







### 2.13 Mean Filter

One of the simplest linear filters is implemented by a local averaging operation where the value of each pixel is replaced by the average of all the values in the local neighborhood.

$$h[i,j] = \frac{1}{M} \sum_{(k,l) \in N} f[k,l] \quad \rightarrow(1)$$

where  $M$  is the total number of pixels in the neighborhood  $N$ . For example, taking a 3 x 3 neighborhood about  $[i,j]$  yields:

$$h[i,j] = \frac{1}{9} \sum_{k=i-1}^{i+1} \sum_{l=j-1}^{j+1} f(k,l) \quad \rightarrow(2)$$

Now if  $h[i,j] = 1/9$  for every  $[i,j]$  in the convolution mask, the convolution operation in Equation (2) reduces to the local averaging operation shown above.

The size of the neighborhood  $N$  controls the amount of filtering. A larger neighborhood, corresponding to a larger convolution mask, will result in a greater degree of filtering. As a trade-off for greater amounts of noise reduction, larger filters also result in a loss of image detail.

When designing linear smoothing filters, the filter weights should be chosen so that the filter has a single peak, called the main lobe, and symmetry in the vertical and horizontal directions. Linear smoothing filters remove high-frequency components, and the sharp detail in the image is lost. For example, step changes will be blurred into gradual changes, and the ability to accurately localize a change will be sacrificed. A spatially varying filter can adjust the weights so that more smoothing is done in a relatively uniform area of the image, and little smoothing is done across sharp changes in the image.

### 2.14 Median Filter

The main problem with local averaging operations is that they tend to blur sharp discontinuities in intensity values in an image [21]. An alternative approach is to replace each pixel value with the median of the gray values in the local

neighborhood. Filters using this technique are called *median filters*. Median filters are very effective in removing salt and pepper and impulse noise while retaining image details because they do not depend on values which are significantly different from typical values in the neighborhood. Median filters work in successive image windows in a fashion similar to linear filters. However, the process is no longer a weighted sum. For example, take a 3 x 3 window and compute the median of the pixels in each window centered around  $[i, j]$ .

In general, an odd-size neighborhood is used for calculating the median. However, if the number of pixels is even, the median is taken as the average of the middle two pixels after sorting.

## 3. Results and Discussion

The result of electrophoresis in this study shows that the oxidized LDL + VLDL which showed more electrophoretic mobility than native LDL + VLDL. This may be due to the fact that oxidant copper cation has conferred new physicochemical properties on LDL + VLDL by binding to it and increases its negative surface charge and consequently enhanced its electrophoretic mobility (Figure 1).

