Thalassotherapy in Porto Santo Island of the Madeira Archipelago: facts and prospects

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Abstract

Thalassotherapy by definition is the use of seawater, sea products (sand, mud, salt, algae, aerosols…) and seaside climate as a form of therapy. However, the actual definition of Thalassotherapy is more precise considering the combined use with preventive and therapeutic purposes of sea water and sea derived products, under counseling and medical supervision, inside the adequate facilities of establishments located near by the sea.

Thalassotherapy is one of the by-products of Health and Wellness Tourism programs which comprise healthy activities such: Thermalism/Crenotherapy (using natural mineral water and natural mud/peloid in Thermal Resorts as healthy resources); Mudtherapy/Pelotherapy (using mud/peloid, that as a rule could be derived from the sea or from natural mineral water, as healthy resource); Psammotherapy or Arenotherapy (using special natural sands as a rule derived from the sea, as healthy resource); Halotherapy (using sea salt as healthy resource); and Climatotherapy (using seaside climate as healthy resource).

All these healthy, touristic and economic activities take place in Health Resorts and spas that as a rule provide just one specialized healthy activity using or natural mineral water, or seawater, or sea and natural mineral water derived products such as mud, sand and salt. The therapeutic use of any of these natural resources has indications and contra-indications, reason why it should have the involvement (diagnosis, prescription and supervision) of specialized medical staff, the sanitary safety control of the natural resources, facilities and equipments being required too. Such conditions are fundamental requisites for getting the necessary accreditation and certification.

Health and Wellness are intrinsically connected, and Health and Wellness Tourism is fundamental in what attractiveness and competiveness of touristic destinations is concerned.

In Portugal, unlikely in other countries such as France and Spain, do not exists legislation for the actually existing 6 (six) Thalassotherapy spas, legislation (Decreto-Lei nº 142/2004) that exists for the 41 (forty one) Thermal spas.

In Lo Pagán, Mar Menor, Murcia, Spain, Thalassotherapy and Mudtherapy are currently practiced in the same spa, although in separate and adequate facilities.

Porto Santo' Island of the Madeira Archipelago, at the worldwide scale, is one of the very rare territories, where in the same Thalasso Centre, seawater and derived sea products such as sand, mud, algae, … could be used together, naturally in separate and adequate

individual facilities. However, presently seawater applications (inhalation, bath and seaweed therapies) only take place in Vila Baleira Hotel Resort & Thalasso Spa, whereas sand-baths only are provided in Porto Santo Hotel Geomedicine clinic & spa.

Key words: Porto Santo island, Madeira archipelago, health & wellness tourism, thalassotherapy, psammotherapy, mudtherapy/pelotherapy, thalasso spas, accreditation, certification

Talasoterapia en la isla de Porto Santo del archipiélago de Madeira: hechos y perspectivas

Resumen

La talasoterapia por definición es el uso de agua de mar, productos del mar (arena, barro, sal, algas, aerosoles...) y el clima costero como una forma de terapia. Sin embargo, la definición real de la talasoterapia es más precisa si se considera el uso combinado con fines preventivos y terapéuticos del agua de mar y los productos derivados del mar, bajo asesoramiento y supervisión médica, dentro de las instalaciones adecuadas de los establecimientos ubicados cerca del mar.

La talasoterapia es uno de los subproductos de los programas de Turismo de Salud y Bienestar que comprenden actividades saludables como: Termalismo / Crenoterapia (usando agua mineral natural y barro / peloide natural en los Centros termales como recursos saludables); Barroterapia / Peloterapia (utilizando barro / peloide, que en general puede ser de origen marino o de agua mineral natural, como recurso saludable); Psamoterapia o Arenoterapia (utilizando arenas naturales especiales derivada del mar, como recurso saludable); Haloterapia (usando sal marina como recurso saludable); y Climatoterapia (utilizando el clima marino como un recurso saludable).

Todas estas actividades saludables, turísticas y económicas se llevan a cabo en centros termales y balnearios que, por regla general, ofrecen solo una actividad saludable especializada utilizando agua mineral natural o agua de mar o productos derivados del agua mineral natural o marina, como barro, arena y sal. El uso terapéutico de cualquiera de estos recursos naturales tiene indicaciones y contraindicaciones, por lo que debe contar con la participación (diagnóstico, prescripción y supervisión) de personal médico especializado, el control de seguridad sanitaria de los recursos naturales, las instalaciones y los equipamientos que también lo requieren. Tales condiciones son requisitos fundamentales para obtener la necesaria acreditación y certificación.

La salud y el bienestar están intrínsecamente conectados, y el turismo de salud y bienestar es fundamental en lo que se refiere a la atractividad y competitividad de los destinos turísticos.

En Portugal, improbable en otros países como Francia y España, no existe legislación para los 6 (seis) centros de talasoterapia existentes, la legislación (Decreto-Lei nº 142/2004) que existe es para los 41 (cuarenta y uno) establecimientos balnearios.

En Lo Pagán, Mar Menor, Murcia, España, talasoterapia y peloterapia se practican actualmente en el mismo centro, aunque en instalaciones separadas y adecuadas.

En la Isla de Porto Santo del archipiélago de Madeira, a escala mundial, es uno de los territorios más raros, donde en el mismo Centro de Talasoterapia, el agua de mar y los productos derivados, arena, barro, algas, ... se pueden usar juntos, naturalmente, en Instalaciones adecuadas individuales y separadas. Sin embargo, actualmente las aplicaciones de agua de mar (inhalación, baño y algas marinas) solo se aplicam en el Vila Baleira Hotel Resort & Thalasso Spa, mientras que los baños de arena solo se ofrecen en la clínica y spa del Porto Santo Hotel Geomedicine.

Palabras clave: isla Porto Santo, archipelago Madeira, turismo de salud y bienestar, talasoterapia, psammoterapia, barroterapia/peloterapia, centro de talasoterapia, acreditacion, certificacion

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INTRODUCTION - CONCEPTS

By definition **Thalassotherapy** (from the Greek word *thalassa*, meaning "sea", and the word *therapea* meaning treatment) is the use of seawater, sea products (sand, mud, salt, algae, aerosols…) and seaside climate as a form of therapy. However, the actual definition of thalassotherapy considers the combined use with preventive and therapeutic purposes of sea water and the aforesaid sea products, under counseling and medical supervision, inside the adequate facilities of establishments located nearby the sea.

All the treatments involving the resources referred to have health indications and contra-indications, reason why the counseling and supervision of properly specialized medical staff are fundamental requisites.

