# 19 Sea Water and Sea Mud
## *Cosmeceutical Applications*

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**CONTENTS**

19.1 Introduction to Sea Water and Sea Mud ..... 241
19.2 Cosmeceuticals from Sea Water ..... 242
19.3 Constituents of Sea Water Minerals and Their Functions ..... 242
19.3.1 Sodium ..... 243
19.3.2 Magnesium ..... 244
19.3.3 Calcium ..... 244
19.3.4 Potassium ..... 244
19.3.5 Strontium ..... 244
19.4 Cosmeceuticals from Sea Mud ..... 244
19.5 Constituents of Sea Mud and Their Functions ..... 245
19.5.1 Thermal Mud Therapy ..... 246
19.5.2 Clays in Thermal Mud Therapy ..... 246
19.5.3 Mud Pack Therapy ..... 247
19.5.4 Therapeutic Effect of Sea Mud ..... 247
19.6 Cosmeceuticals from Sea Salt ..... 248
19.6.1 Sea Water and Sea Mud for Skin Disease Treatments ..... 248
19.6.2 Psoriasis ..... 248
19.6.3 Atopic Dermatitis ..... 249
19.6.4 Antiagaing and Bleaching Agent ..... 249
19.6.5 Antioxidative Influence of Thermal Mud Therapy ..... 252
19.7 Conclusion ..... 252
Acknowledgments ..... 252
References ..... 252

## 19.1 INTRODUCTION TO SEA WATER AND SEA MUD

From ancient days, sea water and sea mud have been widely used for various applications, including fishery, algae aquaculture, medicine, food, drinks, cosmetics, and other economic value-added products (Liu et al. 2008). Cosmeceutical products often consist of water, which comes from different sources such as sea, river, flowers, and plants. Water from sea sources is promising and most widely used for cosmeceutical applications due to its rich mineral substances and trace metals. Recent research studies reveal that sea water and sea mud are useful for treating various skin diseases, such as psoriasis, acne, wrinkles, and photoaging effects.

Sea water used as a cosmetic agent is 100% natural with no side effects, fragrance-free, oil-free, alcohol-free, and preservative-free (Soto 2008). The minerals of sea water play a significant role in

treating the various skin diseases. Sea water is highly effective on inflammatory skin diseases due to its constituent minerals, such as sodium, potassium, magnesium, strontium, and selenium (Lee and Maibach 2004, 2005).

## 19.2 COSMECEUTICALS FROM SEA WATER

The deep-sea water industry is characterized by rich mineral substances and trace metals suitable for multiapplication development. Deep ocean water is commonly referred to as the water below the photic zone and is typically cold, clean, stable, and rich in nutrients. Japan and the United States have been exploiting deep ocean water for utilization in pharmaceutical, cosmetic, and fishery industries for many years (Liu et al. 2008).

## 19.3 CONSTITUENTS OF SEA WATER MINERALS AND THEIR FUNCTIONS

Sea water is mainly composed of chloride, sodium, magnesium, calcium, potassium, and sulfate, which are present in the ionic state. The important constituents of sea water are shown in Table 19.1.

Minerals cannot be produced within the body; they need to be consumed through food, drink, or other means. Dead Sea water consists of naturally stable, purified, and enriched essential minerals, including sodium, magnesium, calcium, potassium, lithium, and rubidium. These elements play a necessary role in human body skin metabolism (Ma'Or et al. 1997). The Dead Sea is composed of organic and inorganic portions; the overall salt content of the Dead Sea is 320 g/L, and the average mineral salt content is carbonate, 23.20%; calcium, 20.40%; magnesium, 4.90%; chloride, 7.80%; sulfate, 7.80%; sodium, 1.70%; and potassium, 1.30%. Another mineral-rich constituent of the Dead

