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# *Hair Strengthening Activity Of Rice Bran Oil And Synergistic Effect With Some Natural Hair Dyes On Hair Protection*

H. Rim Farasoa[1], F. Miandrimanana[1], N.L. Rakotohasimanana[2], M.J.M. Randrianarivo[2], J.M. Razafindrakoto[3]

[1]Faculty of Science
University of Antananarivo
Antananarivo, Madagascar

[2]Laboratoire de Contrôle des Pesticides
LCP Nanisana
Antananarivo, Madagascar

[3]High School of Agronomic Sciences
University of Antananarivo
Antananarivo, Madagascar



**Abstract— Ultrasound extracted Rice bran oil (RBO) from the Madagascan Makalioka variety contained 40.25% of oleic acid as the major compound and 34.36% of linoleic acid. Reverse HPLC revealed that 24-methylene cycloartanyl ferulate was the most dominant Oryzanol compound and β and γ-tocotrienols were the dominant tocols. Stretching test was chosen as the method for evaluating the protective effect of RBO and natural dyes. Afro, Caucasian and Asian natural hair types were used to perform the study. The natural dyes consisted of a mixture of Lawsonia inermis and Cassia obovata aqueous extracts. To simulate the daily coloring routine, hair shafts were immersed in the plant extracts during 12 hours. For the RBO treatment, hair rods were massaged for about 10 minutes with the oil until fully absorbed. A load equivalent to 75 g was applied to hair shafts until rupture and the maximum elongation was recorded. The hair shafts treated with RBO have shown greater elongation compared to the control: 0.35, 0.73 and 0.50cm respectively for Afro, Caucasian and Asian hair types. Combined with natural dyes, this difference in elongation varied from 0.51cm for the Afro type to 1.08 cm for the Caucasian type. Asian hair type has shown the maximum stretching ability and the Caucasian hair type has shown the most positive response to treatments.**

**Keywords—Hair- Stretching ability –Oryzanol – Tocols– Lawsonia inermis – Cassia obovata**

## I. INTRODUCTION

Rice bran oil (RBO) is referred to as unique among edible vegetable oils [1] and a unique gift of nature [2]. Its activities on cholesterol level lowering, blood pressure regulation and insomnia alleviating are well known. In cosmetics, it is a moisturizing agent for adult and baby skin, it protects against sunrays and its high quality antioxidant compounds prevent skin damage [3]. It is also an important ingredient in capillary products. Its hair growing activity has been well stated. However studies on its effects on hair physical properties are scarce or inexistent even if physical and mechanical characteristics are among criteria of appreciation of hair quality. The aim of this work is to investigate the activity of RBO in enhancing hair strength through tests on hair physical properties. Hair fiber characteristics allow the distinction of three hair types: Asian hair with circular geometry, Afro hair which is elliptic, and the oval Caucasian hair [4]. All the experiments in this work are performed with samples of each category. European

**Corresponding Author:** H. Rim Farasoa

legislation has banned animal testing of cosmetic products. This study was conducted using natural human hair rods.

Adverse reactions to some chemical hair dyes have led to a greater market tendency in natural dyeing products consumption [5]. Some tinctorial plants like *Lawsonia inermis* and *Cassia obovata* have gained increasing interest. The protection effect of RBO on hair dyed with a mixture of extracts from these plants was also investigated.

## II. Materials And Methods

### 2.1. Rice bran collection

Dried rice paddy was collected from farmers of Ambohimanambola, a suburb of the Madagascan capital city Antananarivo. After milling, rice bran was transported directly to the lab for extraction.

### 2.2. Oil extraction and physico-chemical characteristics

Extraction was performed using a 200W laboratory ultrasonic bath at 50 HZ, 40°C during 1 hour with hexane as the solvent. The oil obtained was subjected to a physico-chemical analysis according to the methods described in Tesfay, 2016 [6] for the determination of parameters such as acid value, peroxide value, iodine value and saponification value. Determination of the unsaponifiable matter was carried out according to the Manual of methods of analysis of foods, 2012 [7].

### 2.3. Fatty acid content analysis

Prior to analysis, RBO was treated for the preparation of methyl esters. 1µl of the sample was then injected into an analytical Gas Chromatograph. The apparatus was a SHIMADZU GC-14A equipped with a SOLGEL-WAX megabore column (30m * 0,53mm*1µm) and a Flame Ionization Detector. The oven temperature was set at 260°C. Injection temperature was 260°C and detection temperature was 280°C. Carrier gas was Nitrogen at a flow rate of 3ml/min.

### 2.4. Tocols and oryzanol content

Tocols and oryzanol were analyzed simultaneously by means of reverse phase HPLC. RBO was treated with hexane before analysis: 500 mg of oil in 2 ml hexane. After centrifugation, 50 µl of the supernatant was taken for injection. The apparatus was a SHIMADZU LC-6A chromatograph equipped with a C18 column (250 mm*4.5 mm) and a UV scanning detector between 290 nm and 330 nm. Mobile phase was methanol/acetonitrile/dichloromethane/acetic acid (50:44:3:3, by volume).

