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Restructuring Palm Oil's Fat Structure to Replace Butter: Assessing Physicochemical, Composition, and Rheology Changes in Dark, Milk, and White Chocolate Ganache

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ABSTRACT

Ganache is made from a combination of chocolate and dairy cream. Dark, milk, and white chocolate compounds can be used to make ganache, in which some of the cocoa butter is replaced with other vegetable fats in the compound chocolate. Palm oil is used as an alternative to butter due to its availability and can help lower the cost of production of confectionery products. Chocolate ganache is prepared with chocolate compound, whipped cream, RBD palm oil, unsalted butter, and inverted sugar, then mixed on a hot plate. This study added 70% and 100% RBD palm oil to the dark, milk, and white chocolate ganache as a substitution for butter. The effect of RBD palm oil on the physicochemical properties of the ganache was evaluated. Several analyses have been done, including pH, moisture content, water activity, colour profile, texture profile, viscosity, and fat analyses. Dark, milk, and white chocolate ganache made with unsalted butter were used as control samples. The addition of RBD palm oil did not significantly affect the pH, moisture content, water activity, and colour of chocolate ganache. This study showed that the dark chocolate ganache with RBD palm oil has the highest viscosity than other samples. It suggests that dark, milk, and white chocolate ganache with 100% RBD palm oil are the preferred formulations due to their viscosity. These three preferred formulations showed the highest percentage of fatty acid at C12:0, C14:0, C16:0, and C18:0. The main distribution of triacylglycerol for these three formulations is on C50 and C52.

INTRODUCTION

Chocolate comes in various types, including solid chocolate, often shaped into flat, square bars. Shell chocolate has a solid exterior filled with ingredients like nuts, fruit, or caramel. Enrobed chocolate combines chocolate with wafers or biscuits. Hollow chocolates are often used for decorative treats and pan-work chocolate, in which almonds and peanuts are coated with a layer of chocolate [1]. Other type of chocolate is couverture. Couverture contains a significantly higher concentration of cocoa butter. Another type is ganache. Ganache is a smooth blend of chocolate mixed with whipped cream, butter, and milk [1-3]. This research focuses on chocolate ganache. The chocolate ganache was said to have originated accidentally in the 19th century in French, when an apprentice unintentionally poured milk into a batch of chocolate, resulting in a distinctive flavour and soft texture that turned out to be famous [1].

Kim et al. [1] stated that chocolate is typically produced by combining cocoa powder and sugar with various flavourings with cocoa butter. In contrast, pave chocolate also known by another name of ganache is made by mixing chocolate with whipped cream or fresh cream, resulting in a smoother texture compared to regular firmer chocolate [1]. The rising prices of dairy commodities including butter have increased the demand for cheaper alternatives like palm oil [4]. Palm oil production has nearly doubled over the last decade, contributing to its lower price point compared to butter [4]. However, the challenge lies in whether RBD palm oil can effectively mimic the physicochemical properties of food products (especially ganache) made with butter. This research explores using palm oil as an alternative to butter in ganache formulation. According to the Malaysian Palm Oil Council (MPOC), palm oil is important in the confectionery industry and is a vital vegetable oil for ensuring global food security. The primary advantage of using palm fat as a butter substitute is its wide availability, which can help reduce the production costs of confectionery products (Malaysian Palm Oil Council, n.d.). This research aims to determine the effects on the physicochemical properties of dark, milk, and white chocolate ganache with different concentrations of refined, bleached, and deodorized (RBD) palm oil as a butter substitute.

MATERIALS AND METHODS

Preparation of Dark, Milk, and White Chocolate Ganache

The formulation of dark, milk, and white chocolate ganache was developed according to Izzreen et al. [5] and Izzreen et al. [6] with a few modifications on the ingredients used. To make the ganache, the chocolate compound (Beryls, Seri Kembangan, Malaysia) is chopped into small, uniform pieces to ensure even melting. The chocolate is melted by using the double boiling technique. The formulation is displayed in **Table 1**. The whipped cream and inverted sugar were heated using a hot plate to 80 °C. Chocolate is added to the heated cream combinations after it reaches 80 °C. The chocolate-cream mix is then mixed with unsalted butter. Lastly, RBD palm oil is introduced into the chocolate emulsion mixes. Including the control formulation, the emulsion that contained RBD palm oil is homogenised using an IKA T25 digital homogeniser (Ultra Turrax, Germany) for 30 seconds at 11500 rpm [6]. The ganache is then poured into a glass jar and stored in a chiller.

