DEVELOPMENT OF AN ANTI-AGING CREAM WITH AHA/BHA AND SUNSCREENS

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ABSTRACT
The skin aging is a matter of discomfort verified in the population. Thus, every day, new products are launched on the market to offer different manners to prevent the premature aging of the skin. In this context, active substances, as alpha and beta hidroxyacids (AHA/BHA), beyond the sunscreens, are considered a way of prevention and amelioration of the effects caused in the skin due to the time. The aim of this study was to develop and evaluate a cosmetic cream containing AHA/BHA and sunscreen. It was studied in relation to its physic-chemical and microbiological characteristics. According to the results, the formulation developed present a shelf life of 758 days and the preservative system was effective. Considering the parameters evaluated, the cream probably would be commercially accepted.

Keywords: Rejuvenation, alpha-hydroxyacids, beta-hydroxyacids.

INTRODUCTION
The skin aging is promoted by genetic factors, hormonal alterations (menopause), and also by environmental and life style influences, such as the umidity and pollution of the air, food, cigarette, alcoholic beverages and, especially the radiation from the sun (Velasco et al.,...
2004). It is an uncontrollable phenomenon that researches and population look for manners to minimize its signals and to prevent it (Velasco et al., 2004).

Alpha and beta hydroxyacids (AHA/BHA) constitute a group of active substances of natural origin. Examples are the glycolic, lactic, citric, malic, tartaric and salicylic acids. They are widely employed to treat skin that presents acne, wrinkles, dyscromias and, also, the skins damaged by the sun. When associated, AHA and BHA could act sinergically, improving the cellular proliferation. In a general way, AHAs promote the pelling of the skin, and the BHAs stimulate the mitosis of the skin cells. It promotes the thinning of the corneum stratum and the sweetening of the facial expression lines (Draelos, 2000; Henriques et al., 2007).

However, the treatment is not the best manner to obtain a healthy and beauty skin. The prevention is of great importance to avoid the rise of signals of aging and, inclusive, skin pathologies. The use of sunscreens is an effective manner to prevent skin pathologies caused by the deleterious effect of the sun (Costa and Weber, 2004).

Sunscreens are chemical substances able to efficiently disperse or absorb the incident light, mainly the UVA and UVB rays, which are able to promote damage to the skin (Paola and Ribeiro, 1998).

Thus, in this study, we proposed the association of AHA, BHA and sunscreens as a way to use a unique product to obtain the prevention and the sweetening of the signals of aging on the skin. The aim was the development, physical-chemical and microbiological characterization of the formulation, to predict if it could be well accepted on the market.

MATERIAL AND METHODS

Prepare of the formulations

The centesimal composition of the emulsion is described on Table 1. It was prepared heating the aqueous and oily phase, separately, until reach 75 °C. Thus, the aqueous phase was poured on the oily phase and it was mixed vigorously until it have reached the environmental temperature.
<table>
<thead>
<tr>
<th>Raw material (INCI name)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cetearyl Alcohol</td>
<td>6.40</td>
</tr>
<tr>
<td>Glyceryl Stearate</td>
<td>5.00</td>
</tr>
<tr>
<td>Shea Butter</td>
<td>1.50</td>
</tr>
<tr>
<td>Sweet Almond Oil</td>
<td>2.00</td>
</tr>
<tr>
<td>Ceteareth – 20</td>
<td>3.00</td>
</tr>
<tr>
<td>Myristil Lactate</td>
<td>2.00</td>
</tr>
<tr>
<td>BHT</td>
<td>0.05</td>
</tr>
<tr>
<td>Water</td>
<td>100.00</td>
</tr>
<tr>
<td>Propylene Glycol</td>
<td>2.00</td>
</tr>
<tr>
<td>Xanthan Gum</td>
<td>0.10</td>
</tr>
<tr>
<td>Carbomer</td>
<td>0.10</td>
</tr>
<tr>
<td>Phenoxyethanol and parabens</td>
<td>0.20</td>
</tr>
<tr>
<td>EDTA</td>
<td>0.05</td>
</tr>
<tr>
<td>Soy protein coupled to the glycolic acid</td>
<td>4.00</td>
</tr>
<tr>
<td>(Protacid® SJGL 20L)</td>
<td></td>
</tr>
<tr>
<td>Codium Tomentosum Extract</td>
<td>2.00</td>
</tr>
<tr>
<td>(Codiavelane®)</td>
<td></td>
</tr>
<tr>
<td>Magnesium Ascorbyl Phosphate (VC-PMG Thalaspheres)</td>
<td>2.00</td>
</tr>
<tr>
<td>Dimethicone PEG-7 Phosphate (Pecosil® PS-100)</td>
<td>3.00</td>
</tr>
<tr>
<td>Fragrance</td>
<td>0.50</td>
</tr>
<tr>
<td>Citric acid</td>
<td>5.5-6.0</td>
</tr>
<tr>
<td>Ethylhexyl Methoxycinnamate (Parsof® MCX)</td>
<td>7.50</td>
</tr>
<tr>
<td>Butyl Methoxidibenzoylmethane (Parsof® 1789)</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Even the fact that only one formulation has been developed on this study, the manner of incorporation of the sunscreens and AHA/BHA was alternated:
CB = Base cream (without sunscreens and active substances).
CBF = Base cream with the sunscreen on the oily phase of the emulsion.
CBA = Base cream with the active substances (AHA/BHA) in the ready cream.
CBFA = Base cream with the sunscreens on the oily phase of the emulsion and the active substances incorporated on the ready cream.