### 2.5. Collecting of hair rods

Strands of hair were taken from a professional hairdressing salon, the donors having given their consent, even if the haircut was on their own initiative. The three different hair types Afro, Asian and Caucasian were collected at different moment according to their availability, and were stored in a safe place, away from humidity and extreme heat until the time of testing.

### 2.6. Preparation of dyes

Natural dyes were prepared from the aqueous extracts of two tinctorial plants growing locally: *Lawsonia inermis* and *Cassia obovata*. Leaves were dried in the shade and then ground. 30 g of each powder in 90 ml of distilled water were heated at 70°C in a water bath for 30 min. After filtration, equal volumes of each extract were mixed.

### 2.7. Stretching test

Hair shafts from each of the 3 hair types were carefully selected for each test, and cut into 15 cm lengths. A load equivalent to 75 g was applied and the hair was stretched until rupture. The maximum elongation was recorded. The result was expressed as the average of three tests for each hair type. Untreated hair served as control. An imported chemical hair dye brought in local market was used as a reference product.

### 2.8. Hair treatment

RBO treatment consisted of applying oil to the hair shafts, followed by massage during 10 min until fully absorbed. The stretching test was carried out 1 hour after. For the natural dyeing, hair rods were immersed in a vessel with the extract mixture for 12 hours under a water bath at 45°C. The threads were left to dry in the shade for 12 hours before the stretching test. For the RBO protecting test, the oil was applied and massaged into dyed hair shafts during 10 min. The stretching test was performed after 1 hour. For the reference, treatment with chemical hair dye was done by dropping the hair shafts during 3 hours according to

the directions for use in the product label. Stretching test was performed after 1 hour.

## III. Results And Discussions

### 3.1. Oil extraction and physico-chemical characteristics

Extraction yielded 11.02% of a dark yellow oil with a relative density of 0.891 at 20°C. Physico-chemical characteristics are shown in table 1. The bran has not undergone any prior stabilization process. According to Fahmida, 2019 [8], high peroxide and acid values are signs of low oxidative stability, and this shows the importance of stabilization treatment. Compared to other edible oils for which unsaponifiable matter is quantified between 0.5-2%, RBO contains a high amount of unsaponifiable matter. However the saponification method used to assess its quantity underestimates the real quantity as some compounds were destroyed during the alkalinization process [9]. Thus it can be expected that unsaponifiable matter may be estimated to be higher than 3.8% in reality.

TABLE I. PHYSICO-CHEMICAL CHARACTERISTICS OF THE RICE BRAN OIL FROM MAKALIOKA VARIETY

| Properties | Values |
|---|---|
| Unsaponifiable matter (%) | 3.8 |
| Acid value (mg KOH/g) | 96 |
| Iodine value (g/100g) | 80 |
| Saponification Index (mg KOH/g) | 170 |
| Peroxide Value ($meqO_2/kg$) | 30.7 |

### 3.2. Fatty acid content

Table 2 shows the fatty acid composition of the oil.

TABLE II. FATTY ACID COMPOSITION OF THE RICE BRAN OIL FROM MAKALIOKA VARIETY

| Fatty acids | Values |
|---|---|
| Myristic acid | 0.35 |
| Palmitic acid | 20.27 |
| Stearic acid | 1.65 |
| Arachidic acid | 0.69 |
| Palmitoleic acid | 0.33 |
| Oleic acid | 40.25 |
| Gadoleic acid | 0.39 |
| Linoleic acid | 34.36 |
| Linolenic acid | 1.72 |

Compared to the results obtained by Gaydou, 1980 [10] for which, linoleic acid content of the Makalioka variety is about 30.6%, this ultrasound extracted RBO is richer: 34.36%. Linoleic acid is implied in the activation of the hair cell growth [11]. The major compound is Oleic acid. This fatty acid confers a glossy effect to the hair [12].

### 3.3. Tocols and oryzanol content

As mentioned by REF 9 cited above, the method for assessment of the unsaponifiable matter by saponification deteriorates the quality of some of the compounds. The HPLC result shown in table III reveals a more detailed information on the composition of the antioxidant compounds tocols and oryzanol.

TABLE III. TOCOLS AND ORYZANOL CONTENT OF THE RBO

| Compounds | Retention time (s) | Area (%) |
|---|---|---|
| δ-tocotrienol | 382 | 0.34 |
| β and γ-tocotrienols | 436 | 1.88 |
| α-tocotrienol | 555 | 0.39 |
| β and γ-tocopherols | 932 | 0.31 |
| α-tocophérol | 1092 | 0.62 |
| Cycloartenyl ferulate | 1272 | 18.93 |
| 24-methylene cycloartanyl ferulate | 1406 | 25.29 |
| Campesteryl ferulate | 1758 | 13.77 |
| Sitosteryl ferulate | 2065 | 3.41 |

Among the oryzanol compounds, 24-methylene cycloartanyl ferulate is the major constituent followed by Cycloartenyl ferulate. Ferulic acid and its esters are known to stimulate hair growth [13]. Among the tocols, β and γ-tocotrienols are the most dominant compounds. Tocotrienols are claimed to possess a greater antioxidant activity compared to tocopherols. They offer a good protection against UV-light and ozone induced oxidative stress [14].

