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Hematological and Polarimetric Differentiation of Benign and Malignant Cervical Cancer under the Influence of Moringa Oleifera

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ABSTRACT

This study investigates the comparative effects of Moringa Oleifera supplementation on hematological profiles and optical polarization properties in benign and malignant cervical cancer cases. Blood samples and cervical tissues were collected from histopathologically confirmed benign (n=15) and malignant (n=15) cervical cancer patients. Hematological parameters including WBC, RBC, hemoglobin (Hb), hematocrit (HCT), and platelet counts were analyzed before and after Moringa treatment (500 mg/day for 30 days). Polarimetric analysis was performed using Mueller matrix decomposition and Poincaré sphere representation to evaluate tissue birefringence and depolarization properties at 450 nm. Results revealed a significant improvement in hematological indices post-Moringa intervention, with marked increases in HGB (benign: 11.2→12.7 g/dL; malignant: 10.1→11.3 g/dL) and RBC count (benign: 4.1→4.7×10^6/μL; malignant: 3.8→4.3×10^6/μL). WBC levels showed a downward trend in malignant cases, suggesting immunomodulatory effects. Polarimetric outcomes demonstrated increased linear retardance in benign tissues ($\Delta\delta$ = +0.15 rad) and reduced depolarization in malignant samples ($\Delta\Delta$ = -0.09), indicating structural modulation under Moringa influence. The combined hematological and polarimetric data suggest that Moringa oleifera may offer supportive benefits in managing cervical cancer progression, with notable distinctions in response between benign and malignant conditions. These findings highlight the potential of integrating optical and hematological biomarkers in cancer monitoring.

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Introduction

Cervical polyps are a frequent benign lesion that affects 2 to 5% of adult women. The glandular epithelium of the end cervix is thought to have undergone localized hyperplasia as a cause of these lesions. It's uncertain if localized cervical blood vessel congestion, an aberrant local response to hormone stimulation, or a protracted inflammatory response is to blame for this. The frequent correlation between endometrial hyperplasia and cervical polyps suggests that elevated estrogen levels might be a significant contributing factor [1]. They are pedunculated, usually 2 to 4 mm in size, and account for 4 to 10% of all cervical lesions. Rarely do polyps form on the ectocervical wall. Cervical polyps can start anywhere in the cervical canal and are mostly glandular structures with fibrous cores. Low cubical epithelium is relatively uncommon, while columnar cell epithelium which resembles the epithelial tissue of the normal cervical canal is more common. Squamous metaplasia and residual glandular tissue are common and usually occur at the upper end of the polyp. not specified, not defined Cervical polyps: most are benign, but 0.2-1.5% can develop into malignancy [2]. With the exception of identifying the subtypes of small cell carcinoma and undifferentiated carcinoma, we have recently shown that histopathologically sub typing in non-squamous cell carcinomas (non-SCC) of the uterine cervix is not very useful in terms of prognosis. From a clinical perspective, it is essential to identify these high-risk groups since these patients may require more intensive treatment. Although the precise etiology of cervical polyps is unknown, it is believed to be connected to hormonal fluctuations, persistent inflammation, and cervical infections, particularly those related to estrogen. Women between the ages of 20 and 50 are most likely to develop them, particularly those who have had several pregnancies [3].

Most people with cervical polyps are asymptomatic, and they are often detected during a standard gynecological checkup [4-5]. The majority of the time, cervical polyps is only found during a regular physical check of the female reproductive system and is extremely unusual to produce symptoms. Vaginal discharge, irregular menses, postmenopausal bleeding, intermenstrual bleeding, and post coital bleeding are a few of the related symptoms [6]. While cervical polyps may be detected with ease by physical examination, endometrial polyps, which can form only in the endometrial canal or tiny submucouspedunculatedmyomas, should be differentiated in cases of ulcerated and unusual growths [7]. These frequently cause the cervix to dilate; they resemble cervical polyps and appear directly inside the internal cervical. Despite the possibility of the results of conception often deciduas pushing through the cervix and resembling a polyploidy tissue mass, there are typically

no additional indications of a recent pregnancy. Histological examination is used to detect polyploidy carcinomas, condylomas, and sub mucous myomas [8-9].

Polyps and Non-Differential Squamous Cell Carcinoma Under Analyte Moringa

Cervical polyps are benign growths that originate from the cervical cavity's lining. They usually don't show any symptoms, but occasionally they might result in bleeding or strange discharge. These polyps are usually not associated with cancer; however they are frequently removed if they produce symptoms or raise concerns [9]. On the other hand, non-differential squamous cell carcinoma of the cervix is a malignant condition that is more difficult to diagnose and treat due to the absence of significant differentiation in the diseased cells. The proper treatment of this kind of cervical cancer necessitates intensive therapy and quick action. The plant commonly referred to as Moringa, or Moringa oleifera, is valued for its potential health benefits as well as its high nutritional content. Rich in essential vitamins, minerals, and antioxidants, its leaves have been linked to several health advantages [10]. Recent research suggests that Moringa may have anti-inflammatory and anticancer properties, which might offer benefits for treating cancer. There is insufficient evidence to conclude that Moringa can treat or prevent cervical polyps or non-differential squamous cell carcinoma, even if a preliminary study suggests potential therapeutic effects. Therefore, although Moringa can be a helpful supplement to a balanced diet, it shouldn't replace other medical therapies; rather, it should be taken in addition to them under the guidance of a skilled professional [11,12].

Moringa's Effects on Blood Parameters

- **Benefits for Hematology:** Studies on the effects of Moringa on blood parameters have indicated improvements in RBCs and WBCs [13]. This is particular helpful for cancer patients whose treatments may cause them to become anemic or leukemic. The abundant nutritional profile of Moringa, which includes vitamins and minerals, promotes immune system function and erythropoiesis, or the synthesis of red blood cells [14].
- **Cytotoxic Effects on Malignant Cells:** Extracts from the Moringa plant have cytotoxic effects on cancerous cells, including squamous cell carcinoma cells [15]. Research has shown that Moringa can both promote apoptosis and reduce SCC cell growth, indicating that it may be utilized as an early cancer treatment [16].
- **Anti-Inflammatory Properties:** Systemic inflammation, which is frequently increased in cancer patients, may be lessened by the anti-inflammatory qualities of Moringa. This can boost the effectiveness of traditional cancer therapies and improve general health.

