Formulation of a Synbiotic Beverage Based on Red Bean with Addition of Inulin Dahlia Tuber

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Abstract.. This study aims to determine the effect of adding inulin to synbiotic beverage chemical and organoleptic properties. The study consisted of two stages, the first stage was the isolation of inulin from dahlia tubers and the second stage was the manufacture of synbiotic beverage. The design used in this study was a Randomized Block Design (RBD) with one factor, namely the concentration of dahlia tuber inulin added with a concentration level of 0 %, 1 %, 3 %, 5 %, and 7 %. One-factor research with two replications has ten experimental units with research variables: qualitative dahlia tuber inulin, synbiotic beverage water content, ash content, lipid content, protein content, fiber content, and organoleptic tests. The addition of inulin significantly affected the chemical variables of ash, lipid, protein, and fiber, and organoleptic variables of aroma, texture, colour, and taste. The best treatment results from this study were F0 treatment with the addition of 1 % inulin concentration resulting in 85 % water content, 0.14 % ash content, 3.58 % protein content, 0.32 % lipid content, and 1.76 % fiber content. The best treatment organoleptic results were 4.96 % aroma variables, 5.20 % texture, 4.96 % colour, and 4.60 % taste variables.

Keyword: *Dahlia pinnata* L, digestive problems, functional drink, *Phaseolus vulgaris* L., probiotic and prebiotic.

1 Introduction

The human body's health index can be seen from internal and external factors. The digestive system is one of the internal indicators that can affect the body's overall health.

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The digestive system has a high level of sensitivity, so it tends to experience problems often. The main issue currently faced by many people and is very closely related to the pattern of consumption of the community is the digestive system disorder. Digestive system disorders can occur in all circles, infants, children, and adults. But in general, many digestive system disorders occur in children. Gastrointestinal disease is the main contributor to deaths worldwide, causing one in ten child deaths [1]. Various digestive system disorders can be found in the community, such as the stomach, duodenum rectum, and the most straightforward problem, diarrheic and colon or significant intestine disorders [2]. Factors that can affect the digestive system disorder can be caused by infection or allergies, such as intestinal obstruction, diseases of acid-base balance, disturbances of intestinal molality, and allergies to cow's milk protein or lactose intolerance [3].

Efforts to overcome the digestive system disorder are through functional food consumption, one of which a is synbiotic beverage. The synbiotic beverage includes functional food combining probiotic and prebiotic components related to the digestive and health system that can affect the number of microbes, increase the number of substrates and trigger the growth of good bacteria [4]. Synbiotic consumption can increase the immune system, prevent colon cancer and launch a digestive system. Synbiotic beverage are made of probiotics and prebiotics. Lactic acid bacterial probiotics that can produce lactic acid and provide the body's immune response [5]. Prebiotics are sourced from the carbohydrate group that cannot be digested by fructooligosaccharides (FOS), galactooligosaccharides (GOS), food fibers, and inulin. Inulin is one type of prebiotic that has been widely studied and has the best effect among other prebiotics. Therefore, adding inulin to probiotic fermentation products provides more effectiveness in overcoming digestive problems [6].

Previous research has been conducted by about making Synbiotic beverage using banana puree raw materials as a substrate and the addition of commercial inulin as a prebiotic [7]. Synbiotic beverage based on puree bananas with the breeding of the inulin are known to produce drinks according to SNI standards and increase protein digestibility. But in previous study, it is known that it does not show effectiveness associated with fiber levels to overcome digestive problems. In addition, it is known that banana puree is not suitable as a probiotic growth substrate. Based on this, this study provides alternative red bean-based synbiotic beverage with the addition of dahlia tubers as a prebiotic source. Red beans, a raw material for synbiotic beverage, can be a suitable substrate for probiotic growth. Red beans are also low in lipids but have high fiber levels, compared to cow's milk, and are friendly for people with lactose intolerant [8].

Inulin is sourced from Dahlia tubers that are easily found, have high inulin content, and are commercial inulin producers. In this study, inulin isolation was carried out directly, meaning that it did not use commercial inulin as in previous research. The combination of these two ingredients in making synbiotic beverage will produce synbiotic beverage according to SNI standards, increase the digestibility of protein such as previous research and also increase the value of fiber levels so that it can overcome digestive problems such as diarrhea, disorders of the large intestine and allergic to cow's milk protein or intolerant lactose. Based on this, research on making red bean-based synbiotic beverage formulations with the addition of dahlia tubers inulin is expected to produce synbiotic beverage as functional food to overcome the digestive system problem and can be accepted by the community.

