

Study on Chocolate Production from Coconut Oil and Palm Oil Shortening

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Abstract

Chocolate is a well-known dessert all over the world. The original chocolate is made from cocoa products: cocoa bean and cocoa butter. Research and Development on low-fat chocolate process were conducted for value addition of coconut oil and Thai fruit. This chocolate processing study composed of (1) coconut oil fractionation, (2) chocolate formulation and (3) shelf-life storage determination. Accordingly, fatty acids composition of the blend of coconut fat and palm oil shortening were determined. It was found that the said product composed of Caproic acid $0.47\pm 0.12\%$, Caprylic acid $5.65\pm 0.31\%$, Capric acid $5.14\pm 0.14\%$, Lauric acid $42.56\pm 0.28\%$, Myristic acid $16.31\pm 0.18\%$, Stearic acid $14.55\pm 0.13\%$, Oleic acid $9.26\pm 0.17\%$, and Linoleic acid $2.16\pm 0.35\%$. The saturated fatty acids and unsaturated fatty acids found in this product were $88.57\pm 0.14\%$ and with $11.42\pm 0.81\%$, respectively. The range of melting point is 26°C - 33°C and oxidative stability is 14.2 to 16.7 hours. The chocolate formula of pale and dark chocolate 1kg composed of coconut fat, palm oil shortening, and lecithin as emulsifier in same amounts such as 250g, 100g, and 0.5g. However, icing sugar and defatted cocoa powder are in different amounts; the icing sugar in pale chocolate and dark chocolate is 350g and 450g while the defatted cocoa powder in pale chocolate and dark chocolate is 200g and 300 g, respectively. These chocolate products have physical properties similar to the chocolate products produced from cocoa butter. The shelf life of these products is 3 months.

Keywords: chocolate, fractionate coconut oil, medium chain fatty acids

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Introduction

At present, many kinds of chocolate products are produced in our food industries. The conventional chocolates are produced from cocoa bean and cocoa butter obtained from cacao plants. The cocoa plants are cultivated in West Africa, South and Central America such as Ivory Coast and Brazil. The method of manufacturing of chocolate products comprised the steps of fat extraction to make cocoa butter and therefore, the cocoa butter is an important major constituent of the chocolate formulations. Normally, chocolate and chocolate flavored products consist of sugar and cocoa fat or butter. In the case of dark chocolate has unrefined cocoa butter but in the case of milk chocolate, the fat phase is refined cocoa butter.

In Asia we have plenty of coconut oil that have special good quality, high in saturated fatty acid, especially lauric acid which is recorded in Thai coconut at an average of 48% (Twishsri et al., 2012). Saturated fatty acid in coconut oil is suitable to substitute cocoa butter in chocolate for vegetarians or consumers who do not prefer to consume animal fat.

In view of nutritional and medicinal value, the coconut oil is found to be composed predominately of a unique family of fats, such as caprylic acid (C8), capric acid (C10), lauric acid (C12) and myristic acid (C14), called medium chain fatty acids (MCFA) which are in the form of medium chain triglyceride (MCTs). The purification of fractionated coconut oil or MCT oil was developed by Dr. Vigen K. Babyyan. The process includes distilling the coconut oil down into pure MCT oil. The MCTs possessed unique biological properties with a number of important nutritional and medical applications (Babyyan, 1981 cited by File, 2012).

Medium chain fatty acids (MCFA) are a unique form of dietary fat that impart a wide range of positive health benefits. The potential anti-aging properties of medium chain fatty acids have been largely unrecognized by many life extension enthusiasts (Babyyan, 1981). The MCFA provide about 10% calories per gram. As a result of this MCFA medium are not stored in fat deposits in the body and to enhance thermo

genesis (Baba et. al., 1981). MCFA seem to be good to anyone who has increased energy and to weight loss.

In addition, lauric acid which can be transformed to Monolaurin, a monoester formed from medium chain fatty acid has profound antiviral and antibacterial activity (Kabara, 1978). It is more effective against gram-positive bacteria such as staphylococcus and streptococcus. In a study conducted by Preuss et al., monolaurin was shown to be bactericidal to *S. aureus* and *Mycobacterium terrae* but not to *Escherichia coli* and *Klebsiella pneumoniae*, which are both gram-negative, confirming prior work on monolaurin, and was shown to be static to a variant of the virulent anthrax pathogen, *Bacillus anthracis* Sterne. Monolaurin also inhibits the production of staphylococcal toxic shock syndrome toxin-1 effectively. The monoester is also effective antiviral agent against cytomegalovirus and the expression of virulence factors including protein, alpha-hemolysin, β -lactamase, and the induction of vancomycin resistance in *Enterococcus faecalis* (Kabara, 1977). Comparatively speaking, lauric acid (C12) has a greater antiviral and antibacterial activity than other medium-chain triglycerides such as caprylic acid (C8), capric acid (C10), or myristic acid (C14) (Kabara, 1977).

