Development, characterization and efficacy evaluation of dermocosmetic formulations based on a thermal water of Beira Interior region of Portugal.

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Abstract

Portugal is one of the richest European countries in what concerns to thermal waters, and the majority of Portuguese spas are distributed by northern and central regions. The use of such water for therapeutic purposes, also known as mineral-medicinal water, has always been aroused a continuous interest in carrying out the characterization of this type of waters for the treatment of a specific condition.

Many natural mineral waters are known for centuries for their dermatologic properties. Indeed, in the region of Beira Interior of Portugal, there is a spa with thermal water presenting dermatological therapeutic effects, named Termas do Cró, and therefore the incorporation of these thermal water in a cosmetic preparation will be a valuable tool.

In the present work, it is aimed to develop cosmetic formulations based on a portuguese thermal mineral water, namely a gel, where it were carried out characterization and stabilities studies as well as the effects on the skin were evaluated through non-invasive biometric techniques, to demonstrate the potential of the vehiculation of thermal water in such systems. Furthermore, according to the therapeutic qualities exhibited by this thermal water and the developed dermocosmetic product, it could be also of great interest to use in specific dermatological diseases, like psoriasis and atopic dermatitis.

1 Introduction

Portugal is one of the richest European countries in what concerns to thermal waters [1], and the majority of Portuguese spas are distributed by northern and central regions. The use of such water for therapeutic purposes, also known as mineral-medicinal water, has always been aroused a continuous interest and the categorization of its therapeutic indications regarding their physico-chemical composition constituted an important research topic, specifically in the Beira Interior region of Portugal [2].

Mineral waters are commonly used for the treatment of various dermatologic conditions. The major dermatologic diseases that are frequently treated by balneotherapy with a high rate of success are psoriasis and atopic dermatitis [3]. Furthermore, the different properties of these mineral waters, such as detergent, anti-inflammatory, keratoplastic, antipruriginous, and antioxidant ones can be used together with cosmetics [4]. In this sense, they can be used as an active or “cosmeceutical” (or functional cosmetic) ingredient in dermocosmetic formulations. The resultant cosmeceutic products will be applied with the aim to improve the moisturizing, flexibility and elasticity properties of the skin, but also adding the anti-inflammatory, calmative, desensitizing, healing and anti-oxidant effects [5]. In fact, there is evidence that pure thermal water when used as a vehicle or as an active principle in cosmeceutic formulations have been used in dermatology as an adjunct in skin hydration, in the management of ageing skin, acne, rosacea, and other inflammatory dermatoses; in the recovery from cosmetic procedures such as chemical peels and laser treatment; and to increase quality of life and compliance in patients with chronic disease [6].

Actually, in the region of Beira Interior of Portugal, there is a spa with thermal water presenting dermatological therapeutic effects, named Termas do Cró, and therefore the incorporation of these thermal water in a cosmetic preparation could be a valuable tool. This water is sulphurous, rich in silica and certain cations that play an important role in skin physiology.

2 Aims and methods

In the present work, it was aimed to develop a dermocosmetic formulation in which the major component was the thermal water (more than 90%), a gel, where it were carried out stability studies (namely organoleptic evaluation, pH, viscosity and texture analysis) and its efficacy was evaluated through biometric analysis. For that, a comparative study was conducted with a gel with the same formula, but prepared with purified water as vehicle.

The formulation was a hydrophilic gel, with a gelling agent, and it was added a preservative, a dye and a flavoring (essential oil of lavender).

The determinations were made at ±20ºC and ±60% of relative humidity.

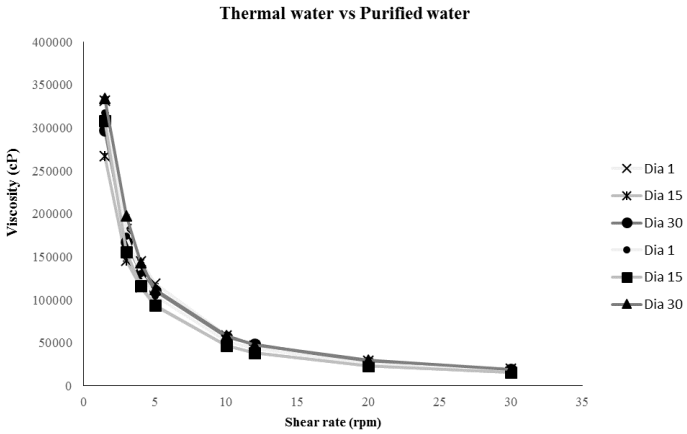
Regarding the stability studies, they included the pH determination, rheologic studies and texture analysis, after 1, 15 and 30 days of storage. The pH was determined using potenciometer Metttler Toledo, the rheologic studies were conducted with a rotational viscometer (Fungilab) and texture analysis with a texturometer (Stable Micro Systems TA.XTPlus), namely the parameters firmnessn, adhesiveness and spreadbility.

