Application of agroindustrial organic yard for organic vegetable cultivation

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Abstract. The availability of organic vegetables is still low because it needs a quite large yard to cultivate. The system of organic yard utilizes the available yard as a place to cultivate organic vegetables. The application of organic yard aims to increase the total production of organic vegetables with a very limited yard, and even it can be applied in the home yard. The method that uses to apply organic yard is counseling and coaching how to apply organic yard to people society as the target. The output of organic yard is the availability of organic vegetables which can be marketed as fresh or processed vegetable products. A housewife can apply this method to supply the daily needs of organic vegetables as an application of organic healthy lifestyle.

Keywords: Organic yard, vegetable, agroindustry

1. Introduction
The organic farm is one of many answers to supply healthy and safe food. The organic farming system is planted cultivation without chemical material added such as fertilizer, pesticide, and other chemical compounds. People nowadays start to apply a healthy lifestyle, so organic farm cultivation is important to concern [1]. This consumer preference will increase the demand for organic farming products [2].

The organic yard is one of organic farming engineering results, which utilize the house yard to plant organic vegetables. Organic yard can be one solution to increase organic vegetable availability for daily family consumption.

The application of organic vegetable cultivation in the house yard has to obey the Indonesian organic farm standard which is ruled in SNI number 6729:2016. Soil which uses as growing media derived from non-contaminated inorganic chemical soil. Materials that are allowed to use as soil fertilizer can be seen in table 1. Optimizing in-situ utilization of nutrients in the organic vegetable cultivation yard can be done in many ways such as barrier plants that can be used as green fertilizer and compost. Organic fertilizer from manure waste can be used from organic stockbreeding which composted [1].

This research will use vegetable seeds that will seed in the house yard. The seeds which use in this research are tomato, chili, cucumber, and Chinese cabbage. The crops of vegetables will be used as kimchi and pickle main materials.
Vegetable crops commonly process into simple products to eat. Kimchi and pickle are samples of processed vegetables which are process easily by fermentation with salt, sugar, and/or other ingredients added necessarily. Organic yard crops can be utilized as the raw material of kimchi and pickle. This paper research aims to applicate kimchi and pickle to optimize organic crops into a long shelf-life product and to increase the vegetable product value.

**Table 1.** List of allowing material in organic cultivation.

| No. | Material                               | Information                                                                 |
|-----|----------------------------------------|-----------------------------------------------------------------------------|
| 1.  | Green fertilizer                       | Turi, lamtoro, sesbania, orok–orok, and legumes.                            |
| 2.  | Livestock manure                       | Made of organic livestock waste. Factory farming can be composted for two weeks. |
| 3.  | Livestock urine                        | Made of organic livestock liquid waste, can be applied after fermented and diluted. |
| 4.  | Plant residue                          | It can be used in organic farming.                                          |
| 5.  | Straw mushroom compost media           | It can be used in media and straw made of organic farming.                  |
| 6.  | Organic vegetable waste                | It can be used in organic farming.                                          |
| 7.  | Green algae                            | It can be used in media and straw made of organic farming.                  |
| 8.  | Azolla                                 | Natural source of nitrogen                                                 |
| 9.  | Blue-green algae                       | Natural source of nitrogen                                                 |
| 10. | Molasses                               | Organic material which added in compost making                            |
| 11. | Organic fertilizer                     | Local Non-GMO mikroorganisme                                                |
| 12. | Rhizobium                              | Nitrogen enhancer microorganisms which are symbiosis with roots of legume plants |
| 13. | Decomposer                             | Non-GMO                                                                     |
| 14. | Natural ZPT                            | Not made of synthetic ZPT                                                   |

(Source: [1])

Kimchi is one of the pickled products which is the most popular in Korea. Kimchi is made of vegetables with a fermentation process and spicy seasoning addition. Kimchi is made by washing vegetables and salting. All parts of the vegetable must be submerged by salt water to prevent the growth of other unwanted microorganisms, then fermented vegetables are mixed with seasoning. Pickle is one of the fermented product. Pickle is the product of processing fruit or vegetables using salt and preserved with acid, with or without adding sugar and spices as a spice.

**2. Research methods**

Kimchi will be made in two variances, which are Chinese cabbage kimchi and cucumber kimchi. Additional ingredients used to make kimchi are salt, chili powder, sugar, ginger, garlic, onion, and fish sauce. Kimchi will be fermented for 48 hours at room temperature.

Tomato and chili will be used as pickle main ingredients. Pickle was fermented by sugar and salt solution added. The vegetable is put in the sterilized jar, sugar and salt solution is inserted into the jar, then close the jar tightly. Pickle will be fermented for 14 days at room temperature.

All fermented products will be analyzed in the laboratory to know the quality of the products. Responses which will be tested are organoleptic, chemical, and microbiological characteristic such as antioxidant activity, lactic acid, vitamin C, acidity, and total microbes of the products. The data from analyst computed with randomize group design method to know the correlation between factors that have determined before.
3. Results and discussions

3.1. Kimchi

3.1.1. Taste. The higher the concentration of salt and two-day fermentation the higher the cucumber kimchi taste value. Salt can give salty taste in sensory. Too long fermentation time can cause dislike taste which is disliked by the panelists. The higher concentration of salt can increase product saltiness and lactic acid content formed by the fermentation process. Growth of lactic acid bacteria during fermentation will make several changes in products that can limit the growth of pathogenic microbes, inhibit product decay, and produce various special flavors made by organic acid accumulation, so that is obtained final results product which is different from raw materials [3].

