



Influence of botanical extracts in the texture profile of shampoo formulations

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Abstract

Background: Each day, even more consumers are concerned about hair care, once its appearance influences the self-perception and, consequently, the quality of life. Nowadays, another preoccupation is the search for cosmetic products with natural raw materials. In this context, botanical extracts have been used as a natural active ingredient in cosmetic formulations to attend the demand of the consumer. The texture profile evaluation helps to find the best formulation that will have more acceptance in the market. In this context, this study aimed to evaluate the influence of three botanical extracts on the texture profile of shampoo formulations.

Materials and Methods: A shampoo formulation was developed and added or not (Vehicle –V) with *Hamamelis virginiana* leaf extract (F1), *Camellia sinensis* leaf extract (F2) and *Paullinia cupana* extract – Guarana extract (F3). The analysis of the texture profile was performed using a TA.XT Plus Texture Analyzer (Stable Microsystems, Surrey UK). The formulations were evaluated in terms of hardness and spreadability, and the parameters calculated were hardness, adhesiveness, cohesiveness, elasticity, gumminess, compressibility, firmness and work of shear.

Results: The obtained results showed that the botanical extracts decreased the hardness, firmness, and work of shear of the shampoo formulations, it was also observed an increase of elasticity. Comparing with the vehicle, the reduction of values of hardness and work of shear are desirable parameters, such as the increase of benefits of elasticity, once they are related to the formulation spreadability and softness. When comparing the botanical extracts, the *Paullinia cupana* extract promoted a decrease in the adhesiveness, while *Camellia sinensis* and *Hamamelis virginiana* increased this parameter. It was also observed smaller values of hardness and high elasticity, even though the firmness and work of shear did not present significant differences among them.

Conclusions: In conclusion, even with the decrease of the firmness, the formulations with the extracts showed a good performance in other parameters, such as hardness, elasticity, and work of shear. Therefore, the formulation with guarana extract can be considered the best formulation due to the smaller values of hardness, and higher values of adhesiveness and elasticity.

Keywords: Texture profile evaluation, Botanical extracts, *Paullinia cupana* extract, *Camellia sinensis* extract, *Hamamelis virginiana* extract



Background

Each day, even more consumers are concerned about hair care, once its appearance influences the self-perception and, consequently, the quality of life.^{1,2,3} Nowadays, another preoccupation is the search for cosmetic products with natural raw materials.⁴ In this context, botanical extracts have been used as a natural active ingredient in cosmetic formulations to attend the demand of the consumer.

Guarana (*Paullinia cupana*) has been used for centuries by indigenous of the Amazon, and this plant is known by its stimulant and medicinal properties. Caffeine is a component of guarana and responsible for the stimulating

properties present in guarana seeds, the useful part of the plant. The first reports of the guarana properties were given by the indigenous what led to the inclusion of this seed in the group of medicinal plants. Besides caffeine, theobromine, theophylline, terpenes, flavonoids, and starch were found in guarana plants. The compounds are scientifically interesting because of their potential application in pharmaceutical, food, and cosmetic industries and by its antioxidant function.⁵

Hamamelis virginiana, also known as witch hazel, is a small tree native of eastern North America and Canada.⁶ This plant is used in many kinds of preparations for



the treatment of dermatological disorders because of its astringent and anti-inflammatory properties.^{6,7} *H. virginiana* compounds are hydroxycinnamic acids, flavonoids, quercetin, kaempferol, caffeic acid, quinic acid, and gallic acid. Due to its composition, *H. virginiana* has strong antioxidant activity.⁶

Camellia sinensis is native of South and Southeast Asia, but nowadays, it is cultivated even in tropical and subtropical regions. Tea is known by its pharmacological properties due to its components mainly the alkaloids, as caffeine and catechins. The catechins are divided into 4 primary compounds epicatechin (EC), epicatechin gallate (ECG), epigallocatechin (EGC), epigallocatechin gallate (EGCG), and 4 secondary compounds, catechin (C), catechin gallate (CG), gallic catechin (GC), and gallic catechin gallate (GCG). *C. sinensis* has other components including fats, amino acids, vitamins, minerals, proteins, and sterols. Studies showed that tea could act as antimutagenic, anticarcinogenic and anticlastogenic, and for this reason, it has become an interesting research material.^{8,9}

The texture analysis has an essential role in the Research and Development (R&D) of cosmetic products, once it can be helpful in the design of new products and contributes to find the right sensorial to a product according to its purpose.^{10,11} Today, the correlation between theoretical and sensory properties is known, and it's considered a valuable tool to understand consumer preferences once their choices generally are based in efficacy and by the pleasure given in terms of texture.^{10,12} Also, instrumental methods can be correlated to sensorial tests, and they are preferred by its objectivity and time saving.^{10,13} The texture profile evaluation helps the industry to find the best formulation that will have more acceptance in the market and contributes to choosing the best raw materials according to each cosmetic product.¹⁴

Thus, considering the importance of texture analysis and the market demand, evaluation of shampoo formulations with botanical extracts can be attractive to the design of new products that attend consumers' preferences.

