HEALTHY SNACK BAR FORTIFIED WITH PALM TOCOTRIENOL RICH FRACTION (TRF)

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MPOB INFORMATION SERIES • ISSN 1511-7871 • JULY 2017 MPOB TT No. 624

Snack bars are ready to eat food bars which consist of various cereals, nuts, seeds or dried fruits as the major ingredients. They are portable snacks that can provide energy during the day. Snack bars can be formulated to contain high energy, high protein and high fibre. Snack bars can also contain vitamins, minerals and other functional ingredients. In the production of healthy snack bars, a binding agent which consist of fats, sweeteners and stabiliser is used to bind the dry ingredients and transform the dry ingredients into a bar.

Healthy snack bars are long considered as an economical source of nutrient that occupies a large portion of the consumer market. A snack bar usually comes in a weight range between 25-35 grams to give it better portability. Its excellent portability and nutrient quality have made it a convenient meal option especially for those with a busy lifestyle. Besides being a meal replacement, people are looking for more function in food that they eat every day. The market for functional food is expanding from year to year due to the increase in health awareness among the public and the rise in medication costs. Hence, the snack bar is a potential carrier which can be fortified with certain nutrients or vitamins to increase its nutritional value and deliver extra beneficial health effects that help in disease prevention. For example, a snack bar can be fortified with vitamin E, an essential micronutrient that is not produced by the human body and has to be obtained through the daily diet.

Vitamin E comprises four tocopherols (T) and four tocotrienols (T3) isomers, namely alpha (α), beta (β), gamma (γ) and delta (δ). Palm oil (PO) is one of the most abundant natural sources of vitamin E *i.e.*, 800-1270 mg kg^{-1} PO (Puah *et al.*, 2007). Palm vitamin E, assigned as palm Tocotrienols Rich Fraction (TRF) comprises about 20% T (α–T) and 80% T3 (22% α–T3, 46% γ–T3 and 12% δ–T3) (Hashimoto *et al.*, 1980).

Health enhancing benefits of Vitamin E. Vitamin E especially palm TRF, possesses a myriad of health-enhancing benefits. Vitamin E, especially its T3 isomers, is known for antioxidant properties and prevention against radical and oxidative damage. T3 exert more potent (40-60 times) antioxidant and free radical scavenging properties than T due to better distribution in the lipid layers of the cell membrane (Cerecetto and López, 2007). The scientific world has also explored more health enhancing benefits of vitamin E beyond their antioxidant effect. Vitamin E, especially T3 has cardioprotective (Mutalib *et al.*, 2003; Tomeo

ISSN 1511-7871
9 771511 787001

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et al., 1995), anti-cancer and cancer suppression (Husain *et al*., 2011; Nesaretnam *et al*., 1998), anti-diabetic (Siddiqui *et al*., 2013), nephroprotective (Siddiqui, 2010) and gastroprotective (Azlina *et al*., 2005) effects. Studies by Mangialasche *et al*., (2010); Liu *et al*., (2009) and Sen *et al*., (2000) showed that T3, particularly α-T3 has a neuroprotective effect. α-T3 protects neuron death at an extremely low level (nanomolar concentrations). T3 is able to reach the brain to provide protection against stroke, Parkinson's and Alzheimer's disease. Vitamin E also helps in the maintenance of bone metabolism (Norazlina *et al*., 2010). Vitamin E is critical to neurologic and brain development in the foetus and children below 3 years old (Traber, 2014a,b).

Vitamin E dosage. The recommended dietary allowance (RDA) for vitamin E to maintain good health is about 15 mg day^{-1} (or 22.4 IU) for people over the age of 14 and 20 mg day^{-1} for lactating women (Traber, 2014a). The more common dosages fall within 50-360 mg day^{-1} (Tan *et al*., 1991). The upper limit for safety is 1000 mg day^{-1} (Traber, 2014a).

Effect of deficiency in vitamin E. A lifelong proper intake of vitamin E is important to maintain good health. Adequate levels of this essential micronutrient are especially critical for infants, the elderly, and women who are or may become pregnant. Vitamin E deficiency happens with an alarming frequency globally, by the fact that this nutrient is one of the most difficult to obtain through diet alone (Traber, 2014a,b, Butte *et al*., 2010). Vitamin E deficiency can cause poor transmission of nerve impulse, muscle weakness and degeneration of retina that leads to blindness. Severe vitamin E deficiency can be lethal and cause the loss of life. According to Traber (2014b), vitamin E deficiency particularly for infants, the elderly, and women who are or may become pregnant may result in:

- increased infection, anemia, stunting of growth and poor outcomes during pregnancy for both the infant and mother.
- neurological disorders, muscle deterioration and cardiomyopathy, especially in children
- poor cognitive function in young children.
- acceleration of Alzheimer's disease progression and higher risk of developing all-cause dementia.
- smaller brain size and lower cognitive function.

