

Palm Fractions and Phytonutrients in Chocolate Spread

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INTRODUCTION

Chocolate is a product craved for and desired by many people. Good quality chocolate has smooth texture, good snap ability and glossiness, and most importantly melts in the mouth. The quality of chocolate has a close relationship with the fat component of the chocolate in that it should solidify at room temperature and fully melt at body temperature. However, bloom and loss of glossiness can occur in a chocolate product mostly due to unfavourable storage conditions and improper tempering (for chocolate made from cocoa butter). Although bloom and loss of glossiness do not correlate with rancidity, these surface defects appear unappetising to the eater. These weaknesses in chocolate can be eliminated by producing an alternative chocolate product in paste form that is spreadable; what is commonly called chocolate spread.

Chocolate spread should not solidify during storage at room temperature. Having this property, chocolate spread is normally eaten with bread and waffles, used as filling for biscuits and bakery products, or consumed as such. It is enjoyed by people of all ages, especially children, as it is delicious with its sweet and chocolaty taste as well as creamy texture. It can be produced as pure chocolate spread, milk chocolate spread or flavoured chocolate spread. Supermarkets normally carry chocolate spread of all these categories in glass

jars or plastic tubs. More than 1000 chocolate spread products are produced worldwide. The Netherlands launched the highest number of chocolate spread products in the world, followed by the United Kingdom, Germany

and the United States of America (Innova Market Insight, 2017). Well-known brands of chocolate spread in the market are Nutella (by Ferrero), Hershey and Cadbury.

ROLE OF FAT IN CHOCOLATE SPREAD

Chocolate spread is a dispersion of fine solids in lipid fractions. It can be produced through oil emulsion or water-in-oil emulsion (Malaysian Palm Oil Board, 2017). Oil emulsion chocolate spreads are commonly made of vegetable fat, cocoa powder, sugar, milk powder, emulsifier and flavouring. For water-in-oil emulsion chocolate spreads, milk powder is normally replaced by liquid milk. This type of emulsion is also used to produce low-fat chocolate spread

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Figure 1. Applications of chocolate spread.

where water makes up part of its ingredients. Having water in the formulation means there is a possibility of microbiological attack; thus, a preservative is crucial to be included in this type of chocolate spread (Malaysian Palm Oil Board, 2017). Fat content of chocolate spread varies from one product to another. Common chocolate spread consists of 40%-44% fat content while low-fat chocolate spread consists of 28%-35% fat (Shamsudin, 2006).

The structure of chocolate spread is closely linked to the behavior of the lipid fraction (Daubert *et al.*, 1998). A low content of solids at room temperature is required. However, formulations of chocolate spread having low content of solids should not develop oil separation during storage for at least 6-12 months (Shamsudin, 2006). Therefore, there is a need for a specific ratio of solid and liquid phases in the lipid fraction which will influence the lipid's plasticising properties. This provides good stability (longer shelf-life) as well as minimises post-hardening of the chocolate spread, resulting in good appearance (Malaysian Palm Oil Board, 2017; Manzocco *et al.*, 2014). A melting point of 32°C-38°C, that is close to body temperature, is normally preferred when formulating chocolate spread. In addition, this spread will be able to melt quickly when being consumed providing good flavour release. Chocolate spread should be spreadable, soft and creamy. Notwithstanding this, a narrow range in particle size distribution in the spread will increase product stability, especially against heat as well as biological deterioration (Malaysian Palm Oil Board, 2017).

PALM FRACTIONS AND PHYTONUTRIENTS IN CHOCOLATE SPREAD

In the past, soft oils that undergo partial hydrogenation were commonly used to produce

TABLE 1. CHOCOLATE SPREAD FORMULATION USING PALM OIL AND PALM OLEIN (OIL EMULSION)

| Ingredient | Percentage (%) |
|-------------------------------------|----------------|
| Palm oil | 15.15 |
| Palm olein | 5.05 |
| Sucrose | 44.00 |
| Cocoa mass | 4.00 |
| Cocoa powder | 4.00 |
| Full cream milk powder | 20.25 |
| Skimmed milk powder | 6.75 |
| Vanillin | 0.01 |
| Lecithin | 0.70 |
| Polyglycerol polyricinoleate (PGPR) | 0.14 |