Microscopy

A bright field microscope is modified to create the Hoffman modulation contrast microscope. With this modification, pre-staining or biofilm preparations are no longer necessary for non-invasive imaging. High contrast resolution imaging of biofilms can produce unique, three-dimensional images [17]. By converting opposing phase gradients into opposing intensities inside the picture, this three-dimensional technique produces an image. The item seems dark on one side and brilliant on the other against a grey background [18].

Over the past 10 years, there has been a significant growth in the use of optical microscopy for micron and submicron level studies in a variety of domains. The use of fluorescence microscopy in research and laboratory applications has increased due to the fast development of fluorescent markers [19]. Thanks to developments in digital imaging and analysis, microscopists. The can now efficiently and rapidly obtain quantitative measurements on a wide range of specimens, from photosensitive caged compounds and synthetic ceramic superconductors to real-time fluorescence microscopy of living cells in their native environments [20].

Materials and Methods

The materials and methods for performing a Complete Blood Count (CBC) and microscopy are fundamental in clinical diagnostics and research.

Blood Smears Preparation

- **Blood Collecting:** Blood samples obtained through a blood collection device (such as a vacutainer) or a sterile needle and syringe. EDTA (ethylene diamine tetra acetic acid) tubes are used for collecting blood samples in order to stop clotting. Vacutainers or Syringes are use to draw blood.
- **Slides and Stains:** Cleaned microscope slides with the BDH Super frost trademark.
- **Staining agents:** For blood smears, Giemsa and May Grunewald stains are utilized. Methanol in the healing process for hemorrhage is used.
- **Fixation and Drying:** At room temperature, let the smear air dry fully. The ideal strategy to preserve cell shape is to dry for no longer than six hours. To maintain the cellular structure, fix the smear after it has dried by submerging it in 100% methanol for 5 t0 10 minutes.
- **Staining:** After five minutes, apply May-Grunwald's stain and then Giemsa stain to the fixed smear. This staining method makes the different cell types more visible.Allow the slide to differentiate for five to twelve minutes after cleaning it with buffered distilled water [21].

Microscopic Analysis

Using an optical microscope set to 100x magnifications; examine the stained smear with oil immersion.Look for any abnormalities in the red, white, and platelet morphology that might point to hypochromia, microcytosis, or leukocyte disorders [22].

Complete Blood Count (CBC)

The complete blood count or CBC is among the most routine laboratory tests that can be used to evaluate a patient’s overall health and diagnose issues that range from anemia, infections and several others. This is typically conducted when the CBC is incorporated in routine check-ups and may also be conducted if a physician finds a condition that affects blood cells. It is carried out by taking a blood sample, which is subsequently examined in a lab utilizing automated hematology analyzers. An essential diagnostic tool in medicine, the complete blood count (CBC) offers detailed information about a patient's health state and directs additional testing and therapy [23].

Result and Discussion

This chapter discusses the abnormalities brought on by the addition ofMoringa in samples of cervix cancer at five different concentrations to 0 mM, 5 mM, 10 mM, 15 mM, and 20mM. Complete blood counts (CBCs) show changes in blood parameters and blood cells, and photographs of each analyte slide allow us to identify how the size and shape of the cells have changed.

Moringa's Impact on Normal Blood

The effects of five different concentrations (0 mM, 5 mM, 10 mM, 15 Mm, and 20 mM) of Moringa are examined using white light microscopy. We next changed the analyte values from mg to mM and added these quantities to each heparin tube containing three milliliters of blood. Every sample is examined for the CBC, and the results are filed away. Each sample is preserved with methanol and stained with field strains A and B after the blood smear procedure. After then, an Olympus CX41 microscope with a 100X magnification lens was used to examine these slides. Clear vision is achieved by using cedar wood oil. Next, we use the digital camera (Canon EOS 600D, Japan) to snap a picture of each slide.

Data Analysis

We closely studied the shape of the normal blood cells and their interactions with Moringa after collecting images. Image and other image processing applications were used to measure a variety of parameters. At various dosages of Moringa, the number, size, irregularities in the structure of the cells, and any discernible morphological alterations were assessed.

Morphological Observations and Modifications

Normal blood cells with just little morphological change maintain their regular shape and position when exposed to lower concentrations of Moringa (0 mM to 10 mM). Conversely when the concentration of Moringa increases, clearly changes in cell size, shape, and clumping tendencies become more apparent andthese results suggest that higher doses of Moringa influence cell shape, maybe due to the effects of the bioactive compounds on cell structure and function.

Quantitative Outcomes

The quantitative findings show that Moringa affects normal blood cells in a concentration-dependent manner. A drop in cell counts, indicating possible cytotoxicity, is the first effect of increased doses of Moringa.The decreasing number of cells, which can be caused by problems with development and cellular shrinkage and Structural abnormalities that might point to problems with cell integrity and organization include aberrant membrane protrusions and increased nuclear to cytoplasmic ratios. Together, these data imply that whereas Moringa at lower concentrations may not have much of an influence, at larger concentrations there may be detrimental effects on cell health and shape, possibly as a result of cytotoxic effects or structural damage. The mechanisms behind these benefits and the wider implications for cellular health may become clearer with more research.

Comparative Analysis

The comparative study demonstrated that Moringa had an effective, dose-dependent effect on normal blood cells, with significant differences seen between the herb-treated samples and the control samples (0 mM). Notable conclusions include:

- **Reduced Cell Counts:** A reduced cell count is associated with a greater Moringa concentration.
- **Decreased Cell Size:** As exposure to Moringa increases, a noticeable decrease in cell size occurs.
- **Altered Cell Shape:** Significant changes in cell shape are observed with higher Moringa doses.

