Physic-Organoleptic Characteristics of Fermented Vegetable Juice in Different Level of Garlic

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Abstract. Allicin, an active compound of garlic and lactic acid bacteria (LAB) derived from the fermented cabbage and Chinese cabbages were reported provide positive effects to control the gastrointestinal micro-flora. However, interactive effect between Allicin and LAB to the fermented cabbage and Chinese cabbage juices simultaneously was not well defined. To the reason, an effect of addition of garlic in the fermentation process of cabbage and Chinese cabbage on the physic-organoleptic of the juice characteristics was examined. The study was conducted by a completely randomized design with 5 treatments i.e.: 0, 5, 10, 15 and 20% of garlic levels (weight based) and 3 replications of each. Parameters observed were the odor, color, texture, pH fermentation products. The results showed that although it is remained in a good category, the addition of garlic decreased the odor scores (p<0.05). The color and texture scores of fermentation products increased with increasing of the garlic concentration (p<0.05). The acidity of the effluent and substrate increased with the fermentation time (p<0.05), but at the end of the process the pH was relatively equal, that was 3-4 (p>0.05). It was concluded that the addition of garlic was able to improve the fermentation performance of vegetable juices.

Keywords: garlic, characteristics, fermentation, vegetable, juice

1. Introduction

The use of antibiotics in sub-therapeutic doses as antimicrobial growth promoters (AGPs) into the ration feed has been proven effective in improving growth performance, suppressing populations of potentially pathogenic microorganisms and reducing the risk of diseases associated with bacterial pathogens [1]. AGPs generally mixed in poultry feed [2]. However, many of the antimicrobials given to animals are the same as those used to treat the human. Thus giving rise to concerns about the possibility cross resistance and or resistance of some antibiotics to the pathogenic bacteria. Furthermore, it will pose a risk to the possibility of many antibiotics that are currently effective for treating human diseases will not be effective in the future [3,4,5]. An alternative approach to replace sub-therapeutic antibiotics in animal feeding is an administration of the probiotic microorganisms, prebiotic substrates to enrich certain bacterial populations, as well as synbiotics, the combinations of prebiotics and probiotics, and phytogenic- antimicrobial.

Lactic acid bacteria (LABs) have been used in food and feed fermentation[6]. LAB produces various antimicrobial substances and contributes greatly to the nutritional value of the product so that LABs has the potential to become a bio-protective agent that extends product shelf life. Extract of the fermented vegetable waste has been proven to contain Lactic Acid Bacteria (LAB) and it was effectively used in the processing and preservation of the feedstuffs, with the products characterized...
rich in the LAB. It was reported that extracts of fermented vegetable waste can be used to preserve fish meal [7]. Moreover, LABs contained in extracts of fermented vegetable waste has proven effective in improving the microbiological quality of feedstuffs and has the potential to be developed as a probiotic[8,9]. However, the products were still not completely free from pathogenic contaminants. Allicin, that cause of garlic's distinctive smell and taste is a natural compound that contains sulfur with many biological properties. Its use is increasingly popular in the medicine and agriculture, aimed to the discovery and development an alternative drug, as well as the use of natural resources for medicinal and antimicrobial purposes[10,11]. There are various abilities of eyebrows in suppressing the development of pathogenic bacteria, fungi, cancer cells, controlling germination and development of plant roots, thus requiring a broader study to apply to the world of medicine and agriculture [12]

Combining the potency of extract fermented vegetable wastes and garlic is expected to provide synergic effects among probiotics (LABs) and phytoogenic (allicin). Therefore, characterizations the process of fermentation of vegetable waste and garlic need to be studied to find the effective ratio of garlic in the fermentation process as a basis on developing a functional feedstuff to replace the AGPs additives.

2. Materials and Method

The experiment was carried out by a completely randomized design with 5 garlic level treatments of 0, 5, 10, 15 and 20% (weight based) and 3 replications. Fermentation technique of fermented vegetable wastes was conducted referring to other researcher [7] and BPOM [13]. The waste of cabbage, Chinese cabbage and garlic were collected from traditional market. Salt (iodine free) and molasses were support by local suppliers. Seven hundred and fifty gram of vegetable wastes (60% of cabbage and 40% of Chinese cabbage) was chopped into small pieces. The chopped vegetable was mixed with 22.5 g of salt (iodine free), 52.5 g of molasses, and the garlic was added according to the treatments desired. The mixture was blended and homogenized in the juicers for 5 minutes. The juice was put into a fermenter bottle until it was full, and the fermenter was closed tightly. Anaerobic fermentation was carried out in the limited lighting chamber at 25°C of temperature for 7 days and the liquid that flow out was collected into the closed container containing distilled water to prevent contraflow of the air into the fermenter. Change of pH of the effluent was measured every four hours. At the end of fermentation process, the odour, colour and texture were scored by 15 panels, the range of scores given were good (> 6-9), less (>3-6) and poor (0-3). After observation the smell, colour and texture, the substrate was filtered to separate a solid and liquid part of the material and its pH were measured by digital pH meter (Crison pH 25). The liquid obtained was mixed with the effluent to measure final pH of the liquid part.

