Screening of Lactic Acid Bacteria from Fermented Foods with Enzyme Production and Antibacterial Property for Further Application as Precision Probiotics

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Abstract

Lactic acid bacteria are an important source of metabolites and play a vital role in human health by modulating gut microbiota, enhancing immune response and controlling metabolic diseases in human. They are widely utilized in probiotic application and are essential for the development of precision probiotics targeting specific diseases. This study aimed to isolate and preliminarily screen LAB strains based on their enzyme production and antibacterial property against the representative pathogenic bacteria. A total of sixty-one isolates were obtained from fermented foods. Among these, sixty isolates exhibited protease production, which isolate DS5, a gram-positive rod-shaped bacterium derived from fermented pork, showed the highest protease production by forming a halo zone of 6.17 ± 0.86 mm on solid media. Furthermore, 5 isolates from fermented pork and kimji showed cellulase production, while 2 isolates from fermented fish, exhibited pectinase production. The antibacterial activity of top 20 isolates which produced three target enzymes was evaluated against *Bacillus cereus, Staphylococcus aureus, Escherichia coli, Listeria monocytogenes* and *Pseudomonas aeruginosa* using the agar well diffusion method. 6 isolates demonstrated inhibitory effects against *B. cereus*, *E. coli*, and *P. aeruginosa*. Among these, isolate MV2-2, which was obtained from fermented pork, revealed the strongest antibacterial activity to those pathogenic bacteria with inhibition zones of 11.33 ± 0.58 mm, 11.67 ± 0.58 mm and 11.67 ± 0.58 mm, respectively. These findings indicated that LAB isolated from fermented foods revealed the potency in probiotic characterization. The isolates will be examined and characterized particularly in the development of precision probiotics targeting metabolic syndrome and specific immune responses in human.

Introduction

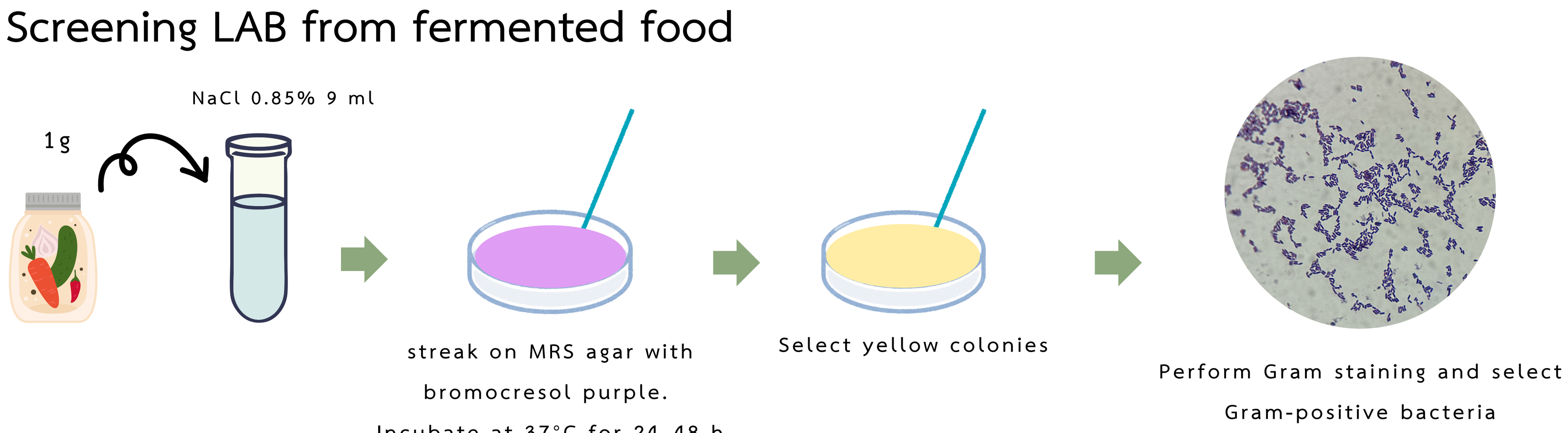
Lactic acid bacteria (LAB) play a vital role in various biological and industrial applications. They are well known for their ability to produce bioactive metabolites, regulate gut microbiota, enhance immune responses, and aid in the prevention and management of metabolic diseases in human. A key functional trait of LAB is their capacity to produce extracellular enzymes and exert antimicrobial effects through the production of organic acids, bacteriocins, and other antimicrobial compounds, which help inhibit pathogenic bacteria and promote a balanced microbiome. Despite their recognized health benefits, further research is needed to identify and characterize LAB strains with enhanced functional properties for probiotic applications. In particular, strains with superior enzymatic activity and antimicrobial potential could serve as promising candidates for the development of precision probiotics targeting metabolic syndrome and immune modulation.

