

Effects of Microbial Inoculants on the Fermentation and Preservation of Triticale Silages at High and Low Moisture Levels

Ilavenil Soundharrajan ¹ Karnan Muthusamy ¹, Ouk-Kyu Han ², Hyun Jeong Lee ³, Sumitha Purushothaman ⁴, Dahye Kim ^{5,*} and Ki Choon Choi ^{1,*}

¹ Grassland and Forage Division, National Institute of Animal Science, RDA, Cheonan 31000, Korea; ilavenil@korea.kr (I.S.); karnantm111@gmail.com (K.M.)

² Department of Crop Science, Korea National College of Agriculture and Fisheries, Jeonju 54874, Korea; okhan98@korea.kr

³ Jangsu Agriculture Technology Center, Jangsu, Jeollabuk-do 55640, Korea; leehj5328@korea.kr

⁴ Department of Biotechnology, Bharathidasan University, Tiruchirappalli, Tamilnadu 620024, India; gpsumitha@gmail.com

⁵ Faculty of Biotechnology, College of Applied Life Science, Jeju National University, Jeju 63243, Korea; pioioiq@nate.com

* Correspondence: choiwh@korea.kr; Tel.: +82-41-580-6752; Fax: +82-41-580-6779

Supplementary Table 1. Taxonomic characteristics of KCC-51 and 52.

Items	KCC-51	KCC-52
Gram stain	gram-positive	gram-positive
Morphology	rod-shaped	rod-shaped
Motility	Non	Non
Catalase	Negative	Negative
Growth medium	MRS agar and broth	MRS agar and broth
Optimum temperature (°C)	32	32
Rotary shaker speed (rpm)	150	150
G+C content (%)	52.5	53.1

Supplementary Table 2. Fermentation of carbohydrate substrates by KCC-51 and KCC-52 *in-vitro*.

Name of carbohydrates	KCC-51	KCC-52
1. Glycerol	++	+
2. Erythritol	+	+
3. D-Arabinose	+	+
4. L-Arabinose	+	+++
5. D-Ribose	ND	+++
6. D-Xylose	ND	+++
7. L-Xylose	ND	+
8. D-Adonitol	ND	ND
9. Methyl- β -D-xiloside	ND	ND
10. D-Galactose	+++	+++
11. D-Glucose	+++	+++
12. D-Fructose	+++	+++
13. D-Mannose	+++	+++
14. L-Sorbose	+++	+++
15. L-Rhamnose	++	++

16.	Dulcitol	++	ND
17.	Inositol	++	+
18.	D-Mannitol	+++	+++
19.	D-Sorbitol	+++	+++
20.	Methyl- α D-mannoside	+	ND
21.	Methyl- α -D-glucoside	+++	++
22.	N-acetyl glucosamine	++	++
23.	Amygdalin	+++	++
24.	Arbutin	+++	++
25.	Esculin ferric citrate	+++	+++
26.	Salicin	++	++
27.	D-Celiobiose	+++	+++
28.	D-Maltose	++	+++
29.	D-Lactose	+++	+++
30.	D-Melibiose	ND	ND
31.	D-Saccharose	+	+
32.	D-Trehalose	+++	+++
33.	Inulin	ND	ND
34.	D-Melezitose	+++	+++
35.	D-Raffinose	ND	ND
36.	Amidon	ND	ND
37.	Glycogen	ND	ND
38.	Xylitol	ND	ND
39.	Gentiobiose	++	+
40.	D-Turanose	+++	+++
41.	D-Lyxose	ND	ND
42.	D-Tagatose	+++	+++
43.	D-Fucose	+	ND
44.	L-Fucose	+	ND
45.	D-Arabitol	ND	ND
46.	L-Arabitol	ND	ND
47.	Potassium gluconate	+	+
48.	Potassium 2 cetoGluconate	+++	+++
49.	Potassium 5 cetoGluconate	ND	+++

+++ Strong fermentation; ++ moderate fermentation; + Weak fermentation; ND- Not detected.

Supplementary Table 3. Detection of extracellular enzymes from KCC-51 and KCC-52 by API-ZYM test.

Enzymes	KCC-51	KCC-52
Control	ND	ND
Alkaline phosphatase	+++	+
Esterase (C ₄)	+++	+++
Esterase lipase (C ₈)	+++	+++
Lipase (C ₁₄)	+++	++
Leucine arylamidase	+++	+++
Valine arylamidase	+++	+++
Cystine arylamidase	++	++
Trypsin-like serine protease	+	+
α -Chymotrypsin	+++	+++
Acid phosphatase	+++	+++
Naphthol-AS-biphosphohydrolase	++	+++
α -Galactosidase	++	0

β -Galactosidase	++	0
β -Glucuronidase	++	1
α -Glucosidase	+++	+++
β -Glucosidase	ND	+++
N-Acetyl- β -glucosaminidase	ND	++
α -Mannosidase	ND	ND
α -Fucosidase	+++	ND

+++ Strong fermentation; ++ moderate fermentation; + Weak fermentation; ND- Not detected.

Supplementary Table 4. Antibiotic sensitivity properties of KCC-51 and KCC-52 against commercial antibiotics.

S. No	Names of Antibiotics	<i>L. rhamnosus</i>	<i>L. paracasei</i>
1	Chloramphenicol (C)	SS	SS
2	Kanamycin (K)	SS	SS
3	Nitrofurantoin (NIT)	SS	SS
4	Tetracycline (TE)	SS	SS
5	Streptomycin (S)	SS	SS
6	Sulphafurazole (SF)	SS	MS
7	Colistin methane sulphonate (CL)	SS	SS
8	Dicloxacillin (D/C)	SS	MS
9	Ampicillin (AMP)	SS	SS
10	Amikacin (AK)	MS	SS
11	Gentamicin (GEN)	SS	SS
12	Cefoxitin (CX)	MS	SS
13	Cefalexin (CN)	SS	SS
14	Cefuroxime (CXM)	SS	SS
15	Co-Trimoxazole (COT)	MS	SS

SS- strong susceptible; MS- moderate susceptible.