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PHYSICOCHEMICAL AND ORGANOLEPTIC PROPERTIES OF COCOA BUTTER-BASED AVOCADO ICE CREAM AS AFFECTED BY AVOCADO PULP CONCENTRATION

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ABSTRACT-*Avocado is a nutrient and phytochemicals dense fruit which may support a wide range of potential health benefits especially in reducing cholesterol and preventing cardiovascular diseases. Therefore, this phytochemical rich avocado was utilised to enhance the nutritional value of cocoa butter-based ice cream. The objective of the study was to investigate the physicochemical and organoleptic properties of cocoa butter-based avocado ice cream as affected by avocado pulp concentration. Milk content in the formulation of ice cream was substituted with avocado pulp at concentration of 10, 20 and 30% respectively. Samples were analysed for total solids, meltdown, colour (L*, a* b* values) and organoleptic properties (colour, sweetness, avocado flavour, texture, meltability, overall acceptability). Increment of avocado pulp concentration from 10 to 30% significantly increased ($p<0.05$) the total solid (35.21±0.01 to 39.10±0.05); and colour changed significantly to greener (a* value: -2.46±0.01 to -3.34±0.06) and more yellowish (b* value: 17.55±0.08 to 27.53±0.08). Nevertheless, the meltdown of the ice cream was reduced with the increase of avocado pulp concentration. Sensory evaluation showed that ice cream contains 30% of avocado pulp was most preferred by the panels.*

Keywords: avocado, cocoa butter, ice cream, physicochemical properties, sensory evaluation

INTRODUCTION

Avocado (*Persea americana*) also known as alligator pear is a tropical fruit that has been recognized for its health benefits especially in reducing cholesterol and preventing cardiovascular diseases due to the compounds present in the lipid fraction such as omega fatty acids, phytosterols (β-sitosterol), tocopherols (α-tocopherol), and squalene (Duarte *et al*., 2016). Moreover, avocado especially *Hass* variety containing significant levels of fibre (6.80 g/100 g) vitamin A (7 µg/100 g), B_2 (1.91 mg/100g), B_3 (1.46 mg/100 g), B_6 (0.29 mg/100g), C (8.80 mg/100 g), E (alpha-tocopherol) (1.97 mg /100g), K (21.0 µg/100 g), folic acid (89 µg/100 g), and minerals such as potassium (507 mg/100g), phosphorus (54 mg/100g), magnesium (29 mg/100 g), calcium (13 mg/100 g) and sodium (8 mg/100g) (Dreher and Davenport, 2013).

Ice cream is one of the most indulge frozen desserts in the world; however, this cold, creamy and comforting treat are generally labelled as an unhealthy food. Therefore, this phytochemical rich avocado was utilised to enhance the nutritional value of cocoa butter-based ice cream. Moreover, ice creams can be regards as a favourable vehicle for incorporating health-promoting ingredients due to the frozen storage that enable to preserve the functional traits of added health-promoting compounds (Soukoulis *et al*., 2014). The objective of the current study was to investigate the physicochemical and organoleptic properties of cocoa butter-based avocado ice cream as affected by avocado pulp concentration.

MATERIALS AND METHODS

Materials

For the production of cocoa butter-based avocado ice cream (CBAIC), the ingredients comprised of ripe avocados (variety: Hass; imported from Australia), sugar, fresh skim milk and salt were purchased from the supermarket, skim milk powder was obtained from the pharmacy store, vanilla flavour was obtained from the bakery shop, deodorised cocoa butter was procured from the local cocoa grinder,

stabilizer and emulsifier were obtained from Danisco Malaysia Sdn. Bhd.

Methods

Production of Cocoa Butter-Based Avocado Ice Cream (CBAIC)

The processing steps involved in the production of CBAIC is shown in **Figure 1**. Avocado pulp (the mashed flesh of avocados) in the concentration of 10, 20, 30% respectively were incorporated into fresh skim milk and heated to 50ºC followed by adding the dry ingredients such as sugar, skim milk powder, salt, stabilizer and emulsifier (total: 26%). All the dry ingredients' composition were kept constant in the formulation of CBAIC. The ice cream mixture were mixed until homogenous prior to pasteurization at 74ºC for 20 minutes using batch pasteurizer (Brand: Taylor; Model: CH02, United State of America). Molten deodorized cocoa butter was added to the pasteurized ice cream mixes followed by homogenization at 5000 rotation per minutes (rpm) for 20 minutes (Brand: Silverson; Model: L5M) before aging at 5ºC for 24 hours. Vanilla flavour was added to the aged ice cream mixes prior to freezing process (12 minutes) using counter top batch freezer (Brand: Taylor by Frigomat; Model: C122, United State of America). The frozen cocoa butter-based ice creams with the avocado pulp concentration of 10%, 20%, and 30% respectively were deposited into ice cream plastic containers (1 kilogram) and stored at -20ºC prior to analyses.

