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EVALUATION OF THE BENEFITS AND SAFETY OF THE COSMETIC USE OF IN NATURA COCONUT OIL FOR SKIN AND HAIR

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Abstract: The search for natural alternatives that meet the precepts of the so-called clean cosmetics for skin and hair care is growing. The use of in natura vegetable oils for care purposes through topical application is gaining more and more followers around the world. Used in medicinal and cosmetic formulations, the oils demonstrate excellent cosmeticity and practicality of use, in addition to providing satisfactory and lasting results. Among the oils that stand out the most for cosmetic application in its in natura form, is extra virgin coconut oil, which is a versatile substance with several applications for the skin and hair due to its lipid composition, and is also used as a base substance for numerous pharmaceutical products. The objective of this study is to elucidate the possible benefits and safety of using coconut oil in natura for cosmetic purposes. In addition to evaluating the reversal of capillary and skin damage from the results obtained in a clinical test of use, associated with references available in the literature. Coconut oil showed great cosmetic satisfaction and appreciability among users. Also showing the potential for action both in the intercuticular regions and in the cortex, in addition to the possibility of forming an additional layer of protection for the hair, with the potential to reduce water fatigue and capillary dryness. The tests related to the safety of use also showed very positive results, so that none of the participants developed any kind of discomfort, irritation and did not present any clinical sign that would show any incompatibility for capillary or cutaneous use. Coconut oil has also not been shown to cause acne, pustules or comedones in combination and oily skin. Thus, it proved to be a versatile and safe substance for application on hair and skin, according to the findings of this study.

Keywords: Cosmetics; Coconut oil; skin; hair; capillary wetting; phytocosmetics.

INTRODUCTION

The search for natural alternatives for skin and hair care is growing and the use of vegetable oils for beautifying purposes, through topical application, is gaining more and more followers around the world. Data indicate that in recent years, the growth of this market has surpassed products of synthetic origin (PINTO, 2020). One of the reasons for the high interest in natural products is associated with the great impact of the environmental crisis, which brings to light the need to prioritize the choice of so-called clean cosmetics, which includes vegan products, formulations without dyes, preservatives and additives that are toxic or pollutants, and that respect the principles of sustainability without causing damage to the environment and the health of users (LYRIO, 2011; ZUCCO, 2020).

Used in medicinal and cosmetic formulations, vegetable oils demonstrate excellent acceptability and practicality of use, providing satisfactory and lasting results, presenting great potential when used in isolation, as well as when used in the development of phytocosmetics (LYRIO, 2011). Faced with the growing worldwide trend towards the use of natural substances from plants and derivatives in cosmetic formulations and the vast diversity of oleaginous plants that make up the Brazilian flora, there is enough capacity for Brazil to stand out worldwide in the production and commercialization of vegetable oils (KUMAR, 2011).

Among the oils that stand out the most for cosmetic application in its in natura form, is cold-pressed, non-hydrogenated coconut oil, which is a versatile substance, considered a phytocosmetic with several actions for the skin and hair and basis for numerous pharmaceutical, cosmetic and food products due to the quality of its lipid composition (ALECRIM et. al., 2017; DAUBER, 2015).

Coconut products are included in the diet of thousands of people, mainly among populations in the tropical and subtropical regions. However, it stands out in cosmetic and medicinal applications in these cultures, with its millennial use disseminated from generation to generation (CHAN et. al., 2006; DEBMANDAL et al., 2011).

The physicochemical properties of coconut oil vary according to preparation and extraction. The main fatty acids present are: caproic, caprylic, lauric, myristic, palmitic, stearic, arachidic, palmitoleic and omega 9 oleic and omega 6 linolenic (KUMAR, 2011; DAUBER, 2015). Its derivatives, such as lauric acid (C12) which corresponds to approximately 50% of the weight of coconut oil (DAYRIT, 2015) and myristic acid (representing about 18.6% of the natural composition), are widely used by the industry. cosmetics and pharmaceuticals (MARTINS, 2015).

