RTBfoods

WP3: High-throughput phenotyping protocols (HTPP)

SOP: Colour Measurement in Fresh Yam (*Dioscorea Sp.*) and Fresh cassava (*Manihot esculenta)* using Chromameter

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1 SCOPE AND APPLICATION

Colour is a characteristic of light, which is measurable in terms of intensity and wavelength. The primary pigments imparting colour quality are the fat-soluble chlorophylls (green), carotenoids (yellow, orange, and red), water-soluble anthocyanins (red, blue), flavonoids (yellow) and betalains (red) (Barrett et al. 2010). The measurement of Colour could be determined by human vision, which could be subjective. Thus, colour measurement using the instrument is recommended. Colour can be correlated with other quality attributes such as sensory, nutritional, and visual or non-visual defects. Enzymatic browning of yam caused by the oxidation of phenols by polyphenol oxidases and peroxidases is a common phenomenon associated with yam discolouration during injury or processing at low temperature. The extent of this discolouration is determined by the L*, a* and b* values of measurement using the Chromameter.

2 REFERENCES

Barrett, D. M., Beaulieu, J. C., & Shewfelt, R. (2010). Colour, flavour, texture, and nutritional quality of fresh-cut fruits and vegetables: desirable levels, instrumental and sensory measurement, and the effects of processing. Critical Reviews in Food Science and Nutrition, 50(5), 369–389.

Granato, D., & Masson, M. L. (2010). Instrumental Colour and sensory acceptance of soy-based emulsions: a response surface approach. Ciência e Tecnologia de Alimentos, 30(4), 1090–1096.

Hutching, J. B. (1999) Food Colour and Appearance (London: Chapman and Hall Publisher)

Pankaj BP and Umezuruile L.O. 2013. Colour Measurement and Analysis in Fresh and Processed Foods: A Review. *Food and Bioprocess Technology*. vol: 6 pages 36-60. DOI: 10.1007/s11947-012-0867-9.

3 PRINCIPLE

The CIELAB colour scale is approximately uniform, and the differences between points plotted in the colour space correspond to visual differences between the colours plotted. The CIELAB colour space is organized in a cube form. The L* axis runs from top to bottom. The maximum for L* is 100, which represents a perfect reflecting diffuser, the minimum for L* is red, Negative a* is green, Positive b* is yellow and Negative b* is blue (Fig 1). However, the HunterLab L*, a*, b* values are directly read using portable Minolta CR-400 Chroma Meter. L* is an approximate measurement of luminosity, which is the property according to which each Colour can be considered as equivalent to a member of the greyscale, between black and white (Granato and Masson 2010).

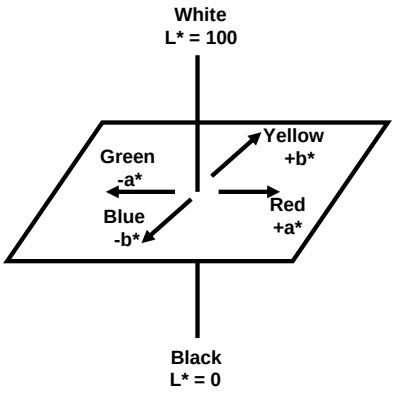


Fig 1. CIELAB colour space

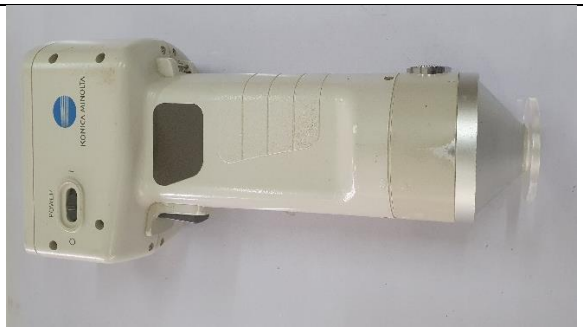
4 REAGENTS

No reagent is required

5 APPARATUS

Material	Image

Stainless steel knife. The stainless-steel knife is carbon steel with added chromium to resist corrosion and other elements which increase performance levels.	
Sample trays Disposable antistatic square weighing trays. Dimension 124 x 22 mm	
Mixing Laboratory blender The blender is with stainless cup and steel blades	

Petri-dishes **Small size 60mm (diameter) x 15mm (height)** Petri dishes are shallow cylindrical containers with fitted lids and are typically made of borosilicate glass or transparent plastics (usually polystyrene or polycarbonate).	
Chroma meter (Minolta CR- 400 Chroma Meter)	

6 PROCEDURE

The Colour of fresh yam samples was measured using Minolta CR- 400 Chroma Meter (Minolta Corp., Osaka, Japan) using L*a*b* systems. It was calibrated against a white standard before taking readings. Colour measurement involves the following steps;

a) Sampling and sample preparation
b) Homogenizing and blending of sample
c) Chromameter reading

The harvest plus sampling protocol was adopted where the fresh yam tuber or fresh cassava root was washed, air-dried, and peeled. A stainless-steel knife was used to cut the tuber/roots into four portions, longitudinally from the proximal to the distal end. Two opposite parts of the four portions were selected and cut into reduced sizes. Chopped pieces were quartered, and two

opposite portions were mixed manually to obtain representative sample lots and then transferred into an electric blender (Figure 1). Blended samples were collected in clean, transparent Petri dishes in duplicate and ready for measurement with a Chromameter, as shown in Figure 1.

