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Introduction

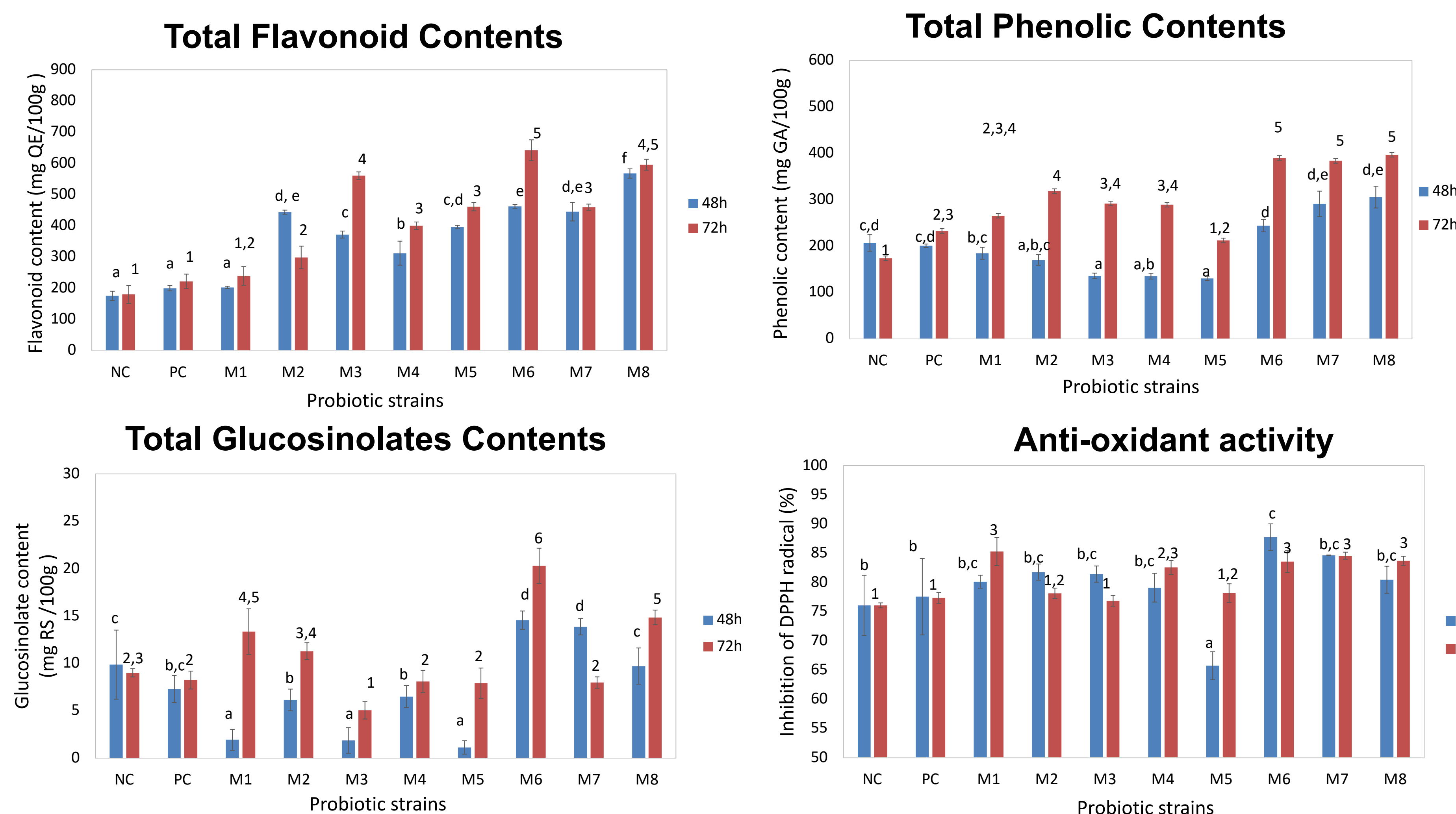
There is emerging interest on the discovery of symbiotic functional food in the many therapeutical applications. Symbiotic include the combination of prebiotics and probiotics, which promote good gut health and maintain balance of biological activity. The use of cabbage as prebiotic coupling with probiotics strains had been investigate under fermentation process for optimal yield of total flavonoid (TFC), phenolic (TPC), glucosinolates (TGLs) and antioxidant activity. The symbiotic probiotic fermented cabbage (PFC) could offer high nutritional value and bioactive compounds that benefit for health.

