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Development of Mangosteen Juice using Mangosteen Peel Extract Mixed with Tropical Fruits

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Abstract **– The objectives of this study were producing juice from whole fruit of mangosteen using enzymes (cellulase and pectinase enzyme), autoclave (120°C, 15minutes) and ultrasonic pretreatment, followed by removing bitter taste using chemical and physical methods. The results of this study have shown that the highest juice yield could be achieved by using autoclave pretreatment. Debittering of mangosteen peel extract using chemical methods such as adding calcium carbonate, calcium acetate, gelatin and pectin showed that the calcium acetate is suitable chemical to reduce the bitter taste of mangosteen peel extract. Furthermore, the formulated mangosteen peel juice as a mixture from passion fruit juice and orange juice indicated that the prepared juice have high sensory acceptant of odor, taste and color.**

Keywords **– Mangosteen Extract, Bitter Removal, Juice Formulation.**

I. INTRODUCTION

The mangosteen (*Garcinia mangostana* L.) is a tropical evergreen tree, belonging to the family of *Guttiferae*. Its origin is in Southeast Asia. It can now be cultivated in many countries including Northern Australia, Brazil, Central America, southern India, Indonesia, Malaysia, Thailand, and other tropical countries. The edible fruit is deep reddish purple when ripe. The fruit hull of mangosteen has been used as a medicine for skin infection, wound, dysentery and diarrhea [1]. The rind (pericarp) of mangosteen fruit contain high amount of xanthones with antioxidant [2-5], antibacterial [6-8], antifungal [9], anti-inflammatory [10, 11], antitumor [3, 12-19], antiplatelet aggregation [20], antithrombotic [21] and vasorelaxant activities [22]. In addition xanthones are histamine and serotonin receptor blockers [23, 24], and can inhibit HIV [25]. Mangosteen has been used as a ingredient in several popular commercially available nutritional supplements, including Xango, a on mangosteen fruit basis drink.

Although mangosteen peel has many active substances such as xanthons, it does not use to produce juice because of its bitter taste. Xanthones belong to a class of plant polyphenolic compounds. Xanthones are effective against atherosclerosis, hypertension and thrombosis [26]. It is necessary to improve production technique of mangosteen juice from whole fruit by using advanced techniques to increase the juice yield and to improve the consumer acceptance.

II. MATERIAL AND METHODS

A. *Raw Materials*

Fresh mangosteen was purchased from the market (in Bangkok, Thailand) and stored at -20 °C until used. Chemicals used in this study were analytical grade. Enzymes used in this study were technical grade (company AB, Germany and company Valley, USA). Activated charcoal (granular size of <1mm) was from Suksapan Panit Company, Thailand. Pectin (ED = 34%) was from Herbstrieeth & Fox KG, Germany.

B. *Preparation of Mangosteen Peel Juice*

Untreated method: 100 g of Mangosteen peel was mixed with 200 g distilled water and grinded in a household mixer (Philips, type Twist, Indonesia). The grinded peel was adjusted at pH = 4 using fresh lemon juice. After that the sample was pressed using a laboratory scale hydraulic press at 50 bars for 15 min. The juice was collected and weight.

Autoclave method: 100 g of Mangosteen peel was autoclaved at 120 °C for 15 min. After that the sample was mixed with 200 g distilled water and grinded in a household mixer. The grinded peel was adjusted at pH = 4 using fresh lemon juice. Finally the sample was pressed using a laboratory scale hydraulic press at 50 bars for 15 min. The juice was collected and weight.

Ultrasonic treatment: 100 g of Mangosteen peel was mixed with 200 g distilled water and grinded in a household mixer. The grinded peel was adjusted at pH = 4 using fresh lemon juice. After that the grinded sample was pretreated using ultrasonic equipment (sonopulse 3200, Bandlin, Germany) in an ultrasonic chamber with cooling jacket at 100 W for 10 min. Finally the sample was pressed using a laboratory scale hydraulic press at 50 bars for 15 min. The juice was collected and weight.

