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# PHENOTYPIC SELECTION TECHNIQUE IMPROVED CHEMICAL PROPERTIES OF PINEAPPLE (Ananas comosus L.) FRUIT

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## ABSTRACT

Phenotypic selection, although considered as traditional breeding method, is an indispensable technique in crop improvement. Hence, this study aimed to 1) select superior clones of 'MD-2' pineapple (coined as "MD-2 Prime") through phenotypic selection and 2) evaluate and compare the chemical properties of 'MD-2 Prime' pineapple fruits with other pineapple cultivars (MD-2, Del Monte Cayenne, Dole Cayenne and Sensuous) in Bukidnon, Philippines. Suckers (300-350 g) of "MD2 Prime" were collected from commercial 'MD-2' pineapple fields at Mt. Kitanglad Agricultural Development Corporation (MKADC), Valencia City, Bukidnon, Philippines.

"MD-2 Prime" and other pineapple cultivars were planted at MKADC Research Field and received similar intercultural management practices. Fruits were harvested at shell color index 3 and chemical properties were evaluated. Based on overall chemical properties evaluated, "MD-2 Prime" had superior chemical properties (18.67O brix, 0.49% titratable acidity, 38.45 brix and acid ratio and 68.67 mg/100 mL ascorbic acid) compared to other cultivars although "Sensuous" fruits had the highest brix (20.53O). This implies that pineapple fruit chemical properties were improved through phenotypic selection technique.

**Keywords:** phenotypic selection, "MD-2" pineapple, "MD-2 Prime", fruit quality, chemical properties

## INTRODUCTION

Pineapple is one of the most important fruit crop in the world in terms of production. In the Philippines, production of pineapple in January-March 2016 reached 591.25 thousand metric tons (Philippine Statistics Authority, 2016) which contributed to the country's economy. Aside from its economic contribution, pineapple is a good source of vitamin C and has pharmaceutical uses.

Vol. 3, No. 02; 2018

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Pineapple export industry in the Philippines is concentrated in the province of Bukidnon. Among the commercial cultivars are MD-2, Dole Cayenne and Del Monte Cayenne. There are also new varieties ("Sensuous", "Ulam Pine" and "PACO") developed by local plant breeders. The "Sensuous" and "Ulam Pine" were developed by Dr. Juan C. Acosta (Filipino plant breeder), whereas "PACO" is a product of phenotypic selection technique by the research department of Mt. Kitanglad Agricultural Development Corporation.

Propagation of pineapple is through asexual or vegetative means, thus retaining the fruit quality. However, due to the globally recognized climate change issues, it cannot be denied that off-types or mutants would occur which leads to either poor or better fruit quality. Hence, the study was conceptualized to1) select superior clones of 'MD-2' pineapple (coined as "MD-2 Prime") through phenotypic selection and 2) evaluate and compare the chemical properties of 'MD-2 Prime' pineapple fruits with other pineapple cultivars (MD-2, Del Monte Cayenne, Dole Cayenne and Sensuous) in Bukidnon, Philippines.

## MATERIALS AND METHODS

The study was conducted at the Research Field of Mt. Kitanglad Agricultural Development Corporation (MKADC), Lurugan, Valencia City, Bukidnon. Selection of superior 'MD-2' pineapple (coined as "MD-2 Prime") was done at 'MD-2' pineapple commercial fields of MKADC. There were two general factors considered in the phenotypic selection process: (1) plant phenotypic traits at the field and (2) fruit quality at harvest.

Fruit size (diameter ≥12 cm, length ≥15 cm), estimated fruit mass (≥2.0 kg), fruit shape (square shouldered), fruit and crown ratio (3:1 based on length), suckering ability (at least one sucker per plant), slip production (not to exceed one slip per plant) were the phenotypic traits considered in the selection process at the field. Selected plants were then tagged with a plastic sheet and properly labelled for reference purposes and to prevent the fruits from picking by commercial harvesters.

As the fruit reaches maturity (shell color index 2-3), these were harvested and subjected to fruit quality evaluation. Among the fruit quality parameters gathered were flesh color, translucency, brix and titratable acidity. Fruits with 3-4 flesh color, not translucent, brix $\geq 16^{O}$ and titratable acidity of 0.4-0.6% were only to qualify and others were discarded.

Suckers (300-350 g) of "MD-2 Prime" plants were collected and planted at MKADC Research Field. Likewise, suckers of commercial pineapple cultivars (MD-2, Del Monte Cayenne, Dole Cayenne and Sensuous) were also planted in the same area. Similar intercultural management practices established by MKADC was employed to all pineapple cultivars including "MD-2 Prime".

