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A Review on Microbial Control and Preservatives of Cosmetics

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Abstract: Microbial control and the use of preservatives are crucial aspects of cosmetic formulation, ensuring product safety and longevity. Microbiological safety is paramount to protect consumers from potential harm caused by pathogenic microorganisms, contributing to overall product quality and public health. Various strategies, including chemical, physical, or physicochemical methods, are employed to ensure microbiological safety, controlling and eliminating harmful microorganisms. Contamination of cosmetics by microorganisms can lead to spoilage, degradation, and potential harm to consumers. The presence of microorganisms can induce changes in taste, smell, texture, and overall product quality. Some microorganisms may even produce toxins, posing health risks if consumed. Preventing and addressing contamination is essential to maintain the quality and safety of cosmetic products. Preservatives play a vital role in preventing the growth of harmful microorganisms such as bacteria, fungi, yeast, mold, and algae, which can cause product spoilage or skin infections. Common preservatives used in cosmetics include parabens, phenoxyethanol, benzyl alcohol, organic acids, and formaldehyde. These ingredients help extend the shelf life of products and ensure they remain safe for use. In pharmaceutical dosage forms, including liquid preparations such as aqueous solutions, suspensions, syrups, emulsions, creams, and semisolids, preservatives are widely employed to maintain microbial safety. The main function of antimicrobial preservatives is to inhibit the growth of unwanted microorganisms, contributing to the overall stability and safety of pharmaceutical and cosmetic products. Preserving cosmetic products is essential not only for maintaining their quality but also for safeguarding the well-being of consumers. The careful selection and use of preservatives are key considerations in cosmetic formulation, ensuring that products meet safety standards and remain effective throughout their intended shelf life.

Keywords: preservatives in cosmetics, microbiological safety, microbiological purity, antimicrobial agent.

INTRODUCTION:

Cosmetics are products designed for use on various external parts of the human body, including the skin, hair, nails, lips, and external genital organs, as well as teeth and mucous membranes in the oral cavity. They serve purposes such as altering a person's appearance, cleaning the body, perfuming the body, maintaining skin health, addressing body odor, and providing skin protection[1].

Cosmetic products, especially those containing water, oils, peptides, and carbohydrates, can provide a favorable environment for bacteria and fungi to grow. Proper storage and hygiene are crucial to prevent contamination and ensure the safety of these products[2]. preservation is essential to prevent microbial growth in cosmetic products. Preservatives are added to inhibit the growth of bacteria (both gram-positive and gram-negative), yeast, and mold, which can spoil the product and potentially lead to skin infections or other health issues when applied to the skin. Properly preserved cosmetics are safer for consumers to use[3]. the term "preservative" is derived from the Latin word "conservo," which means "to preserve." As the name suggests, preservatives play a crucial role in ensuring the microbiological safety of cosmetic products throughout their shelf life and during their use by preventing the growth of harmful microorganisms. This helps maintain the product's quality and safety for consumers[4]. Safety is paramount when selecting preservatives for cosmetic products, as they must be safe for human health. Primary contamination typically occurs during the manufacturing process, where impurities or microorganisms can inadvertently get introduced. This emphasizes the need for strict quality control and hygiene during production. Secondary contamination, on the other hand, can happen when consumers use the product. For instance, when fingers or applicators come into contact with the product, they can introduce bacteria from the skin into the product. This highlights the importance of user education and proper product handling to minimize the risk of secondary contamination. Preservatives in cosmetics serve the critical role of reducing the risk of microbial contamination in the product. They help maintain the product's safety, quality, and efficacy throughout its shelf life and during its use by consumers. This is crucial for ensuring that cosmetic products remain suitable and safe for the intended purpose[5].bacteria, yeasts and molds are naturally present in our environment and on our skin. Contamination of cosmetic products with these microorganisms can indeed lead to significant problems, especially for products applied around the eyes or on the skin. Preservatives, which are antimicrobial ingredients, are essential in most cosmetic products to prevent damage caused bymicroorganisms and to safeguard against contamination by consumers during use. They play a crucial role in maintaining product safety and quality[6]. In addition to their role as antimicrobial agents, preservatives can also function as antioxidants. Antioxidants are added to cosmetic products to protect them from damage and degradation caused by exposure to oxygen, which can lead to issues like product discoloration or changes in texture. So, preservatives can serve a dual purpose in maintaining the quality and stability of cosmetic products. Without preservatives, cosmetic products are susceptible to contamination, similar to food. This can lead

