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DIAGNOSTIC PAPER STRIP

Suiichi Tomioka, Tokyo, and Motoharu Shiba and Sakae Wade, Saitama, Japan, assignors to Chugai Seiyaku Kabushiki Kaisha, Tokyo, Japan

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ABSTRACT OF THE DISCLOSURE

An improved diagnostic paper strip which is applicable to whole blood sample, which is prepared by dipping a diagnostic paper strip into an organic solvent solution of one or more of cholesterol, rosin and their esters and drying the strip.

This invention relates to an improved diagnostic paper strip applicable to whole blood samples of human of animals in testing of such blood for the determination of various disease states.

Human or animal blood is chemically composed of various components, for example inorganic components, proteins, glycose, organic acids, enzymes, vitamins and the like. The quantities of these components varies depending upon the disease state; and, accordingly, the quantitative determination of these various components is important for diagnosis of various diseases, and many blood determination methods have been utilized in the past. For example, precipitation method, flame analysis method, titration method, colorimetric determination method, enzyme reaction method, gas chromatography method, turibidimetric analysis method, electrophoresis analysis method, chromatography method, etc. (I. Kanai: Rinsho Kensa-ho Teiyo, ed. 21, Kanehara Shuppan K.K., Japan) have all been used in blood testing. However, clinical field results are often required rapidly and, therefore, more simple and rapid methods had been required particularly for use in the field and away from laboratories.

Recently, diagnostic paper strips, for example urea (nitrogen)-determining strip, serum cholinesterase-determining strip, calcium- or magnesium-determining strip were found to meet such a demand, and it has been estimated that they can be conveniently used for the determination of content or activity of these components in blood serum by dipping them into serum and observing color developed thereon.

However, the method using these strips is still inadequate for rapid clinical diagnoses for the following reason; that is, these strips can be used to test only the serum which must be separated from whole blood sample by standing more than 30 minutes, since to dip the strip in while blood causes the strip to become so red due to hemoglobin in blood that it is impossible to observe color development by the component to be determined.

An object of this invention is to overcome the deficiencies of the prior art; and to provide an improved diagnostic paper strip which is applicable to whole blood samples. Another object of this invention is to provide a method for preparing the improved diagnostic paper strip. Further objects of this invention will be understood in detail in the following exemplary expanation.

We have now carried out examinations to fulfill the above objects and have found, as a result, the fact that if a diagnostic strip is treated with cholesterol, rosin or their esters, adsorption and permeation of red corpuscles on the strip can be prevented without preventing adsorption of the components to be determined and that color development by a component to be determined can be rapidly and accurately determined by dipping the so treated strip into a fresh whole blood sample.

This invention is found on such new findings and relates to an improved diagnostic paper strip which is applicable to whole blood sample, which is prepared by dipping a diagnostic paper strip into an organic solvent solution of one or more of cholesterol, rosin and their esters and drying the strip.

The diagnostic paper strip may be preferably prepared by dipping a diagnostic paper strip previously prepared, e.g. urea (nitrogen)-determining strip, serum cholinesterase-determining strip, calcium- or magnesium-determining strip, into 1–10% by weight of an organic solvent solution of one or more of cholesterol or its esters, e.g. cholesterol acetate or cholesterol benzoate, or rosin or its esters, e.g. gum rosin, ester gum (glycerin ester of rosin), methyl abietate, diethylene glycol ester of abietic acid, diethylene glycol ester of 2-hydro-abietic acid, etc. for 5–20 minutes and drying the strip at room temperature. In the above, the organic solvent is not critical as long as it dissolves the rosin or cholesterol or their derivatives, but suitable solvents are methyl alcohol, ethyl alcohol, carbon tetrachloride, benzene or the like. Thus obtained strip contains 0.5–2.5 mg. of cholesterol, rosin or their esters per square cm. of the strip.

The diagnostic paper strip of this invention may be practically used as follows: the strip is dipped directly into blood obtained from a human or other animal and is kept for a period long enough to permit color development; after washing with water the color developed is compared with standard color chart. In the strip, no contamination and no red change are observed and the content or activity of the component to be determined can be rapidly and accurately determined.

The invention will be more clearly illustrated by reference to the following detailed example, the scope of the invention not, however, being limited to the specific details of the examples wherein percents are weight by weight.

Blood was obtained from a healthy man and from two renal failure patients and sera were separated from a half of the blood samples. Urea content was determined by using untreated urea (nitrogen)-determining diagnostic paper strip and an improved urea (nitrogen)-determining diagnostic paper strip of this invention, both as disclosed in Example 1 below.

The results are shown in the following table.

RESULTS OF UREA (NITROGEN) CONTENT IN BLOOD

	Serum		Whole blood	
Sample	Diacetyl mono-oxime method (mg./dl.) [1]	Untreated strip (mg./dl.)	Untreated strip (mg./dl.)	Treated strip of Ex. 1 (mg./dl.)
Healthy man	13	10	[2]—	10
Renal patient I	28	30	—	30
Renal patient II	42	40	—	40

[1] Diacetyl mono-oxime method: Ormsby, J. Biol. Chem. 146: 595, 1942.
[2] "—" means that it is impossible to determine the content.