**TABLE 19.1**
**Composition of Sea Water at 3.5% Salinity**

| S. No. | Element | Symbol | Atomic Weight | ppm[a] |
|---|---|---|---|---|
| 1 | Oxygen | O | 15.9994 | 883,000 |
| 2 | Hydrogen | H | 1.00797 | 110,000 |
| 3 | Chloride | Cl | 35.453 | 19,400 |
| 4 | Sodium | Na | 22.9898 | 10,800 |
| 5 | Magnesium | Mg | 24.312 | 1,290 |
| 6 | Sulfur | S | 32.064 | 904 |
| 7 | Calcium | Ca | 40.08 | 411 |
| 8 | Potassium | K | 39.102 | 392 |
| 9 | Bromine | Br | 79.909 | 67.3 |
| 10 | Carbon | C | 12.011 | 28 |
| 11 | Nitrogen | N | 14.007 | 15.5 |
| 12 | Fluorine | F | 18.998 | 13 |
| 13 | Strontium | Sr | 87.62 | 8.1 |
| 14 | Boron | Br | 10.811 | 4.45 |
| 15 | Silicon | Si | 28.086 | 2.9 |
| 16 | Argon | Ar | 39.948 | 0.45 |
| 17 | Lithium | Li | 6.939 | 0.17 |
| 18 | Rubidium | Rb | 85.47 | 0.12 |

*Source:* From Turekian, K.K., *Oceans*, Prentice-Hall, Englewood Cliffs, NJ, 1968.

[a] Other elements are <0.1 ppm (mg/L).

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**TABLE 19.2**
**General Functions of Various Sea Water Minerals**

| S. No. | Element | General Function in Skin |
|---|---|---|
| 1 | Chloride | Vital for proper cell metabolism |
| 2 | Sodium | Helps fight free radicals formed in the skin; mitigates skin aging |
| 3 | Magnesium | Increases the production of antioxidants; insufficient levels of manganese may lead to dermatitis |
| 4 | Sulfur | Important for collagen synthesis and for healthy skin keratinization |
| 5 | Calcium | Strengthens cell membranes; aids skin cell metabolism; essential for healing wounds and preventing infection; helps cleanse pores |
| 6 | Potassium | Regulates the transfer of nutrients through cell membranes; helps prevent the formation of free radicals; helps prevent acne |
| 7 | Bromine | Stimulates the skin's natural repair process; acts as a natural antibiotic; helps relieve the discomfort associated with skin disorders |
| 8 | Boron | Plays a crucial role in maintaining transmembrane functionality |
| 9 | Fluorine | Promotes healthy skin and nails |
| 10 | Strontium | Plays a role in connective tissue formation, reduces sensory irritation such as stinging, burning, itching, and inflammation |
| 11 | Silicon | Important for maintaining proper skin thickness and strength, as well as for the production of collagen |

*Source:* Obey Your Body, http://www.obeyyourbody.com/Catalog_47.html.

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Sea is black mud, which is generally rich in organic portions and is also known as bituminous tar (Matz et al. 2003).

The skin-smoothing treatment can be very efficiently performed with 1% Dead Sea mineral solution, without mineral additives, and control gel without antiwrinkle agents (Ma'Or et al. 1997). Treatment of natural mineral-containing amorphous silica, aluminum oxide, ferric oxide, titanium oxide, calcium oxide, magnesium oxide, potassium oxide, sodium, and phosphorus oxide on human skin cells with keratinocytes after UV irradiation significantly decreased MMP-1, MMP-2, and IL-2 secretion and increased cell growth and laminin expression (Jung et al. 2009). The common minerals and their general role in skin treatment are explained in Table 19.2

### 19.3.1 Sodium

Sodium is present in the form of sodium chloride (NaCl) in a major portion of sea water, and present as 10,800 ppm level of water in the fourth position. The combination of sodium and chloride is a major constituent of water next to oxygen and hydrogen. The effect of sea water may be attributed to skin barrier preservation by sodium chloride and potassium chloride, and an emollient effect by only sodium chloride (Yoshizawa et al. 2001). Mineral water with 250 mM sodium chloride and 50 mM potassium chloride was the most effective for preventing disruption of the skin barrier and stratum corneum water content after cumulating irritation by sodium lauryl sulfate (Yoshizawa et al. 2003). Moreover, acute irritant contact dermatitis is frequently treated with cool water or saline compresses, as a result of which significant reduction has been found in transepidermal water loss, with no statistically significant difference between the efficacies of both waters (Levin and Maibach 2001). In mice challenged with 1-chloro-2,4-dinitrobenzene (DNCB) in combination with sodium chloride (14%) there was no statistically significant difference in the degree of ear swelling (Greiner and Diezel 1990).

### 19.3.2 Magnesium

Current research studies suggest that magnesium-containing sea water solution has a great beneficial effect on various skin diseases such as psoriasis, wrinkles, and irritant contact dermatitis. Magnesium bromide and magnesium chloride inhibit the well-known excessive proliferation of psoriatic keratinocytes (Levi-Schaffer et al. 1996). Bathing in sea water containing magnesium chloride has significantly increased skin hydration and reduced skin roughness, redness, and inflammation of the skin compared to tap water control (Proksch et al. 2005). *In vitro* and *in vivo* studies reveal that magnesium ions significantly inhibit the antigen-presenting function of human epidermal langerhans cells (Schempp et al. 2000).