3.1.2. Textur. Different times of fermentation can give different cucumber kimchi texture in the sensory score. Microbe which is caused softening in cucumber kimchi texture is not grown in large amount on two days of fermentation because it is in adaptation phase, but in four days of fermentation microbe starts developing in logarithmic phase, and in six days of fermentation microbe starts stationary phase which the growth of microbe is not grown significantly, so the softening of cucumber kimchi texture will get different scores [4].

3.1.3. Aroma. Different time of fermentation can give different aroma responses of cucumber kimchi. The smell of cucumber kimchi is obtained from lactic acid content which is affected by nutrients and proteolytic microbes. Enterobacter and flavobacterium will grow first in the fermentation process. They will create acid odor excessively which is not significantly different from other long fermentation times [4].

3.1.4. Total microbe. The length of fermentation time the higher of the total microbe which contains in cucumber kimchi. Total microbe enhancement from the different varieties of fermentation time will increase differently because the total microbe in the first stage of fermentation is still low. Commonly the total microbe population will continue to grow because one type of microbe population which has been destroyed will be replaced with other microbe populations that are more suitable to grow in that situation. The enhancement of total microbe during the fermentation process, allegedly because the condition of substrate is still possible for the microbe to carry out their metabolic activities even in a small level, however, at a certain time of fermentation, the bacteria activities will decrease again because it is hampered by acid production [5]. The enhancement of total lactic acid bacteria is caused by a long time of fermentation, so the total microbe that grows and evolves will be more and more. It will increase the total microbe of products. This situation is directly proportional to total lactic acid results which tell that the higher of acidity the higher of total microbe colony growth because total acid comes from microbe metabolism results.

3.1.5. Water content. The water content result showed that the higher the concentration of salt solution added, the lower the water content of cucumber kimchi. Salt has higher osmotic pressure, so the pressure differential caused by salt will absorb the water content in the material until the equilibrium point between them. Rochima (2005) said that during the fermentation process there was degradation of water content because the equilibrium of the product has disturbed [6]. Salt will absorb water of the product then sign in to the system of product, so water content will be decreased. Herawati (2008) appended that water content on food material not only affected the chemical changes but also determined the total microbe on the product [7]. Salt has a hygroscopic characteristic which means that salt absorbed water easily. Therefore, the water content of cucumber kimchi will be decreased after the fermentation process.
3.1.6. Vitamin C. Vitamin C is one of the vitamin groups that can dissolve in water, so the longer the time of fermentation, the lower vitamin C content on cucumber kimchi. The damage of vitamin C on cucumber kimchi can be caused because during the fermentation process there is a loss of carbon dioxide gas where it can prevent the damage of vitamin C through the formation of anaerobic conditions. Four-day and six-day fermentation did not give significantly different because the damage of vitamin C can be prevented by the acid condition. In that situation, cucumber kimchi already in an acid condition which will decrease the damage of vitamin C. Ramdan (2007) said that from all vitamin that contains in food material, Vitamin C can be damaged easily [4]. Vitamin C easily oxidizes, and that process can be accelerated by high temperature, ray, alkali enzyme, oxidizer, and catalyst (Cu and Fe). Oxidation will be hampered if Vitamin C saved in acid and low temperature. Two-day, four-day, and six-day fermentation is decreased because of the oxidation of water. Vitamin C will be oxidized by oxygen by giving 2 electrons to the oxidizer. Vitamin C might be utilized by a microbe in the metabolism process so that the percentage of vitamin C in the product decreased. Pusplitasari (2017) said that CO2 will react and form ascorbic acid (vitamin C) with water [8]. The longer time of fermentation will spend sugar content so that vitamin C content will be decreased until the optimum value because microorganisms have run out of food.

3.1.7. Lactic acid content. The concentration of salt and different time of fermentation give a different score of cucumber kimchi lactic acid. Mijayani (2008) said that total acid increased along with fermentation duration [9]. Long-time fermentation will give the microbe the chance to fermented longer and change the substrate from carbohydrate into lactic acid. Misgiyarti (2002) said that lactic acid produced by lactic acid bacteria (LAB) will be secreted outside the cell and accumulated, so it will increase acidity [10]. The bacteria group which grew first was Leconostoc mesenteroides which produced lower sour than other groups of bacteria. This group will grow naturally in fermented cucumber and make an ideal environment situation. When total acid which produced increased, this group growth will be hampered. Pederson (1979) [11] told that there was another growth of LAB named Laktobacilus Brevis which produced higher lactic acid (0.4–0.6%). Next stage more resistant bacteria will grow, named Lactobacillus Plantarum. This group produced higher lactic acid than Lactobacillus Brevis. Fermentation continues with Pediococcus cerevisiae grew which produced twice higher lactic acid than Leconostoc mesenteroides. Lactobacillus Plantarum produced lactic acid and Lactobacilus Brevis completed the fermentation. The highest lactic acid content in this research was 0.63% with six days of fermentation. This is higher than research conducted by Lestari (2016) [12] which told that the higher lactic acid was 0.57% with seven days of fermentation and 2% of salt concentration in 20 °C. The time differential fermentation and salt concentration were two of the factors which determine the lactic acid percentage. The higher concentrations of salt and the longer the time of fermentation, the higher the percentage of lactic acid on products.