2 Methods

The tools used in the processing of synbiotic beverage are water bath shaker, hotplate, freezer, centrifuge (Gemmy PLC-05), analytical scales (Pioner Ohaus), oven (Romand),

and furnaces. Glassware analysis tools used in this study include desiccators, porcelain cups, lipid cups, Kjeldahl set, distillation set, burette, thermometer, spatula, stirring rods, filler, measuring pipette, measuring flask, erlenmeyer, beaker cups, and petridish cups. The ingredients used in making this synbiotic beverage are dahlia tubers (*Dahlia pinnata* L.—Pompom Maroon, from Yogyakarta, Indonesia), red beans (*Phaseolus vulgaris* L. from Karangploso, Malang, Indonesia), skim milk, sugar, water, yogurt, ethanol (food grade), ethanol (96 %), distillated water, NaOH (50 %), HCl (0.02 N), boric acid, petroleum ether (*p.a.)*, H_2SO_4 (25 %), seliwanof reagen, andresorcinol.

2.1 Research design

The experimental design in this study was a simple group design (shelf) with one factor. There are five treatments and three replications in each sample of the experiment. This study's treatment is adding different concentrations of Dahlia tubers in red bean synbiotic beverage. The amount of red beans used for each treatment is 100 %, with five inulin addition formulations, namely F0 (inulin concentration 0 %), F1 (1 %inulin concentration), F2 (3 %inulin concentration), F3 (5 %inulin concentration), F4 (7 %inulin concentration). This research was conducted in two stages: inulin insulation from Dahlia tubers and the second stage of making synbiotic beverage. Dahlia tuber inulin isolation begins with cleaning and washing tubers, then cutting and channeling.

Furthermore, the mashed tubers are heated at 80 °C to 90 °C for 30 min to separate the filtrate and residue. The filtrate obtained is soaked using ethanol food grade and stored in the freezer at 0 °C temperature for 18 h. After 18 h, the heating process is again carried out using a water ratio 1: 2 (b v^{-1}) temperature of 80 °C to 90 ° C for 30 min to separate the second filtrate. The filtrate is then re-soaked using ethanol (30 %) as much as 40 % of the filtrate volume and stored in the freezer for 18 h. The following process is the separation of the precipitate that is formed, then centrifuged, and the deposits are dried using a vacuum oven so that inulin powder is obtained [9]. The second stage is making synbiotic beverage from red beans, which are washed and soaked for 24 h and then the boiling process carried out to get red bean extract. After that the pasteurization process is carried out by adding sugar, skim milk and inulin. Furthermore, the incubation process for 24 h and synbiotic beverage were obtained [10].

The research variable was carried out in inulin powder analysis and product analysis. Inulin powder analysis is a qualitative test using resorcinol. Product analysis includes chemical variables and organoleptic tests. Chemical variables include water content, ash content, lipid content, protein content and fiber content. Organoleptic variables of the product consist of aroma, texture, colour and taste. The data obtained were analyzed using variety analysis at the level of confidence $\alpha = 5$ %. This is done to determine the real effect between treatments that are tried on chemical-physical properties and the inulin organoleptic analysis of dahlia tubers. If the results of the variety of analysis show the difference, then it is followed by the DMRT test (Duncan's Multiple Range Test) at $\alpha =$ 5 %. Furthermore, the best treatment test uses the De Garmo method.

3 Result and discussion

3.1 Inulin and yield qualitative analysis

Inulin qualitative tests from dahlia tubers are done by observing inulin powder (Figure 1) and calculating the inulin yield. Inulin qualitative test shows reddish brown. At the same time, the yield level of the dahlia tuber inulin powder produced is 1.47 %. Inulin isolation utilizes the principle of inulin solubility in water and ethanol. Inulin powder Dahlia tubers obtained are then tested to determine the inulin's purity.

Fig 1. Inulin qualitative analysis result

Based on Figure 1, it is known that qualitative inulin tests show a change in white inulin colour to red—changes in colour to red due to a fructose reaction with resorcinol [11]. Inulin can be hydrolyzed well into fructose at acidic pH, and temperature of 80 °C to 100 °C. Chloride acid contained in resorcinol will hydrolyze polypructose into fructose. Fructose is a faster solution; rejecting gives a red colour and red brick deposits. It happens because fructose is a carbohydrate containing a ketone group. If it reacts with Seliwanoff it will provide furfural derivatives, then condensed with resorcinol will provide complex red or brick red discolouration. The yield of dahlia tubers obtained from the initial mass of 1 500 g produces 22 g of pure inulin powder. Inulin isolation utilizes the principle of inulin solubility in water and ethanol. Inulin powder Dahlia tubers that have been obtained are then tested to determine the inulin's purity. Inulin is tested using resorcinol in HCl solution will produce a red colour which is a yield of the inulin [11].