Coconut oil is considered an exception when compared to other vegetable oils. Even though it is predominantly composed of saturated fatty acids, which are related to greater consistency of fats stored at room temperature, it is presented in liquid form. This atypical behavior is justified by the predominance of medium-chain fatty acids, which correspond to about 70-80% of its composition (KUMAR, 2011; DEBMANDAL et al., 2011). The average pH value of coconut oil is in the range between 3.33 to 3.50, with moisture ranging from 0.263 to 0.382% and density from 0.903 to 0.924 g/mL (MARTINS, 2015; ROHMAN et. al., 2019).

The skin is relatively permeable to fat-soluble molecules and impermeable to water and salts, as cell membranes are composed of a lipid bilayer. Products with a high lipid content are recommended for the care of dry skin and for the treatment of inflammatory conditions because they penetrate through the

skin layers and reach their target structures, which are partially located below this barrier (WYSOCKI, 2012). Added to this fact and due to the physical-chemical characteristics, including the molecular mass and the linear chain, coconut oil also has a high protein affinity and high efficiency in reducing and preventing water fatigue of the wires (GAVAZZONI, 2017; LASZLO, 2018).

Both the skin and the hair fiber are often exposed to damage that can compromise their structure, functionality and appearance. Such damage is caused by general factors that include exposure to pollution, lack of adequate sun protection, use of inappropriate cosmetics, smoking and nutritional factors. Added to specific conditions such as physical and chemical capillary damage that can be caused by straightening processes, discoloration, excessive use of heat sources directly on the hair, structural impairment caused by combs, brushes or artifacts used to hold the strands (NAKAMO, 2009).

The fact that the capillary thread is amorphous, does not present repair capacity and the degree of hydration of the stratum corneum and the transepidermal water loss (TEWL) are related to the degree of damage to the barrier, the use of cosmetics that contribute to this balance is an option for hair repair and prevention (ADDOR, 2010). Given this scenario, this study aimed to elucidate the benefits and safety of coconut oil, cold pressed and not hydrogenated, based on the results obtained in a clinical test of use, associated with the references available in the literature.

METHODOLOGY

GENERAL CONSIDERATIONS

The studies carried out to evaluate the cosmetic benefits of coconut oil for hair and skin were coordinated by dermatologists and carried out at a clinical and pre-clinical research institute located in the interior of

São Paulo. The results were released for the production of this study, in order to elucidate the effectiveness and feasibility of applying coconut oil for cosmetic purposes. The coconut oil samples used in the tests were from a brand available on the market with physicochemical characteristics that include: non-hydrogenated, cold pressed and free from the addition of any other component.

Tests carried out on human beings are regulated according to strict laws, with the aim of protecting and safeguarding individuals. This research met the protocols approved by a Medical Ethics Committee and followed the precepts of the Declaration of Helsinki and Resolution 196/96 (NATIONAL HEALTH COUNCIL, 1996). All ethical precepts and legal principles were observed throughout the study. The integrated research institute responsible for carrying out the clinical tests is certified by ANVISA, also having ISO/IEC 17025 accreditation. All the participants who met the exclusion and inclusion criteria signed an informed consent form to participate in the study.

The tests carried out and the criteria for their execution are described below:

GENERAL INCLUSION AND EXCLUSION CRITERIA

The following general inclusion and exclusion criteria were considered for the tests: Participants who had any of the following characteristics were excluded: presence of solar erythema in the experimental area due to intense exposure to the sun in the month prior to the study; skin marks in the experimental area that interfere with the evaluation of possible skin reactions (pigmentation disorders, vascular malformations, scars, increased hairiness, freckles and nevus in large numbers, sunburn); pregnant or lactating women; participants with a history of allergy to the material used in the study; history of

atopy; people with immunodeficiencies; kidney, heart or liver transplants; active skin pathologies that may interfere with the study (vitiligo, psoriasis, lupus, atopic dermatitis); topical use of corticoid in the experimental area up to 8 days before the beginning of the study; treatment with acidic vitamin A and/or its derivatives orally or topically up to 03 months before the beginning of the study; atopy, skin hyperreactivity; being instructed not to perform aesthetic or dermatological treatments during the study.

Participants who met the exclusion and inclusion criteria signed an informed consent form to participate in the study.

GENERAL GUIDELINES

Participants were instructed not to change their diet, cosmetic and hygiene habits, exercise routine, and usual contraceptive methods. They were instructed not to use products from the same category as the product tested in the experimental region, not to perform aesthetic or dermatological treatments during the study.

