MANGO QUALITY DETERMINATION USING DESTRUCTIVE AND NON-DESTRUCTIVE RIPENING INDICATORS

U.K. Acharya

Nepal Agricultural Research Council, Singhdurbar Plaza, Kathmandu

e-mail: umeshach@gmail.com

ABSTRACT

Mango is third important fruit crops of Nepal in terms of import (13353 MT / year) of fruit commodities. It is harvested at mature but green stage in Indian and Nepalese orchard and transported to distance market in Nepal. In the collection point, the fruit is stored ripen with application of ethephon and transported to selling point (wholesale/ retailer's shop). Post-harvest loss of over-ripe produce is up to 30% if not transported from the store ripen mango in appropriate time. An experiment was executed to find out a robust portable tool to allow quantitative assessment of incoming consignments. Batches of 60 fruits (cultivar B-74 and KP) were collected from commercial farm and ripen with spray of ethephon (0.2%) and stored at 20oC for a period of 6-8 days. Each day five fruit were sampled and ripening indices (dry matter, TSS, firmness, chlorophyll content and skin color) were examined. Firmness was measured with firmness tester (destructive) and Aweta meter (non-destructive- sound velocity method) while TSS measured using Bench-top refractrometer and chlorophyll content assessed using DA meter. The skin color in term of L, a* and b* were measured using Chromameter (CR-400). Ripening stage of B-74 mango could not be tracked with conventional destructive parameters like dry matter and TSS due to little change during ripening course. Non-destructive firmness test (Aweta) and skin chlorophyll measurement (DA meter) could be used as best indicator of ripeness quality check at selling point. Skin colour in term of CIE a* and b* could be another alternative; however, red blush on skin could make this indices unsuitable in coloured skin varieties.*

Key words: *colour, firmness, fruit, ripening index, total soluble solids*

Introduction

Mango is one of the most preferred fruits in Nepal and cultivated in 66 Terai and Hill districts covering 46,469 ha area with 2,70,432 MT production and 7.03 MT productivity (MoAD 2014). The in-country production cannot support total demand as shown by import of 13,353 MT in Fiscal year 2013/14 which was worth of NRs 220.6 million (Fig 1). In Nepal, mango fruits are harvested at a mature green stage and transported to ripening facilities. Based on market price (Fig 1), the consignment is to put on hold for few days to weeks and treated with ethylene to induce ripening process. Once the ripening process is triggered, fruits are monitored based on skin colour and firmness as judged by eye and hand feel, with a subjective judgement made on when to release to retail shop (Abbot, 1998). Judgement of skin colour can be problematic as some consignments have a greater level of greenness (chlorophyll content) to start with while other have red blush. The objective measures of the ripening process include change on TSS, flesh colour and penetrometer readings of the flesh (destructive measures) and rate of ethylene release and respiration

(gas exchange procedures that are relatively complex) (Kader, 2013). An experiment was performed to find out a robust portable tool to allow quantitative assessment of incoming consignments at retail shop as well as judgement of outturn of mango from ripening room.

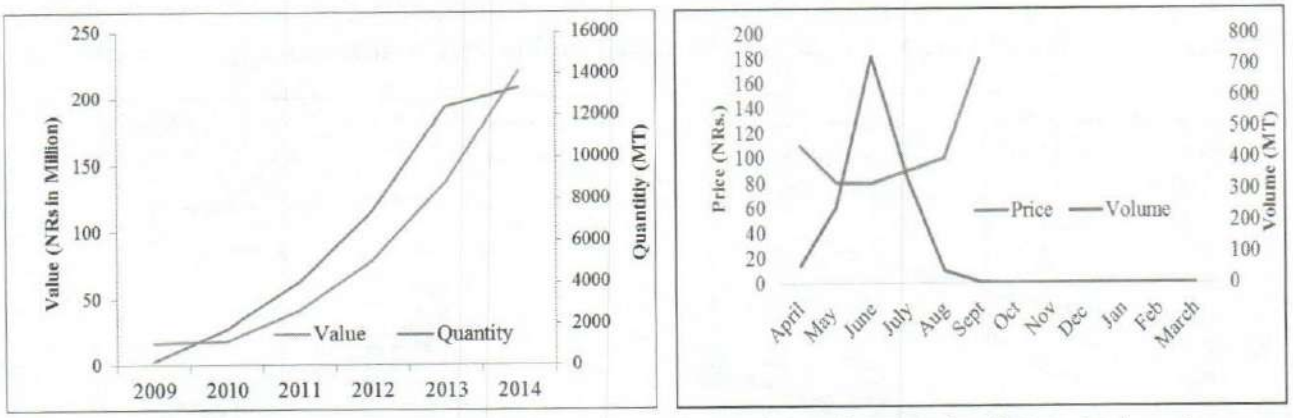

Figure 1. a) Import of mango in Nepal in figure and b) monthly volume arrived at and price of mango at Kalimati market in year 2014