3.2 Proximate content

Based on the results of the analysis of the variety shows that the addition of inulin concentrations did not significantly affect the water content of the synbiotic beverage. The proximate content of synbiotic beverage is seen in Table 1.

Table 1. The proximate content of synbiotic beverage

Treatment	Moisture Content (%)	Ash Content (%)	Protein Content (%)	Lipid Content (%)	Fiber Content (%)
S0 (Inulin 0 %)	85.50±0.021^{a}	0.150±0.014^{a}	3.55±0.077^{a}	0.21±0.028^{a}	1.45±0.127^{b}
S1 (Inulin 1 %)	85.80±0.007^{a}	0.145±0.021^{a}	3.58±0.014^{ab}	0.32±0.042^{b}	1.76±0.332^{b}
S2 (Inulin 3 %)	86.75±0.321^{b}	0,140±0,014^{a}	3.65±0.014^{ab}	0.22±0.042^{a}	0.95±0.007^{a}
S3 (Inulin 5 %)	86.55±0.014^{b}	0,135±0,021^{a}	3.75±0.063^{b}	0.32±0.049^{b}	1.31±0.63^{ab}
S4 (Inulin 7 %)	85.28±0.032^{a}	0.175±0.007^{b}	3.92±0.077^{c}	0.32±0.077^{b}	1.52±0.028^{b}

The mean value followed by the same letter shows no significant difference according to the DMRT 5 % test

3.2.1 Moisture content

Based on Table 1, showed that the mean value of ash content from treatments S0, S1, S2, and S3 or the addition of inulin from dahlia tubers at concentrations of 0 %, 1 %, 3 % and 5 % was not statistically significant, besides that there was a tendency for the ash content to decrease. The four treatments were significantly different from F4. The 7 % concentration was 0.175 ± 0.021, while the highest average value of ash content was 0.175 ± 0.007 in the F4 treatment with a concentration of 7 %. The ash content of the synbiotic beverage is known to follow the Indonesian National Standard (SNI) 289:2009, which has a maximum value of 1.0 %. The raw material strongly influences the value of ash content. Red beans themselves are known to have a reasonably high mineral content. The most dominant mineral element of red beans is phosphorus, which is 4.05 % [10]. The formulation of this synbiotic beverage is dominated by red bean extract, which is 100 %, so the ash content value is quite good and has met SNI standards. The relationship between treatments and ash content was known. The treatment with the highest concentration of dahlia tubers gave the highest mean value of ash content and met the Indonesian National Standard. In connection with this, it can be stated that adding inulin will increase the average value of the ash content of synbiotic beverage. It was due to the combination of red bean raw materials with high phosphorus ash content and ash content from dahlia tuber inulin.

3.2.2 Ash content

In addition, as well as water content, the value of ash content is also influenced by additional ingredients added to the process of making synbiotic beverage, primarily components of skim milk and sugar. The value of the ash content of each treatment is known to have no significant difference for each mean. It is presumably due to several factors. First, the soaking and boiling factors occur in raw red bean materials before being processed into red bean extract. The soaking and boiling process will decrease the mineral content due to the osmosis process, namely the release of minerals in red beans and dissolved in red beans [12]. Raw materials significantly affect the fiber content of this synbiotic beverage. Red beans, a raw material in the manufacture of synbiotic beverage, are known as raw materials with relatively high fiber content. Red beans have a higher fiber content than other types of beans. 100 g of red beans has a fiber content of 3.8 g [13]. This value is relatively high compared to soybeans, only about 1.9 g $(100\ g)^{-1}$. When making synbiotic beverage, red beans undergo a process of refining and filtering twice after boiling. It is one of the causes of reducing the value of red bean fiber content.

