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Evaluation of the antioxidant and physical properties of an exfoliating cream developed from coffee grounds

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Abstract

Currently, around 1.6 billion cups of coffee are consumed daily in the world, generating around 6 million tons of waste known as spent coffee grounds (SCG), which are a source of environmental pollution. The main objective of this research was to develop an exfoliating body cream from SCG. The methodology included convective drying of the SCG at 60°C. The exfoliating cream was formulated with 4, 6, and 8% of SCG, the antioxidant contents were determined by ABTS+; the adhesiveness was analyzed with a Texture Profile Analyzer and the exfoliating capacity evaluated with a Mexámeter MX18. The results were analyzed by means of an ANOVA analysis, with $\alpha = 0.05$. As the main result, final moisture of SCG was of 5%. The content of antioxidants of body cream was 97.64–128.15μMol ETrolox/gSS. The exfoliating capacity of the three formulations showed similar behavior and do not show significant differences ($p > .05$). It can be concluded that the SCG can be used for the development of exfoliating body cream, obtaining a cosmetic product with exfoliating and antioxidant properties; being the above, a processing alternative for the agro-industrial residues generated in the coffee industry.

Practical application

In this study, an exfoliating body cream was developed from the SCGs, which is an agro-industrial waste generated by the coffee processing industry. It was determined that the hot air-drying process is a suitable method for the processing of coffee grounds since a stable product with low moisture is obtained. In addition, it was also possible to obtain an exfoliating cream for the body with antioxidant and polyphenol content, with textural and exfoliation properties similar to that of a commercial cream. The main application of this research is that it gives full use to the waste of coffee to obtain a cosmetic product with sensory, textural, and exfoliating properties of this type of products, being a processing alternative for agro-industrial waste generated in the coffee processing industry.

1 | INTRODUCTION

Coffee is the second most marketed product in the world after oil (Peshev, Mitev, Peeva, & Peev, 2018) of which ~ 1.6 billion cups a day are

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consumed globally (Dirks-Naylor, 2015). Given its high consumption, the coffee industry generates different kinds of waste or agro-industrial byproducts such as pulp, mucilage, parchment skin, cisco, and the spent coffee grounds (SCG) (Rodríguez Valencia & Zambrano Franco, 2010). The SCG, is generated during the preparation of the beverage or the manufacture of the instant coffee, on average, 2 kg of SCG is produced per kilogram of instant coffee produced (Karmee, 2017; Zuorro & Lavecchia, 2012) with an annual production of 6 million of tons approximately (Kovalcik, Obruca, & Marova, 2018). Currently, the coffee waste is considered an environmental pollutant due to the organic load it has (Janissen & Huynh, 2018; Mussatto, Carneiro, Silva, Roberto, & Teixeira, 2011). However, this waste is attracting more interest because it contains numerous compounds such as carbohydrates, proteins, lipids, minerals, nonprotein nitrogenous compounds and phenolic compounds and antioxidants (Peshev et al., 2018). In this sense, several authors report some applications for the use of the SCG, biodiesel production (Urribarrí et al., 2014), bioethanol, biogas (Rodríguez Valencia & Zambrano Franco, 2010), fuel for boilers (García & Riaño, 1999), composting (Zuorro, 2015), and in the formulation of food products with high nutritional value (Martinez-Saez et al., 2017). In the same way, some authors reported extraction of antioxidant compounds and phenolic compounds (Bravo, Monente, Juániz, De Peña, & Cid, 2013), which can have beneficial effects for health (Maldonado-Saavedra et al., 2010; Oroian & Escriche, 2015).

However, many of these applications do not make full use of the SCG, which is why it is necessary to find alternatives where full use is made of it. One of these options is the development of products for the cosmetics industry, in this sense, several agro-industrial wastes have been used in the preparation of creams bodily and facial from coffee grounds extracts and fruit residues (Idárraga, 2015; Isabel Andueza & Cabrera, 2014; Ribeiro et al., 2013), exfoliating creams with cacao peels and fibers of fruit (Torres & Yessenia, 2017; Villagrán & Mariela, 2014). An exfoliating cream, is an emulsion of two immiscible liquids, where one is dispersed (oil phase) in the other (aqueous phase) in the form of globules, and with the use of an emulsifier facilitates the formation and stability of the emulsion (Aranberri, Binks, Clint, & Group, 2006; Torres & Yessenia, 2017). The mechanism of these products is based on mechanical entrainment of dead cells and impurities present in the skin, through the solid abrasive particles that compose; decreasing the thickness of the stratum corneum (Torres & Yessenia, 2017). Other functions of the exfoliating creams are as follows: removing dirt from the pores, preventing the formation of pimples, and improve the efficiency of any subsequent cosmetic treatment because it favors the penetration of active compounds (Azcona, 2006; Garrote & Bonet, 2008; Ribeiro et al., 2013).

Given the above, the main goal of this research was the development of an exfoliating body cream using the SCG, in addition to evaluating the effect of the SCG on the rheological, sensory and antioxidant properties of the exfoliating cream. The intention was to investigate an alternative for the use of both the antioxidant properties and the particle size of the coffee ground, which favors the exfoliation of the skin. This study is also a contribution to the reduction of environmental problems, generated by the coffee industry in Colombia and the world.

