토마토 주스의 미생물 발효 산도 특성에 관한 연구

A Study on the pH Characterization for Microbial Fermentation in Tomato Juice

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〈Abstract〉

This study was conducted to know the behavior of pH behavior in the tomato juices to find out an effective medium for microbial cultivation. Bacterial culture media is a material consist a mixture of nutrients used to grow microorganisms on or in it. In addition, microbial culture media can also be used for isolation, propagation, testing the nature physiological, and calculation of the number of microorganisms. Fresh tomato juice is used for basic ingredient, therein added salt, sugar and EM (Effective Microbial). The fermented solution placed in a room with a temperature of 40oC. Data retrieval before the pH value reached a constant value is done every 12 hours, after constant rate data collection was done every 24 hours. The pH value has been steady after 372 hours of fermentation process (15.5 days). From the results obtained that the amount of additional ingredient which added into tomato juice does not affect final pH value of solution. Thereby the most effective treatment for microbial cultivation media is treatment number four.

Keywords : pH characteristic, sugar, brix, fruit fermentation, microbial growth, tomato juice

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1. INTRODUCTION

Vegetables and fruits are fundamental sources of water-soluble vitamins (vitamin C and group B vitamins), pro vitamin A, phytosterols, dietary fibers, minerals and phytochemicals for the human diet. Scientific evidences encouraged the consumption of vegetables and fruits to prevent chronic pathologies such as hypertension, coronary heart diseases and the risk of stroke (Gebbers, 2007). Unfortunately, the daily intake of vegetables and fruits is estimated to be lower than the doses (400 g, excluding potatoes and other starchy tubers) recommended by the World Health Organization (WHO), and Food and Agriculture Organization (FAO) (He et al., 2007).

The consumer trend towards fresh like, highly nutritional value, health promoting and rich flavor ready-to-eat or -to-drink foods and beverages is increasing (Endrizzi et al., 2006). Lactic acid fermentation is considered as the simple and valuable biotechnology to keep and/or enhance the safety, nutritional, sensory and shelf life properties of vegetables and fruits (Demir et al., 2006). As shown in the last decade literature data, the combination of this ancient method of bio-preservation with the current biotechnology tools should allow controlled fermentation processes and the selection of starter cultures to increase the consumption of fresh-like vegetables and fruits (McFeeters, 2004).

Fermented feed is characterized by high numbers of lactic acid bacteria, high number of yeast, a low pH and high concentration of lactic acid. Various sources of raw food materials can be fermented by either direct microbial inoculation in diets or of milk based source (Hølund, 1993). However, the effects of fermented fruits (FF) with mixture of lactobacilli cultures as additive in the diet have not been investigated. Fermented feed has been shown to have a bactericidal effect on pathogen such as salmonella and enterobacteriaceae (Urlings et al., 1993).

Lactic acid bacteria are generally mesophilic but can grow at temperatures as low as 5° C or as high as 45° C. Similarly, while the majority of strains grow at pH 4-4.5, some are active at pH 9.6 and others at pH 3.2. Strains are general weakly proteolytic and lipolytic and require preformed amino acids, purine and pyrimidine bases and B vitamins for growth (Stamers, 1976: Cogan and Hill, 1993) on overview of the lactic acid bacteria is presented in the texts edited by Wood and Holzapfel (1996) and Salminen and von Wright (1998) and the reader is directed to these sources for informations relating to

aspect such as taxonomy, biochemistry, physiology, ecology and applications.

2. MATERIALS AND METHODES

2.1 Effective Microbial (EM)

Fig. 1 Microbial powder produced by MIEL

EM (MIEL, Miryang, South Korea) were used contains several types of microbes that has a function as a starter in the fermentation process. In the EM containings L. acidophilus, L. bulgaricus, L. casei, L. fermentum, L. paracasei, L. plantarum, L. rhamsosus, L. reuteri, Bifidobacterium bifidum, Bifidobacterium breve, Bifidobacterium longum, Streptococcus thermophiles. The numbers of L. plantarum in the EM powders are the most dominant.

2.2 Fruit solution

This study used 5 kinds of treatments, each treatment has a different amount and ratio of ingredients. The outline of this research was used tomato juice as the main ingredient and salt, sugar and EM (effective microbial) as supplementary ingredient. Composition of materials that was used to make a solution is presented in Table 1 below.

