

The Education On The Effectiveness Of Herbal In Thai Geographical Indication

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Abstract

This pre-and post-trial (quasi-experiment) aimed to explore the effectiveness of effectiveness of herbal in Thai Geographical Indication (GI). That was local hair serum products for people aged 30-60 years in upper northeastern Thailand. In total, 13,637 people were chosen for the study during January 2021 to May 2022. The samples were divided into experimental groups and control groups, with 26 persons in each group. Data were collected from the sample groups by interviewing at 0.90 confidence and then analyzed using: Descriptive statistics: percentage, average, standard deviation; and Inference statistics: odds ratio and 95% CI, independent t-test, and paired t-test.

The results showed that risk factors for hair loss were staining, bending, stretching, and environmental factors ($p < 0.05$). Compared with the control groups, the growth rate of the experimental groups increased from 0.16 to 0.82 centimeters ($p < 0.0001$), the rate of dandruff decreased from 30.10 to 8.34 ($p = 0.028$), and the rate of hair loss decreased from 14.56 to 10.19 ($p < 0.0001$). The effectiveness of reduced hair loss and dandruff, and increased hair growth among the experimental groups was better than for the control groups ($p < 0.05$). In addition, the sample groups were satisfied with the hair serum products from local herbs at the moderate-to-good level at 57.7%.

Keywords: Serum, Herb, Geographical Indication(GI), Indigo, Hair loss.

1. Introduction

A geographical indication (GI) is a sign used on products that have a specific geographical origin and possess qualities or a reputation that are due to that origin. In order to function as a GI, a sign must identify a product as originating in a given place. In addition, the qualities, characteristics or reputation of the product should be essentially due to the place of origin. Since the qualities depend on the geographical place of production, there is a clear link between the product and its original place of production [1]. Hair loss could be considered as a global

problem, with 80% of hair loss cases being hereditary. Its causes can also be stress, diseases, and hormonal disorders in the body. Hair loss can cause problems on the scalp itself by being more exposed to dangerous UV rays as well affecting mental health, loss of personality, loss of confidence, or social escaping in some cases [2].

Hair loss can occur at any age for any sex. Hair may start to fall in teenage years but can start at age 20 years and older in males and at age 30 years in females. The issue of hair thinning or hair loss has received a lot of attention. The general perception is for hair to be thick, soft,

and strong, and to not fall out and not be thin [3, 4, 5].

In response to such public perception, suppliers have marketed cosmetics or cosmeceutical products for hair and scalp care, such as hair serum products, to supplement the appearance of hair and to reduce scalp problems. However, some products are synthetic chemicals [6,7,8]. One of the favorite alternatives to such synthetic cosmetics is herb-based products in line with the rising global tide of health awareness and using herbs in health care and for treating diseases. Herbs are one of the most popular alternatives due to their long-term use and the knowledge transfer from generation to generation [9,10,11]. It is easy to find local herbs that are safer than synthetic substances. Moreover, in Thailand the use of herbs and traditional Thai medicine has long been promoted continuously in government policies [12,13,14]. Herbs with important ingredients for nourishing the hair and scalp include Indigo, Lakoocha, Gotu kola, Ginger, Dainty spure, Yanang, and Leech Lime [15,16]. While past studies have focused on attempts to apply such herbs for the above benefits, the current study investigated maximizing the beneficial use of local herbs which in turn promotes and supports both agriculture and industry in the community, society, and the country.

The study objective was to understand the characteristics of hair and scalp problems of the sample groups and the risk factors for hair and scalp problems of the sample groups, to compare the effectiveness of the use of hair serum products containing local herbs before and after the trial, and to study the satisfaction of users with hair serum products containing local herbal ingredients.