2 | METHODOLOGY

2.1 | Materials and methods

2.1.1 | Materials

SCG was obtained from the daily production of a cafeteria of the University of Antioquia in the city of Medellín, Colombia. For the preparation of the cream, the following raw materials were used: stearic acid, dimethicone–cyclomethicone, sodium nipagin-bronidox (Chemicals J and M, Medellín, Colombia); ethamin-triethanolamine, cetyl alcohol, lanolin, mineral oil and glycerin (all pharmaceutical grades; Quimitintas, Medellín, Colombia). The reagent of folin–Ciocalteu (2.0 N) (Darmstadt, Germany), Gallic acid, 2,2′-azino-bis- (3-ethylbenzothiazolin-6-sulfonic acid) (ABTS) (Sigma-Aldrich Chemicals, Oakville, ON, Canada); Trolox (6-hydroxy-2,5,7,8-tetramethyl-chroman-2-carboxylic acid) MP Biomedical (Illkirch-Graffenstaden, France) and solvents such as methanol, acetone Merck (Germany).

2.2 | Convective drying

The drying process was carried out in a tray-type convection dryer, which consists of a fan coupled to an electrical resistance for air heating, which passes through a tunnel of 3 m in length. The weight change over time was measured with a balance vector S-type scale, 5AX797, with an error of ± 0.1 g. The drying conditions were of 60°C and an air velocity of 1.5 m/s, the area of the dryer tray was 21.5 × 9.2 cm, with a thickness of 1 cm. Drying was carried out in a time of 6 hr.

2.3 | Physicochemical characterization of the spent coffee ground

Moisture, lipid content, ashes, protein and total nitrogen of the SCGs they were determined in accordance with the AOAC 2005 methodology. Carbohydrates were estimated by difference. All results were expressed in grams per gram of dry solid.

2.4 | Formulation and preparation of the exfoliating cream

For the elaboration of the exfoliating cream with SCG, it was made according to the methodology of Caicedo (2013). The preparation of the cream was made in two phases. The first phase, the oily phase, consisting of the mixture of cetyl alcohol, stearic acid and lanolin, which was produced at 70°C with slow stirring until a homogeneous mixture was obtained, and the second phase, the aqueous phase, constituted by water at 70°C, glycerin, dimethicone, and crystal oil. Subsequently, at 70°C and with constant agitation the oil phase was added to the aqueous phase and the ethamin was incorporated, later at 40°C the sodium nipagin was incorporated; finally, different percentages of SCG (4–6–8%) were added to the cream, the creams were stored in refrigeration (4 ± 0.5°C) until analysis.

2.5 | Determination of antioxidant activity and phenolic compounds

2.5.1 | Extraction of the samples

The extraction and measurement of the antioxidant compounds were carried out according to the methodology described by Contreras-Calderón et al. (2016) with some modifications. One 1 g of each cream exfoliating was added 6 mL of a solution (70:30) water-acetone, which was stirred for 45 min; the samples were centrifuged (C-28A, BOECO, Hamburg, Germany) at 5000 rpm for the period of 20-min, from there, the supernatants were filtered in 10 mL volumetric balloons. The procedure was repeated with the acetone-water solution. Finally, the samples were taken to the water with distilled water; the samples are stored in refrigeration at 7 ± 0.5°C and protected from light until they were analyzed.

2.5.2 | ABTS assay

ABTS method 2,2′-azino-bis-(3-ethyl-benzothiazoline-6-sulfonic acid), was made under the methodology described by Contreras-Calderón et al. (2016), with some modifications. A hundred microliter of the extract was diluted in 4,900 μL of distilled water, from each of the dilutions, an aliquot of 100 μL, was taken to which 1,000 μL of the ABTS radical was added, subsequently, it was taken to a Maria bath (HB 10 CS1, IKA Staufen, Germany) at 30°C for 30 min. Finally, the absorbance of each sample was measured at a wavelength of 730 nm with a spectrophotometer (UV-3300, Mapada Instruments, Shanghai, China).

2.5.3 | Measurement of the total content of polyphenols

The measurement of the polyphenols was done under the methodology described by Duarte et al. (2017), 20 μL of the extract was diluted in 1,580 μL of distilled water, subsequently, 100 μL was given of Folin–Ciocalteau reagent; after 2 min, 300 μL of sodium carbonate was added (20 g/100 mL). The mixture was stored in the dark for 1 hr. The absorbance of the solution was determined with a spectrophotometer (UV-3300 Mapada Instruments, Shanghai, China), at 725 nm, and the absorbance was compared with a calibration curve for gallic acid.

2.6 | Determination of pH

Sample pH was measured with the methodology described by Isabel Andueza and Cabrera (2014), by preparing a solution of 2 g of cream with 40 mL of distilled water and with a pH meter (HI 8424, Hanna Instruments, Ciudad de México, México) at 25°C.

2.7 | Luminosity analysis

The determination of the color parameters was carried out according to the methodology described by Contreras-Calderón et al. (2016), where the luminosity (L) was determined under the CIELab methodology with a spectrophotometer (SP62, X-RITE, Grand Rapids, MI) with an angle D65. An abundant quantity of cream was placed in the center of a petri dish evenly spread.

