Use of lactic acid bacteria to increase antioxidant activities of fruits and tea beverages

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CONTENTS

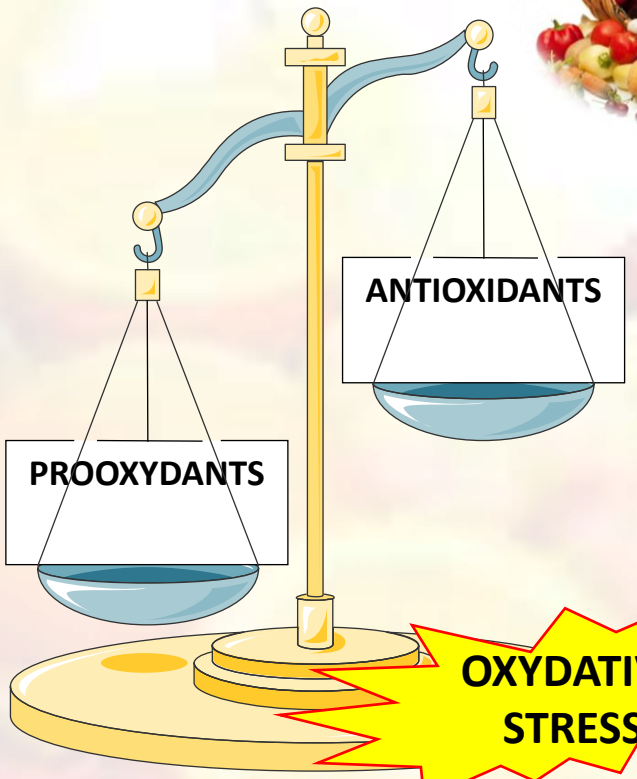
Food, protection against oxydative stress-related diseases

Environmental factors
- *Pollution*
- *Radiation*
- *Cigarette smoke*
- *Herbicides*

Reactive species (oxygen/nitrogen)

Fruits and vegetables (vitamins, carotenoid, polyphenols…)

Beverages (Fruit juice, tea, coffee, wine…)



Dammages (*proteins, DNA, lipids*)

Cancer

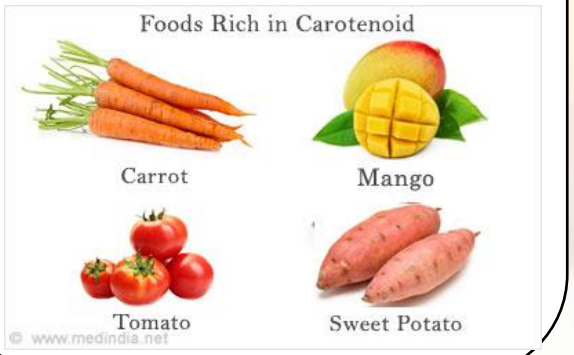
Cardiovascular diseases

Neurodegenerative diseases

Food antioxidants

Carotenoids

- *Beta-carotene*
- *Lycopene*
- *Lutein*
- *Zeaxanthine*
- *Beta-criptoxanthin*



Vitamins

- *Vitamin C*
- *Vitamin E*

Polyphenols

- *Flavonoids*
- *Phenolics acids*
- *Lignan*
- *Stillbene*

Exo-polysaccharides

- *Procuced by lactic acid bacteria*
- *High-molecular mass polymers*
- *Texturizers, viscosifiers*
- *Antimicrobial action*
- *Lowering of serum cholesterol & lipids*
- *Anticancer*
- *Antidiabetic*
- *Antioxidative effect*

Food processes

- Most fruits and vegetables are eaten after they have been **transformed/processed**

→Physical and chemical changes could affect their **antioxidant content**

→Most of the compounds are relatively unstable

- Transformation process can induce:
- Decrease of vitamins and polyphenol content (*pasteurization, blanching, cooking, sterilization*…)
- Modification of nutritional properties (*preservatives and neoformed compounds*)
- Improve antioxidant properties (*Lactic acid fermentation*)