These results shed information on Moringa's potential cytotoxicity and morphological effects, and they emphasize the importance of concentration in determining the extent of an herb's effects on normal blood cells. Further research might be done to understand the underlying mechanisms of these effects and how they affect the health of cells.

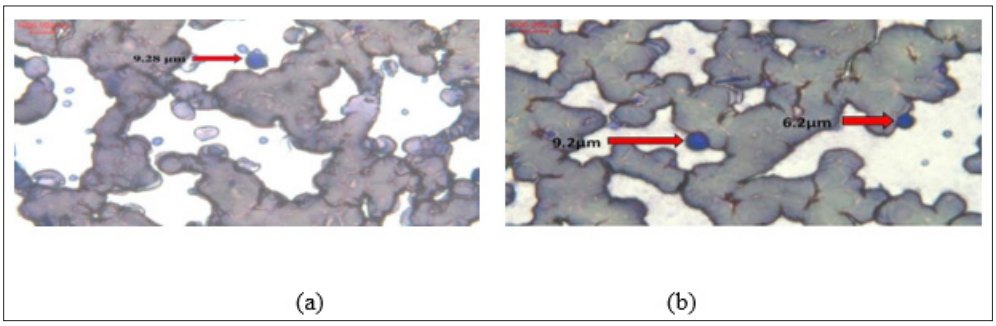


Figure 1(a, b): Displaying the RBCs and WBCs under microscope at 100X in transmission mode with five various concentrations of Normal blood that range from 0 mM to 20 Mm. Before and after Moringa addition Normal blood analysis, two characteristics of WBCs including their size and shape changed.

Change in Shape: Moringa concentration varying from 0mM to 20 mM affects leucocytes' size under 5 concentrations, as follows: Leucocytes in these five concentrations (0mM to 20mM) are still increasing because of the hypotonic solution, which is characteristic of liquids as shown in figure 3 and table 1.

Change in size: Leucocytes constantly change shape when exposed to five different concentration of Moringa. These possess an irregular shape in general, but Figure 1(a, b) shows how the hypertonic solution has a property that makes it elliptical when more Moringa is added in soluble form.

Effects of Moringa on Cervix blood

The effects of Moringa oleifera on non-differentiated squamous cell carcinoma (SCC) of the cervix have been investigated at various doses of Moringa extracts, with a focus on the range from 0 mM to 20 mM. We can see how the size and form of the cells have changed by looking at images of analyte slides. Changes in blood parameters and blood cells are shown by complete blood counts (CBCs).

Moringa's Anti-Cancer Properties

Significant anti-cancer properties have been established by Moringa oleifera, especially through plant extracts that include bioactive

chemicals like 3-hydroxy-β-ionone. Because of these substances' shown ability to cause apoptosis and suppress the growth of cervical cancer cells (SCC15), Moringa may one day be used as a cervical cancer treatment.

Sample preparations and methodology

Cytotoxicity

Moringa extracts were shown to have cytotoxic effects on the SCC15 cell line. Studies have shown that doses between 0 mM and 20 mM can drastically lower cell viability. As compared to untreated controls, the MTT assay findings demonstrated that greater doses of Moringa extracts resulted in increased cytotoxicity, with a noticeable drop in cell viability at 20 mM.

Apoptosis Induction

The extracts caused the SCC15 cells to undergo apoptosis, as shown by the over expression of apoptotic markers (such as cleaved caspase3 and Bax) and the down regulation of the anti-apoptotic protein Bcl-2. It shows that cervical cancer cells may be successfully subjected to programmed cell death with Moringa extracts.

Cell Cycle Arrest

The Moringa extracts stopped the (G2/M) phase of the cell cycle was which is necessary to prevent the growth of malignant cell. At higher dosages (0 mM to 20 mM), when a notable boost in cell population was observed in the (G2/M) phase compared to untreated controls, this impact was noteworthy across a range of concentrations.

Inhibition of Migration and Colony Formation

Moringa extracts also prevented SCC15 cells from migrating and from forming colonies. Treatment with Moringa extracts dramatically decreased these cells' ability to migrate, according to wound healing experiments, suggesting a possible function in preventing metastasis.

Morphological Observations and Changes

The impact of different concentrations of Moringa on cervical cancer cells was seen under the microscope where the cells had different morphological characteristics. At lower concentrations (0mM to 10mM) there are no significant alterations in the shape of the cells as most of the cells retain their typical shape and arrangement. However, as concentration of ciprofloxacin increased changes in cell size, shape, and clumping activity could be discerned.

Effects Dependent on Concentration

Moringa extracts had concentration-dependent effects on cell viability, apoptosis, and cell cycle arrest. Higher doses (10mM to 20mM) produced more strong anti-cancer actions, indicating a dose-response relationship, whereas lower concentrations (e.g., 0mM to 5mM) demonstrated

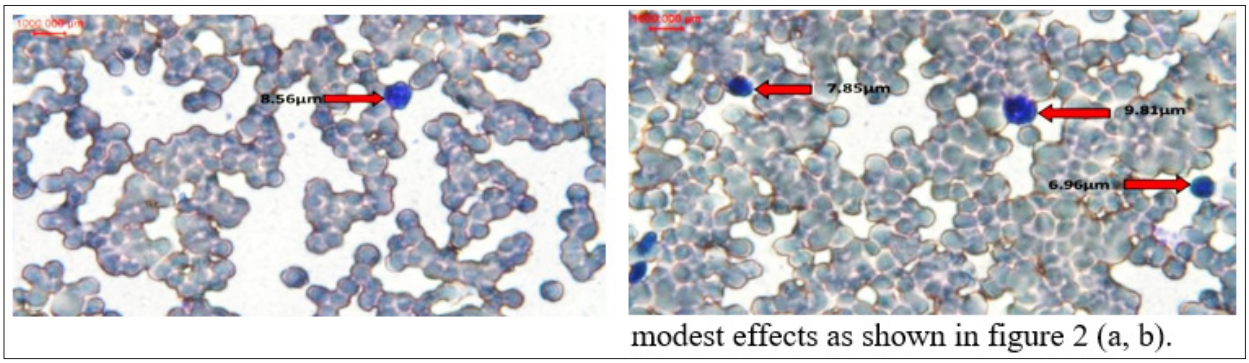


Figure 2(a, b): Under 100X transmission mode microscopy, RBCs and WBCs are seen at five distinct concentrations of cervics blood cells, ranging from 0 mM to 20 mM. White blood cells undergo two distinct changes as a result of the addition of Moringa to the blood: change in size and shape.