Table. 1 Composition of the materials used in this study.

No.	Fruits (g)	Salt (g)	Sugar (g)	EM (g)
1	300	0.3	3	0.3
2	300	-	3	0.3
3	300	0.3	-	0.3
4	300	0.6	6	0.6
5	300	0.15	1.5	0.15

2.3 Storage conditions

Solution placed in a room with a temperature about 40° C. After the pH value indicates of 3 values, the solution placed outdoors. The pH value measured every 12 hours per day, coinciding with the sample placed outdoors pH measurement conducted every 24 hours.

2.4 pH measurement

Measured pH value was used pH meter (SATO, Japan). The device used is pH meter type sk-620PH, this device can measuring the pH with a value of 0-14. Figure of the pH meter that used for data collection can be seen in Fig. 2 below. The device is organized into two parts, the rod sensor and controller devices. Rod sensors used to detect pH value of the solution, to detect pH the tip of rod sensor should be dipped in the solution. Controller device is equipped with a monitor for monitoring the pH value and the controlled button for calibration device. After being used to test the pH value of the solution, this device needs to be neutralized using water or distilled water with pH values is known.

Fig. 2 pH meter

2.5 Brix measurement

Sugar content in the tomato juice was measured using a refractometer (type: Master-53M, capacity: 0.0-53%, ATAGO, Japan). Refractometer is designed to measure the refractive index of a solution. The Brix scale based on sucrose (sugar) and water solution. This refractometer needs to be calibrated before being used for the first time each day.

Fig. 3 Refractometer

2.6 Microbes analyses

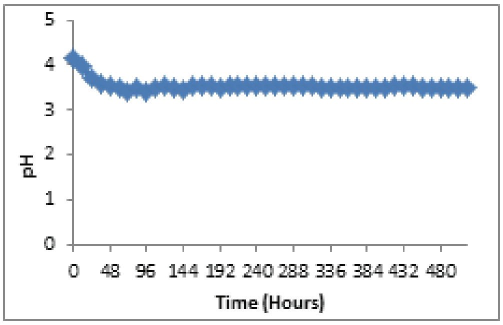
The microscope used is an inverted optically microscope (Nikon, Japan) connected with computer device. The device that used to determine the microbial growth is microscope TS100LED ECLIPSE MV that has been equipped with camera and arranged with computer devices (Samsung, South Korea) to simplify the process of observation. The microscope used in the study as shown in Fig. 4 below.

Fig. 4 Optically microscope with computer device

3. RESULT AND DISCUSSION

3.1 Brix(sugar levels) behavior in the tomato juices during fermentation process

In the process of tomato juice fermentation, the amount of sugar which put in a solution affect the length of time required to achieve a steady period. The development of sugar in the tomato juice during fermentation process is presented in Fig. 5.



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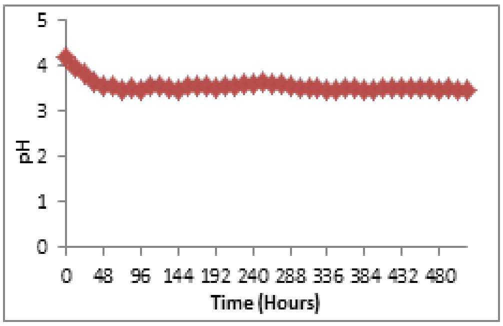

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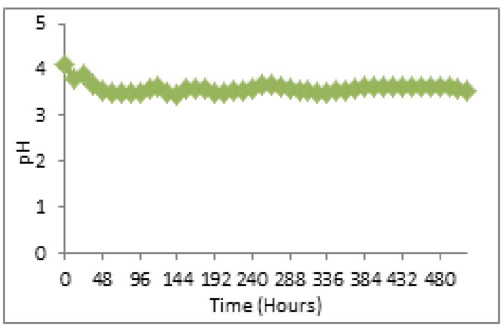

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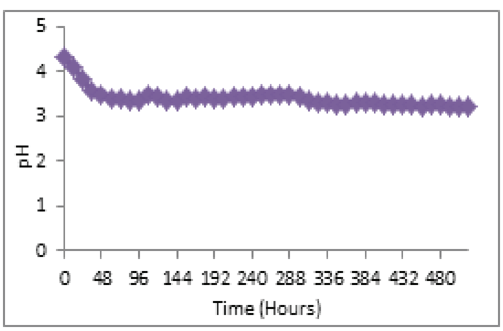

