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# Investigation of Mangrove Apple (*Sonneratia caseolaris)* Juice Production

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**Abstract.**

Mangrove apple (*Sonneratia caseolaris)* is widely grown in Vietnam. Its sour tasting young berry fruits are edible and applied as medicine in poultices to relieve sprain. It is quite a popular fruit usually consumed fresh or made into fruit juice or juice beverage. In order to utilize this good source as a healthy food drink, we attempted to produce mangrove apple juice. We focused on investigation of dilution ratio of mangrove apple juice with water, soluble dry matter, and pasteurization to product quality. Our results showed that dilution ratio 40:60 (juice: water), 18 $^{o}$Brix, pasteurization at 95 $^{o}$C in 4 minutes gave the best mangrove apple juice.

***Keywords:*** *Mangrove apple, Sonneratia caseolaris, juice, pasteurization, soluble dry matter, dilution ratio*

## I. Introduction

Mangrove apple (*Sonneratia caseolaris*) grows widely in the South of Viet Nam. It is widespread in tropical and subtropical tideland. *Sonneratia caseolaris* is a small tree with oblong or obovate-elliptic coriaceous leaves and large (Samir Kumar Sadhu et al., 2006). Extracts of this plant are traditionally used as an astringent and antiseptic. It contains alkaloid, tanin, flavonoid, saponin, phytosterol, and carbohydrate (Prabhu V. Teja, Ravishankar K, 2013; Harekrishna Jana et al., 2015). It exhibits antimicrobial activities against certain microorganisms (Minqing Tian et al., 2009; Shahbudin Saad et al., 2012). The existence of most of the phytochemicals in the leaves showed some important biological activities (Peddinti Nagababu, Vanga Umamaheswara Rao, 2017). It has hypoglycemic effect as dietary fiber (Jariyah et al., 2015), antioxidant and anticholinesterase activities (P. Wetwitayaklung et al., 2013). The half ripe fruits are used to relieve cough, the ripe fruits are used as anthelmintic drug and the fermented fruit juice is said to be useful in arresting haemorrhage (P. Wetwitayaklung et al., 2013). The apple mangrove extract could be employed in shrimp culture as a prophylactic/therapeutant as well as an immunostimulant without negative effects on growth, nutrient utilization and carbohydrate and protein digestion (Pedro Avenido et al., 2012).

In order to utilize this good source as a healthy food drink, we attempted to produce mangrove apple juice. We focused on investigation of dilution ratio of mangrove apple juice with water, soluble dry matter, and pasteurization to product quality.

## II. Materials And Method

### 2.1 Material

We collected mangrove apple fruit in Kien Giang province, Vietnam. After harvesting, they were conveyed to laboratory within 8 hours for experiments. Fruits were washed thoroughly under turbulent washing to remove dirt, dust and adhered unwanted material. Beside mangrove apple we also used other materials during the research such as NaOH, Petrifilm (3M). Lab utensils and equipments included pH meter, autoclave, colorimeter, weight balance, refractometer.

**Figure 1. Mangrove apple (*Sonneratia caseolaris*)**

### 2.2 Methods

#### *2.2.1 Effect of dilution ratio to Mangrove apple juice sensory characteristics*

Ripen mangrove apples were thoroughly washed and then pressed to get juice. We examined three different dilution ratio (juice: water; 50:50, 40:60; 30:70; 20:80). These mixtures would be filled into bottles and sterilized. In each sample, we measured pH, acidity and sensory characteristic (taste and color).

#### *2.2.2 Effect of sugar content to mangrove apple juice quality*

Ripen Mangrove apples were thoroughly washed and then pressed to get juice. The final sugar content in Mangrove apple juice was adjusted to different $^{o}$Brix levels: 16 $^{o}$Brix, 18 $^{o}$Brix, 20 $^{o}$Brix, 22 $^{o}$Brix. In each sample, we measured pH, acidity and sensory characteristic (taste and color).

#### *2.2.3 Effect of pasteurization to mangrove apple juice quality*

In order to preserve mangrove apple juice for a long shelf-life, we examined different temperature (90 $^{o}$C, 95 $^{o}$C, 100 $^{o}$C) and time (2 minutes, 4 minutes, 6 minutes). In each sample, we measured sensory characteristic, vitamin C, microorganism, soluble dry matter, and acidity.

