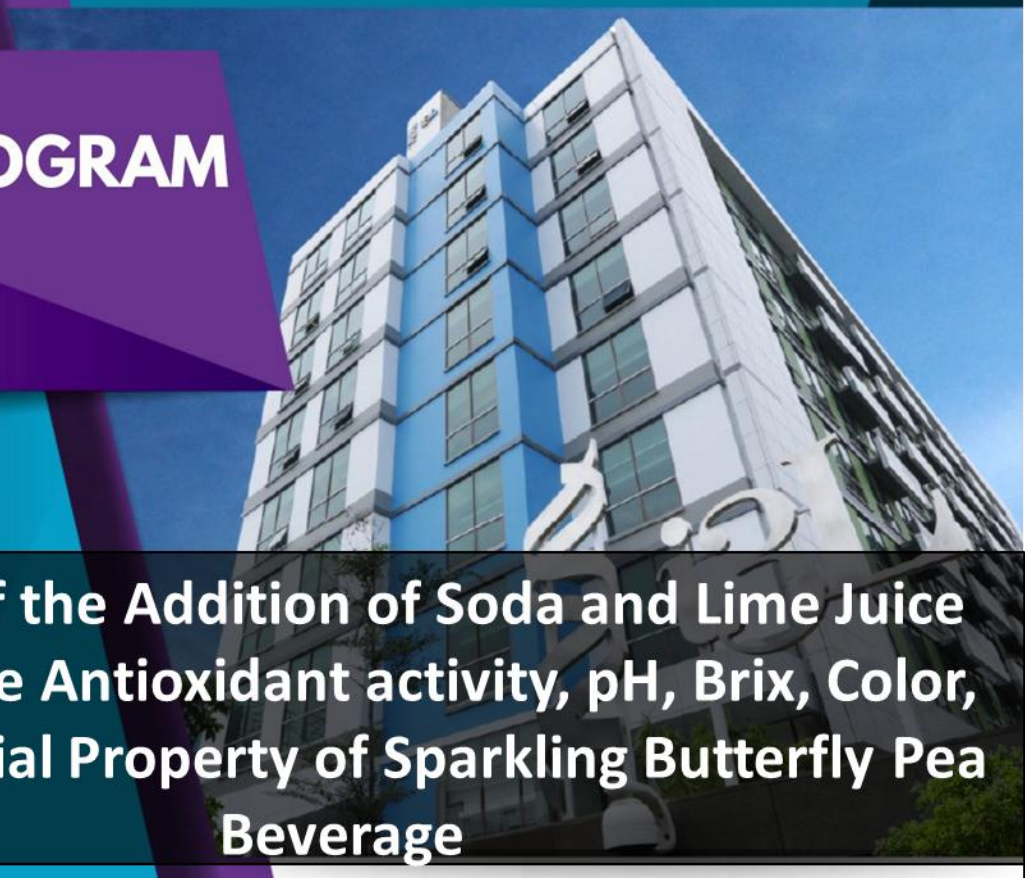
Indonesia International Institute for Life Sciences

ENRICHMENT PROGRAM REPORT



Analysis of the Addition of Soda and Lime Juice towards the Antioxidant activity, pH, Brix, Color, and Sensorial Property of Sparkling Butterfly Pea Beverage

STUDY PROGRAM
Food Technology

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INDONESIA INTERNATIONAL INSTITUTE FOR LIFE SCIENCES (i3L)
2022

INTERNSHIP REPORT

Analysis of the Addition of Soda and Lime Juice towards the Antioxidant activity, pH, Brix, Color, and Sensorial Property of Sparkling Butterfly Pea Beverage

By

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Submitted to

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Food Technology

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Internship Project Field Supervisor: Ahmad Pulung Noegroho

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CERTIFICATE OF APPROVAL

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Certificate of Approval

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Analysis of the Addition of Soda and Lime Juice towards the Antioxidant activity, pH, Brix, Color, and Sensorial Property of Sparkling Butterfly Pea Beverag

We hereby declare that this final thesis project is from student's own work. The final project/thesis has been read and presented to i3L's Examination Committee. The final project/thesis has been found to be satisfactory and accepted as part of the requirements needed to obtain an i3L bachelor's degree.

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ABSTRACT

Clitoria ternatea L. or butterfly pea has a lot of health benefit and is often consumed as high-antioxidant flower tea due to its high bioactive content (Suarna & Wijaya, 2021). The aim of the study is to analyze the effect of the addition of soda and lime water towards the physicochemical properties, bioactive compound content, sensorial properties of the butterfly pea beverage. The results showed that addition of lime and soda to the butterfly pea drink increased its antioxidant content due to its high ascorbic acid and citric content while lowering the pH and brix value. The color of the sample added with soda and lime turned slightly from light transparent blue to darker opaque blue. For the sensory evaluation with variables of appearance, taste, aroma, texture, the addition of lime and soda did not have a significant effect on any of the variables.

Keyword : butterfly pea, lime, antioxidant activity, hedonic test, sensory evaluation

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First of all, I would like to thank God, because without His blessings, all of this would not be possible. I would also like to thank my parents for their continuous and never-ending support, both financially and mentally during my study in i3L and also in the process of creating this thesis. I am also grateful to my friend for their continuous support during my ups and downs of the creation of this thesis

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I would also like to thank other parties involved such as i3L procurement department, i3L laboratory department who support in terms of equipment and services.

It is my deepest hope this thesis report could be useful for further research and will bring knowledge to the readers.

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LIST OF ABBREVIATIONS

1. BPD : Butterfly pea Drink
2. BPS : Butterfly pea Sparkling (contain lime and soda)
3. DPPH : 2,2-diphenylpicrylhydrazyl

I. INTRODUCTION

1.1 Brief history and information of the host company

PT. Oesodo Alam Mandiri (OAM) is a startup Limited Liability Company (LLC) that focuses on producing various products from traditional Indonesian herbs such as *Jamu, Wedang,* herb ice cream, herbal medicines, etc. In early 2022, PT OAM launched a new business line which is modernized jamu cafe called "Cafe Daun Mas". It is built upon the mission of inspiring and encouraging more people to drink jamu and at the same time conserve the Indonesian tradition; however, the taste of jamu is often not perceived well by the younger generation. Thus, PT OAM wants to overcome this problem by creating modern version of the jamu beverage that have better taste and can be accepted by more people.

PT OAM chose to be a multi platform company where they can focus on selling the franchise to B2B but also develop their own main branch cafe. The operational plan of PT OAM is to focus on development and new product innovation, working together with toll manufacturing to produce their products. PT OAM also follows the ISO 31000:2018 as their risk management system. Their goal is to make health and wellness destination in the form of jamu cafe.

PT. OAM main activity is to provide various types of jamu products starting from *Rajangan, Wedangan,* Instant Jamu, Herbal Coffee, and various other healthy drinks. PT. OAM also provides franchises of the modern jamu cafe if other might be interested to open the cafe as well.