The human hair is divided into two parts: the follicles and hair shaft. Follicles are located under the skin, and the hair shaft is the part above the skin. Hair contains 80.0 percent keratin (a water-soluble protein) and other chemicals. Individual hair grows from dermal papilla to a cell called the matrix which is

tissue that produces hair cells. As these cells divide more and more, they are pushed upwards above the skin and gradually die while producing keratin. This keratin is piled up and arranged in parallel and adhered together with a disulfide bond. When the keratin is pushed higher, its parallel structure is clearly divided into three layers: the core layer or medulla, the intermediate layer or cortex, and the outermost layer or cuticle. Taking care of the hair is an important issue. One form of hair care is the use of serum, a care product designed to deliver high concentrations of specific active ingredients. Serum can be either gel or emulsion and may be rich in nutrients with more active ingredients than a cream and it is capable of quickly penetrating deeply. It can be absorbed into the structural levels of the skin because of its higher concentration although it is lighter than a cream. Most serums are water-based and non-sticky [17]. There are several types of ingredients used in serums, with the most popular ingredients being herbal extracts. Importantly, all the herbs were from the Northeastern region and were Thai Geographical Indication (GI)[18,19]. Herbs in the hair serum in this research were listed.

Indigo

Scientific Name: Indigo feratinctoria. Its qualities include:

- As a cold medicine in preventing fever;
- As a natural source of animal food;
- Large indigo leaves containing rutin and rutinoid and high nitrogen levels making it suitable for fertilizer and pesticides;
- As indigo-dyed fabrics to make a herbal compress ball for treating muscles by folk healers in northeastern and northern Thailand; and
- As fabric dyes, as locals considers indigo as "the "King of the Dyes" [20,21].

Lakoocha

Scientific Name: *Artocarpus lacucha* Buch.-Ham. Its qualities include:

- **Heart wood:** Used for hot favors, tapeworm excretion; treatment for gas in digestive tract, flatulence, wasting disease, tendon problems, loss of appetite, expelling gas in the stomach, haematogenic disorders by dissolving blood, clots, facilitating urines, all kinds of fevers, lymph disorders, asthma, and phlegm;
- **Root:** Used for treating fever, parasite detoxification, wasting disease in the tendon;
- **Bark:** Astringent taste, chewed with betel leaves instead of cutch leaves;
- **Fresh bark:** Used for wound healing, boiling in hot water for fever relief, and parasite detoxification [22,23].

Gotu kola

Scientific Name: *Centella asiatica* (L.) Urb. Its qualities include: Triterpenoids for wound healing, strengthening hair and scalp, preventing hair falling while enriching the hair making it stronger, shiny and darker [24,25].

Ginger

Scientific name: *Zingiber officinale* Roscoe. Its qualities include: rich in minerals and vitamins (vitamin A, vitamins B₁, B₂, B₃, and vitamin C) and plenty of fiber to help prevent hair loss; sweet and spicy taste; treatment for gas in digestive tract, flatulence, queasy and vomiting inflation, nausea, vomiting, coughing, phlegm, relieving dysentery, and improving appetite [26,27].

Dainty spure

Scientific name: *Rhinacanthus nasutus* (Linn.). Its qualities include: a prominent feature in the treatment of dermatitis, eczema, and antifungal effects on the skin or on the head, stopping hair loss, promoting darker-colored hair. Thai medicine textbooks suggest using leaves and roots to treat eczema and rashes; fresh leaves and pounded roots are soaked in alcohol for a week and applied on the skin, relieving fever,

skin parasites; roasted fresh or dry leaves and brewed in drinking water as a diuretic or laxative [28,29].

Yanang

Scientific Name: *Tiliacora triandra*. Its qualities include: treating toxicity and relieving fever, neutralizing wrong manifestations and sickness. It contains high amounts of vitamins necessary for the body, such as vitamin A, vitamin B₁, B₂, B₃, vitamin C and calcium, phosphorus, iron, and beta-carotene. Yanang leaves help thicken hair and slow down the formation of gray hair [30,31,32].

Leech Lime

Scientific name: *Citrus hystrix* DC., Its qualities include high in antioxidants, strengthening the immune system and resisting disease. Used as a shampoo to cleanse, to make hair shiny, to prevent gray hair, and to treat hair loss. The acidic sourness of leech lime juice helps remove shampoo stains or purify any blockages along the hair follicles on the scalp, making hair easy to comb [33,34,35]. Little is known on the production of serums with herbal ingredients; in particular a new herbal formula requires marketing support and consumer incentives. Therefore, two theoretical concepts were used as a guide for this research.

