



**yuva**kshētra<sup>®</sup>

Institute of Management Studies (YIMS)  
Ezhakkad, Mundur, Palakkad - 678631, Kerala.

ACCREDITED BY NAAC WITH B+ GRADE (1<sup>st</sup> CYCLE)

Affiliated to the University of Calicut & Managed by the Diocese of Palghat

**DEPARTMENT OF COMPUTER SCIENCE**

# ICACRI

**INTERNATIONAL CONFERENCE FOR ADVANCED  
COMPUTATIONAL RESEARCH AND INNOVATIONS**



**2024**

**VOLUME I , ISSUE I**

**CONFERENCE PROCEEDINGS**

English Language  
Title of the Book : International Conference for Advanced Computational Research and Innovations (ICACRI - 2024)  
Editor : JIBIN JOY  
Published by : Yuvakshetra Institute of Management Studies  
Address : Ezhakkad, Mundur, Palakkad, 678600  
Rights Reserved  
First Edition : FEBRUARY 2024  
Cover Design : JIBIN JOY  
Printed at : Jim Offset, Palakkad  
Publishers : Yuvakshetra Publications, Ezhakkad, P.O, Mundur, Palakkad  
E mail : yimspublication@yuvakshetra.org,  
: yuvakshetra@gmail.com  
Website : www.yuvakshretra.org  
Tel : 9400012368, 8714345789  
Distributors : Yuvakshetra Publications, Ezhakkad, P.O, Mundur, Palakkad  
E mail : yimspublication@yuvakshetra.org,  
: yuvakshetra@gmail.com

No part of this publication may be reproduced or transmitted in any form or by any means without prior written permission of the author.

ISBN : 978-81-968246-5-5.

## IMAGE PROCESSING TECHNIQUES IN DETERMINING THE QUALITY OF TEA

**C M Sulaikha,**

Research Scholar, Department of Computer Science  
Sri Krishna Arts and Science College, Coimbatore

**Dr. A SomaSundaram**

(Assistant Professor, Department of Computer Applications, Sri Krishna Arts and  
Science College, Coimbatore)

### **Abstract:**

For the past 100 years, the tea process is largely controlled by hand-made interventions and the color of the tea leaves (both finished and mid-process) play a key role in the process efficiency, quality measurement and dissolving classification. tea. The development of digital image processing techniques has been successfully used to assess tea quality . Key components of the research include image segmentation, feature extraction, and classification. Image segmentation techniques are employed to separate individual tea leaves from the background, providing a basis for subsequent analysis. Feature extraction involves quantifying visual attributes, such as color intensity, texture patterns, and leaf morphology. The significance of this research lies in its potential to revolutionize the traditional methods of tea quality assessment, offering a more objective, efficient, and automated approach. The developed image processing techniques not only provide a reliable means of determining tea quality but also pave the way for real-time quality monitoring in tea production processes. This research contributes to the broader field of food quality assessment and sets a precedent for the application of image processing in the context of agricultural products

### **Introduction:**




Tea is one of the most popular and lowest cost beverages in the world [1]. Currently, more than 3 billion cups of tea are consumed every day worldwide. This popularity is attributed to its health benefits, which include prevention of breast cancer [2], skin cancer [3], colon cancer [4], neurodegenerative complication [5], prostate cancer [6], and many others. Tea is also attributed to the prevention of diabetes and boosting metabolism [7]. Depending on the manufacturing technique, it may be described as green, black, oolong, white, yellow, and

compressed tea [8]. Black tea accounts for approximately 70% of tea produced worldwide. The top four tea-producing countries are China, Sri Lanka, Kenya, and India.

Black tea is the only tea variety that is fully oxidized. The process involved in producing black tea may vary from country to country and even from region to region. The taste and aroma of black tea are achieved during fermentation. Oxidation of polyphenolic compounds in tea leaves to theaflavin and thearubigins results in discoloration and enhancement of taste. In the process of fermentation the tea leaf particles are spread into small layers under cool, moist air and left to oxidize for 50 - 80 minutes.

There are six steps to producing black tea. The process begins with plucking green tea, in which two leaves and a twig are the standard. The next step is to wither, when the tea leaves are placed on the bed you have in order to lose moisture. Then there is the cutting, tearing, and folding process, in which the tea leaves are cut and shredded to open to release oxidation. The fermentation phase is when the tea reacts with oxygen to produce compounds that are responsible for the quality of the tea. The heat is transferred to the tea in the drying stage to remove moisture. The final step is to filter the tea into categories according to their quality. In these steps, fermentation is very important in determining the level of tea produced.

