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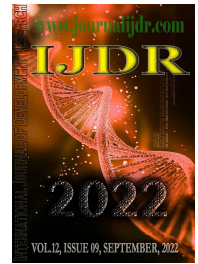
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RESEARCH ARTICLE

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MICROBIOLOGICAL CONTAMINATION IN COSMETICS

¹Cristianne Confessor Castilho Lopes, ²Franciele Scheffmacher, ³Gabriela Nardi, ²Eduardo Barbosa Lopes, ⁴Lucas Castilho Lopes, ⁶Daniela dos Santos, ⁷Tulio Gamio Dias, ⁸Marilda Moraes da Costa, ⁹Paulo Sergio Silva, ¹⁰Leandro Vinicius Bealuka, ²Lucas Bottesini dos Santos, ²Alex Moreira Souza, ²Maykon Ribeiro, ²Izabelle Cavanus Fontana, ²Suellen Balbinoti Fuzinato, ²Joao Vitor Freitas Bertuci, ²Gabriele Alves dos Anjos, ²Fábio Herget Pitanga, ¹¹Liamara Basso Dala Costa, ²Youssef Elias Ammar and Marivane Lemos

¹University of Joinville Region - Joinville – SC; ²Alto Vale do Rio do Peixe University - Caçador – SC; ³Faculty of Applied Social Sciences - Xaxim – SC; ⁴Federal University of Santa Catarina - Florianópolis - SC; ⁵USP School of Arts, Sciences and Humanities – São Paulo – SP; ⁶Lutheran Educational Association - IELUSC College - Joinville – SC; ⁷UniSociesc - Joinville – SC; ⁸Unisul - Tubarão – SC; ⁹Federal University of Pampa (UNIPAMPA) - Uruguaiiana – RS; ¹⁰Volta Redonda University Center - UniFOA - Volta Redonda – RJ; ¹¹University of Southern Santa Catarina/Tubarão – SC; ¹²Contestado University – Concordia - SC

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*Corresponding author:

Cristianne Confessor Castilho Lopes,

ABSTRACT

Of synthetic or natural origin, cosmetics are products with various functions intended for body or facial beautification. Cosmetics are also intended to raise self-esteem and contentment. Every year, companies in the personal care, perfumery and cosmetics sector produce more innovative products on the market with new technologies. For this growth, safety and microbiological protection are mandatory to ensure that cosmetics are protected from microorganisms. Formulas with expired validity and term can cause an unwanted effect such as contact dermatitis, irritations, allergies. Microbiology in cosmetics has the function of identifying living organisms of microscope size. The objective of this work is to demonstrate how microbial contamination compromises the stability of the formulation. Methodology to achieve an optimal quality product depends on stability and reliability in the formulations and microbiological quality control evaluated. Results and conclusions, most contamination is caused by pathogenic microorganisms such as *Pseudomonas* spp, *Enterobacter* spp, *Klebsiella* spp, *Escherichia coli*, *Proteus* spp and *Staphylococcus* spp. It is concluded that cosmetics lose their function, preservatives undergo oxidation of the actives.

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INTRODUCTION

Microbiology in cosmetics has the function of identifying living organisms of microscope size, classifying the most common bacteria, molds and yeasts. Microbiotic contamination can compromise the product's functions, losing the stability of the formulation, changing its physical and visual composition, increasing the contamination of the active ingredients excipients of the formula and can lose the credibility of the brand, thus the contaminated products. We must have microbiological quality control in cosmetics, avoiding health damage caused by the misuse of cosmetics with microbial contamination (HALLA *et al.*, 2018). Cosmetic products generally combine various technical solutions and various inputs, which also

allow for performances that meet the new expectations of consumers, such as preservative-free, paraben free, organic, among others. The three main axes are mainly explored: the formulation that integrates a self-protection research, protective packaging against microbial contamination and, at times, almost aseptic production processes. The challenge remains to guarantee the microbiological safety of this new generation of products, whose antimicrobial protection, often attenuated, can represent a certain form of risk-taking, in balance with the search for an economic equilibrium point still acceptable to the consumer market (VECINO *et al.*, 2017). The legislation recommends that for cosmetic products, microbiological quality is considered a safety element. In fact, the evolution of regulations places the elements related to microbiology, ie, the microbiological quality must be documented by information on the specifications of

