Study of hydrolysis and production of instant ginger \((Zingiber officinale)\) tea

Abstract: The aim of this study is to determine the suitable conditions for enzyme-assisted hydrolysis and the production of instant tea from hydrolysed ginger. Several parameters of ginger hydrolysis were investigated, such as the enzyme concentration from 0.1 to 0.4 g/100 g ginger powder (w/w), material/water ratios of 1/10; 1/15; 1/20; and 1/25 (w/w), pH from 3.5 to 5.0; temperature of hydrolysis process from 45 to 60°C, and time of hydrolysis process from 90 to 150 min. Subsequently, the hydrolysed ginger was spray-dried to produce instant products with surveyed parameters, including the maltodextrin concentration from 15 to 35 g/100 g ginger extraction, feed flow rates from 120 to 600 mL/h, and the temperatures of spray drying from 120 to 150°C. The suitable parameters for enzyme-assisted hydrolysis and production of instant tea were determined, including enzyme concentration as 0.2 g/100 g ginger powder (w/w), material/water ratio as 1/10 (w/w), pH at 5.0, temperature process as 55°C, the time of hydrolysis process as 120 min, the maltodextrin concentration as 15 g/100 g extraction (w/w), feed flow rate as 240 mL h\(^{-1}\), and the inlet temperature as 140°C. Furthermore, the physicochemical properties of the product were identified with moisture content as 2.36 ± 0.09%, total phenolic content as 98.34 ± 0.59 mg gallic acid equivalent/g DW, and IC\(_{50}\) value as 1,082 μgAA/mL.

Keywords: ginger, instant tea, enzymatic hydrolysis, physicochemical properties of ginger

1 Introduction

Gingers \((Zingiber officinale)\) Roscoe) are nutritionally and economically essential food grown worldwide [1]. Gingers also provide a wide range of nutrients, such as carbohydrates, fibre, minerals, vitamins, and polyphenol compounds [2]. Previous studies have identified more than 100 compounds in ginger, of which gingerol, shogaols, zingerene, zingerone as well as terpenes, vitamins, and minerals are commonly found [3,4]. Ginger is a common flavour in home kitchen for food, teas, and herbal medicines. Ginger is often used to aid digestion, anti-inflammation, and cure for morning sickness [5]. Vietnam is one of the world-leading producers of ginger, with 1.68 million tons in 2020 [6]. Currently, the consumption of instant tea products on the market is limited due to reduced nutritional content and unfavourable taste. Furthermore, fresh ginger is only used in methods of conventional processing. This could limit their scope of use in many fields, such as the food industry, cosmetics, pharmacy, and so on.

Enzymatic hydrolysis employs enzymes to break down the structure and release the active ingredients of the raw material [7]. The hydrolysis method with assisted enzyme provides many benefits, such as less formation of undesirable by-products, no need for corrosion-resistant processing equipment, less acid waste, and high potentials for complete conversion and safety products to consumers [8]. In the previous study, hydrolysis of ginger extraction with cellulase-assisted enzymes to break down cellulose structure to release many beneficial physicochemical compounds were reported [9]. Due to the above reasons, enzyme-assisted hydrolysis was chosen for ginger extraction aiming to separate beneficial compounds in it easily, and this extraction is used as a material for other processes.

The spray-drying method involves atomizing a solution, slurry, or emulsion containing one or more components of
the desired product into droplets by spraying, and then allowing the water to quickly evaporate from atomised droplets into solid powder by hot air at a specific temperature and pressure [10], leaving the heat sensitive compounds in the product undenatured for a long time [11]. Moreover, the spray-drying method offers many economic benefits, such as very short drying time, large-scale continuous production, low labour costs, and relatively simple operation and maintenance [12]. From these advantages, spray-drying method is suitable for preserving beneficial compounds in ginger extraction.

The aim of this study is to determine the appropriate parameters for hydrolysis of ginger juice by using “green” enzyme catalysis to increase the yield of beneficial compounds and produce instant product with retained valuable compounds. Furthermore, the physicochemical properties of products, including total phenolic content and antioxidant activities, were thoroughly investigated in this research. The findings provide a new research direction for diversifying ginger products.

