Chemical and Physical Characteristics of Fermented Beverages from Plant-Based Milk with the Addition of Butterfly Pea Flower (Clitoria ternatea L.) Extracts

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Abstract. The prevalence of lactose intolerance in Indonesia is increasing now. Almond milk (A), soymilk (S), and almond-soy milk (A-S) are plant-based milks that can be used to prevent lactose intolerance. Besides that, in Indonesia, about 45% of an estimated 25.300 child deaths is attributable to air pollution. Air pollution is a source of free radicals that are hazardous to the body. The butterfly pea extract has high antioxidant activity. Antioxidant can counteract free radicals. The aim of this research is to know the chemical and physical characteristics of fermented beverages from A, S, and A-S with the addition of (10%) butterfly pea flower extracts. These beverages were produced by fermentation with Lactobacillus acidophilus, Lactobacillus plantarum, Lactobacillus rhamnosus, Lactobacillus salivarius, and Bifidobacterium breve. The research method is Completely Randomized Design (CRD). The research revealed that fermented beverage from A has the highest antioxidant activity and protein content. Hedonic test revealed that panellists prefer aroma, taste, and texture of fermented beverage from A-S; however, the colour of fermented beverage from A is more preferred.

1. Introduction
Consumers began to demand fermented foods, because they have nutritional content that is beneficial to health; they also provide and preserve vast quantities of nutritious foods in a wide diversity of flavours, aromas and textures [1]. Fermented beverage is one kind of fermented foods. Generally, fermented beverages are produced from animal milk, cow’s milk. However, some individuals can’t digest lactose in cow’s milk completely or can be called lactose intolerance. The prevalence of lactose intolerance in Indonesia was increasing within the past two decades, especially in children 3-15 years old, that is 21.3% (aged 3-5 years), 57.8% (aged 6-11 years), and 73% (aged 12-14 years) [2]. Plant-based milk can be used as an alternative to cow’s milk [3], so it can be used for lactose intolerance prevention. Plant-based milk is colloidal suspensions or emulsions consisting of dissolved and disintegrated plant material [4]. The popular plant-based milk is soymilk, but almond milk is also beginning to be demanded by consumers [5]. Almond milk and soymilk do not contain lactose. Besides that, almond-soy milk had a better sensory value compared to almond milk and soymilk [6]. Almond milk and soymilk have a different nutrition content (especially carbohydrates, proteins, vitamins, and minerals), the nutrition content will empower growth and metabolism of lactic acid bacteria, and the results of the metabolism will affect the characteristics of the fermented beverage.
produced [7]. Butterfly pea flower (*Clitoria ternatea* L.) extracts have been approved by Food and Drug Administration as a natural food colouring that is safe for consumption [8]. The addition of butterfly pea extracts is expected to improve the quality/characteristics of fermented beverages, especially their antioxidant activity. Butterfly pea flower extract contains anthocyanin with high antioxidant activity [9]. Butterfly pea flower is rich in protein [10], and contains carbohydrate and mineral [11]. In fermented beverages, pH4, anthocyanin will display a purple colour, the colour attribute will affect the sensory value [12]. Butterfly pea flower extract had been widely added to a number of food products. Benefits of butterfly pea flower extract for health, including reducing nephrotoxicity (toxins that interfere with kidney functions), and increase the amount of antioxidant enzymes in the body, including superoxide dismutase/SOD, catalase/CAT, reduced glutathione/GSH, and glutathione peroxidase/GPx [13]. Addition of butterfly pea flower extract can increase the sensory value of lemon juice with stevia [14]. Characteristics of fermented beverages were influenced by several factors, one of which was a kind of milk used [15]. Indratiningsih’s research showed that a kind of plant-based milk influenced protein content, water content, and sensory value (texture and acceptability) on fermented beverage product “eggurt”, plant-based milk used included sesame milk, black soymilk, and green bean milk [16]. This research aimed to know the chemical and physical characteristics of fermented beverages from almond milk, soymilk, and almond-soy milk with the addition of 10% butterfly pea flower extracts.

