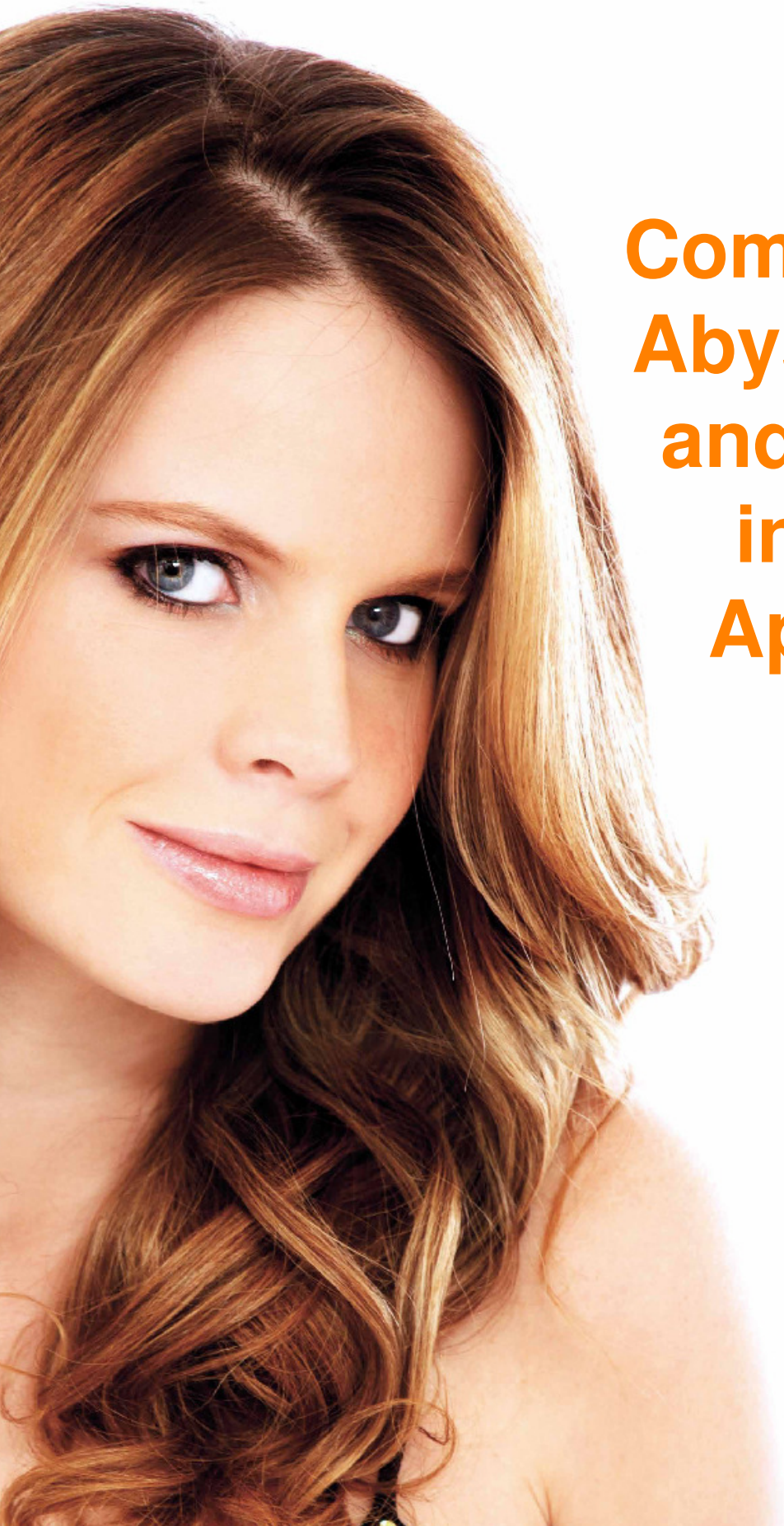


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# Comparison of Abyssinian Oil and Argan Oil in Hair Care Applications

# Introduction

Oils are an essential component to provide natural luster, lubricity and an emollient feeling to hair care products. Therefore different natural oils are commonly used in rinse-off and leave-in products for hair conditioning benefits.