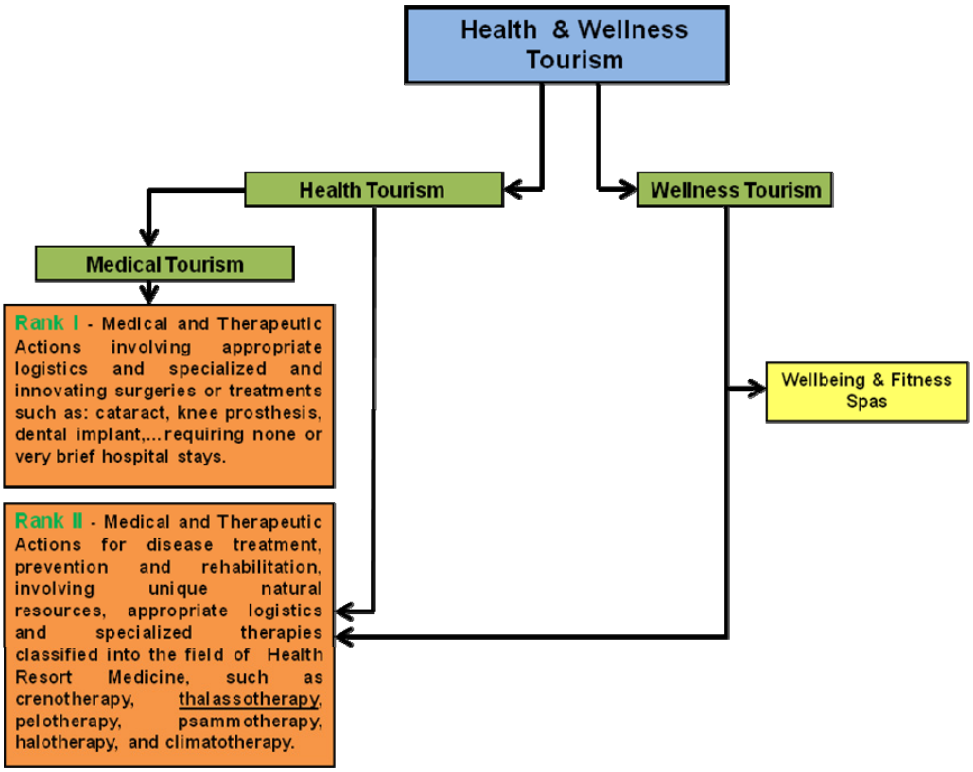
The individual use for preventive and therapeutic purposes and under medical supervision of any of aforesaid sea products should not be called Thalassotherapy, unless it takes place inside the facilities of a Thalasso Centre where the therapeutic use of seawater is necessarily practiced too. As a rule, seawater, and their derived products sand, mud and salt are therapeutically used in separate thalassotherapy, psammotherapy, mudtherapy/pelotherapy and halotherapy spas.

Only exceptionally, seawater and its sand and mud products are used together in the same Thalasso Centre for therapeutic purposes.

Porto Santo' Island of the Madeira Archipelago, at the worldwide scale, is one of the very rare territories where in the same Thalasso Centre seawater and derived sea products sand, mud, algae… could be used together, naturally in separate and adequate individual facilities.

Thalassotherapy is one of other main byproducts, such as thermalism and crenotherapy, of **Health and Wellness Tourism** (Figure 1).

Figure 1 – Diagram showing Thalassotherapy as a subcategory of Medical Tourism within the global framework of Health and Wellness Tourism (Gomes, 2016)



The essence of **Health & Wellness Tourism** is that the Health & Wellness tourists travel from the place where they live to another place looking for healthcare able to improve their health and wellness, all requiring qualified medical intervention provided for periods from few days to few weeks.

Health & Wellness Tourism it is a fast growing market of high economic and social significance, and it includes two main categories: 1) **Health Tourism**; 2) **Wellness Tourism**.

Health Tourism includes two ranks or subcategories:

Rank I - **Medical Tourism** (involving appropriate logistics, specialized physicians and medical teams, and innovating surgeries or treatments, all requiring, as a rule, very short stays, few days to few weeks, in hospitals);

Rank II - **Medical & Wellness Tourism** (involving unique natural resources, appropriate logistics and medical teams specialized on public health and therapies all classified into the field of Health & Wellness and provided **in Health Resorts,** for instance in the so-called **Thermal Resort *spas***, **Thalassotherapy *spas***, **Psammotherapy *spas*, Pelotherapy *spas*,** and **Climatotherapy *spas***, as a rule, for 2 (two) weeks.

The goal of both subcategories of **Health Tourism** in treatment and prevention of disease is the same: "**To die young, but as late as possible**" (Dr. Helmut Pratzel, ex-President of ISMH).

Medical & Wellness Tourism comprises a set of activities: Thermalism/Crenotherapy (using natural mineral waters as healthy resources); Thalassoterapy (using natural products of the sea, water, algae, mud and salt as healthy resources); Psammotherapy (using special natural sands as healthy resources); Mudtherapy/Pelotherapy (using muds/peloids as healthy resources); and Climatotherapy (using climate as healthy resource),…all provided in Health Resorts.

All these activities have health as the main target and use unique natural resources as the basis or support to improve both physical and mental wellness of individuals (patients).

In Medical & Wellness Tourism, travel is associated with the pursuit of maintaining or enhancing one's personal wellbeing.

The term wellness, with origin in the United States of America, has been defined as the seeking for healthy body and mind, particularly carried out inside the specific environments of the so-called wellness *spas.* There are diverse wellness spa typologies, some not having medical assistance and some not requiring the use of water (fitness spa, halo spa, sports spa…).

Medical & Wellness Tourism comprises activities addressed to disease cure, prevention and rehabilitation that could be provided in **Health Resorts**, for instance, at the so-called **Thermal Resorts** located, as a rule, in non urban areas and in sites possessing highly attractive natural resources (high quality environment, healthy climate, exotic landscape, ecologic parks and walking areas), archaeological and architectonic patrimony, excellent logistics (duly equipped Balnearies), human resources (qualified medical and technical), and areas for aesthetic, fitness and relaxing.

Natural mineral water (ingested, inhaled, and/or topically applied), sea water, natural gases (CO_2, H_2S, Rn), and **peloids** are the natural resources currently used in **Thermal Resorts**.

Thermal Resorts are used by those who are looking for cure or temporary improvement of rheumatic, digestive, metabolic, respiratory and dermatologic diseases.

Associated to all the Resorts referred to activities of aesthetic care, cosmetics, healthy nutrition, relaxing and mental dynamics could be provided in the so-called **Wellness *spas*** that could be integrated too into the field of **Health Tourism,** since

they could provide healthcare activities complimentary to those usually carried out in those Resorts.