to product spoilage and, more importantly, can pose a risk of irritation, infections, or other adverse reactions when applied to the skin. Preservatives play a crucial role in ensuring the safety and longevity of cosmetic products[7].preservatives are especially essential in products with higher water content because they help prevent alteration and degradation by microorganisms during storage. Without preservatives, these products would be more prone to spoilage and microbial contamination, which could affect their quality and safety [8]. Chemical preservatives can help slow down the spoilage of products by inhibiting the growth of microorganisms. However, they may not completely prevent spoilage over an extended period. Proper storage and handling are also important factors in preserving the freshness of products [9]. Antimicrobial preservatives work by inhibiting or killing microorganisms to prevent spoilage. Their effectiveness is tied to their ability to be toxic to live cells, including bacteria and fungi, which is the reason they are used in preservation. Balancing their toxicity with the safety for human consumption is a critical consideration in food and product preservation [10]. when potential pathogens contaminate a product, it renders it unsafe for use and spoiled. However, in the context of your paper, the focus is primarily on the degradation caused by contaminating microorganisms that may not necessarily pose an immediate health risk but can still lead to the deterioration of the product's quality and shelf life. This degradation aspect is important to consider in various industries to maintain product quality and safety [11]. factors that can influence the mean life of a product. These factors encompass various aspects like microbial growth, temperature control, moisture content, exposure to light and oxygen, fermentation, acidification, and enzymatic changes, all of which can contribute to the deterioration of a product's quality and safety over time. Managing these factors is crucial in preserving the properties of finished products and extending their shelf life [12]. Extended storage can indeed lead to the deterioration of a product, affecting its stability and causing a decline in its intended quality. Microbial contamination can be a significant contributor to this decline, potentially rendering the product harmful to consumers if not properly preserved and handled. This highlights the importance of effective preservation methods and quality control measures to ensure product safety and longevity [13]. Cosmetic products are designed to be applied to the external parts of the human body, including skin, hair, nails, as well as areas like the teeth, oral cavity, or mucous membranes, with the primary purpose of enhancing or maintaining their appearance. These products can include a wide range of items like makeup, skincare products, perfumes, and more [14]. cosmetics products are typically formulated using a combination of chemicals to enhance the appearance or fragrance of the human body. These products can include items like makeup, skincare products, perfumes, and more, all designed to improve or alter various aspects of one's appearance or scent [15]. cosmetics market has expanded globally, with a notable growth in India. The influx of international brands and the focus on ecofriendly and ayurvedic ingredients indeed play a significant role in this expansion. India's emerging market potential is a key factor in this growth[16].

The development of microbial resistance to preservatives in pharmaceutical and cosmetic products is a concerning issue. This highlights the need for continuous research and innovation in the development of

effective preservation methods to ensure product safety and longevity. Monitoring and adapting to emerging microbial resistance is crucial in maintaining product quality and safety standards [17].

Why do we need preservatives in cosmetics?

Preservatives are indeed used in various products to prevent contamination and extend their shelf life.

When products like skincare items or cosmetics come into contact with our skin, they can potentially introduce bacteria or other microorganisms, especially if the skin is damaged or broken. Preservatives help to inhibit the growth of these microorganisms, ensuring the safety of the products when applied to the skin or near sensitive areas like the eyes. Additionally, they help maintain product quality over time.

Several factors can contribute to the spoilage of finished products, especially in industries like skincare and cosmetics:

Skin Microflora: The natural microorganisms on our skin can contaminate products when they come into contact with it. Preservatives help prevent the growth of these microorganisms.

Hygienic Conditions: The cleanliness and hygiene of the production environment and equipment are crucial in preventing contamination during manufacturing.

Raw Materials: The quality and source of raw materials used in the production process can impact product spoilage. Contaminated or low-quality raw materials can lead to microbial growth. By addressing these factors and implementing proper quality control measures, manufacturers can reduce the risk of spoilage and ensure the safety and efficacy of their products.

Products that contain water or other compounds susceptible to contamination, like creams, solutions, emulsions, suspensions, parental and eye drops, are at a higher risk of spoilage. To mitigate this risk and preserve their quality and safety, the addition of preservatives is often necessary. These preservatives help prevent microbial growth and degradation, ensuring that the product retains its intended properties and remains safe for use[18].

Preservatives are essential components in cosmetics for several reasons:

1.Microbial Safety: Cosmetics contain water, oils, and various ingredients that can provide an ideal environment for the growth of bacteria, mold, and yeast. Preservatives help prevent microbial contamination, ensuring that the product remains safe for use.

