Chemical properties analysis of soygurt with ginger (*Zingiber officinale var. roscoe*) extract as functional foods

A A Anggraini, M Devi, N Nurjanah, and N A Sunaryo

Department of Industrial Technology, Faculty of Engineering, Universitas Negeri Malang, Malang, Indonesia

Email: ayuafifanggraini26@gmail.com

Abstract. The processing of soy milk into soygurt was an effort to eliminated the soybean flavor. Several studies showed that plain soygurt still had soybean flavor. The addition of (*Zingiber officinale var. Roscoe*) extract was an alternative to eliminate the distinctive soybean flavor. This experiment aimed to study the chemical properties of soygurt, which consist of protein, fat, ash, lactic acid, pH. This research used a completely randomized design with one factor of ginger extract concentration (i.e. 4%, 5% and 6%) and all treatments were carried out in duplicate. The collected data were analyzed by One Way ANOVA. If the result was significant (<0.05), it would be processed by the DMRT test. The results showed that the levels of chemical properties of soygurt were 4.507-4.987% of protein; 2.859% -3.220% of fat; 0.455-0.56% of ash, 1.710-2.068% of lactic acid and 3.965-4.230 pH value. The experimental results showed that the addition of ginger extract was also proven to significantly affect the chemical properties of soygurt. The addition of ginger (*Zingiber officinale var. Roscoe*) extract could increase the levels of protein, ash, lactic acid and could reduce fat levels and pH value.

1. Introduction

Functional foods were beneficial to the body in addition to the function of basic nutrients which consisted of several bioactive components, such as isoflavones, dietary fiber, prebiotics (oligosaccharides), probiotics (lactic acid bacteria)[1]. Yogurt was one of the probiotic foods developed in the market. Yogurt made from cow's milk and, currently, various innovations were carried out to increased the diversity of this functional food, for example, soygurt. Soygurt was made from soy milk fermented by the lactic acid bacteria of *S. Thermophilus* and *L. Bulgaricus* [2]. Soy milk could be a substitute for cow's milk, especially for those who suffer lactose intolerance [3]. Soy milk contained 3.50 gr protein and 2.50gr fat [4]. However, soy milk produced a distinctive soybean flavor caused by the lipoygenase enzyme derived from soybeans. Soy flavor could be reduced by soaking, boiling, fermentation and adding flavor. The process of soygurt became an alternative to eliminated the soybean flavor. Soygurt could become a functional food caused by the combination of probiotics and prebiotics that was made from soybeans (oligosaccharides) and probiotics from lactic acid bacteria *L. acidophilus* [5][6]. Nevertheless, plain soygurt had a distinctive soybean flavor [7]. Therefore, additional ingredients were needed to improve the flavor of soygurt. Natural ingredients added could derive from Indonesian herbs, such as ginger which able to reduced soybean flavor. [8].
However, there was no further research on the chemical properties of soygurt with the addition of elephant ginger extract. Ginger contained a protease enzyme called Zingibain [9] which could help the coagulation protein processed in yogurt [10]. Ginger also had the ability to maintain food quality as an antimicrobial against pathogenic microbes which could inhibit the bacteria C. Albicans [11]. This research aimed to analyze the effects of addition elephant ginger extract towards the chemical properties consist of protein, fat, ash, lactic acid levels, and pH values.

2. Materials and Methods

2.1. Preparation of soygurt elephant ginger
The soy milk used soybeans of anjasmoro variety and the ginger extract used Zingiber officinale var. Roscoe types were bought from Balitkabi and the local market in Malang, East Java, Indonesia. The first process of made soygurt mixed 100 ml of soy milk with 15 grams of skimmed milk powder, 10 grams of sugar, and the addition of elephant ginger extract i.e of 4%, 5%, and 6% (v/v). Then, the pasteurization step was carried out for 30 seconds at 75°C. Next, the temperature dropped up to 43°C and an inoculation process was carried out with the addition of lactic acid bacteria (L.bulgaricus, L.acidophilus, and S.thermophilus) 5% (v/v). The last step was the fermentation process in an incubator at 43°C for 4 hours and let it sit at 25°C for 12 hours.

