

**Lactic acid bacteria from indigenous fermented foods
and their antimicrobial activity**

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Twenty-eight lactic acid bacteria (LAB) strains were isolated from various indigenous fermented foods, i.e., *asinan rebung* (bamboo shoot pickle), *asinan terong* (eggplant pickle), *gatot* (fermented dried cassava), *growol* (fermented raw cassava), *tape* (fermented steamed cassava tubers), *tempe* (fermented soybean), *tempoyak* (fermented pulp of durian fruit), and *moromi*. All strains found and identified belong to facultative heterofermentative group of lactobacilli. They produced DL-lactic acid, and contained meso-diaminopimelic acid in their peptidoglycan, and were identified as *Lactobacillus plantarum* and *L. pentosus* complex. These strains were further determined for their antimicrobial activity against *Staphylococcus aureus* using disc assay and turbidimetric assay. Two among them, *Lactobacillus* TGR-2 (from *growol*) and *Lactobacillus* TMO-4 (from *moromi*) were able to increase the lag phase, and to suppress the final population of the *S. aureus* growth after 12 h incubation.

**Antimicrobial substance produced by *Lactobacillus* sp. TGR-2 isolated from
*growol***

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Lactic acid bacteria strain TGR-2 was isolated from *growol* (fermented raw cassava) and then identified as *Lactobacillus* sp. TGR-2. According to results of the turbidimetric assay, the neutralized supernatant of *Lactobacillus* sp. TGR-2 were able to inhibit the growth of spoilage and pathogenic bacteria, i.e., *Staphylococcus aureus* FNCC 0047, *Salmonella typhimurium* FNCC 0050, *Escherichia coli* FNCC 0091, *Bacillus cereus* FNCC 0057, and *Morganella morganii* FNCC 0122. The antimicrobial activity of neutralized supernatant of *Lactobacillus* sp. TGR-2 was stable at room temperature for 60 min, pH 3-8; heating 98 °C for 30 min, pH 3-8; 121 °C for 15 min, pH 3-8; storage at 4 °C for 21 days, pH 6.5. The third fraction obtained from purified of supernatant of *Lactobacillus* sp. TGR-2 by gel filtration which possessed the molecular weight 14,000 Dalton has a bacterial effect on the growth of *S. aureus*.

**Optimalisasi produksi antimikrobia oleh *Lactobacillus* sp. TGR-2
(Optimization of antimicrobial substance production by *Lactobacillus* sp. TGR-2)**

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Antimicrobial substance from lactic acid bacteria, especially those involved in fermented food are preferable to be used as food preservatives due to their safety. In this study, production of an antimicrobial substance by *Lactobacillus* sp. TGR-2 isolated from *growol*, has been carried out. The antimicrobial activity was determined by turbidimetric assay using *Staphylococcus aureus* FNCC 0047 as microbial indicator. The result showed (Erlenmeyer scale) that the maximum production of the antimicrobial substance was obtained when MRS broth used as fermentation medium with its initial pH 6.0, incubation at 30 °C for 16-24 h with antimicrobial activity 1.93 UA/ml. Addition of glucose to MRS broth at final concentration 0.5 % yeast extract, 1.6 % glucose,

**Daya bunuh antimikrobia *Lactobacillus* sp. TGR-2 serta uji coba pada susu
(The activity, presumption mode of action antimicrobial substance
of *Lactobacillus* sp. TGR-2 and its application on milk product)**

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The effectiveness of antimicrobial substance produced by *Lactobacillus* sp. TGR-2 against several pathogenic bacteria, i.e., *Vibrio parahaemolyticus* JCM 2147, *Yersinia enterocolitica* JCM 7577, *Salmonella choleraesuis* JCM 3919, *Escherichia coli* FNCC 0091 & JCM 1649, *Staphylococcus aureus* FNCC 0047 & JCM 2413, and *Listeria monocytogenes* ATCC 7644, have been examined. Results showed that antimicrobial substance produced by TGR-2 had an inhibitory and antibactericidal effect toward tested bacterial pathogen. MIC level between 1.29 – 3.82 AU/ml indicated an inhibitory activity, whereas reduction of population level of pathogenic bacteria, 1 – 4 log cycle, expressed a bactericidal effect.

Antibacterial TGR-2 substance has been used as biopreservative agent on the milk products as a food model. Results showed that antimicrobial TGR-2 substance was able to inhibit the growth of *L. monocytogenes* in 10% skimmed milk medium, and to increase the self-life of pasteurized milk up to 55 days.

Mode of action of antimicrobial TGR-2 substance toward microbial indicator has not yet been understood, further experiments were still needed.

Keyword : Lactic acid bacteria, *Lactobacillus* sp., antimicrobial substance, activity, pathogenic bacteria, milk product.

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Bakteri asam laktat sebagai penghasil agensia antimikrobia

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Pada dasarnya makanan hasil fermentasi dengan mikrobia utama bakteri asam laktat (BAL) akan memiliki daya simpan (keawetan) yang lebih lama. Keawetan ini disebabkan oleh asam laktat khususnya, ataupun asam-asam lain yang dihasilkan oleh BAL selama fermentasi dapat menekan pertumbuhan bakteri perusak maupun patogen. Disamping asam yang dihasilkan, sejumlah spesies BAL juga mampu menghasilkan berbagai komponen yang memiliki sifat antagonis terhadap bakteri yang lain. Komponen antimikrobia ini diantaranya adalah hidrogen peroksida, diasetil, dan bakteriosin. Di Indonesia banyak ditemukan makanan hasil fermentasi yang cara pembuatannya dilakukan secara tradisional, dengan berbagai macam bahan dasar yang digunakan. Pada penelitian ini 28 isolat bakteri asam laktat telah diisolasi dari makanan hasil fermentasi, dan dari hasil identifikasi diperoleh bahwa isolat-isolat tersebut didominasi oleh *Lactobacillus plantarum-pentosus* kompleks. Isolat-isolat BAL juga telah diisolasi dari buah-buahan, nira kelapa, dan produk daging kemasan dan selanjutnya diskriminasi potensinya sebagai penghasil agensia antimikrobia.

Skринing aktivitas antimikrobia menggunakan *Staphylococcus aureus* sebagai indikator, diperoleh hasil bahwa isolat *Lactobacillus* TGR-2 yang berasal dari *growol* diperkirakan memiliki potensi sebagai penghasil agensia antimikrobia. Agensia antimikrobia ini stabil pada suhu kamar selama 60 menit pada pH 3-8, pemanasan pada suhu 98 °C selama 30 menit, pemanasan pada suhu 121 °C selama 15 menit, penyimpanan pada suhu 4 °C selama 21 hari, dan memiliki BM 14.700. Substansi antimikrobia ini juga mampu menghambat berbagai jenis bakteri patogen dan pembusuk serta aktivitasnya hilang oleh enzim protease. Beberapa BAL yang diisolasi dari produk daging kemasan yang diuji dengan menggunakan *Enterococcus faecalis* sebagai indikator juga memiliki potensi sebagai penghasil substansi antimikrobia. Saat ini karakterisasi substansi antimikrobia sedang dilakukan.

Produksi substansi antimikrobia oleh *Lactobacillus* TGR-2, secara batch dengan fermentor volume media 1,5 liter, hasil tertinggi diperoleh menggunakan media cair MRS yang ditambah dengan 0,5 % glukosa, 1,6 % yeast ekstrak, 0,6 % dipotasium fosfat, 1,5 % sodium asetat, dan 0,6 % triamonium sitrat, pH awal 6,0, suhu 30 °C, waktu inkubasi 16 jam, dengan aktivitas antimikrobia yang diperoleh 5,27 ± 5,77 UP/ml. Uji coba penggunaan substansi antimikrobia TGR-2 sebagai agensia pengawet ditunjukkan dengan kemampuannya menghambat pertumbuhan *Listeria monocytogenes* dalam media susu skim 10 %, agensia ini juga dapat memperpanjang umur simpan susu pasteurisasi sampai minimal 55 hari. Untuk aplikasi di bidang pangan, saat ini sedang dilakukan penelitian tentang penggunaan isolat BAL yang berpotensi menghasilkan agensia antimikrobia pada pembuatan yoghurt.

Untuk meningkatkan produksi substansi antimikrobia, studi awal tentang teknik pengembangan strain juga telah dilakukan menggunakan teknik mutasi dan kloning. Empat mutan TGR-2 terseleksi yang masing-masing diperoleh dari mutasi menggunakan sinar ultra violet, etil metan sulfonat, akridin oranye dan NTG dengan klorampenikol sebagai marker, dapat meningkatkan antimikrobia sebesar 3-4 kalinya *wild type*. Studi awal tentang kloning gen BAL yang mengkode agensia antimikrobia ke sel *E. coli* DH5 juga telah berhasil dilakukan. Plasmid dengan ukuran sekitar 2,6 kb yang diisolasi dari *Pediococcus acidilactici* telah berhasil ditransformasikan ke dalam sel *E. coli* menggunakan pUC 19 sebagai vektor. Ekspresi dari sel *E. coli* ini ditunjukkan pada kemampuannya memberikan zona penghambatan pada pertumbuhan bakteri indikator *Enterococcus faecalis*.

