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A CONCEPTUAL STUDY OF BLOOD COLOR SHADE

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ABSTRACTS
Diagnosing the disease has been a major challenge for medical science since ancient times. There are many diagnostic methods available in the present time. A blood sample is most often used for diagnosis. According to Ayurveda, blood color shade test (*Varna Pariksha)* was used for diagnosis. In this study we have decided to study blood color shade and its importance. Identifying the blood color shade is a complex challenge for a person with eyes. Nowadays in the scientific studies involving the appearance of objects and light, color analysis methods are available and broadly used. So using recent advanced scientific methods we can modify ancient blood color shade test. The techniques and process for the analysis of color shade are canvassed by this review. This study pivots on the quantification of color indices accustomed to define change in blood color shade.

KEYWORDS: *Varna Pariksha*, Blood color shade analysis, *Tridosha*, Ayurvedic diagnosis method.

INTRODUCTION

Each object of the universe reflects one color. Human body is also one of them. There are many color shades to human beings. Each part of body has its color. These colors are affected by many factors like races, genes, demography, type of work, exposure to sun, etc. If we took example of human skin, it ranges from dark brown to lightest hue and the most important substance responsible for it is a pigment called as melanin. When we deal with medical science there is a observation of human body and its constituents. We observed colors of skin, eye, hair, sputum, faeces, blood, nail, palm etc. We kept record of normal & abnormal colors. Color is a subjective observation which we cannot quantify in terms of value.

In Ancient time blood color was observed to decide *Dosha* combination of indivisual. The physician was concluding some judgment after observing blood color shade. Our study is focused on this judgment. Can we measure or quantify this judgment with the help of any color analysis method or instrument? This paper is written and dedicated to providing guidelines for the Ayurvedic physician, students to better understand the possible use of color analysis instruments for *Varna Pariksha* (blood color shade test).

AIM AND OBJECTIVES

1. To review *Varna Pariksha*
A. Ayurvedic view and
B. Modern Science view
2. To review of *Varna* (Color) & color analysis methods
A. Ayurvedic view
B. Physics behind color and color analysis

1. To review *Varna Pariksha*

1. A) Review of *Varna Pariksha* (Blood Color Shade) according to Ayurved science:

According to Ayurveda, *Rakta Dhatu* i.e. blood is considered as a basic and important element of human body. Function of blood is *Jeevan* i.e. it helps to increase the life span.

Vata, *Pitta* and *Kapha* are three important and basic elements of body known as *Tridosha*.[01, 02] These *Tridosha* are causative agents of origin of the body, so the equilibrium of T*ridosha* is important for a disease free body. The person's origin, existence and dissolution are associated with these three *doshas* along with blood. So whenever there is vitiation in *Tridosha's* by any cause there is a change is body and it is developed as signs, symptoms or disease. So, *Tridosha* are an important clinical parameter for diagnosis of the disease.

Traditionally, *Tridosha* assessment is performed using *Nadi Pariksha* (Pulse diagnosis), case taking, etc. These are direct observations done by physician.

Varna Pariksha is mentioned in Ayurvedic text to diagnose *Tridosha* condition of *Rakta Dhatu* i.e. observation of color of blood. It is a naked eye examination of blood. In this examination venous blood is collected in the bowl or plate. Then under the sunlight, shade of color of blood is observed and noted it down.[03,04,05,06]

If proportion of *Vata Dosha* is increased in blood, it appears Blackish shed to Red color. If proportion of *Pitta Dosha* is increased in blood, it appears Yellow or Blackish shade to Red color. If proportion of *Kapha Dosha* is increased in blood, it appears Whitish shed to Red color.[07,08,09] These *Tridosha* imbalance causes diseases. If we are able to quantify these *Tridoshas* level among individual it will be helpful to physician to treat accordingly.

It is subjective observation i.e. results may vary according to various physician. Also observing color has its limitations, so until and unless there is marked change in blood it will not be noted. So if there is a minute change in the color of blood, we are unable to measure it.

1. B) Review of *Varna Pariksha* (Blood Color Shade) according to Modern Science

As per modern science, there is no such blood color examination method is established. It may be because of philosophy behind this science. Modern science studied the blood and its components. Many laboratory tests are developed on blood like Hemoglobin, RBC, WBC, TLC, PCV, etc. According to modern science blood is red in color. Hemoglobin is the coloring matter of red blood cell. Arterial blood contains more oxygen so it is scarlet red and venous blood is purple red [10]. Hemoglobin is a protein that attaches with iron molecules and forms complex and it transports oxygen molecules throughout the body. Iron has the property of reflecting red light. Each red blood cell, or erythrocyte, contains about 270 million hemoglobin molecules and each hemoglobin because there is so much iron in the blood, blood looks red. Sometimes we find many shades of red color of the blood. There are some pathological conditions that can alter the color of blood. This can be genetic, as well as induced by certain toxins and drugs.[11]

2. To review of *Varna* (Color) & color analysis methods

According to both sciences color observation is important in some parameters like skin, nails, hairs, conjunctiva etc. Change in color or color shade indicates some physiological and pathological changes.

