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Formulation, Sensory and Pulp Stability of Durian (*Durio zibethinus*Murr) Juice

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Durian (*Duriozibethinus*Murr) is a popular tropical fruit widely grown in South-East Asia. Due to it is highly nutritious; thus, durian juice was formulated with different concentrations of 20, 25 and 30 % w/w of durain puree, and, with or without the coconut milk. The effects of different concentrations of durian pulp on various parameters (e.g., color, pH, total soluble solids (TSS), viscosity and sensoryevaluation) were investigated. The juice was fourel to be light yellow in color similarly to soy bean milk or to light brown color with depended upon time (min) and temperature (°C) of sterilization. The results indicated that TSS, pH and viscosity of the juice increase varied by the puree concentration. Consumer rated this product to like slightly of 6.03±0.2 from 9- point Hedonic scale. Like many commercially available beverages, durian juice has unstable over a period of time. Therefore, the addition of stabilizing additive; gellan gumin various concentrations of 0, 0.01, 0.015 and 0.02 %w/w to maintain the juice homogeneity at room temperature 27-34 °C was studied. As the result, there was significant increased in viscosity of the juice varied by gellan gum concentration which was found that the minimum concentration of 0.015 %w/w could be used to maintain the juice stability within 28 days.

Keywords: Durian, pulp, puree, gellan gum

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Introduction

Durian (*DuriozibethinusMurr*) is a tropical fruit widely grown in Thailand and South-EastAsia. Thailand is the world's largest durian exporter, with roughly 90% of the international market share (Bais, 2016). Durian is entitled "King of Tropical Fruit" due to the superlative flesh, which is the edible portion (aril) of durian has a very strong odor (Baldry *et al*., 1972), andhighly nutritional (Subhadrabandhu and Ketsa, 2001). Attempts therefore have been made to add value to the durian fruit. According to Jagtiani *et al*. (1988), tropical fruitjuices or drinks have become important because of the increasing in consumption of 'natural fruit' juice alternated to the traditional caffeine-containing beverages such as coffee, tea or carbonated softdrinks. Fruit juices which are highly nutritional became an important source of energy in the form of sugars, glucose, fructose and sucrose (Serpen, 2012), and tend to be marketed (Floribeth and Lastreto, 1981). However, one drawback is that many juices suffer from both juice cloud settling and pulp separation during storage. The juice considered 'muddy' or undesirable, once the fruit juice solids (e.g., pulp) have separated which often will have either settled toward the bottom of the container or floated toward the surface, depending upon the relative densities of the solids and the liquid product (Leon and Boak, 1984). In either event, the product thus is non-uniform in composition throughout the container. Viquez *et al*. (1981) reported that producing tropical fruits juices by normal hydraulic pressing or centrifugation tend to be too pulpy and pectinaceous. Thus, commercial pectinolytic enzymes have been used with other fruit juices such as apple and banana (Viquez*et al*., 1981) to reduce the viscosity or maintain the fruit juice solids in suspension.

Like the others fruit juice, durian juices are usually cloudy and colloidal suspensions that have an unstable cloud or the turbidity (Norjana and Noor-Aziah, 2011). The use of pectic enzymes in durian juice processing is essential to get better juice yields, improve filtration rate and produce clear juices of high quality for the concentration process (Norjana and Noor- Aziah, 2011). Nowaday, the important natural or synthetic additive stabilizers which find application in fruit processing as gelling agents include alginate, pectin, carrageenan, gellan, gelatin, agar, modified starch, methyl cellulose and hydroxypropyl methylcellulose (Banerjee and Bhattacharya, 2012). The formation of gel involves the association of randomly dispersed polymer segments in dispersion to form a three-dimensional network that contains solvent in the interstices. The associated regions known as 'junction zones' may be formed by two or more polymer chains (Oakenfull, 1987; Burey et al., 2008). Gellan gum is a water-soluble anionic straight chain polysaccharide based on repeating glucose, rhamnose, and glucuronic acid units that produced

by the bacterium *Sphingomonas elodea*. It was first approved for food additive use in Japan (1988), it has E number E418 and widely used as a thickener, emulsifier and stabilizer (O'Neill *et al.*, 1983; Anderson *et al.*, 1988). Gellan gum can be used to overcome cloud and pulp settling in juices while providing a mouthfeel that is light and refreshing when compared to other stabilizers. The amount of gellan gum present in the beverage is about 0.01-0.15 %w/w of gellan gum and the average temperature for gelation is 30-45°C (Imeson, 2010).