2 Materials and methods

2.1 Materials

Gingers were purchased from a local farm in Ho Chi Minh City, Vietnam, with maturity from 240 to 270 days (since planting). The chemicals, including sodium carbonate (99%) and gallic acid (99%), were purchased from Xilong (China). 2,2-diphenyl-1-picrylhydrazyl (DPPH, 99%) and Folin–Ciocalteu reagent (99%) were supplied by Sigma-Aldrich (Germany). Enzyme cellulase (activity 10,000 U/g) was purchased from AngelYeast Co. Ltd (China). Acid citric (99.5%), acid ascorbic (99%), ethanol (96%), and maltodextrin (DE 12) were supplied by Xilong (China).

2.2 Production of instant ginger tea

The hydrolysis process of ginger: Fresh ginger (which were about 240–270 days mature since planting) was purchased from the local market, and stored at 4°C prior to further experiments within the following 30 days. Fresh ginger was peeled, washed, and cut into slices with a thickness of 1–1.5 mm. Ginger slices were dried at 50°C for 6 h using a convection dryer until moisture content after drying was 10.52%. Then, the dried ginger was ground into fine powder. The powder was dissolved in water and then added with cellulase enzymes with concentration ranges from 0.1 to 0.4 g/100 g of ginger powder. Then, citric acid was used to adjust the pH solution from 3.5 to 5. The hydrolysis was conducted at a temperature range of 45–60°C and time duration of 60–150 min. The hydrolysed ginger was subjected to vacuum filtration to obtain ginger extraction. The ginger extraction was determined with parameters such as Brix content (°Brix), extraction efficiency (%), polyphenol content (mg gallic acid equivalent (GAE)/g DW), and IC50 value (μg/mL).

The spray-drying process of ginger: Ginger extraction was added with maltodextrin at a ratio of 15–35 g/100 g ginger extraction. The mixture was then stirred at 400 rpm for 10 min. The process was conducted with feed flow rate of 120–600 mL h⁻¹ and at an inlet temperature of 120–150°C. The ginger spray drying powder was determined with parameters such as Brix content (°Brix), drying yields (%), polyphenol content (mg GAE/g DW), and IC50 (μg/ml).

2.3 Determination of physicochemical properties of the product

2.3.1 Measurement of moisture and brix content

Each sample (5 g) was placed in a moisture analyser (Ohaus MB90, US) and heated to 105°C. The moisture content was expressed on a wet percentage basis. The experiment was repeated three times for each sample.

Two drops of sample solution were added on the lower prism of the electronic refractometer by glass rod and the results were recorded. The experiment was repeated three times for each sample.

2.3.2 Determination of total polyphenol content (TPC)

The TPC was determined according to the method reported by Živić et al. [13] with some modifications. First, 1 g sample was mixed with 100 mL ethanol 96%. Then, 0.5 mL of the solution was added to 2.5 mL Folin–Ciocalteu 10% and 2 mL Na2CO3 7.5% solution. After 60 min incubation in the dark, the solution was photometrically measured at 765 nm. A gallic acid calibration curve was constructed with concentrations ranging from 0 to 200 μg/mL. TPC was shown as mg GAE per gram of sample (based on dry weight). The fitted curve was Concentration = 61.0676A + 1.8598 (R² = 0.9996).

2.3.3 Determination of antioxidant activity

The antioxidant activity was measured by using DPPH free radical scavenging method according to Kumar et al. [14]
with some modifications. First, 200 μL of the sample was added to 2 mL of DPPH solution prepared by dissolving 3.96 mg DPPH in 100 mL of ethanol at 96%, and then incubated in the dark at room temperature for 30 min. Then, the absorbance of samples was measured at 517 nm. Vitamin C was used as the standard, and the antioxidant activity of the sample was expressed as mg vitamin C equivalent per 100 g dry matter. The vitamin C standard curve was constructed with concentrations from 0 to 100 μg/mL, and the standard curve equation of the form concentration = −31.7238A + 25.0738 (R² = 0.9998).