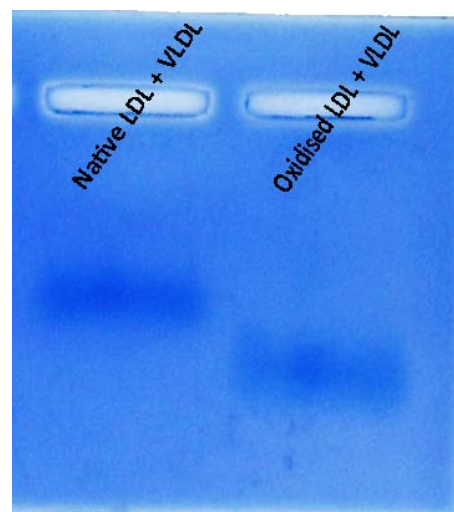


Figure 1: Electrophoretic mobility of Native and Oxidized lipoproteins

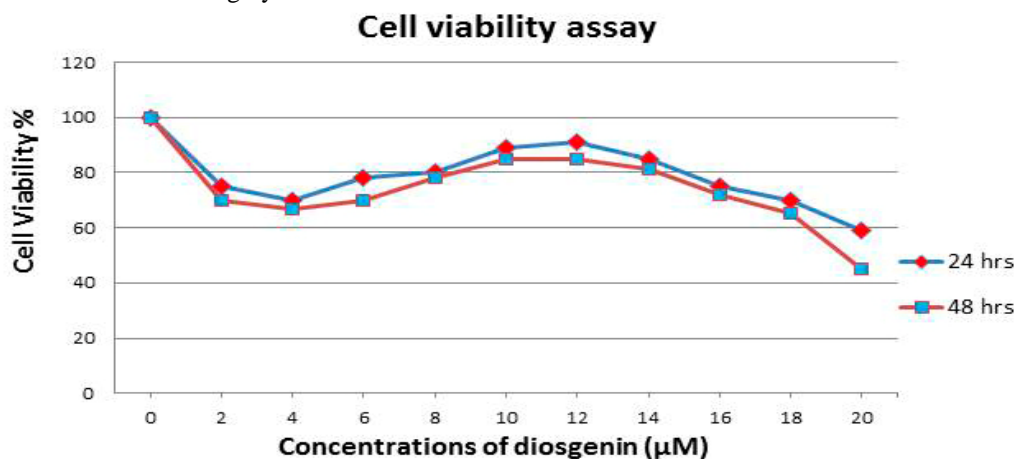
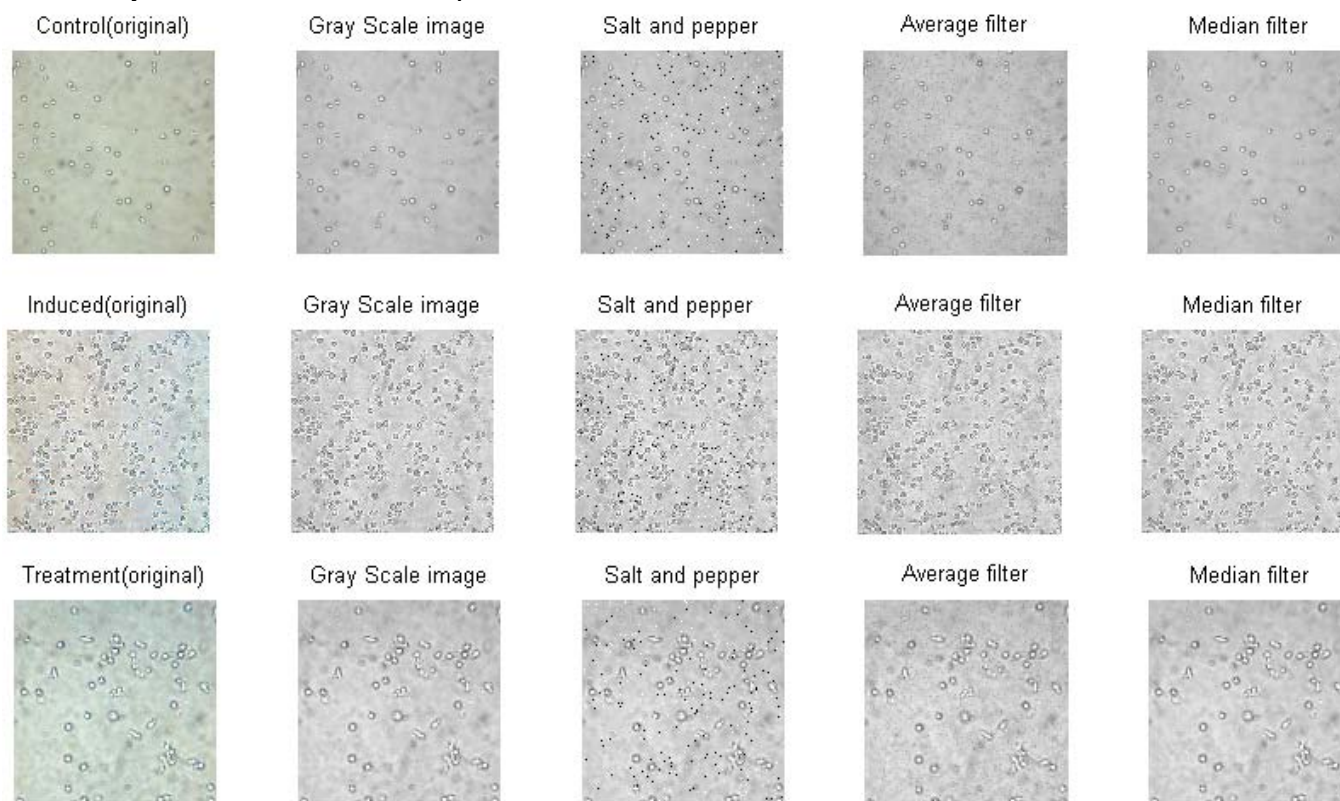


Figure 2: Cell Viability Assay (MTT)

Effect of diosgenin on cell viability is represented by the results of MTT assay (Figure 2). It is suggested that 12  $\mu\text{M}$  of diosgenin was an ideal concentration at which the cell viability was more than 90%. This dosage was used throughout the time period of study. Our findings also coincide with Esfandiarei M, et al [22, 23]. They suggested that over the concentration range of 10-15  $\mu\text{M}$ , diosgenin may provide overall beneficial effects on diseased vascular smooth muscle cells, by blocking migration and contraction without any significant cytopathic effects, implying a potential therapeutic value for diosgenin in vascular disorders. Diosgenin  $\geq 25 \mu\text{M}$  induces apoptosis as measured by the number of annexin V-positive cells and

caspace – 3 cleavages, while decreasing cell viability as indicated by protein kinase B/Akt phosphorylation [24].

Filtering is a very promising algorithm for removing the noise such as speckle noise from cells, cell image. Two filtering techniques namely Averaging filter and Median Filter have been applied for image denoising and enhancement in cells, *in vitro* image. It is noted from the above figure, salt and pepper noise is added to the gray scale image, the median filter gives a better image quality than averaging filter.



**Figure 3:** (a) Original control image with filtering output (b) Original induced image with filtering output (c) Original treatment image with filtering output

Two filtering techniques namely Averaging filter and Median Filter have been applied for image denoising and enhancement in cells, *in vitro* as shown in figure 3. To measure the performance of the noise removal techniques several parameters were used for comparison. The common parameters used for analyzing the present work were signal noise ratio (SNR) and mean squared error (MSE).

**The comparison results of averaging and median filters are summarized in Table 1**

S.No	Filtering Technique	SNR (dB)	MSE
1.	Original image	16.695	811.012
2.	Average Filtering	17.396	799.563
3.	Median Filter	22.120	680.054

Higher the value of SNR and lower the value of MSE of denoised and original image implies that the performance of the denoising filter method and visual quality of the denoised image is good. From Table 1, it is clear that the

Median Filter method shows a better result for noise reduction from cells, *in vitro* image than averaging filter.

#### 4. Conclusion

In this paper, different filtering techniques for removing noises in cells, *in vitro* images have discussed. Furthermore, it has been presented and compared results for the various filtering techniques. The proposed algorithm is tested with various sample images. The results on cells, *in vitro* images indicate that the proposed method is able to enhance the image without noise of background cells. Future work will concentrate on developing an appropriate algorithm to validate the segmentation and image analysis.

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