The influence of magnesium ions on inflammation in allergic contact dermatitis was reduced in DNCB in BALB/c-induced mice. Animals challenged with 0.125% DNCB in the presence of magnesium chloride demonstrated significantly less pronounced contact dermatitis (ear swelling) than did animals challenged with DNCB alone (28 and 14%) (Greiner and Diezel 1990). However, a low concentration of magnesium salt compresses showed no significant effect on barrier disruption or dryness in the irritant (Yoshizawa et al. 2001).

### 19.3.3 Calcium

Calcium is the most abundant element in the human body when compared to other elements. It's normally present in bone, tissue, and blood. The majority is present in bone. The function of calcium for skin treatment is obscure. Sea water contains 411 ppm calcium.

### 19.3.4 Potassium

The role of potassium ions for the skin treatment from sea water remains obscure. However, a few experiments explain that a minimum concentration of potassium salt is useful for skin treatment. For example, 10 mM potassium chloride may be attributed to the prevention of skin barrier (Yoshizawa et al. 2003). The effect of sea water may be attributed to skin barrier preservation by potassium chloride (Yoshizawa et al. 2001). Potassium bromide solution in diluted Dead Sea brine reversibly inhibits cell proliferation in *in vitro* cell culture systems. Potassium bromide is more powerful as an inhibitor than sodium and magnesium chlorides (Shani et al. 1987).

### 19.3.5 Strontium

Strontium is present in sea water to the extent of 8.1 ppm. Strontium-related compounds have been proven for anti-inflammatory properties (Jellum et al. 2004, 2011). Strontium salts to intact skin produced potent suppression of sting, burn, and itch caused by many irritant chemicals (Hahn 1999). Strontium nitrate may act as a topical antipruritic agent in reducing histamine-mediated itch (Zhai et al. 2000). Strontium contributes to stabilization of the calcium phosphate structure in the bone and pointed out that osteoporosis is the lack of not only calcium in the bone but also phosphorus, silicon, magnesium, fluoride, and strontium, the other constituents of bone.

## 19.4 COSMECEUTICALS FROM SEA MUD

Sea mud contains various nutrients and minerals, and even antibacterial components. Therefore sea mud has been used for making skin care and cosmeceutical products. Sea mud has been added to various cosmetic products due to its beneficial effects. Dead Sea mud is especially known for its therapeutic properties for psoriasis and other skin-related disorders. Thus several beauty products are based on this mud. Mud therapy has a beneficial effect for skin due to the following reasons: it

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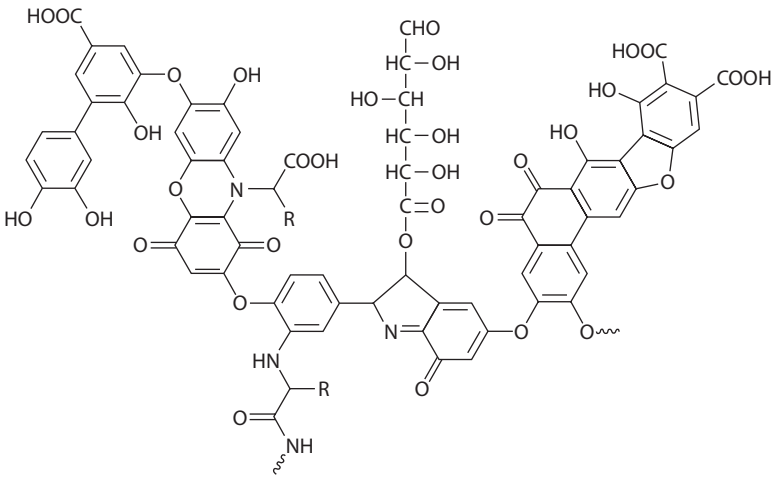



**FIGURE 19.1** Structure of humic acid.

helps to retain water for a longer time, restores skin pH, and helps in blood circulation, acne repair and prevention, and antiaging effect.