2. Materials and Methods

2.1 Materials

Almond milk and soymilk were produced from roasted almond (Blue Diamond, USA) and organic soy (LingkarOrganik, Indonesia). Fermentation culture consisted of *Lactobacillus acidophilus*, *Lactobacillus plantarum*, *Lactobacillus rhamnosus*, *Lactobacillus salivarius*, and *Bifidobacterium breve*. Fresh butterfly pea flower was obtained from Jakarta.

2.2 Preparation of making mother culture and fermentation of plant-based milk

This stage used the modified Bernat research method [17]. Almond, soy, and almond-soy (1:1) were soaked in warm water for 1 hour. After that, nuts are peeled, and then added to water with nut:water ratio of 1:3, so blended by food processor (Oxone; OX-869PB, China) for 3 minutes. Furthermore, it was pasteurized at 72°C for 15 minutes, and added to 5% (w/v) sugar, then fermented with incubator (Memmert; Models 30-750, Germany) at 37°C for 5 hours. Fermentation of plant-based milk was the same as preparation of making mother culture.

2.3 Preparation of making butterfly pea flower extract

Fresh butterfly pea flower was added to water with flower:waterratio of 1:5. Then, it was heated with microwave for 2 minutes, and then it was filtrated[18].

2.4 Antioxidant Activity Analysis

This analysis was using stable free radical 1,1-diphenyl-2-picrylhydrazyl/DPPH (Sigma-Aldrich, Jerman)[19]. One gram of each sample was weighed in centrifuge tube then added to 7 ml methanol, and it was vortexed (Thermo Scientific, China) for 1 minute. Afterwards, it was added to 2 ml DPPH (1mM) and then left in a dark room for 20 minutes. Furthermore, it was centrifuged at 4000 rpm at 4°C for 10 minutes to separated sample extract with precipitate, so the supernatant absorbance was measured at 517 nm with spectrophotometer (Thermo Scientific Genesys; 10S UV-VIS, USA). Standard/blank used was 7 ml methanol added to 2 ml DPPH (1 mM). Antioxidant activity was calculated using the following formula:

\[
\text{Antioxidant activity (\%)} = \left( \frac{\text{Absorbance of standard} - \text{absorbance of sample}}{\text{Absorbance of standard}} \right) \times 100\%
\]
2.5 Protein Analysis
This analysis was using biuret reagent[20]. The reagent consisted of copper (II) sulphate-pentahydrat, potassium sodium tartrate tetrahydrate, and potassium iodide in NaOH 10% (Merck, Germany). One gram of each sample was added to 50 ml distilled water and then centrifuged at 4°C for 10 minutes. Afterwards, the supernatant was taken as much as 4 ml so added to 6 ml biuret reagent and vortexed, then left in dark room for 30 minutes, so measured the absorbance with spectrophotometer at 520 nm.

2.6 Moisture Content Analysis
Aluminium cups were heated in oven (Memmert; Models 30-750, Germany) for 30 minutes, two grams of sample was weighed and placed in cups, heated at 105°C for 6 hours. After this time, the cups were placed in desiccator (Private Equipment, Indonesia) for 15 minutes, and were weighed[20]. Water content was calculated using the following formula:

\[
\text{Water content (\%)} = \frac{x - y}{x - a} \times 100\%
\]

Information:
x = cup weight + sample before heating
y = cup weight + sample after heating
a = cup weight

2.7 Determination of Acidity/pH
To determine the pH, a sample of 20 ml was placed into a beaker [21]. The pH was determined using a digital pH meter (Thermo Scientific; Eutech pH 700, Singapore).