The marketing mix theory consists of four market variables (product, price, place or distribution, and promotion) that can be controlled and must be combined to meet the target market needs to determine the market mix. A company must study the necessities and needs of the target market which is a group of similar customers that have been selected by the company as market goals. The target market may be consumer groups, manufacturers, wholesalers, retailers, and governmental or international markets. The market mix consists of every factor that can influence customers satisfaction and demand to purchases the products. In general practice, the marketing mix is composed of product, price, place or distribution, and promotion [36,37]. On the

other hand, the concept and theory of satisfaction suggest that satisfaction is an abstract attitude in a person's mind expressed as an emotion toward one thing. Satisfaction is a person's positive feelings for something that may arise from expectation or occur only when it can meet a person's needs. Satisfaction can happen and be changed according to the values and experience of a person. Reuben[38] reported that human behavior required motive or drive, a sufficient demand to pressure the motivation of a person to behave to meet one's own need. Each person's needs are different, with some being biological requirements, arising from stressful conditions such as hunger or hardship while others are psychological, due to the need for recognition, esteem or belonging. Most needs might not be enough to incentivize a person to act during that time, the need becomes an incentive when it is sufficiently stimulated [39,40].

2. Materials and Methods

A randomized control-group, pretest-posttest design was used. There were two experimental groups based on a pretest- posttest design. Quantitative and qualitative data collection were used. This research was divided into two phases: reviewing situations and then the experimental phase.

Phase I Reviewing situations

This entailed reviewing and collecting information to understand the situation and the characteristics of the hair and scalp problems of the samples before using the hair serums. The population ages were 30-60 years from the upper northeastern region of Thailand. In total, 13,637 volunteers participated in the research.

Phase 2 Experimental, hair serum products testing

The information from phase 1 was corrected by researchers with knowledge in various fields for the effectiveness of the use of hair serum products. Sampling groups with sample size

were calculated with the specific formula to compare averages of two populations. The solution provided 26 sample groups and 26 controlled groups.

Inclusion criteria

- Aged 30-60 years,
- Agree to participate throughout voluntary research,
- Able to move the body, walk, and no disabilities,
- Recognized intelligence, knowledgeable,
- Not having serious skin disease, such as fungal diseases on the head,
- No cancer treatment, radiation to treat cancer, anti-blood clotting medication,
- No SLEs that may result in hair loss, thinning hair.

Exclusion criteria

Sample persons who were unable to participate in the full trial of the hair serum product treatment over the 4 weeks or unable to complete the interview. Those who stopped using hair serum products due to side effects such as rash, burning, and scalp itching. Those who are not available in the area at the time of the study; therefore, the researchers could not continuously collect data. Those who passed the serum products to other persons.

Experimental models

Experimental groups: TX₁ TX₂ TX₃ TX₄
TX₅ TX₆

Control groups: CX₁ CX₂ CX₃
CX₄ CX₅ CX₆

Experimental procedure

- Request sample cooperation to clarify the research requirements.
- Test hair loss by combing the hair on the left and right sides 10 times each, count on black paper the numbers of hair lost before and after using the products.
- Count the number of hairs lost.

- Dandruff testing by combing the middle of the head and counting the amount of dandruff that falling onto black paper (5 square inches).
- Cut the hair in a patchy sample (approximately 1 square inch).
- Measure hair growth on the cut area after using hair serum products.
- Use a questionnaire to assess the satisfaction of users for the hair serum products from indigo and natural herbs.

2.1 Data collection tools

Research tools

Structural interviews which were developed by researchers based on the literature review and relevant research. The IOC value was 0.8 and the confidence value was 0.9.

The leaflet containing detailed information on the hair serum products. The sample data were collected from the sample groups every 4 weeks for 1 month.

The data were analyzed for cases before and after using the hair serum products.

Experimental data collection tools

Hair serum products containing essential ingredients from indigo, mixed with Lakoocha, Gotu kola, ginger, Dainty spure, Yanang, Leech Lime, and ethyl alcohol, consisting of

- Water 85%
- Indigo feratinctoria 3%
- Artocarpus lacucha Buch.-Ham 1.5%
- Centella asiatica (L.) Urb 1 %
- Zingiber officinale Roscoe 1.5%
- Rhinacanthus nasutus (Linn.) 1.5%
- Tiliacora triandra 1%
- Citrus hystrix DC. 1.5%
- Glycerin 3%
- Phenoxyethanol 1%

Product samples were shown in Figure 1.



