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SKIN SURFACE CHEMISTRY AS A DIAGNOSTIC TOOL FOR SKIN DISEASES

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ABSTRACT

The skin is the biggest sense organ in the body, with a surface area of 1.7m2 in adults. Because standard histological procedures influence skin components, several dermatological research has had little effectiveness in showing skin function. The structure of each skin layer may now be visualised non-invasively thanks to recent advances in non-invasive optical imaging. Individual skin components, on the other hand, remain difficult to identify. Understanding skin's chemical and physical features helps the cosmetics sector create deodorant, lipstick, and moisturizers. In addition, PH regulates the activation of proteases linked to the formation of chronic wounds and impacts skin barrier functions. Optical coherence tomography (OCT) is a non-invasive optical imaging innovation that creates high-resolution photos of the face and cross-areas of the skin. While OCT has a lot of potentials, many dermatologists are unfamiliar with it. This article aims to give professional dermatologists a basic grasp of skin OCT concepts and clinical applications.

Keywords: *Skin, surface chemistry, diagnosis techniques, Skin pH.*

INTRODUCTION

Diagnostic tests are recommended when the aetiology of skin sore or illness isn't obvious from the set of experiences and actual assessment alone. The scalp, nails, and mucous films are completely analysed during a careful skin assessment. The specialist might use a hand-held focal point or a dermatoscopy (an amplifying focal point and an inherent light) [1]. Biopsies of the skin are utilised to analyse skin disease and other harmless skin conditions. Skin is removed (after a nearby sedative) and shipped off to a lab for investigation during a skin biopsy. A surgical tool, extremely sharp steel, or around and hollow punch biopsy device can be utilised to eliminate the skin. Skin stains uncover a great deal about an individual's health [2]. An absence of nutrient makes the skin have a sandpaper surface. The spoon-formed nail is brought about by iron lack sickliness. Unfavourably susceptible responses, immune system sicknesses, parasitic diseases, and different conditions would all be able to cause skin rashes [3]. We demonstrate the efficacy of the offered methods for diagnosis of skin diseases.

Skin compartments

The skin surface is the biggest sensory organ in the body. The epidermis, or outer layer, and the dermis, or inner layer, are the two primary parts of the skin, which are made up of multiple layers of tissue [1]. Multiple systems in the human body are crucial to life's survival. The

integumentary system is one of the most important systems in the human body. By definition, intuition is a covering or outer protective layer. The integumentary system is critical to human physiology. It is composed of the skin and its appendages, including hair, nails, sebaceous, and sweat glands. Human skin is the largest part of the human body, accounts for at least 16% of total body weight. The skin protects the body against external physical, chemical, and biological injury [4].

More than three thousand different skin diseases are known. Skin diseases manifest themselves individually and vary in severity. Skin conditions can be harmless and transient. However, many skin conditions can profoundly affect the quality of life and require constant treatment with medications and creams.

- Acne is a common skin condition that especially affects young people. In acne, the sebaceous glands in the skin become inflamed, causing the sebaceous gland to swell and the skin on it to become red.
- Alopecia areata, or baldness, means removing hair, sometimes other hairs, from a well-defined area without visible inflammation.
- The topic rash is one of the most common skin diseases. The main symptom of atopic dermatitis is intense itching of the skin, often at night and interfering with daily life [5].
- In Hidradenitis suppurativa, severe inflammatory reactions occur around the hair follicles. Chronic disease is not contagious and is not due to poor hygiene.
- Hand rashes are common. There may be an underlying skin condition such as atopic dermatitis or psoriasis. However, it is often caused by irritation or allergies caused by external factors.
- In Prurigo nodular is, strongly itchy nodules form on the limbs and sometimes on the body. The disease often breaks out in middle age and is chronic [6]
- Seborrheic dermatitis is common dermatitis with various manifestations and designations: seborrheic dermatitis, seborrheic eczema, and seborrheic eczema.
- Urticaria, or hives, is one of the most common skin symptoms. As the name implies, the symptoms resemble hives.
- Rash refers to skin reactions that occur in the light of the sun. Multiple light rash (MMVI) is the most common form of a light rash. About one-fifth of Finns suffer from it at some point in their lives.
- Vitiligo is a common autoimmune disease of the skin in which asymptomatic white patches develop on the skin.

