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ESTERQUAT DERIVED FROM SUNFLOWER OIL WITH DEFINITION AND RETENTION OF CURL IN CONDITIONER FOR HAIR CARE PRODUCTS

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1. Introduction

Consumers are increasingly looking for multifunctional and sustainable products that provide high performance [1].

Among all the diversity, curly hair requires the most care and a greater amount of product applied to obtain a satisfactory result. However, most consumers complain about the appearance of hardness and reduction in volume after applying finishing products, characteristics of cationic surfactants like CETAC and BTAC, not meeting all the necessary requirements for a healthy, shiny, voluminous, frizz-free and soft curl [2].

The objective of this article is to evaluate the application of three different cationic surfactants, including one naturally derived from sunflower oil and two other alternatives commonly used in the market, in a conditioner base on three different hair curvatures, analyzing the frizz, volume, length and number of curls after 8, 24, 48 and 72 hours under controlled temperature and humidity, in order to obtain a conditioning agent that provides definition and retention of curls even after rinsing.

2. Materials and Methods

For this experiment, was used three different hair curls, categorized by Loussouarn (2007):

- Type III – Hair 1
- Type V – Hair 2
- Type VI – Hair 3

Before applying the treatments, all hair tresses were washed with non-conditioning shampoo (LESS 20%) to remove residues: 0.3 mL/g of hair was applied to the hair tresses and spread on wet hair. The hair tress was massaged 6 times from the roots to the ends and then rinsed with running water (5 ± 1 L/min and 35 ± 2 °C) for 30 seconds. Then the control and treatments were applied as described below.

The water excess was removed and then, it was applied to the hair tress 0.4 mg of conditioner (table 1) per hair gram and spread on wet hair. For better product distribution, the hair tress was massaged 6 times from the roots to the tips and left action for 2 minutes. Then, the hair tress was rinsed for 30 seconds in running water (5 ± 1 L/min; 35 ± 2 °C). This procedure was repeated for each conditioner sample.

Table 1. Hair conditioner formula. All cationics surfactants were applied 2,0% of active matter.

Phase	INCI Name	T1 Esterquat	T3 CETAC	T4 BTAC	T5 Standard
		% (w/w)	% (w/w)	% (w/w)	% (w/w)
A	Deionized Water	93,15	88,48	92,79	95,15
	Disodium EDTA	0,05	0,05	0,05	0,05
B	Cetearyl Alcohol	3,50	3,50	3,50	3,50
	Ceteareth-20	0,50	0,50	0,50	0,50
	Dioleoylethyl Hydroxy-ethylmonium Methosul-fate (and) Sunflower Seed Oil Glycerides	2,00			
	CETAC		6,67		
	BTAC			2,36	
C	Benzyl Alcohol (and) Dehyacetic Acid	0,80	0,80	0,80	0,80

After cleaning, the tresses were photographed **(T0)** and then the respective treatments were applied. After the application of the control and treatment the hair tresses were styled to form curls by finger coil technique.

Six hair tresses were used for each treatment, as described as below:

- • **Treatment Group (TRT 01):** Esterquat from sunflower oil
- • **Treatment Group (TRT 03):** CETAC
- • **Treatment Group (TRT 04):** BETAC
- • **Treatment Group (TRT 05):** Standard

After styling, the tresses were maintained in an environmental chamber to dry with controlled temperature and relative humidity (85 ± 5 %RH; 22 ± 2°C) and photographed at the following timepoints:

