COLOR AND MORPHOLOGICAL FEATURES OF SKIN IN PEOPLE OF DIFFERENT RACIAL GROUPS

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Racial differences in the color of the human skin and morphological differences responsible for them have long attracted attention. In recent years, besides morphological investigations, objective methods of recording, reflecting the properties of human skin have been introduced into research practice on a large scale; these methods have led to considerable widening of our ideas on the role of individual layers of the skin [1, 11, 13], the primary pigments [1, 2, 5-9], structural proteins of the dermis and epidermis [1, 12], and also phenomena of scattering of light [1, 9, 11] in this process. Meanwhile there are virtually no objective data on skin color in persons of different racial groups and shedding light on the causes of racial differences affecting skin.

EXPERIMENTAL METHOD

A comprehensive colorimetric, spectrophotometric, and morphological investigation of the skin was undertaken among Caucasoids (76 Russians), Mongoloids (87 Vietnamese), and Negroids and Mulattoes (Angolans, 72 and 17 respectively). The skin color of subjects of both sexes was recorded in the same 10 areas of the face, trunk, and upper limbs. Photometric measurements of color were made and coordinates calculated on a "Bicolor" dual-beam colorimeter ("Bik-Mallinckrodt") by a spectral method relative to a colorimetric source C (6500 K) with illumination observation geometry of 45/0. The results of the measurements are given in two colorimetric systems — x, y, β and λ (in nm) — the dominant wavelength, p (in %) — the purity of the color, and β (in %) — the coefficient of brightness [3, 4]. The last parameter, as was pointed out previously [1, 7], is more informative for interpretation of color changes in biological objects. Skin samples and, in separate tests, solutions of dopa-melanin of different concentrations, were used for the experiment and were investigated with the MPS-5000 spectrophotometer ("Shimadzu"). A morphological investigation also was carried out, using light and electron microscopy of pieces of skin taken from cadavers of persons of the same races, dying accidentally, between 12 and 48 h after death.

EXPERIMENTAL RESULTS

According to the histological data the epidermis of Mongoloids and Negroids is somewhat thicker than that of Caucasoids. The number of melanocytes in the basal layer is about the same in all races but the melanin content in the keratinocytes is considerably higher in Mongoloids and, in particular, in Negroids. In Caucasoids, moreover, melanin granules are found mainly in keratinocytes of the basal layer, whereas in Mongoloids and Negroids they are found in all layers of the epidermis, including the stratum corneum. Melanin-containing cells are found rarely in the upper parts of the dermis of Caucasoids, whereas in Mongoloids and Negroids, they are constantly found (more numerous in Negroids).

The electron-microscopic investigations confirmed these data. In the epidermis of Mongoloids so-called dark cells, whose plasmalemma has increased electron density and contains numerous melanosomes, are infrequently found. In Negroids they are found less frequently, and in Caucasoids not at all. Besides the difference in the quantity and distribution of melanin already described above, differences also are found in the structure of the melanosomes, whose contents are distinguished by particularly high electron density, and sometimes

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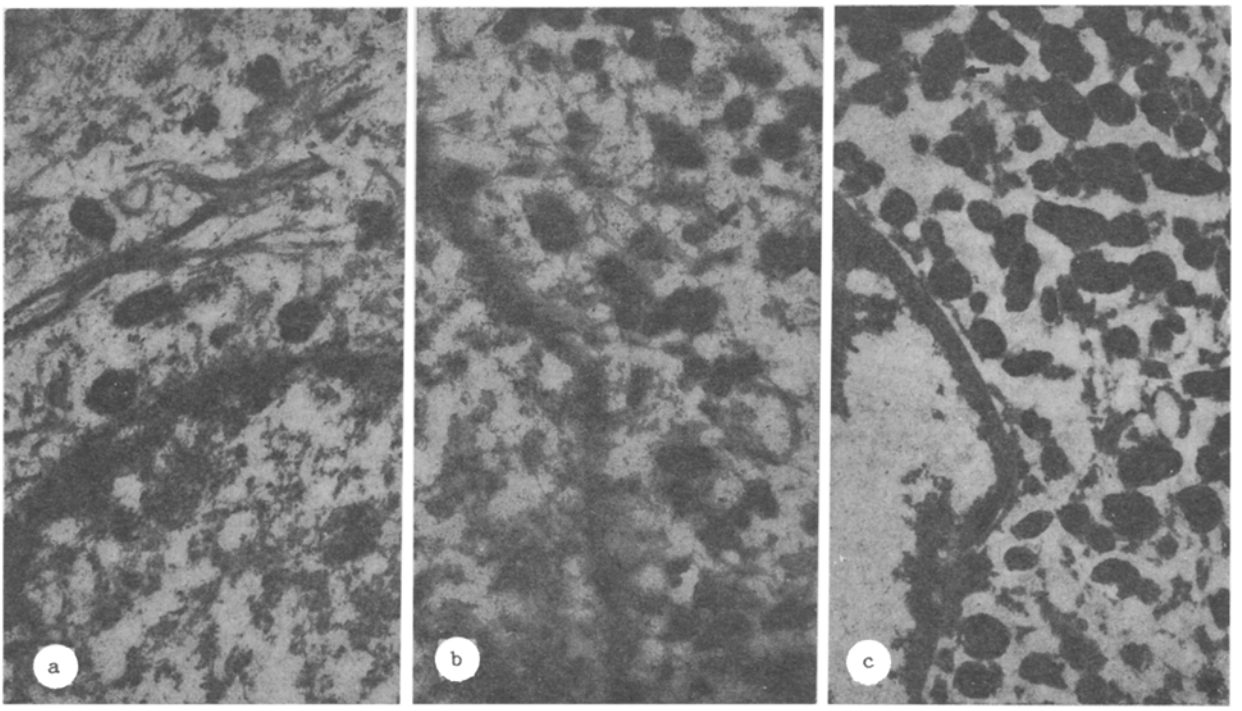