If the skin is dry, red and itchy, there may be some type of eczema. Other rashes can cause similar symptoms. Some rashes are less dangerous, and others may be a sign of a more serious condition. In adults, eczema is sometimes confused with hives, psoriasis, or rosacea, and in children, smallpox, enteric pox, smallpox, and chickenpox may resemble eczema. The only sure way to find out is to see a doctor [7].

Physicochemical Properties of Skin

The skin has a wide range of physicochemical characteristics. Tissues that make up the skin work together to provide certain functions. The skin accounts for 16% of total body weight. Understanding the chemical and physical features of the skin helps the cosmetics industry create items like deodorant, lipstick, and moisturizers [8]. However, the skin's mechanical qualities were not always consistent. Skin is a highly complicated system comprised of interdependent parts such as fatty acids, molecules, blood vessels, nerve fibers, membranes, and fiber networks, all of which contribute to human existence's features and essentialness. The skin is divided into two layers: the epidermis, which is made up of densely packed epithelial cells, and the dermis, which is comprised of compact, anomalous connective tissue that contains blood vessels, hair follicles, sebaceous glands, and other systems [9].

Skin Surface Chemistry

The skin's outer surface is imprinted with a patterned intersecting line that is specific to the individual and the place on the body. Dermatoglyphics is the scientific study of these skin marks and patterns. Lines, ridges, furrows, and folds appear as a person ages. The earliest ridges in the skin appear before birth. During the third and fourth months of fetal development, ridges on the palmar and plantar tips of the fingers and toes begin to form and never alter. Men's ridges are often broader than women's [8]. The ridges on the skin are uneven and seldom follow a straight path; instead, they follow arching sweeps or create recognised patterns. Since they are engaged in many physical processes, physicochemical properties of solid surfaces such as zeta potential, polarisation, or hydrophobicity have received a lot of attention in the literature: wetting, bond strength, and tension. The new study focuses on a particular bio interface, namely skin, the most substantial organ of the human. The various methods for analysing skin physiochemistry are first examined, accompanied by their practical uses, varying from pharmaceutical to cosmeceutical scientific knowledge. These properties represent how skin interacts with topical treatments, as well as its lipid instrumentation and moisture state [10].

Skin PH as a Diagnostic Chemical Tool

Since they are engaged in many physical processes, physicochemical properties of solid surfaces such as zeta potential, polarisation, or hydrophobicity have received a lot of attention in the literature: wetting, bond strength, and tension. The new study focuses on a particular bio interface, namely skin, the most substantial organ of the human. The various methods for analysing skin physiochemistry are first examined, accompanied by their practical uses, varying from pharma to cosmeceutical scientific knowledge. These properties represent how skin interacts with topical treatments and its lipid instrumentation and moisture state. It might be extremely valuable for diagnosing, monitoring, and treating wounds and skin illnesses [7]. PH impacts skin barrier functions and is important in controlling the activation of proteases involved in wound healing and the formation of chronic wounds. PH can be used to determine a person's physiological status. It may be particularly useful for determining skin structure and wound condition. Several new and beautiful smart wound dressings with pH sensors or drug control-released carriers have been thoroughly investigated [6]. Having a better grasp of the function of pH in clinically relevant diagnostics would help physicians and enhance personal health management at home (Table 1).

Table 1. The skin pH and quality of effect.

Media	pH	Skin Effects
Alkaline	11-12	Dryness
	10-11	Sensitivity
		Redness
	9-10	Inflammation
	8-9	Sun-Damage
		Wrinkles
Acidic	4-7	Healthy Skin
	2-3	Acne
	1-2	Oily Skin
	0-1	Inflammation

SKIN DISEASES WITH SURFACE CHEMISTRY MODIFICATION

1) Eczema

Eczema is an inflammation of the skin that causes dryness, redness and constant itching of the skin. Eczema is caused by many factors, including dry skin, impaired skin penetration, or contact with an allergen. Eczema is not contagious. The appearance and symptoms of eczema may indicate atopic dermatitis (also called atopic eczema or atopic dermatitis), sebum rash, contact dermatitis, coin dermatitis, or stasis rash [6].