**Mutation technique for increasing the production of antibacteria
Lactobacillus plantarum TGR-2**

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Production of antibacteria of *Lactobacillus plantarum* TGR-2 was carried out by mutation technique using UV radiation and chemical mutagenic agent (acrydine orange/AO, ethyl methane sulfonate/EMS, and N-methyl-N-nitro sulfonate nitrosoguanidine/NTG). As a marker, chloramphenicol for 10 ppm was applied. Total of 214 mutants were obtained from all of the treatments and then screened based on their activities against *Staphylococcus aureus* FNCC 0047 as bacterial indicator, using agar diffusion and turbidimetric assay techniques. Results showed that 24 mutants could produce higher amount of antibacteria and two of them, NTG and acrydine orange treatments, had higher stability than others. Characterization of two mutants, determination of biochemistry traits and optimization of antibacterial (bacteriocins) production were done. The product showed that UV-15, EMS-10, AO-6 and NTG-21 mutants could produce antibacterial substance 3.90, 4.40, 3.40, and 4.17 AU/ml for 16, 12, 12, and 16 hours incubation, respectively, compared to *Lactobacillus plantarum* TGR-2 which produced 1.07 AU/ml for 24 hours incubations.

Cloning of *lab* gene encoding bacteriocin from *Pediococcus acidilactici* F 11 into *Escherichia coli* DH 5- ∞

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Pediococcus acidilactici F11 is able to inhibit the growth of related species of enterobacteriaceae by secreting bacteriocin. Effort to increase bacteriocin production by transforming *lab* gene encoding bacteriocin from *P. acidilactici* F11 into *E. coli* DH 5- ∞ was carried out. Plasmid pPAF11 (encoding bacteriocin from *P. acidilactici* F11) and pUC19 as vector which were double-digested with *Hind*III and *Bam*HI, ligated, and transformed into *E. coli* DH 5- ∞ . White colonies, as indicator of transformant, were picked up and grown in LB-broth medium containing ampicillin. Test ability of the transformant in expressing *lab* gene was done by heating the supernatant of the transformant at 95-98 °C for 15 min and determining its inhibition against *Enterococcus faecalis* as bacterial indicator. Location of *lab* gene was confirmed by analyzing recombinant plasmid and curing plasmid using acrydine orange. Analysis of the plasmid carried by transformant revealed that plasmid size was similar to that of *P. acidilactici* F11. This led to a suggestion that plasmid was a shuttle plasmid.

**Identification of Lactic Acid Bacteria Isolated
from Chinese Starter, *Ragi*, in Indonesian**

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Indonesia produces a huge amount of rice, *brem* is an Indonesian alcoholic beverage made from rice, and *ragi* is used as a starter for making *brem*. Previously, Uchimura *et al.*, reported that tetrad-forming lactic acid bacteria were abundantly isolated from *ragi*. Recently, in order to verify this, we isolated and identified lactic acid bacteria from newly collected *ragi* samples.

In this study, we isolated a large number of *Pediococcus pentosaceus* strain from the new *ragi* samples, accompanying a small number of *Lactobacillus plantarum* and *Lactobacillus fermentem* strains, as previously reported. Therefore, *P. pentosaceus* strains are regarded as a major group of lactic acid bacteria in *ragi*.

Pediococcus pentosaceus strains showed higher resistance to heat and dryness, and more survival in rice flour than rod-shape lactic acid bacteria. *Ragi* is made by adding an old ground starter to fresh grain flour, and mixing well under open natural conditions. This probably favors the proliferation and survival of *P. pentosaceus* strains at the early stage of production of *ragi*. Thus *P. pentosaceus* would be a major species of lactic acid bacteria in the Chinese starter in Southeast Asian countries, which are made by the similar procedure.

**Inhibition of *Listeria monocytogenes* in refrigerated milk product by
antibacteria of *Lactobacillus plantarum* TGR-2**

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Lactobacillus plantarum TGR-2 was found to produce antibacteria against Gram positive and Gram negative pathogenic bacteria. In this study the effectiveness of this bacteria in inhibition of the growth of *Listeria monocytogenes* in inoculated skimmed milk and bacterial flora in pasteurized milk stored at refrigeration temperature was examined.

Predetermined number of *L. monocytogenes* cells, concentration of antibacteria of TGR-2 and nisin were added to sterile 10 % skimmed milk and pasteurized milk. Treated and untreated (without any addition of antibacteria) skimmed milk and pasteurized milk were stored at refrigeration temperature for 55 days and were enumerated its *Listeria* cells for inoculated skimmed milk and total bacteria for pasteurized milk.

Result in this experiment showed that antibacteria of *L. plantarum* TGR-2 at level of 8.24 IU (Inhibition Unit) was able to inhibit the growth of *L. monocytogenes* which inoculated in 10 % skimmed milk medium for 55 days stored at refrigeration temperature, while nisin was able to reduce the number of bacterial cells. Without addition of antibacteria into inoculated milk, population of *Listeria* reached 10^8 CFU/during 14 days. Experiment using pasteurized milk showed that antibacteria of TGR-2 (8.24 IU/ml) was able to lengthen the pasteurized milk self-life at refrigeration temperature at least 55 days. Antibacteria of TGR-2 could suppress the growth of bacteria present in pasteurized milk. On the other hand, without addition of antibacteria, the bacterial population of pasteurized milk reached 10^7 CFU/ml in 32 days.

Lactic acid bacteria in fermented foods of Indonesian origin

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Indonesia, like other tropical country has many kind of traditional fermented foods, which have been consumed for a long time. These fermented foods are mostly produced by traditional methods using spontaneous inoculant. In this study, about 132 lactic acid bacteria strains have been isolated from 19 kinds of fermented foods (plant materials and fish origin). These fermented foods were fruit pickle, sauerkraut, fermented eggplant, gatot (fermented dried cassava), growol (fermented fresh cassava), moromi, ragi, tape, tempe, and terasi (fermented fish) from Java, fermented bamboo shoot and tempoyak (fermented durian meat) from Sumatra, mandai cempedak & mandai nangka (fermented jackfruit), pakasam & wadi (fermented fish) from Kalimantan, and terasi and peda (fermented fish) from Lombok. Among these strains, 84 belong to lactobacilli, which dominated by homofermentative *Lactobacillus plantarum* – *pentosus* complex, 22 strains belong to *Pediococcus*, whereas the other 26 mostly identified as *Streptococcus thermophilus*. *Lactobacillus* – *pentosus* have been found in all fermented foods, *Pediococcus* in 10 kind of fermented foods both plant material and fish origin, while *Streptococcus* has been only found in fermented fish (peda, teras, wadi). Nine strains belong to *Lactobacillus plantarum* – *pentosus* complex from different fermented food samples have been determined their DNA-DNA homology to *L. plantarum* TUA 392L and *L. pentosus* TUA 334L. Result of their homology to these strains shown that all these nine strains are identified as *L. plantarum*. The 132 strains of lactic acid bacteria were lyophilized and deposited at FNCC, IUC Food and Nutrition, Gadjah Mada University.

Optimasi produksi bakteriosin oleh *Pediococcus* sp. 24 dan aktivitas antibakterinya
(Optimization production of bacteriocin by *Pediococcus* sp. 24 and its antibacterial activity)

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Lactic acid bacteria have long been known to produce antibacterial protein, called bacteriocins. Bacteriocins are proteins that inhibit species closely related to the producer culture. In the experiment, the influence of growth media and growth condition on the production of bacteriocin by 15 producer isolates and their antibacterial activity were studied. The antibacterial activity was determined by bioassay method and was expressed in activity unit per millimeter. The result of preliminary experiment using flask; indicated that the highest level of bacteriocin activity was produced by *Pediococcus* sp. 24 in TGE broth with initial pH 6.5, incubated for 12 h at 30 °C, and its antibacterial activity was 36 000 AU/ml. Production of bacteriocin was negligible when the pH of the medium was maintained at 6.5, 5.5, and 4.5, even in the presence of high cell mass. Aerating the culture during growth almost completely eliminated the production of active bacteriocin. When 1% ethanol was included in the growth medium, increase in the bacteriocin yield was observed (45 000 AU/ml)

*Key words : Bacteriocin production, antibacterial activity, *Pediococcus* sp. 24*

Optimasi Produksi Bacteriosin oleh Sel Amobil *Pediococcus acidilactici* F11

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Abstrak

Sel amobil telah lama digunakan dalam berbagai proses bioteknologi karena mempunyai beberapa kelebihan bila dibandingkan dengan beberapa sel bebas. Penggunaan sel amobil untuk proses fermentasi diharapkan dapat meningkatkan produksi. Pada penelitian ini telah dilakukan optimasi terhadap produksi bakteriosin oleh *Pediococcus acidilactici* F11 yang diamobilisasi dengan matriks kalsium alginat (manik-manik). Faktor yang dioptimasi meliputi pH awal media, suhu inkubasi dan penambahan etanol. Optimasi produksi bakteriosin dilakukan dengan cara menginokulasikan sel amobil pada media TGE (tripton, glucose, yeast ekstrak) cair sebanyak 2.5% (b/v), kemudian diinkubasikan pada shaker waterbath (100 rpm) selama 24 jam. Setiap 4 jam dilakukan pengamatan terhadap pola produksi bakteriosin, perubahan pH selama fermentasi, pertumbuhan sel di dalam manik-manik dan media fermentasi serta kebocoran sel selama penggunaan berulang. Hasil optimasi menunjukkan bahwa pH awal media 6.5 dan suhu inkubasi 37°C menghasilkan aktivitas bakteriosin tertinggi dengan waktu inkubasi 16 jam yaitu 7.000 AU/ml. Media TGE cair dengan konsentrasi etanol 1% (v/v) mampu meningkatkan aktivitas bakteriosin menjadi 9.000 AU/ml. Pada penggunaan berulang, sel amobil menunjukkan stabilitas produksi yang lebih baik daripada sel bebas. Sel amobil sudah tidak efektif lagi pada penggunaan berulang yang ke-4 karena jumlah sel yang terdapat pada media fermentasi hampir sama dengan jumlah sel yang ada pada manik-manik.