Qualified medical and technical assistance is required in all **Health Resorts** referred to, as well as in **Wellness *spas***.

Public Health is the goal of present-day **Health Resort Medicine** whose targets are: **1**) Prevention is better than therapy; **2**) Learning to live healthfully.

ISPA (International Spa Association), in 2007, defines ***spas*** as places devoted to enhance overall wellbeing through a variety of professional services that encourage the renewal of body, mind and spirit.

Nowadays **Health Tourism** of Rank II and **Wellness Tourism** is considered a strategic product, inextricably linked to **Thermal Resorts**.

In Portugal, for instance, the Decreto-Lei 142/2004 of June 11 regulates the activity of **Thermal Resorts** attributing to them an essential role on the **Tourism Sector**. Revitalization of **Thermal Resorts** much depends on the diversification of their offers involving the balance or equilibrium between therapeutic activities and wellbeing and leisure activities.

Thermal Resorts restructuring requires a development model based on the completeness of ***classic therapeutics*** and ***health and wellness*** segments with the segment of ***tourism and recreation***. Also, a more effective ***products differentiation*** is required too, in order to become attractive and competitive.

In what **Wellbeing & Fitness *spa*** is concerned for non European countries, American countries in particular, what characterizes one ***spa*** is the individual promotion of both **wellbeing,** mainly in terms of aesthetics and cosmetics, and mental and physical **fitness,** using methods and techniques of disease prevention, rehabilitation and therapy (treatments with natural products) - concept of ISPA (International Spa & Fitness Association).

Massages (holistic and recover), aesthetic treatments (facial masks, anticellulite), detox treatments, techniques of physical and mental relaxing, hydrotherapy and gymnasium fitness are some of the activities applied in **wellbeing & fitness *spas*,** quite common in urban areas (particularly in hotels), and where clinical treatments are dispensable. On the contrary, as a rule, these therapeutic treatments with medical assistance are essential on traditional **Thermal Resorts** and on **Wellness *spas*** too.

THALASSOTHERAPY IN PORTO SANTO' ISLAND

Facts

The Portuguese coastline reaches 1792 km of which the archipelagos of Madeira and the Azores contribute with 960 km. The Atlantic coast of mainland Portugal is 832 km. Tunisia, the second Thalassotherapy tourist destination, with more than 60

(sixty) Thalasso Centres, has 1298 km of Mediterranean coastline. Most touristic destinations with Thalassotherapy, as Tunisia, are only bathed by the Mediterranean Sea.

Portugal with its Atlantic coastline of 1792 km has only six Thalasso Centres. Despite the great potential that exists, there are only six Thalassotherapy Centers in Portugal: Grand Real Santa Eulália Resort, Algarve; Sofitel Thalassa Vilalara Resort, Algarve; Thalasso Center of Costa da Caparica, Costa da Caparica; Seaside Resort of Espinho City Hall, Espinho; Barra Talasso, SA., Nazaré; Vila Baleira Talassa, Porto Santo's island, Madeira's archipelago.

In Funchal, Madeira' Island, there is one hotel spa, Vidamar Resort Hotel Madeira Thalasso Sea & Spa, where seawater is used for wellbeing purposes.

Portugal has not been taking advantage of the enormous potentiality of Thalassotherapy.

It should be noted that Portugal due to its geographic location, surrounded by the Atlantic Ocean, has better conditions for the practice of Thalassotherapy due to the quality of seawater, sea breezes, algae/seaweeds, sands and muds.

We would like to point out that the seven Lusophone countries have extensive coastlines with enormous potential to develop Thalassotherapy. The implementation of Thalassotherapy could make a valuable contribution to the sustainable development of those countries, and to the improvement of the quality of life and health of the native populations.

The breathing of ocean air loaded with negative ions will have several therapeutic effects (asthma, sinusitis, skin diseases, allergies, heart diseases) as well as anti-inflammatory and relaxing properties in some mental and psychological diseases.

The sea is a source of health and wellness, since the seawater within mineral waters is the most-rich in minerals, containing all the natural chemical elements.

There is a significant number of scientific publications on Thalassotherapy deserving to be enhanced those due to the following authors: Pros (1980), Poncet (1980), Hobel (1985), San Martin (1995), Hoareau (2002; 2006), Tréguer (2003), São José (2004), Tinghérian (2005), Viegas Fernandes & Viegas Fernandes (2006), Cerrada (2007), Núñez & Navarro (2007), Caselles (2007), Soto (2008), Charlier & Chaineux (2009), Chaussabe (2009), Veillet – Berry (2011), Viegas Fernandes & Viegas Fernandes (2011;2013;2014), Alberola & Coll (2013), Maraver (2000; 2015), and Morer (2016).

Viegas Fernandes & Viegas Fernandes have been developing research about 300 (three hundred) Thalasso Centres worldwide and identified the main important countries: France, Tunisia and Spain (about sixty Thalasso Centres each country) and Italy (thirty Centres).

In particular, the Porto Santo' island, that belongs to the Madeira archipelago, possesses natural resources with origin in the sea whose particular specificities are of paramount potential importance for Thalassotherapy purposes and applications. Also, Porto Santo' Island is one territory where nature being almost unspoiled needs

to be preserved. In fact the island requires responsible tourism and sustainability, being well established that the principal ingredients for sustainability are nature and culture. Figure 2 shows a panoramic view of Porto Santo' Island.

Figure 2 – Panoramic view of Porto Santo' Island showing the "golden sand beach that is the ex-libris of the island