Enzymatic treatment: 100 g of Mangosteen peel was mixed with 200 g distilled water and grinded in a household mixer. The grinded peel was adjusted at pH = 4 using fresh lemon juice. The prepared sample was mixed with enzyme solution containing different enzymes (ROHAPECT D5L 0.25 ml, ROHALASE SEP 0.5 ml, ROHALASE CL 0.5 ml, VALIDASE ANC-L 0.5 ml) and incubated in water bath at 50°C for 9 hours. Finally the sample was pressed using a laboratory scale hydraulic press at 50 bars for 15 min. The juice was collected and weight.

C. *Removal Bitter Taste from Mangosteen Peel Juice using Chemicals*

Using gelatin: 1 g gelatin was dissolved in 50 g warm (50°C) mangosteen peel juice ant stirred on magnetic stirrer until the gelatin was dissolved (about 20 min) followed by centrifugation (4000 rpm, 15 minutes).

Using pectin: 2 g pectin powder was dissolved in 40 g boiling distilled water. The prepared pectin solution was added into 15 g of mangosteen peel juice and mixed on magnetic stirrer for 10 min. After that the mixture was centrifuged at 4000 rpm for 15min. The centrifuged juice was mixed with calcium carbonate powder to adjust pH = 9. Finally the sample was centrifuged again (4000 rpm, 15min).

Adding calcium carbonate: The calcium carbonate powder was directly added into mangosteen peel juice to adjust pH = 8. The sample was then mixed on magnetic stirrer for 10 min followed by centrifugation at 4000 rpm for15 minutes.

Adding calcium acetate: The calcium acetate powder was directly added into mangosteen peel juice to prepare 2 and 3% (w/w) calcium acetate containing juices. The samples were stirred for 1 hour at room temperature. After that the samples were centrifuged (4000 rpm, 15 minutes).

Adding potassium hydrogen phosphate: 1 and 1.5 g of potassium hydrogen phosphate powder were added in 5o g of mangosteen peel juice to prepare 2 and 3% (w/w) potassium hydrogen phosphate containing samples. The samples were stirred for 1 hour at room temperature. After that the samples were centrifuged (4000 rpm, 15 minutes).

Adding activated charcoal: 5, 10, 20, and 30 g of activated charcoal powder (granular size <1mm) were g ma-

-ngosteen peel juice. The samples were stirred on magnetic stirrer for 1h at room temperature. Finally the samples were filtered on filter paper (Whatman Nr. 1, Germany).

All the samples after removing the bitter substances were subjected to UV-Spectral measurement to defined the concentration of remaining xanthone in samples 517 nm.

D. *Juice Formulation*

(a) 100 g of mangosteen peel juice prepared by enzymatic method without debittering was mixed with 200 g passion fruit juice, add 20 g of sugar (EN+PA).

(b) 100 g of mangosteen peel juice prepared by enzymatic method without debittering was mixed with 200 g passion fruit juice (Doi Kham Brand, Thailand), add 20 g of sugar and 70 g of rosella extract (EN+PA+RO).

(c) 100 g of mangosteen peel juice was prepared by enzymatic method and subsequent removing bitter taste using calcium acetate was mixed with 400 g orange juice, add 12.8 g of sugar and 75 g of red beet extract (CA+OR+BE).

(d) 100 g of mangosteen peel juice was prepared by enzymatic method and subsequent removing bitter taste using calcium acetate was mixed with 200 g passion fruit, add 20 g of sugar and 70g of rosella juice (CA+PA+RO).

(e) 375 g of mangosteen peel juice was prepared by enzymatic method. 175 g of mangosteen fruit juice was added in peel juice. Finally, the sample was diluted using 562.5 g of distilled water (EN+EN).

(f) For comparison of formulated mangosteen peel juice with commercial on the market available mangosteen juice was the mangosteen juice from company Tipco, Thailand applied (T).

