INFORMATION DETERMINATION OF THE
CONSTITUENTS OF WHITE BLOOD CELLS USING
OPTICAL BIOSENSOR

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Abstract

Human body should resist against infections and also against infection causing organisms that enter our human body. In a human body for every microliter of blood, white blood cells has to range from 4,000 to 11,000 approximately. The main category of white blood cells are Neutrophils, Eosinophils, Basophils, Lymphocytes & Monocytes. In this paper, we are studying the characteristics of these different types of white blood cells & determining their Quality factors as well as transmission power analysis in a suitable Waveguide using Simulation results. The main immunity for the human body is provided by Neutrophils. It becomes very much necessary to know the properties, Information of these wbc’s which is a very important factor. This is determined by using an optical Biosensor.

Keywords: Optical Biosensor, Poweranalysis, Waveguide,White Blood cells, Quality Factors

I. Introduction

White Blood cells acts like Soldiers in our body. Whenever infectious substances like Virus, Bacteria etc enter our body, these White Blood cells rush to fight against them & protects our body from infections, illness & other type of disorders. These Wbc’s are produced in the bone Marrow in our body. They have a short life span of around only 1 to 3 days. A very low Wbc count in our body also results in cancer and many other types of multiple disorders including immunitydisorders.

The different foods that increases White Blood cells in our body are Citrus Fruits, Garlic, Ginger, Spinach, Yogurt, Almonds. Also about 7% to 8% of our total body weight is constituted by Blood. White Blood cells lives less than a
day. This means that the Bone Marrow will be almost constantly producing White Blood cells. They also demolish (VI) or destroy cancerous cells. The different categories of White blood cells are as follows:

(i) Monocytes  
(ii) Lymphocytes  
(iii) Neutrophils  
(iv) Basophils  
(v) Eosinophils

Fig (1.1) Pictorial Representation White Blood cells

II. Monocytes

These form the types of WBC’s which are accumulated in Spleen inside our body. These forms a more Percent of WBC’s Present in the body. The Structure of a Monocyte is almost like Amoeba. These constitute 2% to 10% of Wbc’s in our body. Monocytes have a life Span of 2 to 3 days. If the monocyte count decreases in our body, it causes Monocytosis as well as Monocytopenia.

Fig (1.1.1): Three -D View of a Monocyte

Symptoms of Monocytosis as well as Monocytopenia.

(i) Viral fever
(ii) Chronic Eczema
(iii) Immune Mediated Disease
(iv) Stress management collapse

Let us study about types of Cells in Monocytes a type of Wbc’s (a) T-cells &
(b) B-cells

(a) T-cells

This forms a group of WBC’s where they are responsible to maintain immunity in our body. They are a type of Lymphocytes. These cells starts its origination in our bone marrow & sometimes even in fetal liver during Embryonic development. Since they kill Virus infected Cells & Cancer Cells, they are also
called as Killer Cells. If the Cancer is caused due to T-Cells then it is called as Cancer of T-cells. There are Thymus-cells[2] & B- Lymphocytes. These T-Cells can identify Viral epitopes external to the contaminated Cells and B- Lymphocytes can identify the external antigens present in Bacteria as well as Viruses.

T-Cells can be enhanced by following these habits naturally:
1. Have good food habits like having more Fruits & vegetables.
2. People should not smoke or consume more alcohol than moderate level.
3. Have a proper sleep.
4. We should wash our hands often.
5. Proper body weight has to be maintained.

(b). B-Cells

These are the type of Lymphocytes which are responsible for Secreting Antibodies. B- Cells arise from Spleen & Lymph nodes. These B-cells(V) produces poisonous materials to fight against Germs & viruses. We have Memory-B cells[9] which are the sub-type of B-cells. This will be primarily generated during the Infection. They will again be regenerated if the infection occurs again. B-Cells form Y-shaped Proteins known to be Antibodies. If virus or Bacteria [2] enter the body, the alertness will be given by B-cells. They are Produced inside Bone-Marrow. These B-Cells are generally found in Saliva, Blood Tears etc.
III. Lymphocytes

These are the main type of cells which introduces Immunity[5] to the body. When the Lymphocytes count decreases it results in more chance of the occurrence of Cancer. The different Signs of Lymphocyte Leukemia are:

(i) Weakness
(ii) Chills (iii) Night sweats (iv) Fever
(v) Weight loss etc

The lymphocytes ranges from 1000 to 4800 in one Microlitre of Blood. There are 3 categories of Lymphocytes. They are:

(i) B-Lymphocytes
(ii) Thymus-Lymphocytes
(iii) Native Soldier Cells

Table (1.1) Ranges of Lymphocytes &Wbc for an Adult

| Type of Analysis | Grown up typical cell Count | Grown up normal Person Cell Count (Statistical) | Reduce levels | Arial levels |
|------------------|----------------------------|-----------------------------------------------|---------------|-------------|
| Wbc              | 4.5 to 10 Wbc’s per miili CentL | Around 1 percent of Absolute Content of Blood | Analytical for count fewer than 2,500 lymphocytes/mcL | Greater than |
| lymphocytes      | 800-5000 (0.8-5.0) lymphocytes/mcL | 18 percent to 45 percent of the absolute value of white bloodcells | Lesser than 800 lymphocytes per milli centiliter | More than 5,000 lymphocytes per milli centiliter |

IV. Neutrophils

These constitute 55% to 70% of Wbc’s in the body. They have a very less life span but they are very active in their life span. These neutrophils have a life span of 5 hours to 90 hours. If the count of Neutrophils are less in WBC, then it causes Neutropenia. The test which is used to determine Neutrophils (IV) are CBC test (Complete Blood Count Test). By having food which is rich in Vitamin B12, Neutrophils counts could be managed in our body. It has to be (2*10) millilitre per neutrophil per millilitre of blood present in our body.
V. Basophils

These constitute 0.5% to 1% of the total White Blood Cells[3] present in our Blood. Its range has to be 0-300 per micro-liter of blood. These Basophils produces a very good immuno Response to our body. These are the type of Wbc’s which fight against Allergy causing Virus, Bacteria in our body.