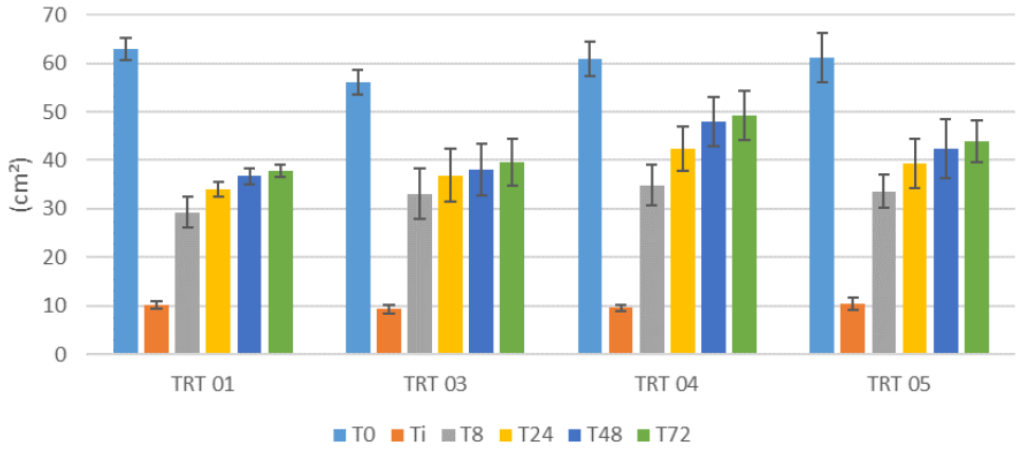
- • Ti: Immediately after applying the treatment and styling.
- • **T8**: After 8 hours of drying in the environmental chamber.
- • **T24**: After 24 hours of drying in the environmental chamber.
- • **T48**: After 48 hours of drying in the environmental chamber.

- • **T72**: After 72 hours of drying in the environmental chamber.

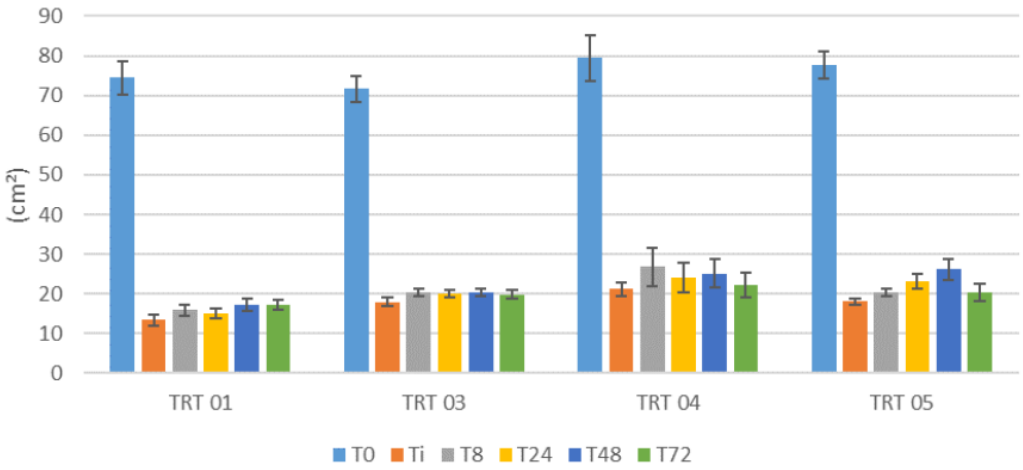
For each timepoint, the images were analyzed by ImageJ® where the number of curls obtained in each tress was counted and compared between the treatments.

3. Results

1.Frizz Analysis

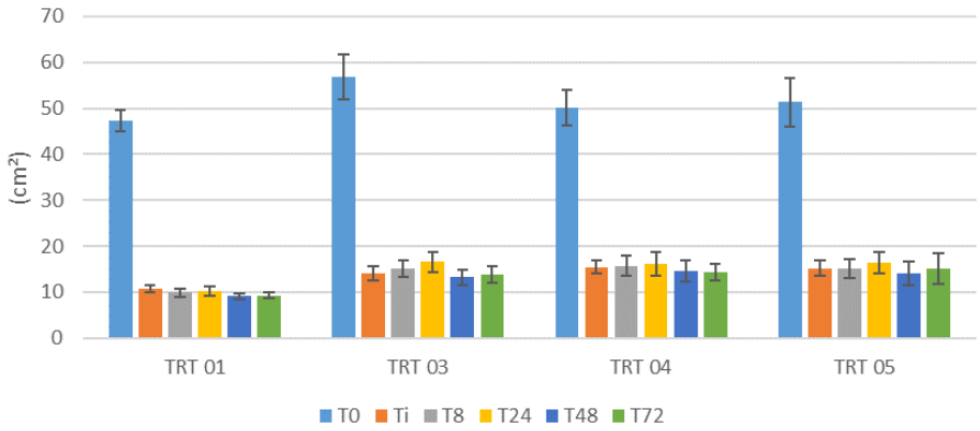


Graph 1. Comparative graph of frizz analysis by treatment (Hair 1 – Type III). No significant differences were observed between treatments for frizz in T0, Ti, T8, 724 and T48. The frizz was significantly higher for the TRT 04 treatment in comparison with the TRT 01 treatment at time T72.



