



Palm vitamin E, tocotrienol rich fractions (TRF) and palm carotene are added to enhance the nutritional value of foods and beverages (F&B). TRF is an extract of palm oil consisting of 25% alpha tocopherol (α -TCP) and 75% tocotrienols. TRF supplementation protects against oxidative DNA damage and has been shown to possess potent antioxidant, anti-inflammatory, anticancer, neuroprotection and cholesterol lowering activities. Palm carotene may slow the progression of cataracts, protect the skin against sunburn and help prevent macular degeneration. Other antioxidant important for health is pomegranate. Pomegranate possesses antioxidant, anti-viral and anti-tumour properties. In addition, it also has anti-inflammatory effects, contains vitamin A, C, E and folic acid. It helps to improve arthritis symptoms and memory. Although these vitamins contain antioxidant properties, it is difficult to add them into beverages as they are generally insoluble. Besides, emulsion containing vitamin A or E has a cloudy and whitish appearance, not attractive to consumers. Nevertheless, with new technology, adding these vitamins into beverages has been made possible.

PRODUCT NOVELTY AND PROPERTIES

The present innovation is on the production of a stable fat-soluble vitamin oil-in-water emulsion and the methods of making the F&B so that it produces healthy nutritional effects and retains the vitamins despite photochemical processes that may promote vitamin degradation. The F&B products innovation may be added flavours such as mango, carrot, orange, pineapple and strawberry.

Red palm olein, palm vitamin E tocotrienols rich fractions (TRF) and carotenes (pro-vitamin A) are the main ingredients in the emulsion for beverages. Other ingredients such as pomegranate were added to enhance health promoting properties. Thermal processing technologies and ultrahigh pressure homogenisation help to retain

the vitamins in the fat-soluble emulsion. It increase the shelf life, emulsion stability, nutritional composition and sensory acceptability of the end products. Phytonutrient beverages can stored at 4°C, 10°C and 20°C for three months.

A sensory descriptive analysis was carried out to determine detailed descriptions on taste, flavour and overall texture of the beverages showed promising results. *Figure 1* shows two samples of beverages with different flavours. The beverages were described as having sweet and sour taste with smooth texture and a distinctive fruity flavour. None of the sensory evaluation panellists detected any off-flavour from the stored samples (3 months) at 4°C.

Vitamin E determination

Vitamin E content in the emulsion was determined by High Performance of Liquid Chromatography (HPLC) (Agilent 1100 Series HPLC Value System) with a fluorescent detector (1100 Fluorescence Detector (FLD) G1321 A). The total content of vitamin E in the emulsion beverages was 18-19 mg/100 g (time =0) as shown in *Figure 2*.

Sensory evaluation

Products were evaluated by 30 trained sensory evaluators for colour, texture/appearance, and taste on a nine point Hedonic scale (*Figure 3*).

NOVEL SOLUTION

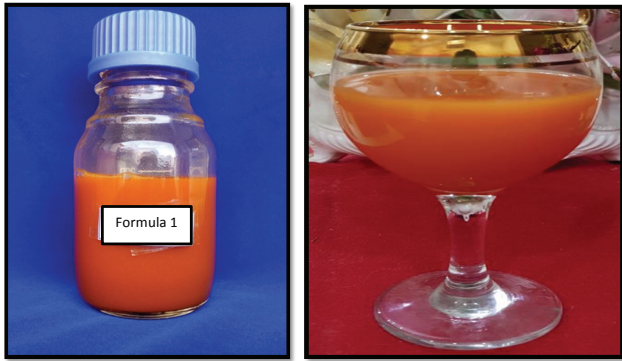
Excellent source of vitamin E and pro-vitamin A - These beverages contain functionally active components rich in antioxidants (palm tocotrienols and palm carotene) good for health.

Multiple flavours and taste good - The beverages taste good and consists of several flavours such as mango, carrot, orange, pineapple and strawberry.

Less calories - These nutritional drinks are low in calories (46 kcal/100 ml) and do not contain preservatives. Antioxidants act as natural preservative.