Regarding the efficacy studies, it were evaluated the skin pH, degree of hydration, transepidermal water loss water (TEWL) and skin relief [7]. The test area was the forearm, being the determinations made before (T0) and at different times until 60 minutes (T30) after the application of a defined quantity of both gel formulations. Skin pH, hydration and TEWL were determined with a Multi Probe Adapter MPA® equipment (Courage-Khazaka). The skin surface images were obtained with the Visioscan® VC 98 equipment (Courage-Khazaka).

3 Results and discussion

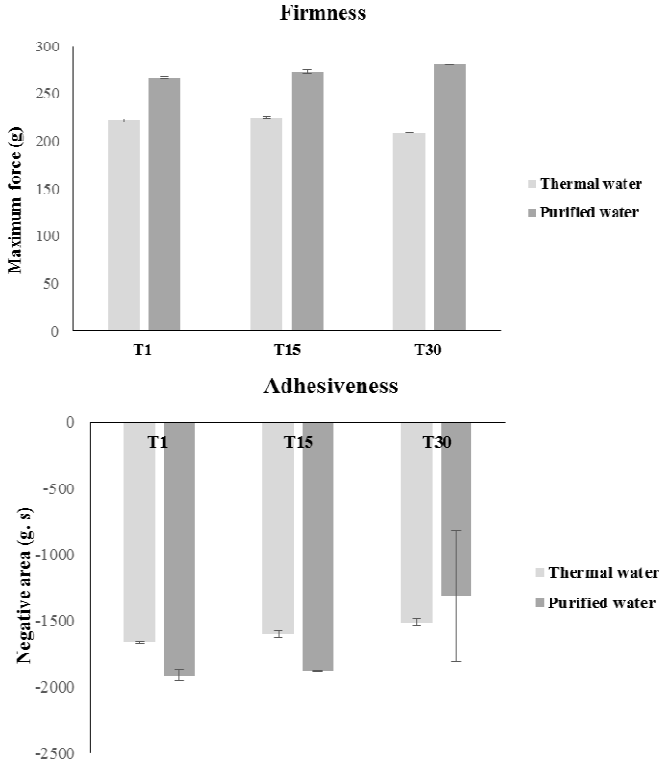
Both developed formulations showed good physical-chemical and mechanical properties over the time of storage at ±20ºC, with favorable results for the formulation based on thermal water, especially regarding the low firmness and adhesiveness values. The pH was kept around 5.5 during the time of storage. The rheologic profiles of both formulations were similar, presenting identical values of viscosity at the different predefined interval times, as it can be seen in Figure 1.

Figure 1. Viscosity determination of the gels based on thermal water and purified water.



Texture analysis are used to determine mechanical characteristics of cosmetic formulations since they must exhibit acceptable characteristics for skin application, such as, suitable firmness and adhesiveness. In fact, the gel with thermal water showed lower firmness and adhesiveness than the respective gel with purified water after 30 days of storage (Figure 2). Therefore, the thermal water-based gel is more ease for application onto the skin and this formulation exhibits favourable adhesive properties.

Figure 2. Firmness and adhesiveness evaluation of both gels.



Furthermore, all the tests of cutaneous biometry clearly demonstrated the potential benefits in using cosmetics based on thermal water. In fact, after the gel application, there was a slight increase in the pH of the skin pH for both formulations (Table 1), less pronounced for thermal based one, but preserving the physiologic acid nature of the skin [8].