3.2.3 Protein content

The results of statistical tests showed that the addition of inulin from dahlia tubers at concentrations of S0, S1, and S2 (0 %, 1 %, and 3 % concentrations) was not significantly different from the protein content of synbiotic beverage. Meanwhile, the addition of inulin from dahlia tubers at concentrations of S3 and S4 (5 % and 7 % concentrations) was significantly different from the protein content of the synbiotic beverage formulation. The lowest mean value of fiber content was found in the addition of 3 % inulin concentration, with a fiber content value of 0.95 ± 0.007. In contrast, the highest fiber content value was found in the expansion of 1 % inulin concentration treatment with a value of 1.76 ± 0.332. Overall, the average value of the fiber content of this synbiotic beverage ranged from 0.95 % to 1.75 %, with the range between treatments not showing a significant value. The results of this study show a value that is not much different that in yogurt products or red bean-based synbiotic beverage, the results are 0.32 to 0.59, even the results of this study show a higher value [14]. Based on the Indonesian National Standard (SNI) for synbiotic yogurt drinks 2981:2009, the minimum standard for protein content is 2.7 %. From the reference, it is known that the red bean-based synbiotic beverage has met the standard provisions. The synbiotic beverage's protein content was only 2.79 %, indicating that the protein content of this synbiotic beverage was much higher [15]. The primary raw material in the manufacture of this synbiotic beverage, namely red beans, is thought to contribute to a reasonably high protein content. As much as 70 % of the world's protein supply comes from vegetable protein (plants), especially seeds and nuts. Another factor that affects the protein content is the addition of skim milk by 5 %. Skim milk also contributed a 3.7 % higher percentage of protein content than the average of several treatments on synbiotic beverage. In addition, the more red bean protein dissolved in food, the higher the value of the final product [16]. Processing synbiotic beverage through the pasteurization method will also increase the protein content. The pasteurization does not give a significant value to the protein content [17]. Still, heating will make the protein content of the material better. This event occurs due to an increase in digestibility due to the breakdown of proteins into simple units.

3.2.4 Lipid content

Based on the results of statistical tests, the average lipid content of the five formulations of synbiotic beverage with the addition of inulin concentration was (0 %, 1 %, 3 %, 5 %, 7 %). The formulation with the lowest mean lipid content value was found in the treatment without adding dahlia tuber inulin, which was 0.21±0.028. In contrast, the highest lipid content value was found in the treatment with 1 %, 3 %, 7 % concentrations of inulin addition, which was 0.325. According to the Indonesian National Standard (SNI, 1992), a quality yogurt or synbiotic beverage has a maximum lipid content of 3.8 % and a minimum of 0.3 %. However, for synbiotic beverage or low-lipid yogurt with a standard of 0.6 % to 2.9 %. If you refer to these standards, this synbiotic beverage has met the standards set for treatment four, adding the highest concentration of inulin. In the manufacture of synbiotic beverage with formulations based on vegetable ingredients, the lipid content results were not much different from the results of this study [15]. The lipid content in his research showed results of a lipid content of 0.2 %. It happens because, in the process of making the synbiotic beverage, skim milk is used. Red beans, the primary raw material for making this formulation drink from vegetable sources, have a lipid content not higher than cow's milk as the primary raw material commonly used to manufacture yogurt or synbiotic beverage. According to the Food Ingredients Composition List (DKBM), fresh cow's milk contains a lipid content of 3.5 g $(100\ g)^{-1}$ of ingredients, while red beans contain a lipid content of 3.0 g $(100\ g)^{-1}$ of elements. Yogurt from cow's milk generally contains denser lipids. Yogurt that thickens will tend to clot more quickly due to lactic acid bacterial fermentation [18]. In addition, red beans have a reasonably low lipid content compared to other nuts. The difference in lipid content values is also thought to be due to adding a starter as a source of probiotic bacteria undergoing fermentation. The lipid content of a product would decrease because the bacteria Lactobacillus bulgaricus, as a type of bacteria in the starter, can reduce lipid content by being absorbed as a source for growth [19].

3.2.5 Fiber content

Based on the results of statistical tests, it is known that the treatment without the addition of inulin concentration and the addition of inulin concentration at the level of 1 %, 3 %, 5 %, and 7 % had a significant effect on the fiber content of synbiotic beverage. The lowest mean value of fiber content was found in the addition of 3 % inulin concentration, with a fiber content value of 0.95 ± 0.007. In contrast, the highest fiber content value was found in the acquisition of 1 % inulin concentration treatment with a value of 1.76 ± 0.332. Overall, the average value of the fiber content of this synbiotic beverage ranged from 0.95 % to 1.75 %, with the range between treatments not showing a significant discount. The results of this study indicate a value that is not much different from previous research [19] that in yogurt products or red bean-based synbiotic beverage, the results were 0.32 to 0.59, even the results of this study showed a higher value. The fermentation process is known to affect the fiber content of synbiotic beverage. This statement is supported by another study [19] who that the fermentation process can affect the fiber content of yogurt. The longer the fermentation process, the higher the yogurt fiber content, and vice versa. A long fermentation time will increase the growth of LAB, where the growing LAB will increase the biomass and make the fiber content in yogurt also increase. The manufacturing beverages carried out by refining and filtering processes will cause some of the fiber to be wasted along with the dregs, which will reduce the fiber content even though it is not so significant. The fermentation process is known to affect the fiber content of synbiotic beverage. The fermentation process can affect the fiber content of yogurt. The longer the fermentation process, the higher the yogurt fiber content, and vice versa. A long fermentation time will increase the growth of LAB, where the growing LAB will increase the biomass and make the fiber content in yogurt also increase [20].

