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Extraction and application of exo-polysaccharides produced by lactic acid bacteria from Nigerian fermented foods

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Microbial exo-polysaccharides are high molecular weight polymers of sugar residues secreted into the extracellular environment in the form of slime. Their low production and high cost of recovery are limiting factors to their use as food additives. This study investigated exo-polysaccharide producing lactic acid bacteria (LAB) fermented foods such as 'fufu', 'wara', 'garri', 'ogi', yoghurt and cassava paste. Isolation and viable LAB count were done using de Mann, Rogosa and Sharpe agar. The isolates were identified using physiological and biochemical methods, and screened for exo-polysaccharides production. Parameters such as temperature, pH and carbon were optimized for the production of exo-polysaccharides. Four highest exo-polysaccharide producers were classified using molecular method. The functional groups present in the purified exo-polysaccharide were determined using Fourier transform infrared spectroscopy. Monomer analysis was done by Gas Chromatography-Mass Spectrophotometry (GC-MS). In vitro application of purified exo-polysaccharides was monitored to control water loss in yoghurt. A 10 man panelist was used for sensory evaluation on a nine point-hedonic scale. Results were analyzed using IBM statistical package for social sciences version 17.0. Total number of bacteria obtained from fermented foods was 265. Wara and fufu had the highest colony forming units of 5.6×107 CFU/ml and 5.9×107 CFU/ml respectively. 55 isolates produced exo-polysaccharides which included *Lactobacillus plantarum* (30.1%), *L. fermentum* (26.8%), *L. delbrueckii* (2.6%), *L. brevis* (9.8%), *L. higardii* (5.6%), *L. rhamnosus* (6.0%), L. acidophilus (2.3%) and leuconostoc spp. (9.8%). Four highest exo-polysaccharide producing isolates were *L. fermentum* (199.1 mg/l), *L. delbrueckii* (186.5 mg/l), *L. plantarum* (199.1 mg/l and *L. rhamnosus* (201.6 mg/l). Molecular characterization based on 16S rRNA genes confirmed these four isolates as *L. plantarum*, *L. fermentum*, *L. delbrueckii* subspp. Buglaricus and *L. rhamnosus*. The best optimizing conditions were temperature of 200 and 300˚C, pH 5 and 6 with 6% sucrose as the best carbon source yielding 15945.4±70 mg/ml exo-polysaccharide. Spectroscopy analysis showed the presence of carboxyl with absorbance peaks between 3446.9 cm-1 and 3454.6 cm-1 and hydroxyl groups between 2065.8 cm-1 and 2362.9 cm-1. GC-MS revealed that the most frequently occurring monomers present in the exo-polysaccharides were glucose and galactose. Yoghurts supplemented with 2% exo-polysaccharide exhibited high resistance to syneresis for *L. fermentum* and *L. plantarum* while 3% was effective for *L. delbrueckii* and *L. rhamnosus*. Yoghurt supplemented with exo-polysaccharide from *L. delbrueckii* subspp. Bulgaricus was preferred with overall acceptability of 7.8. Sensory evaluation recorded ($p<0.05$) higher scores on aroma (6.5±0.0 and 8.0 ±0.4), appearance (5.5±0.3 and 7.3± 0.3), texture (5.8±0.3 and 7.3±0.5), thickness (5.8±0.2 and 8.0±0.4) and overall acceptability (7.0±0.4 and 7.8±0.6). In conclusion, exo-polysaccharide production was optimal at temperatures 20 and 300˚C; pH 5 and 6, while the addition of 2% and 3% sucrose considerable reduced whey loss (syneresis) of yoghurt thereby giving the best stabilization and preservation.

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