3.1.8. Antioxidant activity. Analysis result of antioxidant activity in this research was known that cucumber kimchi had 93871.21 mg/L of antioxidant value. Antioxidant activity stated in percent inhibition to know the value of IC50, which was the concentration value of the material that can hamper 50% DPPH activity. A lower IC50 showed that the product had high antioxidant activity [13] (Molyneux, 2004). Strong antioxidant has alpha-tocopherol with 5.1 mg/L of IC50 value. Medium antioxidant has 48.6 mg/L of IC50 [14].

3.2. Pickel

3.2.1. Taste. Different concentrations of sugar will affect the taste of pickles. Sucrose acts as a nutrient for lactic acid bacteria growth, so sugar is an important ingredient in pickle fermentation. Commonly pickle tasted acid which produced by lactic acid bacteria contained in a pickle. Lactic acid
which has been produced influenced by substrate composition, so a higher amount of sugar added will make pickle more acidic.

3.2.2. Texture. Different concentrations of salt will affect the texture of pickles. The salting process is an important section in the pickle fermentation process. The salt solution serves to remove liquid from the material due to the osmosis process. When liquid material out, the salt will be absorbed, so products become firm and crunchy [15]. Salt has a more important part in forming a texture of pickle than sugar.

3.2.3. Aroma. Different concentrations of salt will affect the aroma of a pickle. Lactic acid-forming and volatile components can provide acidic taste and aroma in a fermented pickle. The type of bacteria that plays a role in the formation of aroma is Lactobacillus, while other bacteria play a role in producing taste. Tomato has volatile components which are carboxyl, ester, lactone, acetal, ketal, and sulphur [16].

3.2.4. Lactic acid content. Pickle is made by spontaneous fermentation, which is fermentation without microorganism starter addition, but it utilizes natural microorganisms that grow spontaneously because the environment is suitable for producing lactic acid and acetic acid [17]. The fermentation process of pickles will produce lactic acid. Pickle had 1.06% of lactic acid which tested by laboratory analysis. That percentage is appropriate with pickle standard in SNI No. 01–2600–1992 which stated that pickle contained 1–2% of lactic acid. The total of lactic acid bacteria is directly proportional to the fermentation period. The enhancement of total lactic acid bacteria during the fermentation process is caused by substrate allow the metabolism of LAB (Abdarianzah, 2014). Bacteria growth will be decreased because of environmental changing during the fermentation, produced acidity situation, so bacteria growth will be hampered [18]. A total of 0.8–2% of acidity that has been produced stated as lactic acid in 5–15% salt solution. That situation will make only lactic acid bacteria growth [15]. Pickle fermentation is a heterofermentative fermentation type, which produces lactic acid, alcohol, and CO₂.

3.2.5. Vitamin C. Tomato as a raw material has 40% of vitamin C, while tomato pickle contains 62.97 mg/100 mL of vitamin C. Fermentation can affect the vitamin C content of pickle products.

3.2.6. Acidity. Tomato pickle had 1.95 of acidity, including the category of very acidic. Tomato itself had 3.34 of acidity. Lactic acid which was produced in pickle fermentation can demote acidity. Pickle was made by the addition of a higher concentration of salt solution than vegetable sauerkraut, which used 10–15% of a salt solution commonly. Lactic acid had the bactericidal effect which demoted the pH of solution into 3–4.5. This condition will hold up decay bacteria [18]. The use of carbohydrate sources greatly affects the final pH of fermentation. The higher the lactic acid content, the lower the pickle pH produced [19].

3.2.7. Total microbe. Tomato pickle which had been analyzed had 5.7 × 10³ CFU/mL of total microbes. Vegetable fermentation commonly uses lactic acid bacteria. The period of fermentation time influences the group of microorganisms that grow [20]. The temperature during the fermentation process determines the type of dominant microbes that will grow. Lactic acid bacteria are the homofermentative group that will produce lactic acid, CO₂, acetic acid, and ethanol. Examples of the bacteria group are Lactobacillus Brevis and Leuconostoc mesenteroides [15].

4. Conclusion
House yard can be utilized in organic farm cultivation. Maintenance of organic plants is chemical-free, without pesticide and chemical fertilizer, so this can give a healthy impact. Organic yard crops can be processed into some types of products such as juice, pickle, kimchi, and others. Kimchi was made by
vegetables fermented, and so do pickles. Panelists told that kimchi and pickle, which have been analyzed in this research has acceptable organoleptic value, high vitamin C, high antioxidant activity, acceptable total microbe, and strong acidity. The process of organic crops can increase product value and make product shelf-life longer.

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