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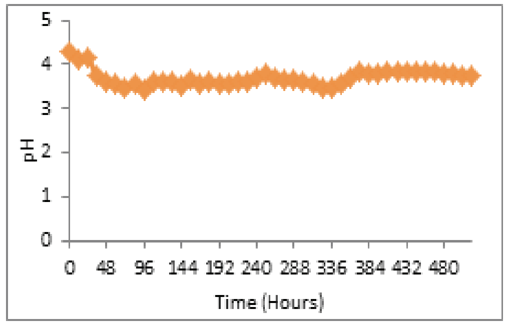

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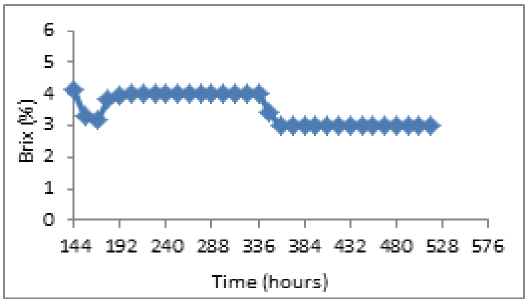
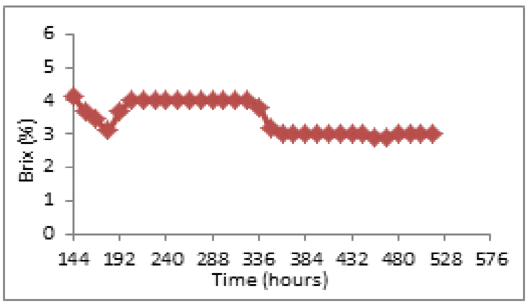
Fig. 5 Brix behavior in the tomato juice during fermentation process; (a) treatment 1, (b) treatment 2, (c) treatment 3, (d) treatment 4, and (e) treatment 5.

In Fig. 5 appears that during the fermentation process, sugar levels in tomato juice reaches stability after 378 hours of fermentation process (± 16 days). The highest level of sugar content in the tomato juice (5.33%) was achieved by tomato juice with treatment number 4. A high level of sugar is due to the addition of sugar to the treatment number 4, the addition of sugar in this treatment more than the other treatments (6g of sugar). For treatment numbers 1 and 2, which is used as much as 3g of sugar, and for the treatment 5 the amount of sugar which is used as much as 1.5g. However, giving a different amount of sugar in to tomato juices with treatment number 1, 2 and 5 had no effect on the value of the constant brix. Tomato juices with treatment numbers 1, 2 and 3 have the same constant brix value, it is about 3%. Tomato juice which has the lowest sugar levels is tomato juice with treatment number 3, the addition of sugars is not conducted on this treatment.

3.2 pH behavior in the tomato juices during fermentation process



(a)



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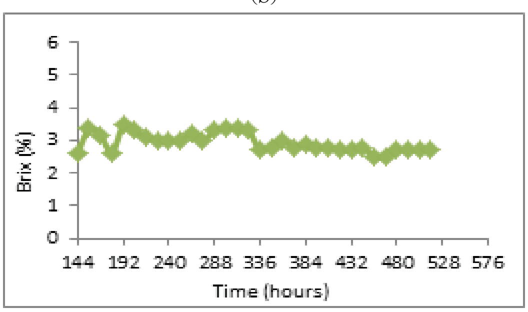

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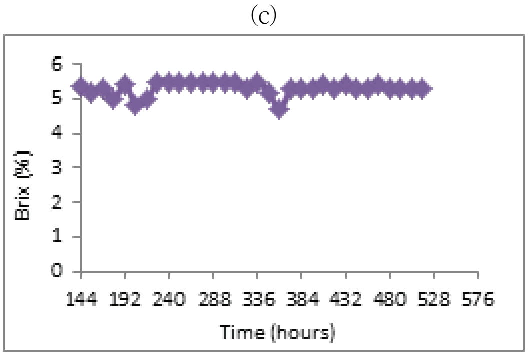

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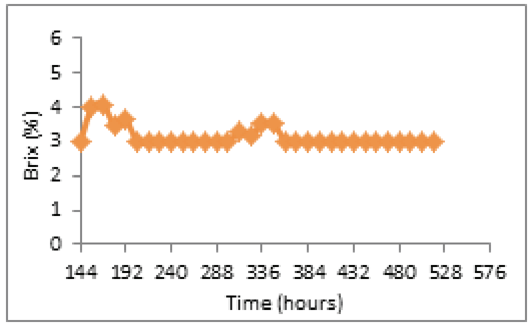


(e)

Fig. 6 pH behavior in the tomato juice during fermentation process ; (a) treatment 1, (b) treatment 2, (c) treatment 3, (d) treatment 4, and (e) treatment 5.