Physician observes these changes with own eyes. Hence these observations are qualitative and may differ by physician to physician.

2. A) Ayurvedic view

In Ayurveda, color is important parameter to identify specific *Dosha's* involvement in physiological or pathological process. In following table no. 1 details are given.

Table No. 1 Blood color shade according to *Dosha* Prominence.

Sr. no	*Dosha*	Color	Physiology	Pathology
1	*Vata*	Black	Skin, Nails, teeth blackish shade prominence	Blood red color becomes darken or blackish
2	*Pitta*	Yellow or mixed	Skin, Nails, teeth yellowish shade prominence	Blood red color becomes darken with yellowish shade
3	*Kapha*	White	Skin, Nails, teeth whitish shade prominence	Blood red color becomes whiten

2. B) Physics behind color and color analysis

Human visual perception is explained through red, orange, yellow, green, blue, or purple categories. This perception of color procures from the stimulation of cone cells in the human eye by electromagnetic radiation in the visible spectrum. There are association between color categories, physical specifications of color and the objects through the wavelength of the light that is reflected from them. This reflection is controlled by the object's physical properties such as light absorption, emission spectra, etc.

The science of color includes the study of the perception of color by the human eye and brain, the origin of color in materials, color theory in art, and the physics of electromagnetic radiation in the visible range. Electromagnetic radiation is characterized by wavelength and intensity. Visible light is known as when the wavelength is within the visible spectrum (approximately from 390 nm to 700 nm). The RGB color space is matching to human trichromacy and with three cone cell types that respond to three bands of light: long wavelengths, peaking near 564–580 nm (*red*); medium-wavelength, peaking near 534–545 nm (*green*); and short-wavelength light, near 420–440 nm (*blue*).[09,12]

Colors differing in several different ways, including hue (shades of red, orange, yellow, green, blue, and violet), saturation, brightness, and gloss. Due to this color analysis standard is required.

Color Analysis: The successful practical application of a color analysis will theoretically allow the physician. However, it has to be problematic and controversial because of the lack of standard training or degree required to market oneself as a color analyst.

Rigorously, we cannot measure perceived color rather we can measure and calculate some factors which are responsible for generating this sensation of color.

An unknown color is evaluated in terms of known colors, this is a technique called color analysis. Color analysis is broadly used in scientific studies and it has huge importance for the analysis of raw materials and products. Color Analysis is useful for monitoring process liquids and as a measurement of water quality. The presence of metals, organic acids, and/or industrial wastes is responsible for color in water or waste water.

Historical Perspective: Absorptiometers was a first device which used to determine by visual inspection whether two solutions were of equal color. After some days, the reflectometer was developed to generate output of the tristimulus values X,Y,Z; then it was called as a Tristimulus Colorimeter. A. C. Hardy, Professor of Optics at M.I.T. had started a study project to prepare the spectrophotometer specifically for the measurement of reflectance.[13] Hardy's design was commercialized in 1935. This instrument established as reference of spectrophotometer. It has created the base of color measurement in the industry.

Types of color analysis according to material: Transmissive color analysis is specified by the measurement of light passing through a semi-opaque sample. The light was transmitted by the sample to measure or determine the color.

Turbidity in the form of colloidal matter, or suspended particulates, can spit out light transmitted from the liquid in a observed color-changing manner. The resulting measurement is known as the apparent color if the suspended source of colloidal or turbidity is drawn before removal. The true color is that the measurement is obtained after removing the suspended source of colloidal or turbidity. Liquid colors are dependent on a pH so there is an increase in color with increasing pH, which may require pH measurement or buffering.

Laboratories have a number of techniques to remove turbidity. Some techniques like filtration by filter paper, centrifugation, and some other techniques are used before sample analysis.

The light reflected from a colored surface cannot be the exact color corresponding to the color we observe with our eyes. Physical color can be evaluated by one of the techniques discussed further. By combining these separate sensations to recognize color, the eye recognizes color through three types of sensitive retinal cells, red, green, and blue. Objects with two distinct colors (red and yellow) will be physiologically understood to be mixed colors (orange). Therefore, while colors measured by physical means may reflect individual color components, physiological effects will be seen from a combination of eye color components.

