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Chemical properties of dragon fruit probiotic drink produced by biocapsules *Lactobacillus paracasei* ssp. *paracasei* M1.3 isolated from "Dadih" traditional fermented food West Sumatra

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Abstract. In this research, Biocapsules *Lactobacillus paracasei* ssp. *paracasei* Ml.3 isolated from "dadih" was used to ferment a probiotic drink made from dragon fruit juice. *L. paracasei* ssp. *paracasei* Ml.3 biocapsules are produced by extruding carrageenan-skim (2:1). Making dragon fruit juice probiotic drink using *L. paracasei* ssp. *paracasei* Ml.3 at concentrations of 3%, 5%, and 7% for 18 hours. The following factors were analyzed: nutritional adequacy rates, moisture content, ash content, protein, fat, crude fiber content, carbohydrate, sugar, and total dissolved solids. The results showed that the use of culture concentrations of 3%, 5%, and 7% had no significant effect on the dragon fruit juice probiotic drink's chemical characteristics. All fermented products (3%, 5%, and 7%) had an average water content of 81.93–82.56%, an ash content of 0.17–0.19%, protein content of 0.53–1.45%, a fat content of 0.33–0.42%, crude fiber content of 0.24–0.39%, carbohydrate content of 15.10–16%, sugar content of 12–13%, and a total soluble solids content of 16.5–17.2%. The highest antioxidant capacity against ascorbic acid was obtained in the 3% treatment, 94.28 ppm. The product's nutritional adequacy rate meets the criteria set forth for functional foods, where the nutritional adequacy rate number indicates that protein makes up 0.267 kcal (0.133%) of total energy, fat makes up 0.196 kcal (0.049%) of it, and carbohydrates make up 35.474 kcal (2.534%).

Keywords: chemical characteristics, dadih, nutritional adequacy rate, dragon fruit, probiotic drink

1. Introduction

Currently, probiotic drinks are one type of functional food that is highly developed. The probiotic drink uses fresh milk and has been developed in various variants using fruit juice. These products' development cannot be separated from the role of microorganisms, especially lactic acid bacteria. Lactic acid bacteria used can improve human health status. It is because lactic acid bacteria can grow and develop in the human digestive tract so that they can provide beneficial effects on human health. The

health effects of probiotics will be obtained if you consume probiotics with a total of 10^6-10^7 colonies/G [1]. Additionally, the findings of clinical investigations support the positive benefits of probiotics on allergic diseases and gastrointestinal diseases (such as IBS, gastrointestinal disorders, the removal of Helicobacter, inflammatory bowel disease, and diarrheas) (e.g., atopic dermatitis). In numerous clinical investigations, probiotics are useful in treating conditions like obesity, insulin resistance syndrome, type 2 diabetes, and non-alcoholic fatty liver disease [2].

Dadih is one of the traditional fermented foods from the province of West Sumatra. Dadih has great potential to be reused as a starter in making other fermented products, especially those made from milk. It is because the curd contains potential probiotic lactic acid bacteria. The isolates from curd could live at low pH, tolerance to bile salts, and high viability of 10^7- 10^{10} colonies/mL, with a coaggregation value of 36 - 74%. The pathogenic bacteria *E. coli*, Listeria monocytogenes, *S. aureus*, and *B. cereus* could not develop when these isolates produced organic acids from 1.04% to 1.2% lactic acid [3].

It should nonetheless be highlighted that the capacity of lactic acid bacteria in the human digestive tract, particularly probiotic bacteria, needs to be continually maintained. One way that can be used is the encapsulation method, where encapsulation can maintain the viability of probiotic bacteria because it can protect bacteria from unfavorable environmental factors. The materials used for encapsulation differ based on the type of microbe that needs to be enclosed. Lower oral doses of probiotics and microbiota can be used while maintaining effective intestinal transport and release due to the capacity of cellulose sulfate microencapsulation to protect bacteria and yeasts against viability losses caused by stomach acid [4]. The use of 3% carrageenan as an encapsulation in the encapsulation of *L. paracasei* ssp *paracasei* Ml3 was able to maintain viability up to 10.11 log CFU/gr [5]. Additionally, a 2:1 ratio of skim to carrageenan was effective in preserving viability up to 1.97 x 109 cfu/g [6]. In this research, probiotic drinks made with dragon fruit juice were made using encapsulated Lactobacillus paracasei ssp. paracasei Ml3 and their chemical and nutritional qualities were then examined.

2. Materials and Methods

Dragon fruit juice and pasteurized cow's milk are used as raw materials, while probiotic bacteria *L. paracasei* ssp. *paracasei* Ml3 encapsulated is employed as the fermentation starter. This study was carried out in four stages, which are as follows:

2.1. Production of probiotic biomass

Bacteria *L. paracasei* ssp. *paracasei* Ml3 was subcultured and incubated at 37^{o}C, then harvested cell biomass was using a centrifuge at 4500 rpm for 15 minutes [7]. The biomass substrate was then taken out of the liquid, twice rinsed with sterile water, then centrifuged one more for 10 minutes at 3000 rpm [5].

2.2. Production of bio capsule

The production of bio capsules consists of three important steps, namely (1) biomass of *L. paracasei* ssp. *paracasei* Ml3 was made in a suspension with a concentration of 10%, (2) preparation of the encapsulation, namely carrageenan and skim milk in a ratio of 2:1, where the skim milk was pasteurized first, and the carrageenan was dissolved in sterile water. (3) Mix biomass suspension with encapsulated material, which is then put into a syringe and dripped into a sterile 3% KCL solution. The formed biocapsules were stored in the refrigerator (temperature 10^{o}C) for 2 hours, rinsed using physiological saline, and drained [8-10].

2.3. Dragon fruit probiotic drink production

The starter used was biocapsules that had been subcultured again on MRSB media for 24 hours, then 4% (v/v) was re-grown on 10% skimmed media and 5% sucrose (w/v) and incubated for 17 hours at 28^{0}C.

Dragon fruit is mashed with a blender, then added water (2:1), 10% (w/v) skim milk, and 8% (w/v) glucose, then the dragon fruit juice was transferred to a bathing pan to be pasteurized for 15 minutes,

then cooled to 37ºC. Next, dragon fruit juice was put into three glass bottles, then 3%, 5%, and 7% (v/v) starters were inoculated. The product was incubated at 25 – 30ºC for 18 hours. Probiotic fermented dragon fruit juice is homogenized into a probiotic drink by adding a solution of sugar and water in a ratio of 1; 2; 2 [11].

2.4. Analysis of chemical properties of the product

Chemical characteristics include moisture content, ash content, protein, and fat content, total carbohydrates [12], total soluble solids with a hand refractometer, and determination of the nutritional adequacy rate by estimating the carbohydrate content, protein, fat, and energy present in each package based on a 2000 kcal diet.

3. Result and Discussion

The results showed that using culture concentrations of 3%, 5%, and 7% had no significant effect on the dragon fruit juice probiotic drink's chemical characteristics (Figure 1 and Figure 2).

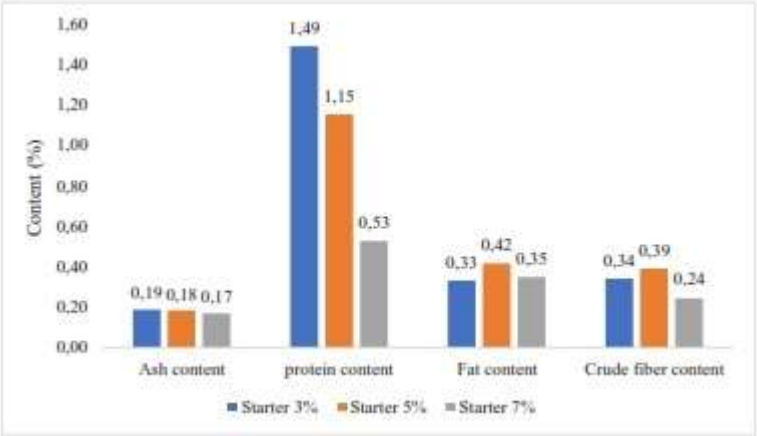

Figure 1. Chemical characteristics of dragon fruit juice probiotic drinks

All fermented products (3%, 5%, and 7%) had an average water content of 81.93 to 82.56%, ash content of 0.17 - 0.19 %, protein content of 0.53 - 1.45 %, fat content of 0.33 - 0.42%, crude fiber content of 0.24 - 0.39 %, carbohydrate content of 15.10 - 16.6 %, sugar content of 12 - 13%, and total soluble solids of 16.5 - 17.2 %

The increase in the number of starters used to manufacture dragon fruit probiotic drinks caused the activity of *Lactobacillus paracasei* ssp. *paracasei* to increase. The starter bacteria's activity increased, but not across the board regarding the product's chemical characteristics. Compared to the starter concentrations of 3% and 5%, the starter concentration of 5% had a more significant effect. The availability of nutrients in the growth medium must support the increase in microbes. It can be indicated that the availability of nutrients in the raw material for making probiotic drinks is insufficient for starters, with a concentration of 7%.

This dragon fruit juice probiotic drink is one of the dragon fruit juice diversification products that can be used as an energy source for consumers. However, this product cannot be used as a staple or the only food consumed because its nutritional content cannot meet all the nutritional needs of humans. Therefore, this product is suitable for use as a by-product only.

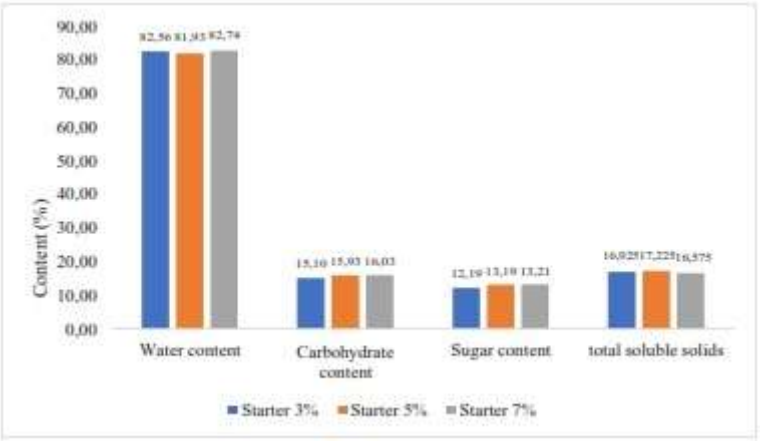

Figure 2. Chemical characteristics of dragon fruit juice probiotic drinks (water content, carbohydrate content, sugar content, and total soluble solids)

Based on the calculation of the nutritional adequacy rate for one pack of dragon fruit juice probiotic drink (100 ml/serving) obtained 35.936 kcal of energy, which comes from protein 0.267 kcal (0.133%), fat 0.196 kcal (0.049%), carbohydrates 35.474 kcal (2.534%). Carbohydrates are the highest source of calories, with 2.534% of the total human calorie need of 1,200 kcal per day. According to a study by [13-15], this probiotic drink produced from dragon fruit juice is considered a low-calorie beverage because it only contains about 100 calories. Additionally, this product is excellent for ingestion by obese persons and those who consistently maintain a healthy weight.

Antioxidant activity is the ability of a product to inhibit the formation of free radicals. The results of this study indicate that dragon fruit probiotic drinks made in several treatments have different antioxidant activities (Figure 3), where the highest antioxidant capacity was obtained in the 3% starter treatment, namely 94.28 ppm; the 5% starter treatment was 76.81 ppm, and the lowest was in the 7% starter treatment, namely 69.47 ppm. It shows that the higher the number of starters used, the lower the antioxidant capacity.

The difference in antioxidant activity was caused by differences in starter activity in utilizing nutrients in the growing medium. As previously stated, the availability of nutrients affects how many seeds are used, which is why it does not correspond to an increase in activity. Dragon fruit juice's antioxidant concentration impacts antioxidant activity, but fermented chemicals, particularly lactic acid, also have an impact.

An increase in antioxidant activity is also associated with increased total lactic acid bacteria, which have high antioxidant activity [16-18]. During the fermentation process, lactic acid levels also continue to increase. The presence of secondary metabolites of bacterial metabolism causes an increase in antioxidant activity. Probiotic bacteria produce antioxidant compounds in the form of vitamin C and vitamin E.

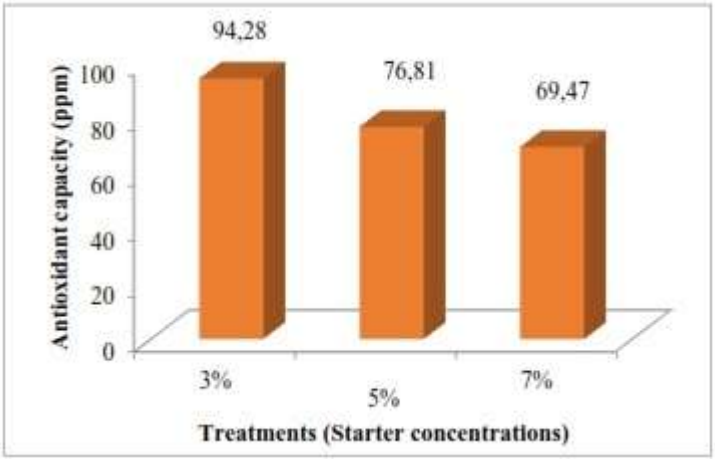

Figure 3. Antioxidant capacity of dragon fruit juice probiotic drinks

Every food item, especially fermented foods, has a unique antioxidant activity. The raw materials utilized and the starter used significantly impact this. One fruit variety with significant antioxidant content in both the pulp and peel is dragon fruit. Beta cyanins and anthocyanins are found in the dragon fruit peel extract, which also has strong enough activity against free radicals [19]. Due to the presence of betalains, which are beneficial for human health, the utilization of dragon fruit peels is advantageous as a waste disposal method and may also be used in producing functional drinks [20, 21].

4. Conclusion

All fermented products (3%, 5%, and 7%) had an average water content of 81.93-82.56%, an ash content of 0.17-0.19%, protein content of 0.53-1.45%, a fat content of 0.33-0.42%, crude fiber content of 0.24-0.39%, carbohydrate content of 15.10-16%, sugar content of 12- 13%, and a total soluble solids content of 16.5-17.2%. The highest antioxidant capacity against ascorbic acid was obtained in the 3% treatment, 94,28 ppm. Dragon fruit juice probiotic drink is potentially classified as a low-calorie diet because this product only has calories of 35,936 kcal per 100 ml.

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