Since coconut oil is rich in nutrition and good for health, the study is aimed to produce chocolate from fractionate coconut oil as a alternated use of coconut oil for food product development and create the value-addition product of coconut oil by producing chocolate-based product such as fruit sauce with chocolate, cereal with chocolate, macadamia nut with chocolate, chocolate coating, and chocolate fondue.

Materials and method

Preparation of virgin coconut oil:

Coconut meat 1 kg was mix with cleaned water 1 liter to make coconut milk, after that to make coconut cream by concentration in refrigerator for 1-2 hr. followed by draining

water and kept coconut cream for overnight to get virgin coconut oil.

Fractionation of virgin coconut oil:

Gentle warmed virgin coconut oil 1 kg at 70° C for half an hour, left until the temperature decrease to 45° C, stored in a refrigerator at 18°C until fat can be observed within 1 hr and filtered the oil by using filter paper Whatman no. 1. The virgin coconut oil was fractionated for 2-3 times or until no longer the formation of crystals in the coconut oil. Keep fat CNO for making chocolate.

Laboratory Analysis:

The samples of virgin coconut oil, coconut fat from fractionation, palm oil shortening and mixture of coconut fat and palm oil shortening for chocolate making were analyzed as follows. The fatty acid composition was analyzed by following the AOCS official method Ce1e-91 revised 2000, Oxidative stability was analyzed by using Rancimat 679, Methrom company, and Melting point was determined by following the AOCS official method Cc 1-25 reapproved 1997.

Preparation of Chocolate:

Chocolate ingredients consist of 250 grams coconut fat, 100 gram palm oil shortening, 350 grams icing sugar and 450 grams high sweet chocolate, 200-300 grams defatted cocoa powder and 0.5 grams pale and dark chocolate and lecithin as emulsifier. The chocolate are mixed with hand mixer at 80-90° C for half an hour until the chocolate homogenized, leave to room temperature and pour to mold and bring them to refrigerator to have hard chocolate.

Result and discussion

Chocolate production using coconut fat and palm oil shortening were studied an extent up to the utilization of coconut oil for all age consumers.

The coconut oil can be prepared or extracted from coconut cream by breaking oil in water emulsion (Escueta, 1980 and Friberg et al., 1990). To obtain 150-200 ml of virgin coconut oil, 1 kg of coconut meat was blended with 1 liter of cleaned water to extract 500 ml of coconut milk and then it was concentrated to

obtain coconut cream in refrigerator and left coconut cream for a night to get VCO.

Table 1. Preparation of coconut oil

Coconut meat (kg)	Coconut milk (ml)	Coconut oil (ml)
1	500	150±3.5-200±5.5

The characteristic of coconut oil is high in saturated fatty acid, lauric acid contain 45.1-53.2% (Codex standard for named vegetable oils, 2001). As a result of this, we studied how to prepare good quality of chocolate from coconut oil. Table 2 shows fatty acid composition of the raw materials used to make chocolate. Fatty acid composition of coconut oil, especially lauric acid was increased in coconut oil to coconut fat from 48.95%±0.16 to 52.08±1.56% and the blended coconut fat and palm oil shortening, were contained lauric acid 42.56±0.28%.

Comparison of melting point between coconut fat and blended coconut fat and palm oil shortening, found that the blended coconut fat and palm oil shortening was harder than coconut fat alone. The results revealed that the oxidative stability of the blended coconut fat and palm oil shortening was longer than coconut fat itself because, the presence of some Butylated hydroxyanisole (BHA) as antioxidant in palm oil shortening increases the oxidative stability.

Fatty acid composition of the blend of coconut fat and palm oil shortening were (%) Caproic acid [C6:0] 0.47±0.12, Caprylic acid [C8:0] 5.65±0.31, Capric acid [C10:0] 5.14±0.14, Lauric acid [C12:0] 42.56±0.28, Myristic acid [C14:0] 16.31±0.18, Stearic acid [C18:0] 14.55±0.13, total saturated fatty acid 88.57±0.14, Oleic acid [C18:1] 9.26±0.17, Linoleic acid [C18:2] 2.16±0.35, and total unsaturated fatty acid 11.42±0.81. The range of melting point was 26 °C to 33 °C and oxidative stability was 14.2 to 16.7 hours.