Fig. 1. Morphological features of melanin-containing skin structures in persons of of different racial groups. 12,700 ×. a) Part of keratinocyte of a Caucasoid. Fragment of nucleus on left. Melanosomes joined into complexes lying between bundles of tonofibrils; b) part of a keratinocyte of a Mongoloid. Fragment of nucleus shown on left. Many melanosomes, some joined into complexes; c) part of the kera tinocyte of a Negroid. Fragment of nucleus on left. Many melanosomes of different sizes and single premelanosomes. Some melanosomes contain vesiculoglobular bodies (arrow).

TABLE 1. Mean Values of Color Coordinates of Caucasoid, Mongoloid, and Negroid Races (M ± n)

Race	No. of areas of skin studied	Color coordinates				
		x	y	λ, nm	r, %	β, %
Caucasoids (Russians)	683	0,370±0,003	0,356±0,004	584,8±0,2	32,1±0,4	27,5±0,5
Mongolois (Vietnamese)	738	0,388±0,002	0,369±0,002	584,0±0,1	41,6±0,3	21,3±0,6
Negroids (Angolans)	635	0,375±0,003	0,351±0,003	588,4±0, 1	30,3±0,5	8,1±0,2

have an ill-defined lumpy structure. In Caucasoids (Fig. 1a) they are more frequently found above keratinocyte nuclei and are often combined into complexes. In Mongoloids (Fig. 1b) melanosomes are distributed throughout the cytoplasm and mainly form complexes, sometimes surrounded by a membrane. Some of the larger melanosomes lie separately. Melanosomes at different stages of development and degradation are frequently seen. In Negroids (Fig. 1c) the cells contain the largest quantity of melanosomes, often large and not grouped into complexes, although occasionally they are found to be arranged in groups. Melanosomes of Negroids are characterized by an osmiophilic cortical zone. Besides melanosomes at different stages of development and degradation, some melanosomes are found with round translucencies 35-40 nm in diameter. The origin and role of these so-called vesiculoglobular bodies are uncertain [10].

Well marked differences between color coordinates of the racial groups investigated are given in Table 1. The value of β for Mongoloids is 1.3 times, and that of Negroids 3.4 times, less than for Caucasoids. Compared with Caucasoids, the value of the parameter p is 1.3 times higher in Mongoloids but much lower in Negroids. The value of λ in Caucasoids and Mongoloids is virtually identical, but rather higher in Negroids. All these differences can be linked with the difference in the number of melanin-containing structures described above. The writers showed previously [2, 7] that an increase in melanin pigmentation in sunburned Cauca-

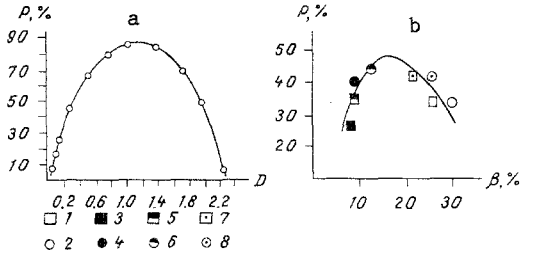

Fig. 2

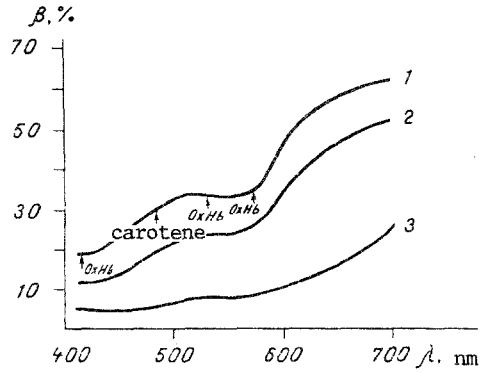

Fig. 3

Fig. 2. Relationship between color purity and melanin content. a) Dependence of values of p on optical density of dopa-melanin solution (D); b) dependence of color purity on values of β for Russian men (1, 2), Angolans (3, 4), Angolans from mixed marriages (5, 6), and Vietnamese (7, 8). Squares — men, circles — women.