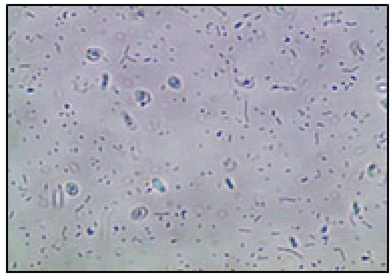
The development of pH or acidity value in tomato juice during fermentation process can be seen in Fig. 6. Initial pH value ranged from pH 4, after fermentation process begins over 54 hours (±3 days) pH value decreased to pH 3.5. The pH value of 3.5 in tomato juice is stable up to 342 hours fermentation process (±15 days). After 15 days, the pH value in treatment number 1 and 2 experienced a constant period at pH 3.5. While for the pH value in the treatment number 3 increased up to pH 3.61. Treatment number 4 and 5 experienced a significant change in the pH value, treatment number 4 decreased to 3.25 while for treatment number 5 increased to 3.80.

3.3 Microbial analysis using inverted microscope

After the end of fermentation process, tomato juice was observed under the microscope. The observation using the microscope is presented in Fig. 6. In the Fig. 6, the number of microbial that seen in the treatment with number 3 and 2 are less than the other treatments.

Level of sugar in the tomato juices with treatments number 2 and 3 ranging from 2.85%, and pH value ranging from 3,55 in the constant period. The amounts of sugars in both treatments are less than the other treatments. The number of microbial contained in the tomato juice is influenced by the levels of sugar, salt and pH value. From the images taken by the microscope, it can be seen that the lower of sugar content in the tomato juice microbial capable of growing too little. In the developing process, microbial need sugars as a source of nutrients to support metabolism process. Giving sugars and salt which limited to a few treatments with numbers 2 and 3 resulted in microbial metabolic processes do not last long. Whereas for treatments numbers 1, 4 and 5, giving sugars, and salt which enough to make the microbial in the tomato juice is able to thrive in a long time.

(a)



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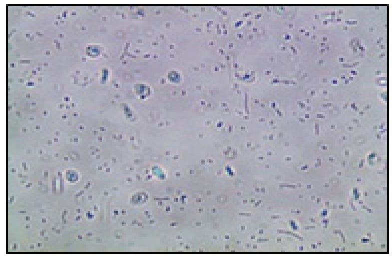

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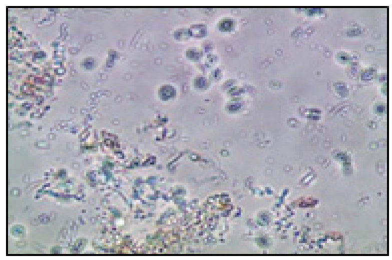

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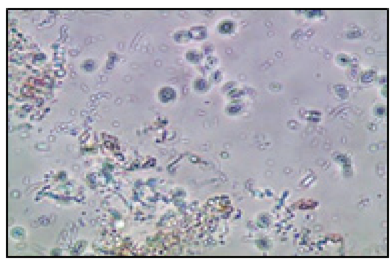

(e)

Fig. 7 The appearance of microbial captured before the fermentation process finished; a) treatment 1; b) treatment 2; c) treatment 3; d) treatment 4; e) treatment 5

3. CONCLUSION

From this research, it can be concluded that the pH value in the treatment number 4 decreased to 3.25 while for the treatment number 5 increased to 3.80. The amount of sugar that used in this research influence the development of microbial, in the tomato juice with treatment number 4 microbial grow more rapidly than tomato juice with another treatments, it is due to the large number of sugar used. The highest level of sugar content in the tomato juice (5.33%) was achieved by tomato juice with treatment number 4. Based on microbial growth, the best treatment is the treatment number 4, while for the efficiency of the amount of material, the recommended treatment is the treatment number 4.

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