Table 2. Fatty acid composition, Oxidative stability and Melting point of Coconut oil (CNO), Coconut fat (CNF), Palm oil shortening (PS), and blended coconut fat and palm oil shortening

Fatty acid composition	Coconut oil	Coconut fat	Palm oil shortening	Chocolate fat (blended coconut fat and palm oil shortening)
Caproic acid C6:0	0.35±0.21	-	0.39±0.4	0.47±0.12
Caprylic acid C8:0	6.46±1.70	9.67±0.69	5.93±0.2	5.65±0.31
Capric acid C10:0	6.48±1.18	7.31±0.29	5.18±0.3	5.14±0.14
Lauric acid C12:0	48.95±0.16	52.08±1.56	43.5±0.2	42.56±0.28
Myristic acid C14:0	18.07±0.82	17.37±0.10	16.50±0.2	16.31±0.18
Palmitic acid C16:0	9.10±0.08	6.84±0.92	13.10±0.3	14.55±0.13
Stearic acid C18:0	2.65±0.14	1.39±0.17	2.45±0.0	3.89±0.15
<i>Total saturated fatty acids</i>	92.06±1.40	94.66±1.84	87.05±0.5	88.57±0.14
Oleic acid C18:1	7.35±0.21	4.45±1.23	10.11±0.4	9.26±0.17
Linoleic acid C18:2	0.35±0.21	0.86±0.10	2.58±0.1	2.16±0.35
<i>Total unsaturated fatty acids</i>	7.7±0.21	5.31±0.80	12.69±0.8	11.42±0.81
Oxidative Stability at 130 °C (hr)	12.7-13.9	11.7-14.5	17.8-20.5	14.2-16.7
Melting Point (°C)	21-24	25-30	30-35	26-33

Table 3. The new chocolate formula which composed of coconut fat and palm oil shortening

Ingredients	Pale chocolate (Weight 1000 grams)	Dark chocolate (Weight 1000 grams)
Coconut fat	250	250
Palm oil shortening	100	100
Icing sugar	350	450
Defatted cocoa powder	300	200
Lecithin	5	5

Table 4. Nutrition Fact of the Chocolate

Tested parameters	Per 100 gram	Per serving	Percentage of serving per day
Energy, kilocalories	586.74	230	-
Energy of Fat, kilocalories	368.46	150	-
Total Fats, grams	40.94	16	25
Trans fatty acid ,grams	0	0	0
Cholesterol, milligrams	0	0	0
Sugar, grams	19.76	8	0
Dietary fiber, grams	9.37	4	16
Sodium, milligrams	4.37	0	0

The chocolate formulae (shown in table 3) of pale and dark chocolate composed of coconut fat, palm oil shortening, and lecithin as emulsifier in same amount with 250g, 100g, and 0.5g per kg respectively. Whereas icing sugar and defatted cocoa powder are in different amounts; the icing sugar in pale chocolate and dark chocolate is 350 g and 450 g while the defatted cocoa powder in pale chocolate and dark chocolate is 200g and 300g.

These chocolates have physical properties similar to the conventional chocolates produced with cocoa butter. The chocolate can be kept within 3 months. Table 4 presents the nutritional facts of these chocolates. The chocolates have no trans fatty acids and low in sodium content which is good for the consumers. Because the consumption of trans fat increases low-density lipoprotein (LDL) or bad cholesterol. This risk factor contributes to the leading cause of death (coronary heart disease) in the U.S. (U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2010) (Food and Drug Administration 2003). Sodium reduction is important for healthy living, because sodium is profusely available in salt and many foods. High intake of sodium can lead to high blood pressure, a major risk factor for stroke, heart disease and kidney disease (Penz E.D. and et.al 2008). This is an advantage to consume coconut fat in snack like chocolate.

Conclusion and recommendation

The new products of chocolate produced from fractionate coconut oil using the new formulae have physical properties similar to the chocolate produced with cocoa butter. And its shelf-life is also three months. The new products produced from fractionate coconut oil can be applied for food product development and created various kind of the value-addition products using coconut oil. This chocolate can be served as dessert or applied to be chocolate based products such as fruit sauce with chocolate, cereal with chocolate, macadamia nut with chocolate, chocolate coating, and chocolate fondue.

European countries are importing cocoa beans from Asian countries, while most of ASEAN countries import chocolate from European countries. This is a good opportunity for coconut oil producers to produce chocolate from coconut oil as it will add higher value to coconut oil. It has been proved that the health benefit of consuming chocolate from cocoa beans is the same with chocolate from coconut oil.

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