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The Potency of Local Fermented Foods Tape Ketan to Improve The Body's Immune System

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ABSTRACT
Food processed by fermentation can be found in almost every area in Indonesia for example is tape ketan. Tape ketan is a traditional food that comes from fermented glutinous rice. The processing of tape ketan involves tape yeast which contains various kinds of microorganisms. The results of fermentation on tape ketan become a habitat for lactic acid bacteria (LAB) which also acts as probiotic bacteria. The bacteria were Lactobacillus curvatus, L. plantarum, L. fermentum, Pediococcus pentosaceous, Weissella confusa, W. paramesenteroides and, W. kimchii. Consuming foods containing LAB has a positive impact because it can increase the body's immune system. The LAB mechanism in enhancing the body's immune system is to maintain the balance of the digestive tract microflora by (1) competing with enteric pathogens (2) triggering the synthesis of cytokines and enterocytes (3) producing toxic metabolites (4) producing butyric acid to increase enterocyte turnover (5) restore normal microflora during antibiotic therapy (6) produce bacteriocins. In addition, the glutinous rice tape produces phenolic compounds and flavonoids as immunomodulators.

Keywords: *Tape ketan; Fermentation, LAB, Probiotic bacteria, Immune system*

INTRODUCTION
Tape ketan is a traditional Indonesian food produced from the fermentation process of carbohydrate foods in the form of sticky rice. Food processing cannot be separated from the role of microorganisms in the form of bacteria and molds (Hidayat *et al*., 2006). The stages of the process of making glutinous tape generally begin with washing glutinous rice, soaking overnight, cooking, cooling, giving yeast, and finally fermentation (Hasanah *et al*., 2018). The microbes contained in yeast have enzyme activity such as amylase which is produced mainly from the mold found in Indonesian tape yeast (Anasa *et al*., 2019). This amylase enzyme will convert starch into oligosaccharides and dextrins. Furthermore, the two ingredients will be converted by the glucoamylase enzyme into maltose and glucose. In addition, tape yeast also contains yeast, the dominant being Saccharomyces cerevisiae (Nuhartadi and Rahayu, 2011). These yeasts produce invertase enzymes that convert disaccharides into glucose and zymase which convert glucose into ethanol (Judoamidjojo et al., 1992 in Nasrun *et al.*, 2015). Some undigested resistant starch has the potential as a prebiotic (Sari & Puspaningtyas, 2019).

Prebiotics are undigested polysaccharides that play a role in supporting the growth and activity of the microflora of the digestive tract. Fermented food in the form of sticky rice tape has the potential to contain good bacteria or molds that can act as probiotics. Probiotics are living organisms can to provide health benefits to the body when consumed in sufficient quantities by improving the balance of intestinal microflora when they enter the digestive tract and immune system (Yahfoufi *et al.*, 2018).

The immune response in the body is divided into 2 types, namely nonspecific and specific immune responses. The non-specific immune response (innate immunity) is an immune response to foreign substances that enter the body, while the specific (adaptive) immune response is a response to certain antigens. Both systems are composed of many cells, such as lymphocytes, macrophages, neutrophils, natural killer (NK), cytotoxic T lymphocytes, and molecules that interact in a complex manner to detect and eliminate pathogens. Immunomodulators are substances or compounds that can modulate or help improve the activity and function of the immune system. Based on how immunomodulators work, they

are divided into agents that increase the function and activity of the immune system (immunostimulators), regulate the immune system (immunoregulators) and inhibit or suppress immune system activity (immunosuppressors) (Spelman *et al.*, 2006).

The discussion of the role of prebiotics and probiotics as agents to improve the body's immune system has been presented quite a lot. However, the discussion of sticky rice tape as a typical Indonesian food with natural fermentation biotechnology and its relevance as an agent to improve the body's immune system is still limited. Therefore, this article reviews the potential of sticky rice tape with fermentation processing as an agent to improve the body's immune system.