2) Urticaria (Urticaria)

The word urticaria comes from the Latin name Urtica for nettle, as the symptoms resemble those burnt by nettle. Urticaria occurs as itchy bumps or patches associated with deeper swelling of the skin and mucous membranes. Urticaria can come to anyone without any guesswork. Hives can be triggered by many factors, such as an allergic reaction or wasp

stings. It can also be a non-allergic reaction to an infection, berries or medicine. Symptoms may also be caused by an external stimulus to the skin, such as abrasion or pressure. In this case, the so-called physical urticaria. Urticaria may also occur in rare cases with an allergic reaction leading to anaphylactic shock [8]

3) **Psoriasis**

Psoriasis is an inherited skin condition in which red, scaly, and sometimes itchy patches cover the skin. The rash usually occurs on the elbows, knees, legs, scalp and lumbar spine but can occur in any part of the body. The disease is caused by inflammation in the skin and is characterised by exacerbation stages, i.e., periods during which the rash is more severe. There are many types of psoriasis, such as plaque psoriasis, tear psoriasis, fold psoriasis, and nail psoriasis. Psoriasis can also occur in people with psoriasis, which causes joint symptoms [10].

4) **Rosacea**

Rosacea (acne rosacea) is characterised by reddening of the skin, pimples and red rash, most commonly on the face. The face may also feel hot and tingling. The rash most commonly occurs on the forehead, cheeks, nose and jaw. The cause is unknown, but highly flavoured food, alcohol, stress, and sunlight can trigger a rash. The disease, which usually occurs after 30, is not contagious [1].

5) **Pityriasis Rosea**

Red spot flaking is most common in children and young adults, but it is also found in middle-aged people. The name comes from the words Rosea = red and pityriasis = scaly. The first symptom of the disease is an oval patch a few centimetres in diameter, the so-called primary medallion on the upper body, arm or thigh. Within a few weeks, similar but smaller patches appear in the vicinity of the firstborn. There is usually no rash on the face. Instead, the rash is pink, scaly and sometimes itchy. The disease is believed to be caused by a virus and is most common in the spring and fall. The disease is not contagious and usually improves on its own within a few months [11].

6) **Chickenpox**

Chickenpox is a highly contagious viral disease that usually affects children. The varicella-zoster virus causes it. A person who develops the disease develops immunity, so the disease is not new. The incubation period for chickenpox is 10 to 20 days after infection. The disease often begins with a fever, followed by a rash. Next, reddish bangs turn into itchy blisters. The later you get chickenpox, the more severe the symptoms [3].

7) **Impetigo**

Wetweed is a contagious bacterial infection of the skin that is most commonly contracted before school age. However, it occurs in people of all ages. The infection manifests as small spots that develop into small blisters.

Sometimes the skin just turns red and shiny. Pustules are most common on the face but can also occur elsewhere in the body. Wet scabs often break out during a cold, making it easier for the bacterium to stick to damp or irritated skin [4].

8) **Smallpox**

Enteric pox is a viral infection that most commonly occurs in children under ten years of age. Smallpox is contagious and occurs especially in late summer and fall. Symptoms include fever and blisters in and around the mouth, sometimes in the hands, feet and buttocks. Thus, smallpox is also called hand-foot-and-mouth disease. For example, the disease is transmitted through the hands, and the risk of infection is greatest during the first few days. After that, the disease usually lasts less than a week, heals on its own and does not cause sequelae [8].

9) **Measles**

Measles is a highly contagious and potentially dangerous viral disease that has been almost completely eradicated from the UK by the MPR triple vaccine. Symptoms include high fever, dry cough, runny nose, photosensitivity, swollen lymph nodes, and a rash that starts all over the body. The rash is pink at first and darkens later, and changes location. The risk of sequelae such as otitis media, sinusitis and pneumonia are high. In the worst case, life-threatening encephalitis can result. The disease most commonly occurs abroad, but there are also occasional cases in the UK [1].

