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Regular paper

The use of Dalmatian pyrethrum daisy and an excipient in the treatment of seborrheic dermatitis

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The active ingredients of the Pyretrin-D trichological cosmetic series, namely benzyl benzoate, Dalmatian pyrethrum daisy, *Cistus incanus*, tea tree oil and geranium oil, almond acid and arginine were tested in respect to the treatment of seborrheic dermatitis. The paper describes the application of Dalmatian pyrethrum daisy and the excipient. Methods and devices used to confirm the effectiveness of the tested formulations included the TrichoScope Polarizer Dino-Lite (MEDL4HM) and the scanning electron microscope (SEM).

Keywords: cosmetics formulations, seborrheic dermatitis, MEDL4HM, tarchonanthus camphoratus oil

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Abbreviations: MEDL4HM, dalmatian pyrethrum daisy, trichoscope polarizer dino-lite; SD, seborrheic dermatitis; SEM, canning electron microscope

INTRODUCION

Seborrheic dermatitis (SD) or seborrheic eczema (SE) is a chronic, recurrent skin disease. The disease most often affects young and physically active people. Under the current sanitary regime dermatosis can occur in any age group. SD is mainly manifested by the presence of eruptions with associated exfoliation formed on the erythematous surface. Eruptions most often occur around the skin most abundant in sebaceous glands (face, scalp, and back). The pathogenesis of the disease has not been clearly explained to date. However, there are several predisposing factors: disturbances in the activity of the sebaceous glands, decreased immunity, colonization of bacteria and fungi, psoriasis, and a deficient diet (Mameri *et al.,* 2017; Fatsini-Blanch *et al.,* 2017; Kołodziej *et al.,* 2004; Gupta *et al.,* 2004; Schwartz, 2006).

SD therapy is still a significant challenge for doctors or teams supporting the treatment and care process. There is no single effective drug that would bring lasting results, and the disease itself is recurrent. However, according to the Polish Dermatological Society, shampoos, scrubs, rubs, and masks play the main role in the treatment of seborrheic eczema of the scalp.

Certain chemicals such as ciclopiroxolamine, ketoconazole, or zinc pyritonate are controversial, since their long-term use may worsen the patient's condition (Dessinioti *et al.,* 2006) Abuse of these substances also leads to resistance to their effects. Therefore, it was decided to implement substitutes. The raw materials included in the Pyretrin-D series have become effective and proven alternatives for treating SD. The main ingredients of this series are benzyl benzoate, Dalmatian pyrethrum daisy, Cistus incanus, tea tree oil and geranium oil, almond acid, and arginine. The ingredients belong to the green chemistry trend.

Further part of the paper presents the results confirming the effectiveness of Pyretrin-D Professional cosmeceuticals dedicated to the scalp and hair.

The tests were carried out on 50 probants using the TrichoScope Polarizer Dino-Lite (MEDL4HM) and a scanning electron microscope (SEM).

The aim of the study was to present natural replacements to abovementioned chemical substances, including primarily. Dalmatian pyrethrum daisy, benzyl benzoate, Cistus incanus, tea tree oil and geranium oil, almond acid, and arginine, Helicrysum Angustifolium extract, and biomimetic ceramide. The ingredients mentioned above have been tested. All of them have been introduced in the formula of the Pyretrin-D trichological series. This series is intended to reduce or completely eliminate the symptoms of seborrheic scalp inflammation. These raw materials have a multifunctional effect.

MATERIALS AND METHODS

In the initial phase of the research, cosmetics from the trichological series were created with the aim of an effective elimination of problems of the scalp and hair. Incidentally, the use of antimicrobial active substances has become part of the desired trends regarding skin and hair care during the coronavirus pandemic. The formulations have been created in such a way to not cause intolerance to any of the raw materials they contain. The main ingredient of the series is Dalmatian pyrethrum, which was used from 1–5%, depending on the product.

Preparation of the Pyretrin-D trichological series

The preparation of cosmetics is presented below (Table 1–4). The series consists of four products. Figure 1 shows ready-made formulations.

Figure 1. Pyretrin-D trichology series.