1.2 Mission & vision of the host company

PT OAM have vision of becoming pioneer of jamu business partnership and can adapt well with the modernized breakthrough of the health industry, thus they want to present jamu beverage product that is more modern in terms of taste and appearance.

Their mission is to provide a comfortable place to drink jamu that have taste that can be well accepted by the society. They also want to develop a business ecosystem with partnership network in the jamu industry. Also to encourage people to conserve the ancestral culture of drinking jamu.

1.3 The student's intern department at the host company

The student's unit or department in PT. OAM is to work and learn under the Research and Development of PT. OAM. The department objective is to provide insights and improvements to exististing products which can increase their quality and efficiency and to develop new line of products.

1.4 Organizational structure of the host company

The organizational structure of PT. OAM is as follows :

Commissary : Erna Setiyawati, S.E., S.Ag.Kes., M.M.

Director : Supriyatna

Operational Supervisor : Benny Suryawarman

Human Resources, Treasurer, Trainer : Ahmad Pulung Noegroho

II. INTERNSHIP ACTIVITIES

2.1 Working Conditions

The student intern at PT. OAM for 5 months, starting from 1st of August 1st until 1st of December. The student was placed at Cafe Daun Mas, located at Ruko Grand Galaxy City Blok EB, Jl. Pulo Sirih Utama No.143, RT.007/RW.014, Pekayon Jaya, Kec. Bekasi Sel., Kota Bks, Jawa Barat. The working schedule is hybrid between WFO and WFH with the time from 9 am to 5 pm. During WFO, the student does daily tasks such as recipe testing, menu development, and product preparation. During WFH, the student does recipe testing, research regarding product that's going to be developed, and data processing from previous trials such as sensory evaluation data.

2.2 Internship Tasks

The students' tasks under research and development were to develop new products and improve the existing products. In doing so, the student have daily tasks which are recipe testing, conducting sensory analysis, testing and re-evaluating the current menu composition. The student also learned how to make the existing menus as the basis of the product development and also helped out in the cafe for the production process. There were also weekly tasks such as helping out the company's weekly social service of preparing and sharing food and jamu to the local community there. The student had also done sensory evaluation of one of the product previously to see the perception and acceptance of the people around the cafe to the taste of the menu. There were also one time event where the student participated when the cafe had exhibition in a mall and helped in preparing and developing the menu that was sold in the exhibition.

2.3 Comparison between theory and practice

Since it is a small scale company, the production process of the jamu were done traditionally and in smaller scale compared to the industrial processing that is often taught in the lectures. As for the production process, the processing steps were similar as what is taught in beverage technology which is through heat extraction process, by boiling the ingredients in medium heat for a specific time until the extract has been transferred to the liquid phase, then it is strained. Cutting might be necessary for some ingredients such as rhizome to ease the extraction process.

A few noticeable things were that there were lack of knowledge regarding the procedures that is supposed to be conducted in the food industry, such as doing sensory evaluation during development of menu. There were also lack of discipline in following the SOP, such as following the exact measurements for making each food product, resulting in non-uniform results of each production batches. However, the student was able to share some of what has been learned in lectures such as the need to conduct sensory analysis and the importance to follow SOP of exact measurements to ensure uniformity. During the main project, the analysis process were all in accordance with the theory that was learned during lab session in i3l, as the protocol were mostly all adapted from the i3l lab protocol, such as for the antioxidant activity analysis, ph & brix analysis, sensory evaluation, and color analysis.

2.4 Difficulties during intern process

The student did not meet major difficulties while doing the daily tasks in the company, except for the constantly changing environment in the workplace, since there were many resignation of the employees, thus the student have to keep adapting to the new environment.

In the process main project, the student had difficulties due to the lack of available equipment to do proper analysis in the company. Therefore, the company had to conduct the analysis for the main project in i3L. During the main project analysis, the student felt slight difficulty in adapting to conduct the analysis alone, since previously all of the analysis were always done in group so the workload can be divided, however the student still succeed in conducting the analysis alone.

III. PROJECT DESCRIPTION

3.1. Introduction

3.1.1 Project Background

Due to the COVID-19 pandemic, many people in the world underthrough changes in their lifestyle and eating habits towards a healthier one. As shown in a study in Italy where there are more subjects (37%) who consumed healthier food compared to the subjects who ate less healthier food (36%) and the rest had mixed eating habit. There were also a 30% decrease in junk food intake and 38% increase in physical activity (Maulina, et al., 2022).

In Indonesia however, consumption of processed foods and beverages, particularly in sugar-sweetened beverages were still high as shown in a 2017 National Socio-Economic Survey (Susenas) 2017 where 67.19% out of 279,331 households were reported to have spent and consumed sugar-sweetened beverage. In more current study which are in 2018 the consumption of the sugar-sweetened beverages seem to have decreased to one serving a day.

With the rising trend and demands for healthier beverages in Indonesia, it is in the company's interest to develop a beverage using blue butterfly pea flowers as an option in healthy beverage industry. *Clitoria ternatea L.*, commonly called as butterfly pea is a herbaceous plant which has wide range of use starting from natural food additives (colorant, antioxidant), medicine to ornamental plant and fodder crops. The flowers petals of the butterfly pea, most commonly from the blue variant, is usually dried and processed to be consumed as high-antioxidant flower tea (Suarna & Wijaya, 2021). The blue butterfly pea petals have shown wide range of health benefits in previous studies including as antioxidant, anti-inflammatory, antibiotic, and help reduces rate of diabetic, obesity and cancer. This is because the flower contain many bioactive compounds such as anthocyanins, flavonol glycosides ,flavones, flavonols, phenolic acids, triterpenoids, steroid. Thus the butterfly pea flower is often promoted as functional food and nutraceuticals. As medicine, it is commonly consumed to treat visual impairment, sore throat, and as healthy drink in general (Ikhwan et al., 2022).

In Indonesia butterfly pea flowers is one of the most commonly cultivated herbaceous plant or tanaman obat keluarga (TOGA) due to its beautiful color and many uses. It is oftenly consumed as herbal tea both in the industry and for private uses. The common preparation is by first picking and cleaning the flowers petals then drying them under the sun or using an oven at 50oC. The dried flower petals can then be prepared to be consumed by boiling 10 to 20 petals with 250ml of hot

water then putting it aside until the color of the water turn to blue (Mulangsri, 2019). In this study in particular, the butterfly pea flower petals is further processed by turning it into syrup form. This was done by adding corn flour and sugar to the already extracted butterfly pea flower water and cooking it in low temperature for 15 to 20 minutes and stirring it continuously. Afterward, additives and preservatives is added. It is to be noted that the blue butterfly pea syrup used in this experiment was not prepared by the author but rather by UMKM that worked together with PT. OAM to supply them with their various needs.