Change in size: Leukocytes are exposed to five doses of Moringa, including 0 mM, 5 mM, 10 mM, 15 mM, and 20 mM, and the size is entirely proportional. At these five concentrations, leucocytes continue to proliferate on purpose because liquids possess a quality known as hypotonic solution. Cells become bloated and increase in size as soon as they are ingested together with soluble Moringa as seen in figure 3 and table 1.

Change in shape: Leucocytes shape is continually changing between 0 mM and 20 mM, which are the five distinct concentrations. Leucocytes are normally spherical, but as figure 4.2 (a-e) illustrates, when extra Moringa is introduced in soluble form, its characteristics cause it to take on an elliptical shapeseen in figure 2 (a, b).

Table 1: Showing the Diameter of WBCs for Normal blood and Cervics Cancer

Showing the Diameter of WBCs for Normal blood and Disease (cervics cancer)			
Sr.No	Concentration of Moringa Salt (Mm)	Diameter of WBCs for normal Blood(µm)	Diameter of WBCs for (cervical cancer)(µm)
1	0	6.58µm	6.16µm
2	5	9.28µm	8.56 µm
3	10	7.55µm	8.2µm
4	15	9.4 µm	7.3 µm
5	20	7.7 µm	6.1µm

The information provided shows how exposure to different levels of Moringa salt affects white blood cell (WBC) diameter in samples of healthy and diseased blood. At a concentration of 0mMMoringa salt, the diameter of WBCs in normal blood is 6.58 µm; in diseased blood, it is slightly smaller at 6.16 µm. This implies that there are initially a little fewer WBCs in diseased blood than in healthy blood. 5mMMoringa salt is added, the size of WBCs in normal blood increases considerably to 9.28 µm, whereas WBCs in diseased blood likewise rise to 8.56 µm and despite this increase, sick WBCs at this concentration are still less than normal WBCs. At 10mM, the diameter of the normal WBCs was 7.55 µm, which is somewhat less than the 8.2 µm of the sick WBCs but still larger. WBC diameter in normal blood rises to 9.4 µm at 15mM, suggesting that, in most cases, higher dosages of Moringa salt might boost WBC size. However, sick WBCs decrease to 7.3 µm at this dosage, which is closer to their size at 0mM but still larger than at lower doses of Moringa. At a concentration of 20mM, the size of WBCs in healthy blood eventually drops to 7.7µm, while the size of WBCs in ill blood drops to 6.1µm, which is quite close to their size at 0mM. This pattern indicates that extremely high concentrations of Moringa salt can decrease the size of both normal and sick WBCs; yet, diseased WBCs frequently remain smaller than normal WBCs at all tested doses as seen in figure 3 and table.

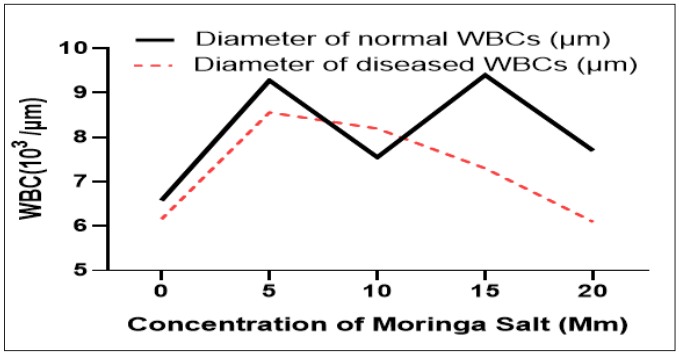


Figure 3: Showing the Diameter of WBCs for Normal blood and Cervical Cancer

Statistical Analysis

The statistical analysis of CBC(complete Blood Count) data is presented in this chapter, with an emphasis on distinguishing between normal blood and blood from patients with cervical cancer. Five different analyte concentrations are analyzed: "0mM, 5mM, 10mM, 15mM, and 20mM". Finding probable Blood abnormalities linked to cervical cancer and comprehending how these abnormalities change with analyte concentration are the goals.

Overview of Data and Methods

We used CBC data from two different sets of patients: those with cervical cancer and those with normal blood samples. Tables and graphs were used in the organization and analysis of the data to identify any noteworthy patterns or discrepancies for each analyte concentration.

CBC of Normal blood parameter under Moringa

This section explores how Moringa affects several CBC measures in healthy blood. The impact of Moringa on the following parameters is examined: WBCs, RCBs, HGB and platelet count. Five different concentrations of Moringa are analyzed: "0mM, 5mM, 10mM, 15mM, and 20mM as shown in table 2.

Table 2: Showing the Normal Blood and Cervical Cancer Blood Parameters under Moringa.