3.2.6 Organoleptic analysis on aroma, texture, colour, and taste

The analysis of variance showed that the addition of inulin concentration had a very significant effect ($P < 0.01$) on the organoleptic test on the aroma, texture, colour, and taste of synbiotic beverage, which can be seen in Table 2.

Table 2. The organoleptic analysis of synbiotic beverage

Treatment	Aroma	Texture	Colour	Taste
S0 (Inulin 0 %)	4.76 ± 0.89^{bc}	5.40 ± 0.70^{d}	4.76 ± 0.66^{bc}	4.84 ± 0.80^{b}
S1 (Inulin 1 %)	4.96 ± 0.79^{c}	5.20 ± 0.76^{cd}	4.96 ± 0.78^{d}	4.60 ± 0.70^{b}
S2 (Inulin 3 %)	4.68 ± 0.84^{bc}	4.88 ± 0.78^{bc}	4.68 ± 0.80^{bc}	4.40 ± 0.76^{b}
S3 (Inulin 5 %)	4.20 ± 0.62^{a}	4.72 ± 0.61^{b}	4.20 ± 0.81^{a}	3.84 ± 0.80^{a}
S4 (Inulin 7 %)	4.36 ± 0.05^{ab}	4.16 ± 0.55^{a}	4.36 ± 0.70^{ab}	3.84 ± 0.74^{a}

The mean value followed by the same letter shows no significant difference according to the DMRT 5 % test

3.2.7 Aroma

Table 2 shows that the average value of the aroma organoleptic test results showed that the addition of inulin concentration had a very significant effect ($P < 0.01$) on the organoleptic test results for aroma, texture, colour, and taste of inulin synbiotic beverage from dahlia tubers. The average value of the organoleptic test on synbiotic beverage in aroma ranged from 4.20 to 4.96 (neutral to slightly like). It means that the panelists quite like the aroma. The lowest organoleptic aroma value was found in the addition of 5 % inulin concentration, with a value of 4.20. In comparison, the highest average value was found in the treatment with 1 % addition of inulin concentration, which was 4.96. These results follow the provisions of SNI 2981:2009 that the aroma attributes produced from yogurt or synbiotic beverage tend to be neutral to acidic. Assessment based on aroma attributes found that yogurt based on cow's milk tends to have a distinctive aroma of yogurt compared to yogurt based on red beans. Red bean-based yogurt generally has a unique red bean aroma or unpleasant aroma, but the level of unpleasantness is not as strong as that of soybean juice. The unpleasant scent can naturally come from breaking or refining the red bean. The argues that the unpleasant aroma is the distinctive smell of nuts caused by the action of the lipoxygenase enzyme [21]. However, the addition of lactic acid bacteria and the fermentation process can reduce the unpleasant aroma. The unpleasant scent of red bean yogurt can be disguised through soaking and fermentation by lactic acid bacteria. In addition, soaking in water, removing the skin, heating at high temperatures, and adding sugar can also reduce the unpleasant aroma [22].

3.2.8 Texture

The statistical test table showed that adding inulin concentration significantly affected the organoleptic texture test. The average value of the organoleptic texture test is in the range of 4.16 to 5.40. The lowest value was found in the treatment with an inulin concentration of 4.16. In contrast, the highest value was found in the treatment with an inulin concentration of 0% or without adding inulin. The texture of the synbiotic beverage in this study is known to have a consistency that is not too dense, like yogurt in general. This synbiotic beverage has a texture that tends to be liquid or like a commercial yogurt drink product. It happens because the number of starters as a source of probiotics and lactic acid bacteria added to the process of making this drink is not too much. The texture of yogurt is strongly influenced by various solids resulting from the fermentation process [22]. The results of the organoleptic texture test showed that the panelists preferred the surface of the synbiotic beverage without the addition of inulin because the texture tends to be lighter, and the panelists liked it because it did not leave any deposits or lumps when consumed. However, the yogurt produced in this study still meets the standards of synbiotic yogurt drinks. The raw material of the yogurt also influences the yogurt texture. In general, yogurt made from animal, cow's, or goat's milk will produce a thick consistency. It happens because synbiotic beverage or yogurt from cow's milk are manufactured directly without prior filtering. Pasteurization at high temperatures will cause lumps due to cow's milk protein coagulation.