2.8 Determination of Total Lactic Acid
Five grams of sample was placed into volumetric flask, so added to distilled water to the limit of 100 ml volumetric flask then was shaken. The solution was taken as much as 10 ml and placed into erlenmeyer flask, then titrated with NaOH 0.01 N[22]. Total lactic acid was calculated using the following formula:

\[
\text{Total lactic acid (\%)} = \frac{\text{volume of } \text{NaOH} \times \text{dilution factor} \times \text{molecular weight}}{\text{weight of sample (gr)} \times 1000} \times 100\%
\]

Information:
Molecular weight of lactic acid = 90.1 g/mol

2.9 Determination of Total Solids
Total solids were analysed with using hand refractometer (Atago, Japan)[23]. Before analysed, prism of refractometer was cleaned first with alcohol. Sample dripped on the prism and refractometer was directed to the light source, then a scale will appear on refractometer which shows total solids in units of °Brix.

2.10 Determination of Viscosity
The viscosity of sample was determined using viscometer (Brookfield; DV1, UK)[24]. A sample of 300 ml was placed into beaker glass 500 ml, then spindle dipped into sample so viscosity was measured for 3 minutes at 60 rpm, at 12 rpm (for fermented beverage from soymilk without extract), and at 50 rpm (for fermented beverage from soymilk with the addition of 10% extracts). After 3 minutes, a viscosity value would appear in units of centipoise (cP).

2.11 Organoleptic Analysis
Organoleptic analysis was performed using a hedonic test[25]. The panelists who participated were 38 untrained panelists. They are students majoring in Food Technology at Bina Nusantara University. Each panelist was given a sample of fermented beverages, and was required to drink water before tasting the sample. Panelists were asked to give an assessment in the form of numbers (1-9), sensory attributes assessed included aroma, color, taste, and texture.
2.12 Experimental Design and Data Analysis
The experimental design was using a one-factor completely randomized design method with 6 treatment levels (A0%, S0%, A-S0%, A10%, S10%, A-S10%) and three replications. All data were expressed as means ± deviation standards. The collected data was analyzed using IBM SPSS Statistics version 23 software. Data processing was accomplished using analysis of variance and Duncan’s Multiple Range Test (DMRT) test to determine the level of difference. Independent t-test was used to compare parameters between placebo and test groups.

3. Results and Discussion
3.1 Fermented Beverages from Plant-Based Milk
These fermented beverages were produced from almond milk (A), soymilk (S), and almond-soy milk (A-S). The fermented beverages were made without the addition of flavourings and stabilizers so that produced the original flavour and texture. In figure 3.1, 3.2, and 3.3, it appears that addition of (10%) butterfly pea flower extracts gave purple colour on fermented beverages from plant-based milk. In addition, it was also seen that fermented beverages with the addition of 10% butterfly pea flower extracts were thinner than fermented beverages without the addition of butterfly pea flower extract.

![Figure 3.1](image1.png)
**Figure 3.1** Fermented Beverage from A0% (left), and Fermented Beverage from A10% (right).

![Figure 3.2](image2.png)
**Figure 3.2** Fermented Beverage from S0% (left), and Fermented Beverage from S10% (right).

![Figure 3.3](image3.png)
**Figure 3.3** Fermented Beverage from A-S0% (left), and Fermented Beverage from A-S10% (right).
3.2 Antioxidant Activity on Fermented Beverages from Plant-Based Milk

Antioxidant activity analysis aimed to determine the ability of antioxidant compounds in the sample to inhibit free radical activity [26]. The process of inhibiting free radicals through the mechanism of taking hydrogen atoms from antioxidant compounds by free radicals, so that free radicals capture one electron from antioxidant compounds [27]. This analysis was carried out using the DPPH method. DPPH is a stable free radical that have a purple colour [28]. Antioxidant activity was measured spectrophotometrically, a reduction in the intensity of the purple colour in the sample solution indicated a reduced DPPH free radical [29], the reduction in the intensity of the purple colour is caused by free radicals capturing electrons so that they are not radicals because the electrons have been paired, the colour change is in harmony with the number of electrons captured [30]. The solvent used in this analysis was methanol that can be dissolved anthocyanin, terpenoid, saponin, tannin, flavone, and polyphenol [31]. The result of antioxidant activity can be seen in Table 1.