Table 1. Formulations of dark, milk, and white chocolate ganache with different concentrations of RBD Palm Oil.

Ingredients	Control (%)			RBD Palm Oil (70%)			RBD Palm Oil (100%)		
	(Dark)	(Milk)	(White)	(Dark)	(Milk)	(White)	(Dark)	(Milk)	(White)
Chocolate compound	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Whipped cream	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
RBD palm oil	-	-	-	6.3	6.3	6.3	9.0	9.0	9.0
Unsalted butter	9.0	9.0	9.0	2.7	2.7	2.7	-	-	-
Inverted sugar	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

Analysis of pH

The pH of the ganache was measured following the Manual of Finished Cocoa Products Analysis (Malaysian Cocoa Board, 2010). The pH was determined using a calibrated pH meter (Eutech Instruments pH 700).

Analysis of Moisture Content

Moisture content was measured referring to the Manual of Semi-Finished Cocoa Products Analysis (Malaysian Cocoa Board, n. d.) with modification by increasing the drying time. The moisture content of chocolate ganache was calculated following this equation:

$$Moisture\ by\ weight, \% = \frac{(m_1 - m_2) \times 100}{(m_1 - m_0)}$$

Where: m_0 is the weight of the empty dish and its lid (g), m_1 represents the weight of the dish and its lid and the test portion before drying, and m_2 is the weight of the dish and its lid and the test portion after drying.

Analysis of Water Activity

The water activity (a_w) of the chocolate ganache was measured at approximately 25 °C using a water activity meter (Aqualab, USA). The measurement was triplicate for each sample [7].

Texture Analysis

The table-top texture analyser (TA-XT plus, Stable Micro Systems, UK) provided with conical probes (SC4-25) was used for the spreadability test of the chocolate ganache. The procedure for the test was measured according to Maslii et al. [8] with some modifications by changing the samples. The sample was carefully placed into a cone-shaped receiver, ensuring no air was trapped and maintaining a smooth upper surface. A cone-shaped probe was then positioned just above the ganache surface. During the test, as the probe moves downward, the ganache should flow outward between the surfaces of the cone-shaped receiver and the probe at an angle of 45° angle. The smoothness of this process reflects the sample's high spreadability. When the cone probe is lifted from the sample (upward movement), it provides information about the ganache's adhesiveness [8]. Each sample was analysed in triplicate at room temperature and in consistent conditions for all measurements.

Colour Analysis

Colour analysis was performed according to Markovic et al. [9] with some modifications to the sample used. The ganache sample is placed in a single layer on a plate and then photographed. The sample is photographed with a colorimeter (CR-400 Chroma Meter, Konica Minolta, Japan). In the CIE L*a*b* colour space, the three matrices represent the pixel values for lightness (L*), greenness to redness (a*), and blueness to yellowness (b*).

Viscosity

The viscosity analysis of chocolate ganache is conducted according to Dias et al. [10, 11] using a rotational viscosimeter (VT 550 ThermoHaake, Karlsruhe, Germany) at 25 °C. The geometries employed were cone-and-plate (PK1 1° with a diameter of 10 mm and PK5 1° with a diameter of 50 mm). The apparent viscosity was obtained using Rheocalc.Ink software at a shear rate of 10^1 to 10^3 s^{-1}. By applying the concept of power-law model interpretation for chocolate viscosity, the equipment was run, and triplicate measurements of the apparent viscosity were made (n=3).

Fat Analysis

For fat analysis of chocolate ganache, several analyses were conducted which are triacylglycerol (TAG), slip melting point (SMP), fatty acid composition (FAC), and iodine value (IV). All methods are referred to the standard procedure of fat analysis by

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the Malaysian Palm Oil Board (MPOB) [12]. Triglyceride (TG) analysis is measured using Gas Chromatography where a capillary column of 15 m x ID 0.53 mm film µm 0.15 um is used. The column temperature is set to 100 °C at the beginning and 340 °C at 10 minutes holding time. The injection and detector temperatures were 350 °C. For the slip melting point, the capillary tube method was used. The sample is melted and filtered to remove impurities. The capillary tubes were marked at 10 mm and 30 mm. At least three clean capillary tubes were dipped into the completely liquid sample and the fat stood at the 10 mm mark. The sample is solidified by pressing against a piece of ice and immediately placing the capillary tubes in a test tube lined with a piece of paper. The test tube is standing in the beaker of water which has been pre-equilibrated in the refrigerator. This tempering assembly is important to avoid melting and recrystallization of the sample once it has been solidified.