In this report we want to demonstrate the benefits and good performance of using FANCOR® Abyssinian Oil in Hair Care applications. Furthermore we compare this natural oil with the popular Argan Oil, which is known for its conditioning and shine enhancing effect on hair.

TRI Princeton, an independent non-profit scientific research and education institute located in New Jersey, USA and well known in the market for its applied hair science, conducted a study to evaluate the effect of both oils for increasing combability, hair strengthening, anti-breakage and detection of the shine of the hair after treatment.

Based on the results of the study we can claim that FANCOR® Abyssinian Oil has a very good overall performance in all evaluated aspects. It can increase the manageability, shine and strength of the hair. These benefits were displayed to be equal or even better when compared with Argan Oil.

The results of the study show FANCOR® Abyssinian Oil is a comparable substitution for Argan Oil in Hair Care applications.



The *Crambe Abyssinica* is an oilseed crop belonging to the family of Brassicaceae. It is known under the name Abyssinian Plant, Crambe or even Abyssinian mustard. It is an annual plant with a higher resistance against drought in comparison to other oilseed crops due to a long tap root. Only moderate rainfall for growth is necessary. It is native to the Ethiopian Highlands (also known as Abyssinia). Nowadays Abyssinian crops are also successfully cultivated in mediterranean and temperate zones due to their ability to grow even in colder regions. The breeding of this plant has been through natural selection without any genetic engineering. The plant can grow up to 1.5 m depending on the humidity during their growth period and flowering with small, hermaphroditic four-leaved flowers. The Abyssinian plant needs around 50 days until it flowers with an additional 30 days before the crops can be harvested. Therefore a high adaptability of this renewable plant on actual market demand is achievable.



Figure 1. Abyssinian Plants



Figure 2. Argan Tree

The *Argania Spinosa* is a slow-growing tree of the Sapotaceae family exclusively endemic in the southwest of Morocco, the land of the Amazigh (native Berber). The Argan groves cover about 8000 km<sup>2</sup> and are designated to UNESCO Biosphere reserve. The normal life span of an Argan tree, see figure 2, can be more than 200 years and it can actively protect the earth crust against erosion. It can grow to between 8 - 10 meters

high and provides an annual crop only once a year. The fruits are 2 - 4 cm long, oval and containing one very hard nut with mainly one oil-rich seed inside.

The Argan oil extracted from the kernels is used by the natives as edible oil for centuries and became a very popular and expensive oil in the last decade, see reference (1), (2) and (3). The Argan tree is facing trouble in maintaining its integrity and may induce degradation due to the recurrent draughts and forest overuse, see reference (1) and (3).



# Abyssinian Oil and Argan Oil

Natural oils are essential ingredients for formulation chemists. Plant oils are esters of Glycerine and fatty acids which form Triglycerides. Natural oils can also contain various smaller components, such as free fatty acids, Phospholipids, Tocopherols and Hydrocarbons.



Figure 3. Abyssinian Seed

FANCOR® Abyssinian Oil is removed from the *Crambe Abyssinica* seeds using a mechanical crushing process. Elementis Specialties does not use an external heat source to aid the process. The seeds of the Abyssinian Plant, seen in figure 3, are about 3 mm diameter and contain approximately 30 % Abyssinian Oil. Unlike many other oils FANCOR® Abyssinian Oil is not produced via solvent extraction so it is a natural product. This green processing method has enabled Elementis Specialties to gain Ecocert certification status for FANCOR® Abyssinian Oil.

The nuts of the Argan tree, seen in figure 4, are about 3 cm long and contain around 60 % Argan Oil. The success of Argan Oil on the international market has created a need to secure the quality of this high-value product. This aspect can be a reason to fraudulent attempt to adulterate Argan Oil with cheaper oils, see reference (1) and (2). Validation of its quality, origin and sustainability is therefore very important. Traditional Argan Oil preparation is following a multistep process that is often not standardised, see reference (3). As a result of this, the quality can vary lot to lot. For cosmetic applications mainly unroasted kernels are used and very often the oil is extracted with lipophilic solvents. Some grades of Argan Oil also have Ecocert certification status, but not all.