VI. Easinophils

These constitute around 1% to 3% of White blood Cells. If Easinophils are present in Blood Circulation, they survive for 8 to 12 hours. If they survive in Tissues, then they survive for 8 to 12 Days. If the level or the Count of Easinophils, decreases or increases then they result in asthma & many other type of Allergies related to Spleen, Ovaries, Uterus etc. The count should be 30-350 in a micro-liter of Blood.

VII. Methods Adopted

The first method adopted is MEEP technique which is used to determine the Quality factor (QF). It clearly shows the Pixel & subpixel variations of wave propagation in different types of Light defects & waveguides of different Structures. It also gives the results in the form of Simulation. The defects used will be (i) rods in air & (ii) Holes in slab.

The other method adopted is Opti FDTD (Finite difference Time Domain) method which is mainly used with light waves. It is mainly characterized with the light Propagation Characteristics with Optical waveguides of different Structures. In this Paper, Linear & Ring waveguide are considered to determine the Optical characteristics (II) for different conditions. A powerful 2-D Simulation method is adopted in this results. The type of Dielectric [7,8] with the Dielectric constant value & the type of the channel decides the Propagation Characteristics of the light. This also gives results in the form of Simulation.
Both the techniques are used in this paper to present the characteristics of optics & to determine the QF value as well as power analysis.

VIII. Results

![Fig (3.1) Structure of a waveguide](image1)

![Fig (3.2) Power Analysis in dB](image2)
Table (3.1): T-Cells R.I value ranges from 1.3958 to 1.4132

| Type                      | RI                  | Steps | QF                      | Power transmission in db(for 1000 Steps) |
|---------------------------|---------------------|-------|-------------------------|----------------------------------------|
| T-Cells with Nucleus (+ve Extremity) | 1.4132 (1.4045+0.0087) | 300   | 197.434349 6577298      | -13.451                                |
| T-Cells with Nucleus (-ve Extremity) | 1.3958 (1.4045-0.0087) | 300   | 106.31844677 033159     | -14.43                                 |

Table (3.2): Neutrophils R.I value ranges from 1.3953 to 1.4169

| Type                      | RI                  | Steps | QF                      | Power transmission in db                                      |
|---------------------------|---------------------|-------|-------------------------|----------------------------------------------------------------|
| Neutrophils with nucleus  | 1.4061+0.0108 =1.4169 (+VE Extremity) | 300   | 9602.0559119 2 1256     | -14.3                                                           |
| Neutrophils with nucleus  | 1.4061-0.0108 =1.3953 (-ve Extremity) | 300   | 423.0646619 898 8176    | -14.4512                                                        |

Table (3.3): Monocytes R.I value ranges from 1.38 to 1.48

| Type          | RI                  | Steps | QF                      | Power transmission in db                                      |
|---------------|---------------------|-------|-------------------------|----------------------------------------------------------------|
| Monocytes (+ve Extremity) | 1.43+0.05 (1.48)  | 300   | 517.0442813 82429       | -14.5db                                                         |
| Monocytes (-ve Extremity) | 1.43-0.05 (1.38)   | 300   | 53.923606658 07976      | -18.82                                                          |
Table (3.4): R.I value of Basophils ranges from 1.4 to 1.42

| Type     | RI         | Steps | QF                  | Power Transmission in db |
|----------|------------|-------|---------------------|--------------------------|
| Basophils| 1.41+0.01  | 300   | 129.30154002358245  | 14.97                    |
| Basophils| 1.42 (+ve Extremity) |       |                     |                          |
| Basophils| 1.41-0.01  | 30    | 355.466194156435    | -14.432                  |
| Basophils| 1.40 (-ve Extremity) | 0     |                     |                          |

Table (3.5): R.I value of Lymphocytes ranges from 1.3556 to 1.3568

| Type     | RI         | Steps | QF                  | Power transmission in db |
|----------|------------|-------|---------------------|--------------------------|
| Lymphocytes| 1.3562+0.0006 | 300   | 87.52570008067381   | -14.4db                  |
| Lymphocytes| 1.3568 (+ve Extremity) |       |                     |                          |
| Lymphocytes| 1.3556-0.0006 | 300   | 05.58437857202445   | -14.41 db                |
| Lymphocytes| 1.3562-1.3568 (-ve Extremity) |       |                     |                          |

Table (3.6): R.I value of Eosinophils ranges from 1.57 to 1.75

| Type     | RI         | Steps | QF                  | Power Transmission in db |
|----------|------------|-------|---------------------|--------------------------|
| Eosinophils QF for normal Persons with Concentration of 18% | 1.57 | 300  | 15975.0098504501 27 | -14.4314                  |
| Eosinophils QF Patients Persons | 1.7 | 5    | 10004.4601639816 303 | -14.43db                  |
IX. Conclusion

The main intention of this paper is the analysis is done for different types of White blood cells. When they are in normal range i.e. with their counts, Quality factor is determined using MEEP tool & the power analysis is done by using Opti-FDTD program. When they fall below or above these ranges then it may result in many types of deficiencies, disorders, diseases in Human beings. This can be done with the abnormal wbc counts also.

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