2.3.4 Determination of drying yields

The powder recovery (DY) is defined as the mass of the obtained spray-dried product over the quantity of feed emulsion, calculated on the dry basis according to the method reported by Geraci et al. [15]:

\[ DY = \frac{m_2 \times (1 - y)}{m_1 \times x} \times 100 \] (1)

where \( m_1 \), \( m_2 \), \( x \), and \( y \) are the mass of the feed emulsion (g), the mass of the obtained powder (g), the solid percentage (%), and the moisture content of the obtained product, respectively.

2.3.5 Determination of extraction efficiency

The amount of a solute that passes from one phase to the next is known as extraction efficiency. It is determined by the partitioning of the solute between the phases equilibrium constant and any other solute-involved side reactions.

2.3.6 Powder morphology

The powder morphology was evaluated by scanning electron microscopy (SEM). The ginger powder was attached to SEM stem-mounted double-sided adhesive tape 1 cm diameter and 1 cm high, coated with gold in a vacuum evaporator, and examined using an MEV 1430 VP - LEO SEM (Electron Microscope Ltd, Cambridge, UK). The SEM was operated at 20 kV with a magnification of 900–1,200×.

2.3.7 Statistical analysis

Data were processed and plotted on Microsoft Excel 2016. Statistical analysis ANOVA and LSD test were used to compare the influence of factors, processed by Statgraphics Centurion Version 20 (Statpoint Technologies, Inc., Warrenton, VA, USA). \( p < 0.05 \) were considered significantly different.

3 Results and discussion

3.1 Physicochemical properties of ingredients

Table 1 shows the basic parameters of fresh ginger and ginger powder. The effects of preliminary processing factors were observed in the ingredients’ compounds, especially the TPC decreased by 29.46%. The author conducted drying at 70°C with hawthorn and wild pear fruits using a convection drier, the obtained results showed that the moisture content of the dried products was below 20% and the TPC content of the raw materials was significantly reduced by 30.95%. Nurhadi et al. showed that TPC reached 148 mg GAE/g DW in fresh ginger. Dehumidification drying affected the compounds present in fresh ginger [16].

3.2 Investigation factors of cellulase enzyme-assisted ginger hydrolysis

3.2.1 Effect of enzyme concentration (w/w) on physicochemical properties of the hydrolysis process

Table 2 shows the effect of enzyme concentrations on the physicochemical properties of ginger hydrolysis extraction. Results have shown that the moisture content and

Table 1: Physicochemical properties of gingers

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Moisture content (%)</th>
<th>TPC (mg GAE/g DW)</th>
<th>Antioxidant activities (μg acid ascorbic/g dry matter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh gingers</td>
<td>84.16 ± 0.02</td>
<td>168.15 ± 2.32</td>
<td>469.42</td>
</tr>
<tr>
<td>Ginger powder</td>
<td>10.52 ± 0.18</td>
<td>118.57 ± 4.40</td>
<td>663.57</td>
</tr>
</tbody>
</table>
extraction efficiency were unchanged at different enzyme concentrations. The ANOVA analysis displayed that the enzyme concentration has not significantly affected extraction efficiency and brix content ($p < 0.05$).

Figure 1 shows the effect of enzyme concentrations (g/100 g) on hydrolysis with the addition of cellulase enzyme catalyst. The TPC reached the highest level (92.86 ± 0.79 mg GAE/g DW) for 0.2 g of enzyme in 100 g of ginger powder and decreased for the other two ratios. The results have shown that the compatibility of enzyme concentration affected the hydrolysis ability. Kagan et al. showed that the enzymatic-assisted hydrolysis yielded the highest TPC of 37.5 mg/g DW in ethanol extraction solvent [17]. In addition, Nam et al. showed that the hydrolysis method with enzyme support is the most optimal with amylase content of 1% [18]. Overall, the enzyme concentration of 0.2 g/100 g ginger powder was selected as the optimal parameter.

### 3.2.2 Effect of material/water ratios (w/w) on physicochemical properties of the hydrolysis process

Table 3 shows the effect of material/water ratios (w/w) on physicochemical properties of extraction. The varied material/water ratios were 1:10, 1:15, 1:20, and 1:25 (w/w). The extraction efficiency did not change significantly for the four material/water ratios. Brix content also tends to be stable despite the material/water ratio change. The ANOVA analysis showed that the material/water ratios did not affect the extraction efficiency and brix content ($p < 0.05$).