3.2.9 Colour

Based on the table shows that the treatment with the addition of inulin concentration affects the organoleptic colour parameters. Overall, the average value of colour parameters is in the range of 4.20 to 4.96. This value indicates that the panelists tend to be neutral to like somewhat to rate this synbiotic beverage. The lowest average was found in the treatment with the addition of an inulin concentration of 7 % with a value of 4.36. In comparison, the highest value was found in the treatment with the addition of 1% inulin concentration, which was 4.96. The mean value between treatments with the addition of inulin concentration was not significantly different. It shows that no colour change contrasts with each addition of inulin. This synbiotic beverage has a distinctive red bean colour: dark red to light purple. The colour is obtained naturally from the content of red bean pigment as a raw material. The compound pelagordin 3-glucoside is the dominant anthocyanin found in red beans [22].

These compounds produce a purplish red colour in red bean synbiotic beverage. However, the colour tends to be less intense because it has undergone several previous processing processes. The process of soaking and boiling will dissolve some of the pigments found in red beans. The immersion process for 24 h in water and the boiling process will cause the red pigment contained in red beans to dissolve so that the resulting colour becomes lighter [23]. In addition to the processing process, the fading of red bean colour can also be caused by the addition of skim milk as an additional ingredient in the manufacture of synbiotic beverage.

3.2.10 Taste

Based on the results of statistical tests in this study, it was found that the treatment with the addition of inulin concentration greatly affected the organoleptic taste parameters. Overall, the average value of the taste parameters is in the range of 3.84 to 4.84. This value indicates that the panelists prefer to rate this synbiotic beverage. The lowest average was found in the treatment with the addition of an inulin concentration of 7 %, with a value of 3.84. In comparison, the highest value was found in the treatment with the addition of 1 % inulin concentration, which was 4.84. The mean value between treatments with the addition of inulin concentration was not significantly different. It shows no contrasting taste change with each addition of inulin. The taste of the synbiotic beverage that the panelists preferred was the treatment without the addition of inulin, while the least preferred was the treatment with the highest concentration of inulin addition, which was 7 %. The treatment without the addition of inulin was a control used to compare whether or not the synbiotic beverage product was accepted with the addition of inulin. The taste produced from this synbiotic beverage is normal to tend to be sour, like the typical taste of yogurt. Yogurt is a fermented beverage that utilizes microbes in the fermentation process with a sour taste. Lactic acid bacteria that play a role in yogurt fermentation will hydrolyze lactose to increase yogurt's acidity. The fermentation process results in increased microbial activity, lower pH, and increased product acidity [24]. Following this statement, this study added microbes as a lactic acid bacteria starter to produce a synbiotic beverage with a neutral sour taste. The primary raw material in the manufacture of this synbiotic beverage is red beans. Red beans are processed into red bean extract first and then pasteurized by mixing other ingredients such as inulin, skim milk, sugar, and starter, and the final stage is the fermentation process. Red beans have a distinctive taste, are not too thick, and have a slightly sweet taste.

3.2.11 Determination of the best treatment

The best treatment was determined based on proximate analysis, namely water content, ash content, protein content, fat content, fiber content, and preference or organoleptic tests. The results of determining the best treatment with the De Garmo method of synbiotic beverage can be seen in Table 3.

Table 3. The best treatment of synbiotic beverage with the addition of dahlia bulbs inulin

Treatment	Score	Rank
S0 (Red bean extract 100 % + Inulin 0 %)	0.539	2
S1 (Red bean extract 100 % + Inulin 1 %)	0.764	1*
S2 (Red bean extract 100 % + Inulin 3 %)	0.528	3
S3 (Red bean extract 100 % + Inulin 5 %)	0.216	5
S4 (Red bean extract 100 % + Inulin 7 %)	0.408	4

Remarks: (*) Best Treated Sample

Based on Table 3, the determination of the best treatment shows that the sample with adding 1 % inulin concentration was the best treatment. The best treatment is determined from various parameters analyzed for all treatments. The best treatment with the addition of 1 % inulin concentration is known to have a water content that meets the Indonesian National Standard for synbiotic yogurt drinks, which is 85 %, which is still in the range of not too low or too high compared to all treatments. Ash content is 0.14 %, protein content is