Table 1. Ingredients of Pyretrin-D trichological shampoo

INCI name	Content. % up to 100 (±6.00)
Phase I	
Aqua	35.30
Ammonium Glycyrrhizinate (and) Mannitol (and) Arginine (and) Niacinamide (and) Calcium Pantothenate (and) Biotin (and) Faex Extract (and) Allantoin (and) Threonine (and) Hydrolyzed Oat protein	0.20–2.00
Mandelic Acid	1.00–1.80
Phase II	
Babassu Oil Glycereth-8 (and) Esters Coco--Glucoside (and) Glyceryl Oleate	1.00–6.00
Cellulose Gum (and) Xanthan Gum (and) Inulin (and) Cellulose (and) Glucose (and) Fructose (and) Hydroxypropyl Guar (and) Panthenol	1.20–7.00
Phase III	
Decyl Glucoside (and) Coco-Glucoside (and) Squalane (and) Sodium Surfactin	10.00–40.80
Dicaprylyl Ether (and) Tarchonantus Camphoratus oil (and) 4 – Terpineol (and) Helicrysum Angustifolium extract (and) Geranium China Oil (and) Tea Tree Oil	0.20–2.00
Phase IV	
Glycerin (and) Aqua (and) Quillaja Saponaria Wood Extract (and) Saponaria Officinalis Leaf/Root Extract	3.50–4.50
Glycerin (and) Aqua (and) Tancetum Cinerariifolium Flower Extrct (and) Benzyl Benzoate	3.50–4.50
Aqua (and) Sodium Levulinate (and) Potassium Sorbate	1.00–2.30
Trisodium methylenediamine discuccinate	0.50–1.30

Table 2. Ingredients of the Pyretrin-D trichological conditioner

INCI name	Content. % up to 100 (±6.00)
Phase I	
Cetearyl Alcohol (and) Isodecyl Oleate (and) Dicapryl Carbamate (and) Cetyl Palimtate(and) Cetyl Alcohol (and) Nigella Sativa Seed Oil	7.50–12.30
Phase II	
Aqua	ds.
Behentrimonium Methosulfate (and) Cetearyl Alcohol	4.00–4.70
Phase III	
Glycerin (and) Aqua (and) Tancetum Cinerariifolium Flower Extract	1.00–1.80
Geranium China Oil (and) Tea Tree Oil (and) Dicaprylyl Ether. Tarchonantus Camphoratus oil (and) 4 – Terpineol (and) Helicrysum Angustifolium extract	0.20–1.00
Perfume	0.90–1.70
Aqua (and) Sodium Levulinate (and) Potassium Sorbate	0.20–1.00
Trisodiummethylenediamine discuccinate	0.10–1.10
Lactic Acid	ds.

Preparation of Pyretrin-D trichological shampoo

Phase I was prepared in a 100 ml beaker (basis weight and names of substances are given in Table 1). Phase I was heated to the temperature of about 60°C in a water bath, transferred to a magnetic stirrer, and allowed to reach the temperature of 40°C. Phase II was heated, combined with phase I and then homogenized to a homogeneous consistency using the IKA T 50 basic Ultra-Turrax homogenizer with rotational speed of 6000 rpm (Mitkowski *et al.,* 2016; Igielska-Kalwat, 2018). Phase III was then weighed out, heated to 40°C, and added to the mixture while stirring. Phase IV was weighed, heated to 35°C and magnetically combined with other phases when the target temperature of 35°C was reached. The mixture was continuously vigorously stirred. It was left on the stirrer to cool completely. Straw-colored shampoo was obtained (Fig. 1). With the importance of the pH value in mind, all Pyretrin-D products are characterized by the pH value of 5.50 (± 0.3).

Preparation of the Pyretrin-D trichological conditioner

The oil phase was prepared in a 100 ml beaker (basis weight and names of substances are given in Table 2). Phase I was melted in a water bath (80–85°C). Phase II was heated to the same temperature and then mixed. Both were stirred for 30 minutes. After the mixture had cooled to 55°C, it was homogenized until a homogeneous emulsion was obtained with the IKA T 50 basic Ultra-Turrax homogenizer with rotational speed of 6000 rpm (Mitkowski *et al.,* 2016; Igielska-Kalwat, 2018). Phase III was heated to 35°C and magnetically combined with other phases when the target temperature of 35°C was reached. The mixture was continuously vigorously stirred. It was left on the stirrer to cool completely. A white homogeneous emulsion was obtained (Fig. 1).