Lactic acid fermentation of fruits

- **Lactic acid bacteria**

Fruits carbohydrates → *Homo-fermentative* → Lactic acid

Fruits carbohydrates → *Hetero-fermentative* → Lactic acid + CO_2 + Ethanol

- **Lactic acid fermentation**

➥ Food preservation (*safety, shelf-life*)
➥ Modification of sensorial properties (*aromatic compounds*)
➥ Removal of anti-nutritional factors (*cyanogenic glucosides in cassava roots*)
➥ Mineral and vitamin preservation
➥ Improvement of food digestibility
➥ Improvement of antioxidant properties (*white cabbage, tomato, cherry, carrot and green beans smoothies*)

Lactic acid fermentation of tea

- **Tea beverage**

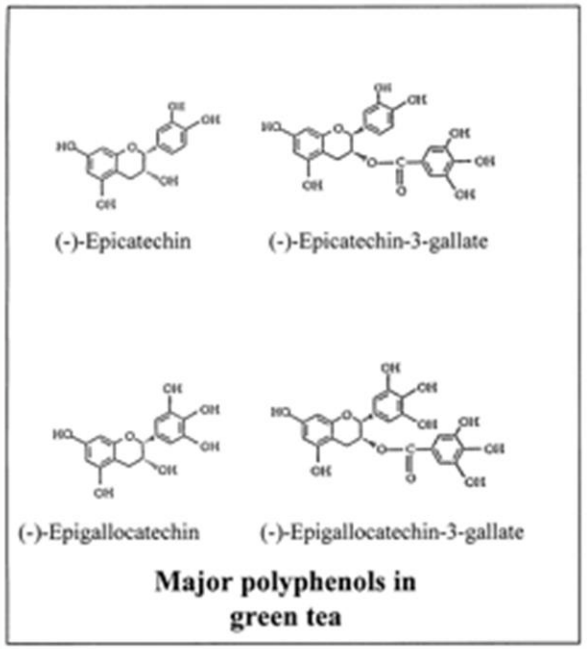
→ One of the most popular beverage worldwide, consumed by over 2/3 of the world's population daily
→ **Rich in antioxidant** : flavonoid, particularly **tea catechins**

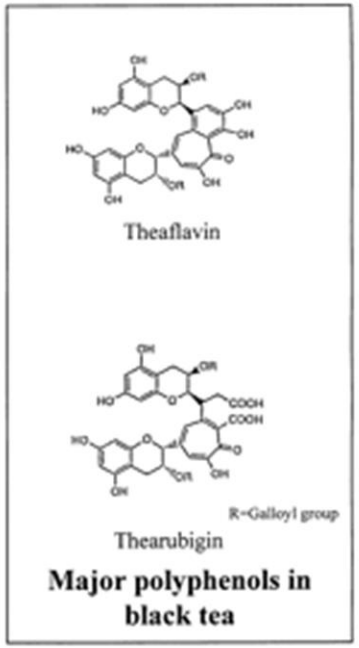
- **Lactic acid fermentation of tea**

→ Tea flavonoids : low bioavailibility
→ **Bioconversion of polyphenols possible by lactic acid bacteria**
→ Increase of polyphenol bioavailibility and bioactivity

- **Kombucha, a fermented tea beverage**

→ Fermentation of green or black tea with sugar





Autochthonous starters for lactic acid fermentation

→ **Autochthonous LAB starters: controlled and safe fermentation**

Technological	Sensorial	Nutritionnal
Growth rate Acidification rate Tolerance to salt Tolerance to low pH and low temperature Synthesis of antimicrobial compounds Tolerance to bile salts	Hetero-fermentative metabolism Synthesis of aromatic compounds Sensory properties	Synthesis of exo-polysaccharides No synthesis of biogenic amines Increase of antioxidant properties Depolymerization of phenolic compounds

Our objectives

1. Characterize the lactic acid bacterial flora present on fruits and vegetables grown in Reunion Island

2. Design new fermented food products from fruits and tea in order to keep/improve nutritional and antioxidant properties