2.8 | Texture analysis

For texture analysis, the methodology of Gilbert, Picard, Savary, and Grisel (2013), was followed with some modifications, the parameters of adhesiveness and cohesiveness of all the creams was determined in a texturometer (EZ-SX; Shimadzu, kioto, Japón) with a cell load of 5 kg, probe cylindrical p/25, pretest speed 100 mm/min, test speed 40 mm/min and speed posttest 70 mm/min.

2.9 | Measurement of exfoliating capacity

For the measurement of exfoliating capacity, the methodology described by Torres and Yessenia (2017), with some modifications. For the analysis of exfoliating capacity, a mexameter (MX 16, Courage+Khazaka electronics, Köln, Germany) was used, which measures the melanin and hemoglobin in the skin. For the exfoliation test, volunteers participated, to which three points were marked on the forearms; to perform the exfoliation and proceeded as follows: The initial melanin was measured in both arms, the creams were applied and the exfoliation was followed for ~1 min, it was concluded with water rinse and the melanin was measured again skin. To determine the percentage of exfoliation of the cream, Equation (1) was used. Where, M is the value of melanin.

$$\%Decrease\ Melanin = \frac{M_i - M_f}{M_i} \times 100 \quad (1)$$

2.10 | Rheological profile, viscosity, and stability analysis

The analysis of stability (centrifugation and thermal stress) and rheological profile were made under the methodology described by Lillini, Pasquali, Pedemonte, Bregni, and Lavaselli (2016) with some modifications.

2.10.1 | Rheological profile and viscosity

The determinations were made in triplicate at 25 ± 0.5°C with a brand viscometer (DV-II Brookfield, Middleboro, MA); a spindle number six was used, the readings were recorded at speeds that varied between 0.8 and 100 rpm.

2.10.2 | Centrifuging

A centrifuge (C-28A, BOECO, Hamburg, Germany) was used, 5 g of each emulsion was centrifuged for 30 min at 3000 rpm.

2.10.3 | Thermal stress

Consecutive storage was carried out for 48 hr, to each of the following temperatures: 40 ± 2°C and 7 ± 2°C, in a drying and heating oven (Model FD 56, Binder, Tuttlingen, Germany) At the end of the trial, samples were observed with the naked eye to detect phase separation.

2.11 | Zeta potential

Zeta potential measurements were made according to the methodology of Sanín (2017), 130 mg of each sample was weighed and dissolved in 20 mL of Milli Q water: subsequently, 50 μL of this solution was drawn and diluted in 1 mL with Milli Q water. With this last dilution, the measurements were carried with a Zeta-sizer (NANO ZSP, Malvern Panalytical, Malvern, UK).

2.12 | Microbiological analysis

For the coliform count and *Escherichia coli*, AOAC 991.14 was carried out under the AOAC method. Mold and yeast count were carried out with the horizontal method for enumeration of yeasts and molds (Technique of colony count in products with water activity higher than 0.95). ISO 21527-1:2008 and finally the mesophilic aerobic count was performed with the AOAC 2015.13 method.

2.13 | Sensory analysis

The sensory analysis of the sample was done according to Colombian Technical Standards 3501, 4489 and Colombian Technical Guides 165,226 and 232; in which the texture and flavor descriptors of the samples are analyzed. The texture profile describes the mechanical, geometric, and surface attributes of the product. We identified and selected the set of descriptors that gave the maximum information about the texture attributes of the product, in order to establish the profile of texture. The consensus method was used, with six trained judges and an age range of 25 to 60 years, assessing intensities on a rating scale of one (hardly recognizable) to five (intense) for all descriptors; except for the general quality, where scale is used from one to three, where three is high and one is low. In the case of the odor profile analysis, the most relevant odor notes of the product and are quantified on a rating scale of one (barely recognizable) to five (intense) for all descriptors.

2.14 | Experimental design

A randomized free experimental design was carried out with three treatments, where the factor of each treatment was the percentage of coffee erases (4, 6, and 8%), with four replicates. Variable responses of the experiment for each treatment were as follows: texture, viscosity, color, pH, exfoliating and antioxidant capacity. The data obtained were analyzed through an ANOVA table, to verify the existence of significant differences. In addition, a Fisher low significant difference (LSD) analysis to find the differences between treatments, with $\alpha = 0.05$. The data were analyzed using the STATGRAPHICS Centurion XVI software (Statistical Graphics Corporation, Version 16.0.07, Rockville, MD). For the selection of the best formulation of the exfoliating cream, was made based on the results of the experimental design; based on the highest content of antioxidants, polyphenols, and exfoliating capacity.