| Kind of plant-based milk | 0% extract | 10% extract |
|-------------------------|------------|-------------|
| Almond milk             | 57.45±0.12% | 74.66±0.20% |
| Soymilk                 | 48.76±0.12% | 61.78±0.19% |
| Almond-soy milk         | 53.01±0.21% | 66.84±0.12% |

1,2 superscript in the same column shows a significant difference (P<0.05)

Based on Table 3.1, fermented beverage from almond milk has the highest antioxidant activity, 57.447% (A0%) and 74.665% (A10%). Almond contains high antioxidant, including vitamin E (α-tocopherol), total phenolic, and total flavonoids [32]. The addition of 10% butterfly pea flower extracts showed that an increase in antioxidant activity in fermented beverages from every kind of plant-based milk. Butterfly pea flower extract has high antioxidant activity and contains bioactive compounds which can also acted as antioxidants. Butterfly pea flower contains a total phenolic 45.6 mg/gm, total flavonoids 67.2 mg/gm, and have antioxidant activity of 58.12% at a concentration of 250 μg/ml [33].

3.3 Protein Content on Fermented Beverages from Plant-Based Milk

Analysis of protein content was carried out using the biuret method. In biuret method, the potential colour deviation is less than using Lowry method [20]. The principle of biuret method is formation of a purple colour when copper (Cu²⁺) ions from the biuret reagent bind with a number of peptides from the sample solution and then form complexes in an alkaline condition, so the more purple colour of the sample solution, the greater protein content in the sample. Analysis of protein used Bovine Serum Albumin (BSA) as a standard because it provides high reproducibility [34]. The result of protein content on fermented beverages from plant-based milk can be seen in Table 2.

| Kind of plant-based milk | 0% extract | 10% extract |
|-------------------------|------------|-------------|
| Almond milk             | 307.16±2.10mg/ml | 342.69±2.74mg/ml |
| Soymilk                 | 25.53±1.83mg/ml  | 29.92±0.91mg/ml  |
| Almond-soy milk         | 148.68±0.60mg/ml | 159.86±1.38mg/ml |

1,2 superscript in the same column shows a significant difference (P<0.05)

a,b,c superscript in the same row shows a significant difference (P<0.05)
Based on Table 3.2, fermented beverage from almond milk had the highest protein content, 307.166 mg/ml (A0%) and 342.695 mg/ml (A10%). When viewed from raw materials, almond contains high protein, is 21.22 g/100 gr [32]. The addition of 10% butterfly pea flower extracts showed that an increase in protein content in fermented beverages from every kind of plant-based milk. This is because butterfly pea flowers are rich in protein, is 0.32% [10].

3.4 Moisture Content on Fermented Beverages from Plant-Based Milk

Moisture content is the amount of water contained in food, expressed in units of percent (%). Moisture content is one of the important characteristics that can affect the appearance, texture, and taste of a product [35]. Analysis of moisture content in these fermented beverages used the gravimetric method. The principle is the loss of weight at 105°C heating which is considered as the moisture content contained in the sample [29]. The result of moisture content analysis can be seen in Table 3.

| Kind of plant-based milk | 0% extract | 10% extract |
|--------------------------|------------|-------------|
| Almond milk              | 76.29±0.52% | 78.99±1.30% |
| Soymilk                  | 83.25±1.06% | 84.38±0.72% |
| Almond-soy milk          | 78.07±2.18% | 81.8±0.93%  |

1 superscript in the same column shows a significant difference (P<0.05)
2 superscript in the same row shows a significant difference (P<0.05)

Based on Table 3.3, fermented beverage from soymilk has the highest moisture content, 83.256% (S0%) and 84.384% (S10%). Fermented beverage from soymilk had greater moisture content compared to fermented beverage from almond milk and fermented beverage from almond-soy milk. It can be related to moisture of plant-based milk. According to the study, the moisture content of soymilk is higher than the moisture content of almond milk and moisture content of almond-soy milk [6]. The addition of 10% butterfly pea flower extracts showed an increase in moisture content in fermented beverages from every kind of plant-based milk. It can be occurred because butterfly pea flower contains high moisture content, which is 92.4%/100 gr [11].