Butterfly pea flower has rather bland taste if consumed by directly boiling it, thus it is usually consumed by adding sugar and lemon or lime squeeze, as what was done in this study. In addition, the anthocyanin in the blue butterfly pea flower which is a base indicator will react to the sudden pH change to acidic, changing its color from blue to purple-pink which provide a beautiful color change (Khoo et al., 2017). The addition of soda will also bring refreshing and fizzy sensation to the drink due to the carbonic acid that can be detected by our tongue. However, the actual effect of the addition of lime and soda to the butterfly pea flower has not been widely studied whether it will bring positive or negative effects. This is why the aim of the study is to analyze the effect of the addition of soda and lime water towards the physicochemical properties, bioactive compound content, sensorial properties of the butterfly pea beverage. The aspects that will be analyzed are antioxidant activity, pH, brix, color, and sensorial property. This study is important for the company to further analyze whether the current formulation has met the demand of people or not and for further development. Also, the results can encourage people to drink butterfly pea as not only healthy but also tasty beverage.

3.1.2 Objectives

- To analyze and calculate the addition of soda and lime to the antioxidant activity of the blue butterfly pea beverage using DPPH method
- To analyze the addition of soda and lime to the physicochemical properties (pH, brix, color) of the blue butterfly pea beverage
- To conduct a sensory evaluation using hedonic scale towards blue butterfly pea beverage and sparkling blue butterfly pea beverage to obtain the likeness towards both their flavor profile

3.1.3. Scope of Work

The scope of the intern main project in analyzing the addition of soda and lime towards the blue butterfly pea beverage :

- Learn how to properly prepare the beverage, including how to make the syrup from scratch
- Literature study in selecting the appropriate method to analyze the addition effect of soda and lime towards the blue butterfly pea beverage physicochemical, bioactive compound content, and sensorial aspect
- Preparation the material to prepare the sample of the butterfly pea beverage
- Preparation of the butterfly pea beverage and sparkling butterfly pea beverage for analysis
- Preparation of DPPH stock for antioxidant analysis
- Calculation and serial dilution of the DPPH stock and sample to the appropriate concentration to be able to be analyzed using spectrophotometer
- Conduct the physicochemical properties using the correct equipment (pH using pH meter, brix using refractometer, color using spectral colorimeter)
- Prepare the form and sample for hedonic sensory evaluation
- Conduct sensory evaluation using hedonic method
- Calculation of the antioxidant value of the sample
- Compare and conclude the results of both sample

3.1.4. Problem Formulation

PT. OAM wants to conduct an analysis to see the whether the addition of the soda and lemon towards the butterfly pea beverage in their menu affect it in the positive or negative way from the physicochemical, bioactive compound content, and sensorial aspects. The beverage have previously been conducted and evaluated for their taste however proper sensorial evaluation have never been conducted, also for other aspects have also not been conducted by the company due to their limited equipment. The variables that will be analyzed are antioxidant content, pH, brix, color, sensory evaluation.

3.1.4.1 Antioxidant activity

Antioxidant activity is important to be analyzed as it can help determine whether the addition of soda and lime reduces or increases the bioactive compound content in the butterfly pea. One of the highest bioactive compound in butterfly pea is anthocyanin which is high of antioxidant activity (Suarna & Wijaya, 2021), moreover lime is also high in ascorbic acid which is high of

antioxidant (Narang & Jiraungkoorskul, 2016), therefore by calculating the antioxidant content of the samples, it can determine the results of soda and lime addition towards bioactive compound content.

Antioxidant content can be determined with DPPH assay method using spectrophotometer. DPPH method utilizes DPPH, an organic chemical compound capable of acting as hydrogen acceptor to antioxidants. DPPH assay analyzes antioxidant activity in sample based on the transfer of electrons to free radicals. Free radicals are byproduct of oxidation process. On the contrary, antioxidants fight free radicals by interfering the oxidative process mediated by free radicals, through initiation, propagation, and termination. The assay uses this principle to do the measurement. The DPPH in ethanol solution initially has a violet purple color and will fade change to colorless in the presence of antioxidant, at the same time lowering the amount DPPH molecules. The color changes can be measured using spectrophotometry to obtain the absorption of the DPPH molecules, which determine the remaining concentration of the DPPH. The less DPPH molecule remaining, means the higher antioxidant activity the sample has as it lowers the concentration of the DPPH due to more DPPH gives off more electron pairs (Garcia et al., 2012; Kedare & Singh, 2011).

3.1.4.2 pH

pH is the measurement of acidity, which equals the negative logarithm of the activity of hydrogen ions. pH is important to be calculated as although acidic food (ph below 4.6) can help extend the food shelf life, food that is too acidic can cause harmful health effect such as GERD (Choe et al., 2017) and dental erosion (Reddy et al., 2016). The acidity level is also related to the consumer acceptability, therefore it is important to be measured to determine the most appropriate formulation.

pH is measured using a pH meter, consists of a glass electrode which can measure the ion exchange is established between the hydrogen ion and the ion in the glass and a reference electrode is added as a stable potential by surrounding an internal element with a known solution. The measurement is conducted by comparing the glass potential and the reference potential at pH 7 where the glass potential and the reference potential is zero. As the solution became acid, the glass potential became higher than the reference electrode (Westcott, 2012).

3.1.4.3 Brix

Brix is a percentage of sucrose in a sugar solution.°Brix is important to be measured as it can determine the total sugar concentration of the beverage. Moreover, studies have found that there is a relationship between °Brix level, °Brix /acidity ratio and consumer acceptability (Jayasena & Cameron, 2008). Therefore it is important to measure °Brix to determine the most appropriate sugar concentration in the formulation.

Brix could be measured via a gravimetric method, hydrometer, and refractometer. The procedure of using a refractometer is by calibrating the instrument with the distilled water by placing a drop of distilled water in the glass prism, and the pointer should intersect zero. If not, the zero is set by turning the small knob to the side. The glass prism is wiped clean and the solution is placed in the glass prism. The cover should be lowered slowly to ensure no bubbles (Featherstone, 2015).

3.1.4.4 Color

The color of food play an important role in the sensory characteristics of food which might affect the determination of selection and attractiveness of the food itself (Dias et al., 2012). Moreover, butterfly pea flower is a color indicator which is affected by the level of pH of the beverage due to its anthocyanin content. Anthocyanin is closely related to the pH range. It is usually purple-blue near neutral pH, turns more red the more the pH go down towards acidic with the maximum red color at pH <3 and turn more green the more alkali the solution is with maximum green color at pH >10.5 (Wiyantoko & Astuti, 2020; Khoo et al., 2017)

Color is of the sample can be measured by a colorimeter, which is used to estimate light and associate it with the L* a* b* color space, where the L* shows the lightness value, the a* shows the value on red to green axis with red color on positive value and green color on negative value and the b* shows the value on yellow to blue axis with yellow on positive value and green on negative value, the value range from -100 to 100 (Becker, 2016). Color measurement can also be done by taking a picture of a sample in a clear container and white background, then using eyedrop tool in adobe photoshop which has similar working method as the colorimeter.

