RESPONSE OF CHOLESTEROL IN THE PRESENCE OF ALANINE AND OTHER BLOOD CONSTITUENTS

Ingrid Anne P. Nazareth
Research Scholar Dept. of Electronics, Taleigao Plateau, Goa University, Goa, India

Sulaxana R. Vernekar
Research Scholar, Dept. of Electronics, Taleigao Plateau, Goa University, Goa, India,

Rajendra S. Gad
Associate Prof., Dept. of Electronics, Taleigao Plateau, Goa University, Goa, India,

Gourish M. Naik
Professor & Head, Dept. of Electronics, Taleigao Plateau, Goa University, Goa, India

ABSTRACT

High Cholesterol levels in the blood plays an important role in developing heart diseases. The paper discusses the response of Cholesterol with varying Alanine concentration in the presence of other blood constituents like Salt, Urea and Glucose. The response is given in the 10 MHz to 500 MHz range with Alanine varying from normal to above normal. The study proposes to establish the influence of Alanine on the determination of Cholesterol. In order to record the responses, an RF spectroscopic technique is used. The study is performed with low cost tracking generator and spectrum analyzer. It has been found that the results are consistent.

Key words: Cholesterol, Alanine, RF Spectroscopy, Tracking Generator, Spectrum Analyzer.


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1. INTRODUCTION

Heart disease is a major disease caused by high Cholesterol and the No. 1 killer in the world. In India, most of the people are prone to heart attacks and eventually every 5th person succumbs to it. Around 79% of Indians have high lipid levels which cause damage to vessel walls and blockage of arteries leading to heart problems.[1][2] Approximately 72.3% have low levels of HDL and 11.8% have high levels of LDL. High levels of triglycerides or fats are associated with the Indian diet consisting mostly of carbohydrates and fats. Low levels of HDL are due to the high levels of triglycerides. There is an inverse relationship between HDL and triglycerides. About 30% of Indians have a high level of triglycerides. In a lipid profile test, if the ratio of triglycerides and HDL is greater than 3.8, then a person has dense and small LDL. Indian guidelines should correct these ratios and dietary demands to cut down on refined carbohydrates.[3] The expenditure incurred by India on CVD is less than 1% and since the government spends around 18%, the balance of over 80% is borne by the common man.[4][5][6] Hence each year, 30 million people are driven into poverty.[7][8] The combination of the in and out patient expenditure of CVD ranged from $2917 in high income group, to $1593 in middle income group and to $773 in low-income group in India. [9]

Amino acids are tiny molecules that are linked together in various patterns to form a protein to build healthy and strong muscles.[10] Essential amino acids are the ones which cannot be manufactured by the body and hence acquired by the food intake. Mental and physical health, are both affected if any of the essential amino acids requirements are not adhered to. Non essential amino acids are the ones which can be manufactured by the body and hence need not be obtained directly through diet. Alanine is one of the non essential amino acids found in a various types of foods especially in meats.

Good sources of alanine comprises of the following

- **Vegetarian**: whole grains, legumes, nuts, beans, soy, seeds, whey, brown rice, brewer's yeast, corn, bran.
- **Non Vegetarian**: seafood, meat, eggs, dairy products, gelatin, fish, lactalbumin.

Alanine or L-alanine is a hydrophobic molecule. It is ambivalent, meaning that it can be on either side of the protein molecule. It helps to convert the simple sugar glucose into energy, regulate blood sugar and remove surplus toxins from the liver. Alanine helps in maintaining glucose levels boosts energy in the body. Chronic fatigue syndrome and Epstein-Barr virus have been correlated to low levels of tyrosine & phenylalanine and excessive alanine levels. An enzyme commonly found in the cells of the kidney and liver is known as Alanine aminotransferase (ALT). [11] Fewer amounts of the same are found in the muscles and heart. ALT levels in the blood in healthy individuals are normally low. When the liver is injured, ALT is released into the bloodstream, even before signs like jaundice occur.