the raw material and the finished product; and what is new, by the results of the conservation challenge test. In other words, antimicrobial protection is now immediately accessible by consulting the product safety report (GOMES *et al.*, 2015; RITO *et al.*, 2012). It should be noted that the regulations do not indicate compliance criteria and are content to draw attention to certain product categories with regard to their microbiological quality specifications. The legitimate question arises more than ever about the acceptable microbiological safety of a cosmetic product in a context of more or less well-founded questioning of the safety of certain antimicrobial preservatives (BENVENUTTI *et al.*, 2017). Among them are the specifications of the finished products with regard to the notice of regulations on certain categories of products, since 2 levels of requirements are foreseen; on the one hand, an acceptable limit of <1000 CFU/g for topical products and, on the other hand, a reduced limit to <100 CFU/g for products used near the eye or mucous membranes, or specifically intended for children younger than 3 years. However, the cases mentioned by the regulation of products intended for the elderly or for people with a deficient immune system remain, which is almost impossible to consider globally by specific criteria (CAMPANA *et al.*, 2006). With regard to antimicrobial protection, after identifying the products whose risk analysis does not allow the conclusion that they are of low microbiological risk, the resistance criteria are clear when the formula complies, which corresponds to the acceptable microbiological safety of the product during their use, under reasonably predictable conditions (HALLA *et al.*, 2018; PULLIRSCH *et al.*, 2014). However, in the context of current media coverage and recurrent demonization of chemical molecules [including certain preservatives (MIT, phenoxyethanol, parabens, etc.), the need for a less "aggressive" formulation emerges, especially as it often makes it possible to support claims considered reassuring for consumers, requiring the emergence of new generation formulations, without the preservative system, however, for all that, perfectly preserved. This approach, from the design of the formula, calls for several combined "galenic" approaches, including the reduction of water activity, the use of emollients (multifunctional or not), among others. Given this context, there is a need to update the literature that discusses the harmful effects on skin physiology with the use of expired or inappropriate cosmetics; this study aims to review the literature and establish the toxic and harmful effects in the use of cosmetics that do not meet the established compliances for antimicrobial preservation.

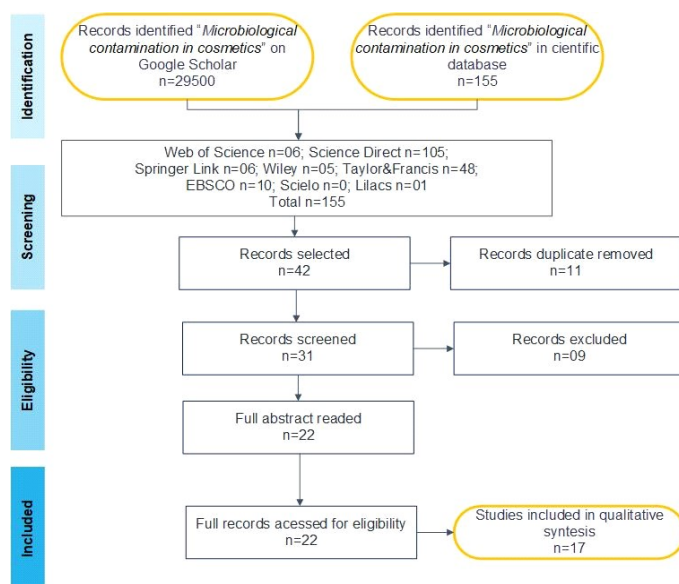
METHODOLOGICAL ASPECTS

This review was carried out in a bibliographic and exploratory character, was conducted by searching scientific articles indexed in the main electronic databases: Web of Science (Thomson Reuters), PubMed Central (NCBI), Science Direct (Scopus, Elsevier), Springer Link (Nature), Wiley Online Library (John Wiley & Sons), Taylor & Francis (Taylor & Francis Group), EBSCO (EBSCO Industries), Scielo (Scientific Electronic Library Online) and Lilacs (Latin American and Caribbean Literature in Health Sciences), published in English, Portuguese or Spanish. In a complementary way, searches were carried out based on bibliographic references of studies that addressed the topic in a relevant way on the Google Scholar search platform (Google, USA). The present study sought to investigate the literature regarding the main dermocosmetic ingredients applied in anti-pollution formulations, correlating with information about possible aesthetic treatments. For that, the descriptors "microbiological contamination in cosmetics" were used, initially in English, and in a complementary way in Spanish and Portuguese. For better updating, the word "aesthetic procedure" was added to the search. References of selected works to other documents of potential interest were also searched. Once qualified for full-text evaluation, articles were included in the qualitative review if they met the following inclusion criteria: a) they contained data on the use of contaminated cosmetics; b) with observational reports or experimental study. Articles were excluded if: a) they were reports, banners or congress abstracts; b) did not present relevant or conflicting data on the use of expired or contaminated products. There

was no review of confidential health information and the study was not interventional. Therefore, ethics committee approval was not required.