Preparation of Pyretrin-D trichological peeling

Phase I was prepared in a 100 ml beaker (basis weight and names of substances are given in Table 3). Phase I was heated to the temperature of about 60° C in a water bath, transferred to a magnetic stirrer, and allowed to reach the temperature of 40°C. Phase II was heated, combined with phase I and then homogenized to a homogeneous consistency using the IKA T 50 basic Ultra-Turrax homogenizer with rotational speed of 6000 rpm (Mitkowski *et al.,* 2016; Igielska-Kalwat, 2018). Phase III was then weighed out, heated to 35°C, and added to the mixture while stirring. It was magnetically combined with other phases when the target temperature of 35°C was reached. The mixture was continuously vigorously stirred. It was left on the stirrer to cool completely. A straw-colored peeling was obtained with a gel-like consistency (Fig. 1).

Preparation of the Pyretrin-D trichological liniment

Phase I was prepared in a 100 ml beaker (basis weight and names of substances are given in Table 4). Phase I was heated to the temperature of about 60°C in a water bath, transferred to a magnetic stirrer, and allowed to reach the temperature of 40°C. Phase II was heated, combined with phase I and then homogenized to a homogeneous consistency using the IKA T 50 basic Ultra-Turrax homogenizer with rotational speed of 4000 rpm (Mitkowski *et al.,* 2016; Igielska-Kalwat, 2018). Phase III

was then weighed out, heated to 35°C, and added to the mixture while stirring. It was magnetically combined with other phases when the target temperature of 35°C was reached. The mixture was continuously vigorously stirred. It was left on the stirrer to cool completely. A straw-colored liniment with a consistency resembling a liquid was obtained (Fig. 1).

Tests confirming the safety and the manufacturer's declaration for the Pyretrin-D trichology series

The tests were performed in accordance with the Act on cosmetic products of October 4, 2018 (Polish Journal of Laws of 2018, item 2227) (Art. 11(3) (The Cosmetics Act of 4.10.2018). Their aim was to assess the impact of the cosmetic on the safety of human health - including studies on skin tolerance to the tested cosmetic at the place of its application. Apparatus confirmation of the type of action of the preparations declared by the Manufacturer was carried out. The research was conducted following the approval of the Bioethics Committee, resolution number 640/20. Tests confirming or excluding the properties and performance of the Pyretrin-D trichological cosmetics series declared by the Ordering Party were carried out at probants' homes and in the Dermatology Center (Centrum Dermatologii Sp. z o. o) in Poznań under the supervision of a dermatologist, chemist, and cosmetologist. The probants were volunteers. A group of 50 people was selected for the research, corresponding to the indications for use of the products reported in the experiments. The selection of probants was done according to the preliminary assessment of the condition of their hair, scalp and, health. Due to the intended use of the product, people who declared their willingness to improve the appearance and condition of the scalp and hair participated in the study (Igielska-Kalwat *et al.,* 2018).

Methodology of the research

At home (home panel)

After conducting the research, the dermatologist found out which of the probes had seborrheic dermatitis. Female probants qualified for the research received one package of products from the Pyretrin-D trichological series. The volunteers were 18-50 years old. They undertook to use the received samples regularly as declared by the manufacturer. Probants should not have been using preparations of the same or analogous purpose during the time of the study. Volunteers were to observe the reaction of the scalp and hair at the application sites. They were to note in detail the comments regarding the functional properties of the tested cosmetic. In the event of any negative symptoms at the place of application of cosmetics, they were to stop using cosmetics and contact the person conducting the examination immediately. No special requirements were imposed on the participants of the study, assuming that the effects of this type of cosmetic should be tested in the natural conditions in which it will be used in practice. The results of the experiment could only be influenced by factors such as health, type and condition of hair and skin, genetic conditions, individual traits, individual preferences, lifestyle, environmental conditions, etc.

