

“GRAIN QUALITY ANALYSIS USING DIGITAL IMAGE PROCESSING”

A Thesis

*Submitted in partial fulfilment of the requirements for the award of
the degree of*

BACHOLER OF TECHNOLOGY

IN

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SUPERVISOR'S CERTIFICATE

This is to certify that the work reported in the B-Tech. project entitled “GRAIN QUALITY ANALYSIS USING DIGITAL IMAGE PROCESSING”, submitted by Shruti(131076),Prachi Sharma(131081) and Sigma Acharya(131095) at Jaypee University of Information Technology, Waknaghat, India is a bonafide record of their original work carried out under my supervision. This work has not been submitted elsewhere for any other degree or diploma.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

In the present grain-handling scenario, grain type and quality are distinguished manually by visual examination which is tiresome and imprecise. There is need for the growth of fast, correct and objective system for quality check of food grains. So for the grain type recognition and analysis an automated system is introduced. For the purification of the grains we are using color extraction property as attribute. According to the size of the grain core and existence of adulteration, grading of the rice samples was done. Nearly as soon as digital computers became available, it was realized that they could be used to process and extract information from digitalized images. Due to increased expectations in quality food and safety standards there is need of correct grading, sorting of fruits and foods, or agriculture products arises. This is being evaluated through visual examination by human inspectors. This process is tiresome and time consuming. After hours of working the operator may lose concentration which in turn will affect the evaluation process. By this manual activity in terms of returns for their crop the farmers get very much affected. Hence these tasks require automation, so as to have a computer vision system as an alternative to this manual practice. Automated system of sorting food and agriculture products provides fast and hygienic inspection with computer vision. Computer vision and image processing are non destructive, correct and good methods to achieve target of grading. Machine Vision Systems are successfully used for Identification and Categorization of plants, leaves, flowers, bulk grain samples. Considerable design effort is necessary in order to perform this task of pattern recognition by machines. Categorization models were based on morphological features, color features or textural features. The region of interest was selected around the boundary of the edge after isolating the grain. The morphological features were obtained from the binary images containing only pixels of the grain edge. Grain quality is a term that refers to the quality of grain. However, what makes up quality depends on the use of the grain. Quality of grain are affected by several factors which includes, growing practices, time and type of harvesting, postharvest handling, storage management and transportation practices. Grain sorting and detailing system secures that a particular lot of grain meets the required set standard customer. Quality of grains is an important requirement for today's market, to protect the consumers from inferior products. The government imposes price control for necessary items in order to protect the consumers from black marketing and unreasonable prices. As a result some traders immorally release inferior products to the consumer market. Because of such practices there are so many poor quality grains arriving to the market day by day. These grains consist of several adulterants like stones, damaged seeds, more broken granules etc. This is often seen today in rice trade where rice of poor quality is sold without being noted. However, there is no appropriate method to identify these low quality grains in the market. Therefore, this has become a significant issue for both the consumer and the government. Hence an automated Quality analysis of the food grains could be considered helpful.

1.2 MATLAB SOFTWARE

“**MATLAB (matrix laboratory)** is a multi-paradigm numerical computing environment and fourth-generation programming language. A proprietary programming language developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python. In 2004, MATLAB had around one million users across industry and academia. MATLAB users come from various backgrounds of engineering, science, and economics”.

Variables

The assignment operator, = is used to define variables. As MATLAB can be completely converted, it is a weakly typed programming language. It is an inferred typed language because variables can be assigned without mentioning their type, except if they are to be treated as symbolic objects, and that their type can change. Values can come from constants, from computation involving values of other variables, or from the output of a function.

Structures

MATLAB has structure data types. A more adequate name is "structure array", where each element of the array has the same field names since all variables in MATLAB are arrays. Also, MATLAB supports dynamic field names (field look-ups by name, field manipulations, etc.). it is unfortunate that, MATLAB JIT does not support MATLAB structures, therefore just a simple bundling of various variables into a structure will come at a cost.

Functions

The name of the file should match the name of the first function in the file, when creating a MATLAB function file. Valid function names start with an alphabetic character, and can also contain letters, numbers, or underscores. Functions are also often case sensitive.

Function handles

By introducing function handles, or function references, which are implemented either in .m files or anonymous/nested functions, MATLAB supports elements of lambda calculus.

Classes and object-oriented programming

Object-oriented programming including classes, inheritance, virtual dispatch, packages, pass-by-value semantics, and pass-by-reference semantics are supported by MATLAB. However, the syntax and calling protocol are notably different from other languages. Depending on whether the class has *handle* as a super-class (for reference classes) or not (for value classes) MATLAB has value classes and reference classes.

1.3 MATLAB IN DIGITAL IMAGE PROCESSING

Pixel

A **digital** image, I_m , is a mapping from a 2D grid of unvarying spaced discrete points, $\{p=(r,c)\}$, into a set of positive integer values, $\{I_m(p)\}$, or a set of vector values, eg, $\{[R\ G\ B]^T(p)\}$. Each column location of each row in I has a value.

The pair $(p, I_m(p))$ is a pixel.

pixel location indexed by row r and column c is $p=(r,c)$.

value of pixel at location p is $I_m(p)=I_m(r,c)$.

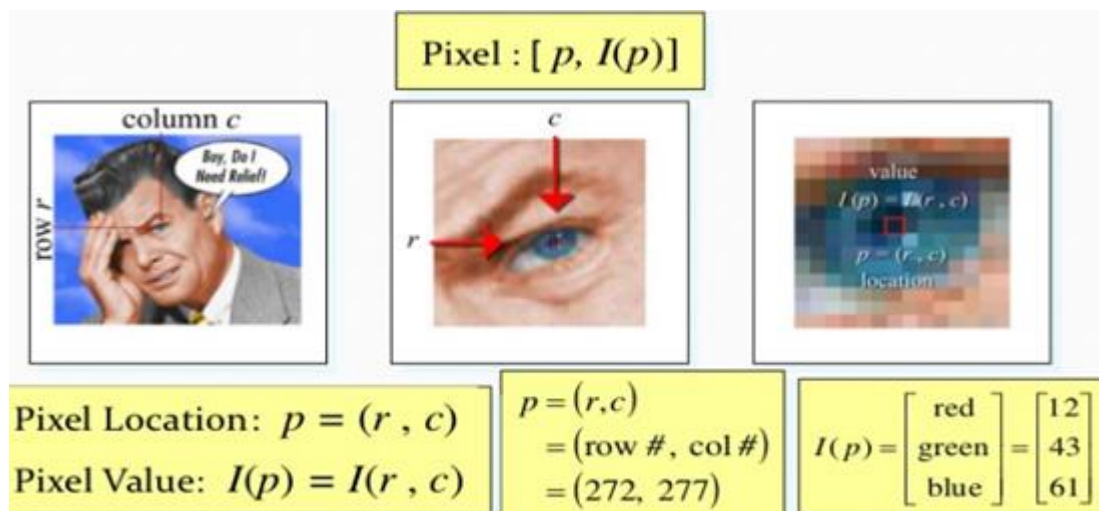
I is monochrome (B&W), if $I_m(p)$ is a single number.

I is colour (RGB) image, if $I_m(p)$ is a 3 element vector.

Monochromatic case:

At each pixel- intensity values are called.

Darker pixel is indicated by smaller intensity and lighter pixel is indicated by bigger intensity.