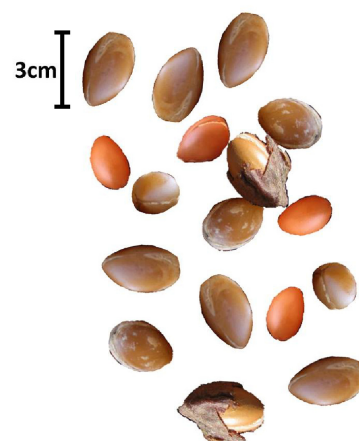


Figure 4. Argan Seed

FANCOR® Abyssinian Oil has the INCI Name: *Crambe Abyssinica Seed Oil*.

Argan Oil has the INCI Name: *Argania Spinosa (Argan) Oil*.

# Abyssinian and Argan Oil Composition

FANCOR® Abyssinian Oil and Argan Oil have both very high levels of unsaturated fatty acids. FANCOR® Abyssinian Oil contains a high percentage of unsaturated C<sub>22</sub> Omega-9 fatty acids. Argan Oil is mainly composed of triglycerides with C<sub>18</sub> Omega-6 and Omega-9 fatty acid, which are major parts of Abyssinian Oil as well.

Both oils will therefore have a similar application on skin and hair, with the Abyssinian Oil offering a slightly richer feel.

The typical fatty acid profiles of Abyssinian Oil and Argan Oil are as follows:

	Abyssinian Oil	Argan Oil
Oleic Acid C18:1	18 %	47 %
Linoleic Acid C18:2	11 %	32 %
Palmitic Acid C16:0	3 %	13 %
Stearic Acid C18:0	1 %	5 %
Erucic Acid C22:1	58 %	-

Table 1. Fatty Acid composition of Abyssinian Oil and Argan Oil

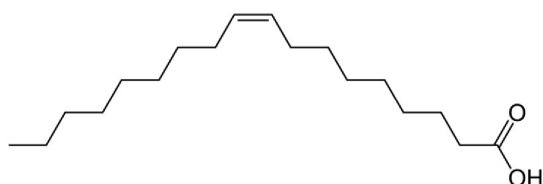


Figure 5. Oleic Acid C18:1 Structure

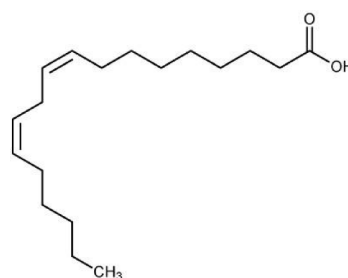


Figure 6. Linoleic Acid C18:2 Structure

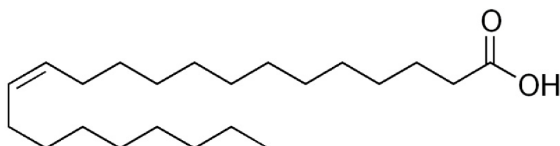


Figure 7. Erucic / Docosadienoic Acid C22:1 Structure

# Abyssinian Oil and Argan Oil Appearance

FANCOR® Abyssinian Oil is a clear liquid oil and very light in color, even though it has a high molecular weight.

Argan Oil can come in various shades, but it is most commonly clear and copper to golden-colored.

Both oils can be seen in Figure 8.

Flowcurves of the individual oils were measured using a Paar Physica MCR 300 Rheometer. The flowcurves, seen in Figure 9, show that FANCOR® Abyssinian Oil has a slightly higher viscosity than Argan Oil. This is probably due to the Abyssinian Oil containing slightly more fatty acids with a higher carbon chain length.