E. *Thermal Treatment*

The prepared juices (about 100 ml) were packaged in a poly ethylene bag, sealed and immersed in water bath at 90 °C for 2 min. Immediately after heat treatment the samples were immersed in cold water bath (about 10°C±1°C) to cool the samples.

F. *Analytical and Sensory Evaluation*

For measurement of xanthone in mangosteen peel juice was 20 ml of mangosteen peel juice evaporated in a rotary evaporator (40°C, 72 mbar). The methanol (99 % v/v) was and in concentrated sample and filtered using whatman no 1. Then adjust volume of filtrate to 25 ml using methanol. The absorbance of sample was measured using UV-Spectrophotometer at 517 nm.

The sensory Evaluation was carried out using hedonic sensory evaluation. 30 volunteers persons have tested the sensory acceptance of prepared juices and give score 1 (not acceptable) to 5 (highly acceptance).

III. Results and Discussions

A. *Analytical and Sensory Evaluation*

Mangosteen peel juice yield: The result of juice yield after different pretreatment methods is shown in figure

1. The juice yield from autoclaved sample is highest followed by enzymes, ultrasonic and untreated samples.

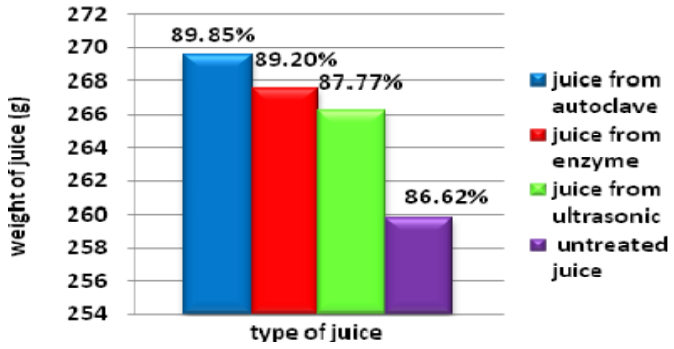

Fig. 1. Juice yield after treatments.

B. *Analytical and Sensory Evaluation*

Measurement of xanthone concentration in mangosteen peel juice showed that the enzyme treated peel contains higher xanthone compare to other pretreatment and untreated samples (figure 2).

Fig. 2. Xanthone content in juice.

The measurement of xanthone after removing bitter taste using different methods indicated that the juice treated with calcium acetate have higher xanthone concentration compare to the juice treated with gelatin, pectin or calcium carbonate (figure 3).

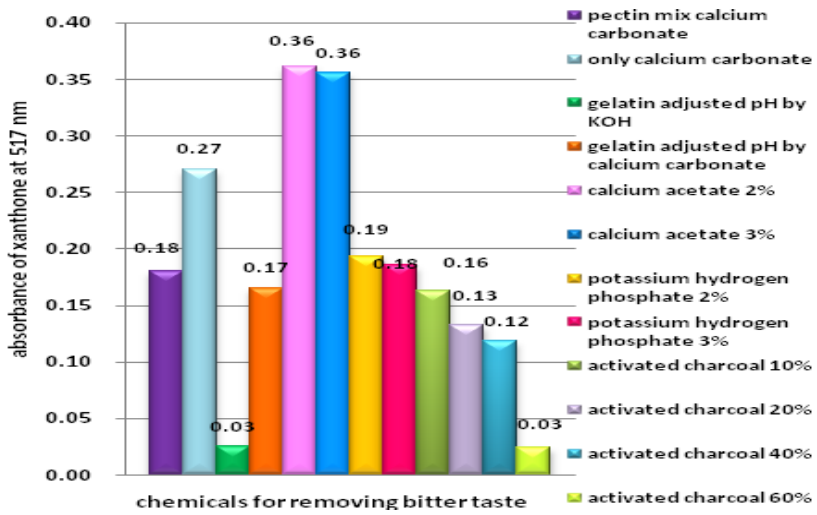

Fig. 3. Effect of different debittering methods on xanthone concentration.