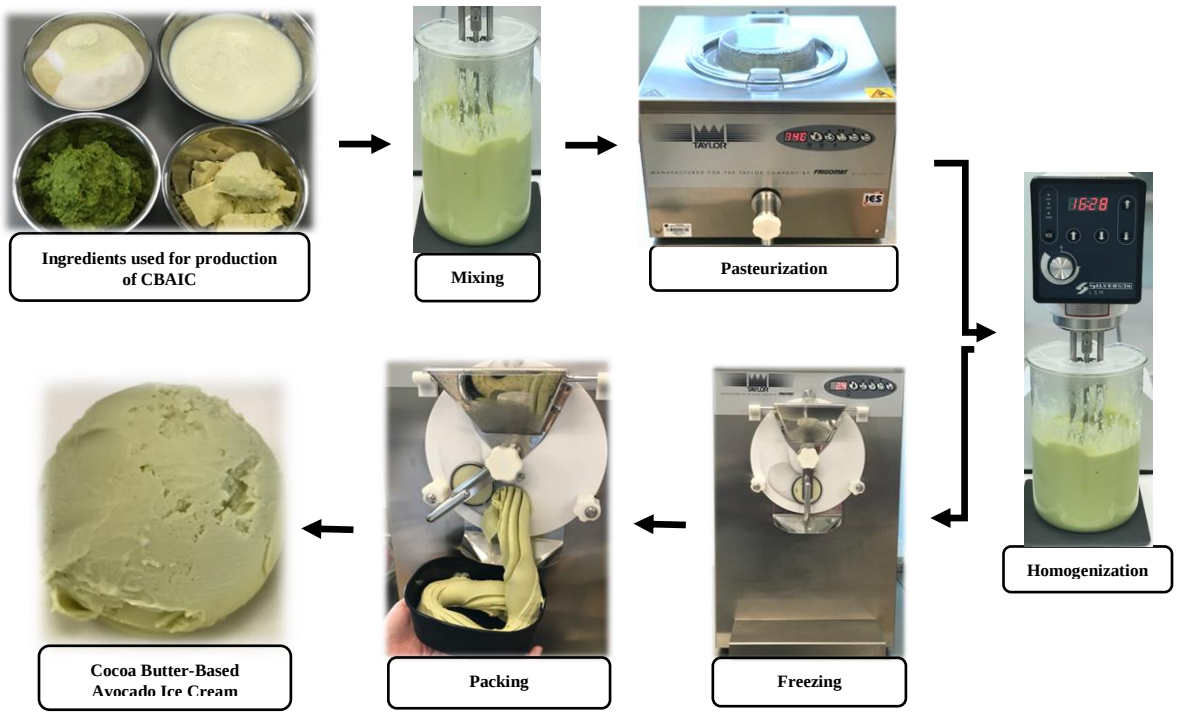

Figure 1: Production of Cocoa Butter-Based Avocado Ice Cream

Physicochemical Properties Analyses

Colour Analysis

The colour of the ice cream samples was measured using a calibrated colorimeter (Brand: Konica Minolta; Model: CR-5, Japan) based on illuminant D65 (intended to stimulated daylight) with 10 degrees viewing angle. Ice cream samples were filled until full into a petri dish (dimension: 60mm (D) x 15mm (H)). The results were expressed using CIELAB parameters (L*, a*, b*) whereby L* measures lightness (100 = white; 0 = black); a* measures chromaticity with positive value indicates redness and negative value indicates greenness; and b* measures

chromaticity with positive value indicate yellowness and negative value indicates blueness.