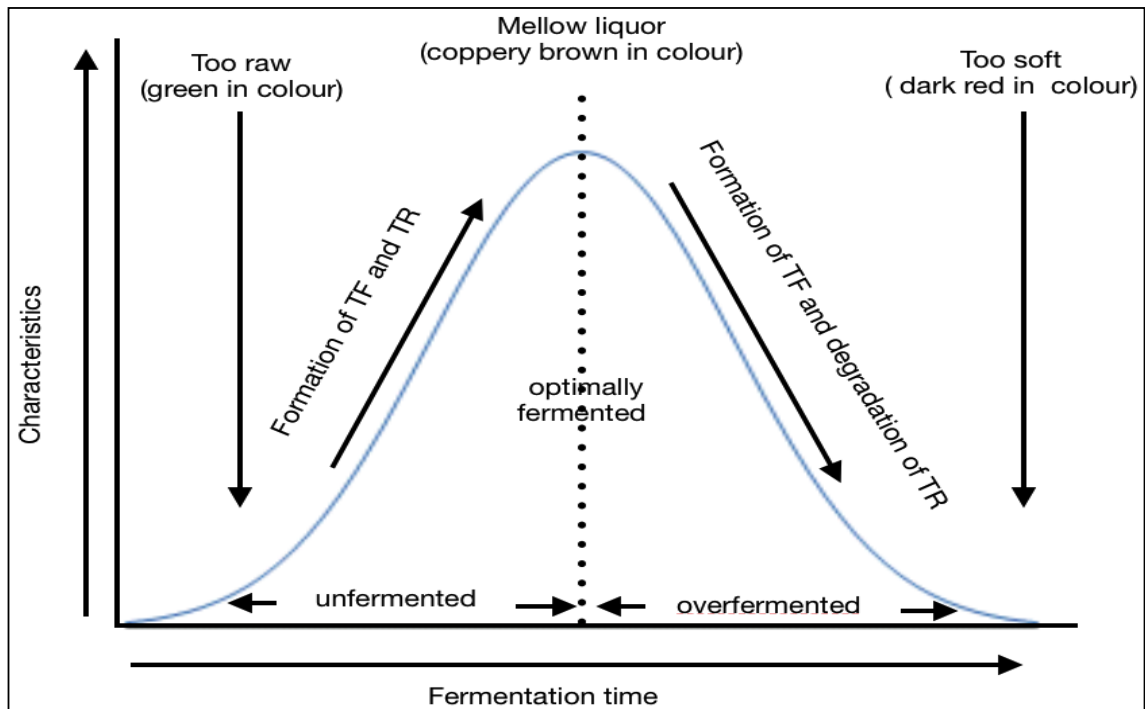
<b>Step:1</b>		<b>Plucking</b>
<b>Step:2</b>		<b>Withering</b>
<b>Step:3</b>		<b>Cut Tear and Curl</b>

Step:4		Fermentation
Step:5		Drying
Step:6		Sorting

**Figure: 1 Steps in Tea processing**

### **Fermentation:**

The fermentation process begins when cells of ruptured tea leaves react with oxygen to produce two compounds: Theaflavins (TF) and Thearubins (TR) [10,11]. Theaflavins are responsible for the brightness and briskness of the tea liquor while TR is responsible for the color, taste, and body of tea [11]. During fermentation, the following parameters must be maintained: temperature, relative humidity, and time [10]. The optimum temperature under which fermentation should take place should be approximately 25 °C. The ideal humidity should be approximately 42% [12]. Fermentation is a process that is timely in the beginning, the alcohol is green and has a raw texture. The formation of TF and TR increases over time until complete maturation is achieved. At the right time for fermentation, the alcohol becomes softer and brighter. This is the desired point in fermentation. After a good fermentation period, TR formation decreases and TF degradation begins. This stage is excessive fermentation, in which the alcohol is soft and dark.



**Figure:2: Quality of Tea Fermentation**

Currently, tea tasters determine optimum fermentation manually by either of the following methods: smell peaks, color change, infusion, or tasting of tea.

### **Problem Statement:**

At present, complete fermentation of tea is obtained by the taste buds using any of the following methods: to monitor the color change of the tea as fermentation continues to taste and to smell the tea as fermentation progresses. These handmade methods are inaccurate. As a result, they lead to a reduction in the quality of the tea. This study identified an improved point of the fermentation stage by applying a color change to a tea leaf without disturbing the person. So it will get the prepared temperature, humidity, fermentation time and oxidation rate. This study will help predict Tea marks after the fermentation phase. Images of tea granules in the dry-out phase are analyzed and sorted based on their color, texture, size, texture, moisture and density. The machine vision technique offers the researcher another non-invasive method that has a purpose different from the normal way to use a human sensory panel that was highly compatible and plagued by human variability.

The main issues required to be addressed by this work include:

- Determination of size, shape, texture, etc. of granules of tea non-destructively by machine vision for assessment of tea grade.
- Determination of colour of brewed tea liquor for assessment of grade.
- Measurement of moisture and density of various grades of tea for grade discrimination.
- Development of a classifier followed by statistical validation of results.