Thermal pasteurization of formulated mangosteen juice resulted distinct higher xanthone concentration compare to on the market available mangosteen juice.

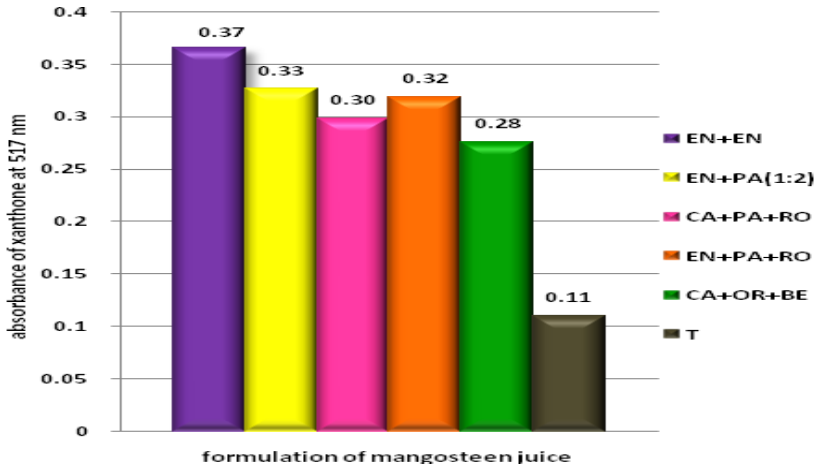

Fig. 4. Effect of thermal pasteurization of different formulated mangosteen juice on xanthone concentration.

Thermal pasteurization at 90 °C for 2 min was sufficient to inactive vegetative microorganism in formulated juice (up to 7 log microorganism inactivation) (Table 1).

Table 1. The microorganism count in formulated mangosteen PEELS juice before and after thermal pasteurization (90 °C, 2 minutes).

Sample	CFU/ml* before Pasteurization	CFU/ml* after Pasteurization
EN+EN	$2x10^3$	0
EN+PA (1:2)	$3x10^3$	0
CA+PA+RO	$1.2x10^5$	0
EN+PA+RO	$2.7x10^4$	0
CA+OR+BE	$1.5X10^3$	0

*CFU = Colony forming unit.

The highest acceptance value for color of formulated mangosteen peel juice was observed for mangosteen peel juice containing passion fruit and rosella extract followed by mangosteen peel juice containing mangosteen fruit juice (figure 4). The lowest color acceptance was observed for mangosteen juice from market and the debittered mangosteen peel juice containing orange juice and red beet extract.

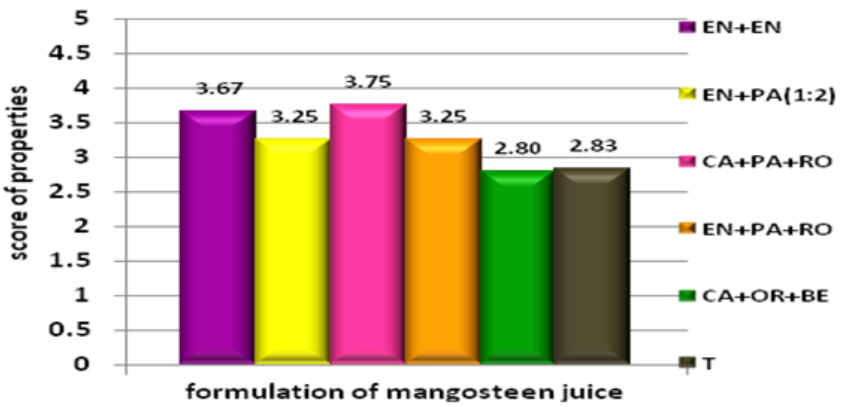

Fig. 5. Color of mangosteen juice with different formulation after thermal pasteurization.