Dead Sea mud and waters rich in minerals can be applied to either the entire body or just parts. Dead Sea mud masks stimulate, tighten, clean, and invigorate the skin with a refreshing glow. Dead Sea mud can also be used for the relief of various aches and pains, and because of these beneficial effects sea mud can be used in promoting health effects and hygiene. The mud from the Dead Sea in Jordan is the most widely talked about sea mud. Dead Sea mud is black in color (called Dead Sea black mud) (Momani et al. 2009). Dead Sea black mud is a homogeneous mixture of Dead Sea minerals and organic materials that may help in decreasing some skin diseases and rheumatism pains and rejuvenate skin cells.

The use of Dead Sea bath salts at home is an effective way to relax and absorb the minerals of the Dead Sea. Research has proven the efficiency of Dead Sea bath salts in alleviating skin diseases such as psoriasis, by treatment that can be administered at home by using about 2.2 lb for each bath. It is also highly beneficial for relieving muscle tension or for simply relaxing and enjoying a rejuvenating experience. The possible role of Dead Sea minerals on skin smoothing was studied. The surprising results were that Dead Sea minerals were found to be superior in comparison with 45 leading cosmetic brands, in smoothing the skin's surface and reducing wrinkle depth and skin roughness (Ma'Or et al. 1996, 1997).

## 19.5 CONSTITUENTS OF SEA MUD AND THEIR FUNCTIONS

Sea mud usually consists of organic and inorganic portions. The organic portion is mainly composed of humic acid (Figure 19.1) and the inorganic portion is rich in more than 19 different mineral components, such as $Na^+$, $Mg^{2+}$, $Zn^{2+}$, and so on. The potential use of the organic and inorganic substances from sea mud in various skin products is a safe biological substances for skin protective purposes (Kim et al. 2010).

Dead Sea mud is believed to be derived from older sediments or the red-brown soils that are swept into the sea during the wintertime. Sediment precipitations in the Dead Sea were investigated for the first time by Neev and Emery (1967). The chemical properties of Dead Sea mud samples are shown in Table 19.3. The pH values are between 5.7 and 6.1 (weak acid), whereas the electrical conductivity values are between 59 and 67 μS/cm. The above pH and electrical conductivity values classify the analyzed samples of the Dead Sea mud as weak electrolytes (Neev and Emery 1967).

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**TABLE 19.3**
**Chemical Properties of Different Sea Mud Samples**

| Property | Samples | | |
|---|---|---|---|
| | North | Middle | South |
| Total surface area ($m^2/g$) | 830 | 774 | 788 |
| Cation exchange capacity (meq/100g) | 45.75 | 29.31 | 35.57 |
| pH at 28.5°C | 6.1 | 6.01 | 5.7 |
| EC µS/Cm | 59 | 65 | 67 |
| Different minerals (%) | | | |
| 1. Clay | 8.76 | 4.15 | 6.65 |
| 2. Dolomite | 5.05 | 5.21 | 6.17 |
| 3. Gypsum | 3.85 | 1.45 | 2.1 |
| 4. Kaolinite | 12.64 | 9.89 | 12.07 |
| 5. Pyrite | 8.93 | 7.21 | 3.32 |
| 6. Quartz | 18.01 | 33.11 | 20.21 |
| 7. Carbonates | 40.21 | 37.75 | 47.75 |
| 8. Total feldspar | 2.55 | 1.23 | 1.73 |

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### 19.5.1 Thermal Mud Therapy

Turkey is one of the top countries in the world in terms of thermal source richness, with almost 1,000 thermal springs throughout Anatolia. The temperature of these hot springs varies between 20 and 110°C. The pH of the thermal waters ranges from 6.60 to 8.70 and temperatures vary from 30 to 84°C (Çelik Karakaya et al. 2010). Thermal mud is a hyperthermal or hyperthermalized mud produced by the primary or secondary mixing of a solid component (usually a clayey geomaterial) with mineral-thermal water. After suitable preparation (maturation), the mixing leads to the production of the therapeutic mud (peloid) that is used as a poultice in medical practice. Nowadays, the clay/water ratio, degree of maturation, and workability of a peloid mud are matters of empirism, hitherto left to the judgment of the practitioner and not repeatable for different spas (Veniale et al. 2004).

There are three main items that determine the final characters of peloids: (1) the chemical and mineralogical features of the clay materials, (2) the chemistry of the waters used to mature and prepare the mud, and (3) maturation procedures that strongly influence microbiological activities and the availability of organic components (Veniale et al. 2007; Tateo et al. 2009). Although there is a general agreement on those premises, the mechanisms of action of muds are still unknown (Fioravanti et al. 2003), likely because several stimuli work on patients: thermic activity, salt composition and concentrations, osmotic pressure, and electric conductivity.