2.2. Methods and analysis
This experimental research used a completely randomized design. The treatment was the addition of elephant ginger extract to soygurt, A1 (concentration of elephant ginger extract 4%), A2 (concentration of elephant ginger extract 5%), A3 (concentration of elephant ginger extract 6%) and all treatments were carried out in duplicate. Then, each treatment was analyzed for the protein levels (semi-Kjeldahl micro method), fat levels (soxhlet extraction method), ash levels (dry ashing method), lactic acid levels (titration method) and pH value (used a pH meter).[12]

The data were analyzed of chemical properties by One Way ANOVA to rate the differences in the product. If the ANOVA test results had a significant difference with the significance level (<0.05), a further test would carried out by DMRT (Duncan's Multiple Range Test) to determine the differences in each treatment.

3. Results and Discussion
The results of the addition of elephant ginger extract with a concentration of 4%, 5% and 6% into soygurt showed significant differences in chemical properties included the levels of protein, fat, ash, lactic acid, and pH value.

| Table 1. The result chemical properties of the addition ginger (Zingiber officinale var. Roscoe) extract on soygurt. |
|---------------------------------------------------------------|
| Concentration of Ginger Extract | Protein | Fat | Ash | Lactic Acid | pH values |
|-----------------------------------------|---------|-----|-----|-------------|-----------|
| 4%                        | 4.506<sup>a</sup> | 3.220<sup>c</sup> | 0.455<sup>a</sup> | 1.710<sup>a</sup> | 4.230<sup>c</sup> |
| 5%                        | 4.901<sup>b</sup> | 3.060<sup>b</sup> | 0.510<sup>b</sup> | 1.980<sup>b</sup> | 4.076<sup>b</sup> |
| 6%                        | 4.987<sup>b</sup> | 2.859<sup>a</sup> | 0.560<sup>c</sup> | 2.068<sup>c</sup> | 3.965<sup>a</sup> |

3.1. Protein levels
The addition of elephant ginger extract to soygurt could increase the protein levels as shown in Table 1. This was caused by the raw materials contained in soygurt. Ginger contained 1.5 grams/100 grams of protein [4], the more elephant ginger extract added to the mixture, the levels of soygurt protein also increased. It was caused by activated of the protease enzyme contained in ginger. Zingibain had protease enzyme that could assist the process of coagulation milk into cheese [9],[13]. Based on the aforementioned theory, zingibain helped speed up the process of protein coagulation in soygurt. The
protein hydrolysis process could increase protein levels in a food product [14]. In the process, zingibain as a protease enzyme in ginger could increase protein levels which causes protein hydrolyzed into large amounts of peptides. The increased protein levels in this research were appropriate with other research [15] that the addition of ginger paste on the chicken could maximize proteolytic performance so that the protein levels increased up to 23.77%. The other research also proved the increasing protein levels in soy milk powder with the additional ginger extract [16]. Protein levels had fulfilled the yogurt standard minimal 2.7% [12] and higher than plain soygurt protein levels in the USDA which was 3.53gr[17].

3.2. Fat levels
Table 1 indicated a noticeable difference that the higher the concentration of elephant ginger extract could reduce soygurt fat levels. The decline was caused of the lipase enzyme in the ginger [18]. Lipase enzyme was an enzyme that breaks down fat into fatty acids. It would transformed into fatty acids either saturated or unsaturated [19]. The processed soygurt with the addition of elephant ginger extract contained a lipase enzyme, especially in the fermentation process that used L.acidophilus lactic acid bacteria also helped the activity of the lipase enzyme more optimally to reduce fat levels. The higher the concentration of addition elephant ginger extract, increasing the performance of the lipase enzyme that could reduce the fat levels in soygurt. The reduction in fat levels following a research [19] that the higher the concentration added the fat content of yogurt decreased to 4.08%. The fat levels contained in soygurt products had met the standardization in Indonesia [11] soygurt with the addition of ginger extract of 4% and 5% included in the standard yogurt of at least 3%, while soygurt with the addition of elephant ginger extract 6% included in the category of low-fat yogurt ranges from 0.6-2.9%. It also added to the functional value of helped the normal maintenance for cholesterol patients it caused ginger contained gingerol that could assist in reduced cholesterol levels [18].