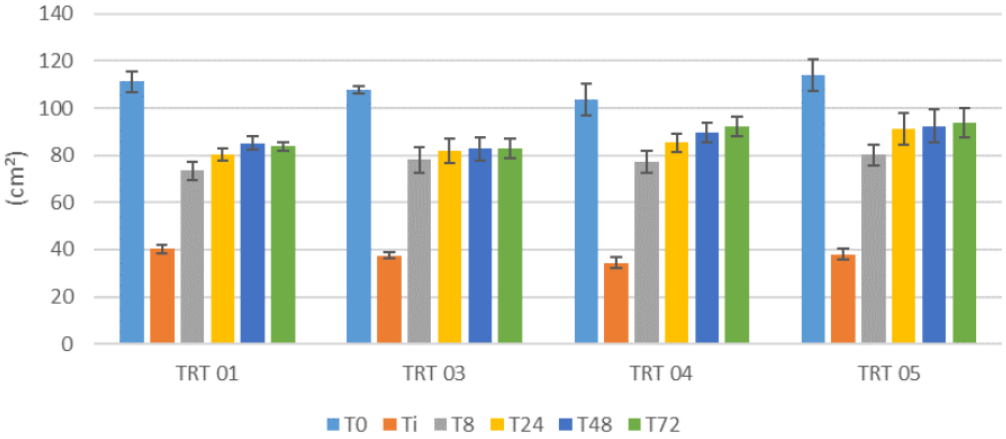
Graph 2. Comparative graph of frizz analysis by treatment (Hair 2 – Type V). The frizz of the hair was significantly higher for treatments TRT 03, TRT 04 and TRT 05 in comparison with treatment TRT 01 at timepoint Ti. The frizz of the hair was significantly higher for treatment TRT 04 in comparison with treatment TRT 01 at timepoint T8. The frizz of the hair was significantly higher for treatments TRT 04 and TRT 05 in comparison with treatment TRT 01

at timepoint T24 and T48. No significant differences were observed between treatments for frizz of the hair in T0 and T72.