RESULTS AND DISCUSSION

The term "microbiological contamination in cosmetics" has 29500 results in English on the GoogleScholar search platform, 7180 results in Spanish, and 12000 results in Portuguese (excluding patents and citations). Most indexed articles use English words to register the descriptors, and this reason is verified in the main researched databases, where there are few articles in Portuguese or Spanish, or even no scientific literature on this topic in these languages. For this reason, the research conducted within the indexed databases continued using the word "microbiological contamination in cosmetics" as a descriptor, together with the word "aesthetic procedure", using the Boolean operator "AND". Within the databases researched, it is possible to find a total of 155 scientific articles, however, most of the articles have a different year of publication, and it is not possible to restrict the period to less than 5 years, as many databases did not present publications during this period (Figure 1). After reading the titles, abstracts and exclusion of repeated articles, it was possible to observe that 17 references met the requirements and used the terms reported above as a tool for studies regarding aesthetic approaches used for the prevention and treatment of aged skin due to smoking.



Source: the authors, 2022.

Figure. Number of articles available in the literature that present the term "anti-pollution cosmetic" associated with the descriptor "skin aging".

Cosmetics are classified as synthetic or natural, products with various functions intended for body or facial beautification, protection and prevention against imperfections for external use. Among a multitude of cosmetic products, the makeup category stands out, such as mascara, post-facials, lipsticks, lip gloss, eyeshadow and foundation and other cosmetics (BENVENUTTI *et al.*, 2017). Cosmetics also have the purpose of raising self-esteem and well-being, cleaning, perfuming, correcting appearance imperfections, body odors and protecting the health of teeth in the oral cavity, according to RDC No. 211, of July 14, 2005 (BENVENUTTI *et al.*, 2017; RITO *et al.*, 2012). Every year, companies in the personal hygiene, perfumery and cosmetics (HPPC) sector manufacture the most innovative products on the market with new technologies with professional segment factors in the Brazilian industry and in the world. Sales of beauty and personal care products reached BRL 109.7 billion in 2018, a real increase of 1.53% (PULLIRSCH *et al.*, 2014; SILVA *et al.*, 2019). With the increase in the cosmetics sector, registrations have increased

significantly, ANVISA has elaborated ways and methods of manufacturing and safety to keep these products safe for the consumer for a longer time, consequently the RDC n° 48 of October 25, 2013, from the Ministry of Health, which emphasizes the importance of complying with Good Manufacturing Practices for Personal Hygiene, Cosmetics and Perfumes products (RITO et al., 2012). For this growth to continue, it is necessary to monitor the use of safe and organized manufacturing standards for cosmetic products, as established in RDC No. Manufacturing Practices for Personal Care products, Cosmetics and Perfumes. Safety and microbiological protection is mandatory to ensure that cosmetics are protected from microorganisms, avoiding harm to human health causing damage, of enormous interest to consumers and regulatory bodies (BOM et al., 2019). Consumers are often unaware of the importance of checking the expiration date of their cosmetic products, and due to lack of information or even lack of interest in reading the label on the packaging of creams, lotions and make-up, they are more likely to have problems with the health and beauty of the skin. Formulas with expired validity, undergo the oxidation of these assets can cause an unwanted effect such as contact dermatitis, irritations, allergies (FAN et al., 2016).