Objectives: this study was to formulate and evaluate the consumer acceptance of durian juice, moreover, the physicochemical characteristics of the durian juice added with gellan gum was dicussed.

Materials and methods

Fruit

Durian fruit (*Duriozibethinus*Murr) used in this study was obtained from Ban kohloi herb manufactrues group SMCE, Chanthaburi, Thailand. The fruits were dehusked (cut open the rind), by cutting along the suture on the back of the locules. Samples were frozen at -18℃ to maintain the quality prior to preparation of the puree.

Preparation of puree

Fruit pulps were thawed and separated from seeds by hand and blended using a food blender (Philips ProMix Hand Blender). Water was added to the pulp in the ratio of 1:2 w/w to facilitate the extraction process. The extraction process was blended for 5-10 minutes and passed through the sieve in order to get a smooth-textured puree.

Preparation of Juice

Durian juice in various concentration of puree of 20, 25 and 30 %w/w were prepared with coconut milk of 0 and 5.0 %w/w, and added sugar of 7.5% w/w. Different formulations of durian juice shown in table 1.

Table 1. Different formulations of durian juice

Sample/ Formulation	Durian puree (w/w)	Coconut milk (w/w)	Sugar (w/w)	Drinking Water (w/w)
T1	20	0	7.5	72.5
T2	20	5.0	7.5	67.5
T3	25	0	7.5	67.5
T4	25	5.0	7.5	62.5
T5	30	0	7.5	62.5
T6	30	5.0	7.5	57.5

Then each formulationcan be blended using a food blender (Philips ProMix Hand Blender) and batch pateurised in a stainless steel, enamelled or aluminium pan over a gas flame, which increases the temperature of the juice to 70-80 ℃ for 5 min, and then hot filled into pasteurized bottles and sealed. The filled bottles were sterized at 118 ℃ for 15 min to chieve the correct shelf life of the juice. Then, the representative samples of 35% with and without coconut milk of 5.0 %w/w were subjected for microbial growth analysis (coliform bacteria, *Escerichia coli*, *Staphylococcus aureus* and *Salmonella spp*.) and nutrition test by using the standard procedures.

Determination of soluble solids content and pH

Juices were analyzed for total soluble solids (TSS) measured by portable Otago Hand Refractometer (N1) with a scale of 0-32 ℃Brix and the values were expressed in degree Brix (℃Brix). The pH value was measured using a digital pH meter (Extech PH100ExStik pH meter).

Sensory evaluation

For sensory evaluation of the juices, the product was evaluated by sensory evaluation, and was conducted in the Rajamangala University of technology Tawan-ok, Chanthaburi campus. Durian juice was evaluated for sensory qualities on the basis of colour (appearance), aroma, taste, texture and overall acceptance using the 9-point Hedonic scale (1= dislike extremely, 9= like extremely) (Amerine *et al*., 1965). Juice samples were allowed to equilibrate in room temperature (27 ℃) for 1h prior to sensory evaluation session. Testing was done in the sensory laboratory. Each panelist was served with randomly coded of juice sample.

The effect of gellan gum amount on durian juice during storage

The stabilizer gellan gum in various concentrations of 0.01, 0.015and 0.02 % w/w was preparied by dissolving the required amounts of each concentration in distilled water at 80 ℃. Then, durian puree and sugar was added at the concentration of 30 and 7.5% w/w, respectively. The mixture was blended using food blender and quickly pasteurized to 70-80 ℃ for 5 minutes and hot filled into pasteurized bottles and sealed. The filled bottles were sterilized at 118 ℃ for 15 min. On days 0 and 28, the viscosity was evaluated.

Determination of viscosity

The viscosity measurement was made by using a viscometer (Model DV-III Ultra, Brookfield). Juice sample was filled to the 50 ml level mark in a 100 ml beaker and the reading was taken using spindle No. 31 rotated at 200 rpm at 28$\pm$0.5 ℃.

Statistical analysis

The data were analyzed with an analysis of variance (ANOVA) with significance defined as $p \leq 0.05$, and the means were separated with Duncan's multiple range tests using SPSS for Windows. Significance of differences between control and treated samples was evaluated using Duncan's multiple range tests at the 5 % level.