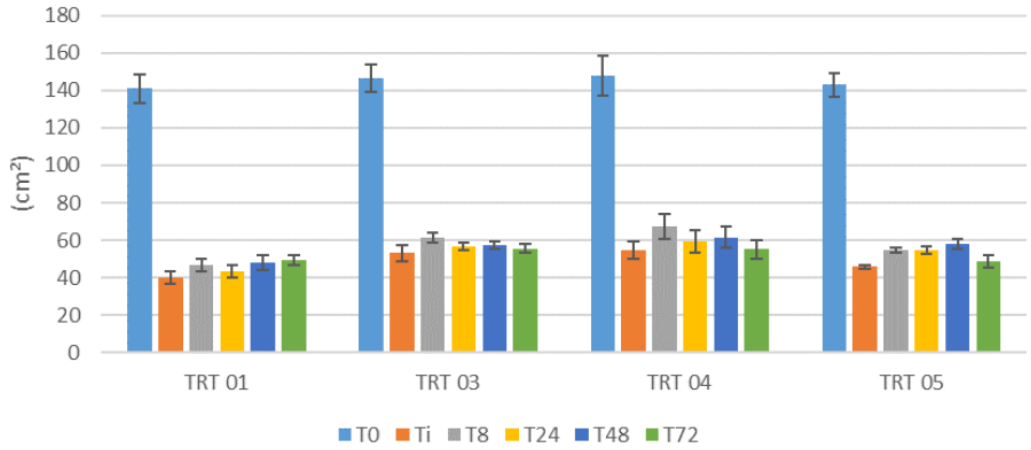


Graph 3. Comparative graph of frizz analysis by treatment (Hair 3 – Type VI). No significant differences were observed between treatments for frizz in T0.The frizz of the hair was significantly higher for treatments TRT 04 and TRT 05 in comparison with treatment TRT 01 at timepoint Ti.The frizz of the hair was significantly higher for treatments TRT 03, TRT 04 and TRT 05 in comparison with treatment TRT 01 at timepoint T8 and T24. The frizz was significantly higher for treatment TRT 04 in comparison with treatment TRT 01 at timepoint T48.The frizz was significantly higher for treatments TRT 04 and TRT 05 in comparison with treatment TRT 01 at timepoint T72.

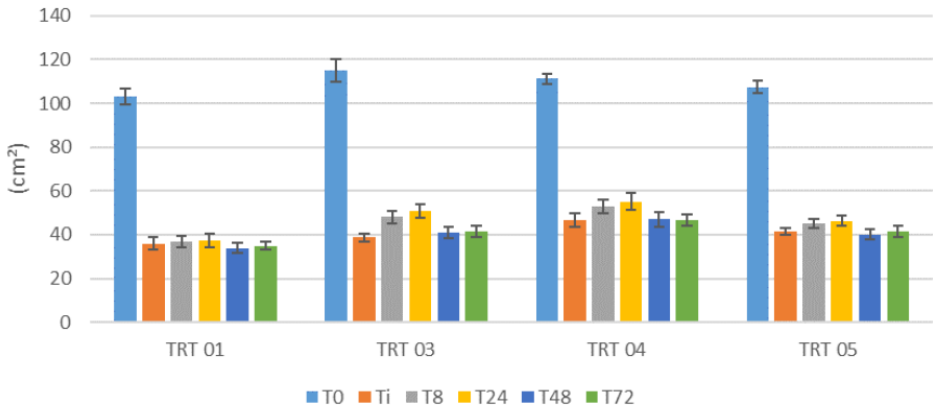
2. Volume Analysis



Graph 4. Comparative graph of volume analysis by treatment (Hair 1 – Type III). The volume was significantly higher for the TRT 01 treatment in comparison with the TRT 04 treatment at timepoint Ti. No significant differences were observed between treatments for volume in T0, T8, T24, T48 and T72.

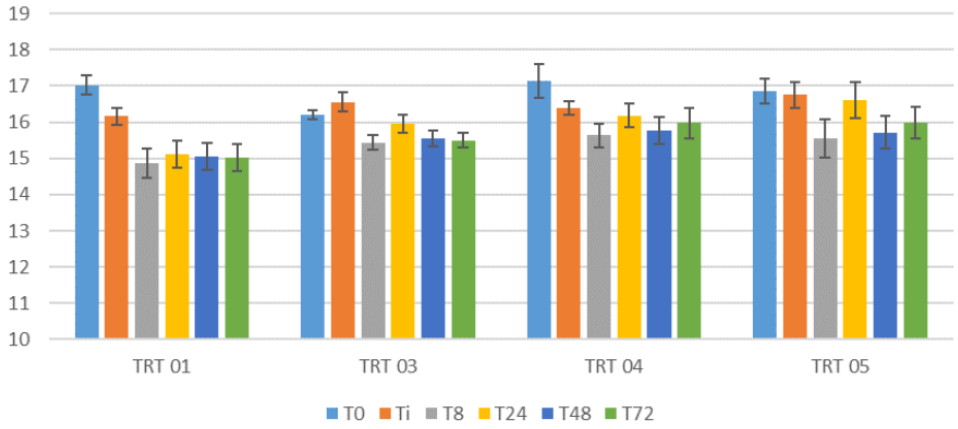


Graph 5. Comparative graph of volume analysis by treatment (Hair 2 – Type V). The volume was significantly higher for treatments TRT 03 and TRT 04 in comparison with treatment TRT 01 at timepoint Ti and T24.The volume was significantly higher for treatment TRT 04 in comparison with treatments TRT 01 and TRT 05 at timepoint T8.The volume was significantly higher for treatment TRT 03 in comparison with treatment TRT 01 at timepoint T8. The volume was significantly higher for treatment TRT 04 in comparison with treatment TRT 01 at timepoint T48. No significant differences were observed between treatments for volume in T0 and T72.

