THE PHYSICAL CHARACTERISTICS, ANTIOXIDANT CAPACITY AND SENSORY EVALUATION OF GINGER CONCENTRATE

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ABSTRACT

Ginger or scientific name Zingiber officinale is widely known of its properties as anti-inflammatory, antioxidant, antidiabetic and anti-cholesterol. "Bentong" ginger is a popular ginger in Malaysia that contain active components which contribute to its therapeutic properties. Four percentage level of ginger puree namely 10%, 20%, 30% and 40% were included in the formulation of ginger concentrate to study the degree of acceptance and their relationship with antioxidant and physical characteristics. The 40% ginger puree contribute to the most viscous sample and the least acceptance by the sensory panels. However, the phenolic content showed the highest among other treatments. The 30% of ginger puree addition showed higher DPPH scavenging percentage and showed significant different ($p>0.05$) with 20% of ginger puree addition. Thus, 30% of ginger puree could

contribute to higher antioxidant capacity with better acceptance of sensory panels and physical characteristics. The findings could be as baseline for other in-depth research such as antidiabetic and anti-cholesterol study.

Keywords: Bentong ginger, antioxidant, sensory evaluation, physical characteristics

1. INTRODUCTION

Ginger (*Zingiber officinale Roscoe*), a herbal plant from the Zingiberaceae family It has been used as spice and medicine for treatment of cardiovascular diseases (Ghafoor and Riaz, 2020) and diabetic (Said *et al.*, 2020). Various studies on clinical and pharmacological of ginger have demonstrated its beneficial effects on human health such as the improvement in inflammation, metabolic syndromes, cancer as well as digestive function, nausea and vomiting (Kiyama, 2020; Anh *et al.*, 2020). Furthermore, the findings from several study showed that ginger consumption has become more interest since it reduces the recovery time and alleviate the severe symptoms of COVID-19 positive patients (Ragnekar *et al.*, 2020; Safa *et al.*, 2020).

Ginger rhizome contains nonvolatile oil and volatile oil compounds such as oleoresin. These chemical constituents of ginger are numerous and different depending on the geographic origin, harvest process and maturity, and storage conditions. The goodness effect of ginger for human health related to the quality of ginger, especially the content of its principle bioactive compounds such as [6]-gingerol. Ginger can be transformed into various food product such as dehydrated ginger, sauce, candy, powder, beverage, and other promising food products. Various type of ginger food-based products become promising since the ginger contain high amount of polyphenol coupled with unique taste and aroma.

Nowadays, the introduction of concentrated type of ginger products become promising which linked to help in treating various type of health-related problems. However, too scanty study related to antioxidant properties as well as the physical and acceptance level of finished product using Bentong variety ginger being discussed. Thus, the objective of the study was to determine the physical properties as well as the antioxidant and sensory acceptance of ginger concentrate. Furthermore, the findings could benefit for food manufacturer as a guideline for them to include ginger puree as main raw materials.

2. MATERIALS AND METHODS

2.1 Preparation of ginger puree

For the ginger puree, the skin was removed from the flesh using peeling machine. The ginger was then boiled for 20 min and grounded using bowl chopper before being sealed with aluminium plastic packaging and stored in the freezer prior to processing.

2.2 Preparation of ginger concentrate

Ginger concentrate was prepared from the ginger puree and other ingredient such as honey, garlic puree, calamansi juice, lemon juice and water. Four treatments were used: 10%, 20%, 30% and 40% of ginger puree. Other ingredients were remained constant except for water. The pasteurized ginger concentrate was then poured hot filled into the aluminium sachet and was labelled and stored at ambient temperature.

2.3 Physical analysis

pH, total soluble solids (TSS) and viscosity of the ginger concentrate were determined according to AOAC (1995). pH was measured using a Hanna portable pH meter (Metrohm Model,744, Herisau, Switzerland) while TSS was measured with a hand refractometer (ATAGO, Japan) and expressed as Brix. The viscosity was determined using vibro viscometer at 25^0C (Model SV-10, A&D Company Limited, Japan).