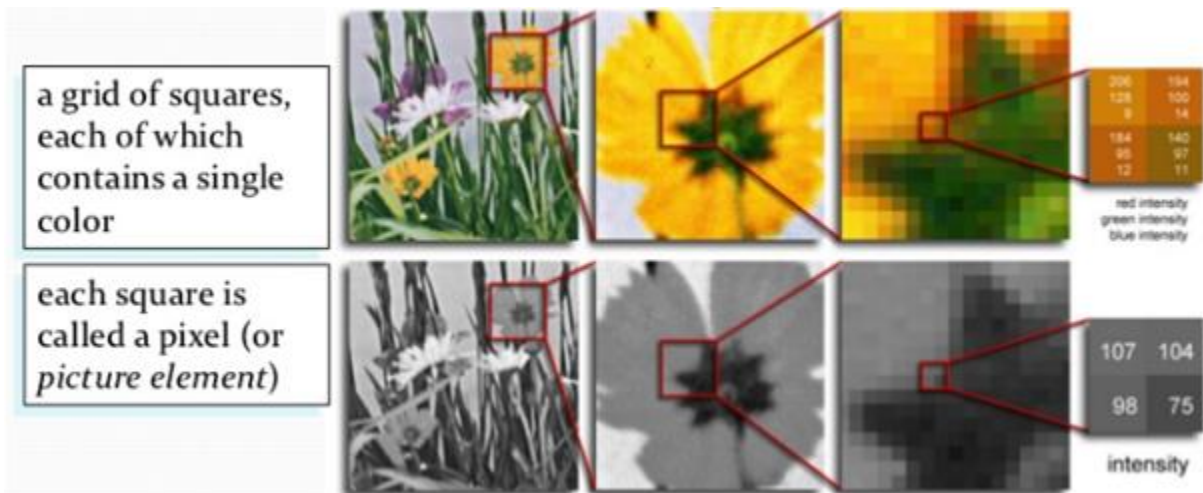
Color case:

If we take a colored image in a 3d matrix it will have three layers first is red, second is green and third is blue.

Why RGB?

According to the Trichromacy Theory All colours found in nature can be decomposed into red, green and blue.

The three element vector tells you how much the pixel is comprised of red, green and blue color.



Neighbours of a pixel:

There are four neighbours (both horizontal as well as vertical) of a particular pixel p which can be determined as:

$(x+1,y)$, $(x-1,y)$, $(x,y+1)$, $(x,y-1)$

These four are the neighbours of a pixel p . There is difference of unit distance between pixel and co-ordinate (x,y) .

The diagonal neighbourhood of a pixel can be represented as follows:

$(x+1,y+1)$, $(x+1,y-1)$, $(x-1,y+1)$, $(x-1,y-1)$

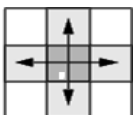
Both the above combine together to form the eight neighbours of a pixel.

Connectivity:

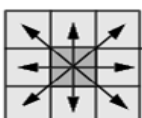
Any two pixels are said to be connected only if a specific criteria (which shows that they are similar) is being satisfied by the grey level and if they both are connected. We can take an example where a binary image is having two pixels having four neighbours but for them to be connected they need to have the same values also.

Types of connectivity:

4-connected: In case the edges of pixels touch they are said to be connected. If the pair of pixels which are adjoined are connected horizontally or vertically then pair is part of the same object.



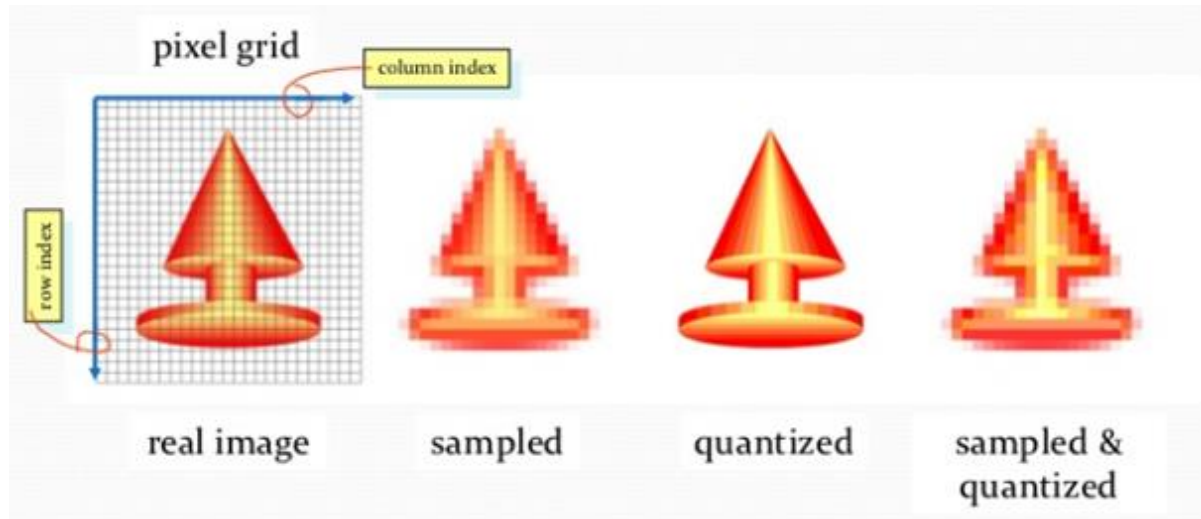
8-connected: If corners of pixels are connected, they are then connected. Any two pixels which are adjoined either connected vertically, horizontally or diagonally, they are part of the same object.



How do digital cameras take images?

Makes use of two techniques sampling and quantization.

Initially we first need to sample the field of view(FoV) than transfer the FoV to a rectangular grid and grab the colour in each location the grid.



Next is the need to quantize the colour.

Reduction of the total number of colours to a smaller amount is done by Quantizing .

When we quantize accurately so that we can't tell much difference between the original image and the quantized one is known as key.

Intensities of digital images are stored as discrete and positive values.

Usually digital images need 8 bits for Black & White and 24 bits for colour(8 bits for each primary colour).

B&W:0 is for Black and 255 is for White.

Colour:0 to 255 for Red,Green and Blue->All integer values

FUNCTIONS USED IN MATLAB

- **imread()** function

Syntax:

```
im=imread('name_of_image.ext');
```

im will contain a 3D matrix of colour values or 2D matrix of B&W values. Matrix corresponds to each pixel in the digital image for Black & White ,or a colour component of a pixel in colour.

- **pix()** function

Syntax:

```
pix=im(row,col);
```

Used for accessing a pixel.

- **imwrite()** function

Syntax:

```
im=imwrite(im,'name_of_image.ext','EXT');
```

Used for saving an image to disk.

- **imhist()** function

Syntax:

```
h=imhist(im);
```

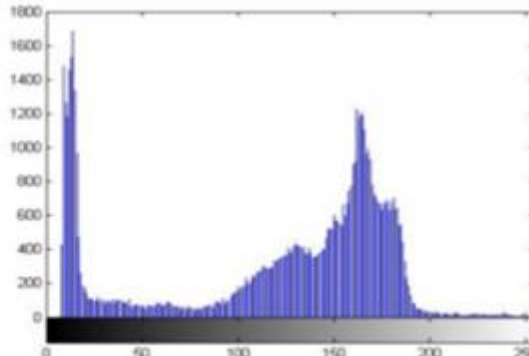
Used for plotting a histogram.