Statistical Analysis

All experimental results were conducted in triplicate and expressed as mean ± standard deviation. The statistical analyses were carried out using Minitab (Minitab Statistical Software) software version 22. Data were analysed by an analysis of variance (ANOVA) at a 95% confidence level to find any significant difference ($p<0.05$) between the sample means.

RESULT AND DISCUSSION

Table 2 showed that the changes in pH, moisture content, and water activity were not significantly different after adding RBD palm oil. A study by Halim and Manaf [13] claimed that palm oil contributes 0.10-0.12%. This suggests that palm oil only gives a small increase in the moisture content of the chocolate ganache. There are only slight changes in the water activity of ganache with RBD palm oil as reported by Samsudin [14] that the commercial chocolate spread was in the range of 0.76-0.79.

Table 2. pH, Moisture Content, and Water Activity of Dark, Milk, and White Chocolate Ganache with Different Concentrations of RBD Palm Oil. [a-g] Mean values with different superscript letters within the column are significantly different ($p<0.05$). DC - dark chocolate; MC - milk chocolate); WC - white chocolate, B - 100% butter, 70PO - 70% RBD palm oil; 100PO - 100% RBD palm oil.

Formulation	pH value	Moisture content (%)	Water activity (A_w)
DC + B	7.51 ± 0.006^{a}	20.91 ± 0.590^{a}	0.7925 ± 0.000^{g}
MC + B	7.12 ± 0.006^{f}	18.84 ± 0.526^{abc}	0.8172 ± 0.000^{b}
WC + B	7.22 ± 0.006^{d}	16.61 ± 0.195^{c}	0.7931 ± 0.000^{g}
DC + 70PO	7.50 ± 0.006^{a}	19.77 ± 0.417^{ab}	0.7989 ± 0.000^{e}
MC + 70PO	7.16 ± 0.006^{e}	18.51 ± 0.689^{abc}	0.8053 ± 0.000^{d}
WC + 70PO	7.27 ± 0.006^{c}	19.34 ± 0.269^{ab}	0.8169 ± 0.000^{b}
DC + 100PO	7.51 ± 0.006^{a}	20.39 ± 1.381^{a}	0.7949 ± 0.000^{f}
MC + 100PO	7.07 ± 0.006^{g}	17.79 ± 1.615^{bc}	0.8131 ± 0.001^{c}
WC + 100PO	7.29 ± 0.006^{b}	19.40 ± 0.815^{ab}	0.8208 ± 0.000^{a}

Table 3 showed that the changes in colour profile of ganache formulations are not significantly different even after the incorporation of RBD palm oil. A previous study by Seçuk and Seçim [15] on the development of chili pepper ganache in white chocolate proved that the addition of chili pepper ganache affects the brightness (L*) of the product. The findings by Seçuk and Seçim [15] proved that the incorporation of chili pepper ganache and chili pepper seed oil ganache increases the yellowness of the white chocolate ganache.

Table 3. Colour Profile of Dark, Milk, and White Chocolate Ganache with Different Concentrations of RBD Palm Oil. [a-i] Mean values with different superscript letters within the column are significantly different ($p<0.05$). DC - dark chocolate; MC - milk chocolate); WC - white chocolate, B - 100% butter, 70PO - 70% RBD palm oil; 100PO - 100% RBD palm oil.