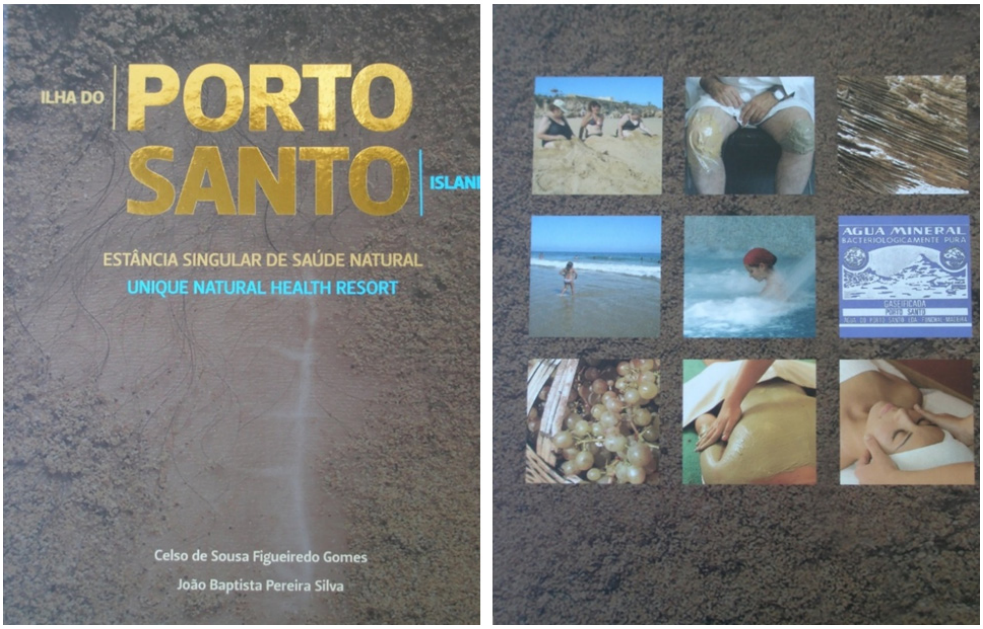
The characteristics of such natural resources are well documented in the book entitled ""Ilha do Porto Santo: Estância Singular de Saúde Natural/Porto Santo Island: Unique Natural Health Resort" by Gomes & Silva (2012) Figure 3.

Firstly like other seawaters that differ in salinity, alkalinity, and chemical composition, Porto Santo's seawater relatively to the standard or reference seawater is characterized by higher total mineralization and higher concentration of certain bio-essential elements like Ca, Mg, Sr and I (Silva 2003; Gomes & Silva 2012); naturally this seawater could be used in hydrotherapy programs, hydrotherapy being defined as the therapeutic use of both thermal and mechanical properties of water (mineral water such as natural mineral water or seawater or just tap water), either in Resort *spas*, or in Wellness & Wellbeing *spas*.

The term Thalassotherapy is due to Dr. De la Bonnardière, in 1867, for the medicinal use of seawater in a Resort, in Arcachon, France. Later, in 1899, Dr. Louis Bagot did create the first Thalassotherapy Centre, in Roscoff, France.

Already in Ancient Greece, Hippocrates (460-370 d. C.) considered as being the "Father of Medicine" had prescribed treatments based on seawater, either for ingestion, or under the form of external applications (baths and ablutions).

Figure 3 – Head of the book "Ilha do Porto Santo: Estância Singular de Saúde Natural" "Porto Santo Island: Unique Natural Health Resort"



About Thalassotherapy the very recent paper by Morer (2016) reports the historical foregoing, the concepts, the physical and chemical properties, and the application methods of seawater and of its derived products (mud, sand, algae, salt, aerosols…) for therapeutic purposes.

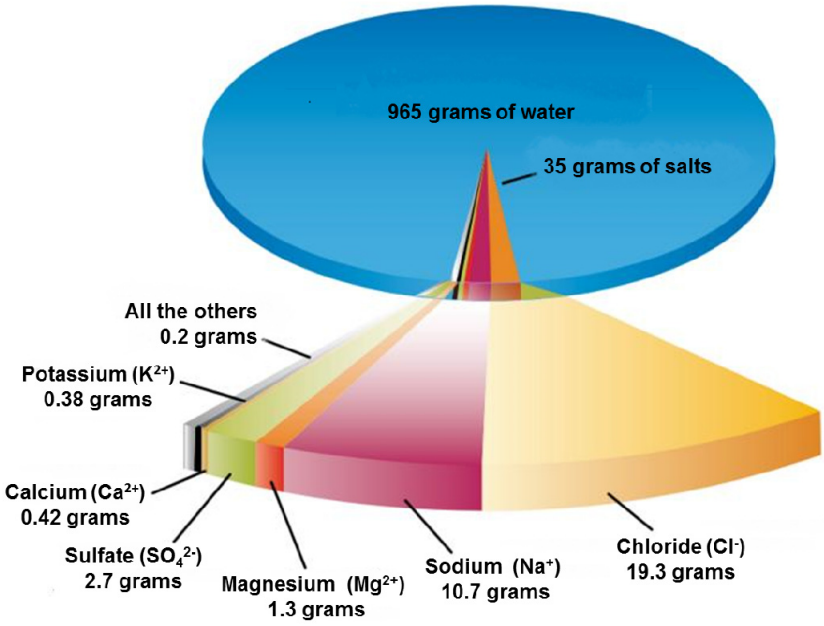
Sea is a source of health and wellbeing, since seawater, within all mineral waters, is the richest in minerals containing all (92) natural chemical elements.

Figure 4 shows de average chemical composition of seawater. Sodium chloride (NaCl) is the fundamental constituent of seawater, representing about 80% of total dissolved salts, the other salts being sulfates, bicarbonates, bromides, fluorides and silicates. Ca, Mg, K, Br, B, F, Si and more 79 oligoelements are present too, as well all gases present in the atmosphere, and within them N, O and CO_2 are the most abundant.

The chemical composition of seawater is almost similar to human blood plasma, although the concentration of the mineral salts is three times higher. The chemical composition of water from seas and oceans is not uniform, varying within narrow limits, depending on regional geology and climate.

Seawater temperature varies from -4ºC in the Arctic sea, up to 30ºC in tropical zones, and seawater density varies 1.028g/l up to 1.032g/l. In Porto Santo' island seawater is warm all year round, 19-20ºC in winter and 22-24 ºC in summer.

Figure 4 – Average chemical composition of seawater; weights (in grams) of the main minerals dissolved in one kilogram of seawater (Gomes, 2015)



Secondly Porto Santo has biogenic carbonate sand, a sea product (derived from the disintegration of coral reefs), that occurs on beaches as well as on aeolian deposits existing both in the littoral (dunes) and inland. Such sand is composed of bioclasts of calcareous red algae (Rhodophyta) mainly of the Corallinaceae family and genus *Lithothamnium*, has been traditionally and empirically used outdoors under the form of sand-bath on the dry sand of island's south coast beaches close to the frontal dune by islanders and visitors in the treatment called Psammotherapy or Arenotherapy of health disorders particularly of the muscular-skeletal system such as osteoarthritis, post-trauma conditions (fractures, sprains), extra-articular rheumatism, inflammatory rheumatism and fibromyalgia with reported success.