The therapeutic effects of peloids have been extensively studied, particularly in the fields of rheumatology and dermatology (Bellometti et al. 2000). Suitable properties and active factors of a mature thermal mud are water retention, consistency, bioadhesiveness, ease of handling, pleasant sensation while applied to the skin, cooling kinetics (thermoinsulation and heat retention), and exchange capacity through mud-skin interface (mobile-soluble chemical elements and organic substances produced by the metabolic activity of growing microorganisms).

### 19.5.2 Clays in Thermal Mud Therapy

From ancient times different types of clays have been under use for multiple therapeutic purposes (Viseras et al. 2007; Aguzzi et al. 2007; Veniale et al. 2007). Soil ingestion is a practice seen in people of all countries. Clay pastes and powders are used as solar protectors, in toothpastes, creams, powders

and emulsions, bathroom salts, and deodorants, as well as in pelotherapy, for treating rheumatism, arthritis, and bone-muscle traumatic damages (Veniale et al. 2007; Carretero and Pozo 2010).

Bentonite, illite, montmorillonite, zeolite, clinoptolite, and kaolin are some of the major medical clays that are currently in use in human and veterinary medicine. The therapeutic activity of the clays mainly depends upon their physical and physicochemical properties as well as the chemical composition. The main properties that make them useful in medical applications are the structure, specific surface area, and grain size distribution, which determine absorption/adsorption and cation exchange capacity.

### 19.5.3 Mud Pack Therapy

Mud pack therapy is frequently used in daily rheumatologic practice. Mud pack application alone or in combination with balneotherapy has been found to be effective on painful arthritic processes. It has been shown to induce anti-inflammatory activity and influence the antioxidant system in patients with osteoarthritis (OA) (Bellometti et al. 1997). Mud pack application is another treatment choice for OA patients. Studies have shown that mud therapy affects several biochemical markers and has antirheumatic actions. It has a protective effect on cartilage homeostasis (Bellometti et al. 1997, 2000). It has a role in the production of pro-inflammatory cytokines and in modulating inflammatory reactions. Mud pack has a therapeutic activity due to both an anti-inflammatory component and thermal effect (Bellometti et al. 1997).

Pelotherapy is the local or generalized application of thermal muds (hot cataplasms called peloids) for treating rheumatism, arthritis, and bone-muscle traumatic damages. The recent development of cutaneous chemotherapy (treatments of seborrhoeic skin, antimicrobial and antifungal agents) has requested clay minerals with peculiar properties, aiming to realize new functional and durable medicaments (Veniale et al. 2004).

### 19.5.4 Therapeutic Effect of Sea Mud

Heat (47–50°C) plays a common fundamental role in the beneficial effects of thermal mud therapy. This kind of exogenous thermic therapy reduces muscle contractions; in turn, muscle relaxation is associated with relief from pain. Heat stimulates opioids and hypothalamic-pituitary-adrenal hormone secretions (Tateo et al. 2009), which modify abnormal muscle conditions. Heat also increases joint collagen extension, favoring stretching and reducing ankylosis and fibrotic retraction. Hence it acts as a good analgesic, rheumatologic arthropathy, and anti-inflammatory agent (Bellometti and Galzigna 1998).

With decreasing side effects better therapeutic results may be obtained by coupling pharmacological anti-inflammatory therapy and mud therapy, which reduces the amount of drug administration. The usefulness of this combined approach has been reported by a few studies on patients affected by OA (Hercogova et al. 2002; Evcik et al. 2007) or fibromyalgia (Fioravanti et al. 2007). Particularly, subjects with knee osteoarthritis (one of the most limiting diseases for deambulation in senescence) have shown pain relief and improvement of articular function, walking, and daily activities (Evcik et al. 2007).

From a clinical point of view, thermal therapy is considered very useful in the treatment of illnesses of the locomotor apparatus, such as primary and secondary osteoarthritis, extra-articular rheumatologic diseases (i.e., tendinitis, bursitis, neuritis, fibroneuritis), and also posttraumatic syndromes (Fioravanti et al. 2003). Elective thermal treatment for ostheoarthritis patients is represented by mud bath applications. Clinical observations describe the effects of mud therapy as antalgic (analgesic and muscle relaxant) and anti-inflammatory. Furthermore, experimental studies have shown regenerative actions of mud therapy on articular collagen and cartilage, which counteract ankylosis and fibrotic retraction and reduce joint stiffness (Tateo et al. 2009). Mud bath therapy

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also influences the condrocyte metabolism, controlling cartilage homeostasis, and significantly modulates the production of cytokines that damage cartilage.