3.58 %, fat content is 0.32 %, and fiber content is 1.76 %. While in terms of organoleptic tests, the treatment with 1 % concentration of inulin added has an aroma parameter value of 4.96, a texture parameter of 5.20, a colour parameter of 4.96, and a taste parameter of 4.60 N. Synbiotic beverage of red bean-based yogurt with an inulin concentration of 1 % overall in terms of chemical parameters and preferences has met the Indonesian National Standard. Protein and fiber are expected to have the highest percentage in this synbiotic beverage. It is because a synbiotic beverage consists of a combination of prebiotic and probiotic components. The primary purpose of combining these two components is to see the effectiveness and functional benefits obtained from this functional drink. The synbiotics are probiotics and prebiotics combined in food products that can affect the amount of microflora in the gastrointestinal tract by increasing the number of substrates so that they can stimulate the growth of probiotic bacteria, especially *Bifidobacteria* and *Lactobacilli* [25].

4 Conclusion

There was a significant effect of treatment with the addition of inulin concentration in dahlia tubers to the variables of ash content, protein content, fat content, and fiber content of red bean synbiotic beverage. Still, it had no significant effect on water content variables. The qualitative test showed a reddish colour with a yield of 1.47 %. The organoleptic analysis showed that adding dahlia tuber inulin concentration significantly affected red bean-based synbiotic beverage' aroma, texture, colour, and taste. The best treatment was determined using the de Garmo method based on the variables of water content, ash content, protein content, fat content, and fiber content, and the organoleptic test showed that the addition of inulin concentration treatment was 1 % (F1) with a moisture content value of 85 %, ash content of 0 .14 %, 3.58 % protein content, 0.32 % fat content and 1.76 % fiber content.

References

1. S.B. Abderrahim, M. Gharbaoui, O. Bekir, M. Hamdoun, and M. Allouche, J. Forensic Sci., **67**, 2: 596–604 (2022) https://doi.org/10.1111/1556-4029.14953
2. Z. Wang, and B. Yang. *Polypharmacology in Clinical Applications: Gastrointestinal Polypharmacology, in: Polypahrmacology, Principles and Methodologies*. Springer, Cham (2022) pp 301–321 https://doi.org/10.1007/978-3-031-04998-9_8
3. R. Meyer, Br. J. Gen. Pract. (2023) https://bjgp.org/content/prevalence-lactose-intolerance-children-non-ige-mediated-gastrointestinal-cow%E2%80%99s-milk-protein
4. D. Dahiya, and P.S. Nigam, Ferment., **8**, 7: 303 (2022) https://doi.org/10.3390/fermentation8070303
5. L.C.L. de Jesus, T.F. da Silva, R.A. Gloria, A.S. Freitas, G.M. Campos, G.C. Gomes, et al., *Lactic Acid Bacteria, Based Beverages in The Promotion of Gastrointertinal Tract Health. in: Microbiome, Immunity, Digestive, Health, and Nutrition*. D. Bagchi, and B.W. Downs (ed.). Academic Press (2022) pp 373–385 https://doi.org/10.1016/B978-0-12-822238-6.00008-X
6. J. Kieps, and R. Dembczyinki, Foods, **11**, 15: 2330 (2022) https://doi.org/10.3390/foods11152330
7. F.Y. Amelia, W. Warkoyo, H.A. Manshur, and A. Husna, Food Technol. Halal Sci. J., **5**, 1: 32–44 (2022) [inBahasa Indonesia] https://doi.org/10.22219/fths.v5i1.18760