The odor of mangosteen peel juice containing passion fruit juice indicated the highest sensory acceptance followed by mangosteen peel juice containing mangosteen fruit juice. The mangosteen juice from market showed lowest odor acceptance.

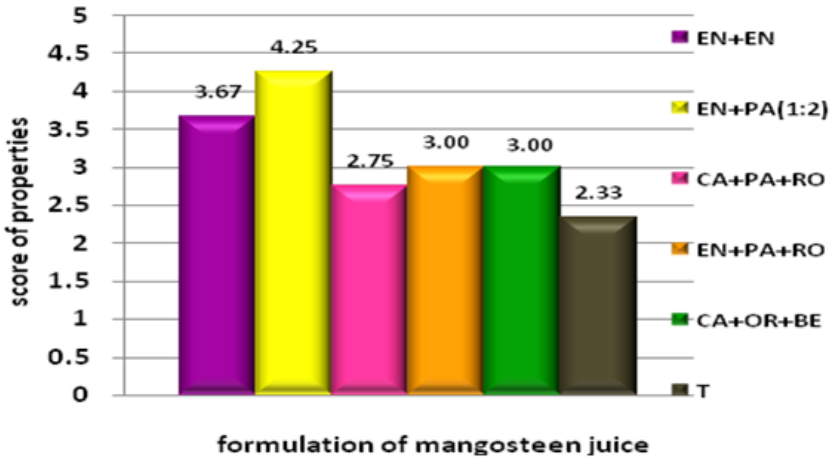

Fig. 6. Odor of mangosteen juice with different formulation after thermal pasteurization.

The sensory evaluation of mangosteen juice taste showed highest value for mangosteen peel juice containing passion fruit. In contrast was the taste of mangosteen juice from market less acceptable compare to formulated mangosteen peel juice.

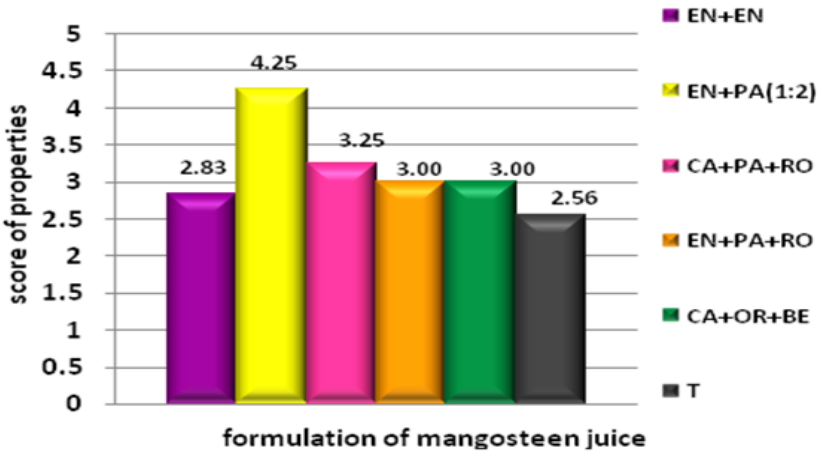

Fig. 7. Taste of mangosteen juice with different formulation after thermal pasteurization.

IV. Conclusion

Using different methods the mangosteen peel juice could be extracted. The highest peel juice yield was achieved using autoclave as pre-treatment method. In contrast was the xanthone concentration in juice pre-treated with enzyme highest. Generally, removing bitter taste using chemicals lead to decrease of xanthnoe concentration in mangosteen peel juice. The best method for debittering was application of calcium acetate. All formulated mangosteen juice had higher xanthone concentration as well as color and taste acceptance compare mangosteen juice from the market. The formulated mangosteen peel juices indicated distinct higher xanthone concentration than xanthone concentration in the commercial available mangosteen juice. The best sensory acceptance for color, odor, and taste was observed for mangosteen peel juice containing passion fruit juice followed by mangosteen peel juice containing mangosteen fruit juice.

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