3 | RESULTS

3.1 | Drying process

Figure 1, shows the results obtained for the drying by convection of the SCG, at a temperature of 60°C. In addition, the variation of

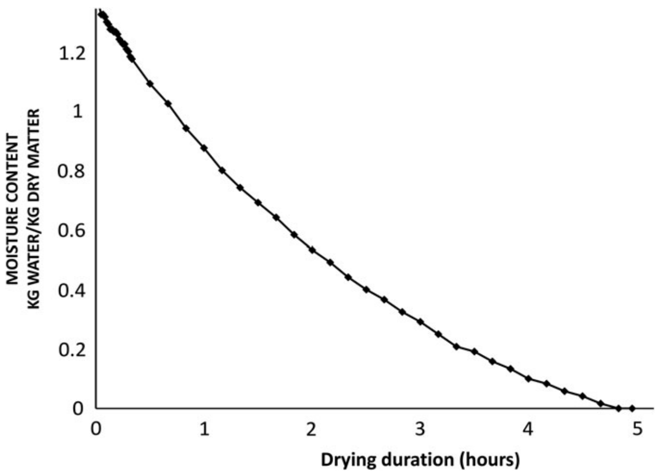

FIGURE 1 Effect of temperature on the drying curve of SCG

moisture content is observed for the drying process of coffee residues, which has a typical behavior of these processes is similar with that reported by Sahylin et al. (2013); Sandoval, Rodríguez, Méndez, and Sánchez (2006); Tinoco and Ospina (2010); in Figure 1, it is possible to observe that the moisture of the SCG varied from 5 to 3, Kg water for Kg dry matter in the drying time, the drying process allowed to obtain a final moisture of 5% (Table 1), this value is similar to that T1 obtained by Mussatto, Ballesteros, Martins, and Teixeira (2011).

3.2 | Physicochemical characterization of the spent coffee ground

In Table 1 the results are obtained for the physicochemical characterization of the dried SCG. As can be seen in Table 1, the protein content presented a value of 12.84%, while the ashes were found in 1.93%, and total carbohydrates with 72.45%. Similar values of protein and ash for coffee waste have been reported by Mussatto, Carneiro, et al. (2011); however, the values found here for carbohydrates are higher than those found by Mussatto, Carneiro, et al. (2011). These differences can be due to the extraction conditions for the preparation of the drink and to the coffee variety (Ballesteros, Teixeira, & Mussatto, 2014). The nitrogen content was 2.05%, similar to that reported by Silva, Nebra, Machado Silva, and Sanchez (1998) which was 2.0%. The fat content obtained for the SCG is in the range reported by Jenkins, Stageman, Fortune, and Chuck (2014), for waste coffee grounds which ranges from 7 to 13%. These compounds present in the SCG are of

TABLE 1 Physicochemical characterization of the dry SCG sample

Parameter	Grams/100 g dry solid
Moisture	5.50 ± 0.07
Ash	1.93 ± 0.01
Total fat	12.77 ± 0.04
Total nitrogen	2.05 ± 0.02
Total protein (N × 6,25)	12.84 ± 0.12
Total carbohydrates	72.45 ± 0.10

TABLE 2 Results obtained for each formulation

No	SCG%	Antioxidants (μMol ETrolox/g de SS)	Polyphenols (mg EAG/g de SS)	Luminosity L[a]	pH	Adhesiveness (J)	Cohesiveness	Exfoliation %
1	8	96.03	1,230.50	45	7.2	−0.0025	0.66	1.92
2	6	101.92	1,547.77	45	7.7	−0.0017	0.62	2.05
3	6	112.70	1,131.33	43	7.7	−0.0016	0.61	1.15
4	4	89.31	1,407.61	48	7.9	−0.0016	0.61	1.35
5	4	96.94	1,091.98	47	7.8	−0.0017	0.63	0.41
6	8	82.81	1,042.63	43	7.4	−0.0023	0.64	1.07
7	4	92.80	1,238.9	45	7.9	−0.0015	0.61	1.35
8	8	80.42	1,276.41	41	7.4	−0.0023	0.58	1.76
9	8	69.23	1,235.74	41	7.3	−0.002	0.63	0.77
10	6	97.64	1,407.9	46	7.4	−0.002	0.6	1.42
11	4	56.31	1,226.6	47	7.9	−0.002	0.68	1.41
12	6	128.15	1,075.67	42	7.6	−0.0018	0.63	0.59

[a]SS: Dry Solid.

great importance as they can be used in different products, as reported by Ribeiro et al. (2013) and Ribeiro et al. (2018) has used the phenolic compounds and lipid content present in the coffee ground in the elaboration of cosmetic products.

3.3 | Physical and antioxidant properties of exfoliating creams with SCG

Table 2 shows the results obtained for each formulation, based on the variables analyzed, it can be observed that the antioxidant