Apparatus tests carried out with MEDL4HM

The research used an imaging method involving a trichological microcamera with the assessment of the condition of the skin and the follicular area. TrichoScope Polarizer Dino-Lite (MEDL4HM) is a device designed for the examination of the scalp and hair analysis. Owing to a very high magnification up to 200 times, a single hair can be viewed in great detail. The built-in polarizing filter minimizes the effect of glare on the scalp or hair (Rudnicka *et al.,* 2011; Ali, N *et al.,* 2015). As already mentioned, the study of the preparations from the Pyretrin-D trichology series was conducted in cooperation with the Symbiosis Dermatology Center, on a group of 50 probants. Before starting the test, each of the volunteers was assigned a sample of the cosmetic. For the subsequent 100 days, the study participants were asked to test the samples at home (in-Home-Use-Test methodology). The order of application and the application time of individual cosmetics have been explained. With a mi-

Table 3. Ingredients of the Pyretrin-D trichological peeling

INCI name	Content. % up to 100 (±6.00)
Phase I	
Aqua	ds.
Mandelic Acid (and) Ammonium Glycyrrhizinate (and) Mannitol (and) Arginine (and) Niacinamide (and) Calcium Pantothenate (and) Biotin (and) Faex Extract (and) Allantoin (and) Threonine	8.00–8.80
Phase II	
Alcohol Aqua (and) Tancetum Cinerariifolium Flower Extract (and) Panthenol (and) Arginine PCA (and) Sodium Cocoyl (and) Apple Amino Acida	7.00–9.80
Dicaprylyl Ether (and) Tarchonantus Camphoratus oil (and) 4 – Terpineol (and) Helicrysum Angustifolium extract (and) Geranium China Oil (and) Tea Tree Oil	0.50–1.30
Phase III	
Aqua (and) Sodium Levulinate (and) Potassium Sorbate	1.90–2.70
Trisodiummethylenediamine discuccinate	0.10–0.90

Table 4. Ingredients of the trichological Pyretrin-D liniment

INCI name	Content. % up to 100 (±6.00)
Phase I	
Aqua	ds
Mandelic Acid (and) Ammonium Glycyrrhizinate (and) Mannitol (and) Arginine (and) Niacinamide (and) Calcium Pantothenate (and) Biotin (and) Faex Extract (and) Allantoin (and) Threonine (and) Alcohol Aqua. Tancetum Cinerariifolium Flower Extract (and) Arginine PCA	06.00–8.80
Phase II	
Decyl Glucoside (and) Geranium China Oil (and) Tea Tree Oil (and) Dicaprylyl Ether. Tarchonantus Camphoratus oil (and) 4 – Terpineol (and)Helicrysum Angustifolium extract	6.00–8.80
Phase III	
Aqua (and) Sodium Levulinate (and) Potassium Sorbate	1.90–2.70
Trisodiummethylenediamine discuccinate	0.50–1.30

crocamera, the experimenter examined the condition of the scalp area and hair of the patients before and after using the preparations. A blank test was performed prior to starting product application. The second test was carried out after 100 days, during which the probates undertook to use the preparation regularly. Each of the probands has been taken 10 pictures before and after.

Apparatus test performed using the SEM method

During the blank test, hair was collected from the probants' both temples, the center of the head and the occiput in order to perform imaging studies using a scanning electron microscope. SEM is a kind of electron microscope enabling the observation of the topography of the tested material (hair). It is used to observe materials on a nanometric to micrometric scale. With scanning microscopy, it is possible to precisely establish the hair morphology, the condition of the hair bulb and stem, the type and size of damage to the hair tissue, as well as to identify factors affecting the hair, to determine its structural changes or to analyze its chemical composition. After a hundred days the test was repeated. Subsequent samples were taken from all probants, and imaging was performed using SEM. All participants remained in the study until the end (Ali, *et al.,* 2015). In order to select the correct tests for comparisons or correlations, compliance with the normal distribution was checked (Shapiro-Wilk test). To obtain knowledge about the differences for a fragment of our complex system, we use multiple comparison procedures, i.e., post-hoc tests.

RESULTS

Apparatus tests carried out with MEDL4HM

The Pyretrin-D series, which includes shampoo, conditioner, peeling and liniment, was tested in a blank test and once again after 100 days. The research used an imaging method involving a trichological microcamera with the assessment of the condition of the skin and the follicular area. TrichoScope Polarizer Dino-Lite (MEDL4HM). A compilation of photos is presented below, showing the difference before the application of the Pyretrin-D series and after the 100-day study. In the most severe cases, the frequency of follow-up examinations was increased. The photos below are taken from different areas of the scalp.