3.1.4.5 Sensory Evaluation

Sensory evaluation is one of the most important aspect in determining customer acceptance and consumption. Since a sensory sensations of one person is different from the other, therefore

sensory evaluation must be conducted as a method to get a proper assessment of the sensorial aspect of food, using a certain scale, in this case, the hedonic scale to measure the intensity of each sensorial aspects. One of the most widely used acceptance testing is the nine-point hedonic scale, consist of a balance bipolar scale upward and below the neutral category (5 is neutral). The categories each represents several arranged degrees of affection with four positive category (6 to 9) and four negative category (1 to 4) which respectively translated as liked/disliked slightly, liked/disliked moderately, liked/disliked very much, and liked/disliked extremely. The results of the sensory evaluation can help determine the responses regarding the product acceptance (Pimentel, Cruz, Deliza, 2016).

3.1.5. Experimental Methodology

Sample preparation

Preparation of the sample was started by cleaning and drying two glass beakers used to mix and contain the sample. The first sample (butterfly pea drink) was made by mixing 35ml blue butterfly pea syrup with 135ml water. The second sample (butterfly pea sparkling) was made by mixing 35ml of blue butterfly pea syrup with 10ml of fresh-squeezed lime juice and 125ml of unsweetened soda water. For the analysis below, three biological replication were conducted each were done in triplicates.

Antioxidant Analysis (DPPH method)

Prior to conducting the experiment, 1mM DPPH stock was made by mixing 19.716mg of DPPH with 50ml of 96% ethanol then vortexed until fully dissolved. Its absorbance was read then the stock was diluted tp 0.25 mM DPPH and the absorbance was read again, making sure the range of absorbance was between 0.9-1 for optimum reading. Each sample was then transferred to a 1.5ml tubes and added with the 0.25 mM DPPH stock (using 1:1 ratio of sample and DPPH) and vortexed for 30 second. A blank was also prepared by mixing aquadest with DPPH)using 1:1 ratio of Blank: DPPH). The reaction tube was covered with aluminium foil to avoid light then incubated for 30 minute in a dark environment. Afterward, 200 uL of each sample were transferred to a well in 96-microwell with each of their replication. Their absorbance was read using using spectrophotometer microplate reading at 517 nm then their absorbance value were obtained for further calculation using the formula below.

$$\text{[illegible]}\ (\%) = \frac{\text{[illegible]}\ (\text{[illegible]}) - \text{[illegible]}\ (\text{[illegible]})}{\text{[illegible]}\ (\text{[illegible]})} \times 100\%$$

Figure 1. Equation to calculate antioxidant activity of a sample

pH analysis

The pH meter were calibrated prior to use using pH 4.0, 7.0, and 10.0 buffer with temperature of the buffer is the same as the temperature of the sensor and rinsed with distilled water before and after each measurement. After calibration is done, the sample (BPD and BPS) were transferred to a beaker then measured using pH meter, each with triplication of the reading and the average was calculated for analysis.

Brix analysis

Prior to use, the prism of refractometer were rinsed using distilled water and wiped using kimtech wipes. Afterward, 1-2 drops of sample were added to the prism of refractometer carefully to avoid bubble. After closing the lid of the prism, reading of the brix value of each sample was done, each with triplication and rinsed before and after reading the sample.

Color analysis

Color measurement was done by taking a picture of the sample which were transferred to a small container with white background, then the picture was put in adobe photoshop. Using the eyedrop tool, the L, a*, b* color of each sample were extracted.

Sensory evaluation

The panelists were each distributed a sample of coded drink which are 841 (BPD) and 805 (BPS) then explained the proper way to conduct the sensory evaluation. There were four aspects that was measured which are appearance/color, taste/flavor, aroma/odor, and texture/mouthfeel. The panelists were ordered to try the 805 sample first then rinse their mouth with water and move on to the next sample, then they were asked to rate using the hedonic 9 point scale for each aspects of each samples.

3.2 Result and discussion

3.2.1 Antioxidant Activity/Content

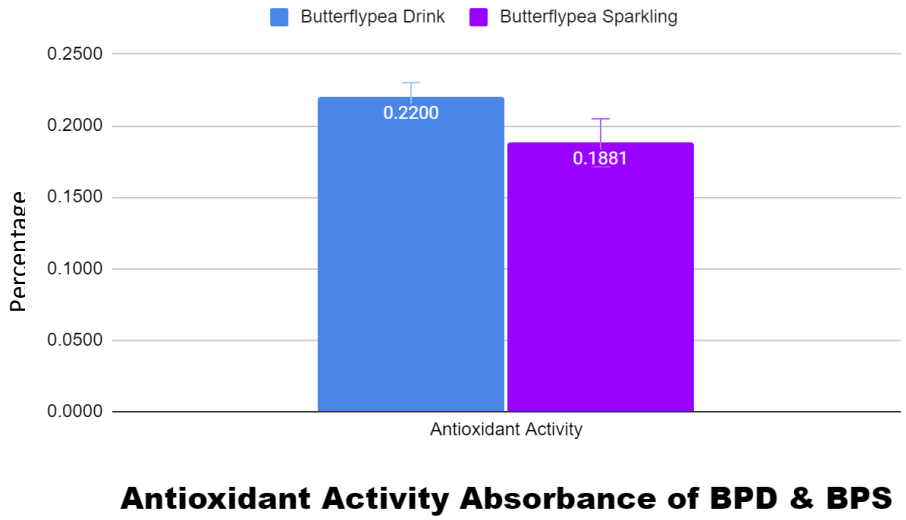


Figure 2. Results of DPPH absorbance towards the butterfly pea drink and butterfly pea sparkling sample

The results of the absorbance of the BPD and BPS sample after being measured using spectrophotometer using DPPH method are 0.21995 ± 0.01018 and 0.18808 ± 0.01676 correspondingly. The BPS sample shows lower absorption value than the BPD sample, which means that it has higher antioxidant activity. This is due to the less DPPH molecule which remains, means more DPPH radicals have been scavenged by the antioxidant compound in the sample, thus it has higher antioxidant content. DPPH exhibits a prominent absorption band at 517 nm which gave the solution deep violet hue, however, the absorption and color fades when the electron pairs is given off, shown by the color fading from purple leaning towards more transparent slightly yellow (Garcia et al., 2012; Kedare & Singh, 2011).

The absorbance data for each biological replication were each calculated for its antioxidant activity using the formula in **Figure 1** to obtain each antioxidant activity value and the final average antioxidant activity value. The results of each calculation were as stated in **table 1**.