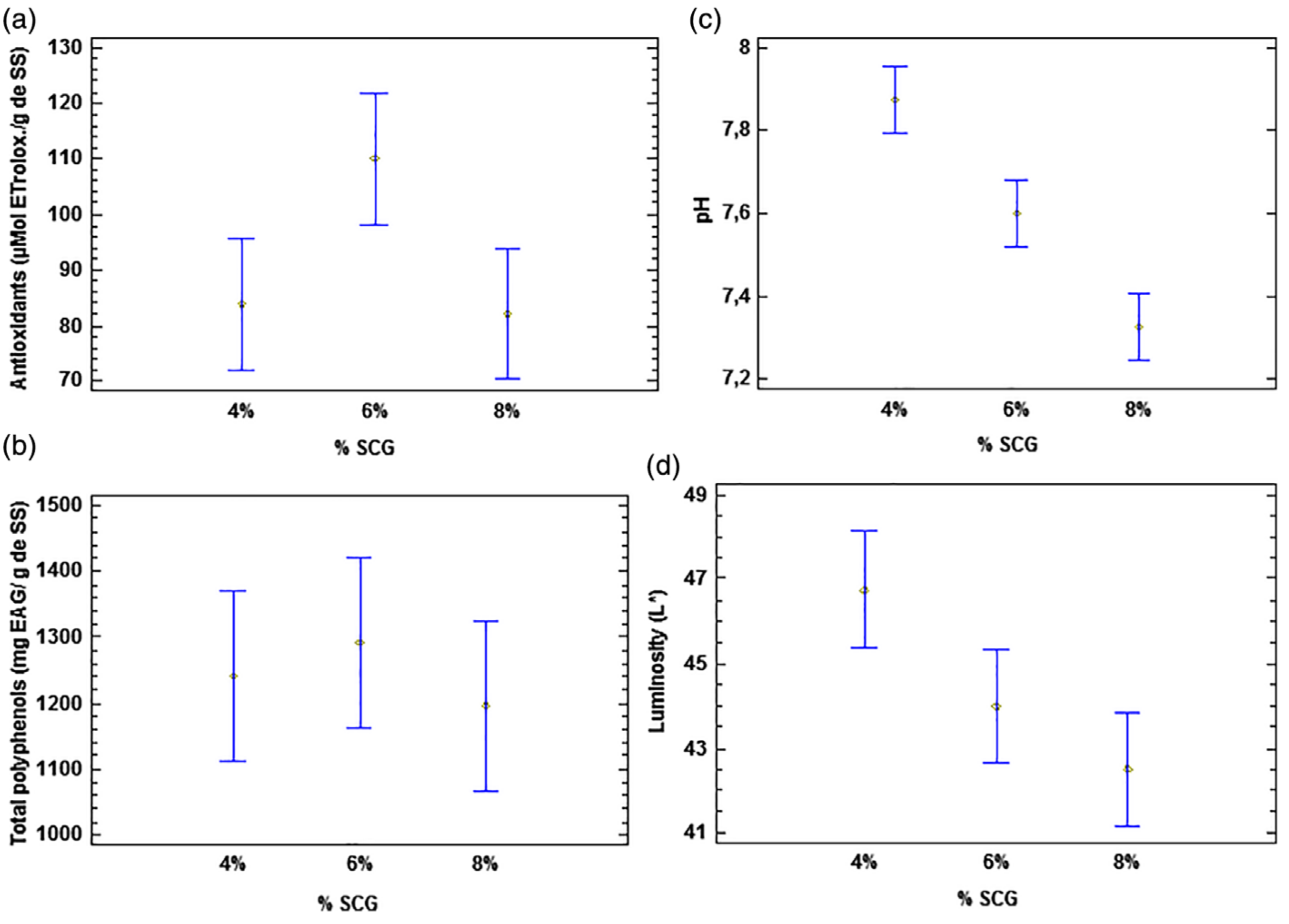

FIGURE 2 Mean graph and LSD intervals 95% for the variables of antioxidants (a), polyphenols (b), pH (c), and luminosity (d)