Table No 02: The relationship between dominant wavelengths and hue is shown below.

Sr. no	*Dosha*	Color	Physiology	Pathology
1	*Vata*	Black	Skin, Nails, teeth blackish shade prominence	Blood red color becomes darken or blackish
2	*Pitta*	Yellow or mixed	Skin, Nails, teeth yellowish shade prominence	Blood red color becomes darken with yellowish shade
3	*Kapha*	White	Skin, Nails, teeth whitish shade prominence	Blood red color becomes whiten

The Platinum-Cobalt Method (EPA Method 110.2 and Standard Method 2120b) is useful for comparing potable water and water colors in which organic acids, seeds, roots, bark, leaves, fungi, and peat are creating color. This method is not useful to most highly colored industrial wastewaters. This method was first approached by observing the sample color with calibrated glass slides or with parameters made from dilute liquids of potassium chloroplatin and cobalt chloride in distilled water.

The most commonly used tristimulus method is the CIE method, which gives three color values that, when combined, roughly deal with the average visual judgment of a color. The trastimulus filter method (standardized method 2120D) is based on the measurement of percent communication at three specific wavelengths (590, 540 and 438nm). Luminance plus three tristimulus values are calculated directly from the percentage of three wavelengths.

The most suitable method for color analysis is the spectrophotometric method (EPA Method 110.3 and Standard Method 2120C). This is perfect for industrial process liquids and for water analysis. This method needs analysis at a large number of wavelengths (90).

Similar to the Tristimulus method, three coefficients are derived from the measurement of three transitions. Each coefficient requires 30 specific wavelength

measurements. Special analysis algorithms are applied to detect chromaticity points and to record results in terms of major wavelength, percentage brightness and percentage purity.[14]

Instruments for the measurement of color

Colorimeter

The colorimeter was a major factor in the development of color science. A colorimeter is a simple design tool based on the concept of visual color. The pattern is illuminated at an angle of 45° relative to the perpendicular to the mounted pattern. The value of the perpendicular to the reflected light pattern is calculated by three and sometimes four color filters that represent the relative proportions of red, green and blue light reflected from the sample.

Colorimeters are simple to build than spectrophotometers. Colorimeters are usually lower in cost. They are commonly offered as quality control equipment such as fastness determination, strength determination, color variation, shade sorting, and so on in various applications. The pitfall of colorimeter is that it can be used in areas where production batches are compared with production standards.

Spectrocolorimeters

A spectrocolorimeter is a useful for providing colorimetric data. It gives values in terms of X,Y,Z or CIEL*a*b* values for various standard illuminants. They are more capable quality control instruments than colorimeters. The spectrocolorimeter is a spectrophotometer by design, except that it does not output spectral data at the various wavelengths. These devices are specifically used for quality control applications only.

Spectrophotometers

Spectrophotometers are different from calorimeters. They can measure reflection, communication, or absorption for different wavelengths in the spectrum. In the case of reflectance measurement, the measured Reflection factor is called as the reflection of a sample at a given wavelength compared to the perfect diffuse white measured reflections measured under the exactly the same conditions.

Hardy-like reflection spectrophotometers were created using a scanning system similar to the UV / VIS absorbent spectrophotometers used for chemical analysis of liquids. It provided wavelengths by measuring lengths of 1nm or less each and data collection if desired. Although it is highly accurate, these tools were slow, mechanical, and expensive.

Instrument Geometry

C.I.E. specified four geometric arrangements for instruments used to measure colors. Equipment with such directional geometry is widely used in quality control applications such as shade sorting, color variation, pass / fail fixation, or color change determination such as speed and stain testing.

Guide to Instrument Specifications

Choosing a tool to measure color can be a time consuming and confusing thing as there are many types of models with different features and options. The following some terms are important to understand technical part.

Geometry - This is the angle of illumination in the optical system of the instrument.

Wavelength range – It is the total range in which the instrument used to measure, usually between 360-750nm. In which 400-700nm is normal range.

Bandwidth- In a compact spectrophotometer, the width of the measured band is measured at 1/2 peak height. It is used as a single point in the reporting of reflection elements. Bandwidths can range from 5nm to 20nm. It is a key factor between two instruments.

Spectral Resolution- It is same like bandwidth. It shows that the actual spectral width is being measured but not required as a point. The instrument can have every 1nm diodes.

Wavelength Accuracy – It is the average difference in nanometers between the working wavelengths and absolute scale of the devices determined by the spectral emission lines from the discharge lamp.

