Universiti Malaysia Perlis

INVENTORS
1 DR. M.F. ABD MALEK
2 DR. M.S. SALIM
DR. NASEER SABRI

CONTACT DETAILS
1 fareq_malek@yahoo.com
SCHOOL OF ELECTRICAL ENG., UNIMAP,
02500 KANGAR, PERLIS, MALAYSIA

2 muhsabri1967@yahoo.com
SCHOOL OF LASER & OPTICAL ELECTRONICS
ENG., NAHRAIN UNIVERSITY, BAGHDAD, IRAQ

NOVEL: TIME OPTIMIZATION MODEL FOR CENTRIFUGATION PROCESS: APPLICATION IN HUMAN BLOOD-PLASMA SEGREGATION

PI No. : PI 2013701444

INTRODUCTION

One way to accurately diagnose many human diseases is to conduct tests on a sample of blood. These tests are based on analyzing precisely the results of a blood - plasma sample free from any other blood cells. Continuing from our previous research [2], we propose a modified centrifugation time model for laboratory centrifuge devices which has the ability to estimate the centrifugation time process for pre-defined separation efficiency.

PROBLEM STATEMENTS

- The current method of separating the contents of a blood sample is not accurate in terms of centrifugation force and time.
- These variables are evaluated based on sedimentation theory, which calculates the sedimentation time based on higher particle density (red blood cells) and depth of sedimentation.

OBJECTIVES

- To minimize or eliminate uncertainties of separation efficiency, developed a new technique that accurately predicts the required time for the separation.
- A mathematical model was also developed to predict the time required for various circumstances based on measuring the attenuation of wave propagate through blood sample
- To reduces the consumption of time and power required to conduct an accurate blood test.

CONCLUSIONS

- The mathematical model of blood-plasma separation efficiency has the ability to estimate centrifugation time.
- The new technique can be adaptive as a new mythological separation method that offers fast and accurate separation measurement of human blood.
- The current centrifuge controller device can be modified with this model to reduce the spinning time required for predefined separation efficiency.
- The amplitude of the wave propagated through the blood sample, whose density decreases with time (during the centrifugation process) increases; while the separation efficiency increases with an increase in spinning time (spinning speed is constant).
- In this research, the use of the centrifugation time model saves about 1.5 min for 95% separation efficiency compared with current methods.

NOVELTY

- Time optimization model has the ability to estimate the spinning time.
- Based on the new model an Intelligent controller for centrifugation device.
- Contrary to the currently device, new model saves about 1.5 min for 95% separation efficiency lead to saving power consumption of separation process.

METHODOLOGY & RESULTS

- In this research, separation efficiency is a key factor in evaluating the performance of blood-plasma separation. It can be defined as:
- Then separation efficiency will produce by derivative two a mathematical model. Attenuation is measured as a function of separation efficiency and separation efficiency as a function of centrifugation time.
- In this research, the procedure consists of empirically results followed by the derivation of the mathematical model, These measurements were produces in the 1 ml pulse echo method shown in Fig. 1.
- Human blood was drawn from 84 healthy volunteers, 23 women and 61 men; their HCT values ranged from 21% to 53.7%; age range, 21– 50 years. Samples of plasma were prepared using a serum separator tube (EDTA (K2); As a result, a mathematical model of attenuation, concentration, and centrifugation time was derived (Eqs. (2)–(4)). Hence, according to these equations, the time required for specific plasma separation efficiency can be determined.
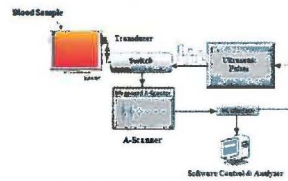

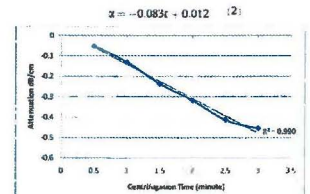Fig.1 Schematic Diagram of Experimental Setup.

$$x = -0.083t + 0.012 \quad (2)$$

Fig.2. Result measurements for the attenuation versus centrifugation time, at 2MHz.

$$\eta = 30.85t + 6 \quad (3)$$
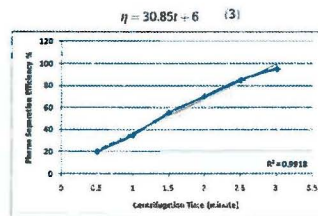
Fig.3 Relationship between plasma separation precision and required centrifugation time process.

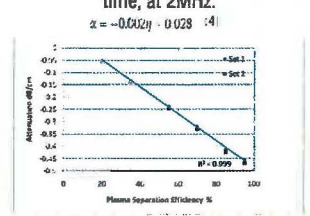$$x = -0.002\eta - 0.028 \quad (4)$$

Fig.4 Result of attenuation measurements for Blood-Plasma concentrations versus separation efficiency at 2MHz. Result of two data sets are shown.

PUBLICATION
- M.S. Salim, M.F. Abd Malek, Naseer Sabri, N.M. Noaman, and K M Juni. Novel: Time optimization model for centrifugation process: Application in human blood-plasma separation. Journal Measurement 46 (2013) 3568–3572. (ISI / Scopus - Cited Publication, I.F. 1.2).
- Salim, M.S., Abd Malek, M.F., Heng, R.B.W., Salim, N.S., Juni, K.M. A new measurement method of separation percentage for human blood plasma based on ultrasound attenuation. International Journal of Physical Sciences, Volume 6, Issue 30, 23 November 2011, Pages 6891-6898. (ISI / SCOPUS-Cited Publication)
- Salim, M.S., Abd Malek, M.F., Heng, R.B.W., Juni, K.M.c, Sabri, N., Capacitive Micromachined Ultrasonic Transducers: Technology and Application, Journal of Medical Ultrasound, Volume 20, Issue 1, March 2012, Pages 8-31. (SCOPUS-Cited Publication)
- M. S. Salim, M. F. Abd Malek, Naseer Sabri, N.M.Noaman, K.M. Juni, and N. A. Binti Abu Talib, A New Ultrasonic Exponential Decay Pulser Technique for Low Concentrations Detection and Measurements. International Review of Automatic Control (I.RE.A.CO.), (SCOPUS-Cited Publication) (under publication)
- M. S. Salim, M. F. Abd Malek, Naseer Sabri, M Iqbal bin Omar, Latifah Mohamed and K.M. Juni. Optimization of Power Consumption for Centrifugation Process Based on Attenuation Measurements. Journal of Physics: Conf. Ser. 423, 012061, 2013. (Scopus-Cited Publication)
- M.S. Salim, M. F. Abd Malek, N.M. Noaman, Naseer Sabri, Latifah Mohamed and K M Juni. A New Ultrasound Pulser Technique for Wide Range Measurements. Journal of Physics: Conf. Ser. 423, 012062, 2013. (Scopus-Cited Publication)