The shelf life of cosmetic products after opening has a reduced shelf life, the cosmetic product may suffer some degradation due to external means, its properties change, the product is subject to the development of pathogenic microorganisms causing reactions such as allergies, skin or eye irritation depending on the region to be applied. After opening the cosmetic product with the entrance of air or even with the contact of the hands, the degradation of microorganisms can occur that can proliferate in the cosmetics, the skin and hands have microorganisms and dirt (GOMES et al., 2015; HALLA et al., 2018; JULIANO; MAGRINI, 2018). The shelf life after opening may have a shorter shelf life, it all depends on how this consumer uses the storage of these cosmetics and how they are handled. In this way, tests to evaluate are carried out on samples to verify how these cosmetic products will behave when exposed to humidity, low or high temperature and luminosity, this procedure is done before reaching consumers, to avoid interference in the quality of the product or even even physical-chemical modifications and changes in active ingredients (COSTA; SANTOS, 2017). But in Europe PAO (Period After Opening) is used with the meaning Period after opening (PAO) can be used as post-opening security of the cosmetic product followed by the letter M together with a number that refers to how many months can be used, example 18M equals 18 months for the use of the product taking into account it all depends on how it is being stored correctly. In Brazil, ANVISA is obliged to establish only the expiration date of the package (GOMES et al., 2015). Storage conditions are related to how the consumer uses these cosmetic products, temperature variation, regarding the transport of this cosmetic, conservation influences the effectiveness of the product, exposure to the sun should be avoided as it can lose its properties. Makeup should be avoided leaving exposed in the bathroom sink so that there is no temperature variation caused by humidity (ALMEIDA et al., 2018; BENVENUTTI et al., 2017). Liquid makeup as a foundation should be stored in an upright position, so it lasts longer. Keep the lipsticks in individual acrylic or plastic containers in an upright position, with the head down it can never happen to remove its base, it can dry out, avoid heat so it does not melt or perspire, thus losing its effectiveness and properties. With blushes, shadows and foundations, keep in the original packaging. The shelf life of the product depends a lot on the packaging, which can provide a longer stable life, maintaining the composition of the product (ALMEIDA et al., 2018; BENVENUTTI et al., 2017; COSTA; SANTOS, 2017). It is important to pay attention to the appearance of cosmetics, such as change in smell, sharpness or rancidity, it is important to pay attention to brightness, texture, appearance if it consists of a grainy, liquid, pasty form more than normal or even dry, this means that the expiration date has expired (BASHIR; LAMBERT, 2020). Regarding guidelines, do not use products with an appearance or odor present in cosmetic products to avoid adverse reactions such as skin irritations, dermatitis, allergic reactions and infections. For better safety and prevention, do not use expired cosmetic products (CARVALHO;

MARTINI; MICHELIN, 2011; FAN et al., 2016). Microbiology in cosmetics has the function of identifying living organisms of microscope size which are classified into the most common bacteria, molds and yeasts. Conservation and strategies in cosmetic microbiology consists of conserving the finished product, reducing the action activity of the product's water, pH control, packaging, addition of preservatives: control of microbial development by reducing or inhibiting microbial activity (GOMES et al., 2015) Microbiotic contamination can compromise the functions of the product, losing the stability of the formulation, changing its physical and visual composition, increasing the contamination of the active ingredients excipients of the formula and can lose the credibility of the brand, in this way the contaminated products change the clinical pictures of people debilitated by pre-established diseases (HALLA et al., 2018). In lipsticks, eye shadows and after-faces in the handling of these raw materials, there may be microorganisms present, bacteria and fungi, and these microorganisms are considered harmful to health and the skin, so these products admit the presence of the permitted microbial load (BASHIR; LAMBERT, 2020).

There is a great risk in sharing or exchanging cosmetic products for your own use with other individuals, the great villain stands out mainly in makeup, as the US Food and Drug Administration warns. In this way, contamination and the risk of microorganisms increase in showcases and testers of products exposed in stores and pharmacies, as several people taste product samples from these showcases. In these products, their manufacture requires safe cosmetics with the quality of these preservatives, according to (TRAN; HITCHINS, 1994) not much information about the effects of preservatives after use and the conditions in which these products are found. In Brazil, so far there are few studies on microbiological contamination related to cosmetic samples for makeup (BENVENUTTI et al., 2017; CARVALHO; MARTINI; MICHELIN, 2011; RODRIGUES et al., 2018). In order to obtain a product of great quality, it depends on the stability and confidence in the formulations and microbiological quality control evaluated, the preservatives must be of excellent quality with the function of inhibiting the contamination of the products and their safety effectiveness for the use of the consumer. The breakdown of stability in a formulation, its performance runs the risk of compromising the quality of the product through microbial contamination, which can cause the inactivation of the active ingredients contained in the formula, manufacturers try to maintain the limit of microbial load using preservatives, disregarding the toxicity of the product. For a good quality, it is necessary to carry out analyzes by service laboratories, where it becomes possible to meet the requirements of the National Health Surveillance Agency (COSTA; SANTOS, 2017).