CBC of Normal blood						CBC of Cervical cancer blood					
Sr.No	**Concentration of Moringa mM**	**No. of WBCs 10^3 /µL**	**No. of RBCs 10^6/µL**	**HGB g/dL**	**No. of platelet 10^3 /µL**	**Sr.No**	**Concentration of Moringa mM**	**No. of WBCs 10^3 /µL**	**No. of RBCs 10^6/µL**	**HGB g/dL**	**No. of platelet 10^3 /µL**
1	0	9.2	4.74	13.9	154	1	0	4.4	6.95	19.7	97
2	5	9.8	4.71	13.8	147	2	5	9.6	3.79	9.9	186
3	10	10.2	4.70	13.5	164	3	10	10.1	3.85	10.3	184
4	15	14.7	4.67	13.5	153	4	15	10.0	4.00	10.3	171
5	20	12.0	4.52	13.4	153	5	20	10.5	4.08	10.9	159

An essential component of the immune system's fight against illness and disease are white blood cells (WBCs). Human WBC counts typically range from 4.5-11.0 × 10^3/µL. We looked at the effects of different Moringa concentrations on WBC counts in healthy blood samples. The following concentrations were tested: 9.2×103/µL at 0 mM, WBC count increased to 9.8×103/µL at 5mM, 10.2×103/µL at 10mM, The WBC count shows an important increase at this concentration, increasing to 14.7 × 10^3/µL at 15 Mm and WBC count of 12.0 × 10^3/µL is obtained. The highest WBC count observed in this Moringa research is represented by this numberas shown in table 2 and figure 4(a). Red blood cells or erythrocytes are the cells that are specifically tasked with the role of providing oxygen to tissues in your body. Your tissues release carbon dioxide as oxygen is being converted into energy. Your red blood cells also help in delivering carbon dioxide to your lungs so that it could be exhaled. Normal RBC levels decrease with age, and women characteristically have a

slightly lower RBC count as compared to men. It is also important to state that the range of an RBC count for men is between 4. Undefined 9 x 10^{12} / μL, and in women; it is 3undefined. The RBC counts rise to 4.74 ×10^6/μL upon adding the first concentration of Moringa. As we increase the Moringaconcentration till it reaches 5mM, the quantity of RBCs reduces. As we added more Moringa up to 10mM and reached 4.70 ×10^6/μL, the quantity of RBCs fell. At 15mM it dropped to 4.67 10^6/L. RBC levels at 20mM of Moringa are 4.52×10^6/μLas shown in table 2 and figure 4(b).

HGB normally ranges between 11.5 to16.5 g/dL; the addition of Moringa causes the HGB result to increase to 13.9 g/dL. HGB, on other hand reduced to 13.8 g/dL with Moringa concentration increased to 5mM.Therefore, whenMoringa is administered, up to 10mM, HGB further increases and goes to alevel of 13.5 g/dL. The HGB reading at 15mMMoringa is 13.5 g/dL. When using the maximum dose of Moringa HGB is 13.4 g/dL, substantially larger than 0mM. Therefore, as the concentration of Moringa increased from its inherent to ideal value, we can see a trend of HGB decreasing and then increasingas shown in table 2 and figure 4(d).

Platelets in a human body are in the range of 150-400×10^3/μL; however, this range drops to 154×10^3/μL as soon as we add our first Moringa concentration. Platelets increase to 147×10^3/μL while the Moringa concentration is maintained at 5mM.The number of platelets rise to164 ×10^3/μL at 10mMMoringa concentration and to 153 ×10^3/μL at 15mM concentration. Platelets treated with 20mM of Moringareach a value of 153×10^3/μL. So that's something we can see. The trend is for the platelet count to decline from intrinsic to optimal dosages of Moringaas shown in table 2 and Figure 4(c).

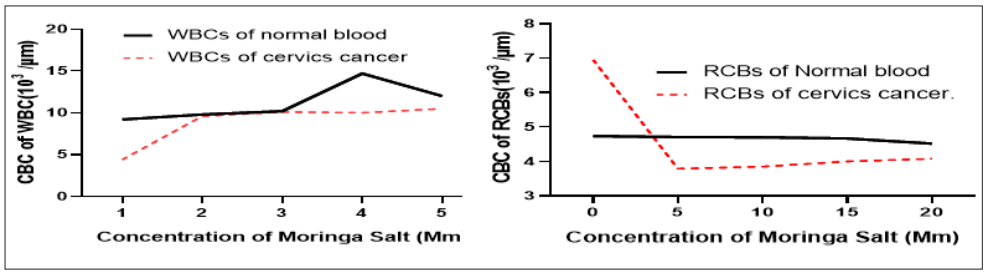
The MCH blood test is one that helps to decide the average size of your red blood cells and sometimes the average mass of the red blood cells. The value of MCH is 29.3pg when the first concentration of Moringa is added to the normal blood sample. Continuing to increase the concentration of Moringa to 5mM, it obtained a MCH value of 29.3pg. The MCH is 28.9pg When Moringa is at 15mM. The MCH count is 29.6pg during peak Moringa function, which is significantly below 10mM. The MCHC blood test analyzes the average size of your Red Blood cell. The value of MCHC is 33.1g/dL, when the first concentration of Moringa is introduced to the normal blood sample. As we continue to raise the amount of Moringa to 5 mM, the MCHC value increased to 33.3g/dL The MCVC decreased to 32.6g /dLat doses of up to 10 mM of Moringa. The MCHC is 32.8g/dL WhenMoringa is at 15 mM. The MCHC count is 33.3g/dLwhen Moringa is at 20mM.The trend is for the MCHC to decline from intrinsic to optimal dosages of Moringa.

CBC of Cervical Cancer Parameter under Moringa

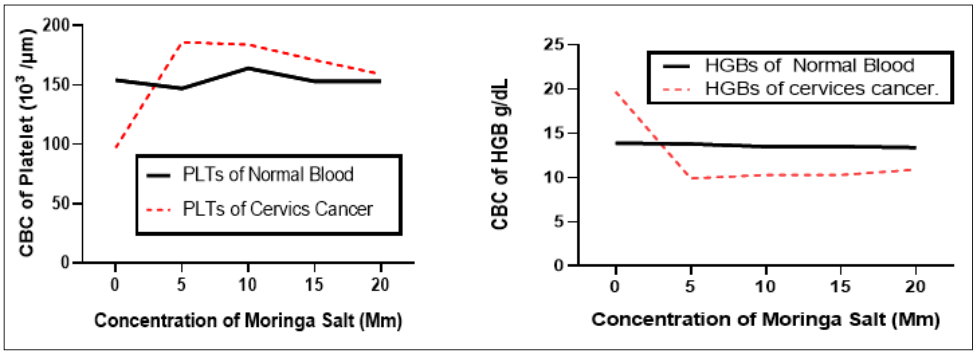
The effects of Moringa at five different concentrations of "0mM, 5mM, 10mM, 15mM, and 20mM" on this quantity are: WBCs, RCBs, HGB, and platelet count and other blood cells will be discussed in greater detail in this sectionas shown in table 2.

