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Food Non-Destructive Quality Evaluation Using Color Image Analysis System

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ABSTRACT

Quality inspection of food and agricultural product are difficult and labor-intensive. Simultaneously, with increased expectations for food products of high quality and safety standards, the need for accurate, fast and objective quality determination of these characteristics in food products continues to grow. However, these operations generally in Cameroon are manual which is costly as well as unreliable because the human decision in identifying quality factors such as appearance, flavor, nutrient, texture, is inconsistent, subjective and slow. Machine vision provides one alternative for an automated, non-destructive and cost-effective technique to accomplish these requirements. This inspection approach based on image analysis and processing has an important place in the food industry. The application of color image analysis system, in this case, shows clearly that all the food product studied here were discriminated over 95%.

Key words: Assessment, Food Products, Images Analysis.

1. INTRODUCTION

The developments in the technology, media and communication accompany the increasing awareness of consumers. Therefore, there are more expectations than ever before. This situation forces the manufacturers to produce and present higher quality of food and agricultural products on the market. Moreover, these products have to satisfy sophisticated desires of the consumer. Computer imaging system is one of the methods serving to the assurance of high quality food products [1]. Quality itself is defined as the sum of all those attributes which can lead to the production of products acceptable to the consumer when they are combined. Quality has been the subject of a large number of studies. The basis of quality assessment is often subjective with attributes such as appearance, smell, texture, and flavor, frequently examined by human inspectors. Consequently we found that human perception could be easily fooled. Together with the high labor costs, inconsistency and variability associated with human inspection accentuates the need for objective measurements systems [2]. However, the old fashion techniques are time consuming, destructive and unable to represent the whole batch [3]-[4]. Product quality is evaluated by a wide range of parameters including the external and the internal. However, in some cases, sensory and safety scores gain higher importance than the one above. External quality parameters, such as surface color, texture, presence of bruises and defects, are generally monitored and sorted manually by workers, whereas the internal quality parameters including firmness, pH value, soluble solid contents and titratable acidity are evaluated using common techniques. Sensory (e.g. sweetness, flavor) and food safety (e.g. pathogenic bacteria and fecal contamination, pesticide residues and other hazardous residues) characteristics influence general palatability of the products [5].

Computer vision systems includes the capturing, processing and analyzing images, facilitating the objective and nondestructive assessment of visual quality characteristics in food products. Unlike to traditional ones, Computer vision

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systems do not cause any damage on/in the product and they are rapid analysis techniques as well as being feasible for in-line process. Being another advantage, these systems in this extent can be easily implemented for any analysis of an individual object and/or a batch of food and agriculture products, like intact fruits, even as they are on the yards. Against the traditional techniques, intensity of the analyzed feature in a bulk is possible to figure out by imaging systems. Moreover, these systems also provide opportunity to perform rapid, hygienic, automated and objective inspections [6].

This paper presents some color features extractions using an image analysis system and the classification of the different food products which were studied here.