METHOD

The method of writing this review article is by studying literacy from various journal articles that discuss sticky rice tape as a fermented product. Microbial species (molds and bacteria) involved it in the fermentation process of each type of food, as well as fermented compounds that have the potential as immunomodulators. The keywords used to search the literature on the internet were sticky rice tape, lactic acid bacteria, immunomodulators, cytokines, innate immunity, adaptive immunity, *Lactobacillus* sp., and *Weissella* sp. The search for scientific journals regarding research on fermented compounds in this review article only includes several compounds that are considered important as agents to increase the body's immune system.

RESULT AND DISCUSSION

Based on Table 1, it is known that the content of Lactic Acid Bacteria (LAB) contained in sticky rice tape is very diverse, starting from the genus *Lactobacillus, Pediococcus* and *Wisella*. The three genera are also included in probiotic bacteria which have great health benefits (Alam, 2015). The results of research conducted by Dede, *et al*., (2018) showed that in glutinous tape, the amount of LAB ranged from 105 -107 cfu/g. LAB contained in sticky rice tape has the potential as a potential probiotic.

Table 1. Types of Lactic Acid Bacteria Found In Tape Ketan

Jenis BAL	Referensi
Lactobacillus mesenteroides	Sulistiani and Hidayat, 2020
L. plantarum	Mustopa and Fatimah, 2014
L. fermentum	Panjaitan dkk., 2018
✧ *Lactobacillus curvatus* ✧ *L. fermentum* ✧ *Pediococcus pentosaceous* ✧ *Weissella confusa* ✧ *W.paramesenteroides* ✧ *W. kimchii*	Azizah and Kumarawati, 2016

The bacteria included in LAB consist of many genera, namely *Lactobacillus* sp., *Lactococcus* sp., *Leuconostoc* sp., *Streptococcus* sp., *Enterococcus* sp., *Pediococcus* sp., *Melissococcus* sp., *Carnobacterium* sp., *Oenococcus* sp., *Tetragenococcus* sp. , *Vagococcus* sp., and *Weissella* sp. (Sumarsih *et al.*, 2012). Several BAL strains, including *Lactobacillus,* have been shown to increase the production of proinflammatory cytokines such as TNF- and IL-1β, immunostimulator cytokines such as IL-6, IL-12, and IFN- in response to macrophages and dendritic cells (Christensen *et al.*, 2002). Some Lactobacillus strains also increase the production of IFN-γ by T cells in the spleen (Lee *et al*., 2011).

L.plantarum is known to have immunoregulatory functions against Th1 immune cell activation, IgA secretion, enhancement of cytokine profile (IL-2, IL-6, and IFN-γ) and improvement of natural killer (NK) cell activity in cyclophosphamide-induced immunosuppressive mice model. intraperitoneal. The combination of *L. plantarum, L. brevis, L. mesenteroides* in kimchi diet has a beneficial effect in stimulating the growth of splenic cells, bone marrow cells, thymus cells, and B cells in rat spleen organ

lymphocytes (Meng, *et al.,* 2018). Research conducted by Astawan, *et al*. (2011) also proved that administration of *L. plantarum* and *L. fermentum* in infected mice (Enteropathogenic *Escherichia coli* (EPEC) was able to increase lymphocyte cells of the spleen organ.

The fermentation process by *L. plantarum* results in the activation of glucosidase which increases the total flavonoid and phenolic content (Lambui, *et al*., 2015). Many studies have investigated the effect of polyphenols on various types of immune cells, such as macrophages (Liu *et al.*, 2017). Dihydroxyl phenolic acid, a product of microbial metabolism, exhibits anti-inflammatory properties in vitro by decreasing the secretion of TNF-α, IL-1β, and IL-6 from PBMCs of healthy subjects (Monagas *et al.,* 2009). Polyphenols also affect the differentiation and maturation of dentritic cells (Švajger *et al*., 2010).

The compounds resulting from the fermentation process in sticky rice tape that have the potential as immunomodulators are phenolic compounds and flavonoids. Based on their carbon skeleton, polyphenols are classified as phenolic acids and flavonoids. Phenolic compounds are an important group of phytochemicals belonging to the polyphenol group which is a secondary metabolite that is very important in plants (Durga *et al.*, 2014). Flavonoids are natural phenolic substances of type C6-C3-C6, derivatives of 2-phenylbenzopyran (flavan) or 3-phenylbenzopyran (isoflavan). Flavonoids are present in plant organs as glycosides or aglycones. Phenolic compounds and flavonoids are sources of antioxidants which are generally derived from plants. Lactic acid bacteria are known to be able to modulate phenolic and flavonoid levels of fermented products of plant origin (Griana and Kinasih, 2020).