Selection of LAB starters

Isolation of **82 LAB** from papaya, tomato and sliced cabbage

↓

Genetic, phenotypic and technological characterization

↓

Selection of **29 LAB**

***Weissella* spp**

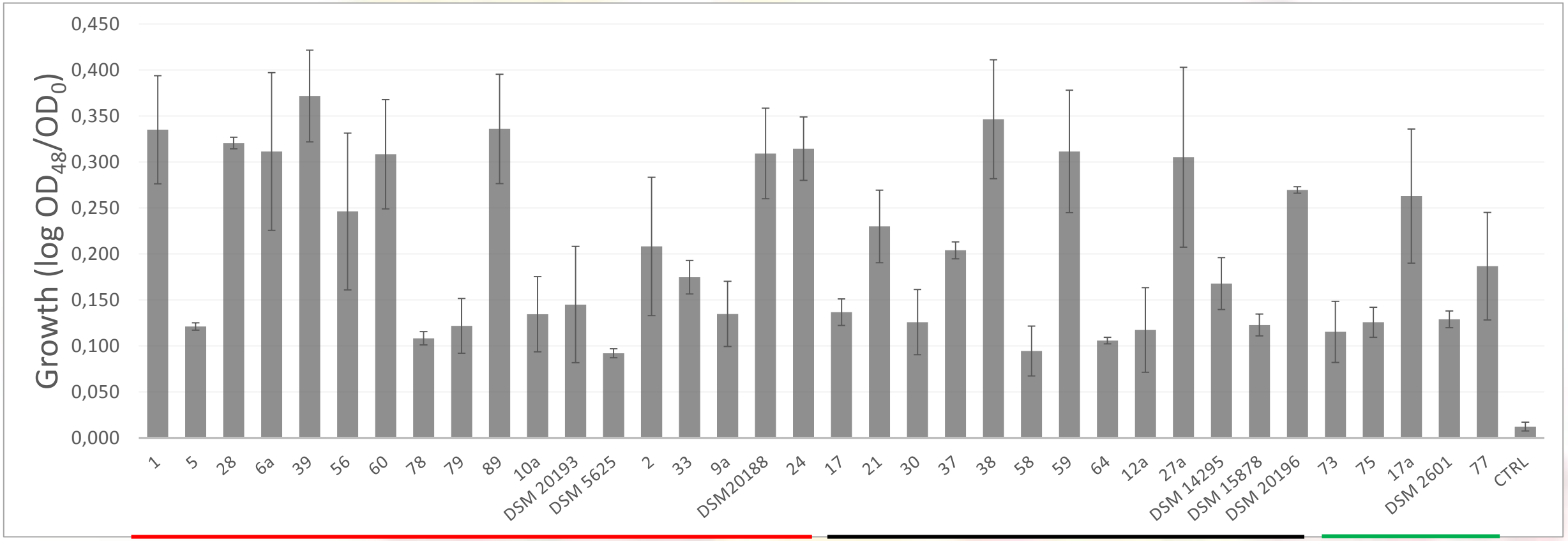
***Leuconostoc* spp**

***Lactobacillus* spp**

***Fructobacillus* spp**

Growth in fruit juice

→ Ability of LAB to grow in apple juice



Leuconostoc spp

Weissella spp

Lactobacillus spp

Fructobacillus spp (77)

Food substrates for lactic acid fermentation

Pineapple juice

Para-coumaric acid
Caffeic acid
Ferulic acid
Sinapic acid
Hydroxycinnamates
Quercétine

Papaya

Ferulic acid
Caffeic acid
Para-coumaric acid
Protocatechuic acid
Chlorogenic acid
Rutin
Lycopene
B-crytoxanthin

Mango

Gallic acid
Vanillic acid
Protocatechuic acid

Green tea

Not fermented
Catechins

Black tea

Fermented tea
Catechins oxidized

Lactic acid fermentation of food substrates

Pasteurized Pineapple juice (8 LAB isolates + 2 reference strains)

Black tea (21 LAB isolates + 3 reference strains)

Green tea (17 LAB isolates + 3 reference strains)

Mango (21 LAB isolates + 3 reference strains)

Papaya (21 LAB isolates + 3 reference strains)