2. MATERIAL AND METHODOLOGY

2.1. Material

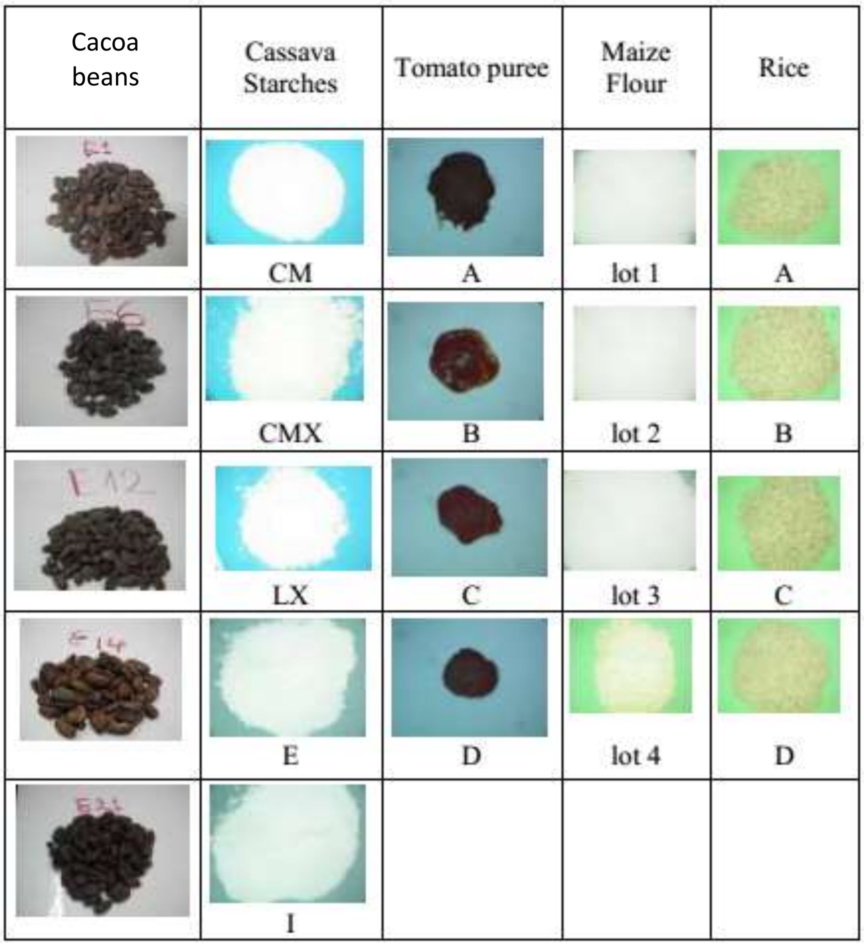

Fig. 1. Samples of food used in this work.

Food product using in this work are presented in Figure 1. This materials is composed of 21 varieties of cacoa beans numbered E1 through E21, 16 samples of cassava starches, 04 different samples of tomato puree, 04 batches of maize flour and 04 varieties of Cameroonian rice. The 21 varieties of cacoa beans were apportioned between the five ranking groups such as: best fermented, over-fermented, violet, slate and mouldy. All these food products were selected in this work because they are a significant impact on the local economy in Cameroon.

2.2. Methodology

In this paper, image of the different samples food products are analyzed by image analyzing techniques to find the quality classification. The Different samples of our food products are collected for analysis and the following steps, shown in figure 2, are to be followed.

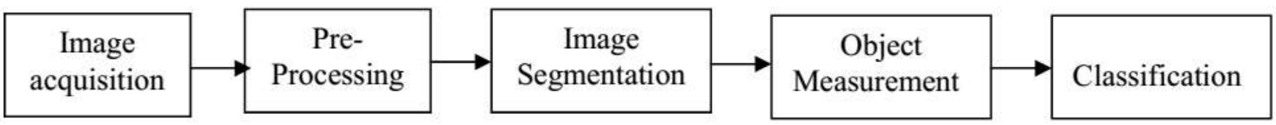

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Fig. 2. Configuration of our common image analysis system applied [7].

The acquisition image was done using the system developed by [3]. The three steps such as Pre-processing, image segmentation and object measurement have been done on the menu of plugins that we have developed using Image software. The acquired images in the RGB color space will be preprocessed and segmented in same space RGB [12]. However, the extraction attribute, which represent the step of object measurement, will be performed in the both L*a*b* and HSV color spaces [9], [11], [14]. For each image pretreated and segmented, the color features such as: value, chroma and hue angle have been calculated. The value represents the mean value of the luminance component L*. The chroma and the hue angle are defined as [16]:

$$Chroma = \sqrt{a^2 + b^2} \quad (1)$$

$$Hue\ angle = Actan\left(\frac{b}{a}\right) \quad (2)$$

The classification method, so as it, was performed using the software data analysis Statgraphics. We perform the classification method from the techniques of classification developed by [8] and [17].

3. Results and discussion

3.1. Colorimetric features of the Cameroonian rice

The table 1, presents the colorimetric features extracted from the images of the Cameroonian rice products.

Table 1: Colorimetric features of Cameroonian rice

Samples	Value	Choma	Hue angle
A	81.073[b]	33.533[b]	119.504[c]
B	85.175[d]	30.907[a]	115.891[a]
C	80.085[a]	33.818[b]	115.435[a]
D	83.557[c]	31.462[a]	116.868[b]

The results obtained show that the 04 varieties studied are ranked in 04 different classes of rice varieties. The classification of rice using images analysis system was reported by [10], [15] with a classification rate respectively of 91% and 86%. Our results confirm as so as the results reported by these two authors.