Photometric Accuracy- The accuracy of the percentage reflection of the reflection - it is usually in the range of 0-100%. This is usually determined by measuring neutral tiles of known absolute reflectance.[15]

Instruments for Special Purposes

There are a number of instruments that have been developed for special purposes such as portability, continuous on-line measurement and extended wavelength instruments.

Portable Instruments

The recent techniques in integrated electronics and small optical components have led to another revolution in color technology i.e. the portable instrument. The variation in model and geometry is as different as the bench top models. Even though it is portable, their advantage is that they can meet many quality control requirements without the use of an integrated computer system. Their microprocessors are efficient for measuring color variation, shade sorting, fairness, pass / fail, fast grade and many other indices and color and appearance. Their simplicity and low cost compared to bench-tops have resulted in general use in quality inspection areas, retail, fabric and clothing sourcing and other areas that previously did not originally use tools and numerical methods.

Portable colorimeters are not efficient for detecting metamerism.

On-Line Continuous Instruments
The tools used for online color monitoring are used in carpeting, continuous wetting processes and in the field of inspection. These devices are generally different from the lab or die house office. They can measure color without contact with sample because they range from 3 inches to 8 feet on the web.

For on-line measurement geometry, it is not feasible to use an integrated field except for the reference beam. Some instruments are used by both direction and have real illumination and the viewing angles are fixed according to the position of the instrument when placed on top of the plane of the fabric. For this reason, it is generally accepted that online measurements do not agree with off-line measurements on samples taken in the laboratory without the application of artificial correlation methods.

On-line study provides various leads in color control such as real-time data, adjusting for side-to-side variants to quickly adjust the pad roller pressure. When used for maintenance, the system can be connected with a yardage meter and a traversing frame to provide detailed color mapping of fabric or carpeting rolls.

Android Color Analysis Application
Color Analysis is outlined to evaluate color groups in selected image based on the visible spectrum. Select existing image or alternatively take a picture from internal camera. Group the colors and categorized them from the most dominant color to the less significant. This application analyzes the image and provides results in terms of known colors and RGB values.

The Image Color Summarizer
The color summary will process the descriptive color statistics for the image. The record of each component of RGB, HSV, LCH and Lab will be average, medium, minimum and maximum. The average hue is calculated by averaging the spherical dimensions.

DISCUSSION

Color analysis is a technique by which unknown colors are analyzed in the term of known colors.

The first device was an absorptiometers. It was used to identify by visual inspection whether the two solutions were of the same color. The first instruments were then reflectometers to measure the light reflected from opaque objects such as textiles. After some time, reflectometer were further developed to provide the production of Tristimulus.

An analyzer with upper, lower and dominant yellow wavelengths is used for automatic analysis.

In early stage visual or comparative color analysis methods were used in the field of color analysis.

Spectrophotometric method is the most suitable method for color analysis. This is the method of selection for the analysis of water with complex and various color components for domestic and industrial wastewater.

Colorimeter is easier to create than a spectrophotometer. They are usually cheaper. Their difference in colors, sort of shade etc. are used as quality control tools in similar applications.

A spectrocolorimeter is a useful for providing colorimetric data. It gives values in terms of X,Y,Z or CIEL*a*b* values for various standard illuminants. An earlier Hardy-like reflection spectrophotometer was created by an UV / VIS absorption spectrophotometer that was used as a chemical analysis of liquids using scanning systems.

C.I.E. The four geometric arrangements specified are most commonly used in quality control applications such as pass / fail determination, color variation, shade differentiation or color change determination such as speed and stain testing.

The color summary will create descriptive color statistics for the image. The record of each component of RGB, HSV, LCH and Lab will be average, medium, minimum and maximum.

All of the above methods can be useful in developing a blood color analysis test. The selection of an instrument for color analysis can be confusing and it may time consuming task. There are many varieties in models with differing features and options like, Geometry, Wavelength Range, Bandwidth, Spectral Resolution, Wavelength Accuracy, Photometric Accuracy, camera.

Blood is in liquid form and it contains iron particles bounded in Red blood cells. So under colorimeter, spectrophotometer it might be difficult to find red color shade wavelength. Here we can use direct blood sample or blood serum by removing RBC and other cells.

CONCLUSION

Blood color shade test is useful to diagnose *Dosha* prominence in the individual. To identify *Varna* (color) of blood sample is very easy but difficult to identify its shade by eyes. But if we standardize it with appropriate color analysis method it will be helpful for physicians to do blood color shade test on the quantitative manner.

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