3.3. Ash levels
Ash levels were factors to determine the quality of food products commonly referred to as organic substances or minerals. The addition of elephant ginger extract increased the ash levels of soygurt as shown in Table 1. The amount of ash levels contained in a food product depends on the magnitude of the material of mineral content used [16]. The mineral could obtain from various foodstuffs. Based on a study [20] soybean milk of anjasmoro varieties had ash levels of 5.88%. Elephant ginger also had a high ash content that is 6.60-7.70% [20]. The ash levels contained in soygurt had qualified the quality of yogurt [12] with a maximum ash level of 1.0%. It could categorize as a functional food product development. It caused the addition of elephant ginger extract to soygurt which could increase the nutritional value of ash or mineral. Soybean contained iron, phosphate, copper, manganese and calcium, and zinc. The fermentation processed soybean could increase the availability of iron and hydrolyzed acid phytate on soy [21].

3.4. Lactic acid levels
The result in Table 1 indicated that the addition of elephant ginger extract on soygurt could increase lactic acid levels. The acidity of yogurt is inversely proportional to pH levels. The lower levels of pH caused the increasing levels of lactic acid in soygurt added with elephant ginger extract. The higher the addition of the concentration of elephant ginger extract in soygurt increased the lactic acid bacteria which could increase the acidity in yogurt [22]. Lactic acid levels in soygurt with the addition elephant ginger extract had fulfilled the Indonesian standard yogurt [12] concentration of 4% and 5%. While the addition of elephant ginger extract with a concentration of 6% in soygurt had a high acidity level exceeds the Indonesian standard yogurt with range 0.6-2% [12]. Therefore, soygurt with a concentration of additional elephant extract of 4% and 5% could be functional food products. L.acidophilus in soygurt could utilize lactose and a sucrose supplement contained in milk so that the metabolic activity optimally and produced high lactic acid [23].
3.5. **pH value**
The additional elephant ginger extract could reduce the pH value in soygurt as shown in Table 1. It was caused by the raw material used. Based on a study the combination of starter on soygurt showed the combination of *Lacidophilus, L.bulgaricus, and S.thermophilus* bacteria could reduce pH levels up to 4.38 due to the change in sugar into organic acids [23]. Organic acids that were formed dissociated in the form of ions H⁺ [24]. The decreased pH levels caused by the increased activity of lactic acid bacteria in the fermentation process and the occurrence of lactic acid was production derived from carbohydrates in soy milk [25]. The fermentation process was optimal because there were other carbohydrate sources derived from sucrose, skim milk (lactose), the starch in elephant ginger [7]. The higher concentration of added elephant ginger extract could increase the lactic acid bacteria in yogurt [22]. The more lactic acid bacteria used, the metabolites especially lactic acid that could dissociate into ions H⁺ thus decreased pH value [24]. Soygurt with the addition of elephant ginger extract proved to decrease pH value and increased lactic acid levels. It was in accordance with the result of research by Putri et al., (2018) that the higher concentration of addition of ginger could reduce the pH value [26]. It fulfilled the Australian fermentation food standard with pH maximum 4.5 [27]. Therefore, soygurt products could be one of the potential products as functional foods.

3.6. **Flavor soygurt**
Soygurt flavor changed with the addition of elephant ginger extract caused by changes in lactic acid levels and pH values. Table 1 showed that lactic acid levels increased, affecting the flavor of soygurt. In addition, the flavor in soygurt with the addition of elephant ginger extract was influenced by the decrease in pH value in Table 1 which showed a high acidity level so as to increase the sour flavor in soygurt. The sour flavor of soygurt with the addition of elephant ginger extract with a concentration of 4% to 6% could eliminate the soybean flavor from soy milk and improve the quality of soygurt.

4. **Conclusions**
The addition of elephant ginger showed significant differences (<0.05) in soygurt chemical properties. The protein levels obtained ranged 4.506%-4.987%, fat 2.8595-3.220%, ash 0.455-0.560%, lactic acid 1.710-2.068%, pH value 3.965-4.230. Based on the results of the chemical properties the higher amount of ginger extract added could increase the value of protein levels, ash levels, and lactic acid levels, but could reduce the levels of fat and pH levels. The added concentration of elephant ginger extract was not more than 5% to be recommended as a functional food product because the value range of chemical properties had fulfilled the quality standard of yogurt.