Mud pack therapy has shown a significant decrease in the circulating levels of TNF-α and IL-1, correlated with joint pain relief (Bellometti et al. 1997), and increments in the serum levels of protective factors against the development and progression of the arthrosic degenerative processes, such as insulin-like growth factor I (IGF-I). Furthermore, recent studies (Mazzetti et al. 2001; Caraglia et al. 2005; Bellometti et al. 1996, 2000) demonstrated the effects of mud therapy against the activity of free radicals, such as nitric oxide and oxygen reactive metabolites, which are known to play a role in the pathogenesis of osteoarthritis.

## 19.6 COSMECEUTICALS FROM SEA SALT

Sea salt is not as refined as table salt, and it still contains traces of various minerals. Sea salt is perfect for creating bath salts, body scrubs, or custom-formulated therapeutic blends and used for food and cosmetic products. Sea salts have a low moisture content, which helps them to absorb fragrances and essential oils. Sea salt could be used in cosmetics for skin care (Blanco-Dávila 2000), skin lightening, deodorizing, hair conditioning, and cleansing (Gupta 2006).

### 19.6.1 Sea Water and Sea Mud for Skin Disease Treatments

In pharmaceutical formulations, thermal water is used as gastrointestinal protectors, oral laxatives, antidiarrheals, dermatological protectors, and cosmetics. The main factors that determine the nature of a peloid and its suitability for pelotherapeutic applications are low cooling rate, high absorption capacity, high cation-exchange capacity, good adhesiveness, ease of handling, and a pleasant feeling when applied to the skin. The composition and granulometry of the initial form of the clay and the composition of the mineral water used for the mixture are also important for getting better results in applying peloids (Veniale et al. 2007).

### 19.6.2 Psoriasis

Psoriasis has been cured by sea water (Shani et al. 1993; Montgomery 1979; Novotny 1977). Psoriasis is a chronic skin disease characterized by dry red patches covered with scales; it occurs particularly on the scalp, ears, genitalia, and the skin over bony prominences. The treatment of psoriasis has been achieved in many ways, including corticosteroids (Lezdey and Wachter 1993), oral administration of 8-methoxypsoralen followed by high-intensity long-wave ultraviolet light (Melski et al. 1977), and methotrexate (Saporito and Menter 2004).

Even though several options are available for the treatment of psoriasis, they each have disadvantages. Hence naturally derived products are highly recommended for psoriasis treatment, such as sea water, sea mud, and deep-sea minerals. Those products are with a consistency of solutions, emulsions, gels, suspensions, and salts, to be used depending on the specific purpose, and can be added to other cosmetic or pharmaceutical products. Balneotherapy with Dead Sea water has been reported as a successful treatment modality for psoriasis, atopic eczema, and vitiligo, but the precise mode of action has escaped definition so far. The saturating salt concentration (346 g/L) together with the unique UV spectrum has been suggested to trigger the release of pro-inflammatory and chemotactic mediators. The antioxidant property of Dead Sea water was observed by decomposition of hydrogen peroxide on pseudocatalse activity using Fourier transform Raman spectroscopy (Schallreuter et al. 2002).

The combination of salt water bath and irradiation yielded a significant decrease of the minimal erythema dose when compared to UVB alone (median 90 mJ/cm$^2$ vs. 130 mJ/cm$^2$, $p < 0.01$). Analysis of variance showed a significant influence of salt water bath on erythema ($p < 0.05$) but not on skin pigmentation. Within the minimal erythema dose test area the erythema index of the salt water exposed forearms was elevated significantly ($p < 0.05$), while skin pigmentation was not affected. Thus, bathing

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the skin in salt water leads to a decreased threshold level for the elicitation of UVB-induced erythema and a selective increase of the erythemal response. This sensitization to the effects of short-wave UVB radiation may increase immunosuppressive effects of UVB radiation and may lead to an increased efficacy of UVB phototherapy. However, there is also an increased sunburn risk when salt water baths are followed by exposure to UV radiation (Schempp et al. 1999; Nissen et al. 1998).