3.5 Degree of Acidity on Fermented Beverages from Plant-Based Milk

Degree of acidity or pH is an important indicator that affects the quality of fermented beverages. The ideal pH for fermented beverages (yogurt) is 4.0-4.6, which gives a sour taste and thick texture [36]. In addition, the pH range can protect fermented beverages against the risk of contamination by pathogens so that they are safe for consumption [37]. The result of degree of acidity can be seen in Table 4.

| Kind of plant-based milk | 0% extract | 10% extract |
|--------------------------|------------|-------------|
| Almond milk              | 4.36±0.01% | 4.36±0.01% |
| Soymilk                  | 4.46±0.02% | 4.48±0.01% |
| Almond-soy milk          | 4.43±0.03% | 4.41±0.01% |

1 superscript in the same column shows a significant difference (P<0.05)
2 superscript in the same row shows a significant difference (P<0.05)

Based on Table 3.4, pH value of all fermented beverage from every kind of plant-based milk had range 4.3-4.4, so it’s the same with Bernat’s research [17]. Then, the addition of 10% butterfly pea flower extract did not affect pH significantly (P>0.05).
3.6 Total Lactic Acid on Fermented Beverages from Plant-Based Milk
Total lactic acid is the amount of lactic acid formed during the fermentation process by lactic acid bacteria [38]. Total lactic acid is a measurement of all acidic components, both dissociated and non-dissociated. In addition to lactic acid, there are also other acids that are easily dissociated, such as acetic acid and formic acid [39]. According to SNI, total lactic acid on fermented beverage (yogurt) ranged from 0.5-2% [40]. The result of total lactic acid can be seen at Table 5.

| Kind of plant-based milk | 0% extract | 10% extract |
|--------------------------|------------|-------------|
| Almond milk              | 0.98±0.07% | 1.15±0.07%  |
| Soymilk                  | 0.86±0.03% | 0.98±0.07%  |
| Almond-soy milk          | 1.22±0.03% | 1.27±0.08%  |

1,2 superscript in the same column shows a significant difference (P<0.05)



Based on Table 5, total lactic acid of all fermented beverages was ranged from 0.8-1.2%, so that according to SNI [40]. Fermented beverage from almond-soy milk had the highest total lactic acid,1.225% (A-S0%) and 1.273% (A-S10%). When viewed from the raw materials, soymilk had a lower total lactic acid compared to almond milk and almond-soy milk [6]. The addition of 10% butterfly pea flower extracts showed that an increase in total lactic acid but was not significantly (P>0.05).

3.7 Total Solids on Fermented Beverages from Plant-Based Milk
Total solids were analysed with hand refractometer which results in units of °Brix. Degree Brix (°Brix) shows the percentage of the number of solids in solution [41]. The solid component in fermented beverages consists of protein, sugar residue, pigment, lactic acid, and other organic acids [42]. Total solids can affect viscosity, the greater the total solids, the viscosity also increases [43]. The result of total solids in fermented beverages from plant-based milk can be seen at Table 6.

| Kind of plant-based milk | 0% extract | 10% extract |
|--------------------------|------------|-------------|
| Almond milk              | 5.66±0.29°Brix | 5.33±0.29°Brix |
| Soymilk                  | 7.66±0.29°Brix | 6.67±0.29°Brix |
| Almond-soy milk          | 7.33±0.29°Brix | 6.17±0.29°Brix |

1,2 superscript in the same column shows a significant difference (P<0.05)



Based on Table 6, fermented beverage from soymilk had the highest total solids, 7.667% Brix (S0%) and 6.667% Brix (S10%). The result of other research showed that total solid of fermented beverage from soymilk was 6.55% Brix [44]. The addition of 10% butterfly pea flower extract showed that a decrease in total solids on fermented beverages from every kind of plant-based milk. I was because moisture content of butterfly pea flower extract can’t dissolve total solids in plant-based milk.