- **regionprops()** function

Syntax:

STATS = regionprops(L,*properties*) for each labeled region in the label matrix L it measures a set of properties.

Example : Let's take a look at an grayscale image



There are ~1500 pixels with a gray level of around 10

There are ~1200 pixels with gray of around 170,etc.

1.4 SEGMENTATION VIA THRESHOLDING

Segmentation is the process of separating objects from background .To make this simpler we convert the image to a Black & White image first if the image is in colour else just leave it. After changing , most of the times the intensities of the object are clearly different from background. We can write code to save pixels that match these intensities and ignore the rest .Pixels that match will be set to white rest black. Output image will be binary image. White belongs to the object and black belongs to the background.

CHAPTER 2

LITERATURE REVIEW

2.1 Quality analysis and grading of rice grain images

Author: Vidya Patil, V.S. Malemath

Summary:

Size has been used as the major factor for the assessment of the quality of the rice grains. Different varieties of rice were considered and based on the parameters like major axis length, minor axis length and area, they were classified as grade 1, grade 2 and grade 3.

2.2 A new technique of quality analysis for rice grading for agmark standards

Author: Priyankaran Tanck, Bipan Kaushal

Summary:

In this paper, digital method for the analysis of rice has been used. MATLAB software has been used for implementation. The assessment of rice has been done on the basis of three parameters, namely, broken rice grains, unwanted particles and blend of different rice grains. The results showed that the three parameters were easily detected by this method.

2.3 An efficient method for the classification of rice grains

Author: Veena. H, Latharani T R

Summary:

Here, an automatic method for the evaluation of rice grains was used wherein only milled rice were taken into consideration. Shape and other geometric features were the basis for the determination of the broken rice grains among the milled rice. The results were used to classify the broken rice kernel

2.4 Classification and quality analysis of food grains

Author: Megha R. Siddagnagappa, A.H. Kulkarni

Summary: This paper has classified rice and pulse grains on various parameters. Shape has been used for the classification of rice grains and color feature was used for the classification of the pulse grains. Three varieties of rice were classified as different grades on the basis of their shape. The different samples of pulse grains were classified on the basis of the impurities present in them.

CHAPTER 3

QUALITY ANALYSIS

3.1 RICE QUALITY ANALYSIS

OBJECTIVE: The key aim is to examine the assorted grains of rice as a superior or an inferior quality. Mixing the superior and an inferior quality, adulterated mixture is formed. This sample is then tested based on a particular threshold value.

EXTENSIVE VARIETIES OF RICE

LONG KERNEL

This variety has an extended kernel with lean shape. The measure of the length is four to five times its width. Distinct, light and fleecy rice are cooked from these kernels

MEDIUM KERNEL

Unlike the long kernels, they have a small and a broad kernel. Length is two times its width. As compared to the long rice, when cooked, they are sticky, wet and slightly raw.

SHORT KERNEL

They are tiny, fleshy and almost circular in shape. They are delicate and extremely adhesive when cooked

3.2 FORMS OF RICE

RUGGED RICE



The shell of the rice holds the rice seed inside. The removal of the shell is an important step before the kernel is cooked or wrapped.

HAZEL RICE



The exterior body removed from the kernel is the Hazel rice. The rice can be consumed as it is or can be granulated to form white rice. Crunchy and crispy rice are cooked from these kernels. The bearing of the bran coating gives the kernels a brown tinge. Abundant nutrition is present in these brown grains of rice.

PULVERIZED RICE



These Kernels are better known as “white” or “polished” rice. The procedure for preparing the kernels is a long one. After the removal of the outer covering, the bran covering is granulated until the grains completely turn white.

STEAMED RICE



Prior to milling the grains, they undergo a steam stress. This condenses the vigor in the grains, and steady, distinct grains are formed as a result. Many people who wish to have fluffy rice prefer steamed rice over others.

READY RICE



Dried up rice after the entire process of granulating is called the “precooked” or ready rice. The time required for preparing the rice is very less i.e. a minute or so.

3.3 METHODS FOR ANALYSIS OF RICE QUALITY

“**Quality** refers to the suitability or fitness of an economic plant product in relation to its end use”. The term quality has different meanings if looked into the seeds from different viewpoints of the seeds, such as growth of the crop, production of the crop, harvest of the crop etc.

CHARACTERISTICS OF THE QUALITY OF RICE

Physical and chemical characteristics of rice together represent the quality of rice grains. These properties may be inherited or acquired properties.

Synthetic properties:

- Gelatinization temperature
- Perceptible enzyme content
- Aroma
- Alkali spreading value

Physical properties:

- Shape
- Size
- Colour of grain
- Chalkiness
- Bulk density
- Thermal conductivity
- Equilibrium moisture content

3.4 PHYSICAL METHODS

Length and width

The grade of the rice can be determined by the length and width of the grains. The classes as specified above: long, medium and short are classified based on the grain length. Arborio rice, followed by short, medium and long rice are classified based on the grain width. The shape and grade of the rice grains are usually determined based on the ratio of these two attributes.

Whiteness and Translucence

The extent of whiteness of the gains range from white to yellow. As the rice grains ripen with time, the grains turn yellow. Yellow rice grains indicate higher protein content. Sometimes, such rice grains increase their tendency to revert cooling, thus changing the cooking properties of the rice altogether. This behaviour of rice arises because of the high protein content.

Translucence defines the extent of transparency of the starch.

Chalkiness

The cloudy area in the rice grains represent the chalky part of the grain. This is the unwanted grain. The deformed fragments of starch with air spaces in between form chalky areas. Chalky areas of the rice grains can be easily differentiated from the transparent areas. The flavour of the two rice grains are easily distinguishable.

Scale	% area of chalkiness
1	less than 10
5	10-20
9	more than 20

Table 3.1 **Percent Area of chalkiness**

$$\% \text{ chalky grains} = (\text{wt. Of chalky grains}) / (\text{wt. Of milled grains} * 100)$$

3.5 CHEMICAL METHODS

Moisture content

To secure the highest production, number of factors play an important role. Moisture content plays an important role in the production of the rice grains. The wetness in the rice grains helps in granulating the grains and thus obtaining the highest yield. The amount of moisture also counts for the quality of the rice grains. The optimum amount of moisture or wetness required in the milling of the rice grains is about 14%. Rice grains bearing a moisture content greater than 14% are soft grains. The soft grains cannot withstand the pressure utmost for the removal of the husk, failing which they tend to break and thus are easily crushed.

Amylose content

Toughness and adhesiveness are the two properties of rice grains which attract customers. These two attributes of the grains are provided by the amylose content present in the kernels. The content of amylose differs for different quality of rice grains.

<u>Category</u>	<u>%Amylose Content</u>
Low	10-20
Intermediate	20-25
High	25-30

Table 3.2 **Percent amylose content**

Gelatinisation temperature

This is the temperature at which the process of cooking starts. The starch in the rice kernels is responsible for the cooking of the rice grains. At this temperature, lucid nature of the starch is lost as it takes in water. Different kinds of rice have different cooking temperatures, based on their characteristics as studied above. Rice granules with a lower gelatinisation temperature are softer when cooked as compared to the ones with higher cooking temperature.