Kata kunci: bakteriosin, *Pediococcus acidilactici* F11, amobilisasi, optimasi produksi.

Viabilitas dan Stabilitas sel Amobil *Pediococcus acidilactici* F 11 penghasil Bakteriosin

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Abstrak

Penggunaan sel amobil untuk proses fermentasi diperkirakan memiliki berbagai keuntungan diantaranya sel dapat digunakan berulang kali dengan viabilitas dan stabilitas yang diharapkan tetap dapat dipertahankan. Pada penelitian ini telah dilakukan amobilisasi sel *Pediococcus acidilactici* F11 yang mampu menghasilkan bakteriosin pada gel calsium-alginat. Tujuan penelitian ini adalah untuk mengetahui viabilitas dan stabilitas sel amobil *Pediococcus acidilactici* F11 selama penyimpanan.

Amobilisasi sel dilakukan dengan metode tetes dan ekstruksi yaitu dengan meneteskan campuran massa sel pada larutan 3% sodium alginat pada larutan 0.1M CaCl₂. Proses penyimpanan dilakukan selama 2 bulan pada suhu dingin 4°C, menggunakan pepton water sebagai larutan fisiologis. Viabilitas sel diamati dengan cara plating dengan media TGE sedangkan viabilitas sel diamati secara kuantitatif pada kemampuannya menghasilkan bakteriosin selama penyimpanan maupun penggunaan berulang selang penyimpanan, dengan metoda bioassay.

Prosedur amobilisasi yang dilakukan pada penelitian ini telah berhasil menjerat 94,95% massa sel yang dipersiapkan untuk amobilisasi, dengan densitas manik-manik berkisar $2,21 \cdot 10^{10}$ CFU/g. Jumlah sel amobil F11 mengalami peningkatan sebesar 1 log cycle pada penyimpanan selama 2 minggu, selanjutnya cenderung konstan. Aktifitas bakteriosin selama penyimpanan, mengalami penurunan 20% dari aktifitas awalnya. Selama lima kali pemakaian berulang selang penyimpanan, ternyata jumlah sel yang lepas dari manik-manik sel amobil F11 meningkat secara bertahap dari 10^6 – 10^9 CFU/ml media.

Kata kunci: Bakteriosin, *Pediococcus acidilactici* F11, Amobil, Viabilitas dan Stabilitas

Purifikasi dan Karakterisasi Bakteriosin dari *Leuconostoc lactis* BR-8

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Abstrak

Bakteri Asam Laktat (BAL) dikenal sebagai bakteri yang memiliki potensi untuk menghambat pertumbuhan bakteri pembusuk dan bakteri patogen. Penghambatan ini disebabkan karena bakteri asam laktat mampu menghasilkan senyawa anti bakteri yaitu asam laktat, hidrogen peroksida, diasetil dan bakteriosin. Bakteriosin merupakan polipeptida yang memiliki aktivitas bakterisidal terhadap bakteri lain yang memiliki kedekatan kekerabatan (*closely related bacteria*). Bakteriosin memiliki peluang baik untuk dapat dimanfaatkan sebagai biopreservasi dalam memperpanjang masa simpan suatu produk makanan, khususnya produk makanan yang disimpan dalam suhu dingin (*refrigerated food*).

Hasil purifikasi bakteriosin dengan DEAE-cellulose mampu meningkatkan aktivitas spesifik sebesar 136 kali. Karakter yang dimiliki oleh bakteriosin adalah sebagai berikut tahan pada suhu 100°C dan 121°C, tahan pada kisaran pH luas (2-10), merupakan protein menghambat pertumbuhan *Eschericia coli*, *Listeria monocytogenes* dan *Bacillus cereus* serta memiliki BM 9.8 kDa.

Optimasi produksi bakteriosin oleh sel amobil *Pediococcus acidilactici* F11

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Sel amobil telah lama digunakan dalam berbagai proses bioteknologi karena mempunyai beberapa kelebihan bila dibandingkan dengan sel bebas. Penggunaan sel amobil untuk proses fermentasi diharapkan dapat meningkatkan produksi. Pada penelitian ini telah dilakukan optimasi terhadap produksi bakteriosin oleh *Pediococcus acidilactici* F11 yang diamobilisasi dengan matriks kalsium alginat (manik-manik). Faktor yang dioptimasi meliputi pH awal media, suhu inkubasi dan penambahan etanol. Optimasi produksi bakteriosin dilakukan dengan cara menginokulasikan sel amobil pada media TGE (tripton-glukosa-yeast ekstrak) cair sebanyak 2,5% (b/v), kemudian diinkubasikan pada shaker waterbath (100 rpm) selama 24 jam. Setiap 4 jam dilakukan pengamatan terhadap pola produksi bakteriosin, perubahan pH selama fermentasi, pertumbuhan sel di dalam manik-manik dan media fermentasi serta kebocoran sel selama penggunaan berulang. Hasil optimasi menunjukkan bahwa pH awal media 6,5 dan suhu inkubasi 37°C menghasilkan aktivitas bakteriosin tertinggi dengan waktu inkubasi 16 jam yaitu 7.000 AU/ml. Media TGE cair dengan konsentrasi etanol 1% (v/v) mampu meningkatkan aktivitas bakteriosin menjadi 9.000 AU/ml. Pada penggunaan berulang, sel amobil menunjukkan stabilitas produksi yang lebih baik daripada sel bebas. Sel amobil sudah tidak efektif lagi pada penggunaan berulang yang ke-4 karena jumlah sel yang terdapat pada media fermentasi hampir sama dengan jumlah sel yang ada pada manik-manik.

Kata kunci : bakteriosin, *Pediococcus acidilactici* F11, amobilisasi, optimasi produksi

Viabilitas dan Stabilitas Sel Amobil *Pediococcus acidilactici* F11 Penghasil Bakteriosin

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Penggunaan sel amobil untuk proses fermentasi diperkirakan memiliki berbagai keuntungan diantaranya sel dapat digunakan berulang kali dengan viabilitas dan stabilitas yang diharapkan tetap dapat dipertahankan. Pada penelitian ini telah dilakukan amobilisasi sel *Pediococcus acidilactici* F11 yang mampu menghasilkan bakteriosin pada gel kalsium-alginat. Tujuan penelitian ini adalah untuk mengetahui viabilitas dan stabilitas sel amobil *Pediococcus acidilactici* F11 selama penyimpanan.

Amobilisasi sel dilakukan dengan metode tetes atau ekstruksi, yaitu dengan meneteskan campuran massa sel pada larutan 3% sodium alginat pada larutan 0,1 M CaCl₂. Proses penyimpanan dilakukan selama 2 bulan pada suhu dingin 4°C, menggunakan pepton water sebagai larutan fisiologis. Viabilitas sel diamati dengan cara plating menggunakan media TGE sedangkan stabilitas sel diamati secara kuantitatif pada kemampuannya menghasilkan bakteriosin selama penyimpanan maupun penggunaan berulang selang penyimpanan, dengan metoda bioassay.

Prosedur amobilisasi yang dilakukan pada penelitian ini telah berhasil menjerat 94,95 % massa sel yang dipersiapkan untuk amobilisasi, dengan densitas manik-manik berkisar 2,21.10¹⁰ CFU/g. Jumlah sel amobil F11 mengalami peningkatan sebesar 1 log cycle pada penyimpanan selama 2 minggu, selanjutnya cenderung konstan. Aktivitas bakteriosin selama penyimpanan, mengalami penurunan 20 % dari aktivitas awalnya. Selama lima kali pemakaian berulang selang penyimpanan, ternyata jumlah sel yang lepas dari manik-manik sel amobil F11 meningkat secara bertahap dari 10⁶ –10⁹ CFU/ml media.

Kata Kunci : Bakteriosin, *Pediococcus acidilactici* F11, Amobil, Viabilitas dan Stabilitas

Purifikasi dan karakterisasi bakteriosin dari *Lactococcus lactis* BR-8

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Bakteri asam laktat (BAL) dikenal sebagai bakteri yang memiliki potensi untuk menghambat pertumbuhan bakteri pembusuk dan bakteri patogen. Penghambatan ini disebabkan karena bakteri asam laktat mampu menghasilkan senyawa antibakteri yaitu asam laktat, hidrogen peroksida, diasetil dan bakteriosin. Bakteriosin merupakan polipeptida yang memiliki aktivitas bakterisidal terhadap bakteri lain yang memiliki kedekatan kekerabatan (*closely related bacteria*). Bakteriosin memiliki peluang yang baik untuk dapat dimanfaatkan sebagai biopreservasi dalam memperpanjang masa simpan suatu produk makanan, khususnya produk makanan yang disimpan dalam suhu dingin (*refrigerated food*).

Hasil purifikasi bakteriosin dengan DEAE-cellulose mampu meningkatkan aktivitas spesifik sebesar 136 kali. Karakter yang dimiliki oleh bakteriosin adalah sebagai berikut tahan pada suhu 100 0C dan 121 0C, tahan pada kisaran pH luas (2-10), merupakan protein menghambat pertumbuhan *Eschericia coli*, *Listeria monocytogenes* dan *Bacillus cereus* serta memiliki BM 9,8 kDa.