Objective

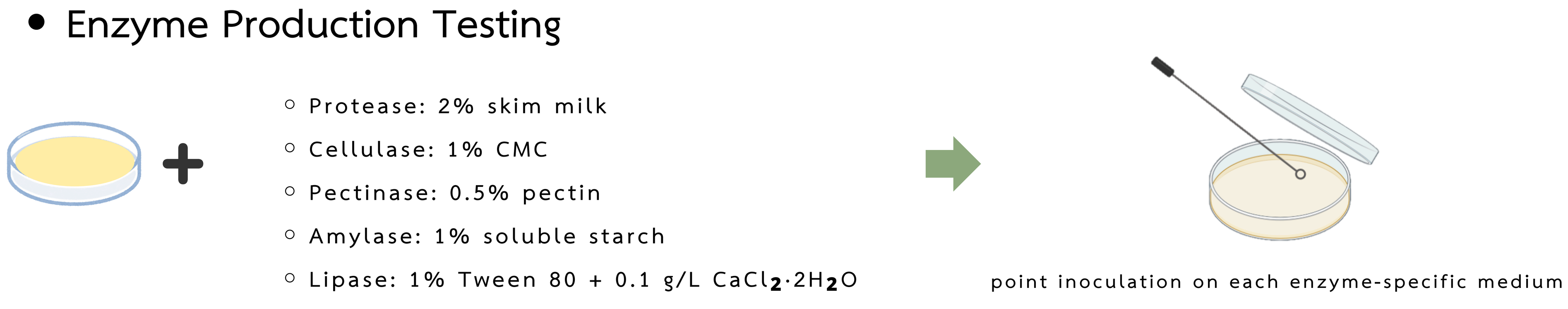
To isolate and preliminarily screen lactic acid bacteria strains based on their enzyme production and antibacterial property against the representative pathogenic bacteria.

