

Characteristics of Fermentation Drink made from Juice of Winged Bean Sprouts (*Psophocarpus tetragonolobus*) and Red Sweet Potato (*Ipomoea batatas*)

Novelina[#], Kesuma Sayuti, and Fitri Nur Rahmadani

Department Agricultural Processing Technology, Agricultural Technology Faculty, Andalas University, West Sumatra, Indonesia
E-mail: [#]novelinasutanto@yahoo.com

Abstract— Fermented milk is a product that was produced from fermentation of fresh milk using lactic acid bacteria, such as *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. A variety of plant materials can also be used as raw material in making of fermentation drinks, such as nuts and tubers. The purpose of this study was to investigate the characteristics of fermentation drink made from juice of winged bean sprout and red sweet potatoes. The treatment in this study is the level of mixing between juice of winged bean sprout with red sweet potatoes, consist of ;A (30:70), B (40:60), C (50:50), D (60:40) and E (70:30). Completely randomized design had been used with 5 treatments and 3 replications. The data collected was pH, viscosity, protein content, fat content, total solids, total acid, ash content, calcium content, total lactic acid bacteria, total plate count and sensory evaluation. Data processing is performed using statistical 8, followed by Tuckey test HSD All-Pair wise Comparisons Test at level of 5%. Mixing of winged bean sprouts with red sweet potato can increase the value of pH, viscosity, protein content, fat content, total solids, total acid, ash content, calcium content, and total lactic acid bacteria. The best product was the product of B (40% winged bean sprout and 60% red sweet potatoes) already meets SNI 7552:2009, contain : 2.36% protein content, fat content of 1.24%, 18.77% total solids, pH was 4, 2, 0.54% total acid, 0.23% ash content, 0.173% calcium content, viscosity was 3.56 DPA, total lactic acid bacteria (CFU / ml) was 1.9×10^{10} , total plate count was 2.1×10^{10} (CFU / ml).

Keywords— weang bean sprout; red sweet potato; fermented drink

I. INTRODUCTION

Winged bean (*Psophocarpus tetragonolobus* L.) is a plant that is rich in protein and carbohydrates. Reference (1) shows all parts of the winged bean plant can be used. Leaves, flowers, and fruit of youth can be used as a vegetable and the tubers are edible.

The seeds of winged bean ripe has not optimally used, as in (2) shows that dry winged seeds ripe are the most nutritious part of the plant, because of the high protein content (30% - 42%) and have good amino acid composition. Winged bean seeds are very rich in the amino acid lysine, but limited to the amino acid cysteine and methionin.

Methionin and cysteine deficiency in winged bean seeds can be covered by combining it with other foods rich in methionin and cysteine. Tubers is one food that is rich in the amino acids methionin and cysteine.

Winged bean seeds not optimally used, it has an unpleasant flavor that is not favored (off flavor), as in (2) the smell of rotten on winged bean seeds caused by the activity of lipoxigenase enzymes that are naturally present in the

beans. Reference (1) shows that germination is one way to eliminate the smell of rotten beans.

Red sweet potatoes are rich in carbohydrates and carotene. One part of the carbohydrates are oligosaccharides, that are a good medium for growing lactic acid bacteria, so the sweet potato can also be used as raw material of fermentation drinks. Reference (3) shows in red sweet potatoes contain 1208 ug/100 g total carotene. It cause the color of the drink become reddish color.

Fermented drink is defined as a result of the fermentation of fresh milk that has been pasteurized by using specific microbial cultures. Fermented milk known as yogurt, has a distinctive sour taste due to bacterial activity of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (4). Yogurt can also be made from the other raw material, like juice of tubers and nuts. The purpose of this study was to analyse the effect of mixing of winged bean sprouts juice and red sweet potatoes juice on the characteristic of fermented drink.

II. METHODOLOGY

The design used in this study was a completely random design (CRD) with 5 treatments and 3 replications. Data processing was done using statistically 8, if the data was significantly different continued by the Tukey HSD test at $\alpha = 5\%$. The Treatment is a comparison of winged bean sprout juice with red sweet potatoes juice.

A. Research procedures is

1) Making of winged bean sprouts (as in 7, the modified)

Winged bean cleaned of impurities such as sand and stone, and then washed by water. Soak the winged bean in water (1:5) for 36 hours then drain and spread it in a hollow basin that has been coated with a wet cloth to keep the seeds moist. Avoid sunlight for germination and cover bowl with a damp cloth surface. Reference (1), winged bean seed germination for 72 hours can decrease the activity of lipoxygenase that cause unpleasant odors.