Synchronized flowering induction treatment was done at 11 months after planting. Fruits were harvested at shell color index 3 and chemical properties were evaluated. Ten fruit samples (weighing 2.0-2.2 kg) per cultivar were evaluated for brix, titratable acidity and brix and acid

Vol. 3, No. 02; 2018

ISSN: 2456-8643

ratio (BAR) data. Each fruit sample served as replicate. Likewise, ten fresh fruit samples per cultivar were brought to the Biotechnology Research Services Laboratory, Alanib, Lantapan, Bukidnon for ascorbic acid analysis.

The following fruit chemical properties were then evaluated and gathered:

a. Brix or total soluble solids (TSS)- pineapple fruit juice was extracted and brix was measured using an Atago handheld refract meter.

b. Titratable acididty (TA)- 10 ml pineapple juice was placed inside a beaker, and 2 mL of phenolphthalein solution was added. Titration then follows by adding a basic solution (0.1 N sodium hydroxide, NaOH) to the fruit juice until the color turns to light red. The formula was then used to determine the %TA.

TA = ml NaOH added x 0.1 (NaOH concentration) x 0.064 x 100 ÷ volume of juice

c. Brix and acid ratio (BAR)- this was determined using the formula:

BAR= brix ÷ titratable acidity

d. Ascorbic acid- 100 mL of pineapple juice was extracted and this was analysed by the Biotechnology Research Services Laboratory staffs.

Data were analysed statistically using the analysis of variance. Treatment means were compared using the Duncan Multiple Range Test (DMRT).

## RESULTS AND DISCUSSION

### Brix

'Sensuous' pineapple had the highest brix ($20.53^{O}$) among the pineapple cultivars evaluated and was followed by "MD2 Prime" with $18.67^{O}$. These figures were relatively higher than the market standard which is $14^{O}$. On the other hand, brix of MD-2 ($17.16^{O}$), Del Monte Cayenne ($15.85^{O}$) and Dole Cayenne ($15.10^{O}$) also surpassed the market standard (Figure 1). Sweetness, or sugar content, is a major component of taste appeal and is often measured as total soluble solids (TSS) using a refract meter. To ensure acceptable flavour a minimum TSS of $13^{O}$ is required (https://www.daf.qld.gov.au/__.../Ch-7-Fresh-Fruit-Varieties.pdf).

### Titratable Acidity

Highest titratable acidity was obtained from "Sensuous" fruits with 0.88%. This was followed by Del Monte Cayenne (0.64%) and Dole Cayenne (0.63). MD-2 Prime (0.49) and MD-2 (0.48) fruits have had the least titratable acidity (Figure 2). Acidity is usually measured in % citric acid equivalent. Acidity varies considerably between varieties, seasons and regions. Like sweetness, acidity has a major impact on flavour, and the relative levels are important. An acidity of 0.3-0.4% in summer harvested pineapple fruit is good. In winter an acidity of up to 0.7% should be acceptable to most consumers (https://www.daf.qld.gov.au/__.../Ch-7-Fresh-Fruit-Varieties.pdf).

Vol. 3, No. 02; 2018

ISSN: 2456-8643

**Brix and Acid Ratio**

A brix:acid ratio of 20-40 is recommended with the higher values applicable to the summer months(https://www.daf.qld.gov.au/ .../Ch-7-Fresh-Fruit-Varieties.pdf). In this study, all cultivars surpassed the minimum brix:acid ratio which is 20. Highest brix:acid ratio was attained by "MD-2 Prime" with 38.45. "Sensuous" fruits had the least brix:acid ratio (23.77) among the cultivars (Figure 3). This result implies that the selected superior MD-2 clone ("MD-2 Prime") improved in terms of brix:acid ratio than the commercial MD-2 cultivars. In this data, it can be said that phenotypic selection is a good tool to use in maintaining, purifying or even improving the characteristics of a current cultivar.

**Ascorbic Acid**

Ascorbic acid or Vitamin C is an essential nutrient for humans. Vitamin C increases the resistance of humans against common diseases such as cough, fever, etc. In fruit crop production, ascorbic acid is one of the factors to consider in varietal selection. In this study, highest ascorbic acid (68.67 mg/100 mL) was obtained in "MD-2 Prime" pineapple. This was followed by "MD-2" cultivar with ascorbic acid of 56.28 mg/100 mL. Compared to other pineapple cultivars, MD2 is better in several qualities including Vitamin C content which is four times higher (Thalip et al., 2015).On the other hand, ascorbic acid content of Dole Cayenne (38.09 mg/100 mL), Del Monte Cayenne (30.41 mg/100 mL) and "Sensuous" (26.27 mg/100 mL) were inferior compared to "MD-2" as well as its superior clone ("MD-2 Prime").