Nowadays, a large increase in the population makes use of makeup from the most relaxed to the most discreet, taking into account the demands of the standards imposed by society of a satisfactory appearance and self-esteem. The lack of knowledge of the users, complications can arise from the incorrect way of use, storage, they have no idea that these products can be microbiologically contaminated, even due to lack of conservation of the products stored in inappropriate places or exposed to heat and are used with the expiry date (BORBA; TIVES, 2018). Giving importance to the development of cosmetics, it is a priority to use and choose an excellent preservative, this step is of total importance in its effectiveness, proceeding in this way in order to reduce microbiological risks, taking into account that this contamination can be in the presence of the raw material, equipment, production environment, employees and packaging many times (MORAES, 2018). Expired makeup and microbiological contamination, we should not insist on using makeup that has expired, as this can lead to serious problems for the facial health of our face causing damage to the eyes resulting from itching, irritation and skin or mucosa causing burning and redness. Knowing how to handle and apply the product correctly, providing proof of touch, so you will know if the product will cause allergy, when you feel any discomfort, stop using it to avoid discomfort and irritation (ANVISA, 2007). We must avoid sharing makeup to prevent microbiological contamination, thus

avoiding contracting conjunctivitis and herpes. Always pay attention to the expiration date and storage conditions (CUNICO; LIMA, 2005).

Microbial challenge test in cosmetics - CHALLENGE TEST

Cosmetic products must be free of microorganisms, so used system challenge tests must contain preservatives to prevent the proliferation of fungi and bacteria, these cell/g harmless microorganism preservatives leading cosmetics to shelf life and correct storage. These growing demands, not only from consumers, but mainly from ANVISA. There is a resolution formulated by ANVISA/RDC 162/01 valid for cosmetics marketed in Brazil listing their preservatives, permitted concentrations, this model already exists in the European Union, its formulations defined by a specific type of preservatives. Cream and lotion formulations are more prone to contamination because they contain a greater amount of water and therefore require more effectively combined preservatives. These cosmetic products are made a final microbial challenge test injected with recognized microorganisms into the product, thus monitoring the growth, called "Challenge-Test" or challenge test (HALLA et al., 2018; LENS; MALET; CUPFERMAN, 2016). There are two categories according to the norm of Resolution nº. of the eyes or mucous membranes. And type 2 cosmetics and other products also follow defined limits. No cosmetic should contain any amount of *Pseudomonas auruginosa*, *Staphylococcus aureus* or coliforms, where these microorganisms can cause infections and be aggressive. Each manufacturer has to guarantee a limit of allowed microorganisms so that its cosmetic product is of great quality to reach consumer use (ALMOUGHARABIE et al., 2020). Microbiological quality control is done despite Res. no. 481/1999 established microbiological parameters, so the Resolution does not define guidelines for its control, since each manufacturer is aware of creating its quality policies and establishing its criteria for carrying out safety tests of the products shipped and documentation related to the test. Regular control of the microbiological quality of water is essential, continuous verification of the efficiency of machinery cleaning, recommending and guiding employees to wash their hands and use individual PPE, this set of measures, among others, is essential when it comes mainly to a free formulation. of preservatives. Microbial count tests must be carried out on the finished product and inputs, raw materials used when applied in the production process.

FINAL CONSIDERATIONS

Based on this study of contamination and microbiotic evaluation, this information brings guidelines and care that we must have with our cosmetics, from the moment we are interested in buying it and consuming this cosmetic, care with expiration dates, conservation of the stored place. handling and correct use of label instructions. After expiration date or microbiological contamination, the cosmetic loses its function and the preservatives undergo oxidation of the actives. In short, innovation in the cosmetics sector is becoming an even more crucial issue in the context of strong pressure on antimicrobial preservatives and their potential shortage in the medium term. New perspectives are emerging with regard to safety issues according to regulatory and normative references, which further justifies the development of objective methods to characterize the dynamic hermeticity of packaging and formulations protected against microbiological contamination, but without the use of preservatives or preservatives.

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