Bakteri asam laktat pada terasi dan peda serta aktivitas penghambatannya terhadap bakteri patogen dan pembusuk

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Bakteri asam laktat mempunyai peranan penting dalam proses fermentasi makanan, misal dalam fermentasi terasi dan peda. Hasil utama metabolisme karbohidrat oleh bakteri asam laktat adalah asam laktat yang dapat menghambat berkembangnya bakteri lain. Disamping itu, bakteri asam laktat mampu menghasilkan senyawa antimikrobia, seperti bakteriosin, hidrogen peroksida, dan diasetil. Tujuan penelitian untuk mengisolasi dan mengidentifikasi bakteri asam laktat pada makanan hasil fermentasi, yaitu terasi dan peda, memilih isolat yang mempunyai potensi antimikrobia dalam menghambat pertumbuhan bakteri patogen dan pembusuk, serta aktivitas penghambatannya terhadap bakteri indikator.

Isolasi dan identifikasi bakteri asam laktat dilakukan secara konvensional, yang meliputi karakteristik morfologi, uji biokimiawi, uji fisiologi, tipe fermentasi, tipe peptidoglikan serta profil protein (SDS-PAGE); asam laktat yang diperoleh menunjukkan bahwa isolat tersebut tergolong ke dalam spesies *Lactobacillus curvatus*, *L. sake*, *L. murinus*, *L. plantarum*, dan *Streptococcus thermophilus*. Semua isolat mempunyai aktivitas penghambatan terhadap bakteri patogen dan pembusuk yang diujikan namun tidak mempunyai aktivitas penghambatan terhadap bakteri indikator, yang berarti isolat yang diperoleh tidak memproduksi bakteriosin..

Key words: bakteri asam laktat, antimikrobia, terasi, peda.

**Skrining bakteri asam laktat dari daging dan produk olahannya
sebagai penghasil bakteriosin**

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Bakteri asam laktat (BAL) banyak terdapat pada daging dan produk olahannya yang dapat diisolasi untuk dimanfaatkan lebih lanjut, khususnya sebagai penghasil bakteriosin. Pada penelitian ini dilakukan isolasi bakteri asam laktat yang terdapat pada daging mentah dan produk olahannya yang mempunyai aktivitas bakteriosin yang selanjutnya (jangka panjang) komponen ini dapat dimanfaatkan sebagai agensia pengawet bahan makanan (biopreservasi).

Sampel yang digunakan sebagai sumber bakteri asam laktat pada penelitian ini adalah daging sapi & ayam mentah, sosis daging sapi, babi & ayam, dan irisan daging sapi yang dikemas vakum. Sampel makanan diinkubasi dalam 5 macam media yaitu media cair TGE (tripton-glukosa-yeast ekstrak) pH 5 plus 3 % NaCl; MRS cair (deMan-Rogose-Sharpe) pH 5,5 ; TGE cair pH 5,5 ; TGE buffer cair pH 5,5; dan TGE cair plus Tween 80 & 1 % Na-azida pH 6,0; inkubasi dilakukan selama 24 – 72 jam untuk menstimulasi pertumbuhan bakteri asam laktat. Skrining isolat bakteri asam laktat yang diduga sebagai penghasil bakteriosin dilakukan dengan metoda pour plate yang dilapisi (overlay) dengan bakteri indikator *Lactobacillus plantarum* NCDO 955, *Pediococcus acidilactici* LB 24, *Leuconostoc mesenteroides* LY, dan *Enterococcus faecalis* MI. Koloni-koloni bakteri asam laktat yang memberikan penghambatan terhadap pertumbuhan bakteri indikator yang ditunjukkan dengan munculnya zona jernih selanjutnya diisolasi dan dimurnikan. Isolat murni bakteri asam laktat yang diperoleh dilakukan identifikasi berdasarkan pada pengecatan Gram, katalase, bentuk & susunan sel, motilitas, pengaruh suhu & pH terhadap pertumbuhan, tipe fermentasi dan tipe peptidoglikan, pembentukan asam dari berbagai sumber karbon, dan pembentukan dekstran dari sukrosa. Pada paper ini identifikasi bakteri asam laktat disajikan pada tingkat genera.

Pada penelitian ini diperoleh 30 isolat bakteri asam laktat yang termasuk genera *Lactobacillus*, *Leuconostoc*, *Streptococcus*, dan *Enterococcus*. Sebagian besar isolat yang diperoleh menunjukkan aktivitas antibakteri nonbakteriosin, hanya 3 (tiga) isolat *Leuconostoc* spp. diperkirakan dapat dimanfaatkan lebih lanjut sebagai penghasil bakteriosin, yaitu SM 22, SM 32, dan SM 46.

**Bakteri asam laktat dari ikan asin & ikan terfermentasi
dan uji aktivitas antibakterinya**

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Bakteri asam laktat, pada beberapa kasus berperan penting di dalam proses fermentasi ikan. Selama proses fermentasi, bakteri ini akan menghasilkan asam laktat sebagai produk utamanya yang dapat menghambat pertumbuhan bakteri patogen dan perusak/pembusuk, disamping komponen antimikrobia lainnya seperti hidrogen peroksida, diasetil dan bakteriosin.

Penelitian ini bertujuan untuk isolasi dan identifikasi bakteri asam laktat pada ikan asin & ikan terfermentasi dan uji aktivitas antibakterinya dalam menghambat pertumbuhan bakteri patogen Gram positif dan Gram negatif serta bakteri perusak. Identifikasi isolat meliputi pengecatan Gram dan morfologi sel, uji biokimia, fisiologis, tipe fermentasi, peptidoglikan dan profil protein (SDS-PAGE). Uji aktivitas anti bakteri terhadap bakteri patogen dan perusak serta uji aktivitas antibakteri terhadap bakteri indikator.

Dari hasil isolasi pada berbagai ikan asin dan ikan terfermentasi diperoleh 60 isolat, yaitu 12 isolat dari ikan asin, 16 isolat dari pindang, 15 isolat dari terasi, 9 isolat dari pakasam dan 8 isolat dari wadi. Dari 60 isolat dapat dikelompokkan sebagai berikut; 18 isolat Genera *Lactobacillus*, 8 isolat *Leuconosnoc*, 9 isolat *Pediococcus*, 18 isolat *Streptococcus* dan 6 isolat *Enterococcus*. Hasil identifikasi lebih lanjut ke tingkat spesies menunjukkan bahwa 60 isolat yang diperoleh di duga adalah *Lactobacillus plantarum*, *L.acidophylus*, *L.fermentum*, *Pediococcus acidilactici*, *P. .pentosaseus*, *Leuconostoc paramesenteroides*, *Enterococcus faecium* dan *Streptococcus thermophilus*.

Pada uji penghambatan, semua isolat mempunyai kemampuan menghambat pertumbuhan bakteri patogen Gram positif (*Staphylococcus aureus* FNCC 0047, *Bacillus cereus* FNCC 0057, *Listeria monocytogenes* ATCC 7644), Gram negatif (*Salmonella choleraesius* JCM 3919, *Escherichia coli* FNCC 0091, *Vibrio parahaemoliticus* JCM 2147, *Shigella* sp), dan bakteri perusak (*Pseudomonas fluorescens* FNCC 0070, *Morganella morganii* FNCC 0122) dengan zona penghambatan 0,5 – 6,5 mm, 4 isolat (DAN 20,25,38,59) mempunyai aktivitas penghambatan terhadap bakteri indikator (*Pediococcus acidilactici* LB 42 dan *Enterococcus faecalis* MI).

Kata kunci : Bakteri asam laktat, ikan asin, ikan fermentasi, antibakteri

Isolasi bakteri psikrofilik dari produk perikanan segar dan uji ketahanannya terhadap agensia biopreservasi

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Produk-produk perikanan segar sangat mudah mengalami kerusakan dan rentan terhadap pembusukan karena adanya aktivitas bakteri. Bakteri psikrofilik merupakan salah satu penyebab pembusukan pada ikan yang disimpan dingin.

Telah dilakukan penelitian yang bertujuan untuk mengisolasi bakteri psikrofilik dari produk perikanan segar dan mengetahui ketahanannya terhadap agensia biopreservasi/bakteriosin. Dalam penelitian ini bakteri psikrofilik diisolasi dari sampel ikan kembung, belanak, udang dan kerang yang diperoleh dari pasar Gejayan dan pasar Kranggan Yogyakarta. Perhitungan bakteri dilakukan dengan metode dilution & plating, sedang isolasi dan identifikasi menggunakan metode Lahallec dan Colin (1995) dan MacFaddin (1980). Uji ketahanan bakteri psikrofilik yang diperoleh terhadap agensia biopreservasi/bakteriosin dilakukan dengan metode langsung overlay.

Hasil isolasi bakteri diperoleh 45 isolat dan 9 diantaranya merupakan bakteri psikrofilik. Dari 9 isolat tersebut dapat dikelompokkan ke dalam genus *Pseudomonas*, *Alteromonas*, dan *Aeromonas/Vibrio*. Hasil uji penghambatan menunjukkan bahwa isolat bakteri psikrofilik dapat dihambat pertumbuhannya oleh kultur bakteri asam laktat, namun tidak dapat dihambat oleh supernatan bakteri asam laktat dan nisin.

