Probiotics in a World Where Dietary Habits Collide

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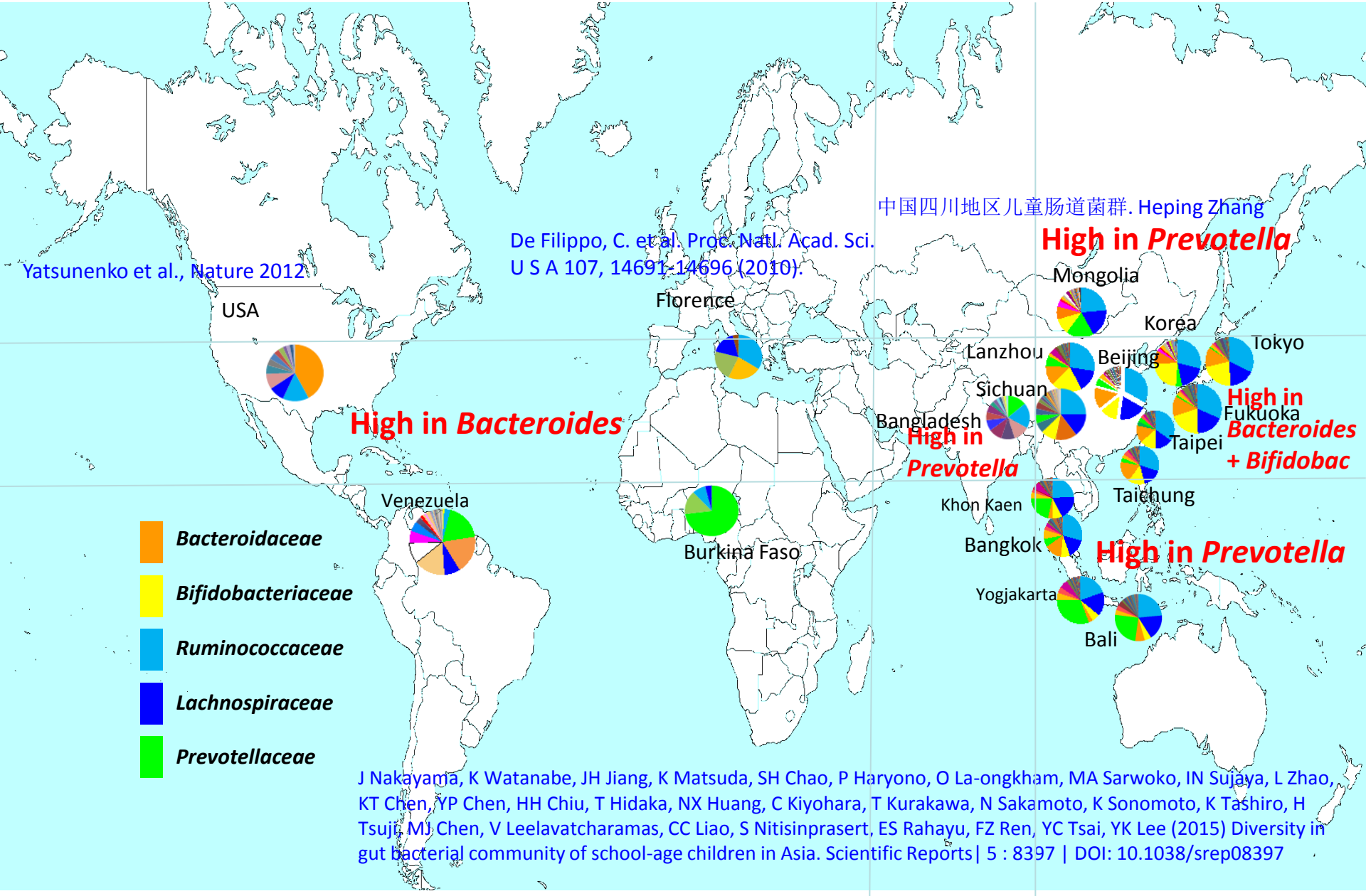
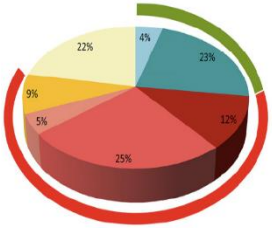
Gut microbiota of healthy children worldwide



J Nakayama, K Watanabe, JH Jiang, K Matsuda, SH Chao, P Haryono, O La-ongkham, MA Sarwoko, IN Sujaya, L Zhao, KT Chen, YP Chen, HH Chiu, T Hidaka, NX Huang, C Kiyohara, T Kurakawa, N Sakamoto, K Sonomoto, K Tashiro, H Tsuji, MJ Chen, V Leelavatcharamas, CC Liao, S Nitisinprasert, ES Rahayu, FZ Ren, YC Tsai, YK Lee (2015) Diversity in gut bacterial community of school-age children in Asia. Scientific Reports| 5 : 8397 | DOI: 10.1038/srep08397



EU children (n=15, 1~6 y.)