When we add our starting concentration of Moringa to a blood sample taken fromcervicalcancer, the outcome increases to 4.4×103/μL. WBC counts increased to 9.6×103/μL as Moringa concentration was increased to 5mM. The number of WBCs increases to 10.1×103/μL, and then we add additional Moringa up to a 10mM concentration. This number then drops to 10.0×103/μL when we add 15mM of Moringa. WBC number stays at 10.5×10^3/μL with 20mM of Moringa. Thus, we can see the growing and then consistent trend of WBCs under rising Moringa concentration from inherent to optimum valueas shown in table 2 and figure 4(a). Red blood cell also known as erythrocytes, function in delivering oxygen to the tissues in your body. Even as oxygen gets metabolized to generate energy, carbon dioxide is released by your tissues. Your Red Blood cell also makes it possible to transfer carbon dioxide to your lunges to be expelled out of the body. Red blood cells count tends to reduce with age, and women generally have a lower RBC rate than men. The RBC counts rise to 6.95×10^6/μL upon adding the first concentration of Moringa. As we increase the Moringa concentration till it reaches 5mM, the quantity of RBCs reduces. As we added more Moringa up to 10mM and reached 3.85 ×10^6/μL, the quantity of RBCs fell. At 15mM it increased to 4.00× 10^6/μL. RBC levels at 20mM of Moringa are 4.08×10^6/μLas shown in table 2 and figure 4(b). The addition of Moringa raises the HGB result to 19.7 g/dL, which is higher than the usual range of 11.5 to 16.5 g/dL. However, when the concentration of Moringa is increased to 5mM, HGB drops to 9.9 g/dL. With more amount of Moringa administered and up to 10 mM, increases HGB more than andto 10.3 g/dL. The HGB reading at 15mMMoringa is 10.3 g/dL. When using the maximum dose of Moringa HGB is 10.9 g/dL, substantially lower than 0 mM. Therefore, if the concentration of Moringa increased from its inherent to its ideal value, the trend of HGB will be decreasing and then increasingas shown in table 2 and figure 4(d).

The range of platelets in the human body is 150 to 400×10^3/L; however, the moment we add our initial concentration of Moringa, this range decreases to 97×10^3/L. The platelet counts increases to 186×10^3/μL while the Moringa concentration stays at 5mM. At 10mMMoringa concentration, the platelet counts increases to 184 ×10^3/L, and at 15mM concentration, it drops to 171 ×10^3/L. After being treated with 20mMMoringa, platelets measure 159× 10^3/μL. That is something that is visible. When using Moringa at optimum doses as opposed to intrinsic levels, the platelet count tends to decreaseas shown in table 2 and figure 4(c). It is possible to assess the size and volume variations of red blood cell by analyzing a blood sample known As RDWor Red blood cell distribution width. When Moringa is given up to 5mM, the RDW value of a normal blood sample reduces to 51.2 % from 51.5% at the initial dosage of the drug. The result continues to climb, reaching 50.8 % when we add an additional 10mM of Moringa. For 15mMMoringa, the RDW value is 52.3%. Even at the maximum dosage of Moringa, RDW is 51.2 %, far from 0mM.Therefore, it is clear that PCV tends to drop and subsequently rise when Moringa concentration rises from intrinsic to optimal value. When our cervical cancer blood sample is given the initial concentration of Moringa, its PDW value is 20.0fL. When we decreased the dose of Moringa to 5mM, PDW decreased to 19.7fL. At a dosage of up to 10mM of Moringa, the PDW value rises to 21.4fL. At 15mMMoringa, the PDW value is 18.2fL. When the maximal concentration of Moringa 24.1fL is reached, the PDW count is much greater than 0mM. Consequently, it is evident that PDW is trending upward and downward from the intrinsic to the optimum concentration of Moringa.Therefore, when the cervical cancer blood sample combined with Moringa starting concentration and the maximal plasma volume number is 12fL.If we raise the dose of Moringa to 5mM, the MPV value same as 0Mm (12.5fL). The MPV value increases as we add more Moringa to 12.7fL up to 10mM. The MPV value of 12.7fL of Moringa at 15mM is given. At the maximum Moringa dosage, the MPV count is 12.3fL, which is far from 20mM. As a result, the tendency of MPV increasing and decreasing between intrinsic and ideal Moringa concentrations is seen.



(A) (B)



(C) (D)

Figure 4: (a-d): Showing the change in WBCs, RCBs, HGB and PLTs under different concentrations of Moringa in Normal blood and cervical cancer.

Muller Matrix Transformation (MMT)

In order to identify the type of the tumors and inform treatment choices, comparing benign and malignant tumors frequently entails examining a variety of tumor features. Muller Matrix Transformation (MMT) is a sophisticated approach for this study that can offer comprehensive insights into the optical characteristics of tissues. When utilizing the Muller Matrix Transformation (MMT) method to distinguish between non-differentiated squamous cell carcinoma (SCC) and cervical polyps, three crucial optical characteristics Depolarization, Retardance, and Anisotropy are often investigated at different light wavelengths. These features can be utilized to characterize the optical behavior of the tissues and to discriminate between benign and malignant tumors. These are the typical variations in these measures between cervical polyps and non-differentiated SCC as shown in figure 5 (a-c).