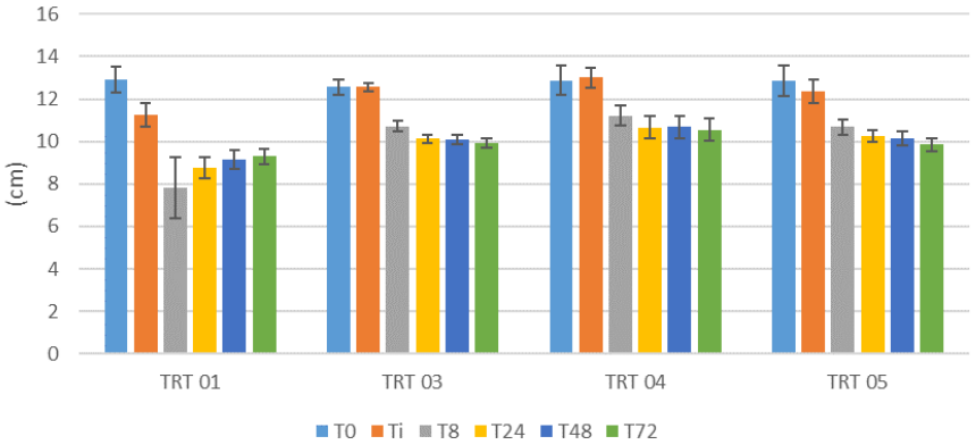


Graph 6. Comparative graph of volume analysis by treatment (Hair 3 – Type VI). The volume was significantly higher for treatment TRT 03 in comparison with treatment TRT 01 at timepoint T0. The volume was significantly higher for treatments TRT 04 in comparison with treatments TRT 01 and TRT 03 at timepoint Ti. The volume was significantly higher for treatments TRT 03 and TRT 04 in comparison with treatment TRT 01 at timepoint T8. The volume was significantly higher for treatments TRT 03 and TRT 04 in comparison with treatment TRT 01 at timepoint T24. The volume was significantly higher for treatments TRT 04 in comparison with treatment TRT 01 at timepoint T48. The volume was significantly higher for treatments TRT 04 in comparison with treatment TRT 01 at timepoint T72.

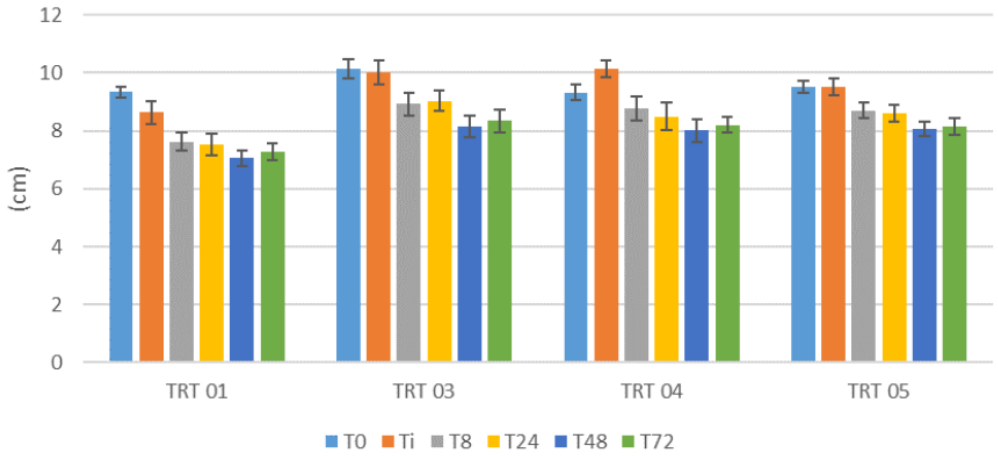
3. Length Analysis



Graph 7. Comparative graph of length analysis by treatment (Hair 1 – Type III). The length of the hair was significantly higher for TRT 04 treatment in comparison with the TRT 03 treatment at timepoint T0. The length of the hair was significantly higher for the treatments TRT04 and TRT05 in comparison with treatment TRT 01 at timepoint T24. No significant differences were observed between treatments for length of the hair in Ti, T8, T48 and T72.