Mango flavour



Orange flavour

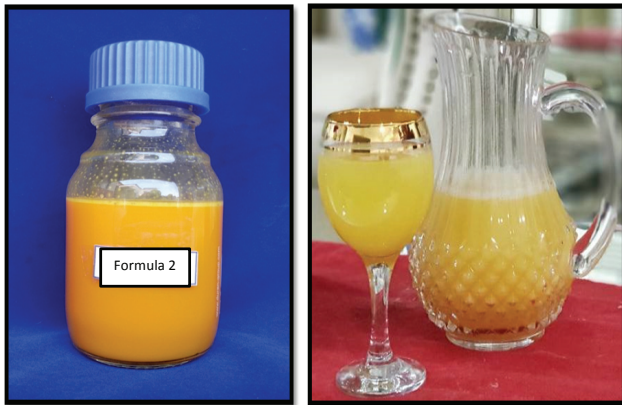


Figure 1. Stable emulsion beverages of different flavours (mango and orange).

ECONOMIC ANALYSIS

The estimated expenditure and other economic parameters in producing palm phytonutrients drinks are shown in *Table 1*. The estimated capital investment cost is RM 4.27 million. At a production capacity of 500 000 kg per year with a long-term price of RM 30.00 kg⁻¹, it is expected to generate an income of RM 13.1 million per year. The prospects for palm phytonutrient drinks are attractive with a payback period of two years (*Table 1*).

TABLE 1. ESTIMATED ECONOMIC ANALYSIS FOR THE PRODUCING OF PHYTO DRINK

Item	Value
Cost of materials (RM) if sold at RM 30.00 kg ⁻¹	25
Capital investment, (RM, million)	4.27
Benefit-to-cost-ratio	1.82
Payback period (yr)	2
Internal rate of return (%)	95
Net present value (RM, million)	13.1
Return on investment (%)	152