PATIENT A (blank test)

Figure 2. Photo of the hair before applying the Pyretrin-D series.

PATIENT A (test after 100 days)

The above patient had symptoms of peeling skin. As seborrheic dermatitis progressed, the lesions turned into irregular erythematous spots with yellow scabs. There were also diffuse inflammatory lesions covering the entire surface of the scalp. The dried layer of dead skin and sebum formed a crust. Moreover, the patient complained of itching. The hair was also thinned. After 100 days, thanks to the application of the Pyretrin-D series, the symptoms disappeared entirely. The remission of the disease was due to the active substances used, such as Dalmatian pyrethrum daisy, biomimetic ceramide, mandelic acid, black seed oil, biotin, *Helicrysum Angustifolium extract*, benzyl benzoate, *Cistus incanus*, tea tree oil and geranium oil, almond acid, and arginine. Their beneficial effects will be developed in the discussion section.

Figure 3. Photo of the hair after applying the Pyretrin-D series for 100 days.

PATIENT B (blank test)

Figure 4. Photo of the hair before applying the Pyretrin-D series.

PATIENT B (test after 100 days)

Figure 5. Photo of the hair after applying the Pyretrin-D series for 100 days.

In another patient, similar results can be observed confirming the effectiveness of the applied series. Problems related to the hairy scalp have been eliminated. The layer of dead skin and sebum that formed the crust has been removed. The patient stopped complaining of excessive itching. Further application of the tested series will contribute to both maintaining and improving the obtained results.

PATIENT C (blank test)

In yet another patient, it should be noted that the symptoms of the scalp have disappeared. It should be added that patients did not use any additional drugs, cosmetics or treatments that could support the final effect.

Figure 6. Photo of the hair before applying the Pyretrin-D series.

Figure 7. Photo of the hair after applying the Pyretrin-D series for 100 days.

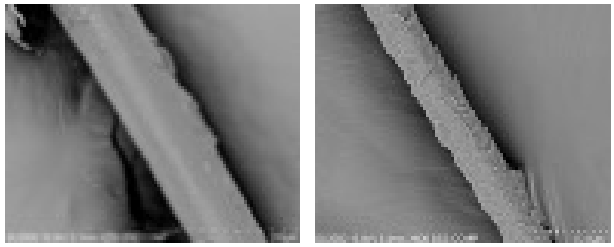

Figure 8. (A) Photo of the hair before applying the Pyretrin-D series (50 microns ×600, 15 kV). (B) Photo after applying the series for 100 days (200 microns x 250, 15 kV.

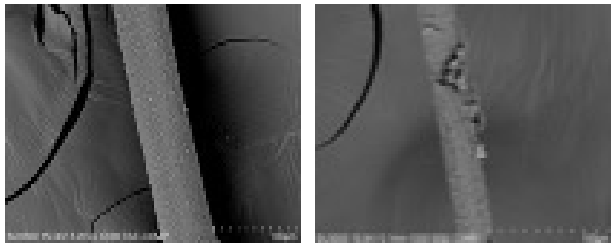

Figure 9. (A) Photo of the hair before applying the Pyretrin-D series (100 microns ×500, 15 kV). (B) Photo after applying the series for 100 days (100 microns ×350, 15 kV).

Apparatus test performed using the SEM method

Based on the research carried out with the use of a scanning electron microscope (SEM) that enables observation of the topography of the tested hair, differences in its condition can be noticed (sample 0 and after 100 days of the test) (Figs 8–10).

After a hundred days of use, the following properties of the series can be confirmed: hydration, nourishment, regeneration, cleansing (closing the hair cuticle) and improving the hair condition. The active substances used in the cosmetics contributed mostly to the improvement of the condition of the hair during the application of the series. As can be seen in the photos showing the hair before using the preparation, it was damaged and characterized by hair sheath of open cuticles. A casing

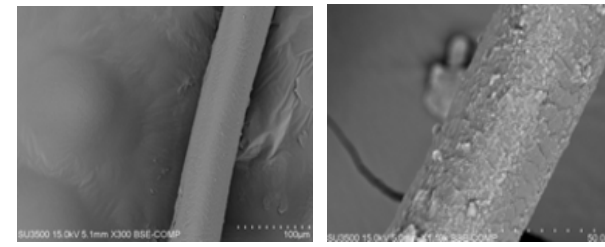

Figure 10. (A) Photo of the hair before applying the Pyretrin-D series (50 micron ×100, 15 kv). (B) Photo after applying the series for 100 days (100 microns ×300, 15 kV).

composed of open cuticles gradually ceases to fulfill its protective function. The cuticles open, among others, under the influence of alkaline pH and heat – high insolation, mechanical treatments, poor styling with the use of aggressive chemicals. Open cuticles result in the hair losing water faster and becoming dry, dull, rough and more sensitive to external factors. After the application of the series, similar results were recorded in the remaining probants (Kim, 2010).