Owing to the importance of vitamin E to human health, thousands of nutritional and wellness supplements, and food and beverage products fortified with vitamin E are launched in the global market every year, and the number is rising from year to year. For example, the number of food products containing vitamin E launched in the global market in 2006 was 2150 and the number rose to 9707 in 2015 (Innova Market Insights, 2016). Vitamin E is widely incorporated in baby food, cereals and nutritional/wellness supplements. With respect to palm TRF, palm TRF supplement is currently globally available in the form of soft gel capsules. The global volume consumption of natural source vitamin E which stood at 10.3 thousand tonnes in 2012 is projected to be 18.1 thousand tonnes in 2020 (Research and Market, 2013).

THE TECHNOLOGY

Technologies offered are the formulation and process for the manufacturing of healthy snack bar fortified with RDA dosage of palm TRF.

THE PRODUCT

The snack bar, 25-30 g in weight, is fortified with the RDA dosage of palm TRF. The snack bar is formulated with low glycemic natural sweeteners, very palatable and can be formulated to have crunchy or chewy texture. Low glycemic diet has various favourable health effects, such as weight loss, decrease of fasting glucose and insulin levels, reduction of circulating triglyceride levels and improvement of blood pressure. All these effects are independently linked to reduced risk of some chronic diseases, for example type-II diabetes and cardiovascular diseases. The composition of the snack bar can be varied to suit various market niches. It can be formulated to be high in energy, high in protein or high in fibre. It can also be formulated with special functional ingredients or nutrients. The palm TRF in the snack was very stable upon storage. The palm snack bar received higher sensory scores than the control snack bar which was produced using a factory formulation. The palm TRF content of the snack bar after 4 months storage at 25°C is shown in *Figure 1*.

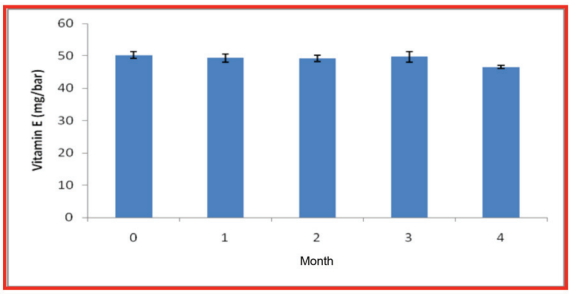

Figure 1. The palm TRF content of snack bar after 4 months of storage at 25°C.

The sensory evaluation scores of the snack bars of different binder recipe as compared to control (factory formulation and process) are shown in *Figures 2* and *3*.

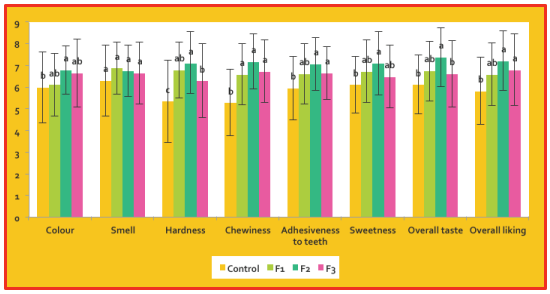

Figure 2. The palm TRF content of snack bar after a month of storage at 5°C.

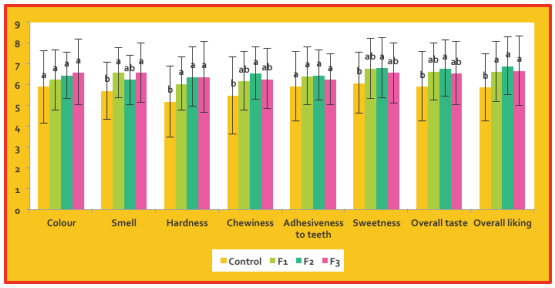

Figure 3. The palm TRF content of snack bar after a month of storage at 20°C.

PRODUCT NOVELTY

Healthy snack bar formulation that contains a stable, sufficient and functional dosage of palm TRF, with excellent palatability and physical characteristics, formulated using low glycemic natural sweeteners.

PRODUCT BENEFITS & ADVANTAGES

- Healthful, nutritious, delicious and multi-flavoured.
- Fortified with RDA dosage of palm TRF.
- Palm TRF possesses a myriad of health-enhancing benefits.
- Palm TRF delivers unique biological functions to maintain healthy body and provides myriad health enhancing benefits (antioxidant, anti-ageing, provides protection against heart disease, cancer, neurological diseases, premenstrual syndrome, eye disorders, diabetes *etc*.).
- Helps to increase vitamin E intake and prevents/tackles vitamin E deficiency.
- Can be tailored to contain high energy, high protein, high fibre or fortified with other essential or functional nutrients/ingredients.
- Can be tailored for niche markets, *e.g.*, children, teenagers, pregnant women, breastfeeding mothers, ageing women/man, sportsmen, *etc*.
- Healthful – may contain high fibre, probiotics and sweetened by natural low glycemic sweetener (suitable for diabetics).
- Convenient for traveling and easily consumed.