Category	Temp ranges (°C)	Alkali Spread
low	55-69	6-7
Intermediate	70-74	4-5
High	75-79	2-3

Table 3.3 Temperature ranges

Consistency of gel:

It helps in measuring the probability of rice which is cooked to get hardened when it gets cooled down. If we heat a little quantity of rice in alkali (dilute) than we can determine the consistency . This helps in differentiating the consistency of almost 4.5% of paste of milled rice.If cooked rice is hard it simply indicates hard consistency of gel.

<u>Category</u>	Consistency, mm
Soft	61-100
Medium	41-60
hard	26-40

Table 3.4 Consistency of gel

Viscosity:

Viscosity helps in indicating few features of the rice (when it is being cooked).These features of cooked rice can be determined by rice visco analysis which determines if there is change of rice to the slurry and water when test is being conducted.

Texture:

Texture tells us what we feel while we are eating the rice in our mouth: example if the rice is hard and how does it feel while we are chewing, flexibility etc.

Flavour and aroma:

Fragrant rice has two classifications: Basmati and Jasmine. There is a special component in fragrant rice that gives it that particular aroma. There are ways by which the flavour of rice can also be changed example deepening the mill, letting the rice age and storing the rice.

CHAPTER 4

OVERVIEW OF THE PROJECT

Segmentation of image plays an important role in processing of image. Morphological methods can be used for efficiently segmenting an image. There are certain parameters such as width, length which are mostly used for doing this. We used digital image processing for analysing the quality of rice on the basis of two parameters: length and width. We processed the digital images and extracted the morphological features of every grain. We extracted the features: length & width. After extracting the above features we pre-processed the image.

4.1 RELATED WORK

Morphological process is being discussed in this section so that rain can be classified on the basis of different parameters.

Study of shape of a particular object is called Morphology. We can perform different operations using the image which is morphological:

- i. Extraction of an image.
- ii. Filtering of an image.
- iii. Segmentation of an image.
- Iv. Analysis of texture and description of an image.

Image is firstly read from file whenever we use morphological process. Then the opening operation, to get the idea of illumination in the background is performed. To create a more uniform background, subtract the background image, background from the original image. Once subtraction is done, there is uniform background in image. Now binary form of the image is created so that functions can be used in order to get the number of the grains. The function `im2bw` is used so that gray scale image is converted into binary image. Next step is to calculate the threshold which is used for conversion of gray to binary and for that we have `graythresh` function. The size of a particular object determines the perfection of the result on the basis of the size as well as the connectivity by checking if there are any objects in touch of one another so that they are considered one object only. Now we are supposed to computer different parameters of every grain. Firstly, we have to identify the objects which are connected which can be done using label matrix.

Morphological feature extractions:

The features which are extracted from the image are as follows:

Length: Every seed was bounded by a rectangle, the length of that.

Width: Every seed was bounded by a rectangle, the width of that.

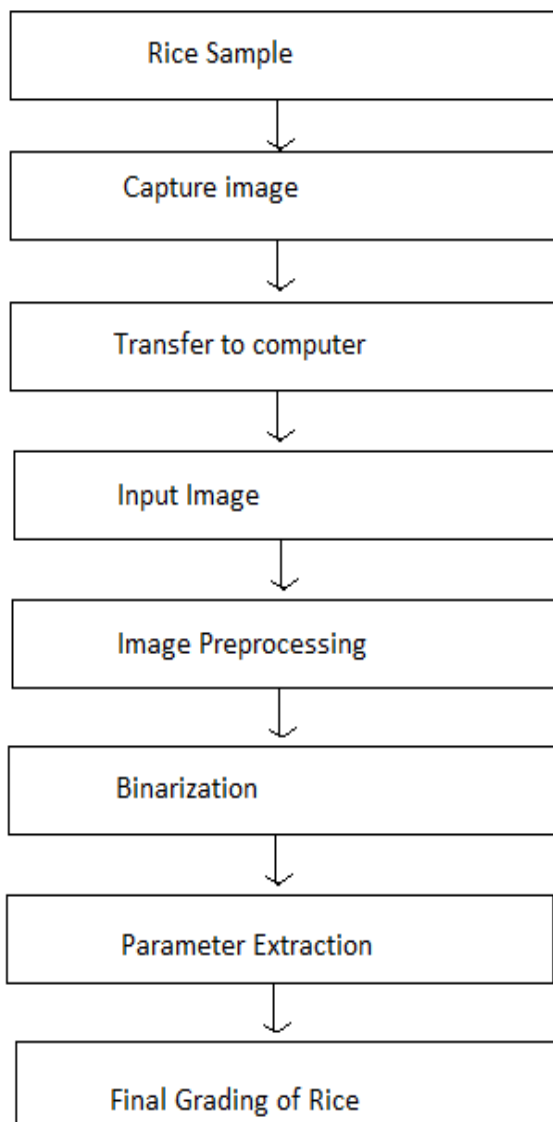
Major axis length: The longest line that was drawn through that particular grain, it is the distance between the two points of that line.

Minor axis length: It is almost same as the major axis length but here we have to make sure that perpendicularity of major axis is maintained.

Aspect ratio: $K1 = \text{Major axis length} / \text{Minor axis length}$.

4.2 METHODOLOGY

Here we took four different varieties of rice which were Basmati, Sela, Parmal and Thick. Parameters like length, width and area were used to grade the grains. First of all we acquired the images with the help of high resolution. By keeping the samples of rice on the paper or any other plain background the images are captured. The position of the camera has to be at normal to the samples. Then the format of image has to be made PNG. For different images a data set had to be created. The flow diagram of entire process of grading of rice grains is given below.



Imread:

It helps in reading the image (either greyscale or colored) and it uses the filename for doing that. There might be a case where the file is not present in the MATLAB path or the currently being used directory, here the pathname has to be specified.

Graythresh:

level = graythresh(I) , this command is used whenever the conversion of an image into binary image has to be done by setting a global threshold level. This threshold value lies between [0,1] and is an intensity value.

Imshow:

This function helps in displaying any image in the figure window of the MATLAB software.

Label matrix:

A matrix is returned by this function bwlabel() known as *label matrix*. Label matrix is a simple image with the size almost same as the input image, here objects have to be differentiated using the integer values (of output image).

bwlabel:

L = bwlabel(BW) , this command is used for retuning the label matrix L containing 8 connected objects (in BW). The size of label matrix L is almost same as that in case of BW.

A label matrix is returned by the function L = bwlabel(BW,n) and here n means the connectivity. [L,num] = bwlabel(____) is used to return the number of objects which are connected.

Connectivity:

Any two pixels are said to be connected only if a specific criteria (which shows that they are similar) is being satisfied by the grey level and if they both are connected. We can take an example where a binary image is having two pixels having four neighbours but for them to be connected they need to have the same values also.

Imcrop:

We use this function whenever we want to take out a rectangular part of a particular image. Here using this function, region to be cropped can be specified with the help of mouse or using the programme (mentioning the size and the position).

Regionprops:

graindata = regionprops(labeled,*basic*) this function is used when a collection properties of region that is labelled is to be measured. In the label matrix L , different regions are represented by positive integer elements.

Regionprops can compute many properties, some of them are given below. First of all, image is read, than connected componenets are found with the function bwlabel. We can measure the properties with the help of the labelled matrix.

Example:

```
A= [0 1 1 0
    1 1 0 0
    1 1 1 1]
```

Finding the Area:

- In a matrix, the number of ones represent that what is the number of ON pixels. Here in this example, they are 8.