Figure 1. Geographical Indication and Local Herb Hair Serum components tested.

- Camera
- Ruler/scissors/comb
- Black paper
- Dandruff measurement table
- Record form

Data collection consisted of follow-up for each trial of hair serum products every week for 12 weeks where the follow up measurements include:

- Combing hair to count the numbers of hair

lost and amount of dandruff on black paper;

- Counting the numbers of hair lost;
- Counting the nest in square inches;
- Measuring hair length in centimeters;
- Taking photographs of both groups of volunteers
- Recording the results after using the hair serum product

2.2 Data analysis

Descriptive statistics: analysis with frequency, percentage, mean, standard deviation, maximum, and minimum. In addition, inference statistics: comparative effectiveness between the sample group and the control group with independent t-test, comparative effectiveness before and after test with paired t-test statistics.

2.3 Research Ethics

The study was approved for human research ethics on 6 December, 2019 by the Ethics Committee of Kasetsart University, Chaloe Phra Kiat Campus, Sakon Nakhon Province. Key number of the project: kucsc. HE-61-005.

3. Results

3.1 Personal Information, Scalp and Hair

The majority of the sample groups, 94.2 percent, were female. The education level was primary education at 55.8 percent. Occupation was farming at 43.3 percent. Income was 400-3,600 baht per month at 40.4 percent. Large hair strands were at 53.8 percent. Oily hair was at 34.6 percent and dry hair at 65.4 percent.

3.2 Knowledge of using hair serum products

Most sample groups had very good knowledge about the use of hair serum products, at 48.1 percent with an average \pm standard deviation score of knowledge at 11.17 ± 1.39 .

3.3 Factors related to purchasing decisions

Most sample groups, 75.0 percent, scored fair on factors affecting the purchasing decision. The average \pm standard deviation score on these factors was 73.8 ± 11.14 .

3.4 Environmental feedbacks

Most of the sample groups, 55.7 percent, had a very high level of opinion on environmental matters that cause hair and scalp health problems with the average \pm standard deviation score at 33.51 ± 4.27 .

3.5 Risk factor for hair and scalp problems of samples

A person who had undergone coloration/bending/stretching was 2.182 times likely to have hair and scalp problems than a person who had never used coloration/bending/stretching (OR = 0.282, 95%CI 0.604 - 0.967), statistically significant ($p = 0.037$). For environmental factors, 36.7 percent of the control groups with significant feedback had hair loss at 63.3 percent, which was 31.8 percent higher than for the low environment- feedback groups. The high-feedback level groups had the risk of hair loss 3.701 times that for the low feedback (OR = 3.701, 95%CI 1.155 - 11.861), statistically significant ($p = 0.025$) as shown in Table 1.

Table 1. Risk factors and factors related to hair loss.

Factor	Hair loss					
	Low Frequency(%)	High Frequency(%)	X ²	OR	95% CI OR	P-value
Through coloring/bending/straightening						

ever	(25.0)	(75.0)	4.333	0.282	0.160 - 0.96	0.037*
never	(54.2)	(45.8)				
Environment factros						
low	(68.2)	(31.8)	5.042	3.701	1.15 -11.86	0.025*
high	(36.7)	(63.3)				

3.6 Comparison of effectiveness of use of hair serum products from local herbs

The average \pm standard deviation of hair growth before using the hair serum products was 0.16 ± 0.072 . The average \pm standard deviation of hair growth after using the hair serum products increased to 0.82 ± 0.242 , which was significant ($p < 0.0001$).

Comparing dandruff in one square inch nest before and after using hair conditioner serum

average \pm standard deviation of 30.10 ± 3.155 . The average \pm standard deviation for before using cases regarding dandruff reduction was 8.34 ± 6.533 , which was significant ($p < 0.0001$).

Hair loss in the experimental groups reduced after using the hair serum products, with the average \pm standard deviation of hair loss before being 14.56 ± 6.692 and after being 10.19 ± 4.370 , which was significant ($p < 0.0001$), as shown in Table 2.