DISCUSSION

The aim of the study was to present natural replacements to abovementioned chemical substances, including primarily: Dalmatian pyrethrum daisy, benzyl benzoate, *Cistus incanus*, tea tree oil and geranium oil, almond acid and arginine, *Helicrysum Angustifolium* extract and biomimetic ceramide. All of them have been introduced in the formula of the Pyretrin-D trichological series. This series is intended to reduce or completely eliminate the symptoms of seborrheic scalp inflammation. These raw materials have a multifunctional effect.

The causes of seborrheic dermatitis are not fully understood. Various hypotheses claim that the causes of the disease include increased production of sebum and improper composition of sebum, the yeast-like fungus Malassezia furfur and inflammation caused by these factors. It has also been confirmed that the *Staphylococcus epidermidis* bacterium and disturbances of the skin barrier function have an influence on the development of the disease. Factors that increase the likelihood of developing seborrheic dermatitis have also been established. They include neurological diseases (e.g. Parkinson's disease, epilepsy) and mental disorders, stress, weakened immune system (e.g. due to HIV/AIDS or certain cancers), use of selected drugs (e.g. haloperidol, lithium, psoralenes, gold salts, buspirone), improper diet (alcohol and nutritional deficiencies of e.g. zinc, selenium, or B vitamins), errors in skin care and overuse of cosmetics. Hence, the selection of components of the tested series was particularly important. The main ingredient is Dalmatian daisy which has proven antibacterial, antiviral, antifungal and antiparasitic properties. The thujone contained in Dalmatian pyrethrum is a component that is toxic to microorganisms (Kim 2010 *et al.*, Del Rosso, 2011; Sampaio, 2011).

This valuable natural ingredient rich in pyrethrins also acts as a regenerating hydro-lipid barrier and is an anti pollutant. The substance contributes to the improvement of protective mechanisms of the scalp, so that the inner layers of the skin are better sheltered (Hardin, 2004). This prevents infections caused by various microbes. Pyretrin-D, by eliminating microbial faeces, contributes to the improvement of the existing inflammations (Del Rosso *et al.*, 2011). After the participation in the study,

all patients noticed that their hair and scalp ceased to be greasy, and that the sebaceous glands functioned in a more regular manner. In addition to the main base substances, the following ingredients of the series are also characterized by antimicrobial, exfoliating, regulatory and soothing properties: mandelic acid, black cumin oil, biotin, *Helicrysum Angustifolium* extract, benzyl benzoate, Dalmatian pyrethrum daisy, *Cistus incanus*, tea and geranium oil, almond acid and arginine. Mild surfactants have been used in the shampoo to avoid irritating the scalp while washing.

The use of these substances eliminated seborrheic dermatitis and made it possible to avoid controversial chemicals such as ciclopiroxolamine, ketoconazole or zinc pyritonate; long-term use of these may lead to deterioration of the patient's condition (Sampaio *et al.;* 2011). Abuse of these substances also leads to resistance to their effects.

Photographs taken with a scanning electron microscope after 100 days of application of the Pyretrin-D series show the closure of the cuticular scales. Closed scales testify to the increased effect of smooth, moisturized, and nourished hair with a natural glow and improved condition. Closing the cuticles was possible by supplying the hair with active substances contained in the cosmetic, such as biomimetic ceramides (RepHair®). The substance is a ceramide-like particle obtained in a green chemical process without the use of solvents, from two saturated vegetable fatty acids. The biomimetic ceramide strengthens the hair fibers, smoothes its surface, improves resistance and provides shine. It also reduces the surface damage. Its preventive effect reduces breaking hair and split ends (Hardin, 2004). Additionally, black seed oil, biotin, hydrolyzed wheat proteins, and panthenol were added to the formulation. These substances also contributed to the restoration of the proper function of the hydro-lipid coat. The hair structure was rebuilt (Del Rosso *et al.*; 2011). It might be stated that the appearance of the hair will improve as the preparation is further used. The above-mentioned active substances contributed to the filling of the defects of the outer layer of the hair and strengthened the internal structure of the hair fiber. The introduction of the conditioner in the form of a liquid crystal emulsion resulted in faster and more effective absorption of the ingredients into the scalp and hair (Gupta, 2001; Gupta *et al.*, 2003; Ceschin-Roques *et al.*, 1991).