Source: El-Kalyoubi *et al.* (2011).

chocolate spread. According to Chrysam (1985), partially hydrogenated oils were used extensively only after 1950 when industry was keen to manufacture partially hydrogenated oil margarine as it is cheaper, has prolonged shelf-life and better organoleptic properties. Unfortunately, partial hydrogenation produces *trans*-fatty acids which are known to have negative effects on health (Tarrago-Trani *et al.*, 2006). Based on a study by Wagner *et al.* (2000) in Austria, *trans*-fatty acid content ranging from 0.6%-8.9% was found in chocolate spread products. As an alternative, palm fractions are among the most widely used fats for the manufacture of chocolate spreads. Palm fractions are free from *trans*-fatty acids, easily available and are cost-effective (El-Hadad *et al.*, 2011; Shin *et al.*, 2010). Palm fractions such as palm oil, palm olein, red palm olein or palm stearin can be blended with other soft oils or butter fat to produce chocolate spread of good quality (Jeyarani *et al.*, 2015; El-Hadad *et al.*, 2011; El-Kalyoubi *et al.*, 2011). It has also been highlighted by Roe *et al.* (2013) that blends

of palm oil and soft oil as well as processing techniques, such as fractionation, interesterification and full hydrogenation, may have been effective in reducing the *trans*-fatty acid value in food in the United Kingdom. Based on their survey in the United Kingdom in 2013, chocolate spread contains only 0.09% *trans*-fatty acids.

El-Kalyoubi *et al.* (2011) found that 25% palm olein would be able to replace palm oil in conventional soft chocolate to reduce hardness. While palm oil is semi-solid at room temperature, palm olein is the liquid fraction of palm oil and is rich in tocotrienols, a form of vitamin E. The 25% replacement of palm olein with palm oil is more acceptable to the sensory evaluators. *Table 1* provides the formulation of chocolate spread using palm oil and palm olein. On the other hand, Jeyarani *et al.* (2015) prepared chocolate spread enriched with omega-3 fatty acids by incorporating palm stearin into the formulation. The study found that a formulation of 85% of soyabean and coconut oils together with 15% of palm stearin was well accepted by the sensory evaluators, receiving scores of 8.3-10.5 out of a possible 15.

El-Hadad *et al.* (2011) substituted butterfat with red palm olein to produce a chocolate spread that has pro-vitamin A functionality. One of the risks of vitamin A deficiency is night blindness (Sundram, 2005). According to Choo *et al.* (1993), red palm olein contains 513 ppm of carotenes. The highest level of carotenes comes from crude palm oil with 643 ppm; however, the oil is still in crude form. A 20% substitution of butterfat with red palm olein was reported to be acceptable by the sensory evaluators, while the chocolate spread lasted for 6 months at room temperature without quality deterioration. This chocolate spread was reported to have 3.7 times more tocopherols and tocotrienols, and 19.8 times

more carotenes, compared with a spread with 100% butterfat (El-Hadad *et al.*, 2011).

Tocotrienols from palm oil are part of the vitamin E family as are tocopherols. Among all the vegetable oils, palm oil is the richest source of tocotrienols. A vitamin E concentration of 600-1000 ppm is present in crude palm oil (Ng *et al.*, 2004) with a tocotrienols concentration of up to 800 ppm, consisting mainly of γ - and α -tocotrienols (Mishra *et al.*, 2014). Shamsudin *et al.* (2015) improved the shelf-life of chocolate spread by incorporating palm vitamin E (including palm tocotrienols) to slow down the lipid oxidation process. Lipid oxidation can greatly affect the quality of chocolate spread, producing displeasing off-flavours in the process. The study compared palm vitamin E (including tocotrienols) and butylated hydroxyanisole (BHA) as antioxidants, and found that the stability (induction period and peroxide value) of chocolate spread containing palm vitamin E (including tocotrienols) was comparable to a similar product with BHA after six months of storage. Chocolate spread with palm vitamin E (including tocotrienols) showed no oil separation, and managed to maintain its original flavour, taste and texture.