Kata kunci: Bakteri psikrofilik, produk perikanan segar, agensia biopreservasi

**Pembuatan yoghurt dengan inokulum *Lactobacillus* yang diisolasi
dari makanan fermentasi tradisional**

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Percobaan ini bertujuan untuk mengetahui tingkat penerimaan konsumen terhadap yogurt yang dihasilkan dengan menggunakan inokulum *Lactobacillus* yang diisolasi dari makanan hasil fermentasi tradisional seperti growol, gatot, asinan rebung, asinan terong, tempoyak dan moromi. Kultur *Lactobacillus* spp. yang digunakan adalah TGA-3, TGR-2, TGR-21, TTK-1, TAR-3, TAT-2, dan TMO-4, hasil isolasi penelitian sebelumnya, dan kultur bakteri asam laktat yang diperoleh dari Food and Culture Collection PAU Pangan dan Gizi UGM Yogyakarta, yaitu *L. bulgaricus* FNCC 0041 dan *Streptococcus thermophilus* FNCC 0015, yang digunakan sebagai kontrol. Hasil percobaan menunjukkan bahwa nilai pH yogurt yang dihasilkan berkisar antara 4,12 hingga 5,26 dan yogurt yang dihasilkan memiliki sifat semi padat. Yogurt yang dibuat dengan menggunakan kultur *Lactobacillus* spp. TGR-2 dan TMO-4 memiliki nilai kesukaan yang lebih tinggi dalam arti yogurt tersebut lebih dapat diterima dibanding yogurt yang lain.

Kata kunci : Yogurt, *Lactobacillus*, sifat yogurt

Isolasi dan identifikasi *Lactobacillus* dari crop ayam yang berpotensi sebagai agensia probiotik ternak unggas

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Bakteri asam laktat dikenal mempunyai efek yang menguntungkan bagi kesehatan tidak hanya bagi manusia tetapi juga bagi ternak unggas khususnya ayam. Penelitian ini ditujukan untuk isolasi dan identifikasi *Lactobacillus* yang berasal dari crop ayam kampung sehat dewasa yang berpotensi untuk dikembangkan sebagai agensia probiotik ayam. BAL yang berpotensi akan digunakan sebagai agensia probiotik untuk mengatur dan menjaga keseimbangan mikroflora dalam saluran pencernaan ayam dengan tujuan agar infeksi patogen enterik yang masuk ke tubuh ayam dapat ditekan.

Isolasi dilakukan dengan memasukkan crop segar yang telah dipotong pada media GYP cair, dan diinkubasikan pada suhu 37°C selama 2 hari untuk memberi kesempatan bakteri yang ada pada crop untuk tumbuh. Selanjutnya dilakukan isolasi menggunakan metoda goresan pada media GYP (glucose yeast extract pepton) yang ditambah dengan CaCO₃, 10ppm natrium azida dan 0,2% oxgall, pH diatur 5. Inkubasi dilakukan pada suhu 37°C selama 48 jam. Identifikasi untuk menentukan genus *Lactobacillus* dan species-nya didasarkan pada pengecatan Gram, morfologi, uji katalase, uji pengaruh suhu dan pH terhadap pertumbuhan, uji fermentasi, uji pembentukan asam dari berbagai sumber karbon, dan tipe peptidoglikan. Sedangkan pengujian terhadap kemampuannya sebagai agensia probiotik meliputi uji resistensi terhadap asam dan bile salt.

Dari sejumlah sampel crop yang diambil dari 15 ekor ayam diperoleh 5 isolat *Lactobacillus*. Satu isolat diduga sebagai *Lactobacillus acidophilus* sedangkan 4 isolat lainnya diduga sebagai *Lactobacillus murinus*. Semua isolat mampu hidup pada bile salt 0-1,0% meski pun setelah 24 jam mengalami penurunan jumlah sel hidup. Untuk pengujian resistensi terhadap asam, hasil yang diperoleh menunjukkan bahwa semua isolat memiliki resistensi hingga pH 4,5, karena pada pH 2,5 menunjukkan penurunan jumlah sel hidup sangat tajam.

Kata kunci : *Lactobacillus*, crop, probiotik, ayam kampung.

Produksi Bakteriosin oleh *Leuconostoc mesenteroides* SM 22 menggunakan Tetes sebagai Sumber Karbon

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Abstract

Leuconostoc mesenteroides SM 22, isolated from commercial refrigerated sliced meat has an ability into produce bacteriocin. This bacteriocin could inhibit or kill psychrophilic and psychrotropic bacteria isolated from refrigerated food and also psychrotropic pathogenic *Listeria monocytogenes*. From commercial purpose as food biopreservatives, bacterial production on industrial scale must be done. In this study, optimization of the production of bacteriocin has been carried out. Several kind of media, i.e., TGE (tripton, glucose, yeast extract), TGE supplemented with buffer, MRS and PGY (peptone, gucose, yeast extract) were used and incubation temperature (30 and 37°C we studied. Result showed that maximum bacteriocin activity (flask scale) was obtained for 12-h incubation time or during the end of logarithmic or early stationary stage. The maximum bacteriocin activity was obtained using MRS and TGE supplemented with buffer with the amount of 4.250 AU/ml and 3.250 AU/ml, respectively. This study shows that molasses could be used as carbon source for glucose substitution. Result on 'fermentor' scale showed that maximum bacteriocin activity was obtained using TGE and TTE (tripton, tetes, yeast extract) supplemented with buffer, incubated at 30°C for 15-18h, with their result of 2.000 AU/ml and 1.600 AU/ml, respectively. Extraction of bacteriocin was carried out using the adsorption-desorption method, and result showed that pH combination treatment was obtained on the pH 6.0 for adsorption and 1.5 for desorption.

Key words: Bacteriocin, *Leuconostoc mesenteroides*, molasses

**Seleksi Bakteri Asam Laktat Sebagai Agensia Probiotik yang Berpotensi
Menurunkan Kolesterol**

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Abstract

Thirty six isolates of lactic acid bacteria obtained from different origins (16 dadih isolates, 2 sausage isolates, 11 fecal isolates, 1 growol isolate, 2 gatot isolates, 2 sauerkraut isolates and 2 yoghurt isolates) were screened as probiotic which have potential properties to reduce serum cholesterol level.

The first screening was conducted to analyse the ability of isolates to assimilate (take up) cholesterol during growth and the ability to deconjugate bile salt. The second screening was done to study the ability the isolates to grow in the medium using bile salt supplementation with various concentrations and the resistancy of the isolates against low pH.

Most of the strains tested had capability to assimilate cholesterol but not all of them had ability to deconjugate bile salt. Nine isolates (Lactobacillus sp. Dad 4, Streptococcus sp. Dad 11, Lactobacillus sp. Dad 13, Enterococcus sp. A1, Lactobacillus sp S1, L. acidophilus N2, L. acidophilus D2, L. Plantarum Mut 7 and L. Sake Mut 13) were most active strains in assimilating cholesterol and deconjugating bile salt. All isolates were capable to grow at MRS medium supplemented with 10% bile salt. But only five isolates (Lactobacillus sp. Dad 13, L. acidophilus N2, L. acidophilus D2, L. plantarum Mut 7, L. sake Mut 13) had resistancy to low pH (pH 2,0). Based on their ability to assimilate, deconjugate bile salt and grow on low pH, three isolates (Lactobacillus sp. Dad 13, L. acidophilus D2, and L. plantarum Mut 7) were potential to be used as probiotic for reducing cholesterol.

Key words: Lactic acid bacteria, probiotic, assimilation cholesterol, deconjugation bile salt, acid and bile tolerance

Isolasi *Lactobacillus* yang Berpotensi Sebagai Kandidat Probiotik

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Abstract

Lactic acid bacteria are important in food fermentation and as an antimicrobial producer responsible for food preservation, and used to balance the microflora in gastrointestinal tract therefore contributing many healthfull benefits as probiotic agent). Disturbance due to pathogenic bacteria colonization in the intestine as well as sterilization of intestine owing to antibiotic ingestion can be overcome by consumption of probiotic of lactic acid bacteria.

The objective of this study was to isolate *Lactobacillus* strains potential for probiotic agent from feces of healthy infant. Isolation was conducted using PGY as a media with addition of 0.2% oxgall at pH 5, followed by incubation at 37°C for 48 hr. Identification covered Gram staining, morphological, biochemical and physiological test, and peptidoglycan types.

The results indicated that *Lactobacillus* was found in feces of the infant of 30-60 days old. In this study 11 strains of *Lactobacillus* were isolated, 8 of them were identified as *L. acidophilus* classified to Group I containing 7 different isolates and Group II based on biochemical and protein profile examination, and the rest were *L. reuteri* designated as Group III. In the preliminary screening, base on the ability of isolates to grow in the media containing oxigall 0,2% and low pH, these isolates were potential for probiotic candidate.

Produksi Sel Bakteri Asam Laktat pada Berbagai Media

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Abstrak

Telah dilakukan penelitian produksi biomasa menggunakan isolat *Lactobacillus acidophilus* dan *Lactobacillus reuteri* yang diisolasi dari feses bayi. Media fermentasi yang digunakan adalah tetes, air kelapa, tripton, pepton, yeast ekstrak, mineral dan glukosa. Pengeringan terhadap biomasa yang diperoleh dilakukan dengan pengeringan beku dan semprot dengan bahan pembawa (carrier) susu skim, tepung beras dan tepung ketan. Viabilitas sel dihitung dengan metoda plating dengan medium MRS selama fermentasi, pembekuan, pengeringan dan penyimpanan. Hasil penelitian menunjukkan bahwa air kelapa dan tetes dapat digunakan sebagai pengganti glukosa pada media TGE (tripton, glukosa, yeast ekstrak), PGY (pepton, glukosa dan yeast ekstrak) dan MRS (de Mann, Regosa, Sharpe). Medium air kelapa dan tetes yang ditambahkan yeast ekstrak 0,5 persen merupakan medium yang baik untuk produksi biomassa sel, yaitu menghasilkan sel sebanyak $1,2 - 4,3 \times 10^{10}$ CFU/ml dengan jumlah sel awal $2 - 6 \times 10^7$ CFU/ml. Selama pengeringan beku dan semprot terjadi penurunan viabilitas sel sebanyak 2 - 4 siklus log. Viabilitas sel kering yang disimpan pada suhu ruang lebih rendah dibandingkan dengan yang disimpan pada suhu rendah. Penggunaan tepung beras, tepung ketan dan susu skim sebagai carrier menghasilkan viabilitas sel setelah pengeringan yang tidak berbeda.