### 2.3 Physico-chemical and biological analysis

We determined total plate count (TPC) by Petrifilm (3M); soluble dry matter by refractometer; acidity by titration

with NaOH; pH by pH meter; color by colorimeter; sensory score by sensory evaluation

### 2.4 Statistical analysis

The Methods were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT) Statistical analysis was performed by the Startgraphics.

## III. RESULTS & DISCUSSION

### 3.1 Nutritional composition in Mangrove apple juice

We conducted the primary analysis in ripen Mangrove apple. Our results showed in table 1.

**Table 1. Nutritional composition in Mangrove apple juice**

| Composition | Value |
|---|---|
| Soluble dry matter ($^o$Brix) | 28.63±0.01 |
| Total acidity (%) | 0.74±0.03 |
| pH | 3.15±0.02 |
| Vitamin C (mg%) | 65.27±0.01 |

From table 1, we could see that mangrove apple has a good source of vitamin C. These results were similar to data by Ray R. et al., (2015). In this research, they showed that mangrove apple contained high percentage of carbohydrates (27.25-62.9), protein (1.2-45.48), lipid (1.75-4.31) and ascorbic acid (0.013-0.032%).

### 3.2 Effect of dilution ratio to mangrove apple juice sensory characteristics

Ripen mangrove apples were thoroughly washed and then pressed to get juice. We examined three different dilution ratio (juice: water; 50:50, 40:60; 30:70; 20:80). These mixtures would be filled into bottles and sterilized. In each sample, we measured pH, acidity and sensory characteristic (taste and color). Our results are depicted in table 2.

From table 2, we saw that the appropriate sensory characteristic (taste and color) at dilution ratio (juice: water, 40:60). We choose this value for further studies.

### 3.3 Effect of sugar content to mangrove apple juice quality

Ripen mangrove apples were thoroughly washed and then pressed to get juice. The final sugar content in mangrove apple juice was adjusted to different $^o$Brix levels: 16 $^o$Brix, 18 $^o$Brix, 20 $^o$Brix, 22 $^o$Brix. In each sample, we measured sensory characteristic.

From table 3, we noticed that when we added sugar to get the final total soluble solid of 18 $^o$Brix, Mangrove apple juice had a pleasant sensory feeling. We selected 18 $^o$Brix of mangrove apple juice for further experiments.

### 3.4 Effect of pasteurization to mangrove apple juice quality

In order to preserve mangrove apple juice for a long shelf-life, we examined different temperature (90 $^o$C, 95 $^o$C, 100 $^o$C) and time (2 minutes, 4 minutes, 6 minutes). In each sample, we measured sensory characteristic, vitamin C, microorganism, soluble dry matter, and acidity.

From table 4, 5, 6, 7 and 8; we realized that the mangrove apple juice should be pasteurized at 95 $^o$C in 4 minutes to get the best product quality.

**Table 2. Effect of dilution ratio to mangrove apple juice sensory characteristics**

| Dilution ratio (juice:water) | pH | Acidity (%) | Taste (score) | Color (score) |
|---|---|---|---|---|
| 50:50 | 3.79±0.02$^c$ | 0.65±0.01$^a$ | 3.29±0.01$^d$ | 3.38±0.02$^c$ |
| **40:60** | **3.93±0.01$^b$** | **0.57±0.03$^b$** | **4.73±0.01$^a$** | **4.63±0.01$^a$** |
| 30:70 | 4.03±0.03$^{ab}$ | 0.45±0.01$^c$ | 4.06±0.00$^b$ | 4.05±0.01$^b$ |
| 20:80 | 4.20±0.00$^a$ | 0.31±0.02$^d$ | 3.70±0.01$^c$ | 3.01±0.02$^d$ |

*Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).*

**Table 3. Effect of sugar content to mangrove apple juice quality**

| Sugar content ($^o$Brix) | Sensory score |
|---|---|
| 16 | 3.23±0.02$^d$ |
| **18** | **4.55±0.01$^a$** |
| 20 | 4.13±0.01$^b$ |
| 22 | 3.84±0.02$^c$ |

*Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).*

**Table 4. Effect of pasteurization to sensory (score) of mangrove apple juice**

| Pasteurization temperature ($^o$C) | Pasteurization time (minutes) | | | Average |
|---|---|---|---|---|
| | 2 | 4 | 6 | |
| 90 | 3.16±0.01 | 3.43±0.00 | 3.41±0.01 | 3.33±0.01$^c$ |
| **95** | 4.45±0.02 | 4.64±0.01 | 4.28±0.02 | **4.56±0.02$^a$** |
| 100 | 4.13±0.01 | 4.50±0.02 | 3.89±0.01 | 4.17±0.00$^b$ |
| **Average** | 3.91±0.03$^c$ | **4.19±0.02$^a$** | 3.86±0.01$^b$ | |

*Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).*

**Table 5. Effect of pasteurization to vitamin C (mg/100) of mangrove apple juice**

| Pasteurization temperature ($^oC$) | Pasteurization time (minutes) | | | Average |
|---|---|---|---|---|
| | 2 | 4 | 6 | |
| 90 | 55.20±0.01 | 53.04±0.01 | 47.24±0.01 | 51.83±0.01$^a$ |
| 95 | 53.09±0.00 | 52.45±0.03 | 45.27±0.02 | 50.27±0.02$^b$ |
| 100 | 51.17±0.01 | 49.11±0.02 | 43.30±0.03 | 47.86±0.00$^c$ |
| **Average** | 53.15±0.02$^a$ | 51.53±0.01$^b$ | 45.27±0.01$^c$ | |

*Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).*

**Table 6. Effect of pasteurization to TPC (cfu/ml) of mangrove apple juice**

| Pasteurization temperature ($^oC$) | Pasteurization time (minutes) | | | Average |
|---|---|---|---|---|
| | 2 | 4 | 6 | |
| **90** | 3.03 x $10^3$ | 2.51 x $10^3$ | 1.19 x $10^3$ | 2.24 x $10^{3a}$ |
| **95** | 2.25 x $10^2$ | 1.35 x $10^2$ | 0.66 x $10^2$ | 1.42 x $10^{2b}$ |
| **100** | 37 | 23 | 7 | 22$^c$ |
| **Average** | 10.97 x $10^{2a}$ | 8.89 x $10^{2b}$ | 4.21 x $10^{2c}$ | |

*Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).*

**Table 7. Effect of pasteurization to soluble dry matter (oBrix) of mangrove apple juice**

| Pasteurization temperature ($^oC$) | Pasteurization time (minutes) | | | Average |
|---|---|---|---|---|
| | 2 | 4 | 6 | |
| 90 | 19.44±0.03 | 19.58±0.01 | 20.22±0.02 | 19.75±0.02$^c$ |
| 95 | 20.75±0.01 | 21.31±0.02 | 21.93±0.01 | 21.33±0.01$^b$ |
| 100 | 21.05±0.02 | 22.46±0.02 | 22.81±0.01 | 22.11±0.00$^a$ |
| **Average** | 20.41±0.00$^c$ | 21.12±0.01$^b$ | 21.65±0.03$^a$ | |

*Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).*

**Table 8. Effect of pasteurization to acidity (%) of mangrove apple juice**

| Pasteurization temperature ($^oC$) | Pasteurization time (minutes) | | | Average |
|---|---|---|---|---|
| | 2 | 4 | 6 | |
| 90 | 0.58±0.03 | 0.64±0.02 | 0.63±0.01 | 0.62±0.01$^c$ |
| 95 | 0.56±0.01 | 0.69±0.03 | 0.72±0.02 | 0.66±0.02$^b$ |
| 100 | 0.63±0.00 | 0.71±0.00 | 0.70±0.01 | 0.68±0.01$^a$ |
| **Average** | 0.59±0.01$^c$ | 0.68±0.01$^b$ | 0.68±0.01$^a$ | |

*Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).*

## IV. CONCLUSION

Phytochemical analysis of fruit extract revealed the presence of carbohydrate, protein, flavonoid and phenolic compounds. The ripe mangrove apple is a potential source of natural antioxidants owing to its significant antioxidant activities. It can enhance the capability of antioxidant human body and therefore reduce the risk of chronic diseases. It is sweet in taste and usually consumed fresh or made into juice. We have successfully produced mangrove apple juice as a healthy drink.

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