Sample	Dilution	Absorbance	Antioxidant Activity (%)	Average absorbance	Average Antioxidant Activity (%)
Butterfly pea Drink	1x	0.21275	62.0157	0.21995 ± 0.01018	60.7302 ± 1.81799
		0.2316	58.6502		
		0.2155	61.5247		
Butterflypea	1x	0.1671	70.1660		67.6665 ± 1.81799

Sparkling		0.1765	68.4878	0.18808 ± 0.01676	
		0.1997	64.3457		

Table 1. Calculated antioxidant activity of BPD and BPS sample with 1x dilution

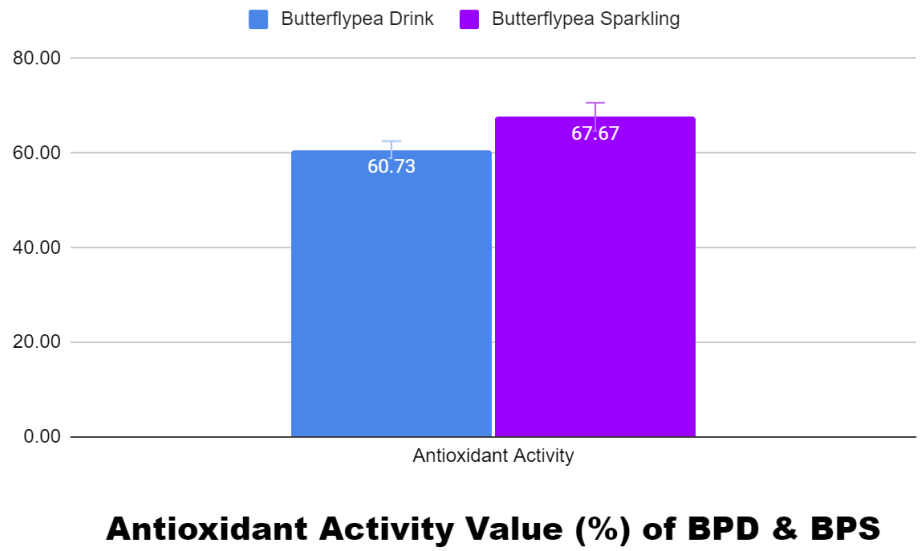
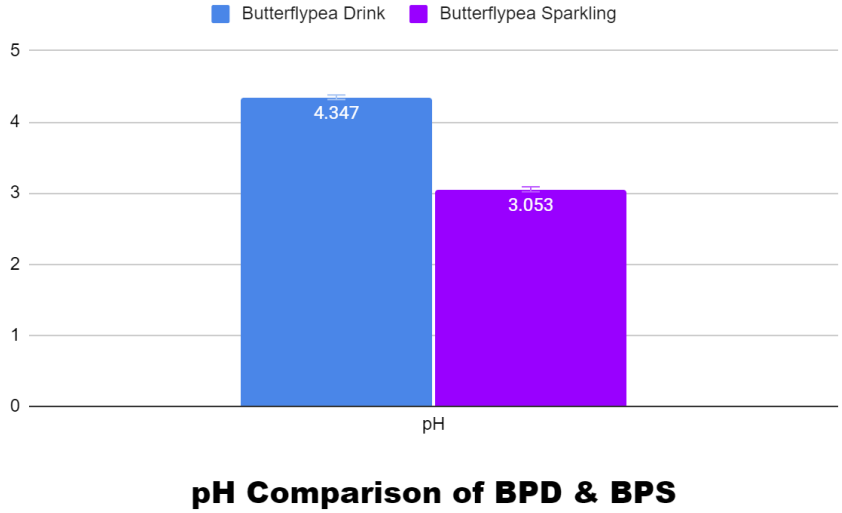


Figure 3. Results of average value of antioxidant activity in % of butterfly pea drink and butterfly pea sparkling

The results show that the BPS sample has higher antioxidant activity/content than the BPD sample with the value of 67.6665 ± 1.81799 and 60.7302 ± 1.81799 correspondingly. As earlier stated, the result of the antioxidant activity/content was inversely proportional to the absorbance value because the higher antioxidant content of the sample, the more DPPH electrons it scavenged. The result means that the BPS sample which was added with soda and lemon has higher antioxidant activity (67.67%). This in accordance with a study conducted by Seftiono, Panjaitan, Sumiasih, (2020), which showed that the addition of lime juice to food product (star fruit sorbet) led to higher antioxidant activity. Moreover, the addition of soda does not lower antioxidant activity as it contains carbon dioxide which is an inert gas and does not react with oxygen (Clarke et al., 2008)

Another note to add was that the average of the antioxidant activity were slightly lower due to the result of the third biological replication of which the BPS sample value were lower. This is most likely due to the use of lime that has been stored from previous day, causing the acidity to not be as low as the previous biological replication which made use of a new whole lime.

3.2.2 pH Analysis



pH Comparison of BPD & BPS

***Figure 4**. Results of pH analysis of butterflypea drink and butterflypea sparkling*

The average pH of BPD sample with value 4.347 ± 0.032 was higher than the pH value of the butterflypea sparkling (BPS) sample at 3.053 ± 0.035. The addition of soda and lime both contributed to the decrement of the pH value. This is because soda water or what is usually called as carbonated water contain carbonic acid, a weak acid from the reaction of carbon dioxide and water with the usual pH range from 4.2 to 5.5 (Marchan, Hector, Bascombe, 2021). On top of that, the addition of lime with typical pH range of 2-3, is high in citric acid and ascorbic acid, both are weak acid which contribute to the further decrease of the pH of the butterfly pea beverage (Rangel, et al. 2011). Therefore, both the addition of soda and lime to the butterfly pea beverage decreased its pH.

3.2.3 Brix Analysis

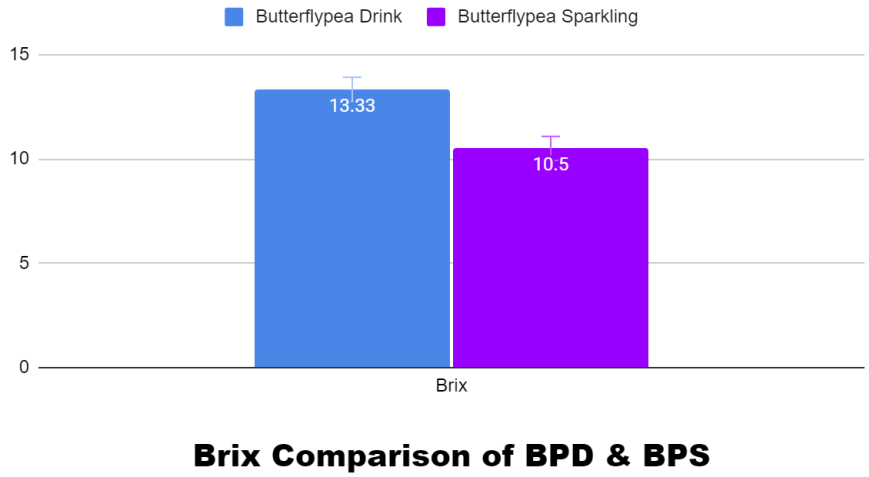


Figure 5. *Results of Brix analysis of butterflypea drink and butterflypea sparkling*

Based on the experiment's result, the average brix value of the butterfly pea drink (BPD) was 13.33 ± 0.577 which was higher than the average brix value of the butterfly pea sparkling (BPS) which was 10.5 ± 0.577. This indicates that the BPD sample has higher total sugar content than the BPS sample. As mentioned earlier, the BPS sample contain lime juice which is high in citric acid and can cause sugar inversion. This is in accordance with the literature, which stated that the addition of citric acid cause a decrement of sucrose due to sucrose hydrolysis and turning it into invert sugar. The rate of inversion is also affected by the pH level of the citric acid, the lower the pH is the higher the inversion rate is (Brighenti, et al., 2011). Invert sugar occured when the bond in sucrose molecules, specifically the bonds between the glucose and fructose is broken, resulting in free glucose and free fructose. Invert sugar occured when sucrose is hydrolysed, through heating process or enzyme reaction such as through the addition of citric acid or cream of tartar (Pubchem, 2023). Thus this is why the brix value, which is measurement of sucrose, of the BPS sample was lower than the BPD sample which contain no citric acid and had higher pH value, since the sucrose in the BPS sample was partialy converted and was not read in the traditional refractometer.