2.Shelf Life Extension: Cosmetics, like other products, have a limited shelf life. Preservatives extend this shelf life by inhibiting the growth of microorganisms, allowing consumers to use the product over an extended period.

3.Product Quality: Preservatives help maintain the product's quality, appearance, and texture by preventing spoilage and the development of unpleasant odors or changes in color and consistency.

4.User Safety: Without preservatives, cosmetics could become a breeding ground for harmful bacteria, increasing the risk of skin infections or other health issues when applied to the skin or near mucous membranes.

Overall, preservatives play a crucial role in ensuring the safety, efficacy, and longevity of cosmetic products. However, it's important to use them in appropriate concentrations to minimize any potential side effects or allergic reactions.

Preservatives may be used in cosmetics to prevent the growth of harmful bacteria and mold [19].

Fragrance:- Preservatives can be present in perfumes and colognes to prevent the growth of microbes in the fragrance formulation itself.

Lipstick:- Lipsticks can contain preservatives to ensure the product remains stable and safe to use over time, even in a moist environment.

Shampoo and Conditioner:- These hair care products often contain preservatives to prevent the growth of bacteria, fungi, and yeast, especially due to their water-based nature.

Lotion and Moisturizer:- Preservatives are common in creams and lotions to maintain their quality and safety by preventing microbial contamination.

Hair Gel:- Hair gels use preservatives to keep their consistency intact and to ensure they do not become a breeding ground for microbes.

Nail Polish:- Preservatives help maintain the integrity of nail polish by preventing clumping or separation of the ingredients.

Facial and Shower Cleaner:- These products often contain preservatives to prevent the growth of bacteria, mold, and other microbes that can thrive in a moist environment, ensuring the product remains effective and safe to use.

Nail Glue:- Nail glue may use preservatives to maintain its adhesive properties and prevent spoilage.

Baby Shampoo:- Baby shampoos typically include preservatives to keep them free from harmful microorganisms and maintain their safety for sensitive baby skin.

Color Cosmetics:- Color cosmetics such as eyeshadows, blushes, and foundations can contain preservatives to prevent bacterial contamination and maintain product consistency.

Anti-Aging Products:- Preservatives are commonly used in anti-aging creams and serums to ensure the stability and longevity of active ingredients, as these products are often used over an extended period.

List of preservatives in cosmetics:

Parabens

which are commonly used preservatives in various cosmetic and personal care products.

Examples:- Methylparaben, propylparaben, and butylparaben are indeed part of this group.

They are effective at preventing the growth of fungi and some gram-positive bacteria in these products. However, there has been some concern about their safety and potential health risks, which has led to increased scrutiny and the development of alternative preservatives in recent years[20].

Formaldahyde

Example:-

DMDM hydantoin, imidazolidinyl urea, and diazolidinyl urea are indeed commonly used preservatives. They are more effective against bacteria but have weaker efficacy against fungi compared to parabens. These ingredients help extend the shelf life of various cosmetics and personal care items by preventing bacterial growth. It's important for consumers to be aware of the ingredients in their products and any potential sensitivities or allergic reactions[21].

Organic acids

Example**:-**

Benzoic Acid/Sodium Benzoate: These are commonly used preservatives, with sodium benzoate being a water-soluble form of benzoic acid. They are effective against a wide range of microorganisms and are often used in acidic products like soft drinks and salad dressings.

Sorbic Acid/Potassium Sorbate: Sorbic acid and potassium sorbate are used to inhibit the growth of molds, yeast, and some bacteria in food and personal care products. They are particularly effective in acidic conditions.

Levulinic Acid: Levulinic acid can function as a preservative and is often used in combination with other preservatives. It's derived from renewable resources and considered more environmentally friendly.

Anisic Acid: Anisic acid is used as a fragrance ingredient and as a preservative in cosmetics and personal care products. It helps prevent microbial growth and extends product shelf life.

As you mentioned, some of these preservatives may require higher concentrations to be effective, which can lead to increased production costs. Balancing cost-effectiveness with product safety and stability is a common challenge for manufacturers[22].

Importance of preservatives in cosmetics:

1)To kill or inhibit the growth of microorganisms and protect a formula from microbial contamination, you can consider the following measures:

Sterilization: Use methods like autoclaving, pasteurization, or sterile filtration to eliminate or reduce microorganisms in the product and its packaging.

Preservatives: Add antimicrobial agents like parabens, benzalkonium chloride, or potassium sorbate to the formula to prevent the growth of microorganisms.

pH Adjustment: Adjust the pH of the formula to levels that are unfavorable for the growth of specific microorganisms.

