

SKIN CARE ASSESSMENT ON THE BASIS OF SKIN HYDRATION, MELANIN, ERYTHEMA AND SEBUM AT VARIOUS BODY SITES

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ABSTRACT

The aim of this work was to study skin parameters like melanin, erythema, skin hydration, and sebum score of six body sites namely volar forearm, cheek, chin, forehead, neck and post auricular skin of Asian (Indian) population with different skin colour and types to depict the formulation to be used for taking care. Initially skin colour of various volunteers was assessed by the reference of colour chart numbers and three groups each of 80 human volunteers were made. Group I was named fair which corresponded with Colour chart number 19, 20, 21; group II (medium) (22, 23, 24); group III (dark) (25, 26, 27). The measurements were taken using Mexameter (erythema and melanin), Corneometer (skin hydration) and Sebumeter (sebum score). Results depicted that facial skin had more melanin content than volar forearm; the sebum score was highest in the forehead and lowest at volar forearm, skin hydration was more in periauricular space and forehead and lowest in cheek. The volunteers of group I had high sebum and skin hydration values than group II and III. In the face, cheeks need more care and are more prone to dryness. People with darker skin, require formulations having more humectants, while people with fairer skin need to protect more from tanning and redness. Hence these studies will be helpful for deciding the criteria for type of skin and selection of formulation to people of various skin types at various body sites.

Keywords: Corneometer, Mexameter, Sebumeter, Skin colour, Skin type

INTRODUCTION

The stratum corneum is a heterogeneous structure composed of protein enriched corneocytes embedded in a lipid matrix which contribute to the barrier function of stratum corneum¹. The water content of the stratum corneum is maintained by natural moisturising factors and lipids². Stratum corneum of healthy human skin has 20-30 % water content³. Insufficient water may impair skin barrier function and create cracks or fissures⁴. The Hydration of the epidermis (stratum corneum) is determined with skin capacitance meter Corneometer that determines the water content of the superficial epidermal layers down to a depth of about 0.1 mm and expresses the values in arbitrary units.

Sebum consists of a mixture of lipids and cellular debris that form a lipidic film on the surface of the epidermis, which regulates the water content of the skin, its integrity, softness, plasticity and hydration⁵. When a photo stress is applied on the skin, the sebum quantity decreases, the hydration index reduces and melanin index increases causing dryness of skin⁶. Excess sebum can lead to discomfort and an unpleasant appearance due to brilliance of the skin and it is a risk factor for the development of skin surface bacterial colonization and inflammation leading to different degrees of acne⁷. The sebumeter measurements are based on the photometric principle.^[8]

Skin colour is determined by pigments such as haemoglobin, melanin, bilirubin and carotene; which could be altered significantly by ultra violet radiations, temperature, air humidity, pathological conditions (like hypopigmentary disorders) and by several substances like drugs and irritants. Hence quantification of skin colour is very important as it can be indicator of skin properties (integrity of the skin barrier, sensitivity)^{9,10}. Mexameter is a narrow band reflectance spectrophotometer and measures the intensity of erythema and melanin pigmentation¹¹. The aim of this study is to depict skin type on the basis of various skin parameters and selection of formulation to people of various skin type, skin colour and different body parts.

MATERIALS AND METHODS

Instruments used were, Corneometer @ CM 820, Mexameter @ MX 18 and Sebumeter @ SM 815 (Courage and Khazaka, Germany). A total of 240 human volunteers, aged from 20 to 35 years, who were willing to give informed consent were included in the study. The studies were carried out as per approved guidelines between February and April (spring time) at University Institute of Pharmacy, Pt. R.S. Shukla University, Raipur which is located at Latitude 21° 15' N and Longitude 81° 41' E. All subjects rested for at least 30 min at 22–24 °C, at a relative humidity of 45–55%, prior to measurement.

1	10			19	28
2	11			20	29
3	12			21	30
4	13			22	31
5	14			23	32
6	15			24	33
7	16			25	34
8	17			26	35
9	18			27	36

Fig. 1: Felix Von Luschan Skin colour chart. The skin colour of volunteers were matched visually comparing the colour chart and three groups were made, Group I (Fair)(19,20,21), Group II (Medium) (22,23,24) and Group III (Dark) (25,26,27)

Initially skin colour was checked with reference to colour chart (Figure 1) and three groups (I (fair), II (medium), III (dark)) of 80 volunteers each were made. The volunteers whose skin matched to number 19,20,21 of colour chart were placed in group I; 22,23,24 in group II and 25,26,27 were placed in group III¹². Then measurements of skin parameters were performed at washed and cleaned body sites namely volar forearm, cheek, chin, forehead, neck and post auricular skin by the use of Corneometer (skin hydration), Mexameter (melanin and erythema) and Sebumeter (sebum). Volunteers were asked not to apply any cosmetic at the same day of measurements.