Sodium chloride (24%) solution is not useful for the treatment of psoriasis; by experiment no difference has been found between salt water and tap water for the treatment of psoriasis (Gambichler et al. 2001). However, the combination of salt water brine baths in different concentrations and subsequent UVA/B irradiation is used increasingly for the treatment of psoriasis or atopic dermatitis (Simon et al. 2000). The effectiveness of salt water baths and subsequent selective ultraviolet phototherapy was investigated in a prospective study of 40 patients with psoriasis vulgaris and atopic dermatitis. There were two groups with 20 patients each. The first group was treated with salt water (15%) that contained synthetic Dead Sea salt called Psorisal; the patients in the second group had a bath in a 3% NaCl solution. After 4 weeks of daily treatment, 80% of the patients in the group treated with Psorisal had significantly better results than the second group (Zimmermann and Utermann 1994).

Treatment of psoriasis vulgaris with tar- and oil-containing sea water baths has been reported and compared to that with sulfur baths. The superiority of the tar–sea water treatment compared to sulfur baths was confirmed. For the first time good experiences with a new oil bath are reported (Kasten 1978). Dermud is a commercial product, made with deep-sea water mud. Dermud has protective, antioxidant, and anti-inflammatory properties that can antagonize biological effects of UVB irradiation in skin and reduce skin photodamage and photoaging, and more generally reduce oxidative stress and inflammation in skin pathologies (Portugal Cohen and Soroka 2009).

Artificial balneophototherapy is an imitation of natural balneophototherapy using highly concentrated salt solutions (25%) and UVB radiation and is useful for psoriasis treatment (Roos et al. 2010)

### 19.6.3 Atopic Dermatitis

Atopic dermatitis is a chronic, eczematous skin disease that follows patients from early childhood. Sea water drinking may be highly useful to reduce atoptic dermatitis treatment (Hataguchi et al. 2005). The usefulness of the mineral water with 250 mM NaCl and 50 mM KCl as therapy was found more efficient for atopic dermatitis than for other chronic dermatitis (Yoshizawa et al. 2003). Short-term application of deep-sea water as found effective for treatment on atopic dermatitis (Adachi et al. 1998).

### 19.6.4 Antiagaing and Bleaching Agent

Cleopatra and the Queen of Sheba both reportedly bathed in the Dead Sea to keep their skin looking youthful. An Israeli company, Ahava, now has the rights to make Dead Sea mud products. The salty mud from the lowest sea on earth contains high concentrations of minerals such as magnesium, sodium, phosphate, and bromides, which work together to create a moisturizer that slows the aging process.

*Photoaging* is the term dermatologists use to describe the type of aging caused by exposure to the sun's rays. The amount of photoaging that develops depends on: (1) a person's skin color and (2) his or her history of long-term or intense sun exposure. People with fair skin who have a history of sun exposure develop more signs of photoaging than those with dark skin. In the darkest skin, the signs of photoaging are usually limited to fine wrinkles and a mottled complexion. Sea mud has a high cleansing ability; it annexes fats and dirt, discards dead skin cells, and exposes a fresh skin layer. It reduces skin laxity and even performs a certain stretch, soothes the skin, and gives it moisture, thus removing the problem of photoaging. In combination, these effects make the skin smoother, more flexible, and give it a clean, fresh, and silky appearance. The observations and significant conclusions of psoriasis treatment with sea water and sea mud with radiation therapy are explained in Table 19.4.

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**TABLE 19.4**
**Sea Water and Sea Mud with Radiation Therapy for Several Skin-Related Diseases**