The characteristics of fermentation were evaluated from the physic-organooleptic performances of the substrate, daily pH of the effluent, and the pH after 7 days of fermentation. Data were analysed by analysis of variance [14].

3. Results and discussion

The results of the experiment showed that garlic significantly decreased the smell score of solid products (p <0.05), but the effect was not shown to the smell of the liquid product. The characteristics of garlic dominate the smell of solid part of products and carry an unpleasant odour, which causes respondents to give a lower score. Unlike the solid, the liquid product the smell of garlic was softly, the product is characterized by the smell of sour and slightly sweet. In general, respondents gave good ratings, namely in the range of scores 6-9. The average reduction of scent of fermentation products in the form of solids follows the equation y = 0.01 x2 – 0.44x + 8.4 (R² = 0.9868), and the liquid pattern follows the equation y = -0.09 x + 8.77 (R² = 0.86). The effect of treatment to the colour scores of solid and liquid products did not show any significant differences (p> 0.05), the product characterized by light brown colour, and the score range was 6-9. The average score of product colour gave the pattern y = -0.06 x2 + 0.18 x + 7.18 (R² = 0.94), while the liquid was y = 0.027 x + 7.38 (R² = 0.79).
The effect of treatment showed that the score of textures of the products of fermentation that treated with high concentration of garlic tends to increase, but statistically was not show any significant differences. The texture of the product was characterized by softies, free-form fungus spots, no lumps. The score of texture gave an equation, $y = 0.36x + 7.25$ ($R^2 = 0.69$).

Changes in pH values of liquid products that observed daily for seven days showed all of the treatments given significant differences in the first day ($p < 0.05$), but the effect was developed in different patterns. As shown in Figure 1 the pH of the effluent decreased rapidly on the first day of observation, and the decrease in pH slowed on the second day until the seventh days. The decrease of pH also slows with the addition of garlic. In the sample with garlic acid, until the 3rd day fermentation the decrease in pH remains large. The pH was relatively unchanged after days 5 to 7. This result indicates an inhibiting process of metabolism as well as the growth of microorganisms by the allisin compound of the onion in the substrate. At the end of fermentation (day 7th), the pH of the substrate was measured. There was no significant difference ($p > 0.05$) among the treatments, the pH were 3.3-4.5 respectively (Figure 2).

The aroma of garlic is caused by the presence of organosulfur compounds in the garlic that is not induced by the fermentation process. The strong odour shown by solid products compared to liquid products shows that the organosulfur compounds are not dissolved in the liquid produced. Garlic contains three times more sulphur than onion. Its taste and burning characteristics are because of the hydrolysis of organosulfur compounds by alliinase enzyme [15]. The alliin is the main organo-sulfur ingredient identified in intact garlic bulbs, as when they are cut or ground, the alliin is changed to allicin by alliinase. The chemical changing of allicin by the heat it yields other sulfur compounds such as ajoenos, vinilditiina and methyl-allyl-trisulfide [16]. The light brown color shows that in this study, the process was normal, there was no decay. The color of the product is influenced by the original ingredients, the colour of the chocolate in this case as a result of the use of molasses. The solid texture also provides a good product description, the absence of lumps and molds, revealing that the fermentation process can run perfectly. The presence of allicin compounds contained in garlic has been shown to be able to control fungal development and does not interfere with the development of lactic acid bacteria. According to Ankri and Mirelman [16] and Leontiev et al. [17], allisin is able to suppress the development of various types of bacteria and fungi, and the antimicrobial properties of allicin refer to their chemical reaction with thiol compounds from enzymes, so that can inactivate essential enzymes. The results of the study generally indicate that the fermentation process is going well, but the pH picture shows the difference in the process. The addition of garlic causes the slowing down of the pH process, but the final pH value produced is equivalent to the previous study [18], which is 3.5-4.5 achieved after 13 days of fermentation. The process of decreasing pH in this study is faster, achieved on 7 days of fermentation. The use of easily digestible carbohydrates, in this case, molasses, is thought to contribute to the provision of energy in the group of lactic acid bacteria, thus developing faster, and acidity is achieved faster. The process of fermentation enhances nutrient accessibility in some foods, detoxifies some other materials, and produced aromatic metabolites that are known to play an important role in bio preservation. In addition to their antimicrobial properties, these aromatic metabolites can also influence the organoleptic characteristics, flavour and aroma profiles of fermented food products [19].

4. Conclusion
It was concluded that administration of garlic up to 20% able to improve the fermentation performance the juice of cabbage and Chinese cabbage. Further evaluation needed to evaluate the number and type of lactic acid bacteria in the solids and liquids to be developed as probiotic sources.

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Figure 1. Daily change of the effluent pH during 7 days

Figure 2. Change of the substrate pH after 7 days fermentation

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