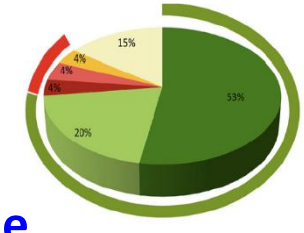
Alistipes
Bacteroides
} Bacteroidetes

Acetitomaculum
Faecalibacterium
Roseburia
Subdoligranulum
} Firmicutes

Others

Children in Burkina Faso (n =14, 1~6 y.)

Filippo, C. D. *et al.* PNAS (2010) 107, 14691-14696



Prevotella
Xylanibacter
} Bacteroidetes

Acetitomaculum
Faecalibacterium
Subdoligranulum
} Firmicutes

Others

Diet determines gut microbiome

Enterotypes:

Type 1: Consumed lots of meat & saturated fat- more *Bacteroides*

Type 2: People who consumed lots of alcohol & polyunsaturated fats- *Ruminicoccus* prevailed

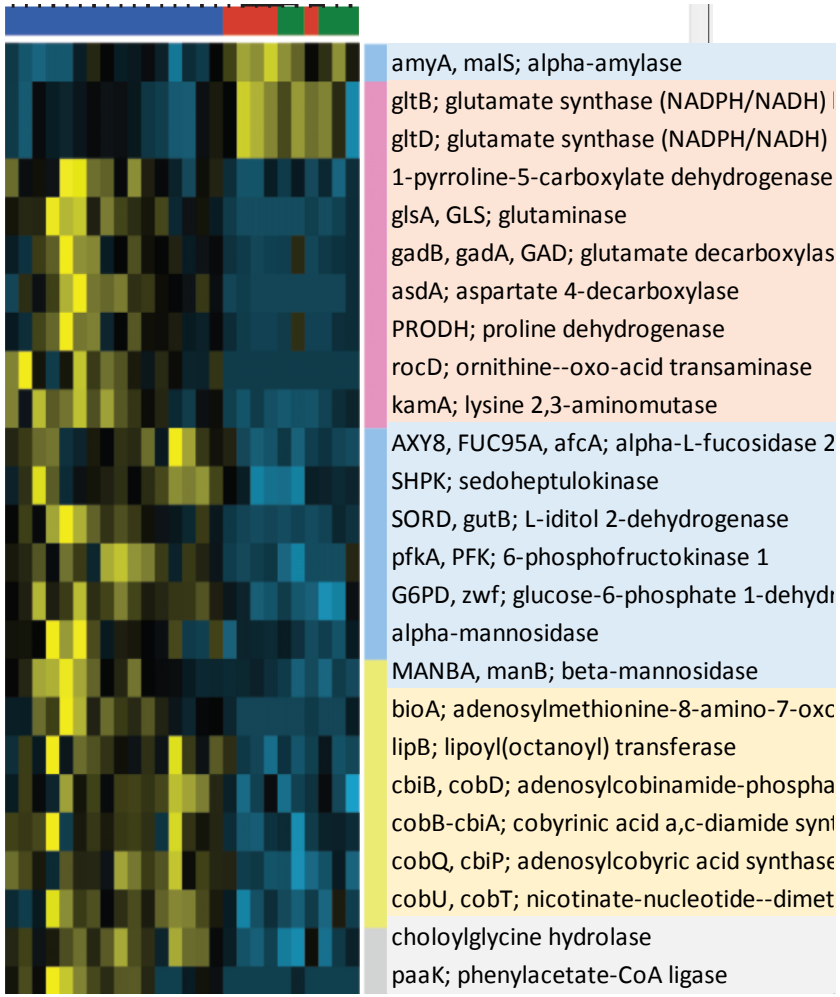
Type 3: Diet rich in carbohydrates- favored *Prevotella*

Linking long-term dietary patterns with gut microbial enterotypes
Wu GD, Chen J, Hoffman C, et al. Science 2011, DOI: 10.1126/Science 1208344