Determination of Total Solids

The total solids was measured as described by Wehr and Frank (2004). Three grams of the melted ice cream was weighed into a dried and pre-weighed pan. The sample was dried in an oven at 100±2ºC for 3.5 hours. The pan with its dry content was cooled and weighed. The percentage of total solids was calculated as follow:

$$\text{Total Solids (\%)} = \frac{\text{Weight of the dried pan and sample} - \text{Weight of the dried pan}}{\text{Weight of the sample before drying}} \text{x100}$$

Meltdown

The meltdown of the ice cream samples was measured as described by Muse and Hartel (2004). The sample (70 g) was placed on a wire mesh fitted on a funnel that drained into a graduated glass cylinder on top of a weighing balance. The sample was allowed to melt in a controlled temperature at 25 ± 0.1°C. The dripped portion was recorded at 5-minute intervals for a total of 60 minutes and plotted as a function of time.

Sensory Evaluation (Acceptability Test)

The sensorial quality of the ice cream samples was performed according to the procedure of Akbari *et al*. (2016). Twenty (20) panels were recruited to evaluate the ice creams in terms of colour, avocado flavour, sweetness, texture, meltability and overall acceptability using 5-point hedonic scale (Score 5-Extremely Like; Score 4-Like; Score 3-Neither Like or Dislike; Score 2-Dislike; Score 1: Extremely Dislike).

Statistical Analysis

Data were collected in triplicate and statistically analysed by analysis of variance (ANOVA) and mean separation was by least significant difference at $p<0.05$ using Minitab®17 (Minitab Inc., United States of America).

RESULTS AND DISCUSSION

The colour values and total solids of the cocoa butter-based ice cream formulated with different concentrations of avocado pulp were showed in Table 1. Increasing the concentration of avocado pulp from 10% to 30% had significantly increased ($p<0.05$) the greenness (a*: -2.46±0.01 to -3.34±0.06) and yellowness (b*: 17.55±0.08 to 27.53±0.08) whilst decreased the lightness of the ice cream (L*: 75.81±0.05 to 66.53±0.34). The changes of colour were corresponded to the contents of carotenoids and chlorophylls pigments in the pulp of avocado (Ashton *et al*., 2006). The increase of avocado pulp content in the ice cream had resulted the total solids of the ice cream increased significantly ($p<0.05$).

Table 1: Colour Values and Total Solid of the Cocoa Butter-Based Ice Cream with Different Concentrations of Avocado Pulp

Cocoa Butter-Based Avocado Ice Cream with Different Concentrations of Avocado Pulp	Colour			Total Solids (%)
	L*	a*	b*	
10%	75.81±0.05[a]	-2.46±0.01[a]	17.55±0.08[a]	35.21±0.01[a]
20%	72.45±0.04[b]	-2.73±0.00[b]	22.44±0.11[b]	37.01±0.08[b]
30%	66.53±0.34[c]	-3.34±0.06[c]	27.53±0.08c	39.10±0.05[c]

Mean values with different superscript alphabets in the same column are significantly different ($p<0.05$)

Figure 2 illustrates the meltdown of cocoa butter-based avocado ice cream with different concentrations of avocado pulp. It was observed that addition of avocado concentrations from 10% to 30% had decreased the meltdown of the ice cream whereby ice cream with the concentration of 30% had slowest meltdown compared to the ice cream with 10% and 20% of avocado pulp concentrations respectively. *Hass* avocado pulp contains 15.4 % of fat (USDA, 2011); therefore, increase level of avocado pulp had increased the fat content of the ice cream. As the fat content of an ice cream increases, its melting rate decreases (Akbari *et al.*, 2016).