Psammotherapy is a worldwide practice, well represented by three distinctive examples: **1**. Sand-baths in the biogenic carbonate sand occurring on the beaches of Porto Santo' island, archipelago of Madeira; **2**. Sand-baths in the radioactive sand occurring on the beaches of Guarapari, state of Espírito Santo, Brazil; **3**. Sand-baths in the dark volcanic sand occurring in the Thermal Centers of Beppu and Ibusuki, Kyushu' island, Japan, which are naturally warmed by geothermal heat.

In the last two decades sand-baths have been practiced indoors, inside local adequate *spa* facilities, as is the case of Geomedicine clinic or spa of Porto Santo Hotel.

Currently groups of patients from Norway are regular users of this spa, the patients being assisted by technical professionals who travel with those groups of patients. During one week, and twice a day, each patient takes a total of twelve sand-baths using the same tube, and finished the program the sand is removed from the tube and exposed to sun radiation for sterilization during one week at least.

Figure 5 shows some of the steel made tubes used for sand-bathing in the Geomedicine Clinic & spa of Porto Santo Hotel. Sand is artificially warmed up to 40-41ºC, temperature sufficient to promote the sweating of the human body, sweat that is required to get the partial dissolution of the film of biogenic carbonate sand that is in direct contact with the body, in order to allow the uptake of the bio-essential elements liberated from the sand.

Figure 5 – View of one box with two steel made tubes where sand-baths take place at the Geomedicine Clinic & spa existing in Porto Santo Hotel

The sand-bath procedure adopted in the Geomedicine spa pretends to simulate the procedure applied in the traditional sand-baths taken in the dry sand of the transition zone beach/frontal dune.

Gomes & Silva (2001), Silva (2003), and Gomes & Silva (2012) did study and report the particular features (genetic, textural, mineralogical, chemical and thermal) of this rare type of sand, and determined too the sand relevant properties that could explain the healing effects obtained from the sand-baths.

With regard to sand textural features particle size (almost all sand grains have sizes in the range 0.250mm-0.125mm) and particle shape (almost all sand grains are platy and porous) are the most relevant. In what concerns sand mineralogical composition it mainly consists of three carbonate minerals (calcite, Mg-calcite and Sr-aragonite) all characterized by relatively easy dissolution in acidic solutions, such as the one corresponding to the sweat necessarily formed along sand-bathing procedure on the interface sand layer/human body, provided that sand is warmed up to a temperature higher than the normal temperature of the human body in natural (solar radiation exposure) or artificial conditions (inside Spa appropriate facilities).

Experience shows that the maximum health benefit of sand-bath comes if once finished the sand-bath, and before removing the sand using a shower, the patient keeps the sand fixed to the skin for few minutes until the skin get fully dry. This procedure potentiates the uptake of the bio-essential elements liberated from carbonates dissolution.

Besides the carbonates referred to the sand contains magnetite and feldspar, as accessory components. Exposed to sunshine in summer days the sand at the ground surface can reach scalding temperatures around 65ºC, and at the depth of 10cm temperatures remain around 40ºC.

Figure 6 shows some features of Porto Santo biogenic carbonate sand, related to grain size, shape and nature in particular.

The chemical analysis of the size fraction < 0.250mm of the biogenic carbonate sand did provide the following results: SiO_2-1.40%; Al_2O_3-1.05%; TiO_2-0.20%; Fe_2O_3-0.80%; MnO-0.10%; CaO-53.10%; MgO-2.50%; SrO-0.6%; K_2O-0.31%; Na_2O-0.50%; IL-41.40%. As trace elements the following were detected and determined: P-40ppm; S-20ppm; Zn-10ppm; Cu-6ppm; Cr-9ppm; Se-25ppm; I-60ppm;and As-5ppm.

Also the authors had investigated the best sand-bathing processes and procedures able to potentiate the healing effects of the therapeutic process. In synthesis experience has shown that the therapeutic properties of the biogenic carbonate sand of Porto Santo are optimized:

1. As much as the size of sand grains is within the range 0.125mm-0.250mm;

2. As much as the number of sand grain showing platy shapes increases;

3. As much as the number of volcanoclastic and ferromagnetic sand grains increases;

4. As much as the number of bioclastic grains of biogenic carbonate sand increases;

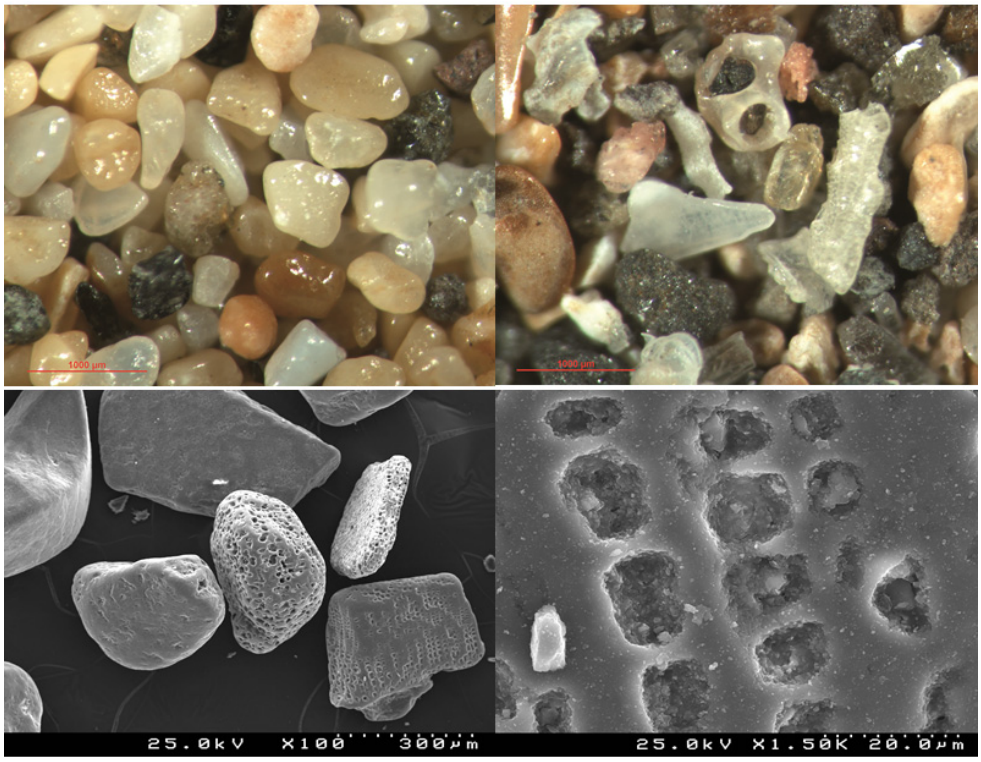
5. As much as the number of bioclastic grains of calcareous algae increases;

6. As much the number of grains of magnesium-calcite (Mg-calcite) increases;

7. As much as the contents of Ca, Mg, Sr, P, S, I and F increase.

The mechanism of action of sand-bath involves both thermal and chemical effects, the first promoting the efficacy of the second (the body uptake of the bio-essential elements Ca, Mg, Sr, Zn, Se, P, S, I, and F).