CRITERIA FOR GENERAL EVALUATION OF RESULTS THE RESULTS RELATED TO FEELINGS OF DISCOMFORT OR CLINICAL SIGNS WERE EVALUATED AS:

- a) Sensations of discomfort: the participants were asked about the sensations of discomfort felt, in parallel with the clinical examination. To be described in relation to nature (example: burning, itching, itching, tightness, cooling, heating, etc.) and classified according to intensity as: mild, moderate or intense; as to location; and as to duration; and verified the imputability to the test product.
- b) Clinical signs: classified according to the presence of erythema, soap effect, edema, papules, coloration, pustules, blisters,

nodules, dryness, desquamation, crust and vesicle, classified as mild moderate and severe/intense.

SPECIFIC CRITERIA FOR EACH TEST

The specific criteria for performing each test and its execution are described below.

EVALUATION OF COSMETIC APPRECIABILITY

For this test, 33 female participants were included; aged between 19 and 60 years, phototype: II to IV; with intact skin in the region (skin/scalp).

The product, without brand identification, was delivered to the participants to be used at home for 30 ± 2 days. All were properly instructed on the use according to the mode of use, which consisted of the following guidelines:

- a) For the skin: Apply to damp skin after showering on the body areas of interest, massaging in light circular motions (no need to rinse).
- b) For the hair: Hair Wetting Technique. Put a sufficient amount of coconut oil in the palm of your hands and apply gently to dry hair, leave it on for 4 hours. After the action interval, wash the wires with the shampoo for daily use, rinse and finish as usual.

The choice of the hair wetting technique for the study was determined, since it is highly adopted by supporters of the in natura use of coconut oil for hair care. For the assessment of appreciability, an initial medical assessment was performed at the time of inclusion of the participants to verify the absence of initial clinical signs incompatible with the inclusion of the participants.

After using the product, the participants returned to the institution for a final medical evaluation of the clinical signs presented and questioning the feelings of discomfort felt.

After the evaluation, the participants

were instructed to answer a questionnaire containing the questions listed as YES or NO. Including: if you liked the product; would buy; if the product improved the appearance of the hair; provided softness and silkiness to the threads; whether the product has repaired damage. In relation to the skin: if the product improved the appearance of the skin; whether the appearance of stretch marks has improved; whether tonicity has improved; and increased hydration in the skin.

ASSESSMENT OF NON-ACNEGENICITY AND NON-COMEDOGENICITY UNDER NORMAL CONDITIONS OF USE OF THE COSMETIC PRODUCT, WITH DERMATOLOGICAL ACCEPTABILITY

For the present study, 33 participants of both genders with the following characteristics were included: age from 18 to 63 years, mixed to oily skin with acne, residents of the neighborhood living close to the clinic, being in healthy conditions, corresponding to the pre-requisites defined by the physician in charge, intact skin in the test region (face), phototype I to IV according to the Fitzpatrick classification, no history of irritation and/or allergy to the material used in the study, agreement to sign the free consent form and informed, participate in the research by free and spontaneous will, without financial profit, being only reimbursed the costs of transportation and food. Exclusion criteria are mentioned in topic 2.1.1 General inclusion and exclusion criteria.

The product was applied by the participants themselves, in their homes, following the instructions for use, for 21 ± 2 days. An initial medical assessment was performed at the time of inclusion of the participants to verify the absence of initial clinical signs incompatible with the test conditions. After 21 ± 2 days of

using the product, the volunteers returned to the Institution for a final medical evaluation of the clinical signs presented and questioning of the sensations of discomfort felt. The results were evaluated as described in topic 2.1.3 Criteria for general evaluation of results.

To evaluate the non-comedogenic effect of the product, the following were observed: oiliness, papules, pustules and comedos in the experimental area determined for product application and these were classified and/or quantified before and after use according to the table below:

PARAMETER	CLASSIFICATION
Oiliness	0 = missing 1 = light 2 = moderate 3 = intense
comedos	0 = missing 1 = light (up to 10 comedos) 2 = moderate (from 11 to 50 comedos) 3 = intense (above 50 comedos)
papules	Quantity count in the experimental area
pustules	

Table1- Parameters and classification for effect evaluationnon-comedogenic.

Source: Integrated Clinical Research Institute.