Infusion for 5 min
(1 tea bag per 250 mL)
+ sucrose

Skin and seeds removal

Pasteurization at 80°C for 5 min

Inoculation
DO_i = 0.05 UDO/mL

Inoculation at 1/10

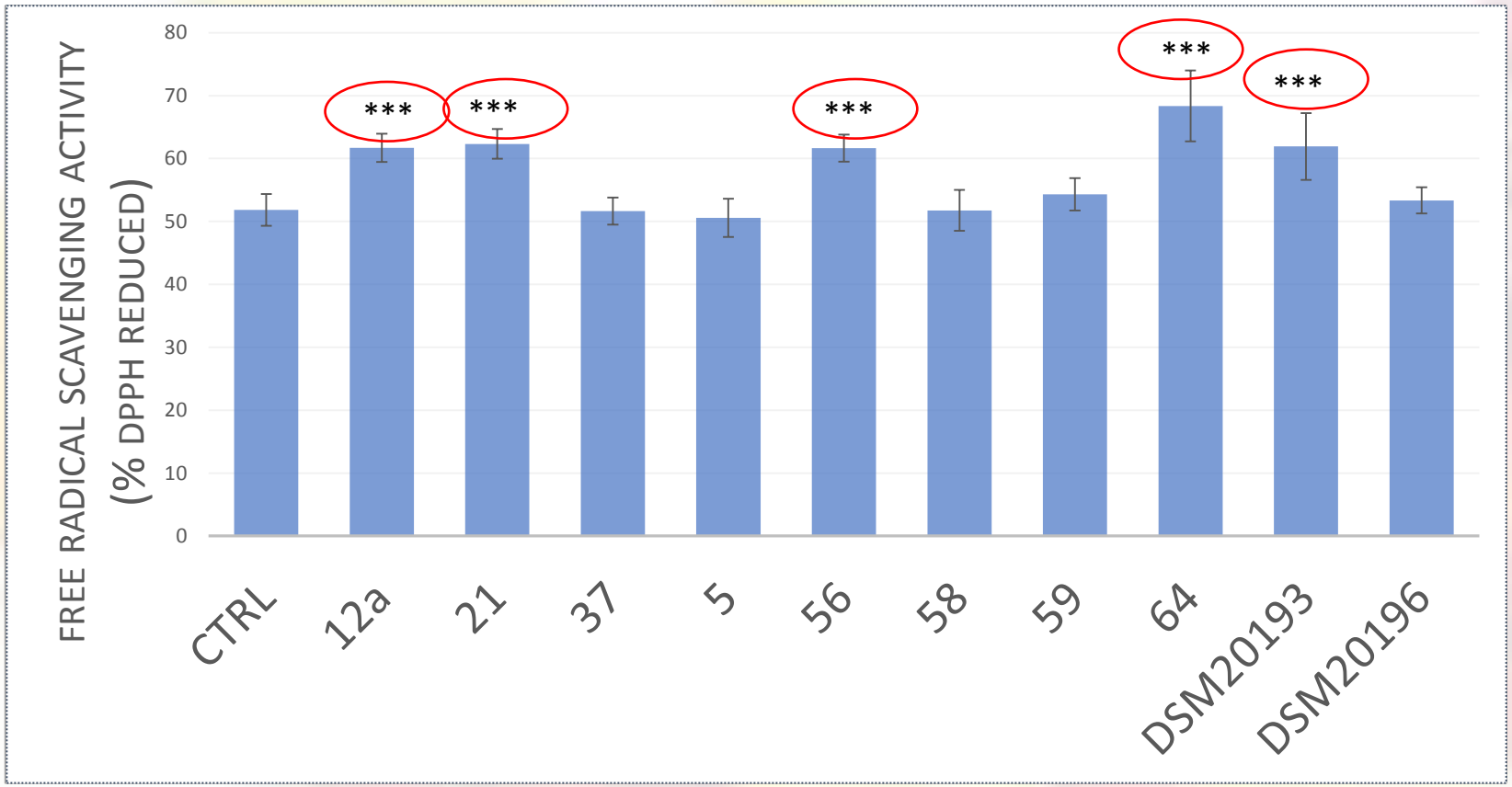
Fermentation for 48 h at 30°C

Total Polyphenol content
(Folin-Ciocalteu assay)