Aseptic Processing: Implement aseptic techniques and environments during manufacturing and packaging to prevent contamination.

Packaging: Use sterile containers and packaging materials, and ensure they are sealed properly to prevent contamination during storage and distribution.

Hygiene: Enforce strict hygiene practices among personnel involved in production to minimize the introduction of microorganisms.

Quality Control: Regularly test and monitor the product for microbial contamination using appropriate methods.

Environmental Control: Maintain a clean and controlled production environment to minimize the risk of contamination[23].

2)bacteria, fungi, and yeast. They help Preservatives are ingredients added to products to protect them against the growth of extend the shelf life of products by inhibiting or slowing down the growth of microorganisms that can spoil the product or make it unsafe for use. Preservatives are commonly used in various industries, including food, cosmetics, and pharmaceuticals, to maintain product quality and safety [24].

3)Preservatives are added to products at low levels to prevent the growth of harmful microorganisms and extend the product's shelf life, allowing consumers to use it safely over a longer period **[**25**].**

4)Without preservatives, personal care products could become contaminated with microorganisms or degrade from the adverse effects of oxygen [26].

Ideal Properties of Preservatives:

1) That doesn't cause skin irritation.

2) It should be non-toxic.

3) It should maintain its physical and chemical stability[27].

4) The preservatives must be harmonious with the other components in the formulation[28].

5) It should function effectively as an antimicrobial agent with a broad spectrum of activity[29].

6) It should possess potency as a preservative even in small concentrations.

7) It should sustain its effectiveness during the entire product manufacturing process, shelf life, and various uses.

8) It should exhibit a wide-ranging antimicrobial activity against both bacteria and fungi[30].

9) It should demonstrate exceptional antimicrobial efficacy when used at low levels in cosmetic products[31].

10) It must remain inert and not react with other components in the formula or the container material[32].

11) It should be compatible with virtually all cosmetic materials and not impact the color or fragrance of the final products.

12) It should offer a cost-effective and readily available solution.

Mechanisms of action of antimicrobial preservatives:-

Preservatives, whether natural or synthetic, can have various modes of action to prevent spoilage and extend the shelf life of products.

1. One of these modes of action is cell wall lysis and leakage, which can be associated with substances like phenols and organomercurials. These compounds disrupt microbial cell membranes, leading to cell damage and leakage of cellular contents, ultimately inhibiting microbial growth.
2. Cross-linkage, as seen with glutaraldehyde, involves creating chemical bonds within proteins or other cellular components, which can interfere with the functioning of microorganisms.
3. Interference with the integrity of the cell membrane can occur through compounds like EDTA and quaternary ammonium compounds, disrupting the structure of microbial cell membranes and rendering them nonfunctional.
4. Inhibition of folic acid synthesis is another mechanism used by preservatives such as paraben and benzoic acid. These substances interfere with the microbial synthesis of folic acid, an essential component for DNA synthesis and cell growth, effectively inhibiting
5. microbial proliferation. These various modes of action help preservatives prevent the growth and spoilage of microorganisms in products[33].

Classification of preservatives:

Preservatives are classified on variety of the basis and some of these are as follows.

A. CLASSIFICATION BASED ON MECHANISM OF ACTION

1. Antioxidants:

Antioxidants are substances that prevent or slow down the oxidation of other compounds, including active pharmaceutical ingredients. Oxidation can lead to the degradation of sensitive substances when they are exposed to oxygen.

Examples of antioxidants include Vitamin E, Vitamin C, Butylatedhydroxyanisole (BHA), and Butylatedhydroxytoluene (BHT).

They help protect sensitive substances from deterioration caused by oxidation.

2. Antimicrobial agents:

Antimicrobial agents are substances that are active against both gram-positive and gram-negative microorganisms, which can cause the degradation of pharmaceutical preparations when present in small amounts.

Examples of antimicrobial agents include benzoates, sodium benzoate, and sorbates.

These agents help prevent microbial contamination and preserve the quality and safety of pharmaceutical products.

3. Chelating agents:

Chelating agents are substances that can form complexes with metal ions, which helps prevent the degradation of pharmaceutical formulations by binding and inactivating these metal ions.

Examples of chelating agents include Disodium ethylenediamine tetraacetic acid (EDTA), polyphosphates, and citric acid.

They are used to improve the stability and shelf life of pharmaceutical products by preventing metal-catalyzed reactions that could lead to degradation.

B. CLASSIFICATION BASED ON SOURCE

1. Natural Preservatives:-

natural preservatives are derived from natural sources such as plants, minerals, or animals, and they are used to extend the shelf life of various products, including pharmaceuticals.