### 3.4. Hair strengthening of activity of RBO

According to Figure 1, Asian hair type shows the greatest resistance to stretching. This elasticity and flexibility are signs of a high quality hair fiber. This would be due to the existence of a double concentric layer structure inside the hair strands [15]. The hair shafts treated with the reference product exhibit a very short elongation which is lower than the value of the control for the three hair types. Chemical dyes change the fiber texture and cause degradation to the cuticle surface [16]. This entails a loss of protection and a direct exposure of the cortex to factors that easily damage the hair. For all three hair types, RBO confers a softer and a more resistant hair. Its strengthening activity is confirmed here. Hair treated with RBO is thus more resistant to various hair care operations such as combing, brushing, styling and conditioning. The lubricating effect of the RBO could contribute to the prevention of the cuticle cell damage [12].

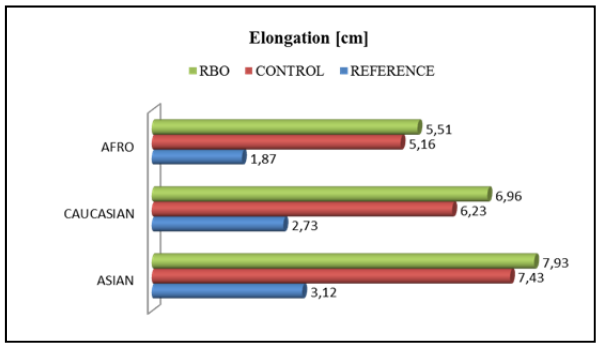


Fig. 1. Elongation of hair shafts after RBO treatment

### 3.5. Hair protecting activity of RBO in synergy with natural hair dyes

Lee, 2019 [17] described that natural henna hair treatment promotes the stretching ability of hair shafts. It is demonstrated in figure 2 that RBO synergizes this activity. For all three hair types, greater elongation is observed for rods treated with both RBO and natural dyes compared to the hair shafts treated only with natural dyes. Afro hair is more susceptible to breakage than

Caucasian and Asian hair [18]. A small difference is thus observed for this hair type between the treated and untreated rods: 0.30 cm and 0.51 cm respectively for the treatment with natural dyes and for the simultaneous treatment with RBO and natural dyes. Asian hair has a high lineal mass which confers a better strength [19], and this would explain its high elongation value. The oils help adjust the pH of the hair and strengthen the hair cuticle [20]. This leads to a better protection of the cortex and confers a high mechanical resistance. Some vegetable oils also penetrate inside the cortex and strengthen its lipid layer. Oils increase the hair core hydrophobicity and provide anti-breakage effect [21].

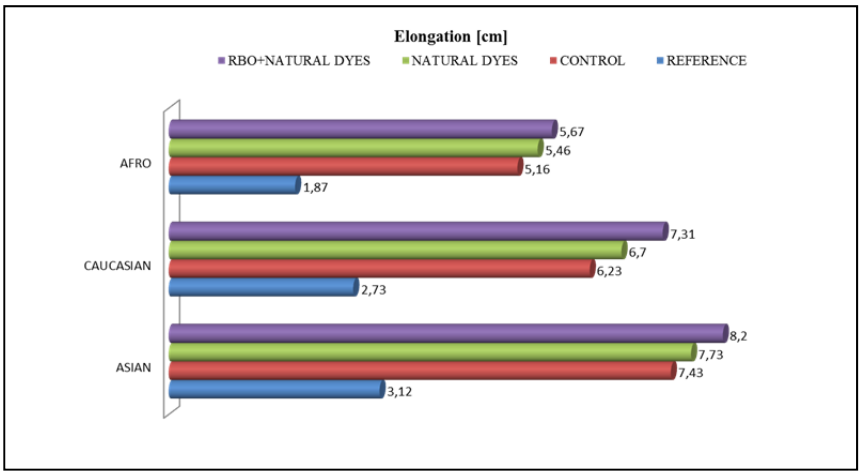


Fig. 2. Synergistic effect of RBO with Natural dyes in confering hair mechanical resistance

## IV. Conclusion

RBO contains fatty acids and natural antioxidants that help protect the hair and strengthen the cuticle. These properties could be observed even for quite fragile hair types. Stretching test allows assessing the mechanical resistance of hair rods. This model can simulate not only the ability of hair shafts to resist to routine treatments but also to evaluate the hair quality. Using RBO and choosing a natural dye help protecting the hair from damage induced by chemical dye treatment.

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