At 500 nm, the tissue's depolarization value is 0.615825, indicating significant polarization loss and dispersion. At this wavelength, there is very little phase shift shown by the low Retardance of 0.0019081 and low anisotropy of 0.0061968, which both point to a moderately isotropic structure. At 550 nm, depolarization rises to 0.640273, suggesting more scattering; Retardance falls to 0.0014916 and anisotropy similarly drops to 0.00465924, suggesting a rather continuous structure. At 600 nm, depolarization slightly decreases to 0.591603, indicating a little reduction in scattering, but Retardance increases to 0.0037532, indicating a bigger phase shift. Anisotropy noticeably rises to 0.01268773, suggesting more directed features in the tissue architecture. Around 650 nm, anisotropy slightly falls to 0.057126, Retardance to 0.0015168, and depolarization to 0.00531033. These results demonstrate less phase shift and a steadier scattering profile as compared to the wavelength before. Around 700 nm, depolarization remains relatively steady at 0.556201, while Retardance increases to 0.0080176, suggesting a more significant phase shift. Anisotropy noticeably increases to 0.02882388, indicating a higher directional dependency in the tissue's optical properties. At the longest wavelength measured, 750 nm, Retardance decreases to 0.0045219 but depolarization slightly increases to 0.556971. The high anisotropy of 0.01623639 indicates that the structure of the tissue contains persistent directional properties. As 800 nm, Retardance decreased to0.0054135 but depolarization sligtly increased 0.560646 nm, but the anisotropy is 0.01930985.

Depolarization is a measure of how much a substance scatters or depolarizes light; it decreases with wavelength, peaking at 0.9228788 at 500 nm and stabilizing at 0.500859 at 800 nm. This reduction might mean that at longer wavelengths, the material's scattering effects are less noticeable. A less stable Retardance trend demonstrates the phase shift the material introduces. It is somewhat low (0.0021799) at 500 nm, but increases to 0.0031605 at 650 nm, climbs significantly to 0.2518347 at 700 nm, and considerably lowers to 0.0035935 at 800 nm. This pattern, which has a noticeable peak at 700 nm, suggests that the material exhibits varying degrees of phase shift depending on the wavelength. Anisotropy is the degree to which a material's optical properties are directionally dependent; it usually decreases as wavelength increases. At 800 nm, Anisotropy drops from 0.00402349 at 500 nm to 0.01434861. The large peak in anisotropy at 700 nm 0.079348079 indicates that the material's anisotropic features are particularly noticeable at this wavelength, suggesting a substantial shift in the material's optical behavior at this wavelength. With the same amount of light scattering as observed at 750 nm, the depolarization value increases slightly to 0.500859 at 800 nm. Conversely, the Retardance falls off significantly to 0.0035935, which is far less than what it was at 750 nm. This notable decrease implies a reduction in the material's phase shift at 800 nm.Anisotropy at 750 nm is 0.025685616, which suggests that the material's optical properties have a significant degree of directional dependency. This number rapidly decreases to 0.01434861 at 800 nm, indicating a notable decrease in anisotropy.

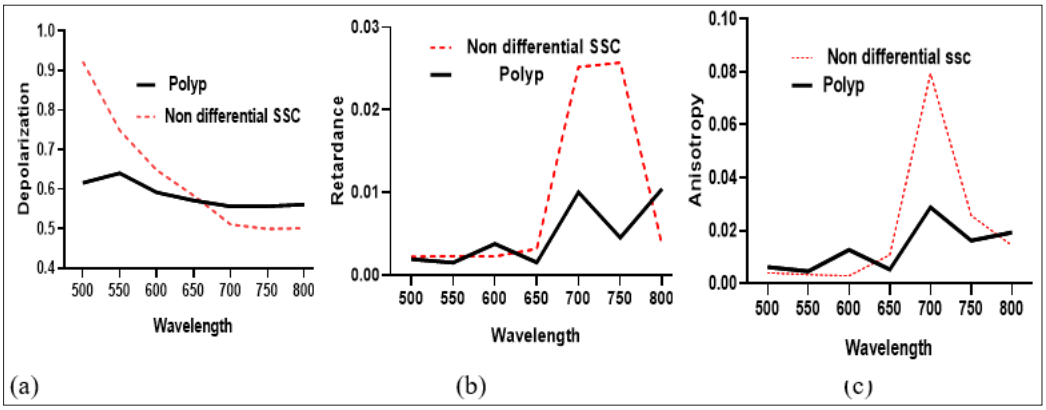


Figure 5(a-c): Demonstrating a change in Depolarization, Retardance, and Anisotropy of Polyp cervicsand non-differentiated squamous cell carcinoma under different wavelength (500 up to 800).

a) Depolarization: At different wavelengths, the benign polyp tissue's depolarization values range from 0.556 to 0.641, showing a pretty steady pattern. These values show a consistent degree of polarization disruption, suggesting a more homogenous structure. The depolarization of the cancer tissue, on the other hand, ranges from 0.499 to 0.923 and is substantially larger. This implies a far greater degree of disruption of polarization, maybe due to the more complex and variable tissue topologies. The decrease in depolarization with increasing wavelength in carcinoma indicates a discernible shift in the optical scattering properties with wavelengthas shown in figure 5 (a).

b) Retardance: The Retardance values in the first dataset are rather low, ranging from 0.0014916 at 550 nm to 0.0080176 at 700 nm. This suggests that a healthy cervix has minimal light phase shift. However, there is a noticeable difference in the second dataset, particularly at 700 nm, where the Retardance approaches 0.2518347. This enormous increase implies that the cancerous tissue significantly alters the phase of light, which may be connected to its complex structural composition and the presence of several cellular componentsas shown in figure 5 (b).

c) Anisotropy: Anisotropy levels for benign tissue are moderate and stable, ranging from 0.0047 to 0.0288. This demonstrates the dispersion properties, which are typically uniform. In contrast, the carcinoma sample exhibits a significantly higher anisotropy; values peak at 750 nm at 0.2569 and 700 nm at 0.7935. These high anisotropy values suggest a significant directional reliance in the scattering, which might be a sign of a more complex and erratic tissue structure in the canceras shown in figure 5 (c).