10) **Smallpox (Exanthema Subitum)**

Smallpox, or three-day fever, is a harmless viral disease common from the age of six months to a couple of years old. The disease begins with a high fever lasting about three days. As the fever falls, a rash or pimples appear on the abdomen and back, which disappears on its own in a few days. The disease can also occur without a rash. A person with smallpox develops resistance to the disease [11].

DEVICE-BASED SKIN DISEASE DIAGNOSIS

Dermoscopy in Dermatology

Dermoscopy has been a beneficial method in supporting the non-invasive identification of various common dermatological problems in recent years. In this article, we discuss the dermoscopic differential diagnosis of relatively frequent dermatological illnesses categorised according to their clinical presentation to give an up-to-date practical perspective on the use of dermoscopy in general dermatology. Dermoscopy is extremely important in the diagnosis of skin neoplasms [12]. However, dermoscopy's true acceptance in the field of skin cancer is the result of a large number of clinical research with a sufficient amount of proof, as recently outlined in two Cochrane reviews, one on the diagnosis of melanoma and the other on the diagnosis of squamous cell carcinoma.

Some successes have been such as dermoscopy for parasitic infections diagnosis, which was validated in a probable comparative analysis and has since become broadly used. Still, it can not see the forest for the trees, and most publications about dermoscopy in general dermatology still have a low standard of evidence. The newly established dermoscopic parameters will then be tested for practicality and reliability in actual medical conditions [5]. In a study conducted by Aqil et al., 2018, confirmed that dermal signs which could be allocated by dermoscopy and their precision rates including broken hair, scales, follicular keratosis, black dots, bent hair, erythema, comma hair, crusts, corkscrew hair, forked hair, barcode-like hair, follicular pustules, zigzag hair, transluscent hair, V-shapped hair [13] (see Figure 1).

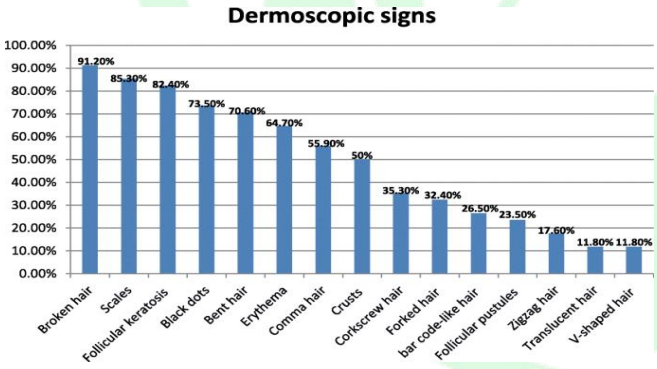

Figure 1. Dermoscopic signswith their percentage by Aqil et al., 2018 [13].

Trichoscopy in Dermatology

Dermoscopic imaging of the scalp and hair is alluded to as "trichoscopy." The onlooker's affectability for hair and scalp sickness diagnosis and follow-up would probably improve if they utilised dermoscopy consistently and knew the structures and patterns of various sorts of alopecia. Trichoscopy can uncover hair shafts of different sorts, the number of hairs in a solitary pilosebaceous unit, hair follicle openings (spots), the peri and interfollicular zones, and the vasculature [6]. Trichoscopy is a painless way of examining hair and scalp that, in most conditions, allows for the diagnostic process of hair loss and the visibility of hair strands and scalps without the need for hair removal. The primary aim is to evaluate the trichoscopy features of likely causes of patchy hair loss in children, such as tinea capitis, alopecia areata, traction alopecia, and trichotillomania. This study comprised 134 patients, including 63 with tinea capitis, 38 with alopecia areata, 18 with traction alopecia, and 15 with trichotillomania. A comprehensive background, assessment of the child's hair and scalp, fungal scraping, and trichoscopy were used to diagnose the baldness issue. Trichoscopy is a non-invasive technique for inspecting the hair and scalp. In most cases, it offers a differential diagnosis of hair loss [14]. Sicinska et al., 2015, has confirmed that the precision and quality of the diagnosis in trichoscopy has been based on the relative density of hair and the daimeters of hair shaft (see Table 2) [15].