Formulation	Colour Profile		
	L*	a*	b*
DC + B	35.76 ± 0.273^{ef}	3.10 ± 0.070^{d}	4.14 ± 0.107^{e}
MC + B	41.38 ± 0.676^{cd}	6.12 ± 0.221^{b}	8.72 ± 0.331^{d}
WC + B	79.14 ± 0.637^{b}	-1.16 ± 0.049^{f}	30.26 ± 0.310^{a}
DC + 70PO	39.51 ± 1.450^{de}	3.68 ± 0.142^{c}	4.88 ± 0.030^{e}
MC + 70PO	44.07 ± 0.337^{c}	7.19 ± 0.042^{a}	10.31 ± 0.070^{c}
WC + 70PO	80.67 ± 0.418^{b}	-0.52 ± 0.042^{e}	27.04 ± 0.076^{b}
DC + 100PO	34.38 ± 0.406^{f}	3.22 ± 0.076^{d}	4.34 ± 0.056^{e}
MC + 100PO	37.51 ± 0.200^{def}	5.92 ± 0.099^{b}	8.16 ± 0.118^{d}
WC +100PO	87.89 ± 4.389^{a}	-2.73 ± 0.370^{g}	26.81 ± 1.327^{b}

Table 4 showed that the firmness of all dark chocolate ganache formulations shows higher values of firmness compared to milk and white chocolate ganache. These results suggest that dark chocolate ganache is the least spreadable. The result showed that milk chocolate ganache is less spreadable than white chocolate ganache. McGill and Hartel [16] proved that white chocolate ganache is the softest and easiest to spread compared to the other two types of chocolate ganache. Based on the table, the addition of RBD palm oil increases the firmness and work off shear of dark, milk, and white chocolate ganache.

Table 4. Texture profile of Dark, Milk, and White Chocolate Ganache with Different Concentrations of RBD palm oil. [a-i] Mean values with different superscript letters within the column are significantly different ($p<0.05$). DC - dark chocolate; MC - milk chocolate); WC - white chocolate, B - 100% butter, 70PO - 70% RBD palm oil; 100PO - 100% RBD palm oil.

Formulation	Spreadability	
	Firmness (kg)	Work of shear (kg/s)
DC + B	4754.86 ± 1.694^{c}	4447.31 ± 4.442^{c}
MC + B	1192.15 ± 1.036^{i}	872.68 ± 6.755^{i}
WC + B	2529.53 ± 0.820^{h}	2237.04 ± 17.956^{h}
DC + 70PO	4841.74 ± 2.119^{b}	4645.47 ± 28.852^{a}
MC + 70PO	3326.31 ± 3.490^{e}	3053.45 ± 27.644^{e}
WC + 70PO	3124.47 ± 3.994^{f}	2586.47 ± 12.927^{f}
DC + 100PO	5221.55 ± 13.402^{a}	4590.08 ± 4.566^{b}
MC + 100PO	2869.17 ± 24.377^{g}	2454.38 ± 9.819^{g}
WC + 100PO	3664.25 ± 16.951^{d}	3227.74 ± 11.599^{d}

Table 5 showed that substituting 70% and 100% RBD palm oil significantly increased the viscosity of dark chocolate ganache compared to butter. This supports Glicerina et al. [17] works who found that dark chocolate ganache has higher viscosity due to lower fat content and smaller particle distance. Milk chocolate ganache with 100% RBD palm oil had a viscosity higher than white chocolate ganache but lower than dark chocolate ganache. This aligns with Glicerina et al. [17], where milk chocolate is slightly more viscous and has a dense microstructure due to cocoa powder. Furthermore, white chocolate ganache with 100% RBD palm oil showed the lowest viscosity compared to the control formulation of white chocolate ganache. Glicerina et al. [17] assert that white chocolate ganache was the least viscous compared to dark and milk chocolate ganache and this is due to the high-fat content, smallest particle size, and least dense crystalline network.

Thus, dark, milk, and white chocolate ganache with 100% RBD palm oil showed the most accurate results with the previous study by Glicerina et al. [17]. **Table 6** showed that C50 and C52 had the highest distribution in dark, milk, and white chocolate ganache with 100% RBD palm oil. Miskandar et al. [18] stated that a longer chain length results in a higher slip melting point (SMP). There is a slight reduction in SMP values (**Table 7**) which is reflected in the previous finding by Miskandar et al. [18] where the changes in SMP values were not significant in this study. The distribution of chain-length fatty acid in this study contributes to the crystallization of the chocolate ganache. According to Yang et al. [19], crystallization of TAGs is influenced by chain length, molecular structure, and high melting point.

Table 5. Viscosity of Dark, Milk, and White Chocolate Ganache with Different Concentrations of RBD Palm Oil. [a-i] Mean values with different superscript letters within the column are significantly different ($p<0.05$). DC - dark chocolate; MC - milk chocolate); WC - white chocolate, B - 100% butter, 70PO - 70% RBD palm oil; 100PO - 100% RBD palm oil.

