Mechanical characterisation of banana fruits

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Mechanical characterisation of banana fruits.

Abstract — Introduction. This protocol aims at measuring the mechanical characteristics of bananas, especially peel and fruit hardness, and pulp firmness; it can also allow the mechanical characterisation of green or ripening fruit of different pedo-climatic origins and/or varieties. **Materials and methods**. This part describes the required laboratory materials and the three steps necessary for the measurement of the mechanical characteristics of bananas. **Results**. The data allow the drawing of a curve characterising the firmness of the fruit (slope), hardness of the peel (peak) and hardness of the pulp (plateau).

France / *Musa* sp. / methods / fruits / measurement / firmness / maturity

Caractérisation mécanique de bananes.

Résumé — Introduction. Ce protocole vise à mesurer les caractéristiques mécaniques des bananes, en particulier la dureté de la peau et du fruit, et la fermeté de la pulpe ; il peut permettre également la caractérisation mécanique du fruit au stade vert ou du fruit en cours de maturation, de différentes origines pédo-climatiques et/ou variétés. **Matériel et méthodes**. Cette partie présente le matériel de laboratoire nécessaire et les trois étapes indispensables pour la mesure des caractéristiques mécaniques des bananes. **Résultats**. Les données permettent de tracer une courbe caractérisant la fermeté du fruit (pente), la résistance de la peau (pic), et la dureté de la pulpe (plateau).

France / *Musa* sp. / méthode / fruits / mesure / maturité / fermeté

1. Introduction

Application

This protocol aims at measuring the mechanical characteristics of bananas, especially peel and fruit hardness, and pulp firmness; it can also allow the mechanical characterisation of green or ripening fruit of different origins and/or varieties.

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Principle

This method was previously described by Chillet and de Lapeyre de Bellaire [1]. Measurements are made with a penetrometer (or texture analyser) connected to an analytical software program. The penetrometer probe is plunged at constant velocity until it punctures the peel and pulp. The analyser and analytical software package record the force applied over a time course to enable the probe to plunge at constant velocity.

Key advantages

A penetrometer connected to an analytical software program makes it possible to obtain:

– a more accurate measurement of mechanical characteristics of the fruit than that given by a manual penetrometer, which can also be used to characterise fruit, but with less accurate measurement;
– a very rapid measurement.

Starting material

This protocol uses:

– freshly harvested green bananas,
– ripening bananas, at different ripeness stages.

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Time required

About 10 min are necessary from fruit preparation to data reading.

Expected results

The results are variable according to the tissues and their development stage. For green bananas, peel hardness should range from (20 to 80) N. Fruit firmness will range from (30 to 70) $N \cdot s^{-1}$, while pulp hardness is generally between (15 and 30) N. Values for these parameters will drop sharply as the bananas ripen.

2. Materials and methods

Laboratory materials

The protocol requires a penetrometer (TA-XT2) with a cylindrical metal 20-mm^2 probe; a computer or a calculator; an analytical software package (X-Trad).

Measurement of the mechanical characteristics of bananas

• Step 1
Prepare fruit material:

– choose a representative hand on a bunch to analyse (the middle hand is generally selected),
– cut off one fruit from the outer rows of the hand.

• Step 2
Determine mechanical characteristics:

– set the penetrometer parameters (probe plunging velocity, maximum probe depth),
– place one of the two test fruits under the penetrometer probe,
– lower the probe to within a few mm of the peel,
– begin measurement.

• Step 3
Analyse the data:

– the maximum force recorded by the analyser corresponds to the peel hardness (maximum force required to puncture the peel),
– the slope prior to peel rupture corresponds to the fruit firmness [2],
– the plateau after the peak corresponds to the pulp hardness (*figure 1*).

Troubleshooting

Two main problems can occur:

(a) Additional reading peaks are detected due to inaccurate positioning of the fruit under the probe.
Solution: the fruit has to be repositioned under the probe so that the probe base and the fruit peel are as parallel as possible.

(b) No reading peaks are detected due to the threshold reading being undetected by the analyser because overripe bananas are tested.
Solution: the maximum banana ripeness stage that the analyser is able to detect must be determined before the test.

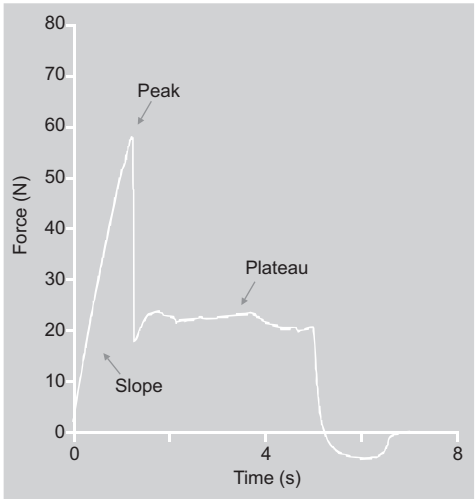

Figure 1.
Mechanical characterisation of a banana fruit: hardness of the peel (peak), firmness of the fruit (slope), and hardness of the pulp (plateau).

3. Typical results obtained

The data allow the drawing of a curve characterising the firmness of the fruits (slope), hardness of the peel (peak) and hardness of the pulp (plateau) (*figure 1*).

References

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