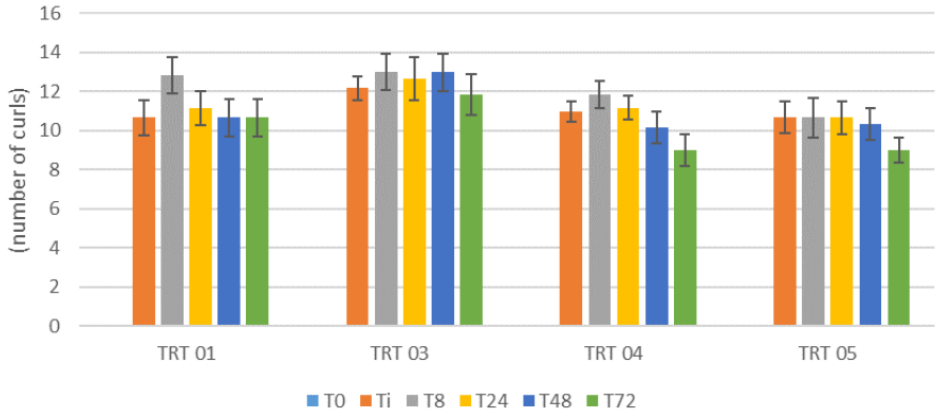


Graph 8. Comparative graph of length analysis by treatment (Hair 2 – Type V). No significant differences were observed between treatments for length in T0. The length was significantly higher for treatments TRT 03 and TRT 04 in comparison with treatment TRT 01 at timepoint Ti. The length was significantly higher for treatments TRT 03, TRT 04 and TRT 05 in comparison with treatment TRT 01 at timepoint T8.The length was significantly higher for treatments TRT 03, TRT 04 and TRT 05 in comparison with treatment TRT 01 at timepoint T24. The length was significantly higher for treatments TRT 04 in comparison with treatment TRT 01 at timepoint T48. The length was significantly higher for treatments TRT 04 in comparison with treatment TRT 01 at timepoint T72.

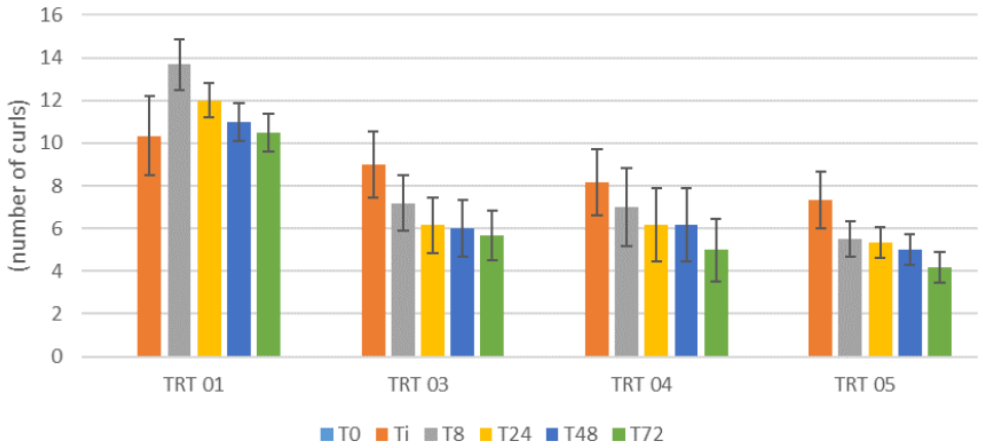


Graph 9. Comparative graph of length analysis by treatment (Hair 3 – Type VI). The length of the hair was significantly higher for treatment TRT 03 in comparison with treatments TRT 01 and TRT 04 at timepoint T0. The length of the hair was significantly higher for treatments TRT 03 and TRT 04 in comparison with treatment TRT 01 at timepoint Ti and T72. The length of the hair was significantly higher for treatments TRT 03, TRT 04 and TRT 05 in comparison with treatment TRT 01 at timepoint T8. The length of the hair was significantly higher for treatments TRT 03 and TRT 05 in comparison with treatment TRT 01 at timepoint T24 and T48.