Based on the research including the cosmetic impact assessment on the safety of human health, tests on skin tolerance at the site of application, interviews with probants and apparatus results, it can be concluded that the products of the Pyretrin-D trichological series, when used in accordance with the intended use recommended by the manufacturer, were very well tolerated in the place of application and meet the requirements for products intended for scalp and hair care. In an appropriately selected group of probants, no negative (objective or subjective) symptoms were observed in the places of regular use (Rosen *et al.*, 1997; Wilk *et al.*, 1995).

CONCLUSIONS

The tests were carried out to confirm the safety and the manufacturer's declaration for the Pyretrin-D trichological series, using the following devices: Scanning Electron Microscope (SEM) and the TrichoScope Polarizer Dino-Lite trichology microcamera (MEDL4HM). It was found that the tested cosmetic series containing these active ingredients: Dalmatian daisy, sage oil, tea tree, rose and geranium oil, and benzyl benzoate is intended for frequent washing of hair and scalp in people with a tendency to seborrheic dermatitis and Demodex infections. The shampoo is based on mild natural biodegradable detergents that thoroughly cleanse the scalp without drying the skin. The product soothes itching, has anti-dandruff properties, and reduces oily scalp.

Owing to its universal base, the Pyretrin-D conditioner is intended not only for oily hair but also for hair with different porosity. It contains active substances that moisturize, nourish, and improve the structure of the hair.

The Pyretrin-D peeling is intended mainly for cleansing the scalp. It regulates the sebaceous glands. It is characterized by an antimicrobial effect, thanks to which it reduces inflammation. Due to its active substances, it soothes the skin exposed to pollution and smog. The best results were noticed after applying the peeling.

In turn, the Pyretrin-D liniment has a toning and regulating function if used after washing the scalp and hair. It allows the physiological pH of the scalp to be maintained, which creates the correct environment for the natural microflora. It helps to strengthen the hair roots which function properly after being cleaned. The selected active substances also nourish and moisturize both the scalp and hair. The liniment also regulates an excess sebum production. The antioxidant effect and the anti-aging effect on the skin have also been noted.

In the future, the team intends to conduct research on the Pyretrin-D series dedicated to facial skin aiming at confirming the antimicrobial properties of these cosmetics.

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Conflicts of interests

The authors declare that they have no conflicts of interest.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Authors' contributions

JIK conceived and designed the experiments; JIK, EKP, SPG analyzed and interpreted the results of the experiments; and JIK, EKP performed the experiments.

REFERENCES

Ali N, Zohra RR, Qader SA, Mumtaz M (2015) Scanning electron microscopy analysis of hair index on Karachi's population for social and professional appearance enhancement. *Int J Cosmet Sci.* **37**: 312–320. https://doi.org/10.1111/ics.12201

Ceschin-Roques CG, Hanel, H, Pruja-Bougaret, SM, Lagarde I, Vandermander J, Michel G (1991) Ciclopiroxolamine cream 1%: *In vitro* and *in vivo* penetration into the stratum comeum. *Skin Pharmacol* **4**: 95–99. https://doi.org/10.1159/000210930

Dessinioti C, Katsambas A (2013) Seborrheic dermatitis: etiology, risk factors, and treatments: facts and controversies. *Clin Dermatol* **31**: 343–351. https://doi.org/10.1016/j.clindermatol.2013.01.001

Del Rosso JQ (2011) Adult seborrheic dermatitis: a status report on practical topical management. *J Clin Aesthet Dermatol* **4**: 32–38. https://doi.org/10.1159/000444682