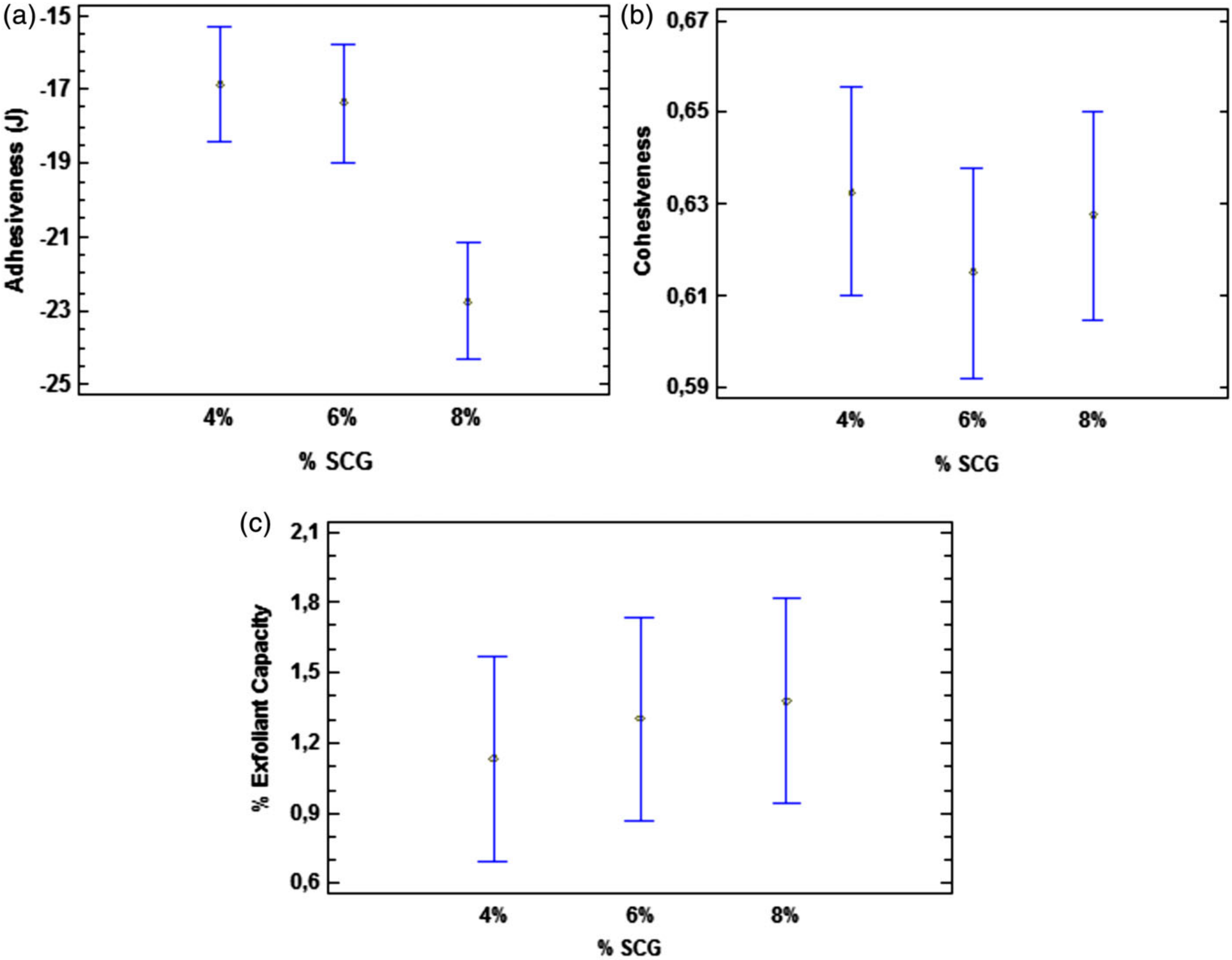

FIGURE 3 Mean graph and LSD intervals 95% for the variables adhesiveness (a), cohesiveness (b), and exfoliating capacity (c)

activity reported values that ranged between 97.64 and 128.15 μMol ETrolox/g of SS, while the phenolic compounds varied between 1,075.67 and 1,547.77 mg EAG/g of SS, these values are

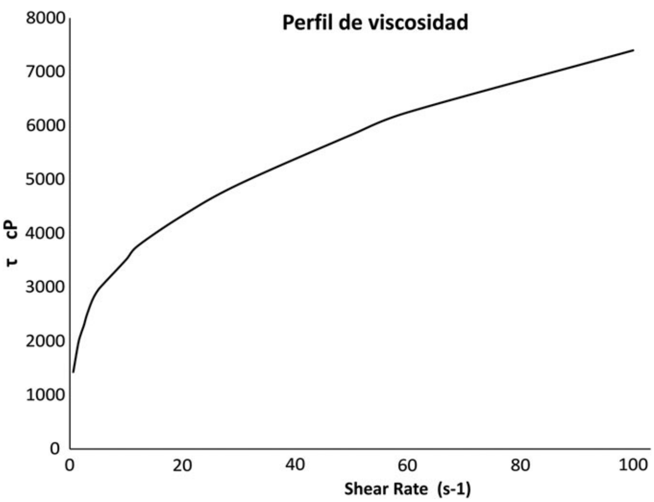

FIGURE 4 Rheological profile of the formulation with 6% of SCG

similar to those found by Contreras-Calderón et al. (2016) for coffee beans.

These results are significant because the SCG is a by-product obtained during the preparation of the coffee beverage. With respect to the statistical analysis, the content antioxidant was significantly affected ($p < .05$) by percentage of SCG, being higher for the formulation with 6% (Figure 2a). This is possibly due to the variation in the content of the different components in the SCG, which can vary according to the method of extraction of the coffee beverage (Ballesteros, Ramirez, Orrego, Teixeira, & Mussatto, 2017). Finally, Low, Rahman, and Jamaluddin (2015), reported that the antioxidant content in cosmetic products favors the increase in the sun protection factor. The above being an important result for the product obtained here.

With respect to the pH analysis, the samples showed values close to neutrality, these results being appropriate for these kinds of products (Mujica et al., 2010), similar values were reported by Villagrán and Mariela (2014), in an exfoliating cosmetic product. However, the percentage of SCG had a significant incidence on the pH of exfoliating cream ($p < .05$); it can be observed from Figure 2c that the cream with

TABLE 3 Microbiological analysis of the formulation with 6% of spent coffee ground

Analysis	Result (cfu/g)
Escherichia coli count	<10
Mold and yeast count	<10
Mesophilic aerobic count	<10

the lowest pH value was the one that contained 8% of SCG; this is due to the fact that the SCG has acid characteristics (Palomino, Lady, & Del Bianchi, 2015), which is evidenced by the decrease in the pH value. On the other hand, the luminosity analysis (L), showed values that varied between 41 and 48; it is observed from Figure 2d that the formulations present significant differences ($p < .05$); being the 4% that presents the greatest luminosity; this it is because it has less amount of SCG, which gives it less color compared to that containing 8%. The color of the coffee ground develops during the caramelization of the carbohydrates present in coffee during roasting (Contreras-Calderón et al., 2016).