Abyssinian Oil

Argan Oil



Figure 8. Comparison of appearance of FANCOR® Abyssinian Oil and Argan Oil

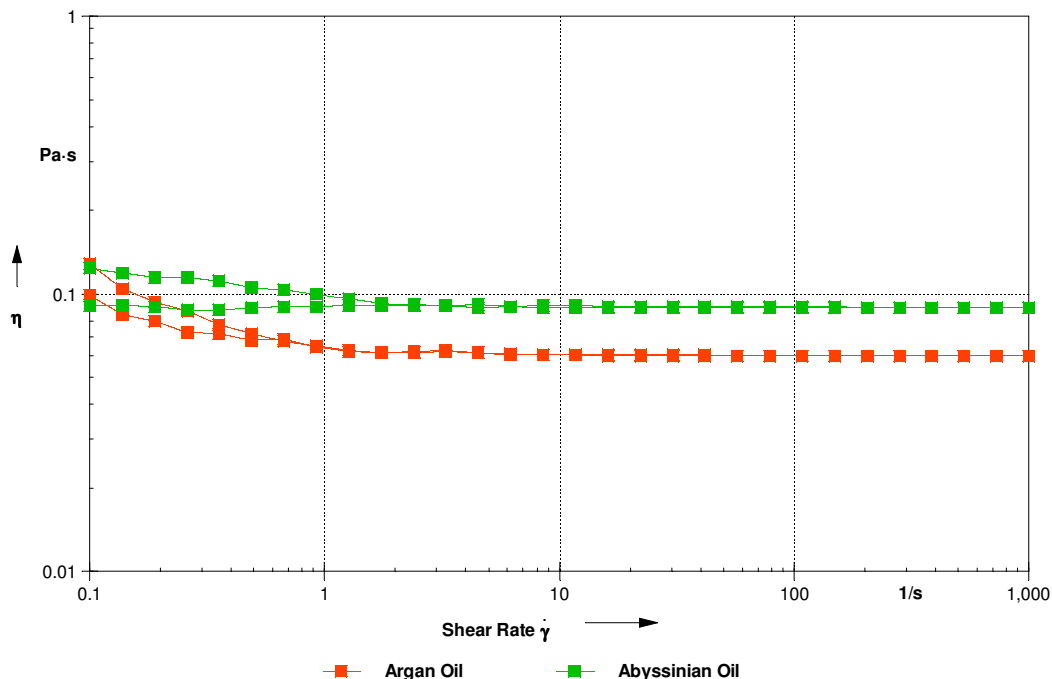


Figure 9. Flowcurve comparison of Abyssinian Oil and Argan Oil

# Impact of treatment with Abyssinian Oil and Argan Oil on Hair

Many claims are being made to demonstrate the effectiveness of hair care products. These include aspects like manageability of the hair, protection, strengthening of the hair fibres and anti-breaking properties. Furthermore a visible benefit like the enhancement of the natural shine of the hair is important to achieve customer satisfaction.

To prove the benefit of hair treatment with FANCOR® Abyssinian Oil in comparison to Argan Oil Elementis Specialtis sponsored an independent study that was carried out by TRI Princeton.

The tests were mainly performed on Mulatto hair, which offers a combination of characteristics of different ethnic hair types mixed with African origin. Due to the ellipticity and high degree of curliness, hair of African or Mulatto origin has a tendency to be very sensitive against damage. Therefore, an improved hair quality in this type of hair can demonstrate the benefit of a treatment with Abyssinian and Argan oil very efficiently.

TRI Princeton conducted a **Dry Combing** test, a **Repeated Grooming** test and quantified the **Shine** of the hair. The hair tresses were cleansed with a non-conditioning shampoo, dried overnight under controlled humidity (60%) and afterwards the oils were applied to the hair at a dosage of 0,5 mL per 3 gram hair tress.

Based on the results of three different test methods we can claim that FANCOR® Abyssinian Oil offers the same benefits as Argan Oil in improving the manageability of the hair, enhancing the shine and strengthening the hair fibres.



*Figure 10: Mulatto hair*

# Measurement of hair manageability - Dry Combing

Most conditioning products claim to increase the manageability and combability of the hair due to a lubrication and conditioning effect of the hair fibers. Improving the combability of the hair is perceived as the hair being in better condition. Better combability decreases the mechanical damage on the hair because less force is needed to untangle the hair, therefore, the combability of hair after treatment with conditioning agents provides an indicator if the effectiveness of the treatment is sufficient.