2) Making of winged bean sprouts juice (as in 7, the modified)

Wash the sprouts from inherent impurities and the epidermis. Boiled at a temperature of 80-90 ° C for 3 min. Then sprouts be drained and then blended until pureed. The amount of water added to the dry winged bean sprout was six times, then filtered and squeezed with filter cloth. Filtered fluid is called the winged bean sprouts raw Juice.

3) Making of Red Sweet Potato juice (as in 9, the modified).

Red sweet potatoes peeled and washed and cut into pieces, washed and put into blender. Added with water as much as twice of sweet potatoes weight and then was blended . Heat the red sweet potato puree at 70 OC for 30 minutes. Put in the room until the temperature of red sweet potato porridge was 45 OC and then filtered the filtrate.

4) Making of Starter (as in 9, the modified)

Winged bean sprouts juice and red sweet potatoes juice (50: 50) added with raw skim milk (w / v) 12%, sucrose (w / v) 5%, xanthan gum (w / v) 0.1%, then pasteurized at 80 ° C for 15 minutes. Then entered into a glass bottle and then cooled at 37 ° C. then inoculated with pure cultures of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* as much as 2%, and fermented at 37 ° C for 24 hours.

5) Making of Fermentation drink made from juice of winged bean sprouts and red sweet potatoes (as in 8, the modified).

Winged bean sprouts juice and juice of red sweet potatoes prepared in according to the treatment., and then was added with skim milk (w / v) 12%, 5% sucrose (w / v), xanthan gum (w / v) 0.1% then heated at 80 OC for 15 minutes and then cooled to 37 C , and Inoculated with 2% (w / v) starter of *Lactobacillus* and *Streptococcus thermophilus* bacillus then fermented at 37 OC for 24 hours.

B. Observation

For starter, consist of total lactic acid bacteria and pH. For fermentation drink made from winged bean sprouts with red sweet potato juice consist of the level of protein, fat, total

solids, pH, total acid, ash, calcium levels, viscosity, total plate count, total lactic acid bacteria, all analyzes refer to (5) and the analyze of organoleptic test including the color, flavor, taste, consistency and appearance refer to (6).

III. RESULT AND DISCUSSION

A. Starter

The observation of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* consist of pH and lactic acid bacteria as shown in Table 1. The starter had been inoculated in the fermentation medium is estimated as 106 CFU / ml of lactic acid bacteria (before fermentation). Reference (5) shows the amount of lactic acid bacteria in the starter at least 1 x 106 CFU / ml. After fermentation is predicted, there is a increasing in the number of lactic acid bacteria.

TABEL 1.
THE OBSERVATION OF STARTER

No	Observation	Value
1	pH starter <i>L. Bulgaricus</i>	3.38
2	pH starter <i>S. Thermophilus</i>	3.63
3	Total Lactic acid bacteria starter <i>L. bulgaricus</i>	8.9 x 10 ⁸ CFU/ml
4	Total Lactic acid bacteria starter <i>L. bulgaricus</i>	3.8 x 10 ⁸ CFU/ml

B. Fermented Drink

Observation of the fermented drink made from a mixture of winged bean sprout juice with sweet potato red juice, consist of the level of protein, fat, total solids, pH, total acid, ash content, calcium content, viscosity, total plate count, and total lactic acid bacteria and sensory evaluation including the color, the taste, flavor, consistency and appearance. The content of amino acid was analyzed in the best product using sensory evaluation.

TABEL 2.
CHEMICAL, PHYSICAL AND MICROBIOLOGICAL ANALYSIS OF
FERMENTED DRINK

Parameter	Value				
	A (30% :70%)	B(40% :60%)	C(50% :50%)	D(60% :40%)	E(70% :30%)
Protein (%)	1,74 a	2,36 ab	3,06 bc	3,85 cd	4,46 d
Fat (%)	0,75 a	1,24 b	1,61 c	2,13 d	2,63 e
Ash (%)	0,20 a	0,23 ab	0,25 ab	0,30 ab	0,33 b
Calcium (%)	0,12	0,17	0,56	0,83	1,08
pH	4,25 a	4,20 ab	4,14 b	4,03 c	3,94 d
Total acid (%)	17,89 a	18,77 b	19,11 c	19,63 d	19,92 e
Total solids (%)	0,51 a	0,54 a	0,59 b	0,62 bc	0,65 c
Viscosity (dpa)	3,03 a	3,56 b	4,50 c	5,23 d	5,63 d
Total BAL (CFU/ml)	1,5 x 10 ¹⁰	1,9 x 10 ¹⁰	2,4 x 10 ¹⁰	2,7 x 10 ¹⁰	2,8 x 10 ¹⁰
Total Plate count (CFU/ml)	1,7 x 10 ¹⁰	2,1 x 10 ¹⁰	2,6 x 10 ¹⁰	2,8 x 10 ¹⁰	2,9 x 10 ¹⁰

The numbers in the same row followed by the same small letters, no significant differently according to Tukey's test at 5% significance level.