Results and Discussion

a) The effect of single probiotic strains

Table 1. The selected probiotic strains used in the study.

Labels	Probiotic strains
P1	<i>Enterobacter xiangfangensis</i> 4A-2A3.1
P2	<i>Lactococcus hircilactis</i> WS16 (1L13x2)
P3	<i>Lactococcus lactis</i> WS18 (4L2)
P4	<i>Lactococcus lactis subsp. lactis</i> TBRC 375
P5	<i>Lactobacillus plantarum</i> SK321
P6	<i>Lactobacillus fermentum</i> SK324
P7	<i>Lactobacillus brevis</i> TBRC 3003
P8	<i>Bifidobacterium adolescentis</i> TBRC 7154



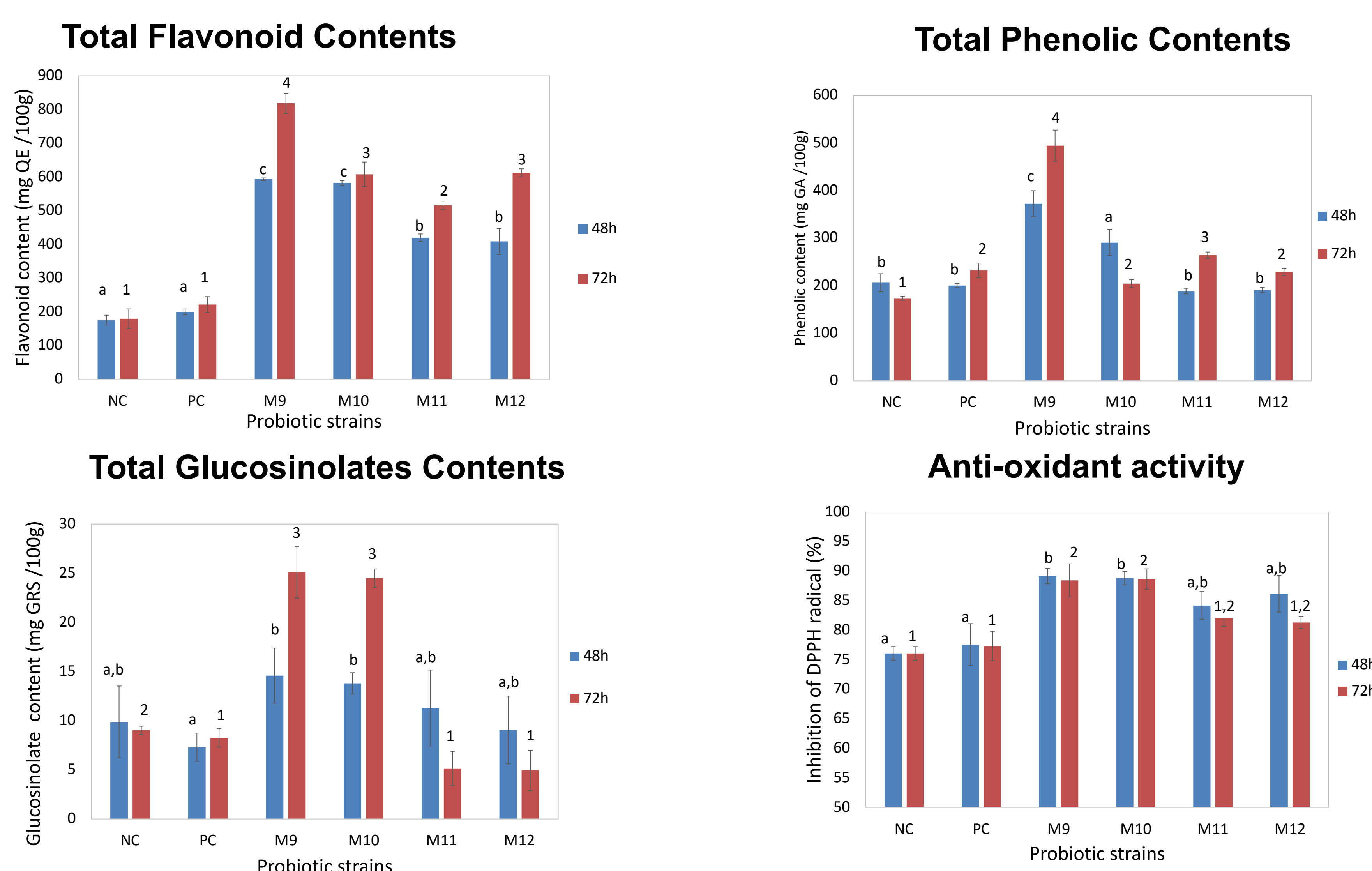
Notes: NC= raw cabbage, PC= fermented cabbage without no probiotic, M1-M8 represented the single strains of probiotic added in respective order from P1-P8. Standard reference label QE = Quercetin, GA= Gallic acids, RS= Rapeseed and DPPH= 2,2-diphenyl-1-picrylhydrazyl

