Development of a Green-Tea-Incorporated White Chocolate

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Introduction

According to the processing method, there are different kinds of tea: black tea, green tea, oolong tea. Sri Lanka is the second largest tea exporter in the world (Anonymous a, 2012); the greater portion is exported as bulk tea (Ganewatta *et al.*, 2005). The average price of bulk tea is lower than that of value-added products (Ganewatta *et al.*, 2005). However, the Sri Lankan tea industry experiences lack of value-added products to local and export markets. Consumption of chocolate and related products has been increased by 11% in the last decade (Anonymous b, 2007). Besides, the consumers have a great interest on the presence of plant-derived compounds in food (Belščak *et al.*, 2009). The chemical composition of green tea differs from that of black tea (Bhagwat *et al.*, 2003); green tea has a higher flavan-3-ol, a type of polyphenol (Löest *et al.*, 2002) and is well-known to provide health benefits (Yang *et al.*, 2011; Cooper, 2012; Narotzki *et al.*, 2012). Therefore, development of a white chocolate with green tea incorporation would be of great interest for both tea and chocolate industries. The objectives of this research were:

- Developing a white chocolate by incorporating green tea powder, and evaluate it for sensory parameters to select the best percentage of green tea incorporation
- Determining the polyphenol content of green-tea-incorporated white chocolate and compare it with the white chocolate available in the market
- Evaluating the developed product for free fatty acids, moisture content and microbial growth during the storage period

Materials and Methods

Coco butter was melted in a gas cooker, and mixed with sugar, milk powder and dried green tea powder (0, 1, 2, 3, 4 or 5% w/w). Lecithin was added to this mixture and thoroughly mixed. This paste was allowed to mold at 2-4 °C in a refrigerator, and the final chocolate product was obtained. The developed chocolate products were evaluated for taste, colour, smell, appearance and overall acceptability, using thirty untrained panelists. The responses were recorded according to a five point hedonic scale (5- for most acceptable treatment and 1- for the least acceptable treatment). Polyphenols in each chocolate type were extracted as described by Meng *et al.* (2009), and the total polyphenol content was determined as used by Badmus *et al.* (2010) with some modifications.

Free Fatty Acid (FFA) and moisture content of developed chocolates were determined during the six-week storage period. A sample of chocolate (1g) was dissolved in a solvent mixture of ethanol and diethyl ether (1:1), 0.3 mL phenopthalein added and titrated with Sodium hydroxide. The acid value W_{AV} and W_{FFA} were determined by the following formulae.

$$W_{AV} = \frac{5.61 \times cV}{} \text{ and } W_{FFA} = 2 \times W_{AV}$$

c = the amount of extraction (mol/L) in the standard Sodium hydroxide solution, V = the volume of standard Sodium hydroxide (mL), m = the mass of the tested sample (g).

To determine the moisture content, a sample of green-tea-incorporated white chocolate was oven dried for 6 hr at 80 °C, and the difference in the dry weight was taken. Detection of yeast, moulds and Salmonella was done during the six-week storage period. A sample (10 g) of green-tea-incorporated white chocolate was dissolved in 90 mL of 0.1% peptone water. From this solution, a sample of 1 mL was added to plates containing Potato Dextrose Agar (PDA) medium. The plates were incubated at 25±1 °C for five days. Enumeration for yeast and mould was done at 1, 2, 3, 4, 5 and 6 weeks following storage.

To detect Salmonella, a sample of chocolate (25 g) was mixed with 225 mL of buffered peptone water. From this, 1 mL was incubated with 10 mL *Salmonella chromogen* medium at 37 °C for 18-24 hrs, streaked onto Brilliant Green Agar (BGA) and Xylose Lysine Deoxycholate Agar (XLDA), incubated again at 37±1 °C for 20-24 hrs, and examined for typical colonies.

The sensory attributes, taste, colour, smell, appearance and overall acceptability were analyzed by Friedman test (MINITAB Version 14). The polyphenol contents of two samples were compared using t-test. The significance was tested at P=0.05.

Results and Discussion

Green tea incorporation at 2% was found to be the best treatment. There are chocolates developed using tea (Anonymous c,d, 2006), but no records on green tea incorporation is available.

Polyphenol content in the green-tea-incorporated white chocolate (164.88 mg/100 g) was higher than in the commercially-available white chocolate (12.6 mg/100 g). Polyphenol in dark chocolate provides better coronary circulation (Tallon, 2008). The health benefits of green tea is already documented (Yang *et al.*, 2011; Cooper, 2012; Narotzki *et al.*, 2012). As green tea contains polyphenols, enhancement of health benefits can be expected in green-tea-incorporated white chocolate, as well.

The FFA value of the green-tea-incorporated white chocolate was 1.8%-1.92%. According to Sri Lanka Standards Institute (SLSI), FFA should be less than 4.0% for chocolates. Within this six-week storage period, the FFA content did not differ significantly. The moisture content ranged 2.1-2.2% during the storage period, and did not exceed the level (4%) set by SLSI.

With advancement of storage period, yeast and mould counts slightly increased. According to Sri Lanka Standard Institute, the Yeast and mould count should be less than 100/g whereas *Salmonella* count should be absent in a sample of 25 g of chocolate. During the storage period, enumerated values did not exceed the standard levels.

Conclusion

Addition of green tea powder at 2% is the best level to produce green-tea-incorporated white chocolate. The increased level of polyphenol content in green-tea-incorporated white chocolate offers more health benefits to consumers compared to the commercially-available white chocolate. Free fatty acid level, moisture content and microbial count of the new chocolate are within the standard limits for six weeks, and thus reveal good shelf life qualities.

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