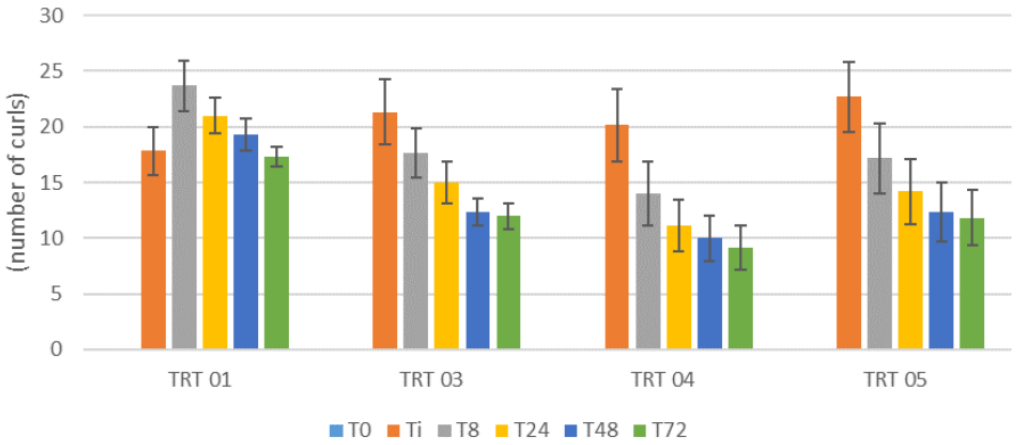
4. Numbers of Curls Analysis



Graph 10. Comparative graph of number of curls analysis by treatment (Hair 1 – Type III) . The difference (delta) in the number of curls between timepoints T8-Ti was significantly higher for the TRT 01 treatment in comparison with the TRT 05 treatment. No significant differences were observed between treatments for the difference (delta) in the number of curls between timepoints T24, T48 and T72 - Ti.



Graph 11. Comparative graph of number of curls analysis by treatment (Hair 2 – Type V). No significant differences were observed between treatments for number of curls in Ti. Number of curls was significantly higher for treatment TRT 01 in comparison with treatments TRT 03, TRT 04 and TRT 05 at timepoint T8, T24, T48 and T72.



Graph 12. Comparative graph of number of curls analysis by treatment (Hair 3 – Type VI). No significant differences were observed between treatments for number of curls in Ti. Number of curls was significantly higher for treatment TRT 01 in comparison with treatment TRT 04 at timepoint T8. Number of curls was significantly higher for treatment TRT 01 in comparison with treatments TRT 04 and TRT 05 at timepoint T24. Number of curls was significantly higher for treatment TRT 01 in comparison with treatments TRT 03, TRT 04 and TRT 05 at timepoint T48 and T72.