Table 2, shows that the winged bean sprouts juice mixed with juice of red sweet potatoes have a significant effect on

the levels of protein, fat, ash content, pH, total acid, total solids and viscosity of fermented drinks produced. The higher the winged bean sprout juice is added, the higher protein content, fat content, ash content, calcium content, total acid, total solids, and the viscosity, but the lower of the pH value.

1) Protein

The main source of protein in the fermented drink derived from winged bean sprouts juice, protein content of winged seeds that mature between 32-41% (1). There are different type of amino acids in protein contained in the fermentation drink, where cultures *Lactobacillus bulgaricus* and *Streptococcus thermophilus* were inoculated will use amino acids to live and proliferate (multiplying).

2) Fat

The main sources of fat in the fermented drink derived from winged bean seeds. Reference (2), besides a high protein, Winged bean seed was also has relatively high fat that is about 15-20%. So, the higher the level of sprouts winged bean juice was added, the higher the level of fat in fermented drink.

3) Total Solids

The ripe winged bean seeds are high in protein and other components that are part of the high total solids. Reference (4) show that decreasing of pH causes the milk proteins coagulate into a solid or condensed period.

3) pH

Increased acidity of the fermented drink is caused there is a change of lactose into lactic acid by lactic acid bacteria inoculated; lactic acid can lower the pH so that it will coagulate milk protein (4). Clumps of protein formed will be used by the lactic acid bacteria as a source of nutrition for the activity and breeding. A high number of bacteria cells have a high ability to metabolize sugar anyway fermentation of media to get energy and produce acid. The more acidic pH produced it will go down.

4) Total Acid

Total acids expressed as lactic acid. Related to the total acid pH value, the higher the value of lactic acid, the lower the pH value. Reference (4) show that lactic acid resulting from the metabolism of carbohydrates will lower the pH value the environment.

5) Ash Content

Ash content is closely related with the minerals contained in the material. Ash content in the fermented drink is influenced by substrate red winged bean, sweet potatoes, and skim milk. Reference (2) shows, winged bean contain 3.3 to 4.3% ash which consists of several types of minerals such as calcium, magnesium, phosphorus and iron. Furthermore Hidayat et al., (2006) mentioned that yams contain 0.39% ash consist of calcium, iron, magnesium, zinc, and potassium. The higher level of comparison winged bean sprout juice added, the higher ash content of the fermented drink.

6) Calcium levels

Winged bean and sweet potatoes contain calcium. The level of calcium is related with ash content. The higher the ash content, the calcium levels are also high. Table 8 shows that the higher the ratio of winged bean sprout juice is added, the higher calcium level. Function of calcium (lime) for the body is for the formation of bones, teeth formation, growth, blood clotting and muscle contraction (12)

7) Viscosity

Viscosity has a proportional relationship to the total solids; the higher winged bean sprouts added, the higher the viscosity of fermented drinks. The texture of the fermented drink is thick that was occurs because of denaturation of the protein of raw materials. It is one of the major components of the total solids. Reference (10) shows denaturation of the protein clots that cause fermentation product becomes thick.

8) Total Lactic Acid Bacteria

In the making of fermented drinks, total solids have a very important role, that is as a source of nutrition for the activity and proliferation of bacteria, the higher total lactic acid, the higher the total solids in fermented drinks, besides the total solids is also important to establish the texture and flavor components of the fermentation products (11).

Increasing of cell number during fermentation is due to the growth of lactic acid bacteria. Adequate availability of nutrients in the substrate will be utilized by BAL to grow and thrive, as in (11) shown that availability of the nutrients is needed to increase the number of bacteria high bacterial cells.

9) Total Plate Count

Total plate count in each treatment equal to the total lactic acid bacteria that is are both powers of 10, it means the products produced there are no contaminants. Reference (4) mention the use of LAB fermented milk can prevent cell multiplication of pathogenic bacteria, these lactic acid bacteria can against pathogenic microbes, that is pathogenic bacteria can not grow or grow very slowly at pH 4.6.