Table 2. Percentage precision of trichoscopy relative to hair density

	Hair density in trichoscopy			Hair shaft diameters (µm)
	70 hair/cm^2	100 hair/cm^2	200 hair/cm^2	
Precision (%)	24	17	12	1.5
	19	13	9	0.9
	14	10	7	1.5
	10	7	5	1.5
	9	7	5	0.9
	22	15	11	1.6
	10	7	5	1.6

Tomography in Dermatology

Optical coherence tomography (OCT) is a nonsurgical optical imaging technique capable of producing high-resolution in frontal and cross-sectional pictures of the body in vivo to a depth of 2 mm. While OCT has significant potential for unobtrusive diagnosis and diagnostic testing, many dermatologists are unfamiliar with it. OCT has received considerable attention in diagnosing keratinocyte carcinomas, notably basic cell carcinoma [16]. In particular, we examine the possible role of artificial intelligence in improving the precision of OCT imaging quantitative reasoning. OCT is a non-invasive optical imaging procedure that can create high-resolution cross-sectional and facial pictures of the skin and cutaneous vasculature in vivo to a profundity of 2 mm. numerous dermatologists are new to OCT, notwithstanding its significant guarantee for non-invasive diagnosis and infection checking [17]. Our goal is to give the expert dermatologist a fundamental handle of skin OCT ideas and clinical applications.

Raman Spectroscopy in Dermatology

In vitro, scientific tests of tissue are done by Raman spectroscopy. Raman spectroscopy may identify the chemical makeup by monitoring the inelastic collisions of light with particles. Diseases that are hard to know visually can be recognised by variations in the chemical components of the affected tissue. Raman spectroscopy allows for direct analysis of skin lesions, which improves cancer diagnosis and treatment [18]. Raman spectroscopy is highly sensitive to chemical composition, and it can detect changes in the composition and quantity of certain compounds in the skin. Raman spectroscopy is an optical nondestructive method that analyses tissue at the molecular level, in addition to morphological examination [19]. Raman spectra are effective in distinguishing cancer from healthy tissue, even pigmented skin lesions. Unconstrained Raman dissipating microscopy is seldom utilised for skin imaging since skin parts, such as water and trans-epidermal specialists, change rapidly. Accordingly, non-direct Raman microscopies, for example, the sound enemy of Stokes Raman dispersing and animated Raman dissipating, have become more normal in skin tissue atomic imaging. This study takes a gander at how Raman microscopies can be utilised to evaluate skin and investigate patterns [20]

THE ROLE OF POSITRON EMISSION TOMOGRAPHY IN DERMATOLOGY

A blend of positron discharge tomography (PET) and registered tomography (CT) pictures is utilised to stage and screen most malignancies. PET-positive cutaneous injuries can be brought about by essential skin growths, contaminations, cutaneous metastases from different diseases, or harmless neoplasms. In dermatology, PET/CT examines have been broadly considered in melanoma and Merkel cell carcinoma patients. PET/CT checks have shown extraordinary guarantee in the therapy of squamous cell carcinoma and cutaneous lymphoma patients. However, their utility in the therapy of other cutaneous diseases is less clear [21]. Positron emission tomography was utilised to examine regional cerebral blood flow changes, which are an indicator of brain activity, and to analyse the influence of increasing levels of delay. A unique point in the temporal, parietal junction is linked to the degree of delay but not its existence. This study allows contrasts between the neural reaction to listening to one's voice after a period and the brain functions associated with this wait [11].

CONCLUSION

Exploring volatile emissions using skin surface chemistry as an added feature. Dermoscopy, an in vivo non-invasive technology for microscopic evaluation of pigmented skin lesions, can increase diagnostic accuracy. Dermoscopy diagnostic performance improved when a group of examiners agreed on a diagnosis, but it deteriorated when the frequency of melanoma rose. However, a study of several dermoscopy diagnostic algorithms revealed no significant variations in diagnostic performance. Hence, we came to know that chemistry is such a field playing a vital role not confined to its domain but also in various other branches of science. As a skin, considered the most sensitive organ of the human body when got infected seeks its help to solve its major issues. It has gained a lot of resources, for instance, as we discussed above, all the effective results to treat the major skin problems with the help of trichoscopy, tomography, dermoscopy, physiochemical properties and the most important, its PH, which is not possible without the knowledge of chemistry.

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