Examples you mentioned like neem oil, salt (sodium chloride), lemon, and honey are commonly used natural preservatives.

They help inhibit the growth of microorganisms and oxidation, thus preserving the quality and safety of products.

2. Artificial Preservatives:

Artificial preservatives, also known as synthetic or chemical preservatives, are human-made compounds synthesized through chemical processes. They are effective in preventing the growth of various microorganisms when used in small concentrations.

Examples include benzoates, sodium benzoate, sorbates, propionates, and nitrites. These preservatives are commonly used in various products to extend their shelf life and maintain their safety and quality[34].

Types of susceptible products used in cosmetics:-

The diversity of pharmaceutical and cosmetic products, as well as the various microorganisms that can cause spoilage, makes each spoilage incident unique. Generalizations about susceptible products can be inaccurate, especially with the inclusion of sophisticated and biodegradable ingredients. However, certain types of products are more susceptible to spoilage by specific organisms based on experience. It's important to closely monitor and test products to ensure their quality and safety.

Liquids

A) water

Water is essential for life, and it plays a crucial role in metabolic reactions. Bacteria, being aquatic organisms, thrive in environments with high water concentrations. This makes products with a lot of free water vulnerable to bacterial spoilage. Proper preservation and storage are essential to prevent this. the water provided by regulated water suppliers in many countries typically meets high microbiological quality standards, making it suitable for use in pharmaceuticals and cosmetics manufacturing. Interestingly, low-conductivity water, often produced through processes like distillation or deionization for enhanced chemical purity, can actually pose a greater risk of microbiological contamination due to its

lack of minerals and ions that can inhibit microbial growth. Proper handling and monitoring are crucial to ensure the safety and quality of water used in these industries.

Without proper treatment and precautions to minimize contamination, water can quickly become a breeding ground for various microorganisms. Initially, both Gram-negative and Gram-positive bacteria can multiply rapidly, followed by the proliferation of a wide range of bacteria, molds, and yeast. This underscores the importance of water quality control and treatment in various industries to prevent such microbial proliferation [36].

B)suspensions

Aqueous suspensions of inorganic materials in pharmaceuticals can indeed provide an environment conducive to microbial growth. The added preservatives might be absorbed or inactivated by the suspended matter, making it challenging to prevent contamination. Unlike visible surface mold, microbial growth within these products can go unnoticed due to their opacity.

Spoilage may only become apparent when an offensive odor or unpleasant taste is detected upon opening the container, potentially leading to unwitting ingestion of a high bacterial load. This highlights the importance of rigorous quality control and microbial testing in pharmaceutical production to ensure product safety[37].

C)emulsions

Oil-in-water (O/W) emulsions are indeed susceptible to spoilage because the presence of water in the continuous phase can facilitate the spread of contaminants throughout the product. Preservatives primarily exert their protective effects within this aqueous phase and at its boundaries. However, their effectiveness depends on factors such as their solubility in the specific oil and water used in the emulsion and the ratio of oil to water. Ensuring the right choice and concentration of preservatives is essential to maintain the stability and safety of O/W emulsions in various products like cosmetics and pharmaceuticals[38].

Besides partition effects, the activity of preservatives can be further reduced by inactivation due to various compounds, including nonionic emulsifiers. These emulsifiers often have minimal bactericidal activity and can even serve as a nutrient source for certain bacteria like Pseudomonas species, which can lead to further microbial proliferation. It's crucial for product formulation to take into account these interactions to ensure the effectiveness of preservatives in preventing microbial contamination and spoilage [39]. some materials used in emulsions can be susceptible to microbial degradation. Emulsions often consist of a combination of water and oil, and if not properly preserved or formulated, they can provide a favorable environment for microorganisms to grow. Emulsifiers, stabilizers, and certain additives can also be vulnerable to microbial contamination.

To prevent this, preservatives are often added to emulsions to inhibit microbial growth and extend their shelf life. It's essential to follow good manufacturing practices when formulating emulsions to ensure their microbial stability. Spoilage in emulsions can manifest in various ways, including changes in

rheological properties, such as separation or "breaking down" of the emulsion. Other signs of spoilage may include discoloration, decolorization, alterations in odor and taste, and visible signs of microbial growth. These changes are indicative of the deterioration of the emulsion's quality and safety, and they are common reasons for products to be considered unsuitable for consumption or use. Proper storage, handling, and formulation can help prolong the shelf life and maintain the quality of emulsions.