DERMATOLOGICAL ASSESSMENT OF PHOTOTOXICITY AND PHOTSENSITIZATION POTENTIAL

This test included 30 participants, of both sexes, with the following characteristics: Age between 19 and 50 years and phototypes: II to IV. Exclusion criteria are described in topic 2.1.1 General inclusion and exclusion criteria. The product was applied over semi-occlusive dressings. Mineral oil was used as a control. The dressings were placed on the right or left back of the participants (according to randomization). The positions of the products and controls in each participant’s dressing room were maintained throughout the entire test. The results were evaluated as described in topic 2.1.3 Criteria for general evaluation of results.

The product and the control were applied under a semi-occlusive dressing on the back of the participants, on the right or left side (according to randomization). The contact test remained on the skin for 48 hours, after which it was removed for irradiation of the region with UVA at a dose of 4 J/cm2. After irradiation, the clinical signs were read and the sensations of discomfort were questioned by the dermatologist. After reading, a new deposit was placed, keeping the products in the same position.

DERMATOLOGIC ASSESSMENT OF PRIMARY, CUMULATIVE, AND SENSITIZATION DERMAL IRRITABILITY

Sixty participants were included in this study, aged between 19 and 50 years; and phototypes: II to IV. Exclusion criteria are described in topic 2.1.1 General inclusion and exclusion criteria.

The product was applied over semi-occlusive dressings. Mineral oil was used as a control. The dressings were placed on the right or left back of the participants (according to randomization). The positions of the products and controls in each participant’s dressing room were maintained throughout the entire test. The results were evaluated as described in topic 2.1.3 Criteria for general evaluation of results.

The product and the control were applied under a semi-occlusive dressing on the back of the participants, on the right or left side (according to randomization). The contact test remained on the skin for 48 hours, after which it was removed for irradiation of the region with UVA at a dose of 4 J/cm2.

After irradiation, the clinical signs were read and the sensations of discomfort were questioned by the dermatologist. After reading, a new deposit was placed, keeping the products in the same position.

The applications were carried out according to the following table:

Day of the week	Week	Monday	Tuesday	Wednesday	Thursday	Friday
induction phase	1st	A		A+L		A+L
	2nd	A+L		A+L		A+L
	3rd	A+L		A+L		L
rest phase	4th	No deposit applied				
	5th					
challenge phase	6th	A+L		L		

Table 2- Dermatological assessment of primary and accumulated dermal irritability and sensitization

Source: Integrated Clinical Research Institute.

Caption: A = application; L = reading

RESULTS AND DISCUSSION

EVALUATION OF COSMETIC APPRECIABILITY

A total of 32 participants were included for this test. Since, 31 participants completed the study. The results related to cosmetic appreciability were:

COSMETIC APPRECIABILITY GENERATESL

91% liked the product and 91% would buy the product.

COSMETIC APPRECIABILITY FOR CAPILLARY USE THROUGH THE HUMECTATION TECHNIQUE

88% thought that the product improved the appearance of the hair; 84% thought that the product provides softness to the hair; 91% felt that using the product provided hair with shine; 84% thought that the product promoted silkiness in the hair.

For a better understanding, the penetration capacity of coconut oil through the layers and capillary structures will be discussed according to its action in the cuticle and cortex region of the hair:

Cuticular action:

Due to its high protein affinity linked to its physicochemical characteristics, such as the molecular mass and linear chain, coconut oil, cold pressed, not hydrogenated and free from

the addition of any other component, is able to protect the hair fiber from predisposition to the variation of the volume of its structure. This mechanism prevents hair thinning, as the oil prevents excessive water absorption and, consequently, reduces protein loss during the hair washing process, which can be linked to use as an agent applied in pre-wash. The adequate molecular volume and the capacity of interaction of polarized regions in the molecules, due to the linear chain, the penetration in the cortex of the wire is facilitated. Process that slows down the loss of pigments and the fading of strands exposed to discoloration (GAVAZZONI, 2015; LASZLO,

A comparative study carried out by Rele and Mohile (2002), between coconut and sunflower oils and mineral oil used in isolation, demonstrated that only the oils of vegetable origin analyzed demonstrated the ability to penetrate the portion of the capillary cortex, with the oil of coconut stood out for its greater absorption capacity. For this verification, protein loss and water retention of locks of different types and textures of hair were evaluated. The locks were previously exposed to various damages, including discoloration and drastic exposure to ultraviolet radiation (RELE, 2002).