Factor	Freque ncy	\bar{x}	SD.	95%CI		T	P-value
				Lower	Upper		
Hair Growth							
Before	52	0.16	0.072	-0.791	-0.51	-10.108	0.0001**
After	52	0.82	0.242				
Hair Dandruff							
Before	52	30.1	3.155	11.614	31.895	4.308	0.0001**
After	52	8.34	6.533				
Hair Loss							

products, for the

before using cases, dandruff was reduced by an

Table 2. Comparison levels of growth, dandruff, and hair loss before and after using hair serum products (n=52).

Before	52	14.56	6.692	1.999	6.732	3.703	0.0001**
After	52	10.19	4.37				

In terms of hair loss, the sample groups had a growth rate of hair with an average \pm standard deviation of 1.2 ± 0.6 centimeters which was greater than the rate of the control groups whose average growth \pm standard deviation was at 0.6 ± 0.06 centimeters, which was significant ($p = 0.002$). The sample groups had average \pm standard deviation dandruff of 17.5 ± 1.75 points

which was less than the average \pm standard deviation of the control groups at 27.1 ± 2.32 points, which was significant ($p = 0.043$). The sample groups' average hair loss \pm standard deviation was 9.8 ± 1.17 lines which was less than the average \pm standard deviation of the control groups at 11.8 ± 1.02 lines, and this was significant ($p = 0.025$), as shown in Table 3.

Table 3. Comparison levels of dandruff, and hair loss betwin experi mental and control group (n=120).

Factor	Frequency	\bar{x}	SD.	MD.	95%CI		t	P-value
					Lower	Upper		
Hair Dandruff								
Experimental group	52	17.5	1.57	-9.60	-20.7	1.4	-1.747	0.043*
Control group	52	27.1	2.32					
Hair Loss								
Experimental group	52	9.8	1.17	-2.00	-8.1	4.1	-0.654	0.025*
Control group	52	11.8	1.02					

* $p < 0.05$

4. Discussion

There were some hindrances in collecting data using questionnaires as the sample groups had some difficulty in interpreting the official language used in the questionnaire and this required more time to finish an interview. Therefore, the interviewer had to change to the local language when interviewing the sample groups. The key notes from the research are: 1) the male sample groups had lower hair loss, dandruff, and hair growth than their female counterparts, possibly because the total number of male samples was less than for females; 2) environmental factors and individuals who had used hair coloring, bending, and stretching were affected by hair loss and dandruff on a large scale. This may have been due to the interviewed individuals who had used hair coloring, bending, and stretching being more

knowledgeable and were able to answer the questionnaire more accurately than those who did not have the experience.

The effectiveness of the research for the key ingredients in the serums containing the 7 types of herbs are discussed below. Indigo and Lakoocha contain hair color nourishing properties. Gotu Kola nourishes the hair and scalp, prevents hair loss, and makes new hair strong and shiny. Ginger can treat hair loss. Dainty spure has antifungal effects on the skin or on the head, stops hair loss, and blackens the hair. [41,420] Yanang helps thicken hair and slows down gray hair. Leech Lime as a shampoo to cleanse makes hair shiny, prevents gray hair, and solves hair loss. Sour Leech Lime juice has acidic effects in removing shampoo stains or purifying any blockages along the hair follicles on the scalp, thus

making the hair easy to comb. [43,44,45,46] After the sample groups had used the hair serums, hair loss and dandruff were reduced while the length of hair increase significantly ($p < .05$), which was consistent with previous research on the effectiveness of hair care products, the performance of lemon grass oil, the effectiveness of *Litsea glutinosa* extracts the effects of four Thai herbal extracts: kameng, ginger, henna, and Dainty spure.[47,48] The development of the master herbal hair fermentation cream, and hair loss treatment on dyeing products and hair treatment diagnosis, and hair loss treatment using a low-level laser; and hair health check-up. [49,50]

Satisfaction with the market mechanism factors of the tested products from the sample groups is discussed below based on each of the listings in the element.

- The product: High score with average of 4.2, clear information on labeling, box packaging and directions.
- Products with suitable packing volume: Average score of 3.9.
- Beautiful packaging: Average product satisfaction score of 4.4.
- Product scent: Average score of 3.4.
- Product colors: Average score of 3.5.