Kata kunci: air kelapa, tetes, viabilitas, kultur kering

Lactic Acid Bacteria in Fermented Foods of Indonesian Origin

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In this study, about 194 lactic acid bacteria strains have been isolated from 21 kinds of fermented foods (plant materials and fish origin). These fermented foods were salted fermented fruits, vegetables and fish; fermented raw cassava (*gatot* and *growol*); tape (cassava and glutinous rice); microbial starter cultures (*ragi*); and fermented soy bean (*tempe* and *moromi*). Among these strains, 109 belong to the genus *Lactobacillus*, which was dominated by homofermentative *Lactobacillus plantarum – pentosus*, 25 strains belong to *Pediococcus* (mostly *P. pentosaceus-acidilactici*), 45 strains belong to *Streptococcus* which mostly identified as *Streptococcus thermophilus*, 7 strains belong to *enterococcus*, which further identified as *E. faecium* and 8 strains *Leuconostoc (Weisella)* as *Weisella paramesenteroides*. *Lactobacilli* have been found in all fermented foods, *Pediococci* in 11 kinds of fermented foods of both plant material and fish origin, while *Streptococci* were mostly found in fermented fish, as well as *enterococci* and *Leuconostoc*. Nine strains belong to *Lactobacillus plantarum-pentosus* complex from different fermented food samples determined by their DNA-DNA homology to *L. plantarum* NRIC 1067 and *L. pentosus* NRIC 1069. Result of their homology to these strains showed that all these nine strains are identified as *L. plantarum*. Lactic acid bacteria from Indonesian fermented foods are dominated by *Lactobacillus plantarum*, followed by *Pediococcus pentosus*, and *Streptococcus thermophilus*.

LACTIC ACID BACTERIA AND THEIR ROLES IN FOOD INDUSTRIES IN INDONESIA

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Lactic acid bacteria have been involved in food industries in several ways. Their capabilities in lowering pH due to the lactic acid produced could give a beneficial effect to the fermented product. Low pH will give more stable product and metabolites which are produced during fermentation, will improve flavor, aroma and texture of the product.

Indonesia has many kinds of fermented foods from plant and animal material which are mostly produced by natural/traditional processes. Lactic acid bacteria, which are involved in this fermentation usually, occur naturally in the raw material used for fermentation. *Ragi tape* is one of starter cultures, which contains a high number of lactic acid bacteria beside amylolytic yeast/mold. This starter culture is used to ferment steamed cassava or sticky rice to produce tape. *Tempe* (fermented steamed soybean) originally from Indonesia which exists all over the country is made through two distinct fermentation steps: first is acidification during soaking where lactic acid bacteria play important role, followed by fungal fermentation. Other fermented foods, in which lactic acid bacteria are involved, are salting fruits, vegetables, fish and fermented milk. Research on the development of lactic acid bacteria and their products for other industrial purposes such as bacteriocins for food biopreservative and biomass of these bacteria as probiotic agent have been carried out.

**Ketahanan Bakteri Psikotrofik dari Produk Perikanan Segar terhadap Bakteriosin
(Resistance of Psychrotrophic Bacteria from fresh Fishery Product Against
Bacteriocins)**

Amir Husni*, Iwan Y. B. Lelana*, dan Endang S. Rahayu**

Abstrak

Fresh fishery products are highly perishable and susceptible to spoilage caused by rapid growth and activity of bacteria. Psychrotrophic bacteria are the major microorganisms responsible for spoilage when the product stored in ice or under refrigeration. The purposes of this study were to isolate psychrotrophic bacteria from fresh fishery product and to evaluate its resistance to bacteriocins.

Fresh fishery products (kembung fish, shrimp, shellfish) samples were obtained from Demangan and Kranggan traditional market. Colony count methods were used to enumerate bacteria, whereas isolation and identification of bacteria was performed by the identification method of LaHallec and Colin (1995). The identification conducted were covering Gram Staining and cell morphological examination (cell form), motility presence or absence of an oxidize, mode of glucose or lactose fermentation, H₂S production, and gas production. The resistance assays by bacteriocin were carried out using agar diffusion method.

Seventeen isolates were found and they were classified as *Pseudomonas*, *Xanthomonas*, and *Flavobacterium cytophaga*. The results show that psychrotrophic bacteria resistance to supernatant of lactic acid bacteria.

The Potency of Traditional fermented Foods as a probiotic Food

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Abstract

Functional food is defined as any potentially healthfull food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains. Many researches have been conducted on the heath benefit of probiotic (life bacterial cells), one of the ingredient of functional foods. One of the potential bacteria used for probiotic agent and also involved in traditional fermented foods are lactic acid bacteria (LAB) Previous research showed that *Lactobacillus acidophilus* SNP-2 isolated from fecal material of healthy infant is resistant to acid and bile salt, and has an antagonistic effect against several enteric bacterial pathogens. The objective of this research was to study the effect of *L. acidophilus* SNP-2 as probiotic agent to the health benefits. These bacteria were supplemented into *tape ketan* (fermented sticky rice), the indigenous Indonesian fermented food. Tape ketan was chosen as the carrier of probiotic biomass based on the microflora study which shown that among *tape* products, population of LAB in *Tape ketan* is the highest, i.e., 1.3×10^8 CFU/g. Addition of *L. acidophilus* SNP-2 biomass prior to fermentation of *tape ketan* resulted in a higher total of LAB cells, i.e., 2.1×10^9 CFU/g compared to the amount of 1.5×10^8 CFU/g when the addition was done after fermentation occur. Consumption of *tape ketan* containing probiotic agent by the volunteers increased the population of LAB and Lactobacilli and decreased the population of enterobacteriaceae in their fecal material. This phenomenom revealed that probiotic agent was able to colonize and inhibit the growth of enterobacteriaceae in the gastrointestinal tract. Thus *tape ketan* can be used as a carrier for probiotic agent and it can be categorized as functional food.

Penyiapan Starter Kering Bakteri Asam Laktat Halofilik untuk Pengolahan Hasil Perikanan Fermentative Beragam

(Preparation of Dry Starter from Lactic Acid Bacteria (LAB) for Salted Fish Product Fermentation)

Ustadi¹⁾, Suparmo²⁾, Endang S. Rahayu²⁾

Abstract

Lactic acid bacteria (LAB) is known as fermentation agent in traditional food fermentation products in Indonesia, which also include fish products. Objectives of this research were to select LAB strain isolated from peda, terasi, salted fish and bekasam which were potential for dry starter preparation.

This research were consisted of three parts: (a) selection of halophilic LAB strain (b) dry starter preparation by addition glycerol protectant, cucrose and starter neutralization and and further testing its viability upon storage and (c) ability of the selected isolate to inhibit pathogenic and spoilage bacteria.

Result of this research indicated there were 8 moderate halophilic LAB, they were *Lb. plantarum* (isolate EDI-14, DES-20, DES-21, DES-24 and DES-26), *Leuc. paramesenteroides* (isolate DAN-7 and DAN-7), and *Lb. casei* subsp. *casei* (isolate DES-27). Addition of 5% glycerol protect of LAB viability during freeze drying process, however it did not keep its viability during storage. Within 5 weeks of storage, the viability of *Leuc. paramesenteroides* (DAN-7) and *Lb. plantarum* (DES-26) decrease 10.24% (from 33×10^7 sel/g to 3.3×10^7 sel/g dried starter) and 9.77% (from 36×10^7 sel/g to 3.5×10^7 sel/g dried starter), respectively. Freeze drying process and dry storage did not affect the LAB isolate toward inhibiting the pathogenic bacteria and spoilage bacteria such as *Salmonella choleraesius* JCM 3919, *Shigella*, *Eschericia coli* FNCC 0091, *Vibrio parahaemolyticus* JCM 2147 (gram negative), *Staphylococcus aureus* FNCC 0091, and *Morganella morganii* NTCT 2847 (gram positive).

Key words: dry starter, lactic acid bacteria, fermented fish

Isolasi dan Seleksi *Lactobacillus* yang Berpotensi Sebagai Agensia Probiotik

Isolation and Selection of *Lactobacillus* Potential for Probiotic Agent

Siti Nur Purwandhani dan Endang S. Rahayu

Lactic acid bacteria are important in food fermentation, in producing antimicrobial substances responsible for food preservation, and in balancing the microflora composition in gastrointestinal tract which contributing many healthfull benefit (as probiotic agent). Disturbance due to pathogenic bacteria colonization in intestine as well as sterilization of intestine due to antibiotic ingestion can be overcome by consumption of probiotic lactic acid bacteria.

The objective of this study was to isolate *Lactobacillus* which potential for probiotic agent from intestinal material of healthy infant baby. Isolation was conducted using peptone glucose yeast extract media added with 0.2% oxgall at pH 5, followed by incubation at 37°C for 48 hr. Identification were carried out based on Gram, morphological, biochemical and fisiological characters, peptidoglycan types and protein profile on SDS-PAGE. Selection of probiotic agents were on based their antagonisms toward pathogenic bacteria, their resistance to antibiotics, and their survival at different oxygen availabilities.