3.2. Colorimetric attributes of cacoa beans

The table 2 presents the colorimetric features extracted from the images of cacoa beans.

Table 2: Colorimetric features of cacoa beans

Samples	Value	Chroma	Hue angle
Best fermented	24.544[a]	28.509[e]	53.976[c]
Over-fermented	27.557[b]	3.662[a]	54.951[c]
Violet	45.649[e]	6.440[b]	-69.668[b]
Slate	42.949[d]	14.011[c]	-86.807[a]
Mouldy	39.472[c]	14.970[d]	87.518[d]

The results obtained show clearly that the 21 varieties were ranked successfully in the five groups of cacoa beans types,

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with a classification rate of 100%. This result is conformed to the result reported by [10] who show that the classification rate of the images of corn, rice and wheat using image analysis system are ranging from 90% to 100%.

3.3. Colorimetric features of cassava starches

The table 3 presents the colorimetric features of cassava starches.

Table 3: Colorimetric features of cassava starches

Samples	Value	Chroma	Hue angle
CM	99.158^{l}	0.823^{a}	130.679^{a}
CMX	98.271^{k}	2.296^{b}	133.750^{b}
LS	99.492^{m}	0.394^{a}	128.878^{a}
A	91.198^{a}	9.064^{h}	168.409^{f}
B	95.078^{fgh}	4.983^{d}	165.506^{e}
C	92.185^{b}	8.910^{h}	161.590^{c}
D	94.914^{fg}	5.198^{d}	161.443^{c}
E	92.386^{bc}	8.125^{g}	165.033^{e}
F	95.517^{hi}	5.175^{d}	160.514^{c}
G	93.097^{e}	7.339^{f}	164.122^{de}
H	95.677^{ij}	4.120^{c}	166.512^{ef}
I	96.069^{j}	3.899^{c}	161.400^{c}
J	94.908^{fg}	5.474^{de}	165.391^{e}
STA	95.404^{ghi}	4.890^{d}	161.149^{c}
STB	94.673^{f}	6.022^{e}	161.717^{cd}
STC	92.836^{cd}	7.695^{fg}	161.584^{c}

The results obtained show that our 16 types of cassava starches were ranking in the 16 classes of cassava starches with a classification rate over 95%. Reporting to the work of [13], the combination of HSV and L*a*b* color spaces provides the better results in food industrial sciences.

3.4. Colorimetric features of maize flour

The table 4 presents colorimetric features of maize flour.

Table 4: Colorimetric features of maize flour

Samples	**Value**	**Chroma**	**Hue angle**
FZ1	94.931^{d}	6.060^{a}	146.832^{a}
FZ2	94.495^{bc}	6.384^{a}	150.894^{c}
FZ3	93.680^{b}	7.578^{b}	147.353^{ab}
FZ4	91.008^{a}	10.703^{c}	149.749^{bc}

The result presented in table 4 show as well as good discrimination of the 04 samples maize flour between 04 different ranking groups.

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3.5. Colorimetric features of tomato puree

The table 5 presents colorimetric features of tomato puree.

Table 5: Colorimetric attributes of tomato puree

Samples	Value	Chroma	Hue angle
TA1	20.034[a]	5.988[a]	20.679[a]
TA2	27.691[b]	22.599[c]	34.251[c]
TA3	29.113[c]	22.322[c]	25.608[b]
TA4	30.723[d]	10.958[b]	21.885[a]

The results obtained demonstrate that, every type of tomato puree has its own image color signature.

4. CONCLUSION

This paper is focused on providing a better approach for food quality assessment using a color images analysis system. Five different food products such as rice, cacoa beans, cassava starches and tomato puree have been used. Firstly the images of these were acquired. The images acquired have been preprocessed and segmented, then color features such as Value, Chroma and Hue angle have been extracted from an image of each food product. The extracted properties are input to Statgraphics software for the image classification. The classification tests have revealed that, the color features extracted set show accuracy over 95% of classification rate.