Figure 6 – Details of the grain size, shape and nature of the bioclasts essential constituents of the biogenic carbonate sand occurring, in particular, in the south coast beaches of Porto Santo' Island



Thirdly in Porto Santo' island there are special clays with excellent characteristics for the preparation of healing muds/peloids with great potential for therapeutic (in rheumatology and dermatology) and cosmetic applications. Since the Antiquity clay/water pastes, the so called healing muds, have been used topically for therapeutic and cosmetic purposes. The designation peloid correspond to an healing mud or muddy suspension that is artificialized through manipulation (refining and beneficiation) and maturation in an artificial environment and in appropriate conditions, whose therapeutic interest is based on scientific evidences, and is applied under medical prescription and surveillance inside spas or other health care facilities (Gomes *et al*., 2013).

Muds whose solid and liquid phases are formed by sediments that have been deposited either in sea or salt-lake environments, actual or fossil, are those more interesting to be used in Thalasso spas.

Examples of actual and well known worldwide saline healing muds/peloids are: Mar Morto mud, in Israel-Jordane, Mar Menor mud, in Murcia, Spain, and Mar

Chiquita mud, in Cordoba, Argentine, utilized as a rule, for therapeutic and cosmetic purposes. Recently, Baschini *et al*., 2014, involving the three natural ecosystems referred to, published an excellent and comprehensive article entitled, "Composición y Propriedades de fangos (peloides), águas y sales procedentes de lagunas y lagos salinos usados com fines terapêuticos y cosméticos".

An example of fossil sea clayey sediment having especial characteristics worldwide considered interesting for therapeutic and cosmetic purposes is the clay classified as bentonite that occurs in Porto Santo' island. Bentonite, an especial clay that is the result of submarine plus sub-aerial argillization of effusive glass rich basaltic rocks, initially under seawater, lately after being brought to surface through submarine explosive episodes and ground uplifting, occurs in small deposits located in certain sites of Serra de Dentro, Porto Santo' island. This clay is characterized by the following properties: Fine grain size, 90% <0.063 mm; Specific surface area, 119 $m^2.g^{-1}$; Cation exchange capacity, 80 $cmol.kg^{-1}$; Exchangeable cations, Ca^{+2}, Na^{+1} and Mg^{+2}; Liquid limit, 203%; Plastic limit, 42%; Abrasiveness, $0.11g.m^2$; Cooling kinetics, 38 minutes from 58ºC down to 30ºC; Chemical analysis SiO_2 - 45.01%, Al_2O_3 -18.57%, Fe_2O_3 - 10.85%, TiO_2 - 2.77%, MnO - 0.86%, MgO - 3.86%, CaO - 5.97%, Na_2O - 2.37%, K_2O - 0.45%, P_2O_5 - 1.76%, LOI - 7.54%.

Bentonite is an excellent natural and mineral product to be used, blended for instance with seawater from the island, in the manufacture of both medical and cosmetic *peloids* for *pelotherapy* applications (Gomes & Silva, 2012; Gomes *et al*., 2013; Gomes, 2017; Rautureau *et al*., 2010; 2017).

Artificial peloids (i.e., manipulated medicinal or cosmetic mud, although being based on natural substances) belonging to the typology "*designed and engineered peloids* ", which are characterized by simple composition and easy controlled sanitary safety, can allow the incorporation of functional additives, reason why they are most recommended for the preparation of formulations used topically in the treatment of muscular-skeletal and epidermal-dermal disorders as well as for aesthetic applications (Gomes *et al*., 2015). The sanitary control of healing mud/peloid used outdoors (in the natural environment) or indoors (in spas) is a fundamental prerequisite (Gomes *et al*., 2017).

Also saline mud with origin in salt-pans is rather interesting in Thalassotherapy, exemplified by the saline mud from the Adriatic coast in Slovenia, more precisely in Sečovlje Salina Nature Park, which are being used along about one hundred years in "Health Resorts", and "Thalassos Resorts" as the Thalasso Spa Lepa Vida (Kovač *et al*., 2017). In Portugal too, geophysical, geochemical and microbiological studies are being carried out on saline mud from the Paraíso salt-pans, in Aveiro, more precisely in the estuary of River Vouga, in order to determine mud potentialities for therapeutic and cosmetic applications (Cardoso Gomes, 2015; Gomes *et al*. 2017).

What was before referred to it is limited to natural saline mud/natural peloid with origin in the sea, inland seas, estuaries, lagoons and salt lakes. However, it

should be taken into account the artificial (or artificialized) saline mud/peloid prepared at the time of application, or after undergoing a maturation process after mixing the solid phase (as a rule, bentonite, kaolin, or fibrous clay) with seawater, as a rule Quinton hypertonic and isotonic water, both of known chemistry, which are commercialized by Quinton Labs or Laboratoires Quinton International, S.L.

Natural mud/artificial (or artificialized) peloid having seawater as the liquid phase is the most used for therapeutic purposes in Thalassotherapy Centres or in Thermal Centres, being examples of its actual interest, in the first case the very recent works of Barra *et al*., 2017, and of Seoane *et al*., 2017, and in the second case, the interesting works of Silva *et al*., 2015, and Krambeck *et al*., 2017.

Silva *et al*., 2015 report the use of one artificial peloid manufactured by mixing a smectite-rich clay from Porto Santo' Island with seawater also from the island. The mixture after being matured for three months was applied in the treatment of mamma or breast pathology of three volunteers/patients suffering from fibrocystic disease and breast tenderness. Before, during and after the completion of the therapeutic peloid application during 90 consecutive days the patients underwent a series of imaging tests control (bilateral mammography and breast echotomography to evaluate the evolution of cysts shape and size (Figure 7). The results were very positive, the number and size of the cysts became significantly reduced, stimulating the preparation and launching of a project entitled "Senopeloidtherapy" involving a multidisciplinary team of specialized professionals.

Figure 7 – Treatment with designed peloids of patients suffering from benign fibrocystic breast disease (Bi Rads < 3)

Finally an interesting natural resource of Porto Santo is the mild oceanic climate that prevails in the island all year round as well as the characteristic fragrance of marine aerosol. The particular climate features and their health benefits of *climatotherapy* have been studied and reported (Gomes & Silva, 2012). However, much more investigation on the health effects of local climatotherapy is needed.