3.8 Viscosity on Fermented Beverages from Plant-Based Milk
Viscosity is an obstacle that holds the liquid caused by the random movement of the liquid molecule. Viscosity is influenced by the constituent molecules. If the resistance of the sample to flow is greater, then the viscosity is also greater [45]. Viscosity on fermented beverage products is formed from the results of protein coagulation [46]. Viscosity is affected by total solids, the more total dissolved solids, the more viscosity it has [43].
Table 7 Viscosity of Fermented Beverages from Plant-Based Milk

| Kind of plant-based milk | 0% extract | 10% extract |
|--------------------------|------------|-------------|
| Almond milk              | 558.33±25.88cP<sup>a1</sup> | 438.33±29.46cP<sup>a2</sup> |
| Soymilk                  | 3616.66±64.78cP<sup>a1</sup> | 1555.33±22.12cP<sup>a2</sup> |
| Almond-soy milk          | 1071.66±35.47cP<sup>b1</sup> | 798.33±33.29cP<sup>b2</sup> |

<sup>1,2</sup> superscript in the same column shows a significant difference (P<0.05)  
<sup>a,b,c</sup> superscript in the same row shows a significant difference (P<0.05)

Based on Table 7, fermented beverage from soymilk had the highest viscosity, 3616.66±64.78 cP (0%) and 1555.33±22.12 cP (10%). It was related to the results of the analysis of total solids which showed the highest total solids was found in fermented beverage from soymilk, the more total solids, the viscosity increase [43]. The addition of 10% butterfly pea flower extract showed a decrease in viscosity in the three kind of fermented beverages, this can be caused by the total solids of fermented beverages being lower after adding ingredients that contain high moisture content [47].

3.9 Organoleptic on Fermented Beverages from Plant-Based Milk

Organoleptic analysis was performed using hedonic test, that aims to determine the level of consumer preferences for the three kind of fermented beverages. Organoleptic analysis is a way of assessment by utilizing the five human senses to observe the aroma, colour, taste, texture of a food product. Organoleptic analysis plays an important role in product development.

Table 8 Aroma Assessment of Fermented Beverages from Plant-Based Milk

| Kind of plant-based milk | 0% extract | 10% extract |
|--------------------------|------------|-------------|
| Almond milk              | 3.74±1.48<sup>b1</sup> | 4.08±1.51<sup>a1</sup> |
| Soymilk                  | 3.87±1.72<sup>b1</sup> | 4.11±1.64<sup>a1</sup> |
| Almond-soy milk          | 4.74±1.46<sup>a1</sup> | 4.50±1.44<sup>a1</sup> |

<sup>1,2</sup> superscript in the same column shows a significant difference (P<0.05)  
<sup>a,b,c</sup> superscript in the same row shows a significant difference (P<0.05)

Aroma is a sensory attribute that affects the taste of a food, consumers will accept a food if it has an aroma that does not deviate from the normal aroma. Before tasting a product, consumers will usually smell the product first [48]. The aroma is a response when volatile compounds from a food product enter the nasal cavity when humans breathe or inhale it, but it can also enter from behind the throat while individual eats [49]. According to Table 8, aroma of fermented beverage A-S (0% and 10%) was more preferred.