TRI Princeton used the Instron Tensile Tester to quantitatively evaluate the combability of Mulatto hair treated both with FANCOR® Abyssinian Oil or Argan Oil (see figure 11, reference (4)).

Virgin Mulatto hair tresses were used and to ensure statistical relevance eight standardised hair tresses were used per sample, the combing force was measured eight times on each tress.



*Figure 11. Instron Tensile Tester, TRI Princeton*



# Dry Combing Results

To comb untreated Mulatto hair it is necessary to use almost 2000 gmf frictional force due to its kinky structure. Both FANCOR® Abyssinian Oil and Argan Oil effectively increased the combability by reducing the needed force down to 1.5 % of the force initial needed for untreated Mulatto hair. In figure 12 this striking effect is obvious, but the difference between a treatment with Abyssinian Oil or Argan Oil cannot be seen, therefore a zoom into the results of both oils is given in figure 13.

In the direct comparison of FANCOR® Abyssinian Oil and Argan Oil even a better combability of the hair treated with Abyssinian Oil can be seen.

This means that FANCOR® Abyssinian Oil is an even more effective conditioner than Argan Oil.

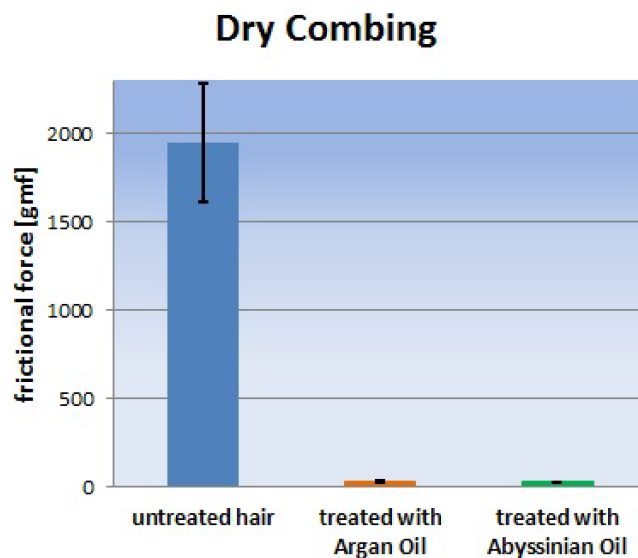


Figure 12. Dry Combing results for untreated Mulatto hair and treated with Abyssinian Oil and Argan Oil.

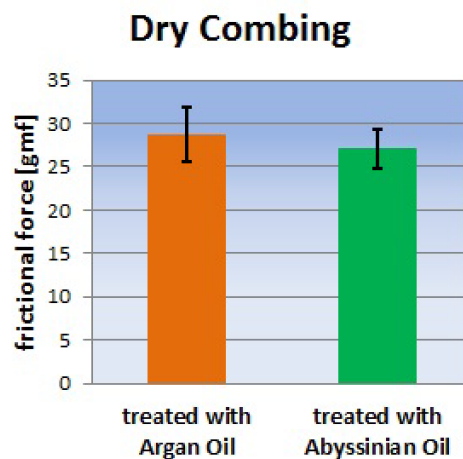


Figure 13. Dry Combing results for treated Mulatto hair with Abyssinian Oil and Argan Oil.