DPPH radical scavenging activity

Lactic acid fermentation of food substrates

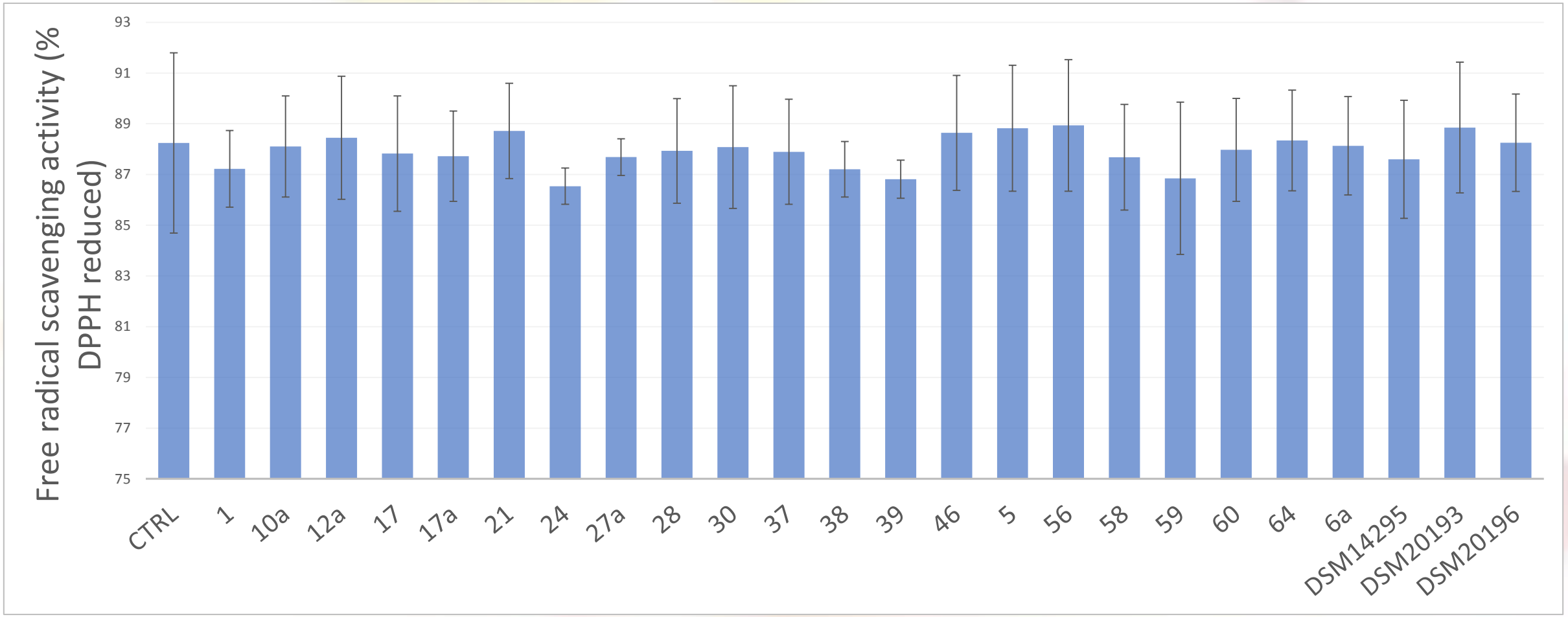
Lactic acid fermentation of pineapple



*Results of 3 independent experiments analyzed in triplicate, *** p < 0.001, compared with Control (CTRL)*