The ratio of 1:10 gives a high TPC in this survey (Figure 2). In the presence of the remaining ratios, the TPC was not significantly different. Ostroschi et al. have also conducted the hydrolysis of cinnamon powder at varying ratios of raw material: solvent (w/w); the results have shown that the highest content of antioxidants (36.36%) was obtained at a ratio of 1:1.75 (w/w) [19]. Therefore, the ratio 1:10 was selected for further experiments.

### 3.2.3 Effect of pH on physicochemical properties of the hydrolysis process

Table 4 shows the effects of pH on the extraction efficiency and moisture content of the ginger extract. Results have shown that the extraction efficiency increased proportionally as the pH increased, especially at pH 4.5 and 5. However, as less citric acid is used to adjust pH for economic purposes, pH 5 is selected for subsequent experiment.
ANOVA analysis showed that the pH value did not significantly affect the extraction efficiency and brix content. Figure 3 shows that the pH factor partially determines the hydrolysis ability, in which the solution with pH 4.5 and 5 showed the highest hydrolysis performance in correlation with the measured TPC. To adjust the initial solution pH 6.54 to the optimal level of investigation, more citric acid was added at pH 5 (around 1.6 g), as compared to pH 4.5 (around 1.9 g). Similar results were also obtained from the study by Nagendra Chari et al. [20]. Schweiggert et al. showed that although the pH factor was one of the determining factors in the hydrolysis process, pH range from 4 to 5 was selected as the optimal pH level due to the enzymatic activity at different pH levels [21]. Phan et al. also showed that the increase in cyanidin-3-glucoside adsorption was in line with the pH increase from 3.0 to 5.0 [22]. Therefore, pH 5 was selected as the optimal parameter of the subsequent experiments.

### 3.2.4 Effect of hydrolysis time on physicochemical properties of the hydrolysis process

Results have shown that the hydrolysis time caused significant difference in the physicochemical properties of ginger extraction (Table 5). The Brix content remained at 4.4%, indicating that the moisture content of the solution remains at a relatively high level. The extraction efficiency and the appearance were almost unchanged. Yusof and Ibrahim also concluded that increasing the enzyme treatment time enhanced the total solid solute in obtained solution [23]. The ANOVA analysis showed that the hydrolysis time has not significantly affected the extraction efficiency and Brix content ($p < 0.05$).

Results showed a significant difference between the hydrolysis time of 60 and 90 min compared with the time of 120 and 150 min (Figure 4). The hydrolysis at 120 min showed the highest TPC (approximately 96.19 mg GAE/g DW). Previously, Schweiggert et al. showed that the optimal hydrolysis time for the rhizome of ginger should be under 2 h, producing a very characteristic smell of ginger due to the loss of $\cdot$OH radical of 6-gingerol to 6-shagaol [21]. Xiao et al. showed that the optimal time for hydrolysis of rice mixture is 90 min; although the enzyme properties and the hydrolysate were different, the processing time was within 90 and 120 min [24]. Therefore, the present study proposed that the optimal hydrolysis time was 120 min.

### 3.2.5 Effect of hydrolysis temperature on physicochemical properties of the hydrolysis process

Table 6 shows the effects of hydrolysis temperature on the extraction efficiency of ginger extract. Results have shown

![Figure 3: Effect of pH on TPC. *a, b, c: Figures with same letters indicate statistical indifference.](image-1)

![Figure 4: Effect of hydrolysis time on TPC. *a, b, c: Figures with same letters indicate statistical indifference.](image-2)
that the efficiency increased proportionally from 77.98% to 83.94% as the temperature increased from 45 to 55°C. However, excessively increasing the temperature to 60°C resulted in reducing the extraction efficiency to 81.47%. According to ANOVA analysis, the hydrolysis temperature has not significantly affected the extraction efficiency and Brix content ($p < 0.05$).