Methodology

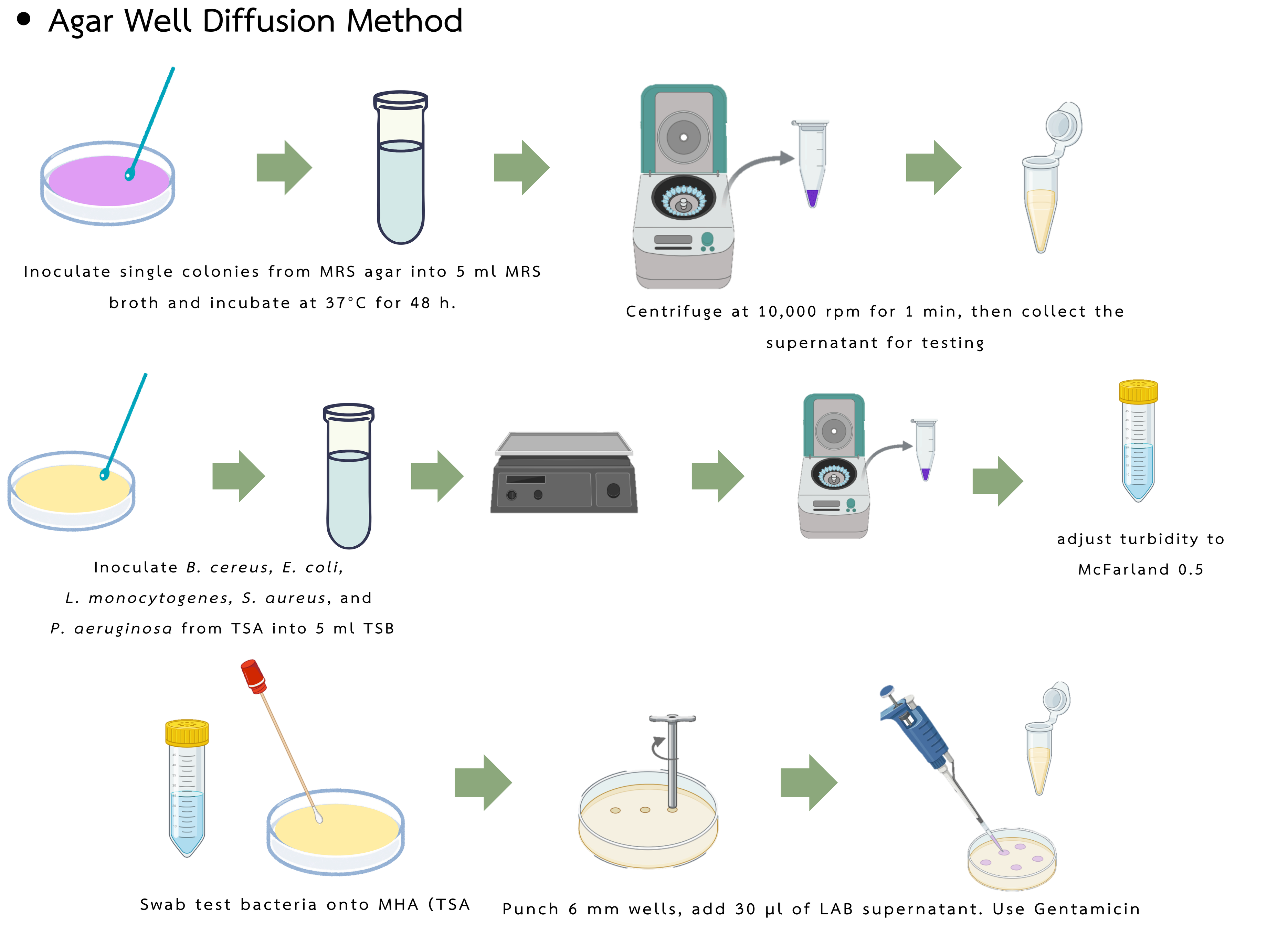
- Screening LAB from fermented food



- Enzyme Production Testing



- Agar Well Diffusion Method



Results

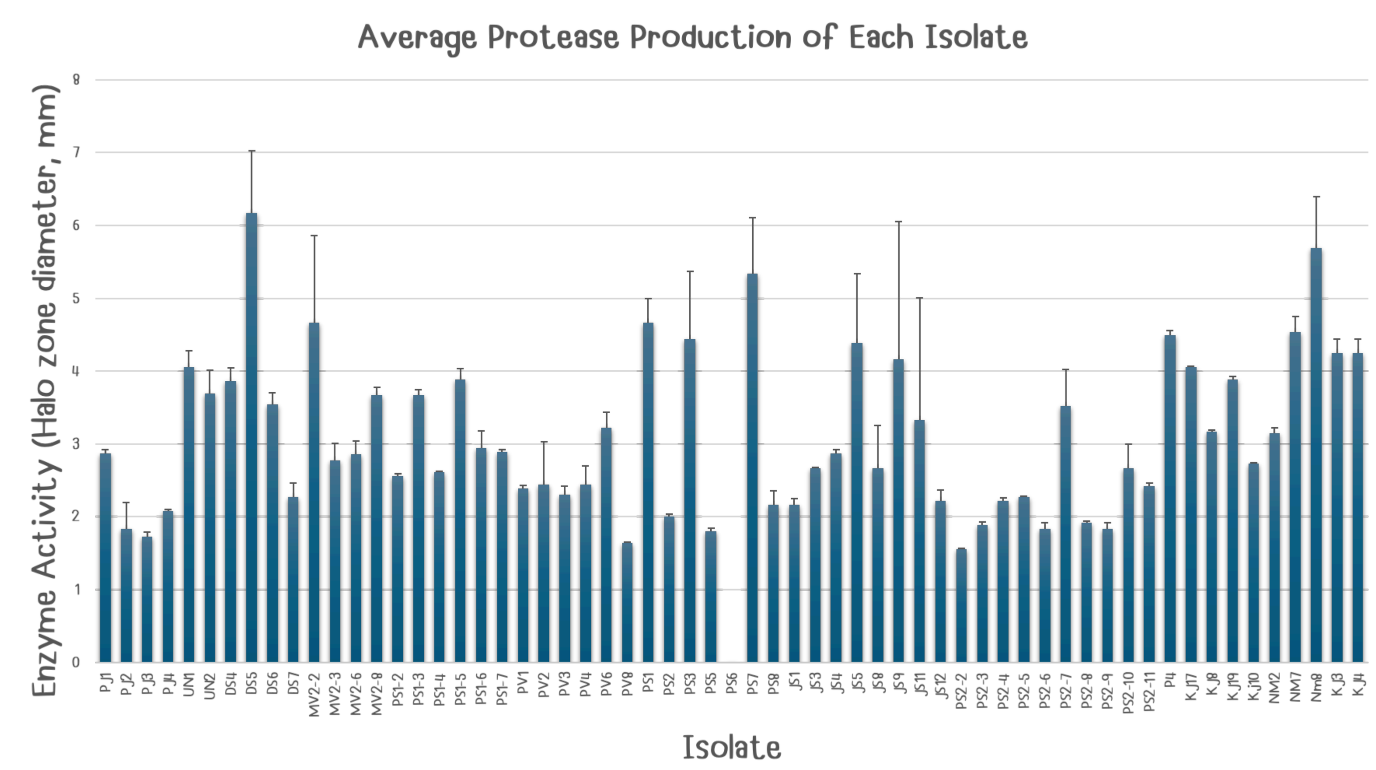


Fig 1 : Enzymatic production of protease

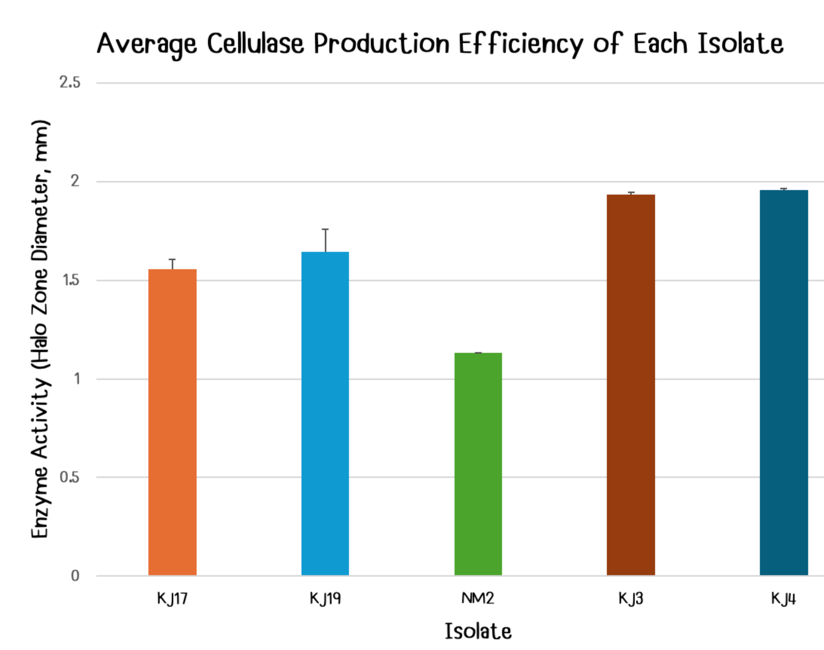


Fig 2 : Enzymatic production of cellulase

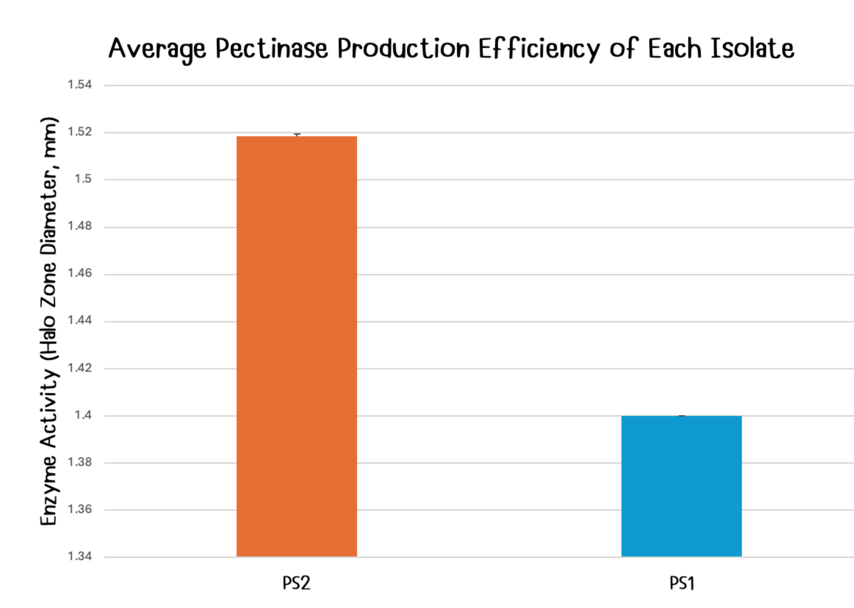


Fig 3 : Enzymatic production of pectinase

Table 1 : Inhibition zones against pathogenic bacteria

Isolate	Inhibition zone (mm) (mean±SD)				
	B. cereus	*E. coli*	*P. aeruginosa*	*S. aureus*	*L. monocytogenes*
UN1	9.67±0.58c	10.33±0.58c	10.00±0.00c	0.00±0.00	0.00±0.00b
PS1	0.00±0.00e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
PS7	0.00±0.00e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
PPS2-9	9.67±0.58c	11.00±0.58b	11.00±0.00b	0.00±0.00	0.00±0.00b