Fig. 3. Average spectral reflection curves of skin of Russians (1), Vietnamese (2), and Angolans (3).

soids is characterized not only by a fall in the value of β, as is generally considered, but also by an increase in the value of p. The results of comparison of the value of p in Caucasoids and Mongoloids confirm this conclusion. In Negroids, however, a fall in the values of p is observed, suggesting that the relationship between the value of p and the melanin content is nonlinear. Investigation of the connection between color purity and optical density of dppa-melanin solutions (Fig. 2a) confirmed this view. Initially, with an increase in the dopa-melanin concentration, there is an increase in the value of p, and under these circumstances the mxaimum of p corresponds to the average value of optical density (a 50% concentration of dopa-melanin in solution), and thereafter the purity of the color decreases. Similar correlation between values of p and β, related to the melanin content, also is found for the skin of persons of different racial groups (Fig. 2b). It will be evident that the value of p for the skin of Negroids and Mulattoes is a much more sensitive indicator of the quantity of melanin pigment than β, although it is the latter which is more frequently used for this purpose [15]. There is no doubt that the quantity of melanin in human skin can be estimated (in %) from the values of p after appropriate correlation analysis.

The writers showed previously [5] that the skin of the forearm of Caucasian males is darker than the skin of the same areas in women; the value of β for men is less, whereas the value of p does not differ significantly. It has been shown by spectral methods that these differences in the value of β were mainly determined by the hemoglobin concentration in the men's skin, as is confirmed by the colorimetric data obtained by other investigators [11]. It will be clear from Fig. 2b that during an investigation of many areas of skin of Cacasoids the same rule is observed, i.e., the skin of the men is darker than that of the women, and values of p are equal in both. It can accordingly be postulated that these differences of skin color in Caucasoid men and women are mainly due to the pigment hemoglobin. In Mongoloids the skin of the men is also darker than that of the women, but values of p are higher. This suggests that these differences are due both to hemoglobin and to melanin. The skin of Negroid men is characterized by a marked difference in color purity from the skin of Negroid women, evidence that melanin pigment plays a more important role in these differences than hemoglobin.

These data are confirmed by spectrophotometric investigations of the skin of persons belonging to different racial groups (Fig. 3). In Caucasoids, for instance, there are well marked maxima of absorption of oxyhemoglobin (OxHb) at 410, 541, and 576 nm, these are less distinct in Mongoloids, and virtually absent in Negroids. Under these circumstances, the patterns of change in the parameters p and mentioned above are observed.

This combined colorimetric, spectrophotometric, and morphological investigation of the skin of Russians, Vietnamese, and Angolans thus revealed the principles governing the differences in coordinates of skin color of persons of different racial groups, depending on the number, distribution, and morphology of melanin-containing structures and of hemoglobin pigment. Sex differences in skin color of Caucasoids are mainly linked with their hemoglobin concentration, in Mongoloids with the hemoglobin and melanin concentrations, but in Negroids, with melanin alone.

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CHANGES IN VENULAR ENDOTHELIUM OF RAT MESENTERY IN RESPONSE TO HYDROGEN PEROXIDE APPLICATION

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Three oxygen radicals (FOR), intermediate products of oxygen reduction, play a very important role in cell injuries. During inflammation, production of short-living FOR, superoxide anions, and hydroxyl radicals, as well as of the more stable compound, hydrogen peroxide, is associated with polymorphonuclear leukocyte activation [4, 13]. The use of enzyme–substrate systems, such as hypoxanthine–xanthine oxidase, as the source of free radicals leads to a sharp increase in permeability of the walls of microvessels for plasma proteins [2, 8]. Electron-microscopic studies of lung capillaries [7, 10, 12] have demonstrated injuries of the endothelium which can be linked with the action of FOR. It is not clear, however, precisely what structural transformations of the endothelial lining of the microvessels increase its permeability.

The aim of this investigation was to reveal injuries to the endothelium of mesenteric venules in response to surface application of hydrogen peroxide (H_2O_2) solutions.

EXPERIMENTAL METHOD

Experiments were carried out on 23 albino rats weighing 180-250 g. During intravital luminescence microscopy of the mesentery, 0.5 ml of a 10% solution of human albumin, labeled with fluorescein isothiocyanate (FITC-albumin), was injected into the femoral vein of the animals, anesthetized with pentobarbital (4 mg/100 g body weight). With illumination provided by an Hg-200 mercury vapor lamp (BG-12, BG-38, and K-530 filters) the dynamics of protein transport through the walls of the venules was recorded photographically in the control series of experiments and after application of H_2O_2 for 10 min. The luminence of FITC-albumin near the vessel walls was estimated by densitometry of negatives, in conventional units relative to nonfluorescent areas of the mesentery. Areas of mesentery of the small intestine

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