UNIVERSITY FOR DEVELOPMENT STUDIES

FACULTY APPLIED SCIENCES

Preserving African Food Microorganisms for Green Growth (DFC No. 13-04KU)

REPORT ON OPTIMIZATION OF TECHNOLOGICAL PROPERTIES FOR SELECTED CULTURES AND ESTABLISHMENT OF PILOT TRIAL (M8 AND O3.2)

October, 2018

UDS-Green growth local project team
Dr. James Owusu-Kwarteng – Team Leader
Dr. Fortune Akabanda - Post-doc/member
MS. Grace Adzo Motey – PhD student
Mr. Oliver Awo – PhD Student

Optimization of technological properties for starter culture development

Lactic acid bacteria and a yeast were selected based on various parameters used to assess their technological potential. These include rate of acidification, proteolysis, lipolysis, antimicrobial activities, low pH and bile salts tolerance, susceptibility to various antibiotics and hemolytic activities (Table 1).

The LAB strains which performed best in the various parameters used to assess their technological properties were used as starter cultures.

Table 1. Lactic acid bacteria (LAB) with best technological properties selected as starter cultures

Parameters	STRAINS		
	Lactobacillus delbrueckii	*Lactococcus lactis*	*Pediococcus acidilactici*
Rate of acidification	**48NL16**		**OS24h9**
Proteolysis		OY9h19	
Lipolysis			OS8h9
EPS production		OS24h12	OS24h11
Low pH tolerance	48NL16	**OY9h19**, OS24h20	
Bile salt tolerance	48NL16	OY9h19, OS24h20, OS24h1	
Antimicrobial activities	48NL16	OY9h19	
Susceptibility to antibiotics	All resistant to Kanamycin, Vancomycin, and Streptomycin but susceptible to Ampicillin, Amoxycillin, Chloramphenicol, Clindamycin, Erythromycin, and Tetracycline		
Hemolysis	48NL16	OS24h1	OY9h10

One yeast strain *Saccharomyces cerevisiae* 36h11CM2, was included as starter culture based on its probiotic potential which was assessed by experiments to determine potential to survive gastrointestinal tract passage, adhesion capacity and effect on the permeability of polarized Caco-2 monolayer. Based on the optimization of the technological properties, three lactic acid bacteria including *Pediococcus acidilactici* OS24h9, *Lactococcus lactis* OY9h19 and *Lactobacillus delbrueckii* 48NL16; and *Saccharomyces cerevisiae* 36h11CM2 were used for pilot fermentation trials.

The selected strains were used as single and combined starter cultures in yoghurt fermentation trials under two different temperatures (25 ℃, and 37 ℃) and three different concentrations (10^8, 10^9, 10^{12} cfu/ml).

Table 2: Rate of acidification of single and combined starter cultures measured at two different temperature and three different concentrations during milk fermentation.

STRAINS/ STARTERS	Inoculum concentration	25°C				37°C			
		0h	4h	8h	12h	0h	4h	8h	12h
	10^8	6.55	6.50	6.30	5.98	6.54	6.11	5.36	4.95
L1	10^9	6.55	6.47	6.23	5.91	6.55	6.12	5.37	4.91
	10^{12}	**6.55**	**6.31**	**6.01**	**5.23**	**6.55**	**6.09**	**5.30**	**4.89**
	10^8	6.54	6.41	6.25	5.91	6.55	6.39	6.14	5.37
L12	10^9	6.55	6.47	6.23	5.91	6.55	6.37	6.14	5.37
	10^{12}	**6.55**	**6.35**	**6.12**	**5.53**	**6.55**	**6.22**	**5.41**	**4.14**
	10^8	6.54	6.48	6.29	6.09	6.55	6.33	5.97	5.23
L20	10^9	6.55	6.48	6.27	6.07	6.55	6.33	5.95	5.10
	10^{12}	**6.54**	**6.45**	**6.10**	**5.51**	**6.55**	**6.11**	**5.12**	**4.91**
	10^8	6.54	6.46	6.32	5.88	6.54	6.40	6.01	5.40
L1+L12	10^9	6.55	6.45	6.31	5.87	6.55	6.39	6.01	5.31
	10^{12}	**6.55**	**6.31**	**6.04**	**5.66**	**6.55**	**6.13**	**5.54**	**4.99**
	10^8	6.54	6.50	6.20	5.71	6.55	6.40	6.10	5.29
L12+L20	10^9	6.54	6.49	6.19	5.71	6.55	6.35	6.01	5.39
	10^{12}	6.54	6.48	6.03	5.51	6.54	6.18	5.34	5.22
	10^8	6.54	6.45	6.32	5.74	6.55	6.30	6.00	5.51
L1+L20	10^9	6.55	6.45	6.31	5.74	6.55	6.21	5.94	5.40
	10^{12}	6.55	6.38	6.00	5.34	6.54	5.98	5.30	5.01
	10^8	6.55	6.49	6.15	5.90	6.55	6.30	5.97	5.53
LI+SM1	10^9	6.55	6.49	6.10	5.84	6.54	6.21	5.93	5.50
	10^{12}	6.55	6.34	6.00	5.51	6.55	5.99	5.55	5.07
	10^8	6.55	6.50	6.41	6.04	6.55	6.42	6.04	5.33
L12+SM1	10^9	6.54	6.49	6.37	6.01	6.55	6.40	6.03	5.31
	10^{12}	**6.55**	**6.47**	**6.12**	**5.34**	**6.54**	**6.20**	**5.20**	**4.55**
	10^8	6.55	6.47	6.41	5.93	6.55	6.47	6.07	5.55
L20+SM1	10^9	6.54	6.41	6.34	5.86	6.54	6.43	6.04	5.51
	10^{12}	**6.55**	**6.40**	**6.24**	**5.58**	**6.55**	**6..32**	**5.32**	**4.65**
	10^8	6.55	6.39	6.03	5.84	6.55	6.23	6.04	5.88
L1+L12+L20+SM1	10^9	6.55	6.35	6.03	5.84	6.54	6.21	6.01	5.83
	10^{12}	6.55	6.20	5.83	5.59	6.55	6.12	5.54	5.33

L1= *Pediococcus acidilactici* OS24h9; L12 = *Lactococcus lactis* OY9h19; L20 = *Lactobacillus delbrueckii* 48NL16; SM1 = *Saccharomyces cerevisiae* 36h11CM2

Lactococcus lactis OY9h19 used as a single culture or in combination with *S. cerevisiae* 36h11CM2 acidifies milk faster at concentration of 10^{12} cfu/ml and temperature of 37 ℃. These cultures together with two combinations, (*Pediococcus acidilactici* OS24h9 + *Lactococcus lactis* OY9h19), and (*Lactobacillus delbrueckii* 48NL16 + *Saccharomyces cerevisiae* 36h11CM2), and two single cultures, *Pediococcus acidilactici* OS24h9, and *Lactobacillus delbrueckii* 48NL16 are currently being used to determine the culture performances and consumer preferences in pilot plant and SME fermentation trials.

Conclusion

Culture made up of combination of *Lactococcus lactis* OY9h19, *Lactobacillus delbrueckii* 48NL16 and *Saccharomyces cerevisiae* 36h11CM2 with QPS have been proposed as starter cultures for nunu fermentation at optimal condition of initial concentration of 10^{12} cfu/ml, fermentation at 37 ℃ for 12 h based on technological optimization of the strains.