Apart from that, palm vitamin E exhibits various health-benefits. This has been confirmed through various studies conducted locally and internationally. Palm vitamin E has anti-oxidant, anti-diabetic, anti-cancer and cancer-suppression properties, as well as positive effects on bone metabolism and is also cardio-, neuro-, nephro-, gastro- and hepatoprotective (Siddiqui *et al.*, 2013; Norazlina *et al.*, 2010; Sen *et al.*, 2010; Siddiqui *et al.*, 2010; Azlina *et al.*, 2005; Mutalib *et al.*, 2003; Nesaretnam *et al.*, 1998; Serbinova and Packer, 1994; Ngah *et al.*, 1991). The Recommended Daily Allowance (RDA) for vitamin E varies for

TABLE 2. RECOMMENDED DAILY ALLOWANCE (RDA) OF VITAMIN E

| Age (yr) | RDA (mg day ⁻¹) | Upper limit (UL) (mg day ⁻¹) |
|--------------|-----------------------------|------------------------------------------|
| 1-3 | 6 | 200 |
| 4-8 | 7 | 300 |
| 9-13 | 11 | 600 |
| 14-18 | 15 | 800 |
| 19 and above | 15 | 1 000 |

Source: Food and Nutrition Board, Institute of Medicine (2000).

children, adults and lactating women, but currently refers only to α -tocopherol (Table 2). However, tocotrienols have been shown to be a more superior antioxidant than tocopherols (Sundram, 2005). RDA of vitamin E for adults to meet body requirement is 15 mg day⁻¹. An intake of 12-15 mg of vitamin E day⁻¹ is sufficient for a normal healthy adult in providing adequate vitamin E on the basis of its health benefits (Traber, 2014). The tolerable upper limit (UL) of vitamin E is 1000 mg day⁻¹ (IOM, 2000).

CONCLUSION

Fats from palm fractions can be used for chocolate spread formulation. These fractions provide structure to the spread. In addition, palm-based phytonutrients can be incorporated into food products, in this case chocolate spread, to provide value-addition to the products. Studies have found that chocolate spreads containing palm fractions and phytonutrients are smooth and creamy with good spreadability and stability properties.

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REFERENCES

Azlina, M F; Nafeeza, M I and Khalid, B A (2005). A comparison between tocopherol and tocotrienol effects on gastric parameters in rats

exposed to stress. *Asia Pacific J. Clinical Nutrition*, 14(4): 358-365.

Choo, Y M; Ooi, C K; Yap, S C and Basiron, Y (1993). Red palm oil – A carotene-rich nutritious oil. *PORIM Information Series, TT No. 11*.

Chrysam, M M (1985). Table spreads and shortenings. *Bailey's Industrial Oil and Fat Products*. John Wiley and Sons. p. 45-126.

Daubert, C R; Tkachuk, J A and Truong, V D (1998). Quantitative measurement of food spreadability using the Vane method. *J. Texture Analysis*, 29(4): 427-435.

El-Hadad, N N M; Youssef, M; Abd El-Aal, M H and Abou-Gharbia, H H (2011). Utilisation of red palm olein in formulating functional chocolate spread. *Food Chemistry*, 124: 285-290.

El-Kalyoubi, M; Khallaf, M F; Abdelrashid, A and Eman, M M (2011). Quality characteristic of chocolate-containing some fat replacer. *Annals of Agricultural Science*, 56(2): 89-96.

Innova Market Insight (2017). *Chocolate Spread*. www.innovadatabase.com, accessed on 27 July 2017.

Food and Nutrition Board, Institute of Medicine (2000). *Dietary reference intakes for vitamin C, vitamin E, selenium and carotenoids*. Washington: National Press Academy.