Formulation	Viscosity (Pa s)
DC + B	50483.00 ± 5.303^{e}
MC + B	31641.20 ± 4.812^{h}
WC + B	58670.33 ± 4.801^{c}
DC + 70PO	72705.00 ± 4.386^{b}
MC + 70PO	32972.73 ± 4.500^{g}
WC + 70PO	54172.93 ± 3.885^{d}
DC + 100PO	95432.20 ± 3.985^{a}
MC + 100PO	37064.20 ± 4.414^{f}
WC + 100PO	28975.27 ± 4.225^{i}

Table 6. Triacylglycerol (TAG) Value of Dark, Milk, and White Chocolate Ganache with Different Concentrations of RBD Palm Oil. DC - dark chocolate; MC - milk chocolate); WC - white chocolate, B - 100% butter, 70PO - 70% RBD palm oil; 100PO - 100% RBD palm oil.

Fatty Acid Group Key	TAG (%)								
	DC + B	MC + B	WC + B	DC + 70PO	MC + 70PO	WC + 70PO	DC + 100PO	MC + 100PO	WC + 100PO
C24	0.24	0.25	0.28	0.22	0.21	0.19	0.16	0.17	0.17
C26	0.30	0.28	0.28	0.30	0.27	0.26	0.26	0.25	0.25
C28	0.51	0.53	0.63	0.41	0.40	0.36	0.37	0.36	0.30
C30	0.95	0.95	1.00	0.85	0.82	0.88	0.66	0.71	0.77
C32	2.98	3.09	3.23	2.68	2.62	2.66	2.34	2.50	2.36
C40	11.35	11.67	11.84	9.44	9.93	10.20	8.69	9.03	9.59
C42	7.82	8.08	8.02	6.21	6.80	6.98	5.99	6.10	6.46
C44	5.99	6.21	5.98	4.51	5.05	5.12	4.41	4.42	4.65
C46	5.59	5.85	5.53	4.09	4.66	4.71	4.12	4.06	4.22
C48	6.31	6.58	6.20	5.45	6.28	6.28	6.24	6.10	6.06
C50	7.47	7.15	6.86	12.38	11.82	11.47	14.41	14.14	13.23
C52	7.42	6.26	5.93	13.07	11.37	10.80	14.67	13.97	12.96
C54	3.89	3.16	3.01	5.12	4.28	4.03	5.52	4.87	4.51
C56	0.26	0.19	-	0.35	0.30	0.31	0.38	0.35	0.34

Table 7. Slip Melting Point of Dark, Milk, and White Chocolate Ganache with Different Concentrations of RBD Palm Oil. DC - dark chocolate; MC - milk chocolate); WC - white chocolate, B - 100% butter, 70PO - 70% RBD palm oil; 100PO - 100% RBD palm oil.

Formulation	Slip Melting Point (°C)
DC + B	32.40
MC + B	33.20
WC + B	33.40
DC + 70PO	29.80
MC + 70PO	30.50
WC + 70PO	31.70
DC + 100PO	32.10
MC + 100PO	28.50
WC + 100PO	28.60

Table 8 showed that all formulations have higher percentages of saturated fatty acids (C12:0, C14:0, C16:0, C18:0). Wassell and Young [20] assert that a spread with higher saturated fatty acids contributes to the increased hardness. Furthermore, palmitic acid is higher for dark chocolate ganache with 100% RBD palm oil, followed by milk and white chocolate ganache. It contributes to their viscosity, where dark chocolate ganache is the most viscous, followed by milk and white chocolate ganache. The results indicate that the formulated ganache exhibited the highest triglyceride polymorphism in DM, while MC and WC had the lowest levels, regardless of whether 70% or 100% RBP palm oil was used as a substitute.

Table 8. Fatty Acid Composition (FAC) of Dark, Milk, and White Chocolate Ganache with Different Concentrations of RBD Palm Oil. DC - dark chocolate; MC - milk chocolate); WC - white chocolate, B - 100% butter, 70PO - 70% RBD palm oil; 100PO - 100% RBD palm oil.