The benefits of LAB include controlling pathogenic bacteria in the gastrointestinal tract and stimulating the immune system. The antagonism or antibacterial effect of LAB consists of two mechanisms, namely by producing primary metabolites such as lactic acid, CO_2, diacetyl, acetaldehyde, and H_2O_2 and by producing bacteriocins (Surono, 2004). According to Astawan *et al*. (2011), LAB maintains the balance of digestive tract microflora and enhances immune response by (1) competing with enteric pathogens (2) triggering the synthesis of cytokines and enterocytes (3) producing toxic metabolites (4) producing butyric acid to increase enterocyte turnover (5) restore normal microflora during antibiotic therapy (6) produce bacteriocins.

In general, the mechanism of probiotics in improving the immune system is as follows:

- Place competition on the host's body
  Pathogenic organisms that will infect the body will require attachment to the mucosal lining and intestinal tract of the host. Through this attachment, pathogenic bacteria will develop and cause infection in the host animal. Probiotic bacteria contained in sticky rice tape will enter the digestive tract, then form colonies in the digestive tract wall. Probiotic bacteria will compete with pathogens for a place on the intestinal wall of the host animal. The attachment made by probiotic bacteria can be non-specific through physicochemical agents, but can be specific through the adhesion between bacterial attachments and receptor molecules on intestinal epithelial cells of the host animal. Zorriehzahra *et a*l., 2016).
- Production of pathogenic growth inhibitory substances
  Probiotic bacteria produce substances that can have a bactericidal or bacteriostatic effect on other microbial populations present in the gut of the host animal. Such substances include bacteriocin, hydrogen peroxide, siderophores, lysozyme, proteases and so on. In some LAB, bacteria are able to produce organic acids and fatty acids (eg lactic acid, acetic acid, butyric acid, propionic acid etc.) which play a role in lowering the pH thereby preventing the growth of opportunistic bacteria in the body. Probiotic bacteria are also capable of producing antagonistic substances through the quorum sensing mechanism. Probiotic bacteria act as immunomodulators that function to increase fish immunity by increasing macrophage and antibody activity. The immune system can be specifically modulated by probiotics. Colony formation and the presence of adhesion of probiotics in the intestine can enhance the immune response. The role of probiotics in the body is to increase enzymes that act as antioxidants, increase the production of cytokines and antibodies, increase the role of macrophages and T cell populations as the body's defense mechanism. Probiotics not only increase the immune system of the host animal, but also reduce stress caused by pathogenic infections from viruses, bacteria and fungi (Zorriehzahra *et al*., 2016).
- The existence of microbial populations in the gastrointestinal tract of the host depends on the availability of nutrients and energy.
  Nutrients and energy are needed for growth and development. In general, bacteria that act as probiotics are lactic acid bacteria capable of producing lactic acid compounds. The low intestinal pH makes it easier for probiotic bacteria to grow and thrive in the intestines of the host animal. Nutrients needed by

pathogens are first used by probiotic bacteria. This causes pathogenic bacteria to lose in the struggle for nutrients, thereby inhibiting the growth of pathogens in the gastrointestinal tract of the host animal (Zorriehzahra *et al*., 2016).

CONCLUSION

The bacteria contained in sticky rice tape are lactic acid bacteria which also act as probiotic bacteria. The bacteria were *Lactobacillus curvatus, L. plantarum, L. fermentum, Pediococcus pentosaceous, Weissella confusa, W. paramesenteroides* and *W. kimchii.* The LAB mechanism in enhancing the body's immune system is to maintain the balance of the digestive tract microflora by (1) competing with enteric pathogens (2) triggering the synthesis of cytokines and enterocytes (3) producing toxic metabolites (4) producing butyric acid to increase enterocyte turnover (5) restore normal microflora during antibiotic therapy (6) produce bacteriocins. In addition, the glutinous rice tape produces phenolic compounds and flavonoids as immunomodulators.

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