• PFC with Probiotic *Lactobacillus fermentum* SK324 (P6) at fermentation period 72h showed optimal yield of TFC, TPC, TGLs and antioxidant activities following by *Bifidobacterium adolescentis*.

• Several studies come in agreement of the improvement yield with fermentation of *Lactobacillus fermentum* in grain sorghum^{1,2}, vinegar³, rice⁴ and juice⁵.

Reference
¹<https://doi.org/https://doi.org/10.1016/j.jcs.2018.05.008>
²<https://doi.org/10.1021/jf101504v>
³<https://doi.org/https://doi.org/10.1016/j.fshw.2022.04.031>
⁴<https://doi.org/https://doi.org/10.1016/j.foodchem.2020.126985>
⁵<https://doi.org/https://doi.org/10.1016/j.fm.2014.08.018>

b) The effect of combination probiotic strains



Notes: NC= raw cabbage, PC= fermented cabbage without no probiotic, M9= addition of all 8 combined strains, M10 = addition of 10⁶ CFU/mL 4 probiotic strains (P1, P3, P6, P8), M11= addition of 10⁶ CFU/mL 3 probiotic strains (P2,P3,P4), M12= 10⁶ CFU/mL 3 probiotic strains (P5,P6,P7). Standard reference label QE = Quercetin, GA= Gallic acids, RS= Rapeseed and DPPH= 2,2-diphenyl-1-picrylhydrazyl

• Combination of probiotics showed significant improved in the total of bioactive compounds of PFC compared with single probiotic strains.

• PFC comprising 8 probiotic strains (M9) showed the highest yield of TFC (810.6 mg QE/ 100 g) TPC (494.62 mg GA/100g) TGLs(25.097 mg / 100 g).

• Probiotic combined from different genus (M9 &M10) showed improved yield of bioactive compound than combination of probiotic from single genus (M11 &M12).

• Combination strains proven to be more efficient than single in the bioactive compound profile in yogurt⁶.

• more strains imply more chances of success; it can mean a broader spectrum of efficacy⁷.

Reference
⁶<https://doi.org/https://doi.org/10.3168/jds.2020-20099>
⁷https://journals.lww.com/jcge/fulltext/2018/11001/efectiveness_of_multi_strain_versus_single_strain.7.aspx

Conclusions

- Combination strains of probiotic significantly improved the overall bioactive compounds level and antioxidant activities.
- Cheap and easy to apply functional food could be developed to reduce the occurrence of disease and cancer, in addition holds great promise for the future of medicine.

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