D)creams and lotions

Cosmetic and toiletry preparations can be complex, and they often contain a wide range of ingredients. The use of natural substances like animal proteins and vitamins in these products has become a common trend. However, it's important to be aware that such natural ingredients can be nutrient sources for microorganisms, potentially inactivating preservatives and leading to contamination. Glycerol, a common ingredient in both pharmaceutical and cosmetic formulations, is also susceptible to microbial metabolism, especially when water is present. This can create an environment conducive to microbial growth. As a result, manufacturers must carefully formulate and preserve these products to ensure their safety and shelf life. Preservatives and other antimicrobial agents are often added to prevent microbial contamination and spoilage in cosmetic and toiletry preparations.

Mould growth is indeed a common cause of spoilage in various types of creams, including antifungal, calamine, baby, hair, moisture, and cleansing creams. Several factors can contribute to this issue: Container Contamination: Mould spores can enter creams through contaminated containers or packaging materials. Proper cleaning and sterilization of containers before filling them with cream are essential to prevent contamination.

Air Spaces: Large air spaces within the product packaging can provide opportunities for mould spores to settle and grow. Reducing excess air in containers and using airless packaging can help mitigate this issue.

Poor Storage Conditions: Creams are often sensitive to temperature and humidity fluctuations. Storing these products in humid or warm environments can promote mould growth. Maintaining proper storage conditions, such as cool and dry areas, is crucial.

Preservation Challenges: Creams typically contain water, which is a key ingredient for mould growth. Preservatives are added to inhibit microbial growth, but their effectiveness can be compromised by factors like container contamination or excess air.

E)Ointments and oils

anhydrous materials, in theory, do not support the growth of microorganisms because they lack water, which is essential for most microbial growth. However, in practice, when anhydrous products like oils and ointments are filled into containers with large air spaces, there is a possibility of mould spoilage. This is because moulds can utilize atmospheric moisture, and the presence of humidity or accidental ingress of water can create conditions conducive to their growth. While the incidence of mould spoilage in anhydrous products is lower compared to creams, it can still occur. Mould colonies can sometimes be

found on the surfaces of ointments, including products like white petroleum jelly and even fungicidal ointments, which are ironically intended to combat fungal infections. To prevent mould growth in anhydrous products, manufacturers should take measures to minimize the introduction of moisture during production and packaging. Additionally, proper sealing of containers and storing products in dry environments can help reduce the risk of mould contamination. oils are at a slightly greater risk of microbial contamination compared to ointments. This is because oils are more fluid and less viscous, which allows condensed water to carry microorganisms to the bottom of the container, where they can become trapped. This trapped moisture can create localized pockets of humidity within the oil, providing an environment where microorganisms can potentially grow[40]

F) shampoos

Shampoos can indeed be susceptible to contamination by various Gram-negative waterborne bacteria. These bacteria are a concern because they are often found in water sources and can thrive in moist environments. When shampoos come into contact with contaminated water during manufacturing, packaging, or usage, these bacteria can be introduced into the product. To prevent contamination, manufacturers of shampoos typically employ strict quality control and sanitation procedures. This includes using purified water in formulations, maintaining clean production facilities, and implementing quality assurance protocols to test for microbial contamination. Consumers can also play a role in preventing contamination by ensuring that shampoo bottles and containers are kept tightly sealed when not in use and avoiding introducing potentially contaminated water into the product. Proper storage and hygiene practices can help maintain the safety and quality of shampoo products[41].

G) syrups

the high sugar content in syrups can inhibit the growth of many microorganisms due to its high osmotic pressure. This high osmotic pressure essentially draws water out of microorganisms, preventing their growth and proliferation. However, as you mentioned, there are osmotolerant moulds and yeasts that can withstand these high sugar concentrations. These microorganisms have adapted to survive in environments with high osmotic pressure, such as sugary syrups. When they contaminate syrup products, they can cause spoilage and lead to issues like off-flavors or changes in texture. To prevent contamination and spoilage in syrups, manufacturers often implement proper hygiene and sanitation practices during production and packaging. They may also use preservatives to inhibit the growth of osmotolerant microorganisms. Additionally, storing syrups in sealed containers and in cool, dry conditions can help maintain their quality and shelf life [42].

solids

A) powders

The spoilage of powdered products can occur when they are exposed to damp conditions, leading to visible mold growth. This can potentially result in microbial contamination and poses a risk of illness, especially if Clostridia spores are present. While there is no clear evidence linking contaminants to

irritation from cosmetic powders, it is generally undesirable to have more than a few hundred organisms per gram in these products. Powders intended for use on broken skin or in the eye area should be made from sterilized raw materials as an extra precaution [43].