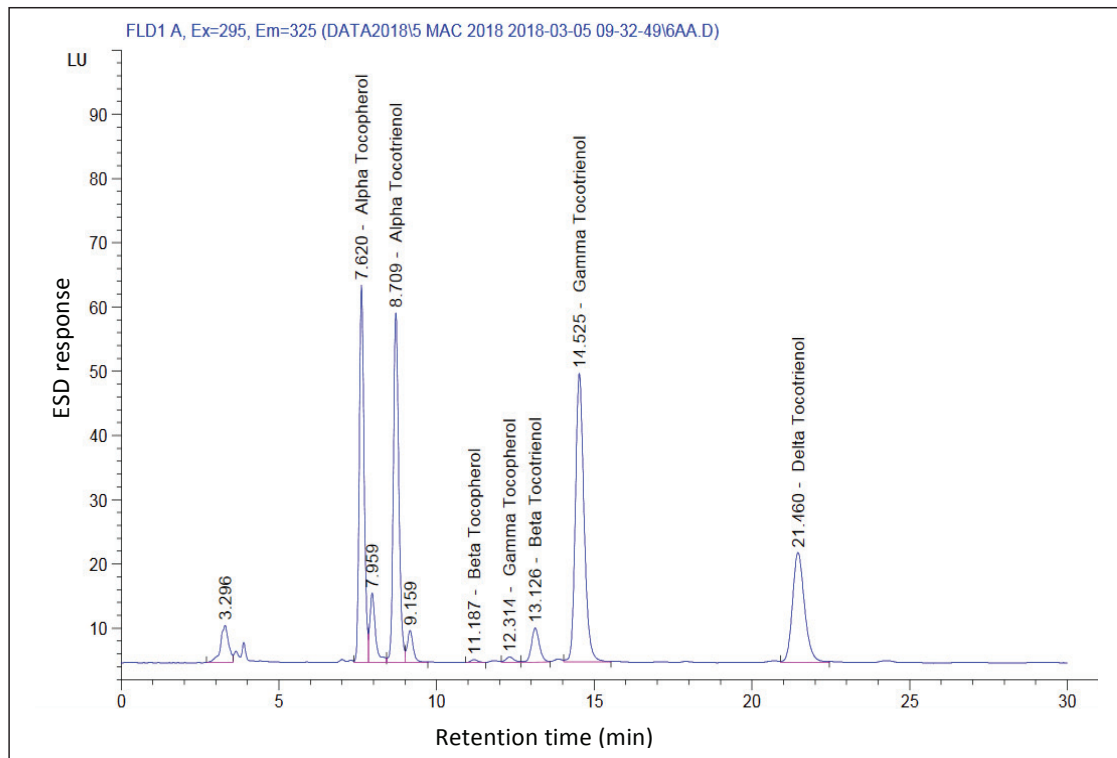


Figure 2. HPLC chromatogram with fluorescent detector for the separation of tocopherol and tocotrienol in a hexane extract of total vitamin E in palm phytonutrient drink. The total content of vitamin E in the emulsion beverages was between 18-19 mg/100 g.

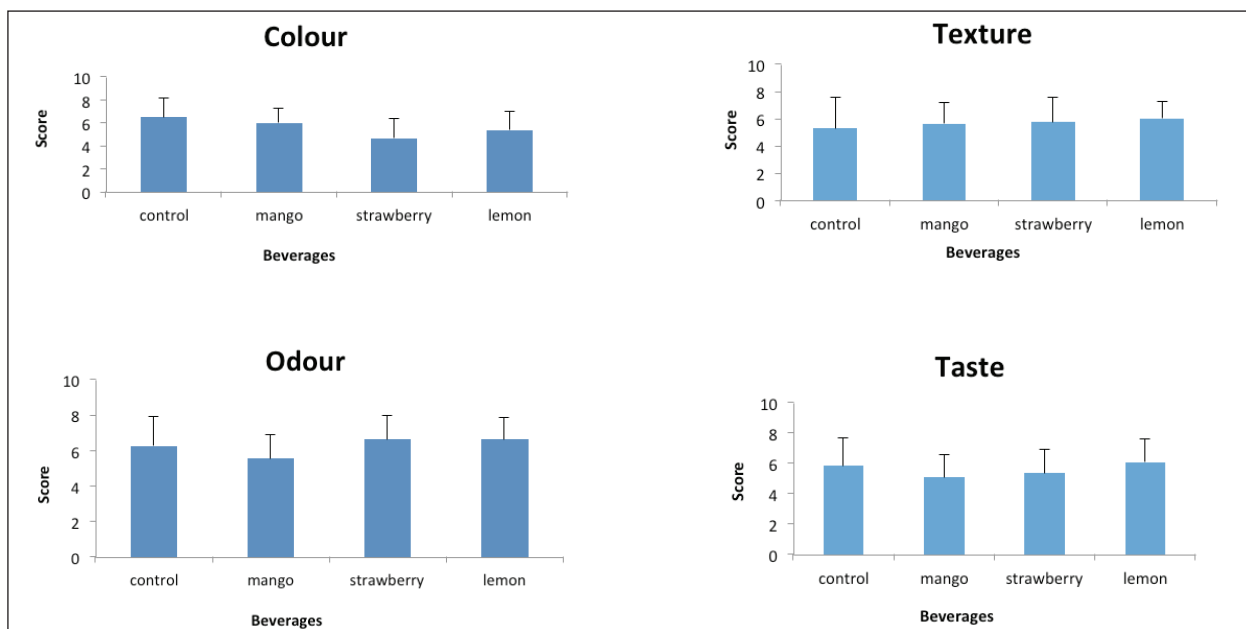


Figure 3. Mean scores from evaluation of palm phytonutrient beverages products with different flavors evaluated by trained sensory panels for colour, texture, odour and taste on a nine point Hedonic scale. The means \pm S.D ($n=30$) are shown. Significant difference was taken at $p < 0.05$ using the t -test. * Significant difference from the control at ($p < 0.05$).

CONCLUSION

The palm phytonutrient emulsion for foods and beverages are rich in antioxidant properties such as higher vitamin E (TRF) pro-vitamin A (palm carotene) and pomegranates. It is nutritious, taste good, stable at 4°C - 20°C for three months, contains less calories with good market potential.

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