Types of FA	Acid Common Nomenclature	Fatty Acid Composition (%)								
		DC + B	MC + B	WC + B	DC + 70PO	MC + 70PO	WC + 70PO	DC + 100PO	MC + 100PO	WC + 100PO
C6:0	Caproic acid	0.87	0.92	0.73	0.68	0.58	0.38	0.24	0.46	0.39
C8:0	Caprylic acid	1.68	1.68	1.70	1.54	1.45	1.43	1.21	1.33	1.33
C10:0	Capric acid	2.89	2.91	2.83	2.46	2.44	2.37	1.98	2.16	2.16
C12:0	Lauric acid	27.36	26.70	27.01	22.72	24.26	24.92	21.48	23.16	24.40
C14:0	Myristic acid	16.22	16.28	16.14	12.66	13.94	13.95	12.02	12.40	13.04
C16:0	Palmitic acid	22.80	23.17	22.54	25.87	25.68	25.17	27.14	26.78	26.00
C16:1	Palmitoleic acid	1.33	1.23	1.18	1.03	1.10	0.99	0.93	0.89	0.83
C18:0	Stearic acid	11.96	12.03	11.58	10.08	9.84	10.03	10.22	9.46	9.24
C18:1	Oleic acid	13.35	13.42	12.83	19.34	17.52	16.43	19.95	19.59	18.02
C18:2	Linoleic acid	1.17	1.28	1.43	3.16	2.75	2.80	3.37	3.38	3.30
C18:3	Linolenic acid	0.21	0.21	1.80	0.20	0.19	1.22	1.24	0.15	1.07
C20:0	Arachidic acid	0.16	0.17	0.22	0.25	0.25	0.31	0.21	0.25	0.20

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This is because there are more C50 and C52, which are types of palmitic acid (C16:0), and then oleic acid (C18:1), showing that there is more solid fat or plasticity, with the highest amount in DC, followed by MC, and the least in WC compared to the control (cocoa butter with types of chocolate). This finding corresponds to a higher viscosity in DC (70% and 100% RBD palm oil) compared to the control, with MC and WC showing the least viscosity in this study. The promoted crystallisation leads to a denser crystal network, increasing the viscosity, though the slip melting point observed was insignificantly different, which could be due to the balanced presence of C54, the unsaturated long-chain which drives the intermediate melting point reported here lower than cocoa butter ganache [3]. The formulations with 100% RBD palm oil, tabulated in **Table 9** showed higher iodine values compared to the other formulations. This is due to the higher amount of unsaturated oleic acid in the formulations as suggested by Tarmizi et al. [21] where iodine value is correlated with the degree of unsaturation.

Table 9. Iodine Value of Dark, Milk, and White Chocolate Ganache with Different Concentrations of RBD Palm Oil. DC - dark chocolate; MC - milk chocolate); WC - white chocolate, B - 100% butter, 70PO - 70% RBD palm oil; 100PO - 100% RBD palm oil.

Formulation	Iodine Value
DC + B	15.32
MC + B	15.48
WC + B	19.36
DC + 70PO	23.61
MC + 70PO	21.37
WC + 70PO	23.11
DC + 100PO	27.12
MC + 100PO	23.92
WC + 100PO	24.80

CONCLUSION

The present study evaluated the effect of RBD palm oil as a butter substitute on the physicochemical properties of dark, milk, and white chocolate ganache. The addition of RBD palm oil did not significantly affect the pH, moisture content, water activity, and colour of chocolate ganache, making it almost similar to the original ganache formulation. Dark, milk, and white chocolate ganache with 100% RBD palm oil showed the best result due to their viscosity. Dark chocolate ganache with RBD palm oil obtained the highest viscosity compared to milk and white chocolate ganache. This is due to the least amount of fat in the dark chocolate ganache. This finding successfully proved that dark chocolate ganache is the most viscous and white chocolate ganache is the least viscous. The fat analyses showed the correlation between fatty acid composition with the physicochemical properties of the ganache.

LIST OF ABBREVIATIONS

Dark Chocolate (DC); Milk Chocolate (MC); White Chocolate (WC); Butter (B); Palm Oil (PO); Fatty Acid Composition (FAC); Triacylglycerol (TAG); Differential Scanning Calorimetry (DSC); Water Activity (a_w); Slip Melting Point (SMP); Iodine Value (IV); Refined, bleached, and deodorized (RBD)

CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

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