**References**

[1] Agustina R, Noor R, Widjayanti R D E, Nuraida L, Ratna N, Nofi L S, Aitonam M, Setiawan B, Giriwono P E2018 Kajian manfaat pangan fungsional setelah terpenuhinya gizi seimbang (Study of the benefits of functional food after the fulfillment of balanced nutrition) Pra-Widyakarya Nas. Pangan dan Gizi 22–23 Mei 2018 [In Indonesian]

[2] Herawati D A, Wibawa D A A 2011 Pengaruh konsentrasi susu skim dan waktu fermentasi terhadap hasil pembuatan soyghurt (The effect of skim milk concentration and fermentation time on the yield of soyghurt making) Jurnal Ilmu Teknik Lingkungan 1 2 48–58 [In Indonesian]

[3] I N K Putra 2015Formulation of skim milk and soy milk on producing soyghurt Jurnal Ilmiah Imu dan Teknologi Pangan 2 1 23–28

[4] Departemen Kesehatan RI 2000 Daftar komponen bahan makanan (List of food ingredients) (Jakarta: Departemen Kesehatan RI) [In Indonesian]

[5] Ma Y, Wu X., Giovanni V, Meng X 2017 Effects of soybean oligosaccharides on intestinal microbial communities and immune modulation in mice Saudi J. Biol. Sci. 24 1114–121

[6] Juffrie M, Helmayanti S 2016 Sinbiotik: evolusi kesehatan melalui saluran cerna (Synbiotics: evolution of health through the gastrointestinal tract) (Yogyakarta: UGM Press) pp 178 [In

---

IOP Conf. Series: Earth and Environmental Science 733 (2021) 012074 doi:10.1088/1755-1315/733/1/012074

International Conference on Green Agro-industry and Bioeconomy IOP Publishing

---

[Note: The above text is a natural representation of the document content. It includes relevant scientific and technical information as well as the references cited in the original document.]

---

4
[7] I G Suryana 2013 Pengaruh penambahan jenis susu terhadap karakteristik yogurt kacang kedelai (soyogurt) (Effect of addition of type of milk on characteristics of soybean yogurt (soyogurt)). Undergraduate Thesis, Bogor Agricultural University [In Indonesian]

[8] N Hanifah 2016 Pengaruh penambahan daun jeruk purut, sereh, dan jahe terhadap aroma langu (beany flavor) pada yoghurt susu kedelai (soyogurt) (The effect of adding lime leaves, lemongrass, and ginger to the unpleasant aroma (beany flavor) in soy milk yogurt (soyogurt)). Undergraduate Thesis, University of Semarang [In Indonesian]

[9] Thompson E H, Wolf I D, Allen C E1973 Ginger rhizome: a new source of proteolytic enzyme J. Food Sci. 38 4 652–655

[10] H P Arum, Purwidiani N 2014 Pengaruh jumlah ekstrak jahe dan susu skim terhadap sifat organoleptik yoghurt susu kambing etawa (Effect of the amount of ginger extract and skim milk on the organoleptic properties of etawa goat milk yoghurt) E-journal Boga 3 3 116–124 [In Indonesian]

[11] Sari K IP, Periadnadi, Nasir N 2013 Uji antimikrobia ekstrak segar jahe-jahean (Zingiberaceae) terhadap Staphylococcus aureus, Escherichia coli dan Candida albicans (Antimicrobial test of ginger fresh extract (Zingiberaceae) against Staphylococcus aureus, Escherichia coli and Candida albicans) Journal Biologi Universitas Andalas 2 120–24 [In Indonesian]

[12] Standar Nasional Indonesia 2009 SNI 2981: 2009 Yoghurt (Jakarta: Badan Standardisasi Nasional) [In Indonesian]

[13] Gagaoua M, Hafid K, Hoggas N 2016 Data in support of three phase partitioning of zingibain, a milk-clotting enzyme from Zingiber officinale roscoe rizomes Data in Brief 6 634–639 [In Indonesian]

[14] Arniah A 2017 Uji kadar protein total pada campuran kacang kedelai (Glycine max L.Merr) dan ekstrak buah nanas (Ananas comosus) dengan perbandingan berbeda (Total protein content test on a mixture of soybean (Glycine max L.Merr) and extract of pineapple (Ananas comosus) with different comparison). Diploma Thesis, Sekolah Tinggi Ilmu Kesehatan Insan Cendekia Medika Jombang [In Indonesian]