Lactic acid fermentation of food substrates

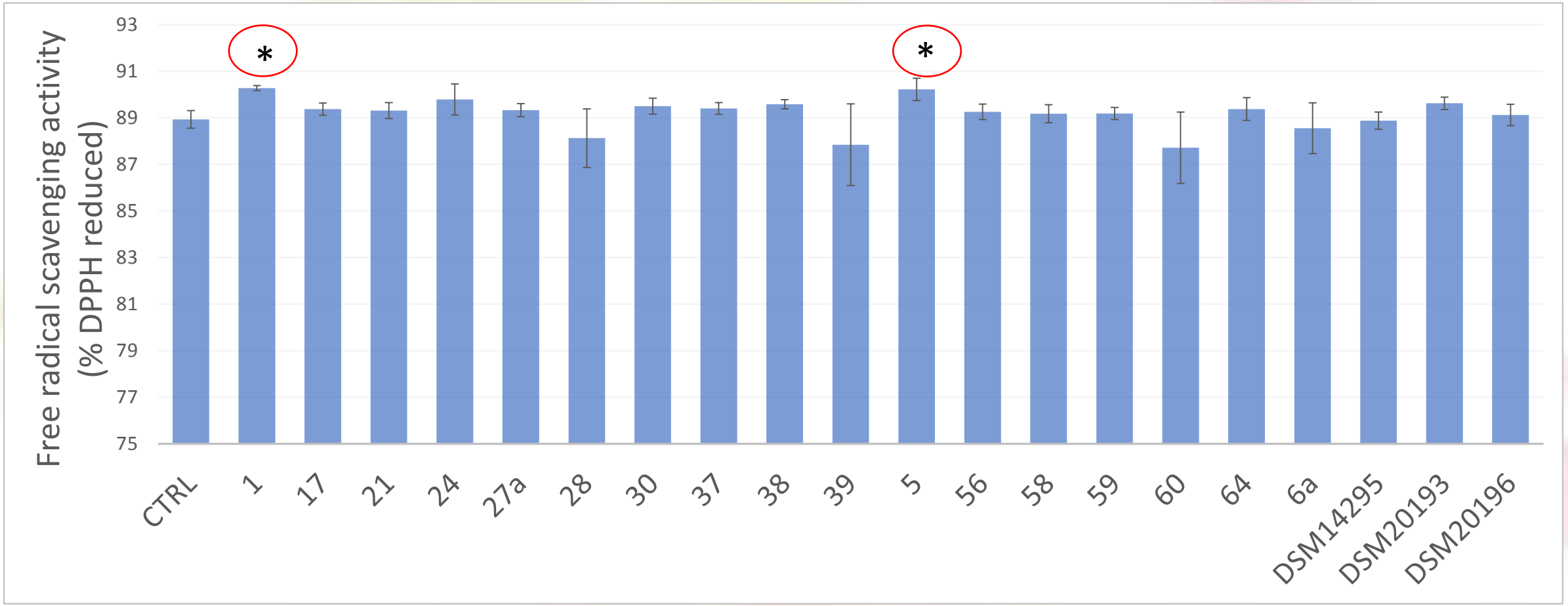
Lactic acid fermentation of papaya



*Results of 2 independent experiments analyzed in triplicate, *** p < 0.001, compared with Control (CTRL)*

Lactic acid fermentation of food substrates

Lactic acid fermentation of green tea



*Results of 2 independent experiments analyzed in triplicate, * p < 0.05, compared with Control (CTRL)*

82 LAB isolates

(Papaya, tomato, sliced cabbage)

Criteria of selection for starters

21 LAB isolates

Lactic acid fermentation

Pineapple juice	Papaya	Green tea	Black tea	Mango
5/8	1/21	2/21	0/21	0/21
12a, 21, 64: *Weissella cibaria* 56, DSM20193: *Leuc. pseudomesenteroides*	64: *W. cibaria*	1,5: *Leuc. mesenteroides*		

- Majority of starters used in food insdustries are *Lactobacillus* species

- ***Weissella* and *Leuconotoc* spp are rarely investigated**
  - → Frequently isolated from fruits and vegetables
  - → Fast growth
  - → High acidifiying activity
  - → Produce EPS polymers
  - → Tolerent to a multitude of stresses
  - → Antioxidant activities

- ***Weissella* and *Leuconostoc* spp as starters for fruit and tea fermentation ?**

Acknowledgements