Based on morphological, biochemical and physiological character among 12 *Lactobacilli* strains obtained during isolation, 8 of them were identified as *Lactobacillus acidophilus* and the rest as *Lactobacillus reuteri*. However based on protein profile, *L. acidophilus* group has two different profiles, the first consist of 7 strains and the second, consist of one strain. All isolates inhibited the growth of pathogenic bacteria including *Shigella sp.*, *Eschericia coli sp.*, *Eschericia coli* FNCC 0091, *Proteus sp.*, *Salmonella choleraesius* JCM 3919, *Staphylococcus aureus* FNCC 0047, *Vibrio parahaemoliticus* JCM 2147, *Bacillus cereus* ATCC 0057 and *Listeria monocytogenes* ATCC 7644, as shown by the inhibition zone ranging from 0.5-8 mm. Eight isolates of *L. acidophilus* were not resistant to antibiotics tested, while 3 isolates of *L. reuteri* were not resistant to chloramphenicol, rifampin and ampicillin, however they were resistant tetracycline and elkosin. At reduced oxygen and anaerobic conditions all the isolates grew well, but at aerobic condition the growth was relatively slow. Strains of *Lactobacillus acidophilus* could be used for probiotic agents.

Keywords: *Lactobacillus*, probiotic, and isolation & selection.

Lactic Acid Bacteria in Fermented Foods Indonesian Origin

Endang S. Rahayu

Abstract

Lactic acid bacteria and their potential benefits: research activities

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Lactic acid bacteria have been involved in food industries in several ways. Their capabilities in lowering pH due to the lactic acid produced give a beneficial effect to the fermented products. Low pH will give more stable product, and metabolites which produced during fermentation, will improve flavor, aroma and texture of the products. About 194 lactic acid bacteria strains have been isolated from 21 kinds of Indonesian fermented foods (plant material and fish origin). Among of these, 109 strains belong to *Lactobacillus*, which dominated by *Lactobacillus plantarum-pentosus*, 25 strains belong to *Pediococcus* (mostly *Pediococcus acidilactici*), 45 strains *Streptococcus* that mostly identified as *Streptococcus thermophilus*, 7 strains belong to *Enterococcus*, which further identified as *E. faecium*, and 8 strains *Leuconostoc* (*Weisella*) as *Weisella paramesenteroides*.

Screening of bacteriocin producers lactic acid bacteria from several sources (fermented foods, meat and meat products) was done. Characterization of bacteriocins produced by species of *Pediococcus*, *Lactobacillus*, *Lactococcus*, and *Leuconostoc*, including antimicrobial spectrum, molecular weight, their stability toward high and low temperature, and various pHs. Production of bacteriocin using simple media and their extraction and purification, the use of bacteriocin as food-biopreservative, which mainly based on refrigerated foods, have been carried out.

Study on probiotics and their health effects have also been conducted. Screening of lactic acid bacteria from several sources (fermented food and infant fecal material), for probiotics agents and followed by its application to fermented foods have been carried out. Consumption of *tape ketan* containing probiotic agent by the volunteers increased the population of lactic acid bacteria and lactobacilli and decreased the population of enterobacteriaceae in their fecal material. Several probiotics agents were also claimed to have a capability in reduction of cholesterol serum in tested mice.

Lactic acid bacteria strains for probiotic chicken was also isolated from fecal material of chicken and screened. Its application to the production of chicken is being carried out currently. Lactic acid bacteria have been proved to have several beneficial affects.

Ekstraksi dan Karakterisasi Bakteriosin yang Dihasilkan oleh *Leuconostoc mesenteroides* SM 22

(Extraction and Characterization of Bacteriocin Produce by *Leuconostoc mesenteroides* SM 22)

Darmawan Ari Nugroho dan Endang S. Rahayu

Abstract

Bacteriocin produced by lactic acid bacteria has potential as food biopreservative due to their capability to control spoilage and pathogenic food borne bacteria. Previous study showed that extraction bacteriocin produced by *Leuconostoc mesenteroides* SM 22 using adsorption desorption method was not optimal. The objectives of this research were (1) to increase the effectiveness of bacteriocins extraction using adsorption desorption method by the addition of heated biomass of *Leuconostoc* SM 22 in various concentration during adsorption (2) to characterize the bacteriocin of *Leuconostoc mesenteroides* SM 22 on its stability during heat treatment, during cool storage and its spectrum activity against pathogenic bacteria.

Result of this research showed that bacteriocin activity obtained from extraction with no addition of heated biomass was 1000 AU/ml, while by addition of heated biomass of 2 to 3 times of original concentration (OD) were 2000 AU/ml. Therefore it was suggested that addition of heated biomass of *Leuconostoc mesenteroides* SM 22 during adsorption desorption with 2 times of original concentration (OD) was able to increase the bacteriocin obtained.

Bacteriocin with original activity of 2000 AU/ml, was stable (no reduction activity) after heated at 100°C for 30 minutes, but slightly decreased after heated at 121°C for 15 minutes, that were 1600 AU/ml and 800 AU/ml respectively. Bacteriocin of *Leuconostoc mesenteroides* SM 22 was stable during 8 weeks storage at refrigerator (4°C), freezer -20°C and -40°C. This bacteriocin has a wide spectrum of activity showed by its ability to inhibits the growth of *Listeria monocytogenes*, *Staphylococcus aureus*, *Salmonella thypimorium*, *Vibrio parahaemoliticus*, *Shigella* and Pshycrophilic bacteria was isolated from milk and isolated from neat.

Key words: Bacteriocin, *Leuconostoc mesenteroides*

Suplementasi *Lactobacillus acidophilus* SNP-2 pada Tape dan Pengaruhnya pada Relawan

(Supplementation of *Lactobacillus acidophilus* SNP-2 Into Tape and its Effect to the Volunteers)

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Abstract

Functional food is defined as any potentially healthfull food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains. Many researches have been conducted on the heath benefit of probiotic (life bacterial cells), one of the ingredient of functional foods. One of the potential bacteria used for probiotic agent and also involved in traditional fermented foods are lactic acid bacteria (BAL). Previous research showed that *Lactobacillus acidophilus* SNP-2 isolated from faecal material of healthy infant is resistant to acid and bile salt, and has an antagonistic effect against several enteric bacterial pathogens. The objective of this research was to study the effect of *L. acidophilus* SNP-2 as probiotic agent to the health benefits. These bacteria were supplemented into tape ketan (fermented sticky rice), the indigenou Indonesian fermented food. Tape ketan was chosen as the carrier of probiotic biomass based on the high population of LAB in this product, i.e., 1.3×10^8 CFU/g. Additional of *L. acidophilus* SNP-2 biomass prior the fermentation of tape ketan resulted in a higher total of LAB cells, i.e., 2.1×10^9 CFU/g compared to the amount of 1.5×10^8 CFU/g when the addition was done after fermentation. Consumption of tape ketan containing probiotic agent by the volunteers increased the population of Lactobacilli (from 1.7×10^7 to 9.9×10^7 CFU/g and decreased the population of enterobacteriaceae (from 5.4×10^9 CFU/g to 4.4×10^8) in their faecal material. This phenomenom revealed that probiotic agent was able to colonize and inhibit the growth of enterobacteriaceae in the gastrointestinal tract. The result implied that tape ketan can be used as a carrier for probiotic agent and it can be categorized as functional food.

Key word: tape ketan, *Lactobacillus acidophilus*, probiotic

Prebiotic Milk Shake and Its Health Benefits

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Abstract

Study on the effect of prebiotic consumption to the fecal material volunteer was conducted at Center for Food and Nutrition Studies, Gadjah Mada University. Aim of this study was to investigate the health beneficial effect of prebiotic product directly using volunteers. Prebiotic product used in this study was *stefit*TM – non fat milk shake which contains dietary fiber, antioxidant (vitamin E and C), calcium and chicory root extract inulin as prebiotic. Seven healthy volunteers (5 males and 2 females), 30-40 years old, were recruited for this study. During the study (6 weeks), volunteers were asked to avoid antimicrobial drugs and fermented foods containing antimicrobial cells. The volunteers were divided into two group, group 1 (consist of 2 persons) were asked to consumed original non-fat milk, while group 2 (5 persons) consumed non fat milk shake prebiotik. Consumption of milk shake was done every day (2 sachets per day, morning and afternoon) during 4 weeks. Twice a week, fecal materials of volunteers were microbiologically analyzed, including a week before and after consumption. Diet of each volunteer was not controlled, they ate as their usual food every day and the menus were recorded. Consumption of milk shake prebiotik by normal healthy volunteer resulted in increased the number of fecal lactic acid producing bacteria (from about 10^6 to 10^7 CFU/g fecal material), and decreased the population of fecal enterobacteriaceae and coliform. According to the data, fecal lactic acid producing bacteria of volunteers who consumed the original milk shake were mostly constant. Conclusion of this study is the increasing number of lactic acid bacteria induced by prebiotic inulin in the colon has the potential to improve the health and well being of the host.

Keywords: prebiotics, inulin, lactic acid bacteria, enterobacteriaceae, coliform

***Pediococcus acidilactici* F11 Penghasil Bakteriosin sebagai Agensia Biokontrol *Eschericia coli* dan *Staphylococcus aureus* pada Sayuran Segar Simpan Dingin**

(Bacteriocin Produces *Pediococcus acidilactici* F-11 as Biocontrol Agent Against *Eschericia coli* and *Staphylococcus aureus* of fresh vegetables stored at refrigerator)

Endang S. Rahayu, Eni Harmayani, Tyas Utami and Kejora Handarini

Our survey indicated that fresh vegetables contained high population of microorganisms including pathogenic *Staphylococcus aureus*. Washing producers, including the addition of sanitizer to the wash water have not been effectively in reduction of the number of microorganisms. Currently, there is interest in possible use bacteriocin producers of lactic acid bacteria as biocontrol agents to ensure safety of minimally processed, refrigerated (MPR) foods which are not acidified, including fruits and vegetables.