The satisfaction scores for the above aspects were consistent with other study on satisfaction with Noni leaf shampoo artifacts of students and personnel of the samples recorded satisfaction with the artifact, the highest level of acceptable; the aromatic acceptable; the acceptable packaging; and the acceptable labeling. Thus, the current study demonstrated the utilization of local herbs while promoting and supporting both agriculture and industry in the community. Society, and the country. [51,52]

5. Suggestions

- Herbal knowledge workshops should be organized for community leaders and public health volunteers to promote practical

applications and to maximize the benefits.

- There should be publicity regarding local herbs, their benefits, and the conservation of medicinal plants, for families and people in the community network.
- Cosmetic products containing herbal ingredients should be promoted and their use encouraged instead of chemical products.
- There should be campaigns in the community to pay more attention to natural cosmetics and herbs for beauty and good health.
- Research should be conducted to create products that meet people's needs for beauty, personality, and health.
- This research only focused on certain variables. Therefore, it is important to study other related variables, such as attitudes and the types of behavior associated with the use of hair serum products, to obtain the more complete and useful information.
- Technical workshops should be organized to transfer more accurate information on herbs to ordinary people.

6. References

1. Daljit K, Jaspeet K, Kamal S. Development and Validation of a UV Spectrophotometric Method for Determination of Diacerein in Bulk and a Capsule Dosage Form. *Indian J Pharm Sci.* 2019;81:124-128.
2. Phakdeekul W, Kedthongma W. Drug Relapse Therapy with Herbs. *IJPS.* 2019;15:104-112.
3. Basma M, Mayada I, Soha H, Mina M, Reham H. Evaluation of the efficacy of fluorescent staining and Chicago Sky Blue staining as methods for diagnosis of dermatophytosis in hair and nails clinical, cosmetic and investigational. *Dermatology.* 2019;12:751-58.
4. Verret DJ. *Patient Guide to Hair Loss & Hair Restoration.* Plano: WJ Sonnier Publishing. 2009.
5. Wimolsiri I, Kanchana L, Poonkiat S. Finasteride and its potential for the

- treatment of female pattern hair loss: Evidence to date. *Drug Des Develop Ther.* 2020;14:951-59.
6. Suchonwanit P, Thammarucha S, Leerunyakul K. Minoxidil and its use in hair disorders: A review. *Drug Des Devel Ther.* 2019;13:2777-86.
 7. Lokaewmanee K, Phakdeekul W, Kanyacome S, et al. Effects of Herb Residue Supplementation on Growth Performance, Economic Return, Carcass Quality and Ammonia Nitrogen of Broiler Chickens. *Int J Poult Sci.* 2020;19:486-492.
 8. Phakdeekul, W., Kedthongma, W. Effectiveness of Bacopa Herb for Solving Dementia in the Elderly. *Sys Rev Pharm.* 2021;12(10), 548-553.
 9. Parab Gaonkar VM, Mannar VS, Mastiholimath VS, et al. Development and Evaluation of Herbal Supplement: A Quality by Design Approach. *Ind J Pharm Sci.* 2020;82:640-649.
 10. Phakdeekul, W., Kedthongma, W. Management System for a Quality and Outcome Framework in the Area of the National Health Security Office in Region 8, Thailand. *LINGUISTICA ANTVERPIENSIA.* 2021;3: 2415-2427.
 11. Kanyacome S, Phattaraworamet Th, Phakdeekul W, et al. A Conceptual Analysis of Mobile Application for the Thai Herbal City. *Test Eng Manag.* 2020;83:18034-18039.
 12. Department of Agriculture Ministry of Agriculture and Cooperatives. *Thai Herbs.* Bangkok: Min Agr Coop. 2017.
 13. Kedthongma W, Phakdeekul W. Effects on Mental Health and Subjective Well-being of Thai Marriages with Foreigners During COVID-19 Pandemic. *Journal of Positive Psychology and Wellbeing* 2022; 6(1), 863-870.
 14. Kedthongma W, Phakdeekul W. The intellectually developed model for community participatory management of child care centers during the COVID-19 Outbreak. *European Journal of Contemporary Education* 2022; 10(4): 854-867. doi: 10.13187/ejced.2021.4.854
 15. Florentia D, Mangana J, and Dummer R. Hair depigmentation and hair loss in advanced melanoma treated with combined immunotherapy and targeted therapy. *Acta DV* 2020;100(1): 1-2
 16. Palaav YK, Priscilla M. Standardization of Selected Indian Medicinal Herbal Standardization of Selected Indian Medicinal Herbal Standardization of Selected Indian Medicinal Herbal Raw Materials Containing Polyphenols as Major Raw Materials Containing Polyphenols as Major Phytoconstituents Phytoconstituents. *Indian J Pharm Sci.* 2006;68:506-509.
 17. Juyoung Lee, Yuko Tsunetsugu, Norimasa Takayama, et al. Influence of Forest Therapy on Cardiovascular Relaxation in Young Adults. *Hindawi Publishing Corporation Evidence-Based Comp Alt Med.* 2014;1-7.
 18. Bilewicz R, Nazaruk E, Zelechowska K, et al. "Carbon nanotubes chemically derivatized with redox systems as mediators for biofuel cell applications,". *Biocyb Biomed Eng.* 2011;31:17-30.
 19. Barka N, Assabbane A, Nounah A, et al. "Photocatalytic degradation of indigo carmine in aqueous solution by TiO₂-coated non-woven fibres," *J Hazard Mat.* 2008;152:1054-1059.
 20. Youxun Liu, Mingyang Yan, Yuanyuan Geng, et al. ABTS- Modified Silica Nanoparticles as Laccase Mediators for Decolorization of Indigo Carmine Dye *Hindawi Publishing Corporation Evidence-Based Complementary and Alternative Medicine.* 2015;1-7.
 21. Teanpaisan R, Ruangkiatkul P, Thammasitboon K, et al. Effectiveness of *Artocarpus lakoocha* extract, poloxamer 407, on *Enterococcus faecalis* in vitro. *J Investig Clin Dent.* 2013;4:219-24.
 22. Saatchi M, Shokraneh A, Navaei H, et al. Antibacterial effect of calcium hydroxide combined with chlorhexidine on *Enterococcus faecalis*: a systematic review and meta-analysis. *J Appl Oral Sci.*