Dead Sea is a paradigm of natural climatotherapy. At Dead Sea, the highest saline lake on Earth, but the lowest topographically located at 420m below sea level, has been proven both highly effective and almost without side effects, for skin and joint diseases (Moses, 2012; Harari, 2012a, 2012b; Dramsdahl, 2012).

Actually in Porto Santo' Island Thalassotherapy is only practiced in Vila Baleira Hotel & Thalasso spa where seawater applications do take place in facilities adequately equipped to achieve the expected health benefits. Figure 8 shows some details of the facilities of the Thalasso spa.

Figure 8 – View of the Thalasso Spa of Vila Baleira Hotel, in Porto Santo' Island

In 2008, in Porto Santo Hotel, was inaugurated its Geomedicine Centre aimed at the indoors practice of sand-baths under controlled technical conditions (for instance, maximum sand temperature 42ºC and bath duration 20 minutes, and under medical advice and supervision). The two first authors of the present communication had been involved in the design of the required spa facilities, and on the definition of sand-bath methodology.

Thalassotherapy is encompassed into the scientific and technical field of Medical Hydrology, a competence within the broad field of Medicine. Hence only physicians, preferably those having that specialization, should be in charge of the *spas*

where Thalassotherapy is practiced, and they should be involved as well in the check up of patients' health state (considering contra-indications), prescription and supervision of the treatment application methods.

Sanitary safety and control, either microbiological or geochemical, due to eventual pathogenicity and toxicity existing in the employed healing sea products are important requirements. Potentially toxic elements (heavy metals included) and potentially pathogenic microorganisms (bacteria and fungi) could be present in such products. In the case of healing muds/peloids Gomes *et al*., (2017) consider that their sanitary safety is a fundamental prerequisite to ensure compliance with the general medical and pharmaceutical legal regulations in force. On this subject no specific legislation exists for healing muds/peloids, and the same happens for healing sands.

In the European Union, for instance there are no uniform rules for the microbiological specifications of healing muds/peloids, despite the concern shown by the European Spas Association (ESA).

Several methods are now used or may be used for *mud/peloid* sterilization, with emphasis on the use of gamma irradiation, combined pressure and temperature (autoclave), and pressure alone. The traditional autoclave method does not keep the chemical integrity of the liquid phase, but is highly efficient in sanitary terms; however, high pressure methods keep the chemical integrity.

Gomes *et al.,* (2018) show an example of the application of a methodology involving the pasteurization of the solid/liquid mixture and a combined methodology involving the sterilization of the *peloid* solid phase (using temperature) and the pasteurization of the solid/liquid mixture (using temperature and high pressure). The authors have prepared one *designed and engineered peloid* of very simple composition by blending one clay (*Portuguese commercial kaolin*) with water *(either sterilized distilled water*; or *natural mineral medicinal thermal water),* assuming that it is in the liquid phase that the eventual active healing substances are found and available. The *sterilized distilled water*, being microbiologically stable, served as a standard throughout the investigation, the *natural mineral medicinal thermal water* of S. Pedro do Sul Thermal Resort being selected due to its well recognized medicinal healing effects. The combined methodology being adopted, based on the sterilization of the solid phase followed by the pasteurization of the prepared paste containing sterile distilled water, was found out to be very effective and microbiologically stable.

The aforesaid considerations should be taken into account in the actual panorama of Thalassotherapy practices in Porto Santo spas.

As a matter of fact Porto Santo' island possesses natural resources recognized by their excellent and unique properties very interesting for medicinal applications. Hence it is a prerogative of decision makers, politicians and industrialists, to protect those natural resources and to promote and regulate all the activities involving their sustainable uses.

Also the authors recommend to the actual existing Thalasso *spas* the preparation of applications within the framework of Health Tourism programs, as is the case of the *Healthy'n Portugal* project. The authors remember that in 1999 several groups of Norwegian citizens have sought treatment at the Hotel Porto Santo' Geomedicine Centre, financially supported jointly by a Norwegian public institution named "Landsforeingen for Trafikkskadde", some Norwegian Insurance Companies, and by the Administration of "Quinta da BelaVista" owner of the Hotel Porto Santo that at the time had just a pilot Geomedicine Centre.

The seashore of Porto Santo' island is particularly rich in green algae whose systematics the authors do not know. The sandy and calcareous beach-rock (locally named "lajedo") is fully coated with these algae (Figure 6) whose dried powders show high concentrations of Ca, Mg, Sr, I, and Br (Gomes & Silva, 2012).

The incorporation of algae in the mud pastes, after being submitted to cryotrituration, can enhance their efficiency for certain therapeutic and cosmetic purposes. In Dax, France, the peloid Terdax contains thermal bacteria (cyanophycae), locally created in order to be incorporated in the peloid (Coudron & Counilh, 2017). Dax is a famous Thermal Station with vocation for the treatment of muscle-skeletal pathologies. Presently the peloid of Dax could be considered as the result of a pharmaceutic process that allows the production of a thermal mud (peloid) with constant characteristics, richer of biologic phase, and satisfactory sanitary conditions.

The utilization of microalgae as a therapeutic and cosmetic resource is much looked at in Thalasso Centres and spas. In this domain significant research is being carried out at the University of Vigo, Spain, with application at the Balneary of El Raposo, Badajoz (Cortés *et al*., 2017). Microalgae paste characterized by high contents of aminoacids, carotinoids, fat acids and anti-oxidants is added to El Raposo natural peloid used, in particular, for the treatment of osteoarthritis (AO) (Piles *et al.,* 2017; Rincón *et al*., 2017). Also Martin *et al*. (2017) are investigating mixtures of seawater, bentonite and microalgae (*Tetraselmis suecica, Phaeodactylum tricornutum, Nannochloropsis gaditana e Isochrysis galbana*). Gómez *et al.,* 2017 are studying peloids containing the algae *Fucus vesiculosus* and other species of marine algae.

Finally, in a very recent article entitled "Microalgas y Cianobacterias Marinas En Cosmética y Talasoterapia" Mosqueira (2018), starts to distinguish microalgae from cyanobacteria (in the past called blue algae), and both could be cultivated in fresh water or in low or high saline water. Afterwards the author shows and comments the actual knowledge and developments of microalgae and cyanobacteria in human health, in cosmetics and Thalassotherapy, and she also reports the investigation going on at the Department of Applied Physics of the University of Vigo about the culture of marine microalgae at the Centro de Talasoterapia Talaso Atlântico, in Pontevedra, Spain, and the development of products for application in programs of Thalassotherapy, such as microalgae-baths and peloids containing microalgae.