8. K. Srikaeo, *Cereal Grain-Based Milks and Their Potential Health Properties*. in: *Functional Cereals and Cereal Foods*, S.P. Bangar, A.K. Siroha (ed.). Springer Cham (2022) pp 251–288 https://doi.org/10.1007/978-3-031-05611-6_10
9. I.H. Nurrosyidah, Jurnal Ilmiah Kesehatan Rustida, **4**, 2: 526–532 (2018) https://www.e-journal.akesrustida.ac.id/index.php/jikr/article/view/60
10. A.S. Sekarningrum, and S. Umar, J. Bioindustri, **2**, 2: 476–486 (2020) [in Bahasa Indonesia] https://doi.org/10.31326/jbio.v2i2.655
11. E. Sundari, E.R. Desfitri, M. Martynis, and E. Praputri, *Identifikasi dan Kondisi Ekstraksi Inulin dari Umbi Dahlia di Sumatera Barat [Identification and Extraction Conditions of Inulin from Dahlia Tubers in West Sumatera],* Prosiding SNSTL I 2014 (Padang, Sept 11st 2014) pp 174–179 [in Bahasa Indonesia] http://lingkungan.ft.unand.ac.id/images/22174-179-Elmi_Sundari.pdf
12. R. Mayasari, *Kajian Karakteristik Biskuit yang Dipengaruhi Perbandingan Tepung Umbi Jalar (Ipomea batatas L.) dan Tepung Kacang Merah (Phaseolus vulgaris L.) [A Study on the Characteristics of Biscuits Affected by a Comparison of Sweet Potato Flour (Ipomea batatas L.) and Red Bean Flour (Phaseolus vulgaris L.)]*. [Undergraduate Thesis]. Faculty of Engineering, Pasundan University (2015) [inBahasa Indonesia] http://repository.unpas.ac.id/id/eprint/3211
13. M. Kusharto, Jurnal Gizi dan Pangan, **1**, 2: 45–54 (2006) [in Bahasa Indonesia] https://doi.org/10.25182/jgp.2006.1.2.45-54
14. R.O. Jasmine, R. Fadhila, V. Melani, P. Ronitawati, and D. Angkasa, Darussalam Nutrition Journal, **4**, 2: 82–93 (2020) [in Bahasa Indonesia] https://doi.org/10.21111/dnj.v4i2.3999
15. D. Desnilasari, and N.P.A. Lestari, Agritech, **34**, 3: 257–265 (2014) [in Bahasa Indonesia] https://doi.org/10.22146/agritech.9453
16. A. Santoso, Magistra, **23**, 75: 35 (2011) [in Bahasa Indonesia] https://fmipa.umri.ac.id/wp-content/uploads/2016/09/Pinki-A-Serat-dan-manfaatnya-bg-kesehatan-74-129-1-SM.pdf
17. T. Abubakar, R. Sunarlim, H. Setiyanto, and N. Nurjannah, Jurnal Ilmu Ternak dan Veteriner, **6**, 1: 45–50 (2001) [in Bahasa Indonesia] http://medpub.litbang.pertanian.go.id/index.php/jitv/article/download/218/218
18. D. Rosyidi, S.E. Sakul, L.E.R. Radiati, P. Purwadi, and H. Evanuarini, J. Microbiol. Biotechnol. Food Sci., **10**, 6: (2021) https://doi.org/10.15414/jmbfs.2551
19. C.G. Gallego, M. Gueimonde, and S. Salminen, Nutr. Rev., **76**, Supp 1: 29–39 (2018) https://doi.org/10.1093/nutrit/nuy059
20. F.J. Gracia-Perez, Y. Lario, J. Fernandez-Lopez, E. Sayas, J.A. Perez-Alvarez, and E. Sendra, Color Res. Appl., **30**, 6: 457–463 (2005) https://doi.org/10.1002/col.20158
21. A. Nizori, V. Suwita, S. Surhaini, M. Mursalin, M. Melisa, T.C. Sunarti, and E. Warsiki, Jurnal Teknologi Industri Pertanian, **18**, 1 (2008) [in Bahasa Indonesia] https://jurnal.ipb.ac.id/index.php/jurnaltin/article/view/4203
22. S.E.P. Wahyuningtyas, I.D.G.M. Permana, and A.A.I.S. Wiadnyani, Jurnal ITEPA, **6**, 2: 61–70 (2017) [in Bahasa Indonesia] https://ojs.unud.ac.id/index.php/itepa/article/download/36950/22387
23. D.G. Bae, Curr. res. agric. life sci., **28**: 31–38 (2010) https://www.koreascience.or.kr/article/JAKO201003750648682.page
24. R.S. Wati, *Kandungan Pati Resisten dan Mutu Fisik Cookies Prebiotik Kacang Hijau Pisang untuk Anak dengan Autism Spectrum Disorder [Resistant Starch Content and Physical Quality of Banana Mung Bean Prebiotic Cookies for Children with Autism Spectrum Disorder*]. [Undergraduate Thesis] Faculty of Medicine, Brawijaya University (2018) [inBahasa Indonesia] http://repository.ub.ac.id/id/eprint/167227

25. S.N. Aritonang, E. Roza, E. Rossi, E. Purwati, and H. Husmaini, Pak J Nutr, **16**, 8: 618–628 (2017) http://dx.doi.org/10.3923/pjn.2017.618.628