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Early detection of kidney failure by using New technique for Sweat analysis

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ABSTRACT

Diagnosis by sweat is one of the emerging methods, whereby sweat can identify many diseases in the human body. Sweat contains many elements that help in the diagnostic process.

In this paper, we analyzed sweat sample by using Colorimeter device to identify the disease of kidney failure in its various stages. This analysis is a non-invasive method where the sample is collected from outside the body and then this sample is analyzed. Urea refers to the disease of kidney failure when its quantity is high in the blood and then in the sweat, and by experience we found that the amount of urea for males differs from its quantity for females, where there is a noticeable increase for males in normal and pathological cases. In this research, we took many samples for a normal group that does not suffer from renal failure and another suffers from the disease to compare the percentage of urea, and after analysis, we found that the urea percentage is high in people with kidney failure disease with accuracy of results 85%.

INTRODUCTION

Sweat is a liquid made from (99%) water and (1%) salt and fat. Sweating is a bodily function that helps regulate our body temperature. Also called perspiration, in humans, sweating is primarily a means of thermoregulation, which is achieved by the water-rich secretion of the eccrine glands. Maximum sweat rates of an adult can be up to 2–4 liters per hour or 10–14 liters per day (10–15 g/min·m2), but is less in children prior to puberty. [1]

Changes in our body temperature, the outside temperature, or our emotional state can cause sweating. The most common areas of sweating on the body include: armpits, face, palms of the hands ,and soles of the feet [2]

Sweat consists of water, minerals, lactate, and urea. On average, the mineral composition is: Sodium (0.9 gram/liter) Potassium (0.2 g/l) Mg (0.0013) ca (0.015). Trace metals that the body excretes in sweat include: Zinc (0.4 milligrams/liter), Copper (0.3–0.8 mg/l), Iron (1 mg/l), Chromium (0.1 mg/l), Nickel (0.05 mg/l), Lead (0.05 mg/l). [1]

The Sweat is sampled and sensed non-invasively

Type of diseases diagnosed by sweat: -

1/kidney failure [3]

2/breast cancer [4]

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3/ lung cancer [5]
4/covide-19[6]
5/rheumatoid Arthritis [7]
6/diabetes [8]
7/cystic fibrosis [9]

In this paper , we analyzed the kidney failure by Sweat sample and detecting the amount of urea in sample.

Kidney failure

Condition in which the kidneys stop working and are not able to remove waste and extra water from the blood or keep body chemicals in balance. Acute or severe kidney failure happens suddenly (for example, after an injury) and may be treated and cured[10].

The urea travels from our liver to our kidneys through our blood stream. Healthy kidneys filter urea and remove other waste products from our blood. The filtered waste products leave our body through urine.

When the person is suffering from kidney failure, the percentage of urea in the blood increases, and so it becomes more visible in the sweat when the kidney fails to function and is un able to excrete urea that has been diverted from the liver after ammonia has been broken down.[11]

High blood pressure and diabetes are the two most common causes of kidney failure. They can also become damage from physical injury, diseases, or other disorders.[12]

Sweat test

In humans, urea is excreted in sweat, largely through the eccrine sweat gland. The urea concentration in human sweat is elevated when compared to blood urea nitrogen.so we take sample of Sweat and analyze it to detect the kidney failure. [13]

Methodology

In our research we used two methods to collect sweat samples for two groups, one group that didn't have kidney failure and the other group had disease, the first method is sweat collection system that we used in winter to solve the problem of collecting the sample.

The second is the traditional method of sample collection, in which person sit in high temperature place and begins sweating ,the sample is collected after cleaned the part of body with Eccrine gland by using soap, alcohol, and distilled water.

A large portion of samples of healthy people were taken from athletes during the exercise, and the eccrine gland in the face and hands was targeted to collect sweat samples.