Finding the Centroid:

- Finding the columns and the rows which are having value of pixel as one.
- Example `.[row,column]=find(label==1)`

Row = [1 1 2 2 3 3 3 3]

Column = [1 1 2 2 2 3 3 4]

Then mean of the row and column with value 1 had to be found.

To find the Bounding Box:

- Four points are needed, width, length and starting points.
- The starting points x and y are given by subtracting 0.5 from min. value of columns and the rows.
- Subtracting 0.5 from 1 gives us 0.5 that is min. value of row.
- Subtracting 0.5 from 1 gives us 0.5 that is min. value of row.
- Breadth of the box is given by subtracting min. value of column +1 from max value of column.
- Max value of the column is four (4).
- Subtracting min value from max value of column gives us 3+1
- Length of box is given by subtracting min. value of row + 1 from max value of row.
- Subtracting the min value from max value gives us 2+1.

MajorAxisLength – It is scalar; it is the length that is in pixels of the major axis having same second moment . Only 2-D input label matrices support this property.

MinorAxisLength– It is scalar; it is the length that is in pixels of the major axis having same second moments. Only 2-D input label matrices support this property.

Mean:

Mean of the field is calculated using these.

CHAPTER-5

EXPERIMENTAL INVESTIGATION

5.1 FOUR VARIETIES OF RICE

1)Basmati Rice



Original Image



Binarized Image

Rice Grain	Length	Width
1	55.58	13.1
2	56.73	13.99
3	57.25	15.65
4	49.59	16.14
5	63.37	15.91
6	53.92	15.11
7	50.45	15.25
8	50.88	15.53
9	48.15	13.25
10	57.98	14.98
Mean	54.79	15.89

Table 5.1.1 Basmati rice

The mean length of Basmati rice is :**54.79**

The mean width of Basmati rice is :**14.89**

2)Sela Rice



Original Image



Binarized Image

Rice Grain	Length	Width
1	47.88	14.8
2	42.3	13.66
3	55.15	11.7
4	46.78	16.2
5	52.47	15.83
6	45.97	12.88
7	41.18	16.78
8	52.85	13.63
9	60.71	10.95
10	49.58	15.39
Mean	49.49	14.18

Table 5.1.2

Sela rice

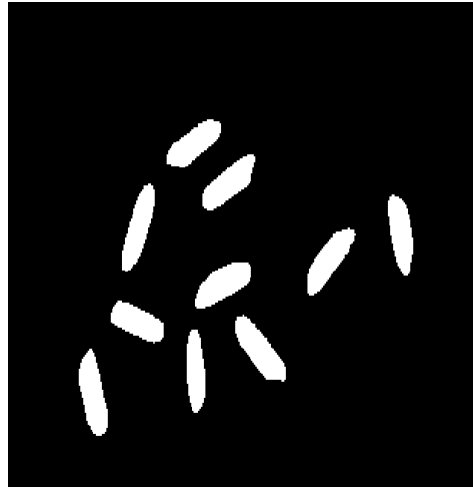
The mean length of Sela rice is:**49.49**

The mean width of Sela rice is:**14.18**

3)Parmal Rice



Original Image



Binarized Image

Rice Grain	Length	Width
1	48.67	13.04
2	33.99	15.14
3	51.36	11.6
4	37.11	14.66
5	45.32	10.72
6	37.37	16.13
7	40.35	14.67
8	43.48	14.45
9	43.69	13.44
10	44.49	12.06
Mean	42.58	13.59

Table 5.1.3 Parmal rice

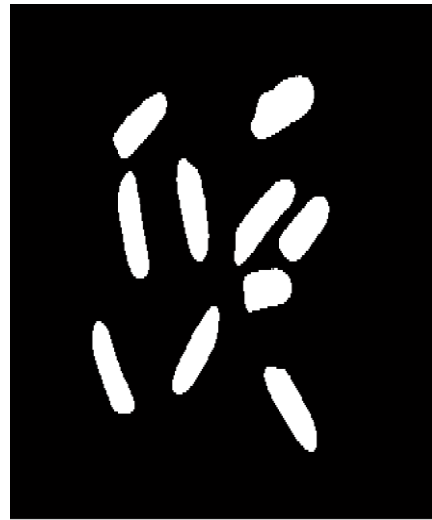
The mean length of Parmal rice is:**42.58**

The mean width of Parmal rice is:**13.59**

4)Thick Rice



Original Image



Binarized Image

Rice Grain	Length	Width
1	51.17	15.07
2	42.48	16.14
3	53.6	15.59
4	50.09	14.99
5	50.51	16.94
6	55.57	16.43
7	33.67	18.96
8	45.5	21.24
9	50.74	16.12
10	40.28	17.82
Mean	47.36	16.93

Table 5.1.4 Thick rice

The mean length of Thick rice is:**47.36**

The mean width of Thick rice is:**16.93**

5.2 MIXED VARIETY

Mixture of Sela and Thick rice

1) Mixture of two Thick grains in eight Sela grains



Rice Grains	Length	Width
1	54.79	16.93
2	49.24	15.02
3	51.26	17.09
4	42.41	12.34
5	51.74	11.84
6	51.69	16.93
7	50.8	16.86
8	43.69	17.85
9	41.51	14.89
10	51.57	12.53
Mean	48.86	15.23

Table 5.2.1 Two Thick in Eight Sela grains

2) Mixture of Three Thick grains in Seven Sela grains



Rice Grains	Length	Width
1	54.13	15.28
2	47.5	14.75
3	50.1	14.52
4	49.89	16.02
5	47.16	12.62
6	53.01	13.89
7	44.4	15.12
8	44.45	15.78
9	48.33	16.15
10	48.78	12.61
Mean	48.78	14.72

Table 5.2.2 Three Thick in Seven Sela grains

3) Mixture of Four Thick grains in Six Sela grains



Rice Grains	Length	Width
1	52.7	15.38
2	39.84	15.89
3	48.72	14.24
4	40.83	14.41
5	56.72	13.74
6	45.47	15.74
7	60.54	10.06
8	42.44	16.13
9	50.07	12.39
10	35.86	18.62
Mean	47.32	14.61

Table 5.2.3 Four Thick in Six Sela grains

4) Mixture of Five Thick grains in Five Sela grains



Rice Grains	Length	Width
1	49.68	14.07
2	41.89	16.96
3	36.88	13.24
4	44.2	15.11
5	47.76	11.94
6	51.45	13.81
7	45.43	12.75
8	39.09	15.83
9	39.66	14.21
10	43.05	16.16
Mean	44.91	14.41

Table 5.2.4 Five Thick in Five Sela grains

MIXTURE OF BASMATI AND THICK RICE

1) Mixture of One Thick Rice in Nine Basmati Rice



Rice grains	Length	Width
1	63.18	14.48
2	55.38	14.93
3	56.44	14.25
4	52.35	12.62
5	53.05	9.15
6	47.98	14.68
7	53.57	11.56
8	45.88	14.86
9	44.61	10.42
10	53.36	9.76
Mean	52.58	12.67

Table 5.2.5 One Thick in Nine Basmati grains

2) Mixture of 2 Thick Rice in 8 Basmati Rice



Rice grains	Length	Width
1	54.57	13.25
2	47.67	14.43
3	38.02	11.58
4	61.55	14.63
5	53.96	12.28
6	51.76	12.35
7	52.09	11.77
8	52.44	13.72
9	53.26	9.46
10	45.72	16.11
Mean	51.1	12.96