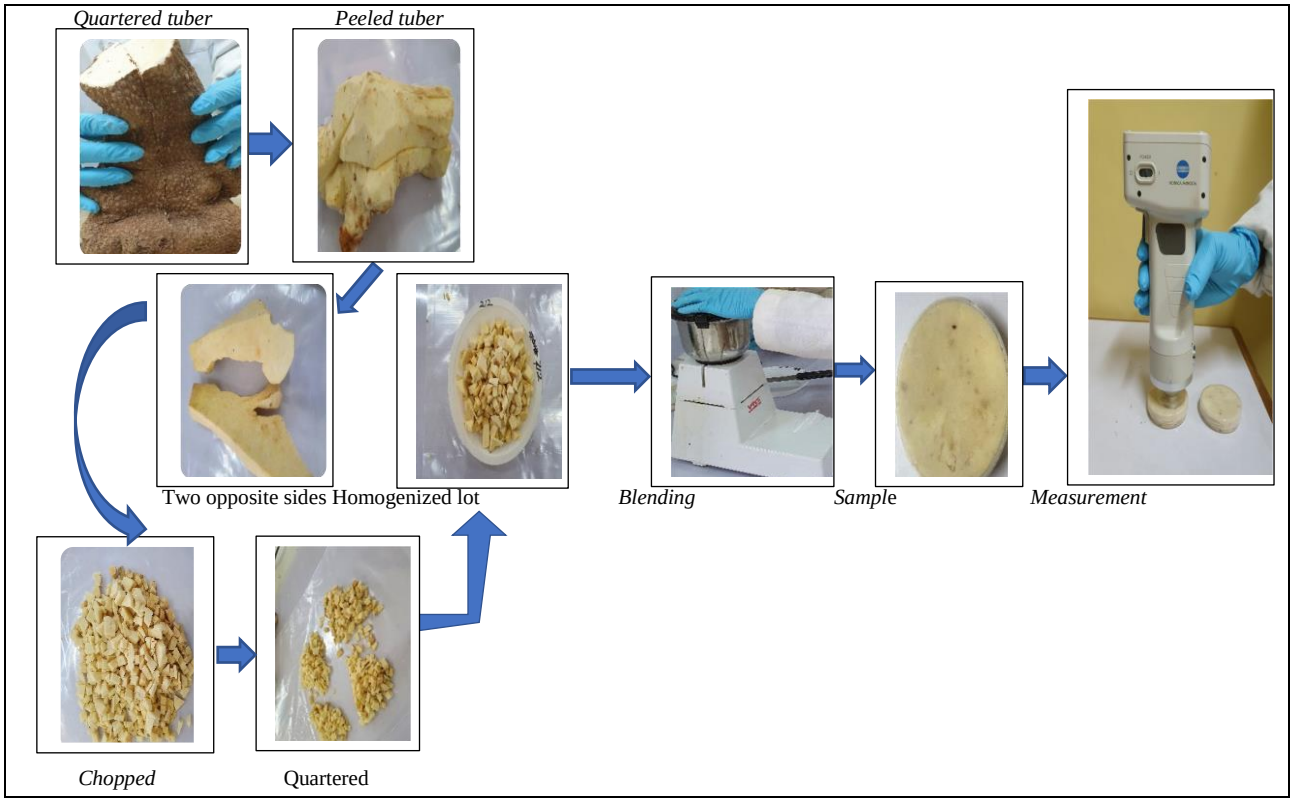


Figure 1: Workflow of color measurements using a Chromameter

7 EXPRESSION OF RESULTS

Total colour difference:

$$\Delta E^2 = L^{2}* + a^{2}* + b^{2}*$$

Brown Index: *(Pankaj and Umezuruile, 2013)*

$$BI = 100 * \frac{(X - 0.31)}{0.17}$$

Where $X = \frac{(a^* + 1.75L^*)}{(5.645L + a^* - 3.012b^*)}$

8 CRITICAL POINTS OR NOTE ON THE PROCEDURE

- Minolta CR- 400 Chroma Meter must be calibrated against white standard before taking sample readings
- The repeatability test must be carried out by taking at least ten readings on the blended samples. The repeatability uses replicate measurements to determine the standard deviation of the replicates. Chroma values repeatability is an indication of the stability and performance of the Chromameter. The standard deviation (SD) and % Coefficient of variation (%CV) of the absorbances for ten average spectra are calculated for each wavelength. The SD for L*, a* and b* values of 10 replicates readings were 0.93, 0.25 and 0.63 respectively, while %CV was 1.15, 1.17 and 2.87 respectively. The SD = -1 $\geq 0 \leq 1$ is acceptable. The lower the SD and the % CV(≤ 5) the better stability and performance of the Chromameter.
- The sample preparation and reading must be completed within 5 minutes

9 REVISION RECORD

Date	Responsible person	Description of change
11/06/	Meghar Karima	Reviewing and editing
29/06/	Alamu Emmanuel (IITA)	Reviewing, editing and adding input
09/10/	Fabrice Davrieux	Validating

10 APPENDIX