Figure 5 shows the effect of hydrolysis temperature on the TPC of the ginger extract, with the highest TPC level of 98.34 ± 0.59 mg GAE/g DW obtained at 55°C. The temperature threshold of the survey prioritises the ability to retain 6-gingerol during hydrolysis because at pH conditions above 4, the temperature affects the ability to lose –OH radicals, leading to the formation of 6-shagaol and the unique smell of ginger extract. Gao et al. [25] have shown that the temperature affects the heat-susceptible compounds, where the most suitable temperature was 50°C in the presence of enzymes. Furthermore, Cruz et al. indicated that the optimal hydrolysis ability was at 60°C with the use of protease enzymes [26]. Therefore, 55°C was selected as the most optimal temperature for ginger hydrolysis in this study.

### 3.3 Investigation factors of production of instant ginger tea using spray drying technique

#### 3.3.1 Effect of maltodextrin concentration on physicochemical properties of the spray drying process

Table 7 shows the effects of maltodextrin mass on the physiochemical properties of the ginger product, particularly the uniform colour and the stabilised structure of the powder. The moisture content exhibited no significant differences in this survey (Table 7). According to ANOVA analysis, the drying yields were affected by maltodextrin concentration ($p < 0.05$).

#### Table 6: Effect of hydrolysis temperature on physicochemical properties of the extraction

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Temperature (°C)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Extraction efficiency (%)</td>
<td>77.98</td>
</tr>
<tr>
<td>Brix content (°Brix)</td>
<td>4.38</td>
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<tr>
<td></td>
<td>± 0.06</td>
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#### Table 7: Effect of maltodextrin concentration on physicochemical properties of the obtained powder

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maltodextrin concentration (g/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Drying yields (%)</td>
<td>73.31</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>2.37</td>
</tr>
<tr>
<td>content (%)</td>
<td>± 0.03</td>
</tr>
</tbody>
</table>
size of the droplets would increase, which makes the particles tend to stick together, leading to a decrease in drying efficiency [29]. ANOVA analysis showed that the feed flow rate has not significantly affected drying yields and moisture content ($p < 0.05$).

Figure 7 shows the slight influence of the feed flow rate on the spray-drying efficiency through measuring the TPC of each sample. Clearly, the feed flow rate was inversely proportional to the TPC in the ginger extract. At the same time, at the flow rate of 120 and 240 mL/h, the TPC did not show significant difference. However, the spray-drying time at 240 mL/h (below 1.2 h) input rate is shorter than 120 mL/h (below 2.5 h), which affects the performance of the machine and the drying intensity. Typically, Goula and Adamopoulos’ study fixed an input rate of 105 mL/h, which is very close to the input rate of 120 mL/h [29]. Carra et al. showed that increasing feed flow rates led to a decline in active agents’ content in the microparticles’ core. Specifically, increasing the feed rate from 10 to 14 mL/min decreased polyphenol content to 37.2%; however, a slower feed flow rate could prolong drying time [30]. Therefore, the survey of two articles partly reflects the compatibility of the operating equipment with the liquid to be dried. Therefore, the feed flow rate of 240 mL/h was selected for the present study.

### 3.3.3 Effect of inlet temperature on physicochemical properties of the spray-drying process

Table 9 shows the similarities of the products in this last survey such as the average moisture content of the four experimental units at 2.42% and the average powder recovery efficiency of 74.22%. The ANOVA analysis showed that the inlet temperature did not affect the drying yields and moisture content ($p < 0.05$). However, when determining polyphenol content, there was a relative difference between experimental units.

**Table 9: Effect of inlet temperature on physicochemical properties of the spray-drying process**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>120</th>
<th>240</th>
<th>360</th>
<th>480</th>
<th>600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drying yields (%)</td>
<td>71.10</td>
<td>78.24</td>
<td>77.57</td>
<td>73.32</td>
<td>71.53</td>
</tr>
<tr>
<td>Moisture content (%)</td>
<td>2.37</td>
<td>± 0.06</td>
<td>2.36</td>
<td>2.36</td>
<td>2.37</td>
</tr>
<tr>
<td></td>
<td>± 0.04</td>
<td>± 0.02</td>
<td>± 0.02</td>
<td>± 0.02</td>
<td>± 0.04</td>
</tr>
</tbody>
</table>

Figure 6: Effect of maltodextrin concentration on the TPC of obtained powder. *a, b, c: Figures with same letters indicate statistical indifference.