Statistical analysis

Statistical analysis was carried out using STAT software¹⁴, the measurements were taken thrice and the values were expressed in mean ± standard deviation. All parameters were statistically analyzed at 95% confidence level. One-way ANOVA analysis, with Tukey correction, was used to determine significant differences, when 3 or more groups were compared. Differences were considered statistically significant if P<0.05.

RESULTS AND DISCUSSION

In each group the mean of values were taken and shown in (figure 2, 3, 4, 5). On the basis of mean values the sequence of order was determined as shown in table 1.

Table 1: The sequence of the parameters at various anatomical sites obtained from the data

Parameter	Groups	Order (Sequence) of values of skin parameters at various body sites as depicted in figures
Melanin	Group I(Fair)	Chin> Neck > Periauricular space > Cheek > Fore head > Volar Fore arm
	Group II(Medium)	Neck > Periauricular space > Cheek > Chin> Fore head > Volar Fore arm
	Group III(Dark)	Fore head > Chin > Periauricular space > Neck > Cheek > Volar Fore arm
Erythema	Group I(Fair)	Chin> Neck > Periauricular space > Cheek > Fore head > Volar Fore arm
	Group II(Medium)	Neck > Chin >Volar Fore arm > Fore head > Cheek > Periauricular space
	Group III(Dark)	Fore head> Periauricular space > Chin> Neck > Volar Fore arm > Cheek
Sebum	Group I(Fair)	Fore head> Periauricular space > Chin> Cheek > Neck > Volar Fore arm
	Group II(Medium)	Fore head > Chin > Cheek> Neck > Periauricular space >Volar Fore arm
	Group III(Dark)	Fore head> Periauricular space> Cheek > Chin> Neck > Volar Fore arm
Hydration	Group I(Fair)	Periauricular space> Fore head > Neck > Chin>Volar Fore arm > Cheek
	Group II(Medium)	Periauricular space> Fore head > Chin > Neck >Volar Fore arm > Cheek
	Group III(Dark)	Periauricular space > Neck >Volar Fore arm> Chin > Fore head > Cheek

The comparison of the measured data for skin melanin content on various body sites are shown in figure 2, which shows that in group I the melanin was highest (430.85±5.5) at chin and lowest (335.71±2.3) at volar forearm, while in group II highest (676.12±7.3) was in neck and lowest (473.8±4.6) at periauricular space and in group III highest (638.75±6.8) was in forehead and lowest at volar forearm (448.8±3.5). We observed that in all the

groups the melanin sequence was quite similar; the face skin had more melanin content than volar forearm. The reason may be the facial skin and neck is in direct contact with the ultra violet radiations as compared to volar forearm so the melanin level is high. This shows that the face and neck requires protection from the deleterious effects of ultra violet radiations and needs some photoprotective formulation.