Results

Durain Juice Formulation

The durian puree obtained from dehusked and freezed (cut open the rind), and, the juices were formulated in the various concentration of puree of 20, 25 and 30 %w/w with and without coconut milk of 5.0 %w/w, and sugar of 7.5% w/w. Each batch formulation can be blended and pateurised the juice to 70-80 ℃ for 5 min, fellowed by hot filled into pasteurized bottles and sealed. Then filled bottles were sterilized at 118 ℃ for 15 min. The characteristics of the juices are indicated in table 2. And the microbial amount in 100 ml of the representative 35% of puree as shown in table 3.

Table 2. Physiochemical characteristics of durian juice

Sample/ Formulation	Durian puree (w/w)	Coconut milk (w/w)	Sugar (w/w)	TSS	pH
T1	25	0	7.5	17	5.7
T2	25	5.0	7.5	18	5.8
T3	30	0	7.5	19	5.7
T4	30	5.0	7.5	20	5.8
T5	35	0	7.5	19	5.8
T6	35	5.0	7.5	22	5.8

Results from table 2 indicated a highly total soluble solid of the juice was increased depended on the amount of the puree and coconut milk added tend to increase TSS in each puree concentration. No such effect on pH value of the juice which indicated in the range of 5.8$\pm$0.1.

Table 3. The microbial amount in 100 ml of sterilized durian juice

Microbial	Coconut milk (w/w)		Standard	Standard Procedure
	(none)	5.0		
Coliform bacteria	<1.1	<1.1	<2.2	MPN
E. coli	none	none	none	APHA(Water): 2012 (9221 E)
S. aureus	none	none	none	ISO 6579: 2002/ Cor. 1: 2004
Salmonella spp.	<1	<1	<1	BAM: 2001

The heat treatment of 80°C for 5 min and fellowed by sterilization process at 118 °C for 15 min of durian juice (35 %w/w durian puree) was suitable controled the amount of coliform bacteria, *E. coli*, *S. aureus* and *Salmonella spp*. to the safety requirement specification of ready-to-drink fruit juice in air tight container-package. Moreover, high temperature and long time sterilization process effected to aroma and color of the juice (data not shown).

Durain Juice nutrition

The samples durian juice with and without coconut milk of 5.0 %w/w were detected of their nutrition values by using the standard procedure are indicated in table 4.

Table 4. The nutrition fact for 1 serving size (50 ml) of durian juice

% Daily Value	Coconut milk (None)		Coconut milk (5 %w/w)		Standard Procedure
	50 ml	%RDI	50 ml	%RDI	
Total Juice Calories (Kcal)	50	-	50	-	In house method TE-CH169
Total Fat (g)	0	-	1	2	AOAC (2016)922.06
Total calorie from Fat (Kcal)	0	0	10	0	In house method TE-CH169
Fat (g)	0	0	0	0	In house method TE-CH143
Protein (g)	0	-	0	-	In house method TE-CH042
Total Carbohydrates (g)	12	4	11	4	In house method TE-CH169
Fiber	<1	3	<1	2	In house method TE-CH076
Vitamin B1 (mg)	0.04	2	0.04	2	In house method TE-CH057
Calcium (mg)	1.67	0	0	-	AOAC (2012)984.27
Iron (mg)	0.14	0	0.12	0	AOAC (2012)999.10
Sodium (mg)	0	-	0	-	AOAC (2012) 984.27
Moisture (g)	85.14		86.01	-	AOAC (2012) 925.45 (A)

The suitable serving size of sterilized durian juice (35 % w/w of puree) is 50 ml which total calories of it was 50 Kcal. In addition, which that combined of 5 %w/w coconut milk was increased 20 % of total calories from fat without the cholesterol. The number of grams of total carbohydrate in a serving expressed 11-12. It was contained dietary fiber, which about 2-3 % of Reference darily intake (RDI), and a source of health benefiting thiamine (vitamin B1) of 0.04 mg, additionally, it also contains high levels of tryptophan and potassium (data not shown).

Sensory quality of Durain juice

Durian juice was evaluated for sensory qualities on the basis of color (appearance), aroma, taste, texture and overall acceptability by a panel of 10 judges on a 9 - point Hedonic scale and the results as shown in table 5.