B)solid cosmetics

Lipsticks, despite containing preservatives, can still be susceptible to mold growth, often occurring inside the lipstick case, especially after the product becomes moistened by breath during use. Moisture, possibly from saliva, can also initiate mold growth in mascara preparations, which can harbor many bacteria. Contamination risks are associated with the brushes used in makeup application, as they can pick up organisms from the skin during use. Similar concerns apply to solid cakes of makeup. In these situations, the effectiveness of preservatives may be limited, possibly because they are absorbed into the solid material. Moreover, their concentration must be carefully controlled to avoid potential irritation to the eyes.

CONCLUSIONS

When it comes to microbial control and preservatives in cosmetics, the main goal is to prevent the growth of harmful bacteria, fungi, and other microorganisms. This helps to ensure the safety and shelf life of cosmetic products. Various preservatives are used in cosmetics to achieve this, such as parabens, phenoxyethanol, and benzyl alcohol. These preservatives work by inhibiting the growth and reproduction of microorganisms. It's important for cosmetic companies to follow strict regulations and guidelines to ensure the safety and effectiveness of their products.

REFERENCE

1. European Union. Regulation (EC) No 1223/2009 of the European Parliament and of the Council. Official Journal of the European Union. 2009;L(342):59.
2. Halla N, Fernandes IP, Heleno SA, Costa P, Boucherit-Otmani Z, Boucherit K, et al. Cosmetics preservation: a review on present strategies. Molecules. 2018;23(7):1571.
3. Mufti J, Cernasov D, Macchio R. Preserving personal care and household products. Household and Personal Products Industry. 2001;38(5):69.
4. Curry J, Brannan D, Geis P. History of cosmetic microbiology. In: Geis P, editor. Cosmetic Microbiology: A Practical Approach. Florida: CRC Press; 1993. p. 3-17.
5. Na'was T, Alkofahi A. Microbial contamination and preservative efficacy of topical creams. J Clin Pharm Ther. 1994;19(1):41-46.
6. Al-Gabr HM, Zheng T, Yu X. Fungi contamination of drinking water. Rev Environ Contam Toxicol. 2013;228:121-139.
7. Molecules. 2018 Jul;23(7):1571. Published online 2018 Jun 28. doi: 10.3390/molecules23071571.
8. Gragg SE, Brashears MM. In: Encyclopedia of Meat Sciences. Second Edition. 2014.
9. Sivakumar S, Kaur H. College of Dairy Science and Technology (CoDST), Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana,141004, Punjab, India.

10. Chiori CO, Ghobashy AA. A potentiating effect of EDTA on the bactericidal activity of lower concentrations of ethanol. Int J Pharm. 1983;17(2-3):121-128.
11. Uerpmann-Wittzack R. European Directorate for the Quality of Medicines and Healthcare (EDQM). 2017.
12. Barnes JM. Aflatoxin as a health hazard. J Appl Bacteriol. 1970;33(2):285-98.
13. Yoshioka S, Stella VJ. Stability of drugs and dosage forms. Springer Science & Business Media. 2000.
14. Blanchin A, Chareyron C, Levert Q. The customer behaviour in men's cosmetics market. 2007.
15. de Groot, A. C., & White, I. R. (2001). Cosmetics and skin care products. Textbook of contact dermatitis, 661-685.
16. Indian Cosmetic Market Outlook 2018 (2014), https://www.rncos.com/Market-Analysis-Reports/Indian-Cosmetic-Market-Outlook-2018-IM705.htm. Accessed 2 Feb, 2019
17. Piper, P., Mahé, Y., Thompson, S., Pandjaitan, R., Holyoak, C., Egner, R., ... & Kuchler, K. (1998). The Pdr12 ABC transporter is required for the development of weak organic acid resistance in yeast. The EMBO journal, 17(15), 4257-4265.
18. Zani, F., Minutello, A., Maggi, L., Santi, P., & Mazza, P. (1997). Evaluation of preservative effectiveness in pharmaceutical products: the use of a wild strain of Pseudomonas cepacia. Journal of applied microbiology, 83(3), 322-326.
19. Khatkar, A., Nanda, A., & Narasimhan, B. (2013). EVALUATION OF PRESERVATIVE EFFECTIVENESS OF FERULIC ACID DERIVATIVES IN ALUMINIUM HYDROXIDE GEL-USP. International Journal of Pharmaceutical Sciences and Research, 4(7), 2721.
20. Harley, K. G., Kogut, K., Madrigal, D. S., Cardenas, M., Vera, I. A., Meza-Alfaro, G., ... & Parra, K. L. (2016). Reducing phthalate, paraben, and phenol exposure from personal care products in adolescent girls: findings from the HERMOSA intervention study. Environmental health perspectives, 124(10), 1600-1607.
21. De Groot, A. C., & Veenstra, M. (2010). Formaldehyde-releasers in cosmetics in the USA and in Europe. Contact Dermatitis, 62(4), 221-224.
22. National Institutes of Health. (1996). Molecules: a journal of synthetic chemistry and natural product chemistry.
23. Cason, J. (1954). Synthetic Methods of Organic Chemistry. Journal of the American Chemical Society, 76(1), 317-317.
24. Herman, A. (2019). Antimicrobial ingredients as preservative booster and components of self-preserving cosmetic products. Current microbiology, 76(6), 744-754.
25. Nasser, L. A. (2008). Fungal profiles isolated from open and used cosmetic products collected from different localities in Saudi Arabia. Saudi Journal of Biological Sciences, 15.
26. Mufti, J., Cernasov, D., & Macchio, R. (2001). Preserving personal care and household products. Household and Personal Products Industry, v38, (5), p69. 23