2.4 Antioxidant analysis

The total phenolic content was assayed using the Follin-ciocalteu calorimetric method with slight modification (Shen *et al.*, 2009). The DPPH free-radical scavenging capacity was evaluated according to the procedure of (Somaratne *et al.*, 2017) with some modifications. The FRAP analysis was evaluated according to the procedure of (Lim *et al*., 2007) with some modifications.

2.5 Sensory evaluation

Sensory evaluations were carried out by 60 untrained consumers consisting of staffs of MARDI. They evaluated samples for aroma, colour, viscosity, hotness, sourness, and overall acceptability on a 7-point scale (1 = dislike extremely and 7 = like extremely).

2.6 Statistical analysis

Result was expressed as the mean ± standard deviation. Data obtained was statistically analysed using analysis of variance (ANOVA) and the Duncan Multiple range test by SPSS Predictive Analytics Software Statistics (PASW) version 19.0 (SPSS Inc, Chicago, Illinois) (SPSS Inc., 2009). All the measurement was carried out in triplicate (n= 3) analysis. Significant level established at $P \leq 0.05$.

3. RESULTS AND DISCUSSION

3.1 Physical analysis of ginger concentrate

Based on Table 1, the addition of ginger puree increases the pH, total soluble solid and viscosity of ginger concentrate. The increasing level of total soluble solid are in line with the addition of ginger puree in the formulation. After processing temperature given to the samples, the increase in total soluble solid may be due to the reduction of moisture content of the product. On the other hand, as expected, the 40% addition of ginger puree increase the viscosity to 35.23 mpa.s compared to 23.9 mpa.s in 10% addition of ginger puree. The total weight including fiber content contribute to the increment of viscosity.

Table 1: Physical characteristics of ginger concentrate using different percentage of ginger puree.

Sample	pH	Total soluble solid (^{0}Brix)	Viscosity (mpa.s)
40% ginger puree	3.97±0.03^a	25±1.00^a	35.23 ±2.12^a
30% ginger puree	3.99±0.05^a	23±1.00^b	32.3 ±1.12^b
20% ginger puree	3.99±0.02^a	20±1.00^c	30.8 ±1.37^c
10% ginger puree	3.87±0.02^b	20±1.00^c	23.9 ±1.56^d

* Different letters indicate significant difference at the level of $p<0.05$ between data in the same column

3.2 Antioxidant analysis of ginger concentrate

As displayed in Table 2, the DPPH scavenging activity showed that the percentage of scavenging in parallel to the level of ginger puree added in the products. On the other hand, higher percentage of ginger puree were found to possess significantly higher total phenolic content then the lower percentage of ginger puree added. Zahid et al. 2001, found that Bentong ginger contain high composition of phenolic compounds. Therefore, the significantly increased level of total phenolic content showed that Bentong ginger puree would certainly gain additional health promoting benefits. Such effects contributed primarily from gingerols during cooking (Tohma et al. 2017).

Phenolics comprise of a significant part of naturally occurring bioactive compounds, commonly are characterized by the presence of a phenolic hydroxyl group and include polyphenolsSheikhhossein *et al.*, 2021 stated that oxidative stress plays a major risk in arthritris, cancer, suabetic nepheopathy and osteoporosis. Moreover, ginger capable to donate hydrogen atom and scavenge the free radicals by its potent antioxidant components (Tohma et al. 2017). To sum up the findings in the present study, the addition of ginger puree enhanced the capacity of antioxidant of ginger concentrate. Kim et al, 2007 found that [6]-gingerol is recognized as a strong anti-oxidant with its anti-inflammatory and anti-apoptotic action both in vivo and in vitro studies.

Table 2: Antioxidant properties of ginger concentrate using different percentage of ginger puree.