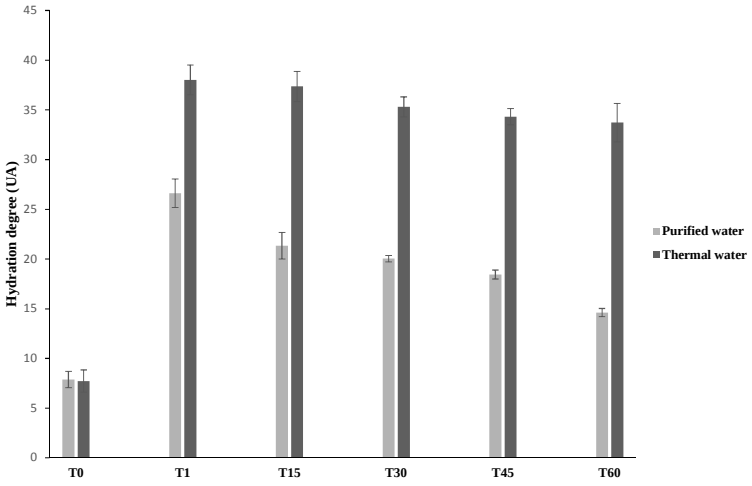
Table 1. Skin surface pH measurements after gel formulations application.

pH	T0	T 30	T60
Thermal water	5.32±0.06	5.38±0.31	5.31±0.16
Purified water	5.66±0.13	5.78±0.08	5.80±0.04

Values: mean±SD (n=3)

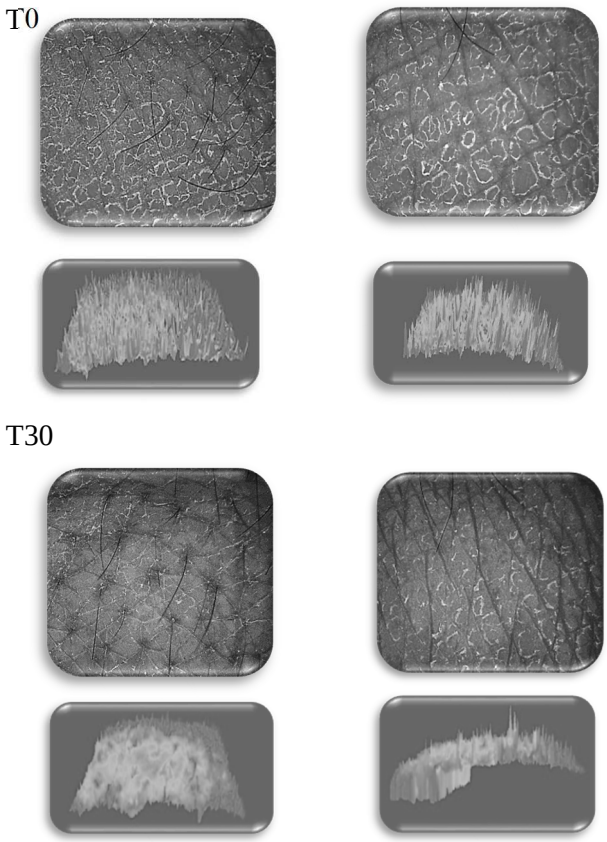
The hydration degree was always higher and kept stable within after 1 hour (Figure 3) and the TEWL (expressed in $g.m^2/h$) experimented a significative decrease, which appoints for an improvement in the stratum corneum barrier function.

Figure 3. Hydration comparison between both gels.



The skin relief was evaluated by the analysis of the images that shows its structure, the level of dryness and the real topography of its surface. The results demonstrate that better results were obtained for the gel formulation containing thermal water, as it can be shown in Figure 4, taking in account the hydration degree as well as the surface smoothing.

Figure 4. Skin relief evaluation for the formulations containing thermal water (left) and purified water (right) before (T0) and 30 minutes (T30) after application.



4 Conclusions

The incorporation of the Termas do Cró thermal water, which has therapeutic indications for dermatological use approved by the Portuguese National Health Authority, in cosmetic products, namely in a gel formulation, was evaluated for the first time. The results obtained showed good stability over the time of storage, demonstrating adequate physical and chemical characteristics for cosmetic use. Moreover, a significant improvement in the different biometric parameters was verified for the thermal water-based gel in comparison with the purified water one.

In conclusion, this work opens promising perspectives in its utilization at Cosmetic as well as the Dermatology fields. In this sense, the vehiculation of this termal water in cosmetic products it is envisioned as a potential tool for the treatment of specific dermatological diseases, like psoriasis and atopic dermatitis.

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