**Microbiological quality control**
The microbiological analyses of the formulations were performed in duplicate, inoculating the samples of creams in Petri plates or pipes containing the appropriate culture medium for the research of each microorganisms of interest (USP, 1998).

**Rheological characterization of the formulations**
The four samples (CB, CBF, CBA e CBFA) were submitted to a shear rate of 0 to 200 s\(^{-1}\) during 120 seconds, and from 200 to 0 s\(^{-1}\) during more 120 seconds (Miner, 1993; Naé, 1993). Using the reograms obtained, the hysteresis areas were determined. To perform this assay a Brookfied programmable DV-III + viscosimeter was used.

**Determination of the shelf life**
The four samples of creams (CB, CBF, CBA, CBFA) was stored on incubators with controlled temperatures (37º C and 45º C). On pre-determined times, the samples were spectrophotometrically analyzed (in relation to the amount of AHA/BHA and sunscreens). The constant of degradation obtained was applied on the Arrhenius’ equation to determine the shelf life (Prista et al., 1990).

**RESULTS AND DISCUSSION**
The incorporation of active substances in excipients could promotes significant alterations in formulations, even generating products of degradation, that could promotes damages to the consumer, if they are toxic. The excipient of the formulation, also could result in ineffectiveness of the product, mainly if it difficulties the release of the active substance contained in it (Cunha, 1970; Silva and Soares, 1996).

Thus, it is easy to understand the need in perform evaluations of the physical-chemical and microbiological characteristics of a formulation.
The AHA used on this research is a commercial product (Protacid® SJGL 20L) in which glycolic acid is bonded to a soy protein by means of an ionic interaction. This interaction favors the affinity of the substance by the keratin present in the corneum stratum and reduces its irritant feature. The AHA is able to promote a peeling effect and rejuvenating agent on the skin (Isaac and Kedor-Hackmann, 2000).

The BHA was used as a concentrated extract of algae containing glucoronic acid and polysaccharides (Codiavelane®) able to maintain water balance of the epidermis and the moisturizing of the skin (Gopa Majmudar, 2013).

In the formulation a derivative of ascorbic acid was also added (Vitamin C PMG. It was used in talaspheres, which increases the stability of ascorbic acid to the oxidation. The vitamin C or ascorbic acid acts by inhibiting the tyrosinase activity on the melanocytes (Isaac and Kedor-Hackmann, 2000) and as an antioxidant compound (Magnani et al., 2011). The increment of the Sun Protection Factor (SPF) of the formulation developed was obtained using Ethylhexyl Methoxycinnamate and Butyl Methoxidibenzoylmethane. They are of great importance due to the photosensitivity promoted by the AHA to the skin (Leonard et al., 1998). The association of these two sunscreens offers a wide spectrum of action, protecting the skin against UVA and UVB rays.

In the formulation was proposed the use of Dimethicone PEG-7 Phosphate (Pecosil® PS-100) that acts as a booster of the SPF.