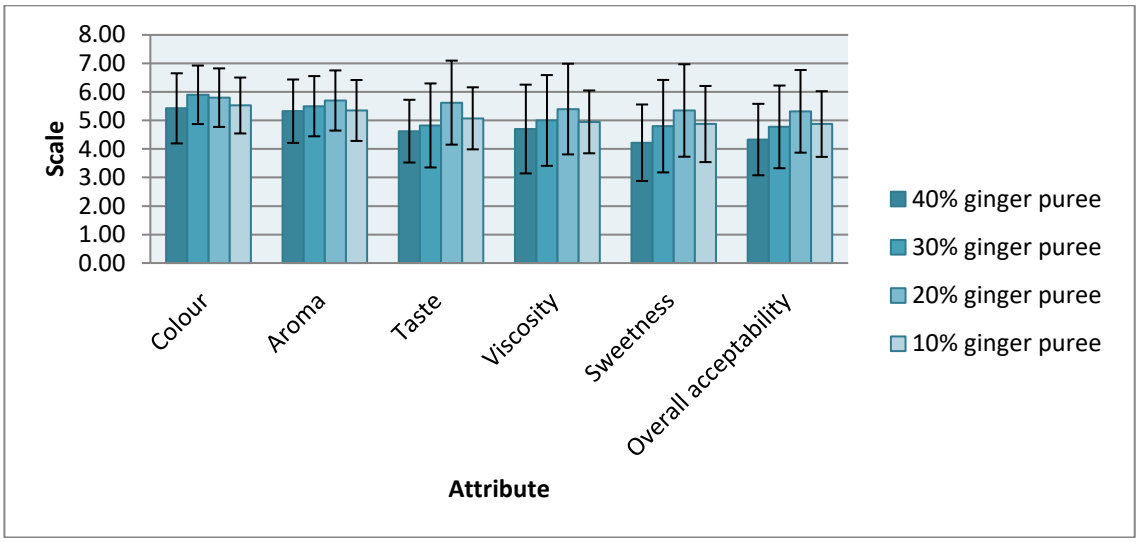
Sampel	Antioxidant Activity		Total Phenolic Content
	DPPH (% absorption)	FRAP (mg $FESO_4$ Eq/100 g)	TPC (mg GA Eq/100 g)
40% ginger puree	90.93±0.10 ^{a}	384.32±20.33^a	304.67±12.24^a
30% ginger puree	74.54±0.22^b	312.87±10.32^b	238.50±7.00^b
20% ginger puree	55.01±1.07^c	298.84±7.17^c	233.72±6.17^b
10% ginger puree	12.77±5.95^d	205.09±2.84^d	231.51±21.96^b

Different letters indicate significant difference at the level of $p<0.05$ between data in the same column

3.3 Sensory evaluation of ginger concentrate

Sensory evaluation is conducted to evaluate the ginger concentrate attributes using human senses. The present result shows that panels prefer all ginger concentrate since the attribute score was above 4. However, the 30% of ginger puree added was selected which highly related to the amount of phenolic content and antioxidant activity results. Moreover, 40% ginger puree reflects the most viscous and the lowest score for colour attribute. For overall acceptability, the 40% added ginger puree shows the lowest score among other treatments. Furthermore, ginger is valued as a spice because of its aroma and pungency. Thus, up to 30% ginger puree added was selected as the best formulation in enhancing the aroma, taste, and viscosity attributes. The addition of ginger puree enhanced astringency and persistence. This might be due to the spicy and pungent characteristics as well as the herbal nature of ginger.

Figure 1: Sensory acceptance of ginger concentrate using different percentage of ginger puree



4. CONCLUSION

The current study focused on using Bentong variety ginger to produce a ginger concentrate product as a promising product with therapeutic values. The study could be a benchmark for other concentrated ginger food-based products developed from Bentong ginger as a functional food in the future. With the assumption of diversification of local raw materials and enhance its health properties, additionally, its application could reduce the cost of national health services in the treatment of diseases and increase the health status of Malaysian population.

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