[15] Arni, Hafid H, Aka R 2016 Pengaruh pemberian pasta jahe (Zingiber officinale roscoe) terhadap kualitas daging ayam kampung (Effect of ginger paste (Zingiber officinale roscae) on the quality of chicken meat) Jitro 3 3 104–108 [In Indonesian]

[16] Pramitasari D, Anandhito R B K, Fauza G 2011 Penambahan ekstrak jahe dalam pembuatan susu kedelai bubuk instan dengan metode spray drying: Komposisi kimia, sifat sensoris, dan aktivitas antioksidan (The addition of ginger extract in making soymilk powder by spray drying method: Chemical constituents, sensory characteristic and antioxidant activity) Biofarmasi J. Nat. Prod. Biochem. 9 1 17–25 [In Indonesian]

[17] United States Department Of Agriculture 2019 Silk plain soy yogurt. National Nutrient Database for Standard Reference, U.S. Department of Agriculture

[18] Setyawana B 2015 Peluang usaha budidaya jahe (Ginger cultivation business opportunities) (Yogyakarta: Pustaka Baru Press) pp 149 [In Indonesian]

[19] Adriani L, Indrayati N, Tanuwiria U. H, Mayasari N 2008 Aktivitas Lactobacillus acidophilus dan Bifidobacterium terhadap kualitas yoghurt dan penghambatannya pada Helicobacter pylori (Lactobacillus acidophilus and Bifidobacterium activity on yoghurt quality and inhibitory growth effect on Helicobacter pylori) Journal Bionatura 10 2 129–140 [In Indonesian]

[20] Budiarti D 2015 Pertumbuhan jahe gajah (Zingiber officinale var. officinale) yang ditanam menggunakan beberapa dosis pupuk bokashi dan pupuk anorganik (Growth of elephant ginger (Zingiber officinale var. Officinale) grown using several doses of bokashi and inorganic fertilizers). Undergraduate Thesis, Sultan Syarif Kasim II State Islamic University [In Indonesian]

[21] Winarti S 2010 Makanan fungsional (Functional food) (Yogyakarta: Graha Ilmu) pp 137-165
[In Indonesian]

[22] Listyani 2011 Pengaruh penambahan sari jahe terhadap sifat fisikokimia, mikrobiologis dan sensoris yoghurt (The effect of adding ginger juice on the physicochemical, microbiological and sensory properties of yogurt). Undergraduate Thesis, Widya Mandala Catholic University Surabaya pp 11–50 [In Indonesian]

[23] Nizori A, Suwita V, Surhaini, Mursalin, Melisa, Sunarti T C, Warsiki E 2008 Pembuatan soyghurt sinbiotik sebagai makanan fungsional dengan penambahan kultur campuran Streptococcus thermophilus, Lactobacillus bulgaricus, dan Lactobacillus acidophilus (Preparation of synbiotic soy yogurt as a functional food with the addition of mixed culture Streptococcus thermophilus, Lactobacillus bulgaricus, and Lactobacillus acidophilus) J. Tek. Ind. Pert 18 1 28–33 [In Indonesian]

[24] Rasbawati, Irmayani, Novieta I D, Nurmiati N 2019 Karakteristik organoleptik dan nilai pH yoghurt dengan penambahan sari buah mengkudu (Morinda citrifolia L) (Organoleptic characteristics and pH value of yoghurt with addition of noni fruit extract (Morinda citrifolia L)) (J. Ilmu Produksi dan Teknol. Has. Peternak. 7 1 41–46 [In Indonesian]

[25] Hidayati D 2010 Pola pertumbuhan bakteri asam laktat selama fermentasi susu kedelai (Growth pattern of lactic acid bacteria during soy milk fermentation) Jurnal Teknologi Hasil Pertanian 3 2 72 [In Indonesian]

[26] Putri N S, Hasanah A A N, Prehatin J 2018 Viabilitas bakteri pembentuk asam pada yoghurt yang disuplementasi dengan ekstrak jahe gajah (Zingiber officinale var. Roscoe) (Viability of acid-forming bacteria in yogurt supplemented with elephant ginger extract (Zingiber officinale var. Roscoe)). Pemanfaatan Sumber Daya Lokal Menuju kemandirian Pangan Nasional 2018 [In Indonesian]

[27] Food Standards Australia New Zealand 2016 Australia New Zealand food standards code - standard 2.5.3. fermented milk products (Australia: Commonwealth of Australia Gazette)