3.2.4 Color Analysis

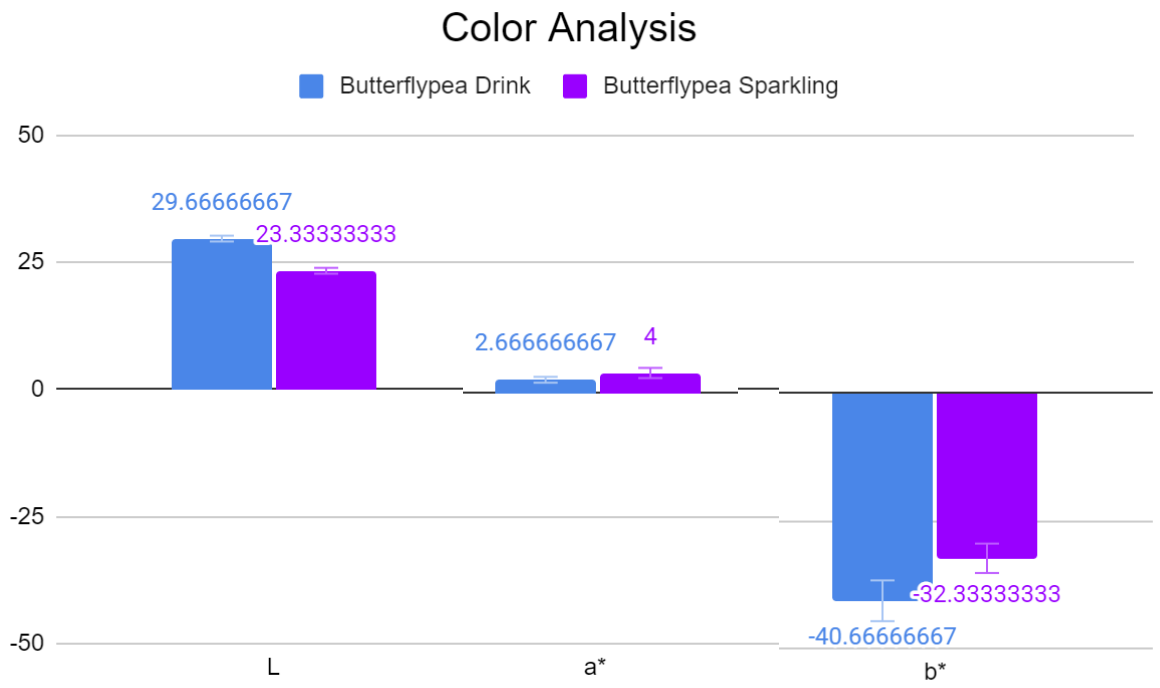


***Figure 6**. Average L*, a*, and b* color values of the Butterfly pea drink and Butterfly pea sparkling*

The butterfly pea drink (BPD) sample had lighter transparent blue color than the butterfly pea sparkling (BPS) sample which had a slightly darker more opaque blue color. This is approved by higher L value of the bpd sample but lower a* and b* value (**Figure 5**), meaning the sample had lighter, more blue color while the BPS sample had slightly darker, more opaque color but still blue color.

The color change in the BPS sample compared to the BPD is sample is mostly due to the addition of the lime, which disturb the stability of the anthocyanin of butterfly pea due to the pH drop towards more acid condition. According to the literature, the color of anthocyanin change depend on the pH of solution due to the ionic nature of its molecular structure. At pH 4-5, the color of anthocyanin is not stable and have little hue to to small amount of flavylium catium and quiononoidal anion. Nearing the acidic condition, anthocyanin have purple-red hue and with increasing pH condition the color turn to blue (Khoo et al., 2017). However this did not happen with the BPS sample that is added with lemon and soda. Although the addition of lemon decreased the pH of the sample, the supposably color change to purple hue did not happen and instead it turned slightly darker and more opaque blue color. This is most likely due to the use of the main ingredient, which was the butterfly pea was already in bottled syrup form made by tolling company.

The supposably color change is caused by the various anthocyanin pigments such as the cyanidin and peonidin, both has red hue at lower pH (<3) and blue at higher pH. During the production of the butterfly pea syrup, it was added with sugar and undergone continuous heating process which might affect the total content of anthocyanin and its color component, as stated by Oancea (2021) that the total anthocyanins content of total anthocyanins reduces significantly during heating under both neutral and alkaline pH. This is supported by the study by Sadilova, Carle, Stintzing, (2007), where the anthocyanin extracted from elderberry, black carrot and strawberry were reduced during heating process at 95^{o}C. The amount of retained anthocyanin depends on the lengths of the heating process, for example in elderberry, the retained percentage of anthocyanin at 0.5, 1, 2, 4 hour of heating is as followed 85.7%, 70.5%, 52.3%, 23.5%. This study show the longer the heating process, the lower the retention of the anthocyanin is. Moreover another study by Song et al. (2018) stated that addition of sugar in sucrose form could decrease the anthocyanin stability, including its color component. Higher sugar concentration caused more decrease in color intensity. Thus, both of this factors might affect the ability of the butterfly pea syrup to change its color under acidic conditions.