### Proposed Methodology:

The "fermentation process" plays an important role in determining the quality and taste of black tea. The method used in many tea factories to determine the duration of fermentation is to use the physical eye of an experienced worker. However, color acquisition will vary from person to person. Therefore, tea leaves can sometimes be stored ripe or less. A calculation method is proposed for this project in order to determine the quality of the fermentation process. The proposed method is based on image processing techniques using the MATLAB software. The proposed system will only require a photo of the tea particles. Therefore, the methodology consists of three main steps; pre-image processing, segmentation, feature extraction and editing.

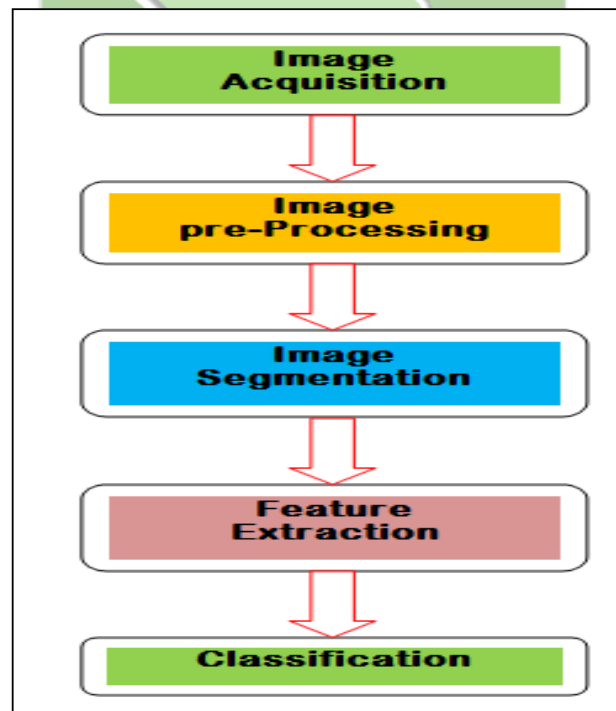


Figure:3: Proposed General research Flow

### **Phase: I: Image Acquisition:**

Images collected during the tea fermentation process were the first input process. Images are collected using the Canon -650D model with 18 megapixel camera. Hand-operated camera mode is used where the ISO value is 400, shutter speed 1/250 Sec, and 36 mm focus time set. White balance is set manually. A light box is used for taking pictures to maintain a controlled environment.

### **Phase:2: Image Pre-Processing:**

The captured image samples of tea contained with irrelevant area. In order to further analyze the image, the region needed for analyzing was extracted from the original image samples. Then it was resized to 1024 x 1024 pixel size in order to lower the processing time. MATLAB software was used in this project for image processing. The image captured may include shadow areas. In order to remove shadow regions, a threshold value was set to 0 and 1 (white 1, black 0) based on trial and error. This step enhanced the image quality significantly.

### **Phase:3: Image segmentation:**

The tea grains were segmented in this phase for better analysis and classification of tea type based on the quality.

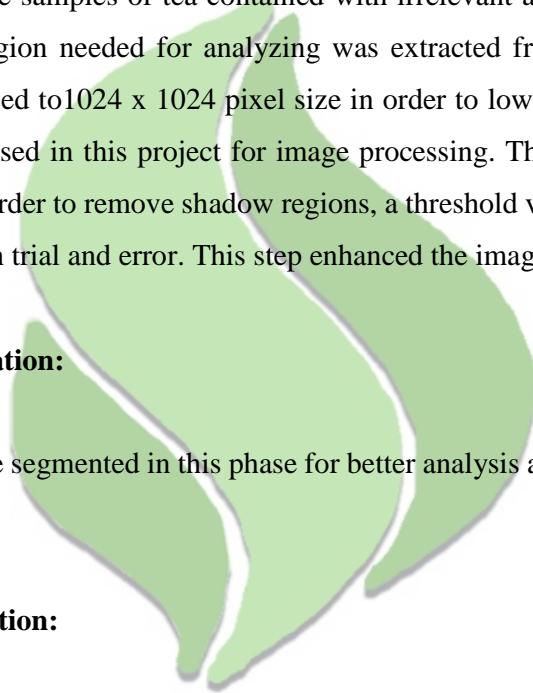
### **Phase:4: Feature Extraction:**

The features of the segmented regions are extracted in this phase. The texture and color feature are extracted. Maximum the feature extracted better the accuracy in classification.

### **Phase:5: Image Classification:**

The quality of the tea fermentation is classified based on the features that were extracted. The performance of the classifiers are measured using the performance metrics like precision, recall, and so on.