COMMERCIAL BENEFITS AND ECONOMIC ANALYSIS

The cost of production is estimated at about RM 1.30 - RM 1.50 per bar. The palm TRF snack bar containing RDA dosage of palm TRF can be marketed at the price of RM 50.00-RM 60.00 per box of 15 bars. The investment prospective is attractive with a payback period of three years. The commercial venture is expected to yield benefit to cost ratio of 1:1.18, net present value of RM 2 828 644 and internal rate of return of 57%. The investment proposition is financially feasible.

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 Pac J Clin Nutr., 14(4):* 358-365.

BUTTE, N F; FOX, M K; BRIEFEL, R R; SIEGA-RIZ, A M; DWYER, J T; DEMING, D M and REIDY, K C (2010). Nutrient intakes of US infants, toddlers, and preschoolers meet or exceed Dietary Reference Intakes. *J Am Diet Assoc., 110*: S27-S37.

CERECETTO, H and LÓPEZ, G V (2007). Antioxidants derived from vitamin E: An overview. *Mini Reviews in Medicinal Chemistry 7(3)*: 315-38.

HASHIMOTO, T; KATO, A; TANABE, K; MAMURO, H; YAMAOKA, M; BERGER, K G and ABD. GAPOR, M T (1980). Studies on tocopherols and tocotrienols in Malaysian palm oil. Proc. Intl. Symp. on the Advanced Industrial Utilization of the Tropical Plants, 1–4 Sept. Tsukuba, Japan. International Research and Development Cooperation Division, Ministry of International Trade and Industry, Japan.

HUSAIN, K; FRANCOIS, R A; YAMAUCHI, T; PEREZ, M; SEBTI, S M and MALAFA, M P (2011). Vitamin E δ-tocotrienol augments the antitumor activity of gemcitabine and suppresses constitutive NF-κB activation in pancreatic cancer. *Mol Cancer Ther., 10(12)*: 2363-2372.

LIU, X; YAMADA, N and OSAWA, T (2009). Assessing the neuroprotective effect of antioxidative food factors by application of lipid-derived dopamine modification adducts. *Methods Mol Biol., 58*: 143-152.

MANGIALASCHE, F; KIVIPELTO, M; MECOCCI, P; RIZZUTO, D; PALMER, K; WINBLAD, B and FRATIGLIONI, L (2010). High plasma levels of vitamin E forms and reduced Alzheimer's disease risk in advanced age. *J Alzheimers, 20(4)*: 1029-37.

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)*: 405-13.

NESARETNAM, K; STEPHEN, R; RAY DILS, R and PHILIPPA DARBRE, P (1998). Tocotrienols inhibit the growth of human breast cancer cells irrespective of estrogen receptor status. *Lipids. 33(5)*: 461-469.

NORAZLINA, M; HERMIZI, H; FAIZAH, O; NAZRUN, A S; NORLIZA, M and IMA-NIRWANA, S (2010). Vitamin E reversed nicotine-induced toxic effects on bone biochemical markers in male rats. *Arch Med Sci., 6(4)*: 505-512.

PUAH, C W; YUEN MAY CHOO; AH NGAN MA and CHUAH, C H (2007). The Effect of Physical Refining on Palm Vitamin E (Tocopherol, Tocotrienol and Tocomonoenol). *American Journal of Applied Sciences, 4(6)*: 374-377.

RESEARCH AND MARKET (2013). Natural Source Vitamin E (Tocopherols and Tocotrienols) - A Global Market Overview. http://www.researchandmarkets.com/reports/2584164/natural_source_vitamin_e_tocopherols_andl. Accessed on 16 February 2016.

SEN, C K; KHANNA, S; ROY, S and PACKER, L (2000). Molecular basis of vitamin E action. Tocotrienol potently inhibits glutamate-induced pp60(c-Src) kinase activation and death of HT4 neuronal cells. *J Biol Chem. 275(17)*: 13049-55.

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.

SIDDIQUI S, RASHID KHAN M 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.

TAN, D T; KHOR, H T; LOW, W H; ALI, A and GAPOR, A (1991). Effect of a palm-oil-vitamin E concentrate on the serum and lipoprotein lipids in humans. *The American Journal of Clinical Nutrition, 53(4 Suppl)*: 1027S-1030S.

TOMEO, A C; GELLER, M; WATKINS, T R; GAPOR, A and BIERENBAUM, M L (1995). Antioxidant effects of tocotrienols in patients with hyperlipidemia and carotid stenosis. *Lipids, 30(12)*: 1179-83.

TRABER, M G (2014a). Vitamin E Inadequacy in Humans: Causes and Consequences. *Nutrition. Adv. Nutr., 5*: 503-514.

TRABER, M G (2014b). Vitamin E intake critical during "the first 1000 days", News and Research Communications. http://oregonstate.edu/ua/ncs/archives/2014/sep/vitamin-e-intake-critical-during-%E2%80%9C-first-1000-days%E2%80%9D. Accessed on 16 February 2016.

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