3.2.5 Sensory Evaluation

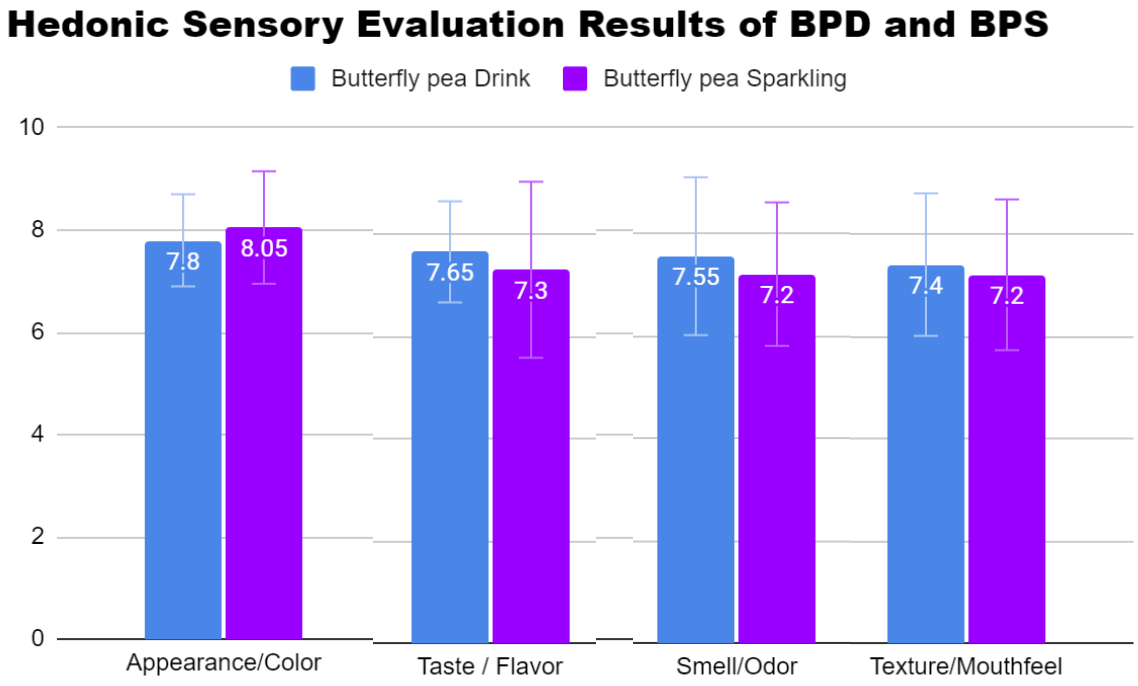


***Figure 7**. Average hedonic test value of appearance, taste, smell, texture of the BPD & BPS*

The average results of the hedonic sensory evaluation showed that on each variable, both samples had similar values and only slight differences, where the BPS sample had slightly higher acceptance for appearance than BPD (8.05 ± 1.1055), while the BPD sample had slightly higher acceptance value for its taste, smell, texture (7.65 ± 0,988, 7.55 ± 1.538, 7.4 ± 1.3917). As stated in a study of Seftiono, Panjaitan, Sumiasih (2020), color, taste, and aroma of a product could affect the consumers' acceptance of that product. However, since as earlier mentioned that the color of the butterfly pea drink did not change significantly after added with soda and lemon, the acceptance of the color of BPS sample and BPD sample were also similar.

The same study showed that the addition of lime juice affected the panelists' preference, with an increasing then decreasing acceptance level as the higher amount of lime was added as it made the product too sour. The BPS sample have slightly lower value might indicate that the addition of lime juice were a little too high, however it still did not significantly affected it.

The study also mentioned that the addition of lime juice affected the food product by giving it a fresh aroma notes. The result of the study is inversely proportional to this experiment's result which showed slight decrement of the aroma after being added with lime juice. This might be because the butterfly pea syrup that was used as main ingredient was already added with aroma additives which had a distinct smell to it, thus the addition of lime did not affect the aroma significantly.

The acceptance of the mouthfeel of the BPS sample were slightly lower than the BPD sample, this might be due to the sour and astringent aftertaste that was left after consuming lime. This is in accordance with a study by Ameh et al. (2015) where the sample that was added with (50:50) lime ratio was least preferred due to it sourness and astringency.

After conducting statistical analysis using spss, the significant difference of the two samples BPD & BPS for each variable were obtained (***Table 2***). The results showed none of them showed any significant difference ($p<0.05$). Therefore it can be concluded that the addition of soda and lime to the butterfly pea drink did not have a significant effect to the acceptance of consumers for its appearance/color, taste/flavor, smell/odor, texture/mouthfeel. Also, the result of the sensory analysis could be affected due to the lack amount of untrained panelists (n=20) as it was suggested that to be able to obtain a thorough review the number of untrained panelists should be 50 or more (Mancini, 2009). In order to obtain a more accurate data, the hedonic testing should be coupled with other sensory evaluation tests such as 2-AFC to know the sweetness and sourness preference of the sample. Another test that can be conducted is JAR(Just-About-Right) to know the intensity of the

attributes such as sweetness and sourness, therefore the data can be used for further development of the drink where the sweetness and sourness balance can be obtained

3.3 Conclusion and recommendation

3.3.1 Conclusion

The addition of lime and soda to the butterfly pea drink increased its antioxidant content due to its high ascorbic acid and citric content. Compared to the sample without it, sample with addition of soda and lime had lower pH and brix value. The decrement in pH was because soda and lime contain weak acid (carbonic, ascorbic, citric), while the decrement in brix level was because citric acid in the lime could turn the sucrose in the butterfly pea syrup to invert sugar, therefore reducing its brix value. The color of the sample added with soda and lime changed slightly to darker opaque blue. For the sensory evaluation with variables of appearance, taste, aroma, texture, the addition of lime and soda did not have a significant effect on any of the variables.

3.3.2 Recommendation

This study could be researched further such as doing the sensory evaluation using different method which can identify the effect of the addition of soda and lime towards the beverage on top of the acceptance test that was already conducted, such as JAR and 2-AFC method to obtain more data regarding the sweetness and sourness aspect. The sensory evaluation should also be done with larger number of panelists to increase the accuracy. Other type of antioxidant activity analysis such as ABTS, ORAC can also be conducted and its result can be compared to this study antioxidant analysis result to know which method is more sensitive to analyze the butterfly pea beverage. In order to learn more about the color change, turbidity test can be conducted to know the specific reaction in the color change reaction, as knowing the concentration of turbidity can help to correlate more to the result of the color analysis. Also, to detect the development of electrolytes, since more electrolyte can cause higher turbidity concentration and might affect the degradation of anthocyanin pigment compound. Further study could also be done to compare the butterfly pea syrup to its freshly made alternatives.

IV. SELF REFLECTION

Through the 5 months I worked at PT. Oesodo Alam Mandiri as an research and development intern, I have gained many new skills such as the ability to produce jamu from scratch, ability to think of a new menu product, critical thinking, and also the ability to prepare and conduct antioxidant analysis and sensory analysis all by myself. I believe that this newly acquired skills will be useful in the further steps and development of my career in the future.

During this internship opportunity, I have identified my weakness which is time management but at the same time identified my strength which is good teamwork, communication skill, able to teach others of something that i know. Furthermore, I can adapt well to the constantly changing condition at the workplace.

Through i3L, I have obtained the basic knowledge of the processes that are needed to conduct the experiment. I have also obtained the right mindset that is needed to work in the food industry and also how to develop new products. Also through BRIGHT sessions, i felt that my soft skills such as communication skill, leadership skill, and personal branding has improved to learn and to be a good role model in the workplace. Having Integrity of a science student, honest and strong moral principle has put me in the right path of conducting research that can be useful for community.

On top of that, the courses I learned from i3L such as food additives lab, food processing, beverage technology and experimental design have taught me a lot of knowledge to be able to conduct a proper experiment.

The results of this experiment and throughout my internship could benefit PT. OAM in the development of their menu as well as improvement to their menu. Moreover, the result of this experiment could be the base of further research on their other products.