Objective

This study aimed to evaluate the influence of the Guarana (*Paullinia cupana*), green tea (*Camellia sinensis*), and Hamamelis (*Hamamelis virginiana*) extracts in the texture profile of shampoo formulations.

Materials and Methods

Development of Formulations

Four shampoo formulations were developed and added or not (Vehicle -V) with Guarana (*Paullinia cupana*) extract (F1), green tea (*Camellia sinensis*) leaf extract (F2) and Hamamelis (*Hamamelis virginiana*) leaf extract (F3). The raw materials used in shampoo were TEA lauryl sulfate, disodium laureth-sulfosuccinate, cocamide DEA, sodium chloride, glycerin, panthenol, disodium EDTA, and sodium hydroxide to correct pH to 6.5.

Texture Profile Evaluation

The texture profile analysis was performed using a TA.XT Plus Texture Analyzer (Stable Microsystems, Surrey UK). The formulations were evaluated in terms of hardness and spreadability, and the parameters calculated were hardness, adhesiveness, cohesiveness, elasticity, gumminess, compressibility, firmness and work of shear. The accessory used for the hardness analysis was a cone shaped acrylic probe with a 45° angle and for the spreadability test the TTC Spreadability rig HDP/SR. The measures were made five times and in triplicate respectively and were performed at room temperature.

Statistical Analysis

The results were analyzed using the software GrandPad Prism 6. ANOVA and unpaired *t* tests were used to compare the formulations.

Results and Discussion

The obtained results showed that the botanical extracts decreased the hardness (Table 1), firmness (Table 2) and work of shear (Table 3) of the shampoo formulations, it was also observed an increase of elasticity (Table 1). Comparing with the vehicle, the reduction of values of hardness and work of shear are desirable parameters, such as the increase of elasticity, once they are related with the formulation spreadability and softness.^{12,13} Smaller values of hardness indicate a formulation easy to spread, and higher values of elasticity means a soft formulation, which are desirable parameters for cosmetic formulations.¹³ The formulation containing *Paullinia cupana* extract presented a smaller value for hardness and the formulation containing *Hamamelis virginiana* extract presented a higher value for elasticity (Table 1). Low values of adhesiveness (Table

Table 1. Hardness analysis results

	Vehicle (V)	<i>Paullinia cupana</i> (F1)	<i>Camellia sinensis</i> (F2)	<i>Hamamelis virginiana</i> (F3)
Hardness	26,08	23,9	24,64	24,68
Adhesiveness	285,0568	280,3232	298,2244	303,6908
Cohesiveness	-0,4671325	-0,4655706	-0,5244261	-0,5555715
Elasticity	-1,8376849	-2,4588974	-2,1499119	-2,7266992
Gumminess	-12,182815	-11,127137	-12,92186	-13,711504
Compressibility	194,295	191,272	195,631	195,228

Table 2. Spreadability analysis – Firmness results

Vehicle	Firmness		
	<i>Paullinia cupana</i>	<i>Camellia sinensis</i>	<i>Hamamelis virginiana</i>
69,38	51,49	51,88	52,03
70,38	50,18	52,57	52,34
69,84	50,34	53,58	54,58

Table 3. Spreadability analysis – work of shear results

Vehicle	Work of Shear		
	<i>Paullinia cupana</i>	<i>Camellia sinensis</i>	<i>Hamamelis virginiana</i>
55,36	36,80	34,68	36,30
48,78	36,15	34,17	36,29
49,07	34,34	36,41	36,01

1) are also desirable in a cosmetic formulation. When comparing the botanical extracts, the *Paullinia cupana* extract promoted a decrease in the adhesiveness, while *Camellia sinensis* and *Hamamelis virginiana* increased this parameter. The parameter firmness and work of shear did not present a significant difference among the botanical extracts. All parameters showed significant differences comparing with the vehicle.

Conclusions

According to obtained results, the formulations with the extracts showed a good performance in the evaluated parameters, such as hardness, elasticity, and work of shear, even with the decrease of the firmness parameter. Therefore, the formulation with guarana extract showed more pronounced results once presented smaller values of hardness and higher amounts of adhesiveness and elasticity when compared to the formulations added with the other extracts under study.

Competing Interests

None.

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