27. Epstein, H. (2006). Cosmetics preservation: sense and nonsense. Clinics in Dermatology, 24(6), 551-552.
28. Orth, D. S. (1981). Principles of preservative efficacy testing.
29. Adams, H. J., Mastri, A. R., & Charron, D. (1977). Morphological effects of subarachnoid methylparaben on rabbit spinal cord. Pharmacological Research Communications, 9(6), 547-551.
30. Aeling, J. L., & Nuss, D. D. (1974). Systemic eczematous contact type dermatitis medicamentosa caused by parabens. Archives of dermatology, 110(4), 640-640.
31. Nielsen, P. B., Müllertz, A., Norling, T., & Kristensen, H. G. (2001). The effect of α-tocopherol on the in vitro solubilisation of lipophilic drugs. International journal of pharmaceutics, 222(2), 217-224.
32. Brul, S., & Coote, P. (1999). Preservative agents in foods: mode of action and microbial resistance mechanisms. International journal of food microbiology, 50(1-2), 1-17.
33. Constantinides, P. P., Tustian, A., & Kessler, D. R. (2004). Tocol emulsions for drug solubilization and parenteral delivery. Advanced drug delivery reviews, 56(9), 1243-1255.
34. Wilson, L.A, A.J. Jilian and D.G. Ahearu, The survival and growth of microorganisms in mascara during use, Am, J. Ophthalmol, (79). 1975, 591-601.
35. Shooter, R. A., Gaya, H., Cooke, E. M., Kumar, P., Patel, N., Parker, M. T., ... & France, D. (1969). Food and medicaments as possible sources of hospital strains of Pseudomonas aeruginosa. The Lancet, 293(7608), 1227-1229.
36. Guyne, C. J. and Bennet, E. O. Bacterial deterioration of emulsion oils. Appl. Microbiol. 7 117 No. 2 (1959).
37. Bean, H. S. (1967). The microbiology of topical preparations in pharmaceutical practice. 2. Pharmaceutical aspects. Pharmaceutical Journal, 199, 289-292.
38. And, M. B., & Tice, L. F. (1957). The preservation of aqueous preparations containing nonionic surfactants I. Growth of microorganisms in solutions and dispersions of nonionic surfactants. Journal of the American Pharmaceutical Association, 46(7), 442-445.
39. Tice, L. F., & Barr, M. (1958). Factors to be considered in the preservation of cosmetic emulsions. J Soc Cosmet Chem, 9, 171-180. 24
40. RIVERS, S. M., & Walters, V. (1966). The effect of benzoic acid, phenol and hydroxybenzoates on the oxygen uptake and growth of some lipolytic fungi. Journal of Pharmacy and Pharmacology, 18(Supplement_1), 45S-51S.
41. Eggins, H. O. W., & Walker, V. (1963). The decomposition of pharmaceutical emulsions by fungi. West Afr J Biol Chem, 7, 2-8.
42. Bryce, D. M., & Smart, R. (1965). The preservation of shampoos. J. Soc. Cosmetic Chemists, 1(6), 187-201.
43. Welthagen, J. J., & Viljoen, B. C. (1999). The isolation and identification of yeasts obtained during the manufacture and ripening of Cheddar cheese. Food Microbiology, 16(1), 63-73.