Table 5.2.7 Two Thick in Eight Basmati grains

3) Mixture of Three Thick Rice in Seven Basmati Rice



Rice grains	Length	Width
1	56.32	12.63
2	53.8	14.86
3	35.55	12.56
4	53.3	12.37
5	54.36	10.16
6	47.22	14.53
7	53.53	13.82
8	46.15	15.73
9	46.41	12.68
10	52.25	13.74
Mean	49.89	13.31

Table 5.2.7 Three Thick in Seven Basmati grains

4) Mixture of Four Thick grains in Six Basmati grains



Rice grains	Length	Width
1	44.06	13.32
2	35.52	12.72
3	42.28	11.85
4	39.52	15.3
5	50.03	10.78
6	49.53	13.19
7	50.96	13.48
8	50.88	14.58
9	54.14	9.9
10	42.59	15.74
Mean	45.95	13.09

Table 5.2.8 Four Thick in Six Basmati grains

5)Mixture of Five Thick grains in Five Basmati grains



Rice grains	Length	Width
1	40.99	12.29
2	48.82	12.47
3	47.45	11.6
4	35.78	10.85
5	50	10.39
6	47.05	12.83
7	51.03	9.63
8	43.04	13.09
9	42.86	12.51
10	27.63	13.15
Mean	43.47	11.88

Table 5.2.9 Five Thick in Five Basmati grains

MIXTURE OF BASMATI RICE AND PARMAL RICE

1)Mixture of One Parmal rice in Nine Basmati Rice



Rice grains	Length	Width
1	51.36	14.44
2	56.87	13.1
3	66.04	13.67
4	58.43	11.6
5	54.01	16.01
6	55.51	14.53
7	54.7	11.97
8	54.39	13.87
9	51.38	11.78
10	43.29	14.41
Mean	54.6	13.54

Table 5.2.10 One Parmal in Nine Basmati grains

2) Mixture of Two Parmal rice in Eight Basmati Rice:



Rice grains	Length	Width
1	44.31	13.99
2	52.97	11.7
3	55.06	13.42
4	52.38	13.17
5	55.27	14.98
6	60.13	11.53
7	55.73	14.58
8	62.99	14.49
9	57.98	13.79
10	39.95	11.75
Mean	53.68	13.34

Table 5.2.11 Two Parmal in Eight Basmati grains

3) Mixture of Three Parmal rice in Seven Basmati rice:



Rice grains	Length	Width
1	44.93	16.19
2	51.46	14.93
3	56.3	14.5
4	46.12	18.42
5	52.68	14.49
6	55.67	16.51
7	56.15	16.5
8	39.65	14.89
9	51.14	17.14
10	35.43	13.21
Mean	48.95	15.68

Table 5.2.12 Three Parmal in Seven Basmati grains

4)Mixture of Four Parmal rice in Six Basmati rice:



Rice grains	Length	Width
1	38.32	12.03
2	44.87	11.19
3	46.6	12.17
4	44.64	11.71
5	51.66	12.57
6	50.94	11.55
7	48.12	13.022
8	45.01	13.4
9	39.07	11.87
10	58.82	11.45
Mean	44.5	12

Table 5.2.13 Four Parmal in Six Basmati grains

5)Mixture of Five Parmal rice in Five Basmati rice:



Rice grains	Length	Width
1	38.76	9.91
2	44.96	9.89
3	49.82	10.56
4	40.39	9.99
5	47.55	12.09
6	51.31	12.31
7	41.58	11.91
8	40.29	12
9	36.79	12.68
10	35.04	11.29
Mean	42.65	11.26

Table 5.2.13 Five Parmal in Five Basmati grains

CHAPTER 6

ANALYSIS OF THE GRAINS

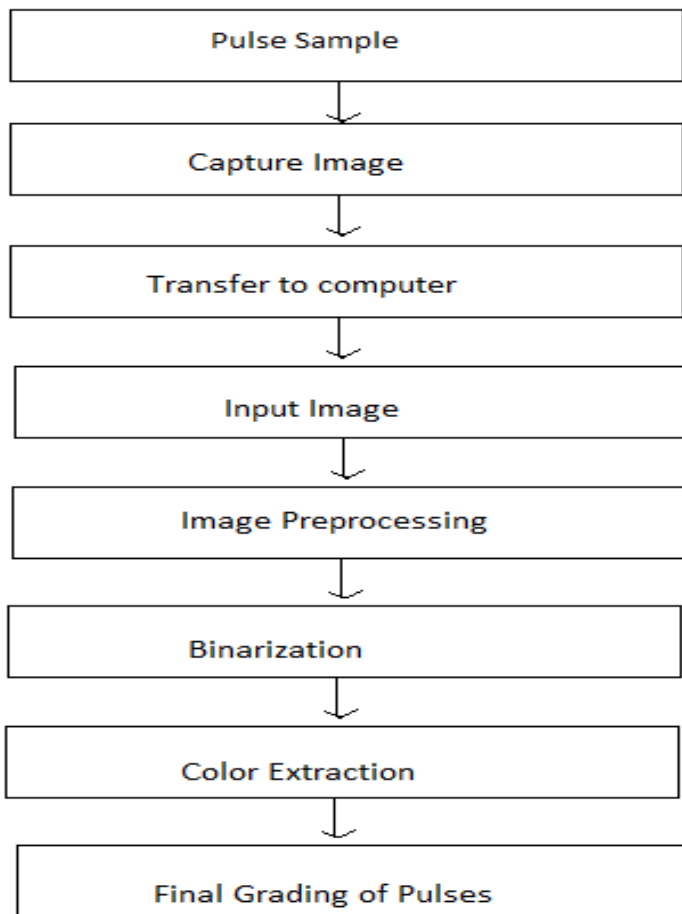
6.1 OBJECTIVE

Color has been used as the basic tool to identify the various grains for their impurities. For implementation, we have considered 3 different types of grains-grams, chana dal ,malka dal. The impurities present in the grain can be easily identified based on color feature. We have fixed the distance of the digital camera to click the photographs and then the various operations on these photographs are performed.

6.2 METHODOLOGY

CLICKING THE PHOTOGRAPH

The foremost step is to click a decent photograph of the sample, making sure that the distance between the camera and the sample remains fixed for all the samples. The lighting conditions should be such that not a single beam of light should brighten the background. It is mandatory to keep the background black. Brightness in the background destroys the entire image ,since all the pixel values play an important role in the photograph. We have captured images of three pulses-white grams ,malka dal and chana dal following the rules of fixed distance. The camera used has a resolution of 8 megapixels. We clicked the photographs in a room , avoiding direct sunlight and also covering the parts receiving too much white light. All the grains are so placed that no grain touches the other. Al the samples are photographed following the same rules and avoiding any kind of error. After editing the pictures in paint ,they have been converted from JPEG format to PNG format.



WHITE GRAMS



CHANA DAL



MALKA DAL



PEPROCESSING OF THE IMAGE

To make sure that the image is ready for all the operations to be performed on it, certain methods are imposed on the picture. This is called preprocessing of the image. After converting the image to grayscale, binarization is performed.

BINARIZATION

An image represented with only two binary values-0 or 1 is a binary image. The grayscale image is converted to binary image using a threshold value. Based on the threshold value, grayscale image is converted into two parts of pixels. Two levels of gray values are created because of the threshold value-one above the threshold and the other below it. The threshold is chosen such that the binary image is a clear one.