With respect to the parameters of texture adhesiveness and cohesiveness of the exfoliating cream, the values oscillated between −0.0025 and −0.0017 J, and 0.58 and 0.68, respectively; being similar to the value found in the measurement of a commercial cream for the cohesiveness parameter, which was 0.62142, while for the adhesiveness, the formulations showed higher values than for the commercial cream, which was −0.0006 J, these texture values indicate that the cream obtained here has more adhesion to the skin, in relation to the evaluated commercial cream, which could be an indication of greater exfoliation capacity. For the analysis of exfoliating capacity, the three formulations showed similar behavior, it can be observed in Figure 3c, also it is observed that there are no significant differences between them ($p > .05$). On the other hand, we obtained data similar to those reported by Torres and Yessenia (2017), these values show the effectiveness of the coffee ground as a mechanical agent for exfoliation.

3.3.1 | Selection of the best formulation

Finally, after evaluating the behavior of the three formulations (4, 6, and 8%) depending on each response variable, it found that the one that has the best performance based on the content of antioxidants and polyphenols was the one that contained 6% of SCG, which was analyzed the rheological profile, stability assessment, microbiological, and sensory analysis.

3.4 | Rheological profile and viscosity

Figure 4 shows the rheological profile obtained for the formulation of 6% coffee grounds. The viscosity profile of the formulation was made with 6% SCG, which had values of 35.82 Pa.s and behaved as a non-Newtonian fluid, that is, there is no constant relationship between the viscosity and the gradient of speed, so it is necessary to apply an initial shear to the system to start flowing (Pérez-Bueno, Rodriguez-Perdomo, Morales-Lacarrere, Soler-Roger, & Martín-Viaña, 2011), this results in a typical