Overrepresenting genes in Southeast Asia/East Asia and US/Africa

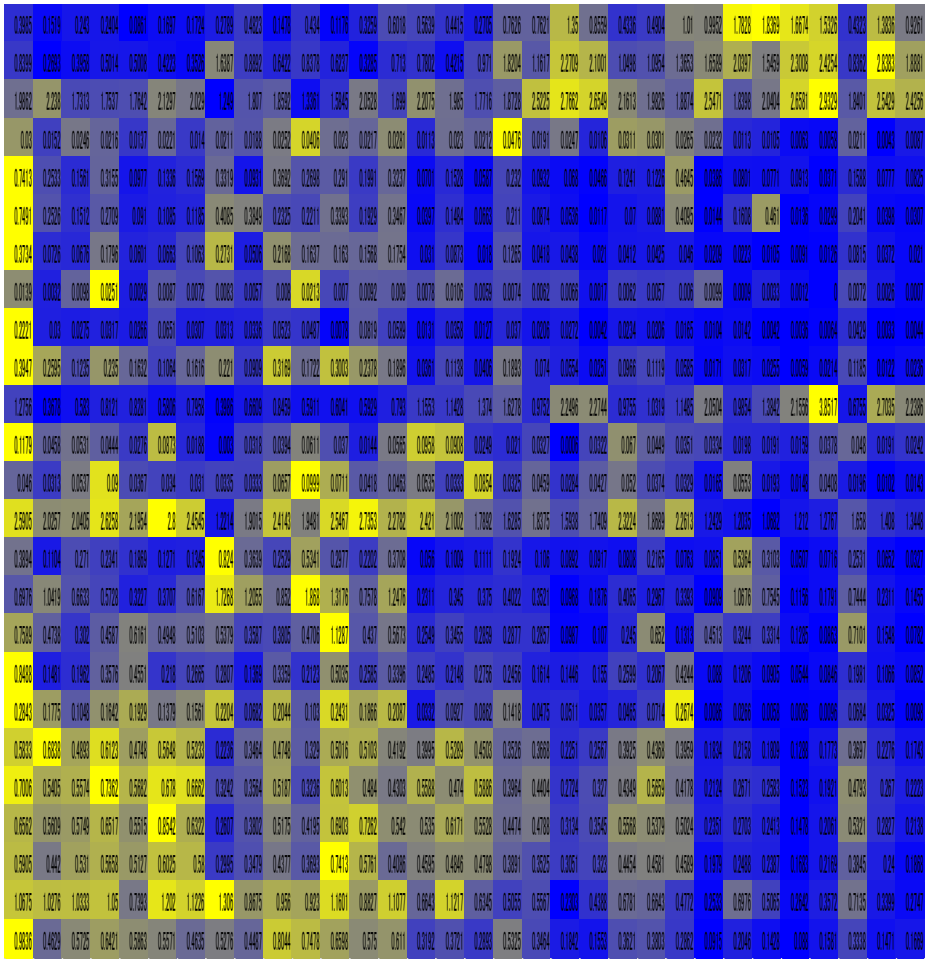
Yatsunenko et al.
2012, Nature

US Malawi



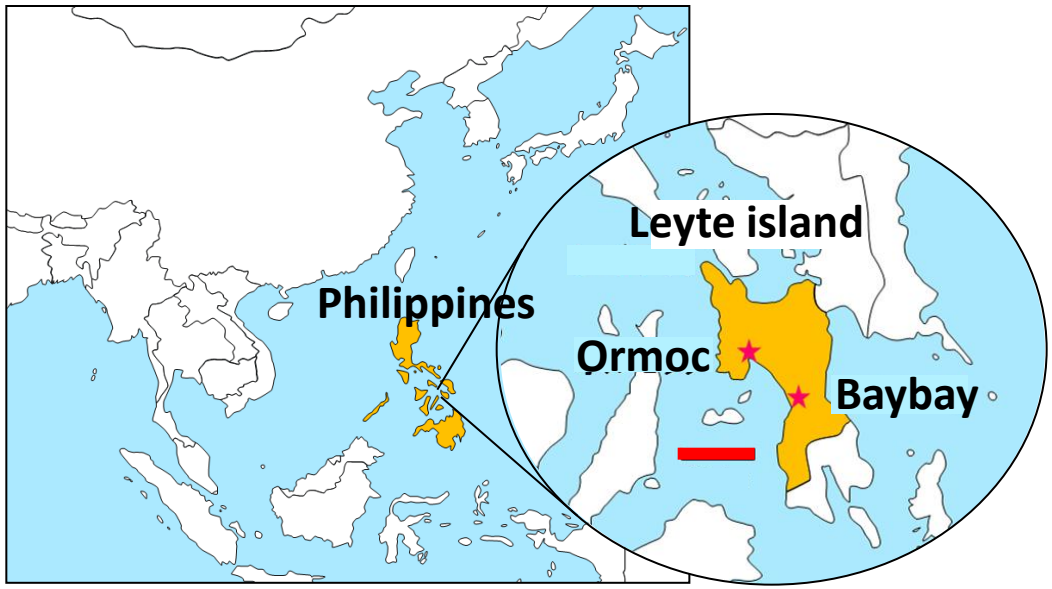
Asian Microbiome Program

East Asia-type | Southeast Asia-type