5. Images of All Treatments

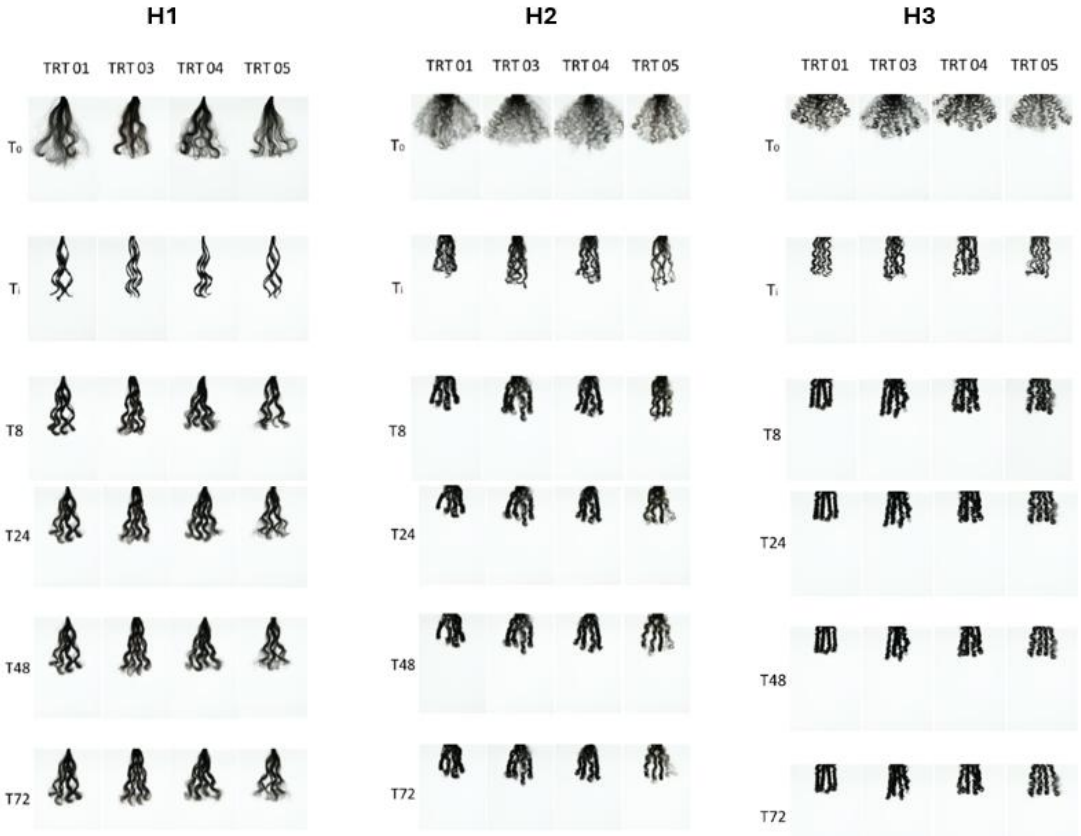


Figure 1. Comparative of all treatments.

4. Discussion

According to the results of statistical comparisons between products in Hair 01, less significant differences were obtained due to the inherent variability of the comparison between treatments, which weakens the statistical power of the comparison. However, the investigational product TRT 01 proved to be more effective than the others as it showed improvements in three of the parameters analyzed, reducing frizz, volume and hair length from 8 to 72 hours after applying the product, which was not observed for all products.

According to the results of statistical comparisons between products in Hair 02, the four products analyzed provide definition and retention of curls, since analyzing the individual results per product, all showed a reduction in frizz, volume, length of the hair as well as maintenance of the number of curls for up to 72 hours. However, when comparing treatments, there is a higher effectiveness of the TRT 01 treatment in relation to the other investigational products evaluated, since there was a higher incidence of significant reduction in frizz, volume and length, as well as an increase in the number of curls.

According to the results of statistical comparison between products in Hair 03, the four products analyzed provide frizz and volume reduction up to 72 hours. In terms of length of the hair, except for TRT-04, the products presented a reduction in this parameter up to 72 hours as well, while the number of curls was retained for 72 hours only for TRT01 and TRT05. When comparing treatments, there is a higher effectiveness of the TRT 01 treatment in relation to the other investigational products evaluated, since there was a higher incidence of significant reduction in frizz, volume and length, as well as an increase in the number of curls,

5. Conclusion

The study conducted on performance of cationic surfactants to evaluate the results after conditioner application in hair curls.

In comparison to CETAC and BTAC, the esterquat from sunflower oil (TRT 01) contributes to definition and retention of curls in rinse off hair care products, promoting healthy and soft hair although increase the index of naturality in formulation and helping during the manipulation process being liquid and 100% active matter material.

6. References

1. TRUDEL, R. Sustainable consumer behavior. Consumer psychology review, v. 2, n. 1, p. 85–96, 2019.

2. LOUSSOUARN, G. et al. Worldwide diversity of hair curliness: a new method of assessment. International journal of dermatology, v. 46 Suppl 1, n. s1, p. 2–6, 2007.