We analyzed these samples where we took with burette a half-milliliter of each sweat sample that we collected, put the sample in the test tube and added reagents. We put one drop of copper sulfate solution and a preliminary 20 drops of sodium hydroxide solution. We measured the color change with a colorimeter. And respectively, we added two drops of sodium hydroxide solution and watched the color change as the sample gradually changed to purple. For each two drops that we added we measured the color change and the absorption up to saturation where the sample reached its peak absorption and the readout was fixed. We got three consecutive readings in the samples of people with kidney failure at 54 drops of sodium hydroxide solution, and the readings for people without the disease fixed at 70 drops of sodium hydroxide solution, which indicates that the

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amount of urea in people with kidney failure is greater, so we got consecutive readings at sodium hydroxide solution less than that used in normal sample.

This block diagram to proposed method to way of collecting and analysis sweat sample :

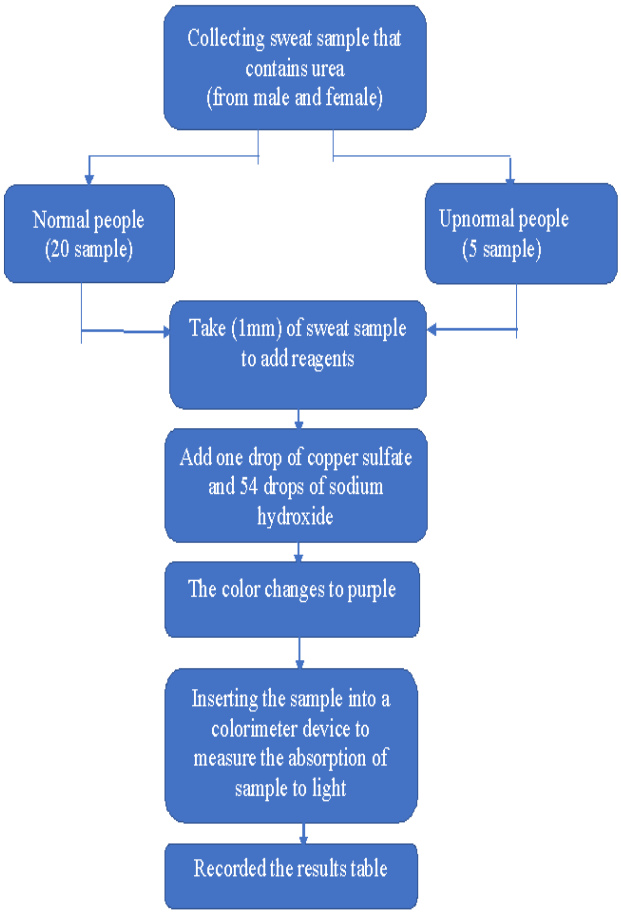


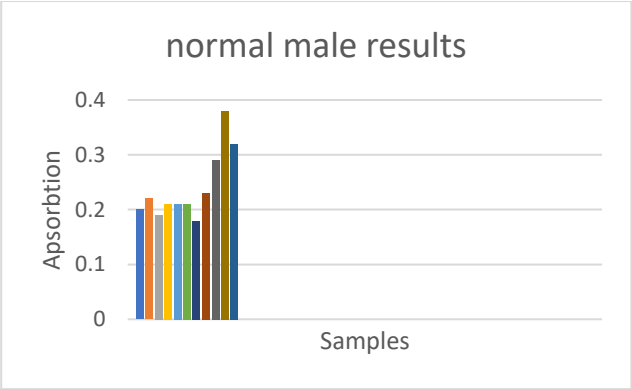
Figure (1): Block diagram of propose method.

We took five samples from people with disease and 20 samples from people without kidney failure, and in each of the samples, urea was targeted. For comparison between samples, one drop of copper sulfate and 54 drops of sodium hydroxide solution used for patients and healthy sample and we found diverge in reading that will be shown in the results tables.