The increase in suppleness of the threads, after treatment with coconut oil, may occur as a result of capillary filling promoted by medium-chain triglycerides, naturally present

in its composition, since the concentration of amino acids is directly related to the weight distributed along the length of the hair thread, positively changing the appearance of the threads. The study also demonstrates that coconut oil can be effective in improving the physiology of the scalp and reducing excessive oiliness observed in some conditions of imbalance in sebaceous production (ALECRIM, et. al., 2017).

COSMETIC APPRECIABILITY FOR CUTANEOUS USE THROUGH TOPICAL APPLICATION, ON DAMP SKIN, WITHOUT RINSING

88% pointed out that coconut oil improved the appearance of the skin; 69% found that improved the appearance of stretch marks; 78% stated that the product promoted an increase in skin tone and 91% noticed an increase in skin hydration with use.

The skin covers the surface of approximately 2 m² of the body and corresponds to approximately 16% of its body weight, being the largest organ of the human body and the main physical barrier against the external environment, it performs several vital functions of communication and control that guarantee the homeostasis of the organism. The skin is an organ that undergoes constant transformations and over the years undergoes changes resulting from time, significantly altering its physiological and structural functions. (NAKAMO, 2009).

As it demonstrates relative permeability to soluble fat molecules, as cell membranes are composed of a lipid bilayer, products with a high lipid content are well suited for dry skin care and for the treatment of inflammatory conditions. This justifies the high cosmetic acceptability of coconut oil for cutaneous applications among the individuals participating in the study, who reported improved appearance (88%),

increased tonicity (78%) and increased skin hydration, which was the most prominent benefit, pointed out by 91% of the participants (WYSOCKI, 2012).

It is known that vegetable oils have the ability to form a protective lipid layer on the skin, which prevents the loss of interstitial water, thus prolonging local hydration, effectively providing a beneficial barrier function, preventing the loss of the tissue's natural moisture, which is fundamental. to prevent the occurrence of fissures in the stratum corneum, which could become undesirable permeation points for higher molecular weight agents, such as pathogens and allergens. This even increases skin absorption, since the concentration of water retained in the stratum corneum is proportional to this capacity (WYSOCKI, 2012).

Since the concentration of water stored in this compartment correlates with the ability to retain water in the tegument and with the degree of softness and flexibility of the skin, even under unfavorable environmental conditions. Such findings reinforce the hypothesis that the previous use of coconut oil in natura can contribute as a positive factor in the protection and also in the preparation of the skin, to better receive other aesthetic treatments that depend on tissue absorption and hydration, thus increasing the response to these resources (ADDOR, 2010).

As demonstrated in the study, coconut oil showed great satisfaction and cosmetic appreciability regarding cosmetic use for hair and skin care. It can be considered an effective phytocosmetic, according to the data obtained in the present study.

EVALUATION OF NON-ACNEGENICITY AND NON-COMEDOGENICITY UNDER NORMAL CONDITIONS OF USE OF THE COSMETIC PRODUCT, WITH DERMATOLOGICAL ACCEPTABILITY

A total of 33 participants were included to carry out the study and all remained until the conclusion of the research. After 21 ± 2 days of using the product, the volunteers underwent a medical evaluation which found that no participant had feelings of discomfort and no clinical signs of increased oiliness, increased number of papules, increased number of pustules or increased of comedos.

The comedogenicity assessment investigates whether or not the product favors the appearance of blackheads or comedones on the skin. The presence of a papule is observed by a circumscribed solid lesion smaller than 1 cm in diameter, elevated, with a flat or curved surface. The pustule is a lesion with a circumscribed elevation of the epidermis, a small cavity similar to a vesicle with the presence of purulent content. Comedones are considered the first signs of acne, with the presence of an enlarged hair follicle filled with bacteria and sebum. Open comedones are known as blackheads, while closed comedones can cause an inflammatory reaction in the skin. When the presence of irritation of the pilosebaceous unit occurs, with or without inflammation, it is evaluated by the acneogenicity test (ANVISA, 2012).