- Jeyarani, T; Banerjee, T; Ravi, R and Gopala, K A G (2015). Omega-3 fatty acids enriched chocolate spreads using soybean and coconut oils. *J. Food Sci. Technol.*, 5(2): 1082-1088.
- Malaysian Palm Oil Board (2017). *Pocketbook of Palm Oil Uses, 7th Edition*. p. 72-73.
- Manzocco, L; Calligaris, S; Camerin, M; Pizzale, L and Nicoli, M C (2014). Prediction of firmness and physical stability of low-fat chocolate spreads. *J. Food Engineering*, 126: 120-125.
- Mishra, B P; Badade, Z G; Langidi, J L; Jaiswal, S and Anand, B K (2014). Tocotrienols and its impact in cardiovascular health. *International J. Clinical Trials*, 1(3): 87-94.
- Mutalib, M S A; Khaza'ai, H and Wahle, K W J (2003). Palm-tocotrienol rich fraction (TRF) is a more effective inhibitor of LDL oxidation and endothelial cell lipid peroxidation than α -tocopherol *in vitro*. *Food Research International*, 36(5): 405-413.
- Nesaretnam, K; Stephan, R; Ray Dils, R and Philippa, D P (1998). Tocotrienols inhibit the growth of human breast cancer cells irrespective of estrogen receptor status. *Lipids*, 33(5): 461-569.
- Ng, M H; Choo, Y M; Ma, A N; Chuah, C H and Hashim, M A (2004). Separation of vitamin E (tocopherol, tocotrienol and tocomonoenol) in palm oil. *Lipids*, 39 No.10.
- Ngah, W Z; Jarien, Z; San, M M; Marzuki, A; Top, G M; Shamaan, N A and Kadir, K A (1991). Effect of tocotrienols on hepatocarcinogenesis induced by 2-acetylaminofluorene in rats. *American J. Clinical Nutrition*, 53: 1076S-1081S.
- Norazlina, M; Hermizi, H; Faizah, O; Nasrun, A S; Norliza, M and Ima-Nirwana, S (2010). Vitamin E reversed nicotine-induced toxic effects on bone biochemical markers in male rats. *Arch Medical Science* 6(4): 505-512.
- Roe, M; Pinchen, H; Church, S; Elahi, S; Walker, M; Farron-Wilson, M; Buttriss, J and Finglas, P (2013). *Trans* fatty acids in a range of UK processed foods. *Food Chemistry*, 140: 427-431.
- Shamsudin, S Y (2006). Low-fat chocolate spread based on palm oil. *Palm Oil Developments*, 45. p. 27-30.
- Shamsudin, S Y; Abd Hamid, R and Kanagaratnam, S (2015). Chocolate spread with tocotrienols. *MPOB Information Series, TT. No. 584*.
- Sen, C K; Rink, C and Khanna, S (2010). Palm oil-derived natural vitamin E α -tocotrienol in brain health and disease. *J. Am. Coll. Nutr.* 29(3 Suppl): 314S-323S.
- Serbinova, A E and Packer, L (1994). Antioxidant properties of α -tocopherol and α -tocotrienol. *Method of Enzymology*, 234: 354-366.
- Siddiqui, S; Khan, M R and Siddiqui, W A (2010). Comparative hypoglycemic and nephroprotective effects of tocotrienol rich fraction (TRF) from palm oil and rice bran oil against hyperglycemia induced nephropathy in type 1 diabetic rats. *Chem. Biol. Interact.*, 188(3): 651-658.
- Siddiqui, S; Ahsan, H; Khan, M R and Siddiqui, W A (2013). Protective effects of tocotrienols against lipid-induced nephropathy in experimental type-2 diabetic rats by modulation in TGF-beta expression. *Toxicol. Appl. Pharmacol.*, 273(2): 314-324.
- Shin, J; Akoh, C C and Lee, K T (2010). Enzymatic interesterification of anhydrous butterfat with flaxseed oil and palm stearin to produce low-*trans* spreadable fat. *J. Food Chemistry*, 120: 1-9.
- Sundram, K (2005). Meeting the rising health awareness: the palm oil formula. *Palm Oil Developments*, 43. p. 20-28.
- Tarrago-Trani, M T T; Phillips, K T; Lemar, L E and Holden, J M (2006). New and existing oils and fats used in products with reduced *trans*-fatty acid content. *J. American Dietetic Association*, 6 No. 6.
- Traber, M G (2014). Vitamin E inadequacy in humans: causes and consequences. *Advances in Nutrition*, 5: 503-514.
- Wagner, K-H; Auer, E and Elmadfa, I (2000). Content of *trans* fatty acids in margarines, plant oils, fried products and chocolate spreads in Austria. *Eur. Food. Res. Technol.*, 210: 237-241.