(Source: MoAD, 2009-2014; KFVMDB, 2014)

Materials and Method

Sixty mature green fruit from each of Kensington Pride (KP-green skinned) and B74 (coloured skin) mango cultivar were sourced from Department of Primary Industry, Rockhampton orchard. Fruit were marked on both side of cheek region and initial measurements were taken on these spots. Skin colour reading (CIE L*, a* and b*) were taken with a CR-400 Chromameter (Konica Minolta Japan; http://goo.gl/5PHGqa). Five fruits were destructively analysed at day 1 for dry matter by oven drying pulp at 65oC for 48 hours. TSS reading was also obtained with temperature compensated bench-top refractrometer. The colour reading of pulp material was acquired just beneath the marked spot after slicing the skin out. During destructive analysis, colour reading of sample skin and pulp were also taken while skin chlorophyll content was measured non-destructively using DA meter (Turino, Italy; http://goo.gl/80EZOl). The destructive firmness was taken with bench-top penetrometer while non-destructive was taken with acoustic firmness sensor (Aweta; Model DTF V0.0.0.105, AWETA, Nootdor, Netherlands). The remaining 55 fruit of each cultivar were treated with Ethephon @ 0.2% and kept in ripening chamber at 170C for 36 hours. After 36 hours, all readings were taken as described above, with a further five fruit destructively sampled. Fruits were further stored at 200C for remaining experiment period. In day 6 (KP) and 8 (B74) final readings of 25-35 fruits were taken and all fruits were used for destructive measurement.

Results and Discussion

The steady change in attribute of interest immediately or a few days after ethylene application to the fruit could be picked as good indicator to release fruit from ripening chamber to retail shop. In coloured mango cultivar (B 74) red blush on skin pose trouble in visual observation of skin colour change. However, the skin colour change as measured by Chroma-meter value CIE a* (greenness to yellowness) shows steady change in first two days (Fig 2). Similarly, the DA meter reading also shows steady decline in chlorophyll loss in earlier days from both mango cultivars (Fig 4).

Ripening stage of both B-74 and KP mango could not be tracked with conventional destructive parameters like dry matter and TSS as they change little during ripening course or showed high variation depicted by standard error (Fig 2 & 3). Similar to this study, Padda et al (2011), while comparing a range of mango maturity and ripening indices, recommended firmness (Aweta) and CIE a* as the best measure to identify mature and ripen mangoes.

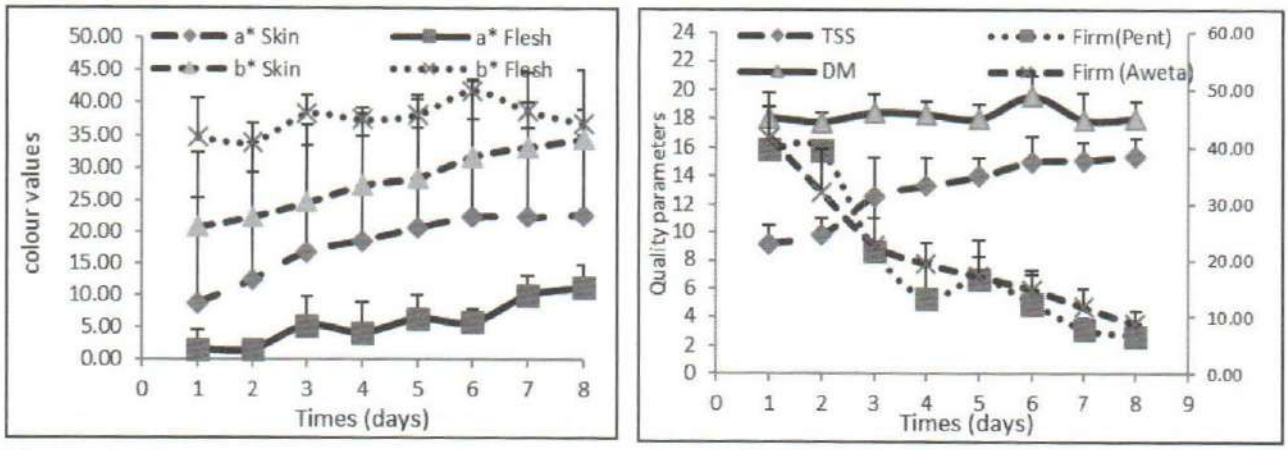

Figure 2. Change on quality parameters of B74 mango during ripening experiment (Firmness-Aweta reading in right Y-axis, error bar represents SD)