Ascorbic acid plays an important role in the shelf life of fruits and vegetables including prevention of flesh browning of sliced fruits. Compared to other fruits, pineapple has higher ascorbic acid content. Hence, its juice extract is used as treatment to prevent flesh browning of banana (Chaisakdanugull et al., 2007) and sliced wax apple (Mitrsang and Srinorkham, 2017). Although pineapple juice extracts were used as treatment to prevent browning, shorter shelf life and flesh browning of sliced pineapple can be attributed to lower ascorbic acid content. Unpublished research work at MKADC suggested that the critical level of ascorbic acid in pineapple is 30 mg/100 mL to inhibit browning of sliced fruits (T. Castro, personal communication, November 6, 2012). This supported the authors' unpublished work in "Sensuous" which exhibits browning because of lower ascorbic content. Sliced "Sensuous" fruit browning was prevented with the treatment of commercial ascorbic acid (Valleser et al., 2013).

Vol. 3, No. 02; 2018

ISSN: 2456-8643

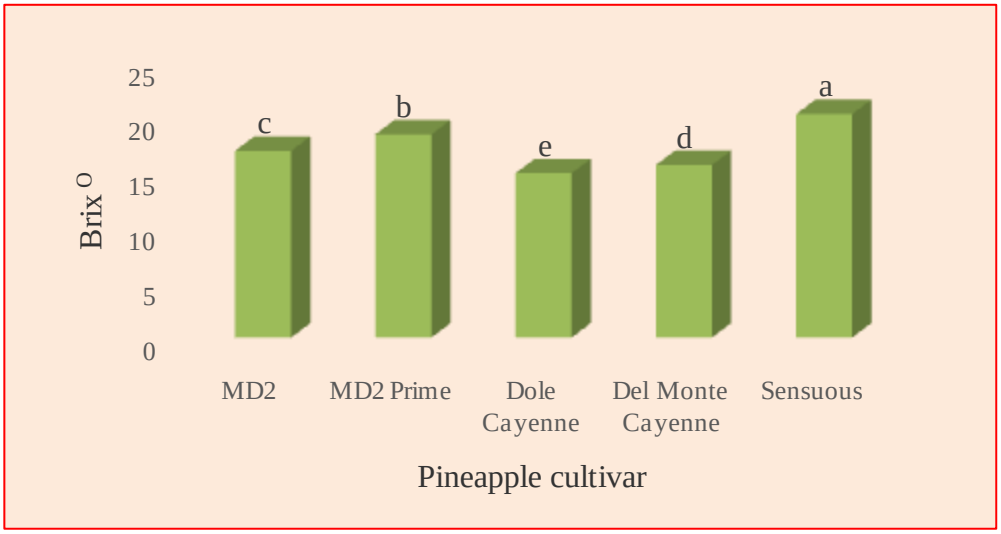


Figure 1. Brix of pineapple cultivars grown at Valencia City, Bukidnon, Philippines

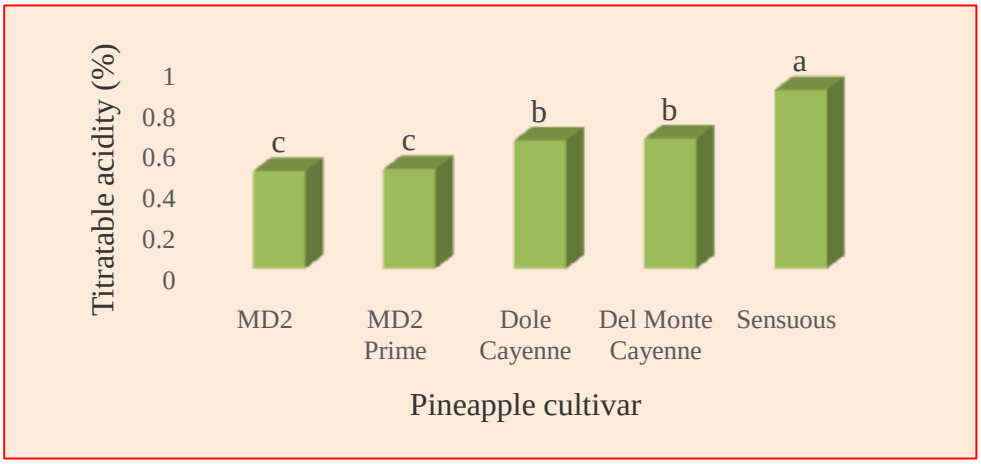


Figure 2. Titratable acidity of pineapple cultivars grown at Valencia City, Bukidnon, Philippines