Figure 9 shows the widespread coatings of marine green seaweeds on top of the so-called "beach rock" that is made of naturally cemented biogenic carbonate sand.

Figure 9 – Coating made of green algae fixed on top of the beach rock occurring in a section of the shoreline at the south coast of Porto Santo' Island

In Porto Santo' Island there is a plant (Figure 10) where several species of microalgae are produced in tubular vertical photobioreactors in a controlled process, in order to be applied in food, pharmacy and cosmetic industries. Some of these microalgae could well be incorporated as functional additive in eventual mud/peloid manufactured and applied in the island.

Prospects

In Thalasso Centres a rigorous chemical and hygienic-sanitary control should be daily carried out, particularly in the seawater from swimming-pools and *jacuzzis*, assessing pH, salinity and the bacteriological state, the control being granted by the Health authorities. Seawater, the essential raw material is warmed up at 31-35ºC, and should be disinfected using the action of ultraviolet radiation, and frequently renewed.

In Portugal, deplorably there is not specific legislation in the field of Thalassotherapy. France, Tunisia and Spain are examples of countries that have developed and created specific legislations for Thalassotherapy. As a matter of fact France, actually with about 60 (sixty) Thalassothérapie Centres, was the pioneer country; one norm from the Health Ministry dated of 1961 and reviewed in 1971, established the legal conditions needed for opening Thalassotherapy Centres, requisites that should be accomplished.

Figure 10 – View of the Unit of microalgae production of Buggypower, nearby the harbour of Porto Santo' Island

In 2013, "Le Syndicat National de Thalassothérapie a sollicité l' AFNOR un Cadre Legal et Médical de la Thalassothérapie", and in consequence of that, in 2015, the Norm XP 50-844, "Thalassothérapie-Exigences Relatives à la Prestation de Services" proposes a list of requisites in terms of quality and safety of facilities, equipments and hygiene, looking at the improvement and harmonization of all Thalassotherapy services and practices.

In Tunisia, the bill nº 92-1297 of July 13, modified and updated by the bill nº 2001-1081 defines norms and requisites for the activities held in Thalassotherapy Centres. Tunisia with about 60 (sixty) Thalasso Centres holds the second place among the world's top Thalassotherapy destinations. Presently Tunisian Thalasso Centres are following the recommendations proposed by ISO 17680- Tourism and Related Services – Thalassotherapy - Services Requirements, published in 2015, establishes the requirements for the provision of Quality Services in Thalasso Centres, the standard being particularly focus on hygiene and safety.

ISO 17680 focuses on five main pillars: **1**. Quality of infrastructures, such as reception, treatment rooms, and technical areas; **2**. Facilities and equipments; **3**. Human resources with the necessary qualifications and being properly trained; **4**. Best practices, methods and medical treatments; **5**. Transportation, storage and handling of raw materials used in the treatments, seawater, mud, sand and algae.

Besides the referred to conditions it is understood that all national legal obligations, especially regarding hygiene, health, consumer and employee rights, are to be fulfilled by the Thalassotherapy Centres.

In Spain, the Decreto nº 55/1997 of July 11 established specific legislation that rules, in particular, the sanitary conditions prevailing in the Balnearies of Thermal spas and of Thalassotherapy spas too, where peloids are applied. In the Murcia's region, in the lagoon of Mar Menor, more precisely in Lo Pagán, San Pedro del Pinar, there is a quite significant number of Balnearies where Thalassotherapy is practiced. The lagoon saline water (sodium chloride-rich water, with Ca and Mg) is characterized by a solid residue estimated at 7,2366mg, at 180ºC), covers an area of 135km^2 and 6m of maximum water depth. Yet in Spain, on the 8 of March, 2004, was created the "Sociedad Española de Talasoterapia", the main goal of which is to supervise the minimum requisites, sanitary safety included, that Thalasso Centres should accomplish, and on top of the requisites is the existence of a physician specialist in Hydrology on the Directive Board.

Viegas Fernandes & Viegas Fernandes (2011) consider that all Thalassotherapy Centres existing in all countries around the world should be accredited and certified, and mention that since 1996 the Federation Internacional de Thalassothérapie Mer et Santé in cooperation with the certifying entity "Comité Francês de Acreditação (COFRAC)", confers the accreditation and certification to Thalassotherapy Centres in all countries through the emission of certificates of quality Qualicert.

Qualicert is an independent entity for certification created in France, in 1991, within the framework of the Société Générale de Surveillance, and has been considered so far as the first world-wide organization for quality control, inspection and audit for Thalasso Centres.

Qualicert certificates warrant the quality of both treatments and facilities applied and existing in Thalasso Centres, and the certificate attribution requires the accomplishment of seven fundamental requisites, all contemplated in French and Tunisian legislations: **1**. Location in a privileged site nearby the sea; **2**. Utilization of natural seawater; **3**. Utilization of natural products extracted from the sea; **4**. Permanent medical surveillance; **5**. Constitution of a permanent health care professional team; **6**. Reception service with information about the Thalasso Centre; **7**. Permanent control of hygiene, safety and satisfaction degree of clients (Viegas Fernades & Viegas Fernandes, 2011).

The authors of the present article are very much hoping that soon the existing Thalasso Centres in Portugal could follow a specific national regulation in the likeness of the international regulations aforementioned in order to be certified and accredited, fundamental requisites to attract clients.

The main Thalassotherapy health indications are: diseases of the respiratory tract (asthma, rhinitis and sinusitis); allergic skin diseases (eczema, acne, urticaria, ichthyosis, psoriasis); chronic rheumatism (arthritis, arthrosis, neuritis); inflammatory rheumatism; sciatica; treatment of reeducation in sequelae, bone fractures and

inflammations; osteoporosis; osteoarticular and lymph node diseases; cellulitis; anemia; gynecological diseases (metritis, salpingitis, vaginitis); combat fatigue, stress and depression; chronic or inflammatory gastrites; disorders of the duodenum and small intestine; premature aging; weight loss; rickets; oral hygiene, teeth and gums.

The main Thalassotherapy health contraindications are: cancer in the acute or severe phase; evolutionary pulmonary tuberculosis; acute kidney and urinary tract disorders; heart failure and heart disease; very high hypertension; severe hepatic insufficiency; phlebitis; diabetes with malnutrition; inflammatory, ulcerated or infected dermatological lesions; hyperthyroidism; postpartum and menstruating women, because of risk of uterine infection; children scrofulous, lymphatic, rickety, and with infected lymph nodes.

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