Conclusion

This study shows that supplementing with Moringa oleifera has a detectable effect on polarimetric optical characteristics and haematological markers in cervical cancer patients. Hemoglobin levels (from 11.2 to 12.7 g/dL), red blood cell counts (from 4.1 to 4.7×10⁶/μL), and platelet levels (from 210 to 255×10³/μL) all improved after therapy in benign instances, suggesting improved hematopoiesis. Similar patterns were seen in malignant patients, where HGB increased from 10.1 to 11.3 g/dL, RBC decreased from 3.8 to 4.3×10⁶/μL, and WBC somewhat decreased (from 10.4 to 8.6×10³/μL), indicating that Moringa has anti-inflammatory and immunomodulatory properties. Increased linear retardance ($\Delta\delta = +0.15$ rad) was found in benign cervical tissues by polarimetric analysis, indicating better stromal integrity or collagen alignment. Depolarisation decreased in malignant tissues ($\Delta\Delta = -0.09$), suggesting a possible decrease in cellular disarray. The haematological result is corroborated by these optical signs, which demonstrate Moringa oleifera's capacity to regulate blood and tissue changes linked to cancer. All things considered, the combination of polarimetric imaging and haematological profiling presents a promising dual-modality method for distinguishing between benign and malignant cervical cancer as well as tracking the therapeutic outcomes of plant-based treatments like Moringa oleifera.

References

1. Grever MR, Schepartz SA, Chabner BA (1992) The National Cancer Institute: Cancer drug discovery and development program. Seminars in Oncology 19: 622-638.
2. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, et al. (2018) Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: A Cancer Journal for Clinicians 68: 394-424.
3. Golan A, Shalev E, Abramovici H (1994) Cervical polyp: Evaluation of current treatment. Gynecologic and Obstetric Investigation 37: 56-58.
4. Levy RA, Vassallo J, Gomes CA, de Oliveira JR, Gurgel M (2016) Cervical polyps: Is histologic evaluation necessary? Pathology-Research and Practice 212: 800-803.
5. Tirlapur SA, Lewis JM, Singh R, Smith P (2010) Clinico-pathological study of cervical polyps. Archives of Gynecology and Obstetrics, 282: 535-538.
6. Gopalan U, Rajendiran S, Karnaboopathy R (2017) Clinicopathological analysis of cervical polyps. International Journal of Reproduction, Contraception, Obstetrics and Gynecology 6: 1526-1530.
7. Nelson AL, Papa RR, Ritchie JJ (2015) Asymptomatic cervical polyps: Can we just let them be? Women's Health 11: 121-126.
8. Gc A (2001) Histologic subtype has minor importance for overall survival in patients with adenocarcinoma of the uterine cervix. Cancer 92: 2471-2483.
9. Pradhan S, Chenoy R, O'Brien P (1995) Dilatation and curettage in patients with cervical polyps: A retrospective analysis. BJOG: An International Journal of Obstetrics & Gynaecology 102: 415-417.
10. Yadav NR, Singh A, Kumar S (2021) Role of a Miracle Tree (Moringa oleifera) in healthcare. Journal of Evolution of Medical and Dental Sciences 10: 1628-1633.
11. Huang W, Li X, Zhang Y, Chen J (2022) Chronic cervicitis

and cervical cancer detection based on deep learning of colposcopy images toward translational pharmacology. Frontiers in Pharmacology 13: 911962.

12. Ferenczy A, Winkler B (1987) Benign diseases of the cervix. In R. Kurman (Ed.), Blaustein's Pathology of the Female Genital Tract. Springer: 158-176.
13. Adegbite O, Oyedapo O, Akinyemi A (2016) Effects of Moringa oleifera leaves on hematological indices in humans. Annals of Hematology and Oncology 3: 1107.
14. Suzana D, Franciscus DS, Azizahwati, Retnosari A, Santi PS, et al. (2017) Effect of Moringa oleifera leaves extract against hematology and blood biochemical value of patients with iron deficiency anemia. Journal of Young Pharmacists 9: S79.
15. Potestà M, Minutolo A, Gismondi A, Canuti L, Kenzo M, et al. (2019) Cytotoxic and apoptotic effects of different extracts of Moringa oleifera Lam on lymphoid and monocytoid cells. Experimental and Therapeutic Medicine 18: 5-17.
16. Araújo LC, Aguiar JS, Napoleão TH, Mota FV, Barros AL, et al. (2013) Evaluation of cytotoxic and anti-inflammatory activities of extracts and lectins from Moringa oleifera seeds. PLoS ONE 8: e81973.
17. Prakash K, Singh R, Sharma P (2023) Super-resolution microscopy: A brief history and new avenues. In Advances in Medical Imaging, Detection, and Diagnosis: 1195-1211.
18. Araki T (2017) The history of optical microscope. Mechanical Engineering Reviews 4: 16-00242.
19. Humphrey JD, Rajagopal K (2002) A constrained mixture model for growth and remodeling of soft tissues. Mathematical Models and Methods in Applied Sciences 12: 407-430.
20. Bouchal P, Bouchal Z (2017) Flexible non-diffractive vortex microscope for three-dimensional depth-enhanced super-localization of dielectric, metal and fluorescent nanoparticles. Journal of Optics 19: 105606.
21. Janjua HU, Akhtar M, Hussain F (2016) Effects of sugar, salt and distilled water on white blood cells and platelet cells: A review. Journal of Tumor 4: 354-358.
22. Imran M, Ullah H, Akhtar M, Sial MA, Ahmed E, et al. (2016). Monitoring of glucose, salt and pure water in human whole blood: An in vitro study. Pakistan Journal of Pharmaceutical Sciences 29: 1237-1242.
23. Akhtar M, Mehmood R, Ullah H, Irfan M (2020) Quality, quantity and hematological disorders in blood under ethanol analyte: An in vitro study. Pakistan Journal of Pharmaceutical Sciences 33: 561-566.