Del Rosso JQ, Levin J (2011) The clinical relevance of maintaining the functional integrity of the stratum corneum in both healthy and

disease-affected skin. *J Clin Aesthet Dermatol* **4**: 22–42. https://doi.org/10.1002/ski2.21
Dz.U. 2018 poz. 2227, The Cosmetics Act of 4.10.2018
Fatsini-Blanch V, Martínez-González MI, Heras-González SA (2017) RF-Itraconazole pulse therapy for seborrheic dermatitis: A treatment approach to consider. *Actas Dermosifiliogr* **108**: 583–584. https://doi.org/10.1016/j/ad/2017.01.006
Gupta AK (2001) Ciclopirox: An overview. *Int J Dermatol* **40**: 305–310. https://doi.org/10.1046/j.1365-4362.2001.01156.x
Gupta AK, Kohli Y (2003) *In vitro* susceptibility testing of ciclopirox, terbinafine, ketoconazole and itraconazole against dermatophytes and nondermatophytes, and *in vitro* evaluation of combination antifungal activity. *Br J Dermatol* **149**: 296–305. https://doi.org/10.1046/j/1365-2133.2003.05418.x
Gupta AK, Madzia SE, Batra R (2004) Etiology and management of Seborrheic dermatitis. *Dermatology* **208**: 89–93. https://doi.org/10.1159/000076478
Harding CR (2004) The stratum corneum: structure and function in health and disease. *Dermatol Ther* **17**: 6–15. https://doi.org/10.1111/j.1396-0296.2004.04s1001.x
Igielska-Kalwat J (2018) Studies on stability of emulsions containing carotenoids. *Acta Biochim Pol* **65**: 455–463. https://doi.org/10.18388/abp.2018_2589
Igielska-Kalwat J, Mahmood T (2018) *In vivo* research of cosmetic forms containing beta-carotene. *Acta Poloniae Pharma* **75**: 313–320
Igielska-Kalwat J, Nowak I, Gościańska J (2016) *In vivo* studies of substances used in the cosmetic industry. *Postepy Dermatol Alergol* **33**: 163–169. https://doi.org/10.5114/ada.2016.60607
Kim YD, Jeon SY, Ji JH, Lee, WS (2010) Development of a classification system for extrinsic hair damage: Standard grading of electron microscopic findings of damaged hairs. *Am J Dermatopathol* **32**: 432–438. https://doi.org/10.1097/DAD.0b013e3181c38549
Kolodziej T, Bialynicki-Birula R (2004) Ciclopirox in the treatment of seborrheic dermatitis. *Mikol Lek* **11**: 329–332. https://doi.org/10.25121/PNM.2018.31.1A.49
Mameri ACA, Carneiro S, Mameri LMA (2017) History of seborrheic dermatitis: Conceptual and clinico-pathologic evolution. *Skinmed* **15**: 187–194
Mitkowski P, Szaferski W (2016) Production of emulsion in tank mixer with sieve bottom. *ChERD* **109**: 618–627
Rosen T, Schell BJ (1997) Orengo, I. Anti-inflammatory activity of antifungal preparations. *Int J Dermatol* **36**: 788–792. https://doi.org/10.1046/j.1365-4362.1997.00309.x
Rudnicka L, Olszewska M, Rakowska A, Slowinska M (2011) Trichoscopy update. *J Dermatol Case Rep* **5**: 82–88. https://doi.org/10.3315/jdcr.2011.1083
Rudnicka L, Rakowska, A, Kerzeja M, Olszewska M (2013) Hair shafts in trichoscopy: Clues for diagnosis of hair and scalp diseases. *Dermatol Clin* **31**: 695–708. https://doi.org/10.1016/j.det.2013.06.007
Sampaio AL, Mameri AC, Vargas TJ, Ramos-e-Silva M, Nunes AP (2011) Seborrheic dermatitis. *Ann Bras Dermatol* **86**: 1061–1071. https://doi.org/10.1590/s0365-05962011000600002
Schwartz RA, Janusz CA, Janniger CK (2006) Seborrheic dermatitis: an overview. *Am Fam Physician* **74**: 125–130. https://doi.org/10.5604/17322693.1019642
Wilk JA, Wilk KE, James VJ, Amemiya Y (1995) The intermediate filament structure of human hair. *(BBA)-General Subjects* **1245**: 392–396. https://doi.org/10.1016/0304-4165(95)00111-5