has likewise been shown to contain polysaccharides [72, 73]. According to a study by Kim et al. [74], polysaccharides may help prevent hair loss by

exerting protective effects on keratinocytes and dermal papilla cells. Extracts of ginseng, green tea, shiitake mushrooms, and aloe vera have been suggested to have the potential to be developed as ingredients in pharmaceuticals and hair care products that are effective in preventing and treating hair loss. In Korea, shampoos, hair packs, and treatment products containing black bean extract, reishi mushroom extract, pine mushroom mycelia culture, tremella fuciformis extract, and phellinus linteus extract are sold on the market and have been receiving considerable consumer attention. Natural ingredients based on safety are used to prevent and improve hair loss, and various products utilizing these ingredients are being actively researched and developed. In addition, domestic companies are continuing their efforts to create products targeting the global hair loss cosmetics market.

Since cooking can lead to nutrient loss or degradation in mushrooms, studies have investigated methods that best preserve their nutritional value. The results showed that the total polyphenol content in mushrooms was higher when stir-fried than when boiled, whereas their DPPH radical scavenging activity was greater when boiled than when stir-fried [75]. A study also demonstrated that roasting or boiling edible mushrooms without soybean oil effectively reduced DNA damage [76]. Finally, rice cookies made with shiitake mushroom powder exhibited increased antioxidant activity and high consumer acceptability. These findings suggest that the nutritional value of mushrooms may be retained or even enhanced when they are heat-treated, processed into powder, and incorporated into food products [77]. In a broad sense, white ferula mushroom (*Pleurotus nebrodensis*) is also expected to exhibit similar patterns to those observed in the aforementioned studies when cooked. Although this mushroom has not yet been widely utilized, it is a food with potential as an effective functional ingredient in promoting health and alleviating hair loss. In the rapidly growing hair loss market, white ferula mushroom is a promising candidate worth exploring as a safe and effective ingredient.

## 7. Conclusions

Modern people are interested in hair loss products, hair loss treatment agents, and hair loss functional foods, but in my opinion, it is necessary to check the constituents of the products. We hope that hair products and therapeutic drugs using natural ingredients will be developed, and it is recommended to take them as health functional foods as much as possible.

Since the consumption of a healthy diet effectively prevents hair loss with no side effects, it is advisable to consume those food items which prevent hair loss. Therefore accordingly, the demand for black soybean and white ferula mushroom (*Pleurotus nebrodensis*), which minimizes the risk of hair loss, may increase further, and the frequency of consumption of these items is expected to

grow.

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