As shown, the non-acneogenicity and non-comedogenicity tests in patients who have mixed to oily skin showed very satisfactory results, so that none of the participants developed any type of discomfort and irritation and did not hear any evidence of clinical signs of increased oiliness, papules, pustules or comedos. Demonstrating the safety of using cold-pressed coconut oil, non-

hydrogenated and free from the addition of other components, in users with combination to oily skin.

DERMATOLOGICAL EVALUATION OF THE POTENTIAL FOR PHOTOTOXICITY, PHOTSENSITIZATION

A total of 30 participants were included, of which 27 completed the study. After clinical evaluation carried out by the specialized medical team, no adverse reactions were detected in the product and control areas during the study period. No participant reported feeling uncomfortable with the product or the control during the study.

The dermatological evaluation of the potential for phototoxicity and photosensitization observes the cytotoxicity and/or allergenic potential of coconut oil against non-toxic exposure to UVA light. Photosensitivity is an unusual, extreme sensitivity reaction of the skin when exposed to sunlight or artificial light sources, induced by chemical substances. Phototoxic reactions are those capable of causing long-term damage, and can be observed minutes and hours after exposure. Photoallergic-type reactions, on the other hand, are rarer and take longer to observe, and can spread in the body (ANVISA, 2012).

After irradiation of UVA light, it manages to reach the epidermis and dermis, altering the protein matrix of the skin, in a way that leads to photoaging and local immunosuppression. Irradiation and the presence of a product can lead to photoallergic and phototoxic reactions, the latter being more frequent. Factors such as the site tested, the degree of melanin pigmentation of the skin, the consumer's immune status and the product used can aggravate these reactions (SALGADO et al., 2010; BENEDETTI, 2019).

In view of the above, the dermatological

evaluation tests of the potential for phototoxicity and photosensitization showed satisfactory results, so none of the participants developed any type of discomfort and irritation during the study. Thus, it is possible to observe the safety of using cold-pressed coconut oil, not hydrogenated and free from the addition of other components, as a phytocosmetic for the skin.

DERMATOLOGICAL ASSESSMENT OF PRIMARY, CUMULATIVE DERMAL IRRITABILITY AND SENSITIZATION

The test was carried out with the aim of to evaluate whether coconut oil has the ability to cause primary and cumulative dermal irritability and sensitization compared to a control (patch test). In the total, 60 participants were included in the study. Of these, 54 remained until the final phase of the study.

No adverse reactions were detected in the product and control application areas during the study period. No participant reported feeling uncomfortable with the product or the control during the study. The medical team responsible for conducting and supervising the study concluded that the product did not induce skin irritation and sensitization during the study period.

The evaluation tests of primary and accumulated skin irritation aim to prove the absence of irritation reactions in the first application, which is considered as primary and with the constancy of use, being considered accumulated. Irritation is an inflammatory process with product contact in a given area due to tissue damage, varying with concentration, formulation, applied amount, mode of use and frequency (ANVISA, 2012).

CONCLUSION

The choice for natural products such as coconut oil for cosmetic purposes is growing and can be considered a global trend when it comes to cosmetic innovation. Given this, the importance of carrying out studies that evaluate the safety and efficacy in its most diverse applications is of paramount importance. Therefore, the present study evaluated the cosmetic benefits of cold-pressed coconut oil, non-hydrogenated and free from the addition of other components, elucidating its safety, efficacy and feasibility of its use in natura for cosmetic purposes for application in hair and skin treatments.

As it was shown, coconut oil showed satisfactory results when used on the skin and hair through hair wetting, demonstrating a high ability to improve the appearance, silkiness, shine and softness of the hair. The action potential was evidenced both in the intercuticular region and in the hair cortex, with the possibility of forming an additional layer of protection, with the potential to reduce water fatigue and hair dryness.

The effects observed when used on damp skin after bathing, without the need for rinsing, increased hydration was the item most observed by the participants. Clinical safety tests, which included: dermatological evaluation of the potential for phototoxicity and photosensitization and dermatological evaluation of primary, accumulated, and sensitization dermal irritability, showed positive results, so that none of the participants developed any type of discomfort, irritation, or showed any sign of clinical trial that showed some incompatibility for capillary or cutaneous use. Coconut oil has also not been shown to cause acne, pustules or comedones in combination and oily skin. Proving to be a versatile and safe substance for hair and skin application,

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