Table 5. Sensory test of durian juices

Durian puree	Coconut milk	Sensory test				
		Color^{ns}	Aroma	Taste	Texture^{ns}	Overall Acceptibility^{ns}
20	0	6.36	5.88^{b}	5.36^{b}	5.62	5.84
	5.0	6.04	6.12^{b}	5.86^{ab}	5.82	6.02
25	0	6.06	6.08^{a}	5.82^{ab}	5.82	6.24
	5.0	6.20	6.18^{b}	5.62^{b}	5.80	5.82
30	0	6.58	6.30^{b}	6.12^{a}	5.84	6.24
	5.0	6.14	6.02^{b}	5.90^{a}	5.86	6.02

According to the sensory quality of durian juice in table 5 which the regular consumer rated the product of 20-30 %w/w of puree with and without coconut milk to like slightly of 10 judges on a 9 - point Hedonic scale.

Pulp stability of Durain juice

The stabilizer gellan gum in various concentrations of 0.01, 0.015, and 0.02 %w/w was studied on the pulp stability of durian juice; 30 %w/w of puree without coconut milk. Each mixture was blended using food blender and quickly pasteurized to 70-80 ℃ for 5 minutes and hot filled into pasteurized bottles and sealed, fellowed by sterilization process at 118 ℃ for 15 minutes. On days 0 and 28, the viscosity was evaluated as shown in table 6.

Table 6. Viscosity test of durian juices

Gellan gum (w/w)	Needle No.	Speed (rpm)	Torque		Viscosity(cP)	
			0 day	28 days	0 day	28 days
0	31	200	56.5	56.4	93.6^{a}	84.7^{a}
0.01	31	200	63.0	61.0	98.0^{b}	94.6^{b}
0.015	31	200	69.4	65.3	107.4^{c}	103.3^{c}
0.02	31	200	72.6	70.0	112.8^{c}	108.7^{c}

In the presence of gellan gum, floated toward the surface of durian juice was decreased (data not shown). The viscosity of the durian juices were increased dependent on concentration of gellan gum. It is clearly observed that change in the viscosity of the juice is strongly influenced by gellan gum concentration of 0.015 %w/w has been considered as an optimum batch viscosity and appearance.

Discussion

It is an interesting to formulate durian juice as an alternate juice to the traditional caffeine-containing beverages such as coffee, tea or carbonated

softdrinks. Sensory measurement is generally more useful in the development of new products and determining product standards (Shewfelt, 1993). It has been found that the consumers have a preference acceptability score for durian juice at 20-30 %w/w of puree without coconut milk to like slightly. Moreover, with coconut milk their evaluated that were changed flavor and reduced yellowish color of the juice. Like many exotic juice (Kregiel, 2015), durian juice formulations have low acidity that was 5.8±1 which provide conditions suitable not only for the survival but also for the growth of pathogenic bacteria (Tribst *et al.*, 2009). The heat treatment processing of durian juice by hot-filled of the blended juice into 150 ml of clean and pasturied glass bottle, followed by sterilization at 180 ℃ for 15 minutes have been reduced the microoranisms to the level of safety requirement specification of ready-to-drink fruit juice in airtight container-package (Ristovska *et al*., 2012). While, high temperature with long time affected to flavor and color of the juice (data not shown).

The total calories of of 1 serving of sterilized durian juice which contained 35 % w/w of puree combined with and without coconut milk are equally of 50 Kcal. The number of grams of total carbohydrate in a serving expressed to 12, and 11 in the juice with and without coconut milk, respectively. Fiber have been found in durian juice which makes a good bulk laxative (De Vries *et al.*, 2015), and helps protect the colon mucous membrane by decreasing exposure time to toxins (Brownlee *et al.*, 2003), and helps eliminates cancer-causing chemicals from the gut (Shankar and Lanza, 1991; Howe *et al*., 1992). Durian is a source of health benefiting thiamine (vitamin B1) which its phosphate derivatives are involved in many cellular processes. The best characterized form is thiamine pyrophosphate (TPP), a coenzyme in the catabolism of sugars and amino acids (Mkrtchyan, 2015). Additionally, it also contains high levels of tryptophan (data not shown); the essential amino acid which is a precursor to the neurotransmitter serotonin and the hormone melatonin (Slominski *et al*., 2002), and act as building blocks in protein biosynthesis that are required to sustain life (Schaechter and Wurtman, 1990).

Like many cloudy fruit juice, durian juices have the floated of the pulp toward the surface during storage of time. Generally samples with gellan gum individually show more viscosity, lower separation. In general, the gums concentration affected the stability of the durian juice. It is reported that low acylated gellan gum gives non-elastic and brittle gel with a very low concentration (Ghafoor *et al.*, 2008).

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