FEATURE EXTRACTION

This process provides us with the qualitative information of the objects in the images. Color, geometrical and texture features can be easily extracted from the images. In this method we have extracted 3 color features-Red, Green and Blue.

COLOR FEATURES

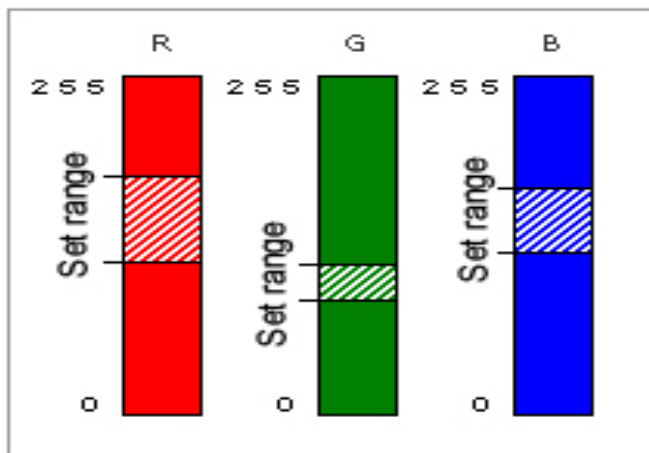
Color has been used as the primary attribute for the classification of the samples. We have extracted three color features from the captured image, i.e. the mean values of the RGB colors.

6.3 COLOR EXTRACTION

A pre-processing method which is used for any coloured image is colour extraction. This process separates some specific colours from all the other colours in an image which was captured. Any original image always contained the content of information as 256 tones as in 8 bits and the three colours and different number of pixels, N extracted image on the other hand contains only 2 tones and the number of images.

RGB Method:

The RGB method was developed when the commercialization of colour image processing systems started taking place. In this method, there is a range which is set for RGB signals and the colours are extracted which fall in that range. Here similar way as is used for monochrome is applied to RGB which are the three colours red, green and blue. But if there is any change in brightness or illumination, this method is affected directly.