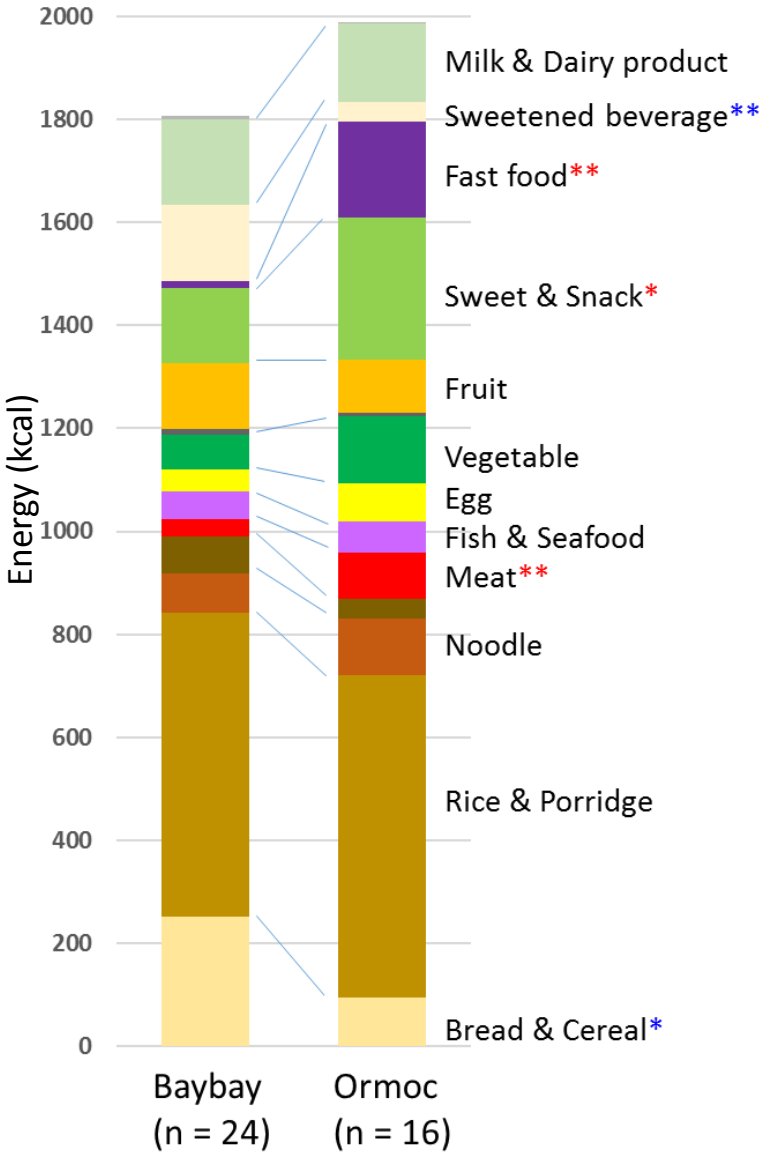


Collision of dietary habits: Impact of Western high-fat, low carbohydrate diet on gut microbiota in youngsters on Leyte island Philippines

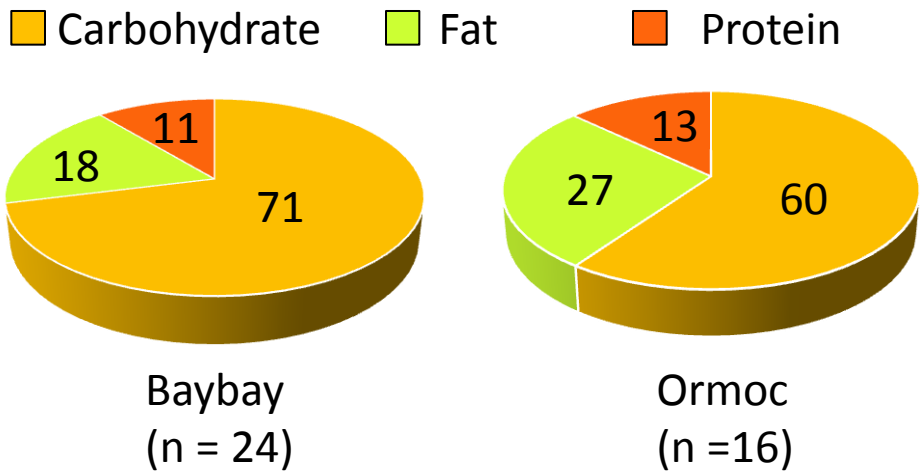
(A)