- 2014;22:356-65.
23. Chandrika UG, Prasad Kumarab PA. Gotu Kola (*Centella asiatica*): Nutritional Properties and Plausible Health Benefits. *Adv Food Nutr Res.* 2015;76:125-57.
 24. Astutik FEF, Fauzia Zuhroh D, Rizqi Lazuardi Ramadhan M. The effect of gotu kola (*Centella asiatica* L.) tea on blood pressure of hypertension. *Enferm Clin.* 2021;31:195-198.
 25. Semwal RB, Semwal DK, Combrinck S, et al. Gingerols and shogaols: Important nutraceutical principles from ginger. *Phytochem.* 2015;117:554-568.
 26. Ghasemzadeh A, Jaafar HZE, Baghdadi A, et al. Formation of 6-, 8- and 10-Shogaol in Ginger through Application of Different Drying Methods: *Alt Antiox Antimicrob Act. Mol.* 2018;23:16-46.
 27. Brimson JM, Prasanth MI, Malar DS, et al. *Rhinacanthus nasutus* "Tea" Infusions and the Medicinal Benefits of the Constituent Phytochemicals. *Nutr.* 2020;12:37-76.
 28. Brimson JM, Brimson SJ, Brimson CA, et al. *Rhinacanthus nasutus* extracts prevent glutamate and amyloid- β neurotoxicity in HT-22 mouse hippocampal cells: possible active compounds include lupeol, stigmaterol and β - sitosterol. *Int J Mol Sci.* 2012;13(4):5074-97.
 29. Balakrishnan BB, Krishnasamy K, Mayakrishnan V, et al. *Moringa concanensis* Nimmo extracts ameliorates hyperglycemia-mediated oxidative stress and upregulates PPAR γ and GLUT4 gene expression in liver and pancreas of streptozotocin-nicotinamide induced diabetic rats. *Biomed Pharmacother.* 2018;112:1086-88.
 30. Assavalapsakul W, Winayanuwattikun P, Yongvanich T, et al. Effect of three fatty acids from the leaf extract of *Tiliacora triandra* on P-glycoprotein function in multidrug- resistant ART-eto cell line. *Pharmacognosy Magazine.* 2014;10:549.
 31. Makinde EA, Radenahmad N, Adekoya AE, et al. *Tiliacora triandra* extract possesses antidiabetic effects in high fat diet/streptozotocin-induced diabetes in rats. *J Food Biochem.* 2020;44:132-39.
 32. Al Attar AM, Alsalmi FA. Influence of olive leaves extract on hepatorenal injury in streptozotocin diabetic rats. *Saudi J Bio Sci.* 2017;26:1865-1874.
 33. Food and Drug Administration. Thai herbs. Nonthaburi: Office of the Food Commission and medicine; 2015.
 34. Wilson SC, Leech CD, Butler L, et al. Effects of nutrient and lime additions in mine site rehabilitation strategies on the accumulation of antimony and arsenic by native Australian plants. *J Hazard Mater.* 2013;261:801-7.
 35. Doherty S. History of evidence-based medicine. Oranges, chloride of lime and leeches: barriers to teaching old dogs new tricks. *Emerg Med Australas.* 2005;17:314-21.
 36. Christopher HL, Lauren W. Principles of Service Marketing and Management. Bergen: Prentice Hall. 2002.
 37. Bedocs LA, Bruckner AL. Adolescent hair loss. *Current opinion in pediatrics* 2008 ;20(4):431-5.
 38. Reuben MB. Theories of motivation and their application in organizations: A risk analysis. *Int J Inn Eco Develop.* 2017;3:44-51.
 39. Phakdeekul W, Kedthongma W. Management System for a Quality and Outcome Framework in the Area of the National Health Security Office in Region 8, Thailand. *Linguistica Antverpiensia.* 2021;2415-2427.
 40. Chaisripattana W, Laoritti N. The study on efficacy of lemongrass oil in Hair oil products through get rid of dandruff. Chiang Rai: School of Cosmetic Science, Mae Fah Luang University; 2013.
 41. Chen W, Yang CC, Todorova A, Al Khuzaei S, Chiu HC, Worret WI, Ring J. Hair loss in elderly women. *European Journal of Dermatology* 2010;20(2):145-51.