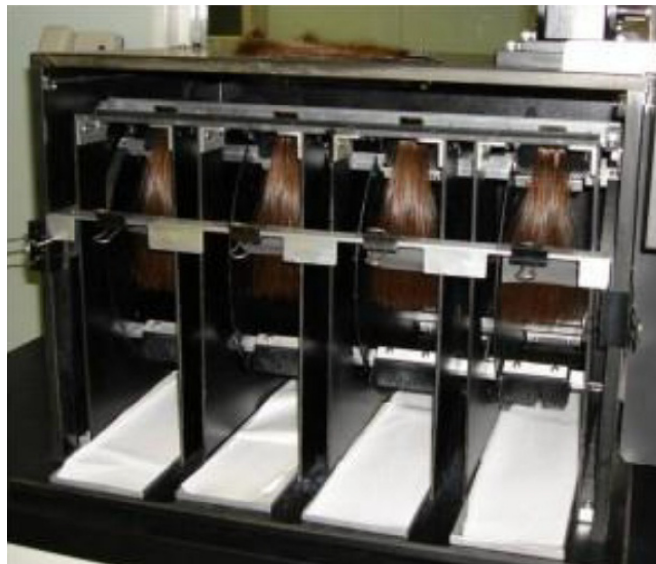
# Measurement of Anti-Breakage and Strengthening

## Repeated Grooming

The ability of natural oils to coat the hair fibers and to reduce snags, entanglements and abrasion leads to strengthening of the hair. This effect is linked to the phenomenon of anti-breakage, which is a common problem in real life due to different stress factors like grooming and hair-dressing. To enable the hair fibers to stay in good and healthy-looking shape, although being confronted with this potential damaging procedure, is highly appreciated by consumers of hair care products.

A Repeated Grooming experiment was used to quantify the strengthening and anti-breaking effect of FANCOR® Abyssinian Oil and Argan Oil, which evaluated broken fibers after repeated combing strokes, see reference (5). Ten hair tresses per treatment were used and brushed 10.000 times, then the broken fibers are counted and analysed. The Repeated Groomer device is shown in figure 14. It consists of a chamber and four rotating combs. The broken fibers are collected on a plate under each tress. The hair was chemically relaxed twice to improve the sensitivity and to simulate the conditions where persons are treating their hair chemically to modify their natural look.

This experiment shows a reasonable representation of real-life conditions and the potential reduction of hair fiber breakage due to conditioning agents. The experiment was conducted on Mulatto hair again due to the fact that Ethnic and Mulatto hair is known to be more affected by breakage than Caucasian or Asian hair.



*Figure 14. Repeated Groomer set-up, TRI Princeton*

## Repeated Grooming Results

Untreated Mulatto hair showed a high number of 170 broken fibers per 10.000 strokes which reflected the higher breaking potential in comparison to Caucasian hair that yielded around 80 - 100 broken fibers per 10.000 grooming strokes. The effect of using FANCOR® Abyssinian Oil or Argan Oil is impressive as they reduce the number of broken fibers for untreated Mulatto hair with 93%. In figure 15 this anti-breaking effect is obvious, but the difference between a treatment with FANCOR® Abyssinian Oil or Argan Oil cannot be seen, therefore a zoom into the results of both oils is given in figure 16.

Figure 16 shows that FANCOR® Abyssinian Oil has an even higher potential to strengthen the hair fibers against grooming damage shown by reducing the amount of broken fibers down to 10,3 per 10.000 strokes. The results display the benefit that Abyssinian Oil offers a high anti-breakage performance desired by many consumers.

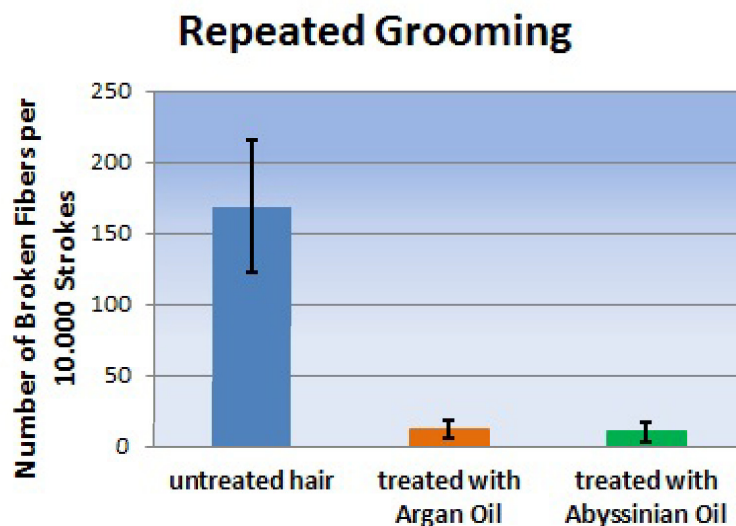


Figure 15. Repeated Grooming results for untreated Mulatto hair and treated with Abyssinian Oil and Argan Oil.