Figure 7: Effect of feed flow rate on the TPC of obtained powder. *a, b, c: Figures with same letters indicate statistical indifference.
Figure 8 shows that the influence of spray-drying temperature from 120 to 150°C on TPC of the microencapsulate is non-significant (p > 0.05). The highest TPC of 96.96 ± 0.71 mg GAE/g DW was obtained at 140°C. Previously, Jangam and Thorat investigated the input temperature range for the spray-drying process of ginger juice from 120 to 160°C, after optimizing the input temperature of the spray drying process, the author has concluded that the best temperature range is from 131.71 to 136.61°C. The author also concluded that increasing the inlet temperature can cause thermal destruction of 6-gingerol to 6-shogaol. Explaining this phenomenon, the author described that increasing the drying temperature increases the atomisation pressure and reduces the storage capacity of 6-gingerol (a specific polyphenol compound in ginger). This may be because the higher atomisation pressure results in smaller droplets, which facilitate the loss of gingerol due to the increased surface area [31]. Cortés-Camargo et al. also claimed that the inlet temperature range from 120 to 200°C was appropriate for the lemon essential oil microencapsulation process using spray drying [32]. Therefore, the spray drying temperature of 140°C was selected as the most optimal in the present study.

Figure 9 shows that the morphology of microparticles were produced at 140°C, with maltodextrin as 15% (w/w), and feed flow rate as 240 mL/h. SEM image analysis showed that the obtained powder particles were quite uniform in size, with an intact particle surface and no cracks, indicating the ability to retain and protect the bioactive compounds well inside. Regarding the particle shape, under the present drying temperature, most of the obtained granules are mainly spherical, with the outer surface shrinking and concave. The current study was similar to the results conducted by Zahi et al. (d-limonene powder), Ferrari et al. (raspberry juice powder), and Santiago-Adame et al. (cinnamon essential oil powder) [33–35].

4 Conclusion

For the enzyme-assisted hydrolysis of ginger extraction, the following conditions have been selected: the enzyme concentration of 0.2/100 g ginger powder (w/w), material/water ratio of 1/10 (w/w), pH 5, hydrolysis time of 120 min, and temperature of 55°C. Results have shown that the produced ginger extract had 95.62% of moisture (as indicated by Brix content of 4.38 ± 0.02°Brx), TPC of 98.34 ± 0.59 mg GAE/g DW, and antioxidant activity IC50 of 883 μgAA/mL. The extraction yield was 83.94% and the recovery was 71.35%. The application of cellulase enzyme in the hydrolysis of ginger is also a possible research direction due to its low cost and high applicability in practice. Ginger hydrolysate is used as a raw material for further processing in the food industry. For the production of instant tea from ginger extraction using spray-drying method, the maltodextrin coating was used at a concentration of 15 g/100 g ginger extraction, the optimal feed flow rate of 240 mL/h and the inlet spray drying temperature of 140°C. The product achieved optimal moisture content of 2.36 ± 0.09%, TPC of 96.96 ± 0.71 mg GAE/g DW, antioxidant activity IC50 of 1,082 μgAA/mL, and spray-drying efficiency of

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Inlet temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120</td>
</tr>
<tr>
<td>Drying yields (%)</td>
<td>76.21</td>
</tr>
<tr>
<td>Moisture content (%)</td>
<td>2.51 ± 0.02</td>
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</table>

*Figures with same letters indicate statistical indifference.*
75.56%. The process of producing ginger tea from hydrolysate is also a suitable application direction for hydrolysed products. In addition, spray-dried soluble ginger tea has low moisture content and high content of bioactive substances, which shows its wide application potential in the food, pharmaceutical, and cosmetics industries in the future. Additionally, sensory analysis of the final products should be carried out in further studies as this helps to assess the customer’s tastes and the commercialisation potential of ginger instant tea products in the market.

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Conflict of interest: All authors state no conflict of interest.

Ethical approval: The conducted research is not related to either human or animal use.

Data availability statement: All data analysed during the current study are included in this published article. The detailed data can be provided on reasonable request.

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