DS5	10.00±0.00c	10.33±0.58c	10.67±0.57b	0.00±0.00	0.00±0.00b
JS5	0.00±0.00e	9.67±0.58d	9.33±0.57d	0.00±0.00	0.00±0.00b
JS9	9.67±0.58c	9.33±0.58d	11.00±0.00b	0.00±0.00	0.00±0.00b
JS11	0.00±0.00e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
MV2-2	11.33±0.58a	11.67±0.58a	11.67±0.58a	0.00±0.00	0.00±0.00b
MV2-3	10.67±0.58b	11.67±0.58a	11.00±0.00b	0.00±0.00	0.00±0.00b
PR4	0.00±0.00e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
NM2	8.33±0.33e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
NM7	9.67±0.33c	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
NM8	0.00±0.00e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
KJ3	0.00±0.00e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
KJ4	0.00±0.00e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
KJ8	0.00±0.00e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
KJ10	0.00±0.00e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b
KJ17	10.33±0.33bc	0.00±0.00e	11.67±0.58a	0.00±0.00	11.67±0.33a
KJ19	0.00±0.00e	0.00±0.00e	0.00±0.00e	0.00±0.00	0.00±0.00b

Conclusion

Sixty-one isolates were obtained from fermented foods, with Sixty showing protease production. Isolate DS5 from fermented pork exhibited the highest activity with a halo zone of 6.17 ± 0.86 mm. Five isolates from fermented pork and kimchi produced cellulase, while two from fermented fish produced pectinase. The top 20 enzyme-producing isolates were tested for antibacterial activity against. 6 isolates inhibited *B. cereus*, *E. coli*, and *P. aeruginosa*, with isolate MV2-2 from fermented pork showing the strongest inhibition, with zones of 11.33 ± 0.58 mm, 11.67 ± 0.58 mm, and 11.67 ± 0.58 mm, respectively.

References

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