Our results confirm the hypothesis that our developed system for analyzing food images is very properly for food quality assessment.

REFERENCES

[1] Turgut, S. S., Karacabey, E., & Küçükönern E. (2014). Potential of image analysis based systems in food quality assessments and classifications. *Foodbalt 2014, 9th Baltic Conference on Food Science and Technology - Conference Proceedings.* (pp. 8 - 12). Riga. Drukatava. ISSN: 2255-9817.

[2] Brosnan, T., & Sun D.-W. (2004). Improving quality inspection of food products by computer vision: a review. *Journal of Food Engineering*, 61, 3–16.

[3] Boukar, O., Bitjoka, L., & Djaowé, G. (2013). Nondestructive Determination of Beans Water Absorption Capacity Using CFA Images Analysis for Hard-To-Cook Evaluation. *International Journal of Electrical and Computer Engineering*, 3 (3), 317–328.

[4] Kaur, J., & Banga V. K. (2014). Quality Assessment of Pulse Grains Based On Image Analysis. *International Journal of Emerging Technology and Advanced Engineering*, 3(5), 603 - 605.

[5] Patel, K., Kar, A., Jha, S. N., & Khan, M. A. (2012). Machine vision system: A tool for quality inspection of food and agricultural products. *Journal of Food Science and Technol*ogy, 49(2), 123-141.

[6] Du, C.-J. , & Sun, D.-W. (2006). Learning techniques used in computer vision for food quality evaluation: a review. *Journal of Food Engineering*, 72, 39–55.

[7] Du, C. J., & Sun D. W. (2004). Recent developments in the applications of image processing techniques for food quality evaluation: a review. *Trends in Food Science & Technology*, 15, 230–249.

[8] Firatligil-Durmus, E., Sarka, E., Bubník , Z., Schejbal, M., & Kadlec, P. (2010). Size properties of legume seeds of different varieties using image analysis. *Journal of Food Engineering*, 99, 445–451.

[9] Lukinac, J., Jukić, M., Mastanjević, K., & Lučan, M. (2018). Application of computer vision and image analysis method in cheese-quality evaluation: a review. *Food Technology*, 7(2), 199 - 214.

[10] Vijayarekha, K. (2012). Machine Vision Application for Food Quality: A Review. *Research Journal of Applied Sciences, Engineering and Technology*, 4(24), 5453-5458.

DOI : 10.31695/IJERAT.2019.3560

[11] Saldana, E., Siche, R., Lujan, M., & Quevedo, R. (2013). Review: computer vision applied to the inspection and quality control of fruits and vegetables. *Brazilian. Journal Food Technology, Campinas*, 16(4) 254-272.

[12] Patel, K. K., Khan, M. A., Kar, A., Kumar, Y., Bal, L. M., & Sharma, D. K. (2015). Image processing tools and techniques used in computer vision for quality assessment of food products: a review. *International Journal of Food Quality and Safety*, 1, 1-16.

[13] Mahendran, R., Jayashree, G. C., & Alagusundaram, K. (2012). Application of computer vision technique on sorting and grading of fruits and vegetables. *Journal of Food Processing & Technology*, S1-001. doi:10.4172/2157-7110.S1-001.

[14] Mery, D. Pedreschi, F., & Sot, A. (2012). Automated Design of a Computer Vision System for Visual Food Quality Evaluation. *Food Bioprocess Technol*, DOI 10.1007/s11947-012-0934-2.

[15] Siddagangappa, M. R., & A. H. Kulkarni, A. H. (2014). Classification and quality analysis of food grains. Journal of Computer Engineering, 16(4), 1-10.

[16] Kang, S. P., East, A. R., & Trujillo, F. J. (2008). Color vision system evaluation of bicolor fruit: A case study with 'B74' mango. *Postharvest Biology and Technology*, 49, 77–85.

[17] Kara, M., Sayinci, B., Elkoca, E., Öztürk, I., & Özmen, T. B. (2013). Seed size and shape analysis of registered common bean (*Phaseolus vulgaris L.*) cultivars in Turkey using digital photography. *Journal of Agricultural Sciences*, 19, 219-234.

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