V. CONCLUSION & RECOMMENDATION

5.1 Conclusion

The aim of the internship is to develop new menu as well analyze the already available menu to improve it. This experiment were conducted in order to achieve that goal of which to analyze the effect of the addition of soda and lime water towards the physicochemical properties, bioactive compound content, sensorial properties of the butterfly pea beverage. The goal has mostly been achieved as analysis of antioxidant activity, pH, brix, color, and sensorial properties have been obtained. However, the lack of time, human resources and money capital have caused some goal to be incomplete as it still needs to be further analyze whether the current formulation has met the demand of people.

5.2 Recommendation

To further improve the internship experience in the future, the student need to learn to have better time management, create an effective working schedule to be able to conduct more work for the internship process. The student should also be more proactive in keeping up to date with the information update. Thus, the goal of the internship can be better fulfilled.

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APPENDICES

Type of Beverage	Brix	pH
Butterflypea Drink	13.33 ± 0.577	4.347 ± 0.032
Butterflypea Sparkling	10.5 ± 0.577	3.053 ± 0.035

Table 1.1 Results of Brix and pH of butterflypea drink and butterflypea sparkling

Tests of Between-Subjects Effects

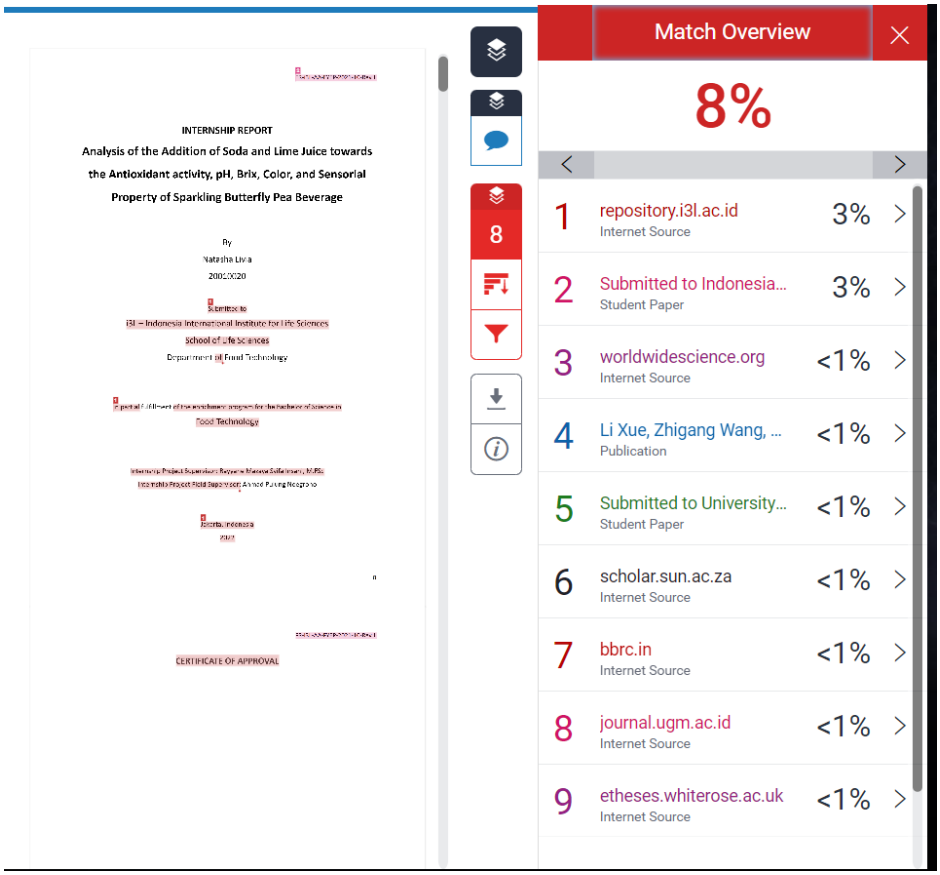
Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Appearance	22.900[a]	20	1.145	1.370	.248
	Taste	41.700[b]	20	2.085	1.156	.378
	Smell	47.100[c]	20	2.355	1.233	.325
	Texture	51.800[d]	20	2.590	1.850	.093
Intercept	Appearance	2512.225	1	2512.225	3006.757	<,001
	Taste	2235.025	1	2235.025	1238.964	<,001
	Smell	2175.625	1	2175.625	1139.542	<,001
	Texture	2131.600	1	2131.600	1522.571	<,001
Panelis	Appearance	22.275	19	1.172	1.403	.234
	Taste	40.475	19	2.130	1.181	.360
	Smell	45.875	19	2.414	1.265	.307
	Texture	51.400	19	2.705	1.932	.080
Sample	Appearance	.625	1	.625	.748	.398
	Taste	1.225	1	1.225	.679	.420
	Smell	1.225	1	1.225	.642	.433
	Texture	.400	1	.400	.286	.599
Error	Appearance	15.875	19	.836		
	Taste	34.275	19	1.804		
	Smell	36.275	19	1.909		
	Texture	26.600	19	1.400		
Total	Appearance	2551.000	40			
	Taste	2311.000	40			
	Smell	2259.000	40			
	Texture	2210.000	40			
Corrected Total	Appearance	38.775	39			
	Taste	75.975	39			
	Smell	83.375	39			
	Texture	78.400	39			

a. R Squared = .591 (Adjusted R Squared = .160)
b. R Squared = .549 (Adjusted R Squared = .074)
c. R Squared = .565 (Adjusted R Squared = .107)
d. R Squared = .661 (Adjusted R Squared = .304)

Table 2. *Statistical analysis of Hedonic Sensory Evaluation of BPD and BPS to evaluate appearance, taste, smell, texture*

	Butterfly Pea Drink (481)				Butterfly Pea Sparkling (405)			
Panelists	Appearance/Color	Taste / Flavor	Smell/ Odor	Texture/ Mouthfeel	Appearance/ Color	Taste / Flavor	Smell/ Odor	Texture/ Mouthfeel
1	9	9	9	9	T	8	9	7
2	7	6	9	8	9	8	8	8
3	9	9	9	8	7	9	6	8
4	7	8	7	8	9	7	7	8
5	8	9	9	8	9	7	7	9
6	6	7	6	6	6	8	6	6
7	9	7	9	8	7	9	8	7
8	8	8	8	7	9	9	8	8
9	8	8	8	8	9	8	9	9
10	7	7	7	7	9	9	9	9
11	8	8	8	8	8	7	7	7
12	7	7	3	9	6	6	7	4
13	9	7	9	4	9	3	4	7
14	8	7	7	7	7	8	8	7
15	9	9	7	7	8	5	7	5
16	7	7	6	8	7	8	8	8
17	7	8	8	9	8	9	8	8
18	7	9	9	8	9	6	7	7
19	8	6	6	4	7	4	4	4
20	8	7	7	7	9	8	7	8
average	7.8	7.65	7.55	7.4	8	7.3	7.2	7.2
std deviation	0.894427191	0.9880869342	1.538112309	1.391704748	1.105541597	1.719853115	1.399247918	1.472555959

Table 3. Table of hedonic Sensory Evaluation Results of BPD and BPS Sample



Turnitin result