| Source | No. of Patients | Type of Dermatitis | Therapy | Treatment Group | Control Group | Duration | Observation | Significance Conclusion |
|---|---|---|---|---|---|---|---|---|
| Sukenik et al. 1994 | 166 | Psoriasis and psoriatic arthritis | Balneotherapy (mud packs and sulfur baths) | 146 | 20 | 3 weeks | Morning stiffness, grip strength, effluent joints, PASI, cervical, thoracic, and lumbar spine pain | Significant results have been found between treated (Dead Sea) and untreated groups. Dead Sea treatment groups had reduction of spinal pain and range of movement in the lumbar spine, and significant improvement ($p < 0.001$ and $p = 0.022$, respectively) was observed in the study group only. |
| Elkayam et al. 2000 | 42 | Psoriatic arthritis | Ultraviolet ray, Dead Sea bath, mud therapy, and sulfur bath | 23 | 19 | 4 weeks | Stiffness, tender joints, swollen joints, right grip, left grip, PASI | Significance difference has been found between treated group and control group, such as PASI, swollen joints, and inflammatory neck and back pain. Addition of mud packs and sulfur bath to sun ultraviolet exposure and Dead Sea baths seem to prolong beneficial effects and improve inflammatory back pain. |
| Codish et al. 2005 | 28 | Ankylosing spondylitis | Balneotherapy, climatic therapy at the Dead Sea area | 14 | 14 | 2 weeks | — | Climatotherapy at the Dead Sea area can improve the condition of patients suffering from long-standing ankylosing spondylitis. |
| Shani et al. 1985 | — | Psoriasis | Dead Sea bath | — | — | 4 weeks | Serum Br, Rb, Ca, and Zn | The improvement of the psoriatic condition after bathing in the Dead Sea may be partly attributed to the minerals' effect on the psoriatic skin. |
| Portugal Cohen and Soroka 2009 | *In vitro* | Psoriasis and inflammatory | Dead Sea mud | — | — | — | MTT, caspase 3, total antioxidant, oxygen radical absorbance | Dermud has protective, antioxidant, and anti-inflammatory properties that can antagonize biological effects of UVB irradiation in skin. |
| Katkhanova and Sakhnov 2009 | 556 | Psoriasis and inflamamatory | Sun, air, and sea water baths | 278 | 278 | — | Psoriasis area and severity index | The study showed a 2.39-fold decrease of the psoriasis area and severity index (PASI) in the children of group 1 compared with its 1.38-fold decrease in group 2. |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dawe et al. 2005 | 60 | Psoriasis | Dead Sea salt solution + ultraviolet B phototherapy | — | — | 8 weeks | Erythema data | In this population the addition of pretreatment Dead Sea salt soaks to NB-UVB did not result in a clinically important improvement in clearance of psoriasis. |
| Abels et al. 1995 | 1,448 | Psoriasis | Dead Sea psoriasis clinic | — | — | — | — | The overall response in a large cohort of psoriasis patients treated at the Dead Sea was excellent. |
| Halevy et al. 1997 | 30 | Psoriasis | Dead Sea water and common salt | 13 | 12 | 3 weeks | PASI score | The present study implies a beneficial effect to bathing with either Dead Sea bath salt or common salt as a sole therapy for psoriasis vulgaris. However, we observed an enhanced beneficial effect of Dead Sea bath salt compared to common salt. |
| Even-Paz et al. 1996 | 81 | Psoriasis | Dead Sea water + ultraviolet radiation | — | — | — | — | In subjects who only bathed in Dead Sea water the improvement was 28%, in those who only sunbathed it was 73%, and in those who did both it was 83%. |

### 19.6.5 Antioxidative Influence of Thermal Mud Therapy

There is also favorable influence of balneotherapy found on antioxidative processes. In a study conducted on patients with type II diabetes beneficial effect of balneotherapy on the glutathione metabolism of platelets was observed (Ohtsuka et al. 1996). Grabski et al. (2004) reported the reduction of superoxide dismutase activity in patients with rheumatoid arthritis undergoing treatment with sulfuric water. Bellometti et al. (1996, 2000) had reported in their papers on the antioxidant property of balneotherapy and medicinal mud, showing the reduction of nitrogen monoxide activity and myeloperoxidase and enhancement of glutathione peroxidase activity. Thus it can be inferred that a therapeutic effect of mud therapy in treating osteoarthritis is mediated by different mechanisms.

Sea mud is nontoxic to skin cells even though it consists of minerals. The water and methanol extract of sea mud is used as an anti-inflammatory agent with UVB-irradiated human keratinocytes by measuring $PGE_2$. The water extract showed higher inhibition of $PGE_2$ production from HaCaT cells (30% inhibition) than the methanol extract at 200 ppm (μg/g). The water extract mainly composed of minerals in the mud inhibited $PGE_2$ production by 83% at 200 ppm, which is more than a standard anti-inflammatory drug, such as (1 μM) indomethacin (Kim et al. 2010).

## 19.7 CONCLUSION

Traditionally, sea water and sea mud are applied for skin-related diseases such as psoriasis, acne, eczema, cellulite, and joint pain due to their high rich content of minerals. However, conflicts are also present in the usage of sea water and sea mud for skin-related treatment that need to be cleared in future research.

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