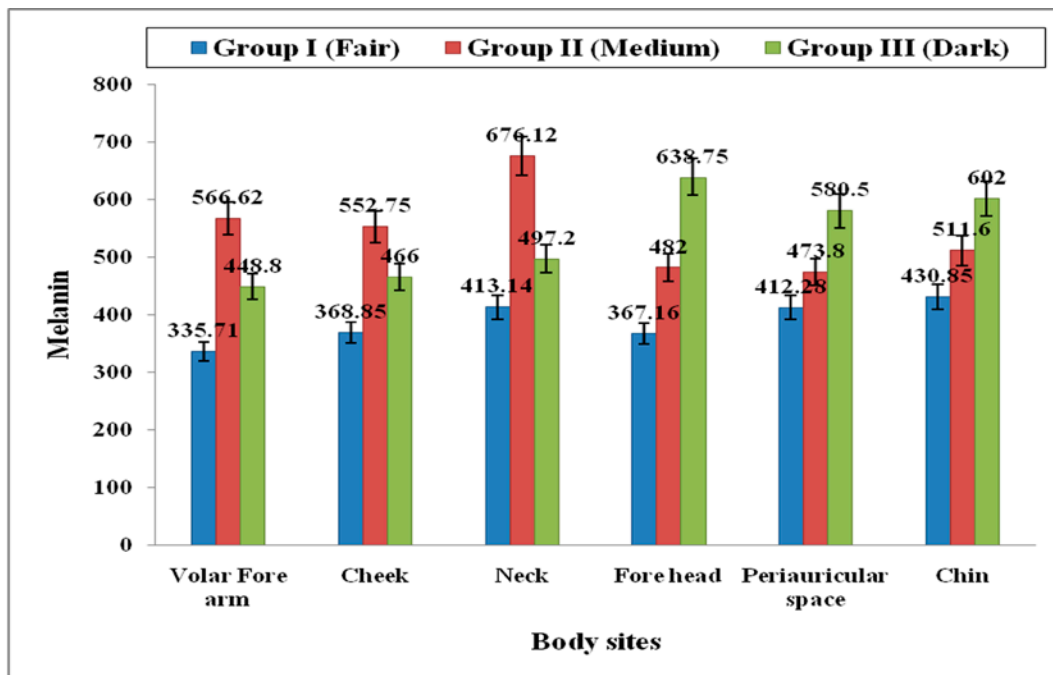


Fig. 2: Comparison of the measured data for skin melanin content on various body sites in subjects categorised in three groups (I Fair, II medium, III dark). Each column shows mean values (p < 0.05)

From erythema score studies (figure 3) it was observed that in group I the erythema was highest (487 ± 2.3) at chin and lowest (299.71 ± 4.1) at volar forearm, while in group II highest (509.25 ± 8.9) was in neck and lowest (401 ± 5.6) at periauricular space and in group III highest (478.5 ± 4.8) was in forehead and

lowest (348.4 ± 2.6) at volar forearm. In the erythema score no specific similarity was obtained amongst various groups, but it was observed that when melanin level was high then erythema level was also obtained higher. Especially in the face and neck it was more as compared to volar forearm.

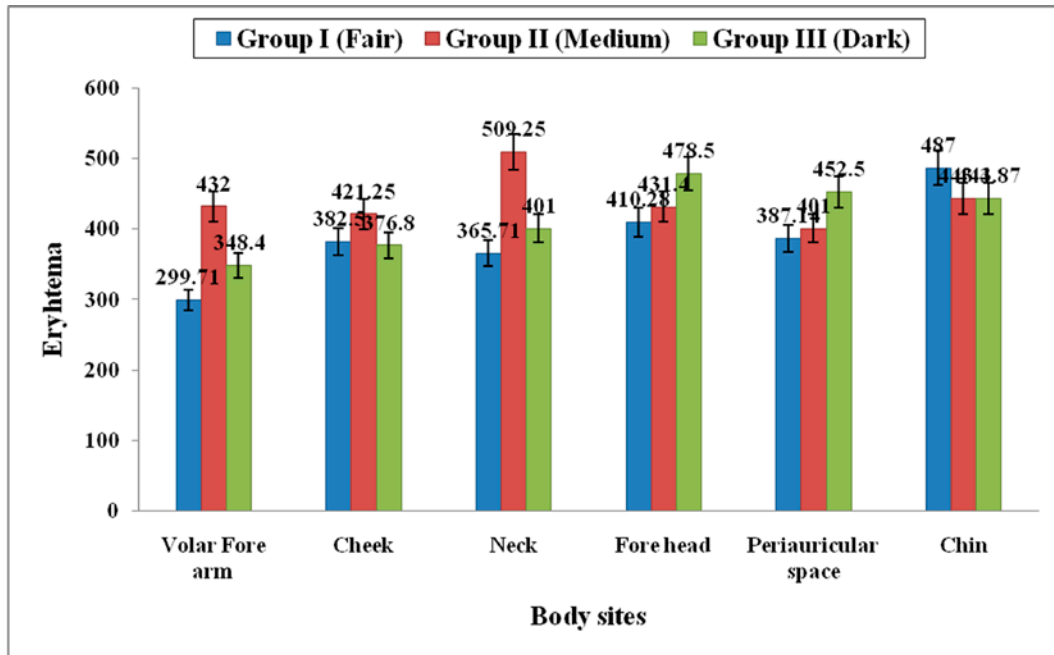


Fig. 3: Comparison of the measured data for skin erythema on various body sites in subjects categorised in three groups (I Fair, II medium, III dark). Each column shows mean values ($p < 0.05$)

Very similar results of sebum score were obtained in all the three groups. (Figure 4) The sebum score was found highest (Group I, 114 ± 3.4 ; Group II, 62.4 ± 2.6 ; Group III 80 ± 4.9) in the forehead region and lowest at volar forearm. (Group I, 11.57 ± 1.5 ; Group II, 7.75 ± 2.4 ; Group III 10.4 ± 1.9). At the periauricular space also the sebum content was quite high in group I (93.85 ± 3.8) and III (46.62 ± 6.7).