**Microbiological quality control**

The samples evaluated did not show presence of pathogenic microorganisms such as *Salmonella sp.*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli*. Also, the units forming colonies was below 3 UFC/mL. It demonstrates the preservatives efficacy.

**Rheological characterization of the formulations**

Rheology is a science able to study the properties of flow of substances that, when submitted to forces of shear, suffer deformations. Depending on the characteristics of flow, the fluid could be classified as Newtonian or non-Newtonian fluid. Also, the non-Newtonian fluids could be more specifically classified as plastic, pseudoplastic or dilatant (Laba, 1993; Miner, 1993; Prista et al., 1990).
The graphical representation of the flow curve offers much information about the fluid, demonstrating the thixotropy, viscosity, resistance to the flow (Miner, 1993; Naé, 1993; Prista et al., 1990). The thixotropy is characterized by the area between the ascendant and the descendant curve (Miner, 1993; Prista et al., 1990). How much higher is the thixotropy of a formulation, higher is the time that the product remains disorganized after the subject of the formulation to external forces. Some studies have also demonstrated a relation between the thixotropy and the release of active substances from the formulation (Chiari et al., 2009, Lee et al., 2009).

According to the rheograms shown on Figure 1, the formulation added with sunscreen and AHA/BHA on different manners has similar viscosities. They are non-Newtonian fluids and thixotropics (Isaac et al., 2013a, Isaac et al., 2013b).

CBFA is the formulation with higher thixotropy (bigger area between ascendant and descendant curve), which is desirable in this case, since it could favor the release of the active substances to act on the skin (Table 2).

![Rheograms of the formulations.](image)

**Figure 1.** Rheograms of the formulations.
Table 2. Hysteresis area of the formulations according to the flow curves.

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Hysteresis area</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB</td>
<td>92.5 mm$^2$</td>
</tr>
<tr>
<td>CBA</td>
<td>186.9 mm$^2$</td>
</tr>
<tr>
<td>CBF</td>
<td>225.0 mm$^2$</td>
</tr>
<tr>
<td>CBFA</td>
<td>433.8 mm$^2$</td>
</tr>
</tbody>
</table>

Determination of the shelf life

To determine the shelf life of the proposed product, analytical curves of the two sunscreens used were prepared (Figure 2). It was done on spectrophotometer, at 312 and 341 nm for Ethylhexyl Methoxycinnamate and Butyl Methoxidibenzoylmethane, respectively. The analytical curves allow correlating the absorbance measure with the amount of sunscreen contained in the formulation, being possible to determine the degradation of these substances with the time.

\[ y = 0.011x + 0.0019 \]
\[ R^2 = 0.9996 \]

\[ y = 0.4975x + 0.0037 \]
\[ R^2 = 0.9999 \]

Figure 2. Analytical curves of Ethylhexyl Methoxycinnamate (on left) and Butyl Methoxidibenzoylmethane (on right).

Using the analytical curves and applying the Arrhenius’ theory, the degradation of the sunscreens on the formulation in relation to the time was determined. It is calculated through the determination of the residual concentration of the actives when incorporated on the excipient. The degradation on this formulation happens according to the first order kinetic reaction, and the shelf life of the product was determined as 758 days (Prista et al., 1990).

All of the data collected on this study indicates that, probably, if this product were launched on the market, it would be well accept by the consumers, since it is stable in relation to its physical-chemical and microbiological aspects. Also, it shows a suitable deformation and
hysteresis area when subject to external forces, which could indicate a suitable spreadability on the skin.

These results are in accordance to a previous study developed by our research group, in which this formulation containing the sunscreens and AHA/BHA was assessed on a sensorial analysis study (Pereira et al., 2001). The attributes evaluated was the spreadability, the aroma, the color, the texture and the global impression of the volunteers. They used a hedonic scale to express their opinion. Also, this product was compared to a commercial formulation. The volunteers judged that this formulation was better that the commercial one, showing the acceptability that it probably would have on the cosmetic market (Pereira et al., 2001).

CONCLUSION
The cosmetic cream containing AHA/BHA and sunscreens that was developed on this study presents physical, chemical and microbiological suitable characteristics, being probably well accepted if launched on the market. It could be an alternative to the prevention of the damages of the sun to the skin and, also, could help in the sweetening of the undesirable signals of aging.

REFERENCES