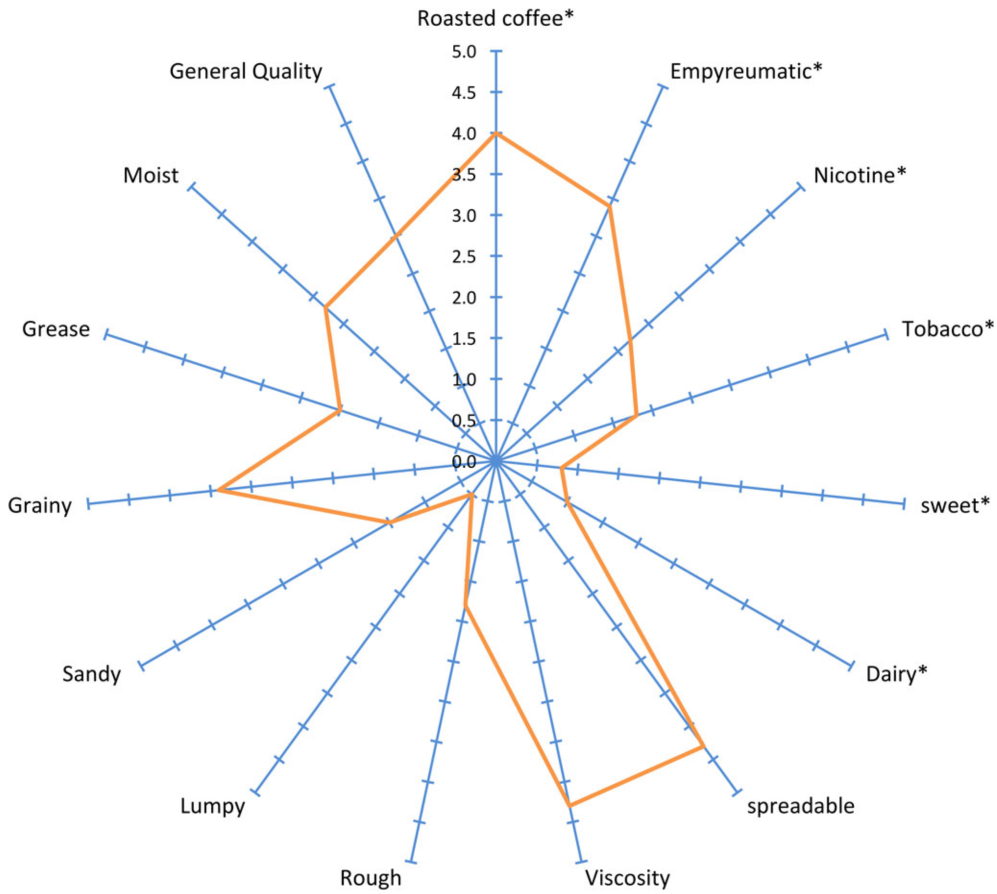

FIGURE 5 Odor and texture profile of the exfoliating cream with 6% SCG

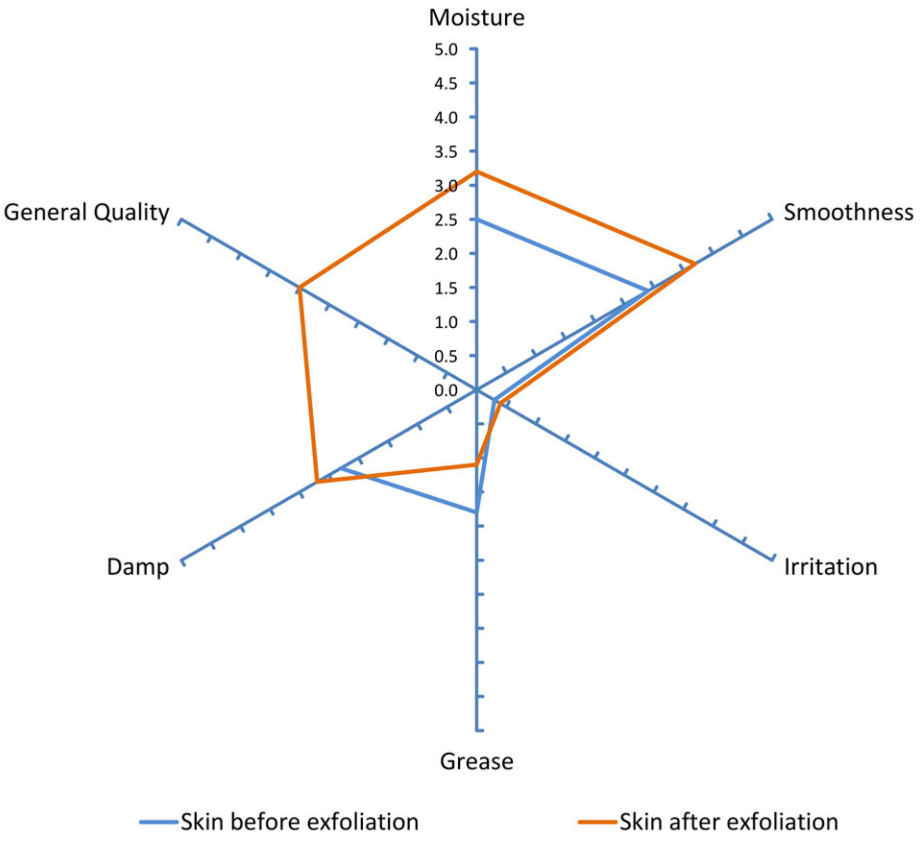

FIGURE 6 Profile of the skin before (blue) and after the exfoliation (orange) with the exfoliating cream with 6% of SCG

pseudoplastic behavior of the emulsions (Rojas Gallardo, 2012), which exhibit high viscosity and internal resistance to flow in the resting state.

3.5 | Stability and zeta potential analysis

In the centrifugation test, after submitting the sample at 3000 rpm for 30 min, there was no separation of the phases, similar behavior was observed in the thermal stress test in which the cream did not show changes during the whole process.

The zeta potential was analyzed to determine the stability of the emulsion. The zeta potential value obtained for the cream on day zero was -35.93 ± 8.25 mV, on the other hand, the value presented for the cream subjected to thermal stress during 8 days, was -34.6 ± 10.2 mV both values reflect the stability of the emulsion even when subjected to changes in temperature, these stability values of exfoliating creams, similar to those reported by Kosegarten and Jiménez (2012) and Sanín (2017).

3.6 | Microbiological analysis

Table 3 shows the results obtained for the microbiological analysis of the formulation, in which a CFU value <10 was obtained for the count of *E coli*, mesophiles, molds and yeast.

3.7 | Sensory test

As for the sensory analysis, the odor profile of the exfoliating cream, presented descriptors of high roasted coffee, followed by empyreumatics descriptors in moderate intensity with a score of 4.0 and 3.5, respectively. The descriptors to nicotine and tobacco were perceived slightly, also sweet and dairy odors were perceived, shown in Figure 5; however, the descriptors of the odor of the coffee are affected by numerous factors during its processing (Lee, Cheong, Curran, Yu, & Liu, 2015). Regarding the texture profile, the descriptors of spreadability and viscosity were high, with a score of 4.3 for both on a scale of 0 to 5, while the granularity of the exfoliating cream was perceived moderate (3.5). Additionally, the descriptors associated with the grease, rough, sandy, and lumpy textures were slightly perceived with a score of 1.5, 2.0, 1.0, and 0.0, respectively. Finally, the quality of the sample in terms of the texture attributes was 3.0, achieving, the highest score.

On the other hand, for the texture profile of the skin before and after exposure to the coffee exfoliating cream, it is observed that after the exposure to the exfoliating cream the skin presented an increase in wettability, softness, and moist composition of the skin. Regarding the greasy texture of the skin, a decrease was observed and the irritation showed no marked changes, Figure 6. The overall quality of the skin texture after exposure was high (3.0).

4 | CONCLUSION

It was possible to obtain a dry coffee ground by the convective drying process, with satisfactory compositional characteristics that allowed its use in the elaboration of a cosmetic emulsion. The formulations showed a high content of antioxidants and polyphenols, in terms of texture parameters the cream showed good adhesiveness, cohesiveness, and exfoliating capacity. The best design formulation was obtained better behavior in terms of the variables analyzed throughout the process as good sensory quality, showing that it can be a cosmetic product of pleasure for future consumers. Finally, an alternative form was found regarding the use of an agro-industry waste that generates pollution, but which in turn has multiple compounds that can be useful.

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