Vol. 3, No. 02; 2018

ISSN: 2456-8643

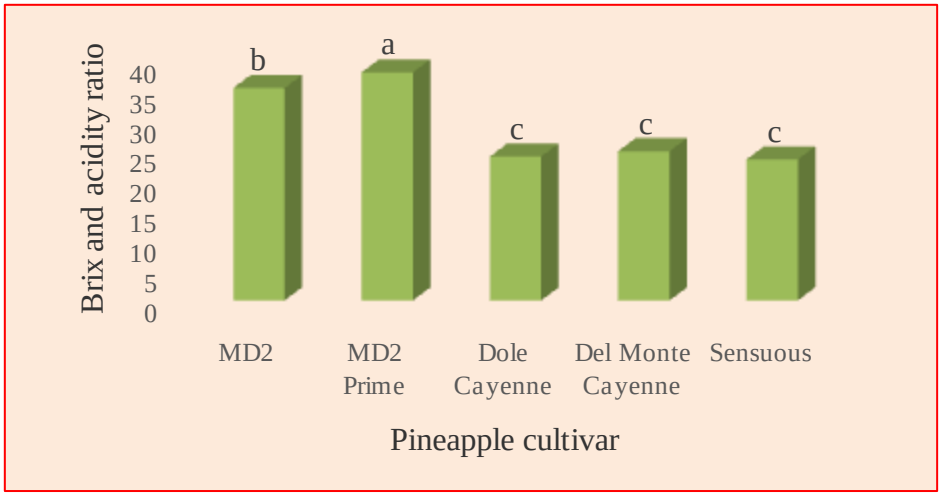


Figure 3. Brix:acid ratio of pineapple cultivars grown at Valencia City, Bukidnon, Philippines

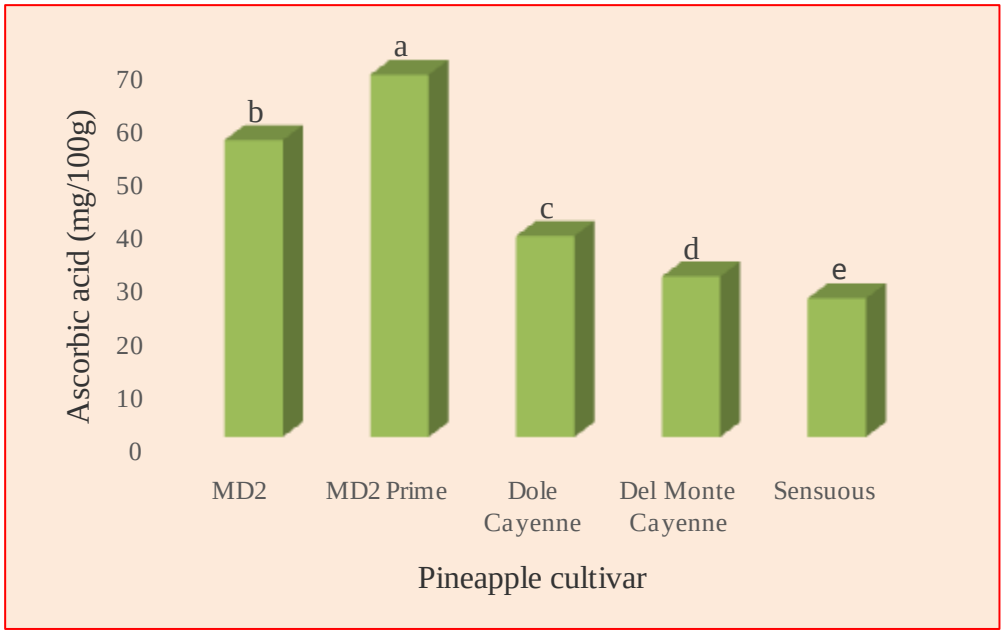


Figure 4. Ascorbic acid (mg/100 mL) content of pineapple cultivars grown at Valencia City, Bukidnon, Philippines

Vol. 3, No. 02; 2018

ISSN: 2456-8643

## CONCLUSIONS AND RECOMMENDATION

Pineapple fruit chemical properties such as brix, acid, brix:acid and ascorbic acid content can be improved through phenotypic selection. It is still an effective technique in maintaining, purifying and even improving quality of a pineapple cultivar. The results obtained was only based on one cropping cycle, thus it is recommended to make a whole year round comparative assessment for all the cultivars evaluated.

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