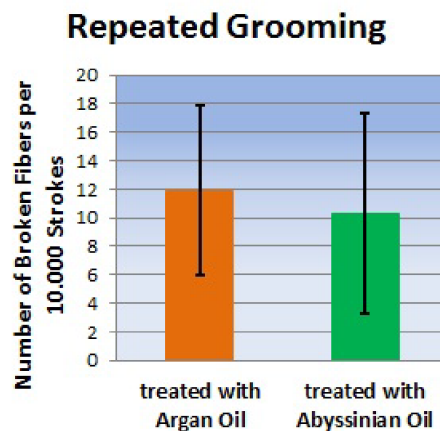
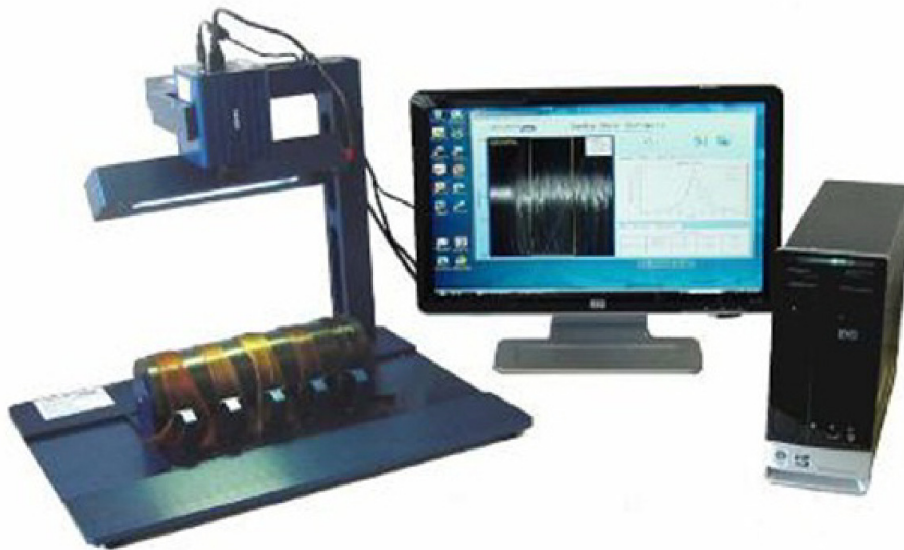


Figure 16. Repeated Grooming results for treated Mulatto hair with Abyssinian Oil and Argan Oil.

## Quantification of Shine

The shine of the hair is a very highly appreciated attribute of healthy-looking hair and a common claim of many hair care products.

The commercially-available SAMBA device by Bossa Nova was used to quantify the shine enhancement from FANCOR® Abyssinian Oil and Argan Oil, seen in figure 17. This method was developed to measure the luster and shine of the hair tress by light reflected from a curved hair tress (see reference (6)). The quantification is based on an image analysis by scanning the light distribution of a hair sample across highlighted and dark areas.



*Figure 17. SAMBA device for shine measurement. TRI Princeton*

## Results of Shine measurements

The natural shine of untreated Mulatto hair is around 165 technical shine units (in Reich-Robbins units, see reference (6)).

The effect of using FANCOR® Abyssinian Oil or Argan Oil to enhance the shine of the hair is impressive for both natural oils by almost doubling the apparent shine on the hair in comparison to untreated Mulatto hair. These results can be seen in figure 18. Mulatto hair treated with Argan Oil offers a slightly higher technical shine of 300 units compared to the Mulatto hair treated with Abyssinian Oil that resulted in 290 units.

Argan Oil is very well known in the market as natural shine enhancer and in some cases claimed being able to outperform the competition in this particular aspect.