CHAPTER 7

Experimental Investigation of pulse grains

1) White grams

ORIGINAL IMAGE



REDBAND



GREENBAND



BLUEBAND

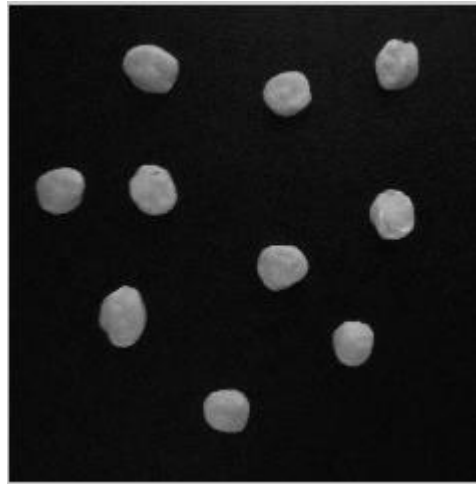


2)Chana dal

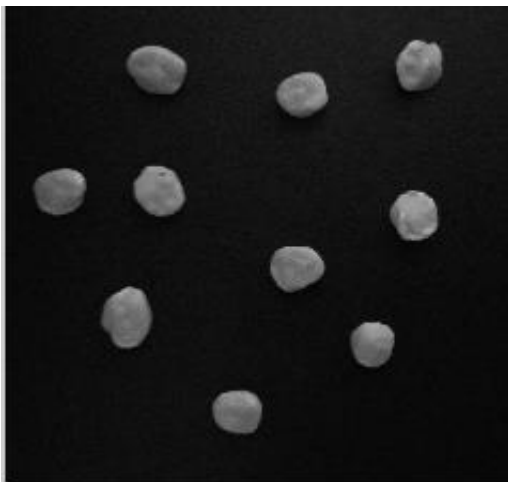
ORIGINAL IMAGE



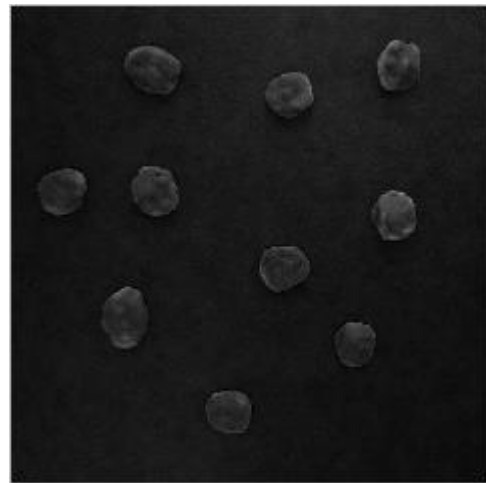
REDBAND



GREENBAND



BLUEBAND

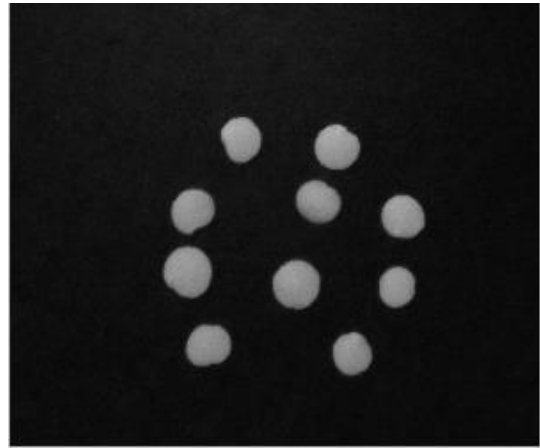


3) Malka Dal

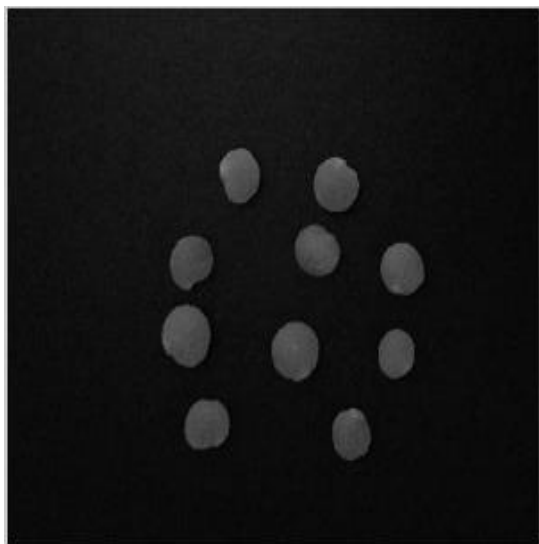
ORIGINAL IMAGE



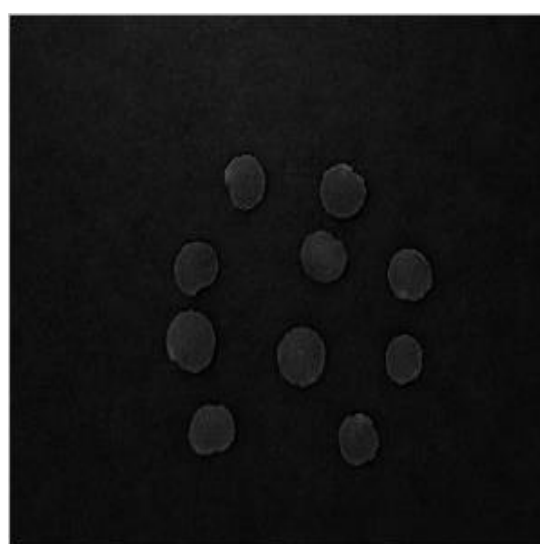
REDBAND IMAGE



GREENBAND IMAGE



BLUEBAND IMAGE

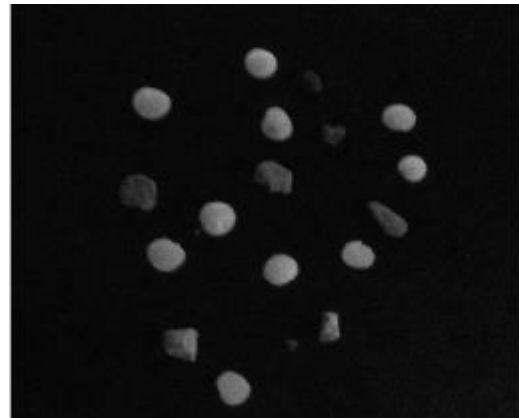


3) Mixing impurities in malka dal

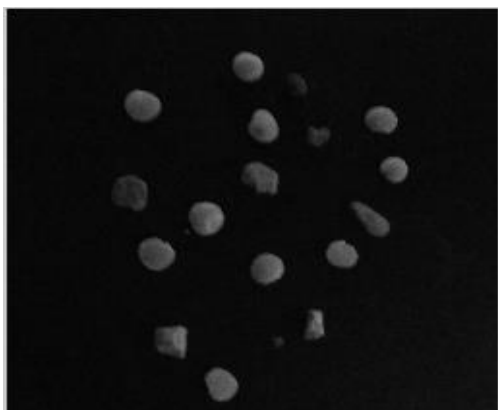
ORIGINAL IMAGE



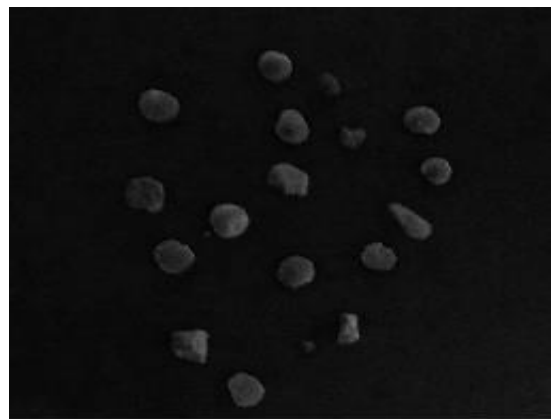
REDBAND



GREENBAND



BLUEBAND

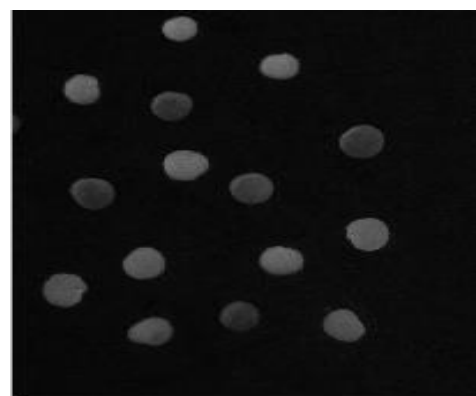


4) Impure Sample

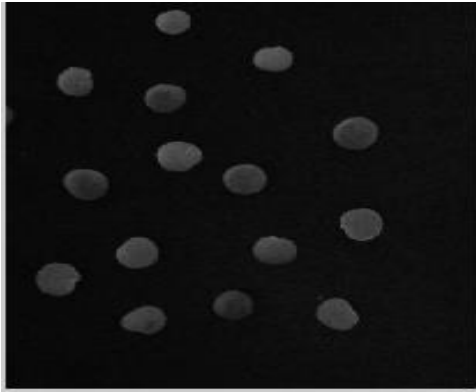
ORIGINAL IMAGE



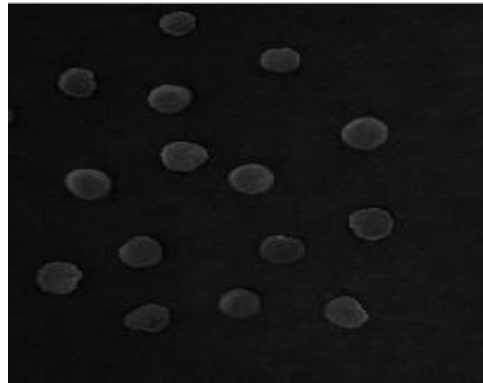
REDBAND



GREENBAND



BLUEBAND



CHAPTER 8

RESULTS AND DISCUSSION

8.1 FOR RICE

Rice Variety	Length	Width
Basmati	54.79	14.89
Sela	49.49	14.18
Parmal	42.58	13.59
Thick rice	47.36	16.93

Table 8.1.1 Rice varieties

We can see from the table that Basmati rice and sela rice are good quality and Parmal rice and thick rice are the worst quality.

Mixture of basmati and thick rice grains

S.NO.	Mixed grains	Length
1	1 in 9	52.58
2	2 in 8	51.1
3	3 in 7	49.89
4	4 in 6	45.95
5	5 in 5	43.48

Table 8.1.2 Mixture of Bsmati and Thick grains

On the basis of the information computed in the table, we can see that the average length is decreasing on adding thick rice grains (poor quality) in Sela rice grains (good quality). Average length of sela rice is 49.49 pixels. If it decreases it means adulteration has occurred and if the length decreases below the threshold i.e. 47.36 pixels, then the mixture is unacceptable and is highly adulterated. Adding 4 or more thick rice grains makes the mixture highly adulterated.

Mixture of basmati and parmal rice grains

S.No.	Mixed grains	Length
1	1 in 9	54.6
2	2 in 8	53.68
3	3 in 7	48.95
4	4 in 6	44.5
5	5 in 5	42.65

Table 8.1.3 Mixture of Basmati and Parmal

On the basis of the information computed in the table, we can see that the average length is decreasing on adding thick rice grains (poor quality) in Sela rice grains (good quality). Average length of basmati rice is 54.79 pixels. If it decreases, it means adulteration has occurred and if the length decreases below the threshold i.e. 47.36 pixels, then the mixture is unacceptable and is highly adulterated. Adding 4 or more thick rice grains makes the mixture highly adulterated.

8.2 FOR PULSES

IMPURITIES MIXED

It can be easily interpreted from the images that the impurities present in the mixture can be easily differentiated from the pulse grains from their color. The color of the pulses in the redband is brighter than those of the impurities present. In the greenband, the pulses can be easily differentiated from the impurities present. Similarly in the next sample, the impurities can be easily differentiated based on their color. Redband and greenband provide a clear vision of the impurities present in the sample.

8.3 CONCLUSION

- On the basis of the result computed, we can say that one sample of the thick rice mixed with sela rice is adulterated.
- Two samples of Thick rice mixed with Basmati rice are adulterated.
- Two samples of Parmal rice mixed with Basmati rice are adulterated.
- On the basis of the results computed, we can say that color feature can be easily used to differentiate impurities from the pulse grains.
- Different images of impure samples easily show that color of the impurities are darker than the pulse grains.

8.4 REFERENCES

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REMARKS