42. Loarpasuwong N, Pintathong P. Efficacy of *Litsea glutinosa* (Lour.) extract on hair Enrichment for application in hair care product. School of Cosmetic Science, Mae Fah Luang University; 2014.
43. Kunlayalong P, MakSri T. Satisfaction with Noni Noni leaves Shampoo of Students and officers in Phutthamonthon Vocational College, Phutthamonthon District Nakhon Pathom Province. Nakhon Pathom: Phutthamonthon Vocational College; 2016.
44. Joshi RK, Sharma AK. Determination of Seasonal Variation of Volatile Organic Constituents of the Leaves of Traditional Herb *Ocimum sanctum* Linn. *Indian J Pharm Sci.* 2021;83:750-757.
45. World Health Organization. Quality control methods for medicinal plant materials, Geneva 1998.
46. Ahmed SM, Azhar I. Darakhshan Masroor and Nadia Ahmed. Preference of Herbal Therapies: Cost of Illness and Cost Benefit Analysis for Major Diseases in the City of Karachi, Pakistan. *Indian J Pharm Sci.* 2019;81:885-891.
47. Poonkiat S, Noppanun C, Saranya K. Low-level laser therapy for the treatment of androgenetic alopecia in Thai men and women: a 24-week, randomized, double-blind, sham device-controlled trial. *Lasers Med Sci.* 2019;34:1107-14.
48. Rogers NE, Avram MR. Medical treatments for male and female pattern hair loss. *J Am Acad Dermatol.* 2008;59:547-66.
49. Sammuttiram K, Mukham C, Oangchakan N. Development of Prototype Herbal Hair Treatment for Antioxidant and Antibacteria. Ubon Ratchathani Rajabhat University. *Thai Traditional Medicine.* 2017.
50. Suchonwanit P, Chalermroj N, Khunkhet S. Low-level laser therapy for the treatment of androgenetic alopecia in Thai men and women: A 24-week, randomized, double-blind, sham device-controlled trial. *Lasers Med Sci.* 2019;34:1107-14.
51. Teansi N, Sripanidkulchai B, Jaipakdee N. Effect of four herb extracts on melanin synthesis. *Isan J Pharm Sci.* 2016;11:33-42.
52. Weerarojnaratchakul T. Hair Transplant. Bangkok: Nation International Edtenment 2000.