Therefore FANCOR® Abyssinian Oil is highly comparable to Argan Oil, offering almost the same shine enhancing benefit.

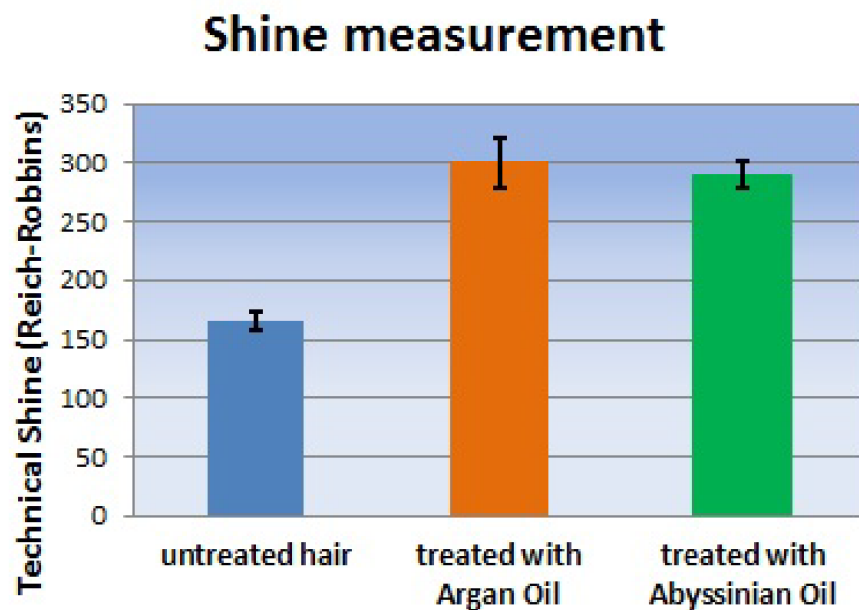


Figure 18. Shine results for untreated Mulatto hair and treated with Abyssinian Oil and Argan Oil.



## Summary

FANCOR® Abyssinian Oil is a comparable substitution for Argan Oil in Hair Care applications. The great performance of FANCOR® Abyssinian Oil for Hair Care applications have been displayed in the test results presented in this report. FANCOR® Abyssinian Oil offers the typical benefits of using Argan Oil in Hair Care products like shine enhancing, conditioning and strengthening, in some cases even outperformed them. Since Abyssinian is an annual crop that is planted each year and yields seeds within months, it is a more reliable oil source than Argan, which is mainly produced in Morocco's Argan forest being designated as an UNESCO reserve. Furthermore, Argan Oil is a high-priced oil for nutrition and cosmetics and its security of supply cannot be guaranteed due to growth and harvesting conditions. Abyssinian is an economic alternative of a reliable source not competing to nutrition usage. In consequence of its short growth and harvesting conditions it is a renewable and sustainable plant easily adaptable to increasing demands of the market. Below we have highlighted the similarities and enhanced performance characteristics of FANCOR® Abyssinian Oil compared to Argan Oil in Hair Care:

### Similar Fatty Acid Composition

- Although slightly different the FANCOR® Abyssinian Oil and Argan Oil both have high levels of long chain unsaturated fatty acids.

### Conditioning Effect

- FANCOR® Abyssinian Oil provides similar or even slightly better combability than Argan Oil. FANCOR® Abyssinian and Argan Oil therefore offer the same conditioning and manageability effect for hair.

### Anti-Breakage Effect

- Repeated Grooming tests showed the capability of FANCOR® Abyssinian Oil and Argan Oil to strengthen the hair and to reduce the breaking of hair fibers significantly. The overall results showed FANCOR® Abyssinian Oil performed superior to Argan Oil in reducing the breakage of the hair fiber.

### Natural Shine Enhancer

- Argan Oil is very well known for its outperforming shine enhancing capabilities. When compared to FANCOR® Abyssinian Oil this is in the same range of benefit. This impressively demonstrates the potential of FANCOR® Abyssinian Oil as alternative to Argan Oil.

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