Table 9 Colour Assessment of Fermented Beverages from Plant-Based Milk

| Kind of plant-based milk | 0% extract | 10% extract |
|--------------------------|------------|-------------|
| Almond milk              | 6.32±1.56<sup>ab1</sup> | 4.84±1.55<sup>ab2</sup> |
| Soymilk                  | 5.61±1.63<sup>ab1</sup> | 4.63±1.74<sup>ab2</sup> |
| Almond-soy milk          | 6.76±1.02<sup>ab1</sup> | 4.66±1.47<sup>ab2</sup> |

<sup>1,2</sup> superscript in the same column shows a significant difference (P<0.05)  
<sup>a,b,c</sup> superscript in the same row shows a significant difference (P<0.05)

Colour is an important quality attribute, if the colour of an attractive product will make consumers interested and can even make consumers want to consume it again [50]. The kind and intensity of the right colour in food products often fade or disappear, both during the preparation, processing and
storage processes, usually a stable food colouring is added. In making this fermented beverage used a natural colouring (anthocyanin) from butterfly pea flower extract, this pigment is stable at the pH of the fermented beverage [12]. Based on Table 9, colour of fermented beverage A-S0% and A10% was more preferred.

Table 10 Taste Assessment of Fermented Beverages from Plant-Based Milk

| Kind of plant-based milk | 0% extract       | 10% extract       |
|--------------------------|------------------|------------------|
| Almond milk              | 3.00±1.39\textsuperscript{a1} | 3.61±1.76\textsuperscript{a1} |
| Soymilk                  | 3.13±1.69\textsuperscript{a1} | 3.63±1.79\textsuperscript{a1} |
| Almond-soy milk          | 3.50±1.79\textsuperscript{a1} | 3.87±1.83\textsuperscript{a1} |

\textsuperscript{1,2} superscript in the same column shows a significant difference (P<0.05)
\textsuperscript{a,b,c} superscript in the same row shows a significant difference (P<0.05)

Taste is an important sensory characteristic in food reception, because if it tastes bad then consumers tend to reject it even though the colour, aroma, texture and other sensory properties are good [51]. Taste is a sensation that results from a sense of taste stimulation [51]. Taste is an organoleptic trait in the form of perception of the sweet, bitter, sour, and salty sensation of a food product [49]. The result of hedonic test (Table 10) showed that taste of fermented beverage from almond-soy milk is more preferred. Texture is the result of a combination of several physical properties which include size, shape, amount, and elements of the formation of a food product, which can be felt by the sense of taste/vision/touch. Food texture is the result of a tactile sense response to the form of physical stimulation when there is contact between the inside of the oral cavity with food [49]. According to Table 11, texture of fermented beverage from almond-soy milk is more preferred.

Table 11 Texture Assessment of Fermented Beverages from Plant-Based Milk

| Kind of plant-based milk | 0% extract       | 10% extract       |
|--------------------------|------------------|------------------|
| Almond milk              | 3.84±1.42\textsuperscript{a1} | 3.89±1.92\textsuperscript{a1} |
| Soymilk                  | 3.53±1.60\textsuperscript{b1} | 3.76±1.63\textsuperscript{b1} |
| Almond-soy milk          | 4.66±1.66\textsuperscript{a1} | 5.39±1.66\textsuperscript{a1} |

\textsuperscript{1,2} superscript in the same column shows a significant difference (P<0.05)
\textsuperscript{a,b,c} superscript in the same row shows a significant difference (P<0.05)

4. Conclusion
Almond milk fermented drink (A10%) showed an increase in antioxidant activity and protein content, namely 74,665% and 342,695 mg/ml. All fermented drinks (0% and 10%) did not show a significant difference, but the viscosity decreased viscosity in fermented drinks (10% extract). Hedonic test showed the panelists preferred the aroma, taste, and texture of fermented drinks from A-S10% with an average value of 4.50 (slightly disliked), 3.87 (disliked), and 5.39 (neutral). However, the panelists preferred the color of the fermented drink of A10% with an average value of 4.84 (slightly disliked).

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