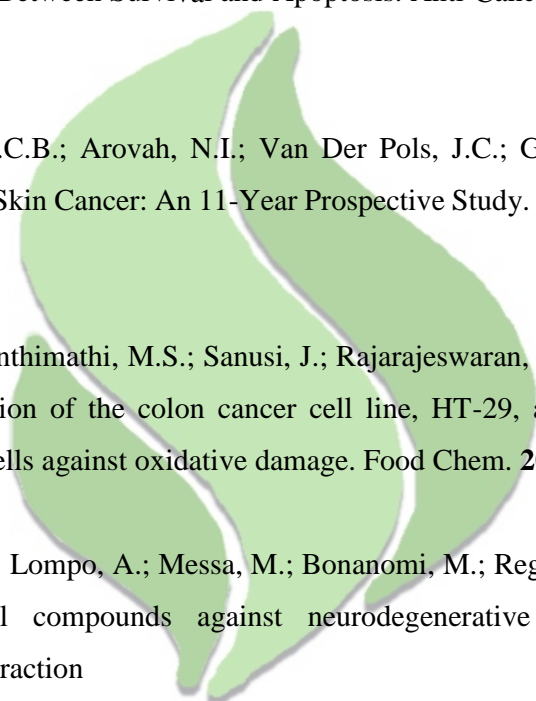
### **Conclusion:**



The current paper explains the general details of the Image processing steps involved in identifying the quality of tea fermentation process. The proposed research work gives solution for errors in manual grading of tea fermentation.

### References:

1. Sigley, G. Tea and China's rise: Tea, nationalism and culture in the 21st century. *Int. Commun. Chin. Cult.* **2015**, 2, 319–341.
2. Yiannakopoulou, E. Green Tea Catechins: Proposed Mechanisms of Action in Breast Cancer Focusing on the Interplay Between Survival and Apoptosis. *Anti-Cancer Agents Med. Chem.* **2014**, 14, 290–295.
3. Miura, K.; Hughes, M.C.B.; Arovah, N.I.; Van Der Pols, J.C.; Green, A.C. Black Tea Consumption and Risk of Skin Cancer: An 11-Year Prospective Study. *Nutr. Cancer* **2015**, 67, 1049–1055.
4. Hajiaghaalipour, F.; Kanthimathi, M.S.; Sanusi, J.; Rajarajeswaran, J. White tea (*Camellia sinensis*) inhibits proliferation of the colon cancer cell line, HT-29, activates caspases and protects DNA of normal cells against oxidative damage. *Food Chem.* **2015**, 169, 401–410.
5. Sironi, E.; Colombo, L.; Lompo, A.; Messa, M.; Bonanomi, M.; Regonesi, M.E.; Salmona, M.; Airoidi, C. Natural compounds against neurodegenerative diseases: Molecular characterization of the interaction of catechins from green tea with Ab1-42, PrP106-126, and ataxin-3 oligomers. *Chem. A Eur. J.* **2014**, 20, 13793–13800.
6. Gopalakrishna, R.; Fan, T.; Deng, R.; Rayudu, D.; Chen, Z.W.; Tzeng, W.S.; Gundimeda, U. Extracellular matrix components influence prostate tumor cell sensitivity to cancer-preventive agents selenium and green tea polyphenols. In *Proceedings of the AACR Annual Meeting 2014*, San Diego, CA, USA, 5–9 April 2014; American Association for Cancer Research (AACR): Philadelphia, PA, USA, 2014; p. 232.



7. Lazaro, J.B.; Ballado, A.; Bautista, F.P.F.; So, J.K.B.; Villegas, J.M.J. Chemometric data analysis for black tea fermentation using principal component analysis. In AIP Conference Proceedings; AIP Publishing LLC: Melville, NY, USA, 2018; Volume 2045, p. 020050.
8. Saikia, D.; Boruah, P.K.; Sarma, U. A Sensor Network to Monitor Process Parameters of Fermentation and Drying in Black Tea Production. *MAPAN* **2015**, 30, 211–219.
9. [https://www.cdac.in/index.aspx?id=pe\\_aee\\_Agri2](https://www.cdac.in/index.aspx?id=pe_aee_Agri2)
10. Jayabalan, R.; Malbaša, R.V.; Lončar, E.S.; Vitas, J.S.; Sathishkumar, M. A Review on Kombucha Tea-Microbiology, Composition, Fermentation, Beneficial Effects, Toxicity, and Tea Fungus. *Compr. Rev. Food Sci. Food Saf.* **2014**, 13, 538–550.
11. Jolvis Pou, K. Fermentation: The Key Step in the Processing of Black Tea. *J. Biosyst. Eng.* **2016**, 41, 85–92.
12. Asil, M.H.; Rabiei, B.; Ansari, R. Optimal fermentation time and temperature to improve biochemical composition and sensory characteristics of black tea. *Aust. J. Crop. Sci.* **2012**, 6, 550–558.