The reason could be due to more sweating and oil secretion at these areas. These results were in congruence with the results obtained by Pagnoni et al., who said that the medium central regions of face are more seborrhoeic as compared to sides¹³. The volunteers of group I (fair) had comparatively high sebum score than group II and III.

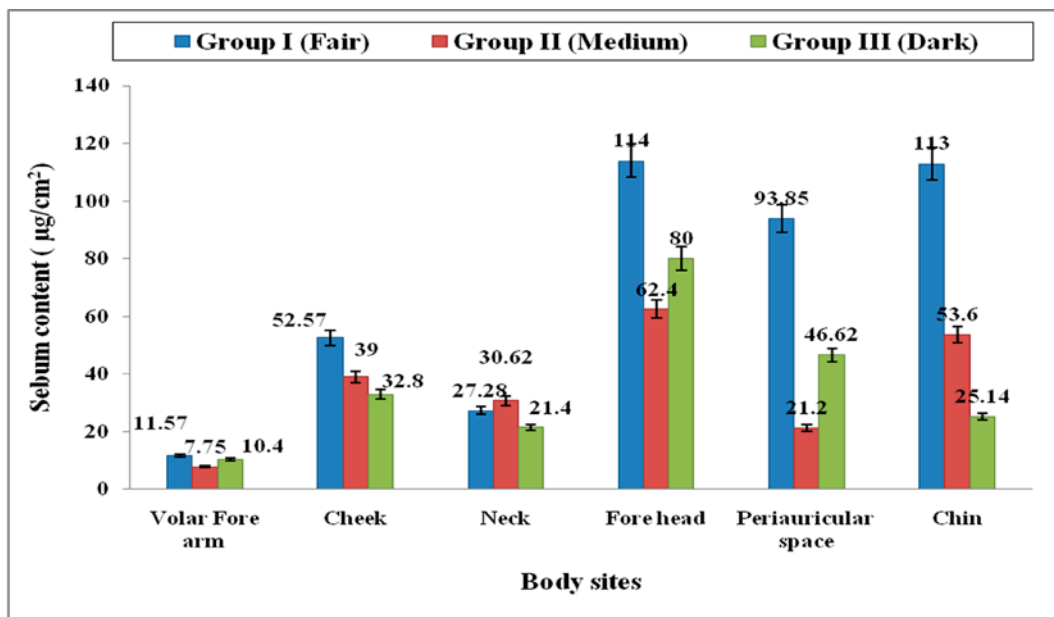


Fig. 4: Comparison of the measured data for sebum on various body sites in subjects categorised in three groups (I Fair, II medium, III dark). Each column shows mean values ($p < 0.05$)

The conductance data of skin hydration (figure 5) shows that in group I the skin hydration was highest (61.4 ± 3.4) at periauricular space and lowest (42.61 ± 2.3) at cheek, in group II highest (64.65 ± 2.9) was at periauricular space and lowest (26.32 ± 4.7) at cheek and in group III highest (59.83 ± 5.1) was at periauricular

space and lowest (33.7 ± 1.7) at cheek. Hence in skin, hydration was found more in periauricular space and forehead and lowest in cheek. It means cheek portion is in need of more moisture as compared to other portions.