Alanine is very important for preserving equal balance of nitrogen and glucose levels in the body through a sequence of chemical actions called the alanine cycle. During the alanine cycle, any surplus amino acids present in the cells or tissues are moved to a receptor molecule called pyruvate, which is created by the breakdown of glucose. In order to avoid a deficiency, alanine supplements are needed to be taken by people with eating disorders, low-protein diets, diabetes, liver disease or genetic conditions that cause Urea Cycle Disorders (UCDs). Alanine helps the body to process vitamin B5 & B6 essential for good health. An international study found a link between high levels of alanine and Cholesterol levels, body mass index, energy
intake and high blood pressure. Other causes of increase in ALT include heart damage, cirrhosis, obstruction of bile ducts and tumors in the liver. [12]

2. METHODOLOGY
The Alanine in the normal human blood ranges from 10-20 mg/dL. The concentration of Cholesterol is below 250mg/dL, Glucose is 70-110mg/dL, Salt is 9g/L, and Urea is 10-20mg/dL. The experiment is performed with average concentrations of Alanine i.e. 15mg/dL, glucose i.e. 90mg/dL and urea i.e. 15mg/dL. 14mL double distilled water is used along with 1mL alcohol to prepare solution samples with concentrations ranging between 0.75 and 2.5 times the normal concentration of Cholesterol. Alanine varying from 0.5 to 3 (1.13mg/15mL to 6.75 mg/15mL) along with constant average concentrations of other constituents is used in the solution sample. Experiments were conducted in slow sweep and fast sweep and repeated after a gap of 1 and 2 hours, to ensure repeatability.

A cell to measure the RF responses of Alanine and Cholesterol in the presence of various blood constituents is designed. [13] A Tracking Generator and Signal Analyzer is used to transmit and receive signals after being passed through the cell. The samples are evaluated in the range of 10MHz to 500MHz. The multifrequency RF spectrum can be modelled through multivariate and curve-fitting statistical applications to develop summary parameters to estimate body composition such as Cholesterol, Alanine, Glucose, Urea etc.[14]

3. RESULTS
The graphs are recorded in Figure 1 to Figure 5, by using the above cell along with the various combinations. Varying Cholesterol and Alanine with constant concentrations of other constituents were used in the solution sample in the frequency range of 10MHz to 500MHz. Only particular frequency regions where Alanine is at the normal average value are shown in the following figures.

It is observed from Figure 1 that as the Cholesterol concentration increases from 0.75 - 2.5, the absorption increases in the range 24MHz to 30MHz when Alanine and the other constituents are at the normal average value.

![Figure 1 Graph of 24MHz – 30MHz](image)

The graph shown in Figure 2 gives the variation in the attenuation of signal, for different concentrations of Cholesterol where Alanine and the other constituents are retained at the normal value in the range 120MHz to 130MHz.
It is noted from the graph shown in Figure 3 that as concentration of Cholesterol increases in the range 200MHz to 280MHz. Here, Cholesterol increases from 0.75 to 2.5 and the other constituents are maintained at 1, i.e. normal average value.

It can be observed from the graph shown in Figure 4 that as concentration of Cholesterol increases from 0.75 to 2.5 and the other constituents are maintained at normal range, the absorption decreases in the range 330MHz to 350MHz.

It can be observed from the graph shown in Figure 5 that as concentration of Cholesterol increases in the frequency range 490MHz - 500MHz. Here Cholesterol is varied between 0.75 and 2.5 and Alanine and the other constituents are kept at the normal values.
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4. CONCLUSION

The manuscript reports a variation of absorption values in samples of solution consisting of different constituents like Cholesterol, Alanine, Glucose, Salt and Urea. The study demonstrates that Cholesterol has a significant change in the attenuation at certain frequencies, in the range of 10MHz - 500MHz, despite concentration of Alanine varying from half times normal, to three times the normal average Alanine, found in the human blood. The study is significant for the development of monitoring Cholesterol. Due to the present lifestyle of people, if Alanine had to influence the estimation of Cholesterol, the development of instrumentation could be more complex. The above results can be used in regression analysis to determine the concentration of Cholesterol. The study conducted is in progress aiming towards the development of a user friendly and portable device to monitor health parameters.

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