Results and discussions

Table (1) results of the analysis of normal male samples:

	Number of drops		
Experiment Number	Copper sulfate(CuSo4)	Sodium hydroxide(NaOH)	Absorption
1	1	54	0.2
2	1	54	0.22
3	1	54	0.19
4	1	54	0.21
5	1	54	0.21
6	1	54	0.21
7	1	54	0.18
8	1	54	0.23
9	1	54	0.29
10	1	54	0.38
11	1	54	0.32



Figure(2) shown normal male results

Table (2) results of the analysis of normal female samples:

	Number of drops		
Experiment Number	Copper sulfate(CuSo4)	Sodium hydroxide(NaOH)	Absorption
1	1	54	0.17
2	1	54	0.19
3	1	54	0.13
4	1	54	0.19
5	1	54	0.17
6	1	54	0.18
7	1	54	0.16
8	1	54	0.15
9	1	54	0.15

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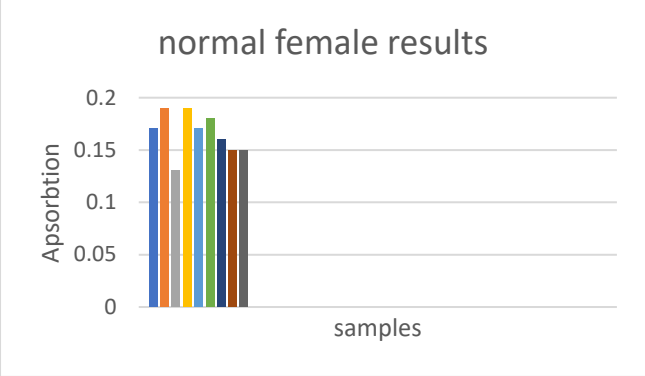


Figure(3) shown normal female results

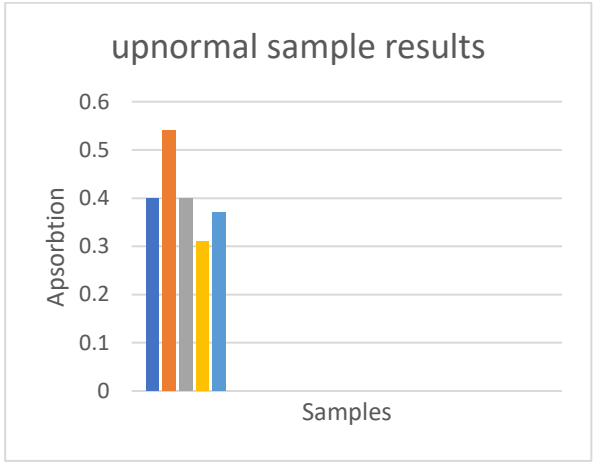
The results of the male are greater than the results of the female, this refer to the percentage of urea for the female is lower than for the male. When conducting the experiment on normal people, there are three errors in reading, this refer to two type of error reasons: the first reason is people did not drink water for a long period of time before collecting the sample, and the other reason was smoking. By calculating the accuracy of this experiment, we find that:

Accuracy = (correct test value / all test value) *100%

$Accuracy = (17/20) * 100\% = 85\%$

Table (3) results of the analysis of upnormal samples

	Number of drops		
Experiment Number	Copper sulfate(CuSo4)	Sodium hydroxide(NaOH)	Absorption
1	1	54	0.4
2	1	54	0.54
3	1	54	0.4
4	1	54	0.3
5	1	54	0.37



Figure(4) shown up normal sample results

Collecting sweat samples for analysis is one of the most appropriate methods for early detection in Sudan and hot areas, as the samples are available in the easiest way and are analyzed in simple laboratories with available reagents. so it can be said that it is one of the ways Powerful help in diagnosis. The method of conducting this paper is one of the safe and helpful methods for early diagnosis to increase certainty, and then for early treatment because in Sweat samples There are substances available in greater quantities than are available in blood samples. In this paper we did a sweat test to diagnose kidney failure, we used noninvasive method, and we got the results, so the accuracy which is 85%, this method helped us to detect kidney failure in primary and deferent stage.

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