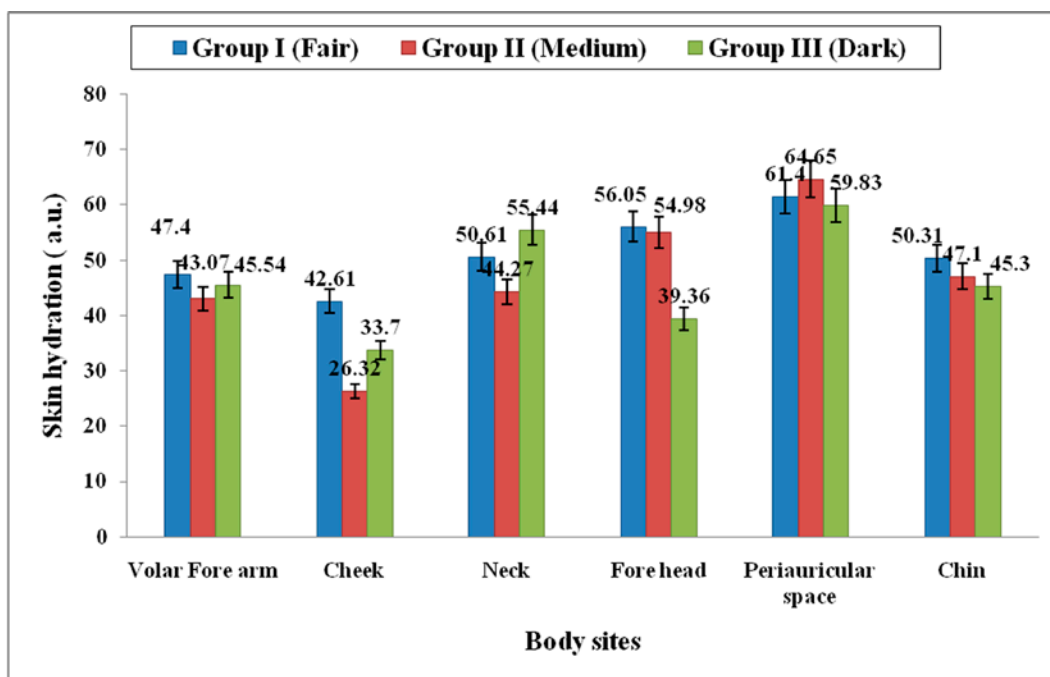


Fig. 5: Comparison of the measured data for skin surface capacitance on various body sites in subjects categorised in three groups (I Fair, II medium, III dark). Each column shows mean values ($p < 0.05$)

The statistical comparison was done between Melanin/Erythema, Melanin/Sebum, Melanin/Hydration, Erythema/Sebum, Erythema/Hydration and Sebum/Hydration of various body sites shows that at all the body sites the skin parameters had significant P values ($P < 0.001$) and higher correlation coefficient. The volunteers of group I (fair) had comparatively high skin hydration values than group II and III. Skin hydration and sebum in males was found higher than that in females.

Pearson product moment Correlation coefficient (r) was also determined amongst various parameters. Values of r were obtained very low between Melanin and hydration at all the body sites, showing least correlation. Appreciably high r values were obtained for Melanin/Erythema, Erythema/Sebum and Sebum/Hydration while considering body sites. But for groups on the basis of colour, correlation coefficient values were low for Sebum/Hydration and Melanin/Hydration.

From the results we observed that in the skin of people of Chhattisgarh region of India, melanin is in the range from 258 to 809, erythema from 255 to 589, sebum from 0 to 218, hydration from 18.6 to 84.7 irrespective of the various body sites. Hence formulations require constituents having wide characteristics including antioxidant, humectants, photoprotective, antiaging, skin moisturising nature which could be beneficial for all the possible sites of body that require special care and attention.

Our studied reveal that all the body parts require separate type of products which could meet the requirement of that body site and the people with varied skin colour also require moisturisers, humectants and other skin properties enhancing formulations according to their skin type. Phytoconstituents belonging to chemical classes like polyphenols, monoterpenes, flavonoids, organosulfides and indoles could constitute important part of the skin properties enhancing formulations^{14, 15}. The incorporation of the phytoconstituents into novel delivery systems like liposomes,

transfersomes, ethosomes, phytosomes etc can also improve its efficacy regarding continuous action of herbs on the human body^{16, 17} and as preventives against deleterious effects of ultraviolet radiations.

CONCLUSION

Bioengineering techniques could be effective tool for cosmetologists and researchers working on topical formulations. We conclude that facial skin needs formulations which could protect the skin from tanning, redness and dryness due to atmospheric conditions. In the face, cheeks need more care and are more prone to dryness. Volar forearm needs formulations which could provide more moisture and oil or lipid content and thereby convert dry skin to normal skin type. Results also show that people with darker skin needs formulations having more humectants while fairer skin people needs to protect more from tanning and redness since autoimmune system of the skin increases melanin and sebum level to combat the deleterious effects of ultraviolet radiations. Hence our studies will be helpful for deciding the criteria for type of skin on the basis of melanin, erythema, sebum and skin hydration and selection of formulation to people of various skin types.

Conflict of interest

The authors declare that they have no conflict of interest.

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