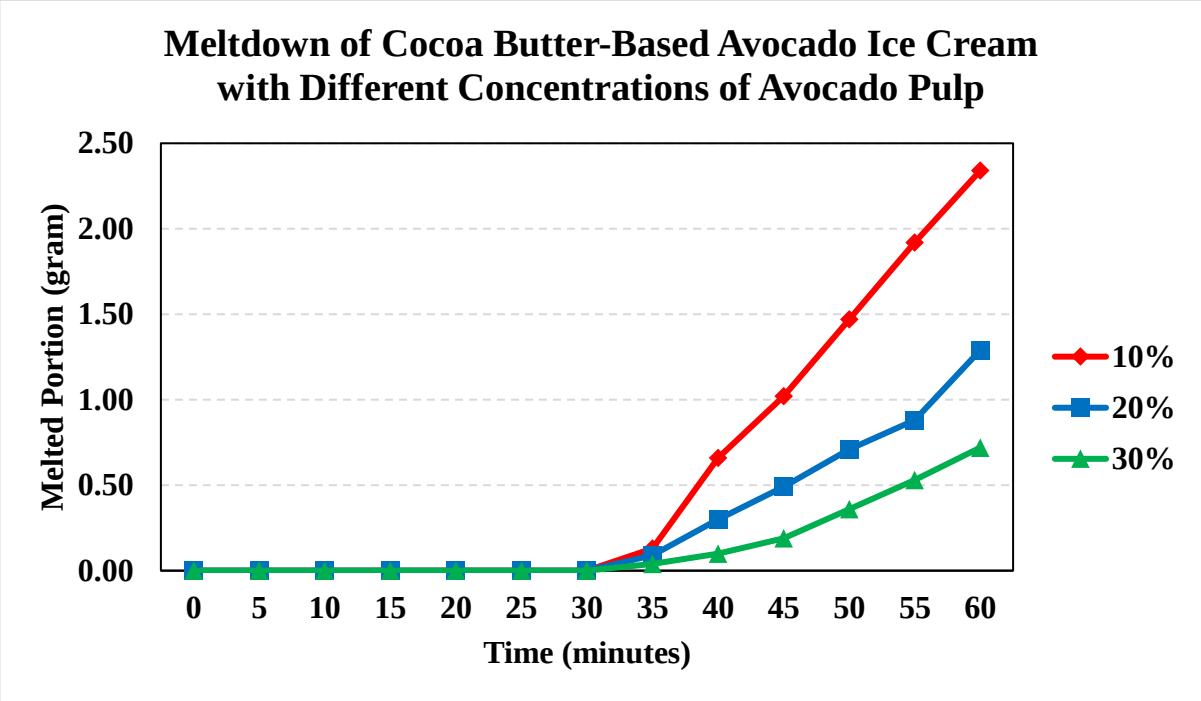

Figure 2: Meltdown of Cocoa Butter-Based Avocado Ice Cream with Different Concentrations of Avocado Pulp

Sensory quality of the cocoa butter-based avocado ice cream with different concentrations of avocado pulp was showed in Table 2. Addition of avocado pulp concentration from 10% to 20% had significantly increased ($p<0.05$) the sensorial quality for colour, avocado flavour, texture and overall acceptability. Nevertheless, no significant difference ($p<0.05$) was observed for the aforementioned sensory attributes between the samples with 20% and 30% of avocado pulp. The sweetness and meltability of the cocoa butter-based ice cream were preferred by the panel regardless of the avocado pulp concentration. Overall, cocoa butter-based ice cream contains 30% of avocado pulp was most preferred by the panels despite had the slowest meltdown (Figure 2).

Table 2: Sensory Quality for the Cocoa Butter-Based Ice Cream with Different Concentrations of Avocado Pulp

Cocoa Butter-Based Ice Cream with Different Concentrations of Avocado Pulp	Sensory Attributes					
	Colour	Avocado Flavour	Sweetness	Texture	Meltability	Overall Acceptability
10%	3.0 ± 0.7^{a}	3.2 ± 0.8^{a}	4.2 ± 0.4^{a}	3.6 ± 0.6^{a}	4.3 ± 0.5^{a}	3.5 ± 0.5^{a}
20%	4.4 ± 0.5^{b}	4.2 ± 0.6^{b}	4.3 ± 0.6^{a}	4.3 ± 0.5^{b}	4.3 ± 0.5^{a}	4.0 ± 0.6^{ab}
30%	4.8 ± 0.4^{bc}	4.2 ± 0.8^{bc}	4.2 ± 0.7^{a}	4.3 ± 0.7^{bc}	4.4 ± 0.5^{a}	4.3 ± 0.8^{bc}

Mean values with different superscript alphabets in the same column are significantly different ($p<0.05$)

CONCLUSIONS

Increment of avocado pulp concentration from 10 to 30% significantly increased ($p<0.05$) the total solid (35.21±0.01 to 39.10±0.05); and colour changed significantly to greener (a* value: -2.46±0.01 to -3.34±0.06) and more yellowish (b* value : 17.55±0.08 to 27.53±0.08). Nevertheless, the meltdown of the ice cream was reduced with the increase of avocado pulp concentration. Sensory evaluation showed that ice cream contains 30% of avocado pulp was most preferred by the panels.

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