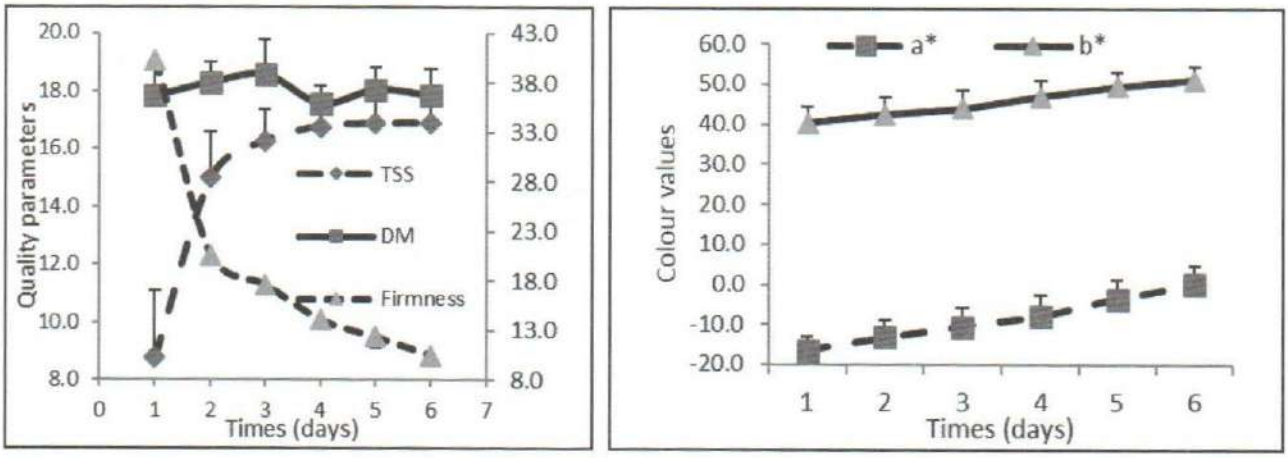

Figure 3. Change on quality parameters of KP mango during ripening experiment (Firmness and DA index on right side of Y-axis, colour information are of skin only)

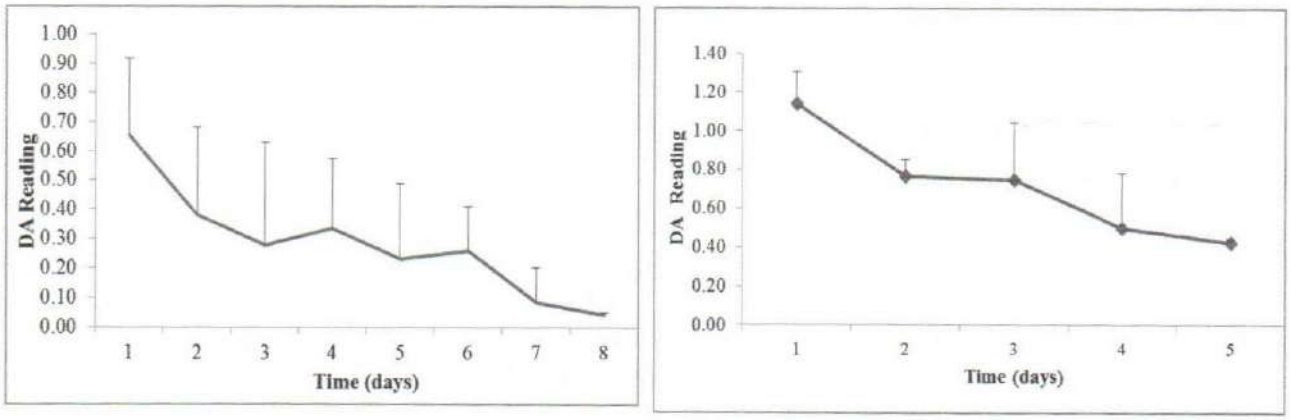

Figure 4. Change in chlorophyll content of B 74 (left) and KP (right) mango skin during ripening experiment (taken from DA meter)

Conclusion

Non-destructive firmness test (Aweta) and skin chlorophyll measurement (DA meter) could be used as best indicator of ripeness to outturn mango from ripening chamber. Skin colour in term of CIE a* could be another alternative; however, it should be used with extra care on coloured mango cultivar. When considering quality check of ripe mango consignment arriving at whole sale market the non-destructive measure (DA meter, Aweta and Chromameter value) are quick and easier alternatives to destructive TSS and penetrometer testing.

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