As is clear from the table, use of the diagnostic paper strip enables rapid and accurate determination of urea content, cholinesterase activity or the like in blood using whole blood samples. As the strip can be easily prepared by mass production and with low cost, the strip of this invention is very valuable in the medical field.

EXAMPLE 1

Amberlite SA–2 type ion exchange resin paper was dipped into 0.05 N-hydrochloric acid solution containing 0.1% p-dimethylamino cinnamaldehyde for 30 minutes. The resulting impregnated paper was dried at room temperature [urea (nitrogen)-determining strip, untreated].

The urea (nitrogen)-determining strip thus obtained was dipped into 5% chloroform solution of cholesterol for 10 minutes and dried at room temperature to give an improved diagnostic paper strip which is applicable to whole blood samples.

EXAMPLE 2

The same urea (nitrogen)-determining strip as obtained in the Example 1 was dipped into 4% ethyl alcohol solution of gum rosin for 10 minutes and dried at room temperature to give an improved diagnostic paper strip which is applicable to whole blood samples.

EXAMPLE 3

The urea (nitrogen)-determining strip obtained in the Example 1 was dipped into 2.5% ethyl alcohol solution of ester gum (glycerin ester of rosin) for 10 minutes and dried at room temperature to give an improved diagnostic paper strip which is applicable to whole blood samples.

EXAMPLE 4

A serum cholinesterase determining diagnostic paper strip, "Acholest" (trademark; produced by Osterreichische Stickstoffwerke A.G., Austria, and sold in Japan by Chugai Seiyaku Kabushiki Kaisha) was dipped into 3.5% carbon tetrachloride solution of cholesterol palmitate and cholesterol acetate (ratio 1:2) for 10 minutes and dried at room temperature to give an improved diagnostic paper strip which is applicable to whole blood samples.

EXAMPLE 5

A serum cholinesterase determining diagnostic paper strip, Acholest (trademark; produced by Osterreichische Stickstoffwerke A.G., Austria, and sold in Japan by Chugai Seiyaku Kabushiki Kaisha) was dipped into 3% carbon tetrachloride solution of cholesterol benzoate for 15 minutes and dried at room temperature to give an improved diagonistic paper strip which is applicable to whole blood samples.

The foregoing description of the specific embodiment will so fully reveal the general nature of the invention that others can, by applying current knowledge, readily modify such specific embodiment and/or adapt it fot various applications, without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents.

We claim:

1. A method of preparing an improved diagnostic paper strip which is applicable to whole blood samples, consisting essentially of dipping a diagnostic paper strip into an organic solvent solution of one or more of cholesterol, rosin and their esters, and drying the strip.

2. The method claimed in claim 1, in which the diagnostic paper strip is urea (nitrogen)-determining strip, serum cholinesterase-determining strip or magnesium- or calcium-determining strip.

3. The method claimed in claim 1, in which the organic solvent to dissolve cholesterol, rosin or their esters is methyl alcohol, ethyl alcohol, chloroform, carbon tetrachloride or benzene.

4. The method claimed in claim 1, in which cholesterol ester is cholesterol acetate or cholesterol palmitate.

5. The method claimed in claim 1, in which rosin ester is gum rosin, ester gum, methyl abietate, diethylene glycol ester of abietic acid and diethylene glycol ester of 2-hydroabietic acid.

6. The method claimed in claim 1, in which the dipping time is 5–20 minutes and the concentration of said organic solution is 1–10%.

7. In diagnostic paper strip for blood testing comprising a paper strip impregnated with a testing chemical, the improvement comprising cholesterol, rosin, their esters or mixtures thereof impregnated in the strip.

8. An improved diagnostic paper strip in accordance with claim 7 wherein said cholesterol, rosin, their esters or mixtures thereof are present in said strip in an amount of about 0.5–2.5 mg. per sq. cm. of said strip.

9. The improved diagnostic paper strip claimed in claim 8, in which the diagnostic paper strip is selected from urea (nitrogen)-determining strip, serum cholinesterase-determining strip and magnesium- or calcium-determining strip.

10. The improved diagnostic paper strip claimed in claim 8, in which said cholesterol ester is cholesterol acetate or cholesterol palmitate.

11. The improved diagnostic paper strip claimed in claim 8, in which said rosin ester is gum rosin, ester gum, methyl abietate, diethylene glycol ester of abietic acid or diethylene glycol ester of 2-hydroabietic acid.

12. A diagnostic method for determining content or activity of a component in blood which comprises dipping an improved diagnostic paper strip claimed in claim 8 into whole blood sample, keeping for a period long enough to take color development and comparing color developed with standard color chart.

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MORRIS O. WOLK, Primary Examiner

R. M. REESE, Assistant Examiner

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