Our previous result, indicated that *Pediococcus acidilactici* F11 (PAF 11) produced bacteriocin with wide spectrum activity. Objectives of this research was to study the potency of PAF-11 as biocontrol agents to inhibit the growth of pathogenic bacteria occurred in ready to eat fresh vegetables, i.e., paprika, lettuce, carrot.

The results showed that PAF-11 was able to inhibit the growth of naturally present Coliform and *Staphylococcus* significantly, as well as that of tested bacteria of *E. coli* and *S. aureus* which were inoculated into paprika and carrot. PAF-11 was able to grow at these two vegetables, and their populations were increased about 1 log cycle. Bacteriocin activity produced by PAF-11 was positively detected from these two vegetables inoculated with these bacteria. However there was no inhibition activity of PAF-11 against naturally present coliform and *Staphylococcus*, as well as inoculated *E. coli* and *S. aureus* on lettuce. Bacteriocin activity produce by PAF-11 was also not detected in this vegetable. Conclusion of this study, *Pediococcus acidilactici* F11 could be used as biocontrol agents in paprika and carrot.

Key words: Bacteriocin-producer, lactic acid bacteria, biocontrol, fresh vegetables

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Probiotic Research in Indonesia

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Abstract

Several researches concerning of probiotic have been carried out in Indonesia. Probiotic research which carried out at the Faculty of Agricultural Technology and Center for Food and Nutrition Studies Gadjah Mada University is covering 4 (four) aspects, i.e., origin of cultures (isolation and identification); physiological aspect (antagonism among pathogenic bacteria, production of β -D-galactosidase, lowering serum cholesterol); technological aspects (production biomass using low cost medium for growth, application to foods i.e., fermented foods and drinks); safety consideration (in vivo studies).

Lactobacillus acidophilus SNP-2 isolated from fecal material of healthy infant was suggested to be probiotics candidate strain. Among the strains obtained during isolation, SNP-2 was the most resistant to acid (pH 2.0) and bile salt (10%), and it has and antagonistic effect against several enteric bacterial pathogens (*Shigella*, *Salmonella choleraesuis*, *Vibrio parahaemolyticus*, *E. coli*, *Listeria monocytogenes*, *Staphylococcus aureus*, *Bacillus cereus*).

For application used, production of biomass probiotic strains were studied using cheap material, such as coconut water, supplemented with yeast extract and sprout extract. Preparation to dried cells was also done using drying and freeze drying methods. The results showed that our probiotic strains were grow well in coconut water and extract of mungbean sprout. Several researches have been carried out for the application of probiotic into food products, including fermented food (yogurt and *tape ketan*) and drinks (fruit juices).

Candidate of probiotic strain was supplemented into *tape ketan* (fermented sticky rice), the indigenous of Indonesian fermented food. *Tape ketan* was chosen as a carrier of probiotic biomass based on the microflora study which shown that among *tape* products, population of LAB in *tape ketan* is the highest, i.e., 1.3×10^8 CFU/g. Addition of *L. acidophilus* SNP-2 biomass prior to fermentation of *tape ketan* result in a higher total of lactic acid bacterial cells i.e. 2.1×10^9 CFU/g compared to the amount of 1.5×10^8 CFU/g when the addition was done after fermentation occur. Consumption of *tape ketan* containing probiotic agent by the volunteers increased the population of lactic acid bacteria and lactobacilli and decreased the population of enterobacteriaceae in their fecal material. This phenomenon revealed that probiotic agent was able to colonize and inhibit the growth of enterobacteriaceae in the gastrointestinal tract. Thus *tape ketan* can be used as a carrier for probiotic agent and it can be categorized as functional food.

The ability of probiotic strain in binding aflatoxin has currently being studied. *Lactobacillus acidophilus* SNP-2 was able to bind AFB1 up to 61.85% present in the liquid buffer; the other lactic acid bacteria studied, including yogurt strains, *Lactobacillus bulgaricus* and *Streptococcus thermophilus* bind AFB1 as much as 31,09% and 37,56%, respectively.

Other probiotic researches covering selection of strains, their health beneficial effects as well as their biomass production have been done in other research institutes (IPB, UI, BPPT). Study in immunomodulator of probiotic strain isolated from *dadih* was carried out as well (BPPT).

Perubahan Fisik dan Biokimiawi Bakal Petis Daging selama Fermentasi Kering Spontan

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Dalam fermentasi kering spontan kualitas produk relatif tidak stabil, karena mikrobiota sangat tidak bervariasi, lingkungan fermentasi yang tidak terkontrol, proses dan bahan dasar yang sangat bervariasi. Melihat kondisi tersebut, proses pengembangan produk fermentasi daging sangat menjanjikan. Untuk itu diperlukan penelitian awal untuk mengetahui perubahan-perubahan yang terjadi baik secara fisik maupun biokimiawi selama fermentasi berlangsung. Tujuan penelitian ini untuk menggali informasi awal berupa perubahan fisik dan biokimiawi yang dapat digunakan sebagai dasar dalam memperbaiki atau bahkan meningkatkan kualitas produk yang dihasilkan selama proses fermentasi.

Penelitian dilakukan di Lab. Mikrobiologi PSPG Universitas Gadjah Mada, Yogyakarta. Pengamatan perubahan secara fisik diamati dari kenampakan, warna, fisik daging dan aroma. Sedangkan untuk perubahan biokimiawi yang diamati adalah protein terlarut metode Lowry, karbohidrat dalam hal ini sebagai gula reduksi dengan metode Nelson-Somogyi, lemak dengan metode soxlet, garam dengan metode Kohman, bioamin dalam hal ini diukur sebagai histamin dengan metode spektrofotometri (Mahendrata, 2003), total asam dengan titrasi, Aw dengan metode cawan Conway.

Hasil penelitian menunjukkan bahwa pH dan asam tertitrisasi selama fermentasi tidak mengalami perubahan yang signifikan, gula reduksi dan protein terlarut meningkat akibat dari degradasi komponen karbohidrat dan protein, kemudian mengalami penurunan karena diduga digunakan untuk metabolisme mikrobia.

Kata kunci: Fermentasi Kering Spontan, Garam.

Pengikatan Aflatoksin B1 oleh Bakteri Probiotik *Lactobacillus acidophilus* SNP-2¹

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Abstrak

Aflatoksin B1 (AFB1) merupakan jenis aflatoksin yang paling sering mengkontaminasi pangan dan pakan, dan juga paling berbahaya. Bakteri asam laktat diketahui mempunyai kemampuan mengikat aflatoksin. Pada penelitian ini dipelajari pengikatan aflatoksin oleh bakteri probiotik *Lactobacillus acidophilus* SNP-2 baik dalam keadaan hidup, maupun mati karena pemanasan, asam dan sonikasi. Proses pengikatan aflatoksin berlangsung pada pH 7,3, suhu 37°C selama 24 jam, stabilitas ikatan antara bakteri dengan aflatoksin dipelajari dengan cara pencucian berulang menggunakan larutan buffer pH 7,3. Kadar aflatoksin B1 dianalisis menggunakan HPLC. Banyaknya aflatoksin yang terikat pada bakteri merupakan selisih dari aflatoksin mula-mula dengan yang tertinggal dalam larutan.

Hasil penelitian menunjukkan bahwa sel mati karena perlakuan pemanasan dan asam mempunyai kemampuan mengikat AFB1 lebih dari dua kali dibandingkan dengan sel hidup. Sedangkan kemampuan mengikat AFB1 oleh sel mati karena sonikasi setara dengan sel hidup. Lebih dari 70% AFB1 yang terikat pada sel hidup dapat lepas selama pencucian. Namun perlakuan pemanasan dan asam meningkatkan secara nyata stabilitas kompleks yang terbentuk antara bakteri dengan AFB1.

Kata Kunci: Aflatoksin B1, Pengikatan bakteri asam laktat.

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Potensi Bakteri Asam Laktat di Bidang Industri Pangan

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Abstrak

Bakteri asam laktat memiliki sejarah panjang digunakan untuk produksi fermentasi dan dapat dikategorikan sebagai *food-grade bacteria*. Di bidang industri pangan, bakteri asam laktat memiliki potensi untuk dimanfaatkan sebagai starter fermentasi makanan, sebagai agensia pengawet makanan (biopreservasi), dan sebagai agensia probiotik dengan berbagai manfaat kesehatan. Namun demikian di dalam pengembangan bakteri asam laktat, maka ketiga potensi ini dapat dikombinasikan. Penggunaan bakteri asam laktat penghasil bakteriosin sebagai kultur starter diperkirakan dapat menghasilkan makanan fermentasi yang lebih aman dan awet, terutama bila proses fermentasi berlangsung secara alami. Penambahan kultur starter bakteri asam laktat penghasil bakteriosin dapat menurunkan secara nyata bioamin dalam produk fermentasi keju, sauerkraut, daging dan peda. Melalui proses penggumpalan tahu dengan bakteri asam laktat penghasil bakteriosin sedang diupayakan sebagai salah satu usaha untuk membuat tahu dengan kualitas lebih baik. Bakteri asam laktat dapat dimanfaatkan sebagai agensia probiotik dengan berbagai manfaat kesehatan. Saat ini sedang diteliti, kemampuan bakteri asam laktat yang dapat mengikat aflatoksin untuk digunakan sebagai starter sekaligus agensia probiotik dalam fermentasi sari kedelai dan kacang tanah untuk dihasilkan minuman probiotik yang menyehatkan.