10) Organoleptic Test

Organoleptic test of the fermented drink made from a mixture of winged bean sprout juice with the juice of red sweet potatoes is shown in Figure 1.

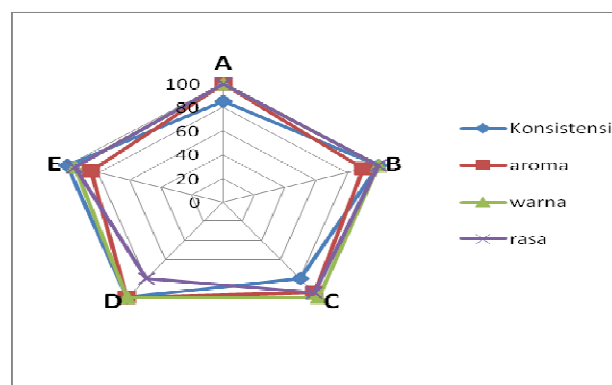


Fig 1. Radar Graph of the percentage of panelists who expressed disliking of the products

Appearance

In general appearance fermented drinks is acceptable 100% by the panelists. If viewed from favorite of the panelists, treatment B has a preference level of 90% (liked 60% level, and really liked 30%). So it can be concluded that treatment B is a fermented drink with the percentage of revenue and the highest percentage compared to treatment A.

The *tekstur* was lumpy, it is due to protein clotting from raw materials and proteins from skim milk. Reference (4) shows, during the fermentation, bacteria will break down lactose (milk sugar) into lactic acid. This will increase the acidity of the environment that causes the milk proteins to be solid or viscous.

Consistency

Consistency of fermentation drinks made from a mixture of winged bean sprout juice with red sweet potato juice can be accepted by panelists with percentages ranging from 80-100%. Highest percentage of acceptance toward consistency found in treatments B, D, E that is respectively 100%. Consistency of fermented drinks can be also caused by coagulation proteins at low pH.

Flavor

Fifty percent of the panelists liked A product (liked 45% and really liked 5%). Getting higher the number of winged bean sprout juice is added, getting less flavored the product, it is associated with a slightly sour smell and unpleasant odor of cooked winged bean

Color

Eighty four percent of the panelists liked A and B product (liked 75% and really liked 10%). Increasing number of winged bean sprout juice is added, getting less flavored the product, it is associated with a slightly sour smell and unpleasant odor of cooked winged bean

The color of the fermented drink is orange to pale yellow. The higher of the level of red sweet potato, the color become orange. Red sweet potato has a distinctive taste and rich in carotenoid pigments that can be natural dyes.

Taste

Fifty percent of the panelist liked B product (liked 45% and really liked 10%). Taste of the drinks made from a mixture of winged bean sprouts with red sweet potato has a sweet and sour taste. Sweet taste in fermented drinks is not only produced from sucrose were added, but it also comes from the juice of red sweet potatoes. Reference (4) shows distinctive sour taste is caused by bacteria *Lactobacillus bulgaricus* and *Streptococcus thermophilus* that breaks down lactose into lactic acid.

Amino acid

Based on all of the testing that has been done shows that B product is the best product (winged bean sprouts juice 40%: red sweet potato juice 60%). The most preferred product using sensory evaluation and has fulfilled the requirements as fermented drinks. Amino acid analysis performed on B product using HPLC as shown in the table 3.

TABLE 3.
PROTEIN CONTENT AND AMINO ACID IN FERMENTED DRINK

Parameter	Value	Parameter	Value
Protein	21.7	Alanine	0.4
Aspartic acid	1.1	Tyrosine	n.d
Glutamic acid	2.0	Methionine	0.2
Serine	0,5	Valine	0.5
Histidine	0,2	Phenylalanine	0.6
Glycine	1.8	Heucine	0.5
Threonine	1.3	Leucine	0.9
Arginine	0.4	Lysine	0.7

IV. CONCLUSIONS

Mixing of winged bean sprouts juice with red sweet potato juice can increase the value of pH, viscosity (DPA), protein content (%), fat content (%), total solids (%), total acid (%), ash content (%), calcium levels (%), total lactic acid bacteria (CFU / ml), and total plate count (CFU / ml). B product (winged bean sprouts juice 40%: red sweet potato juice 60%) meets the requirements as in (5) that are protein content of 2.36%, 1.24% fat, 18.77% total solids, pH 4, 2, total acid 0.54%, 0.23% ash, 0.17% calcium, 3.56 dPa.S viscosity, total 1.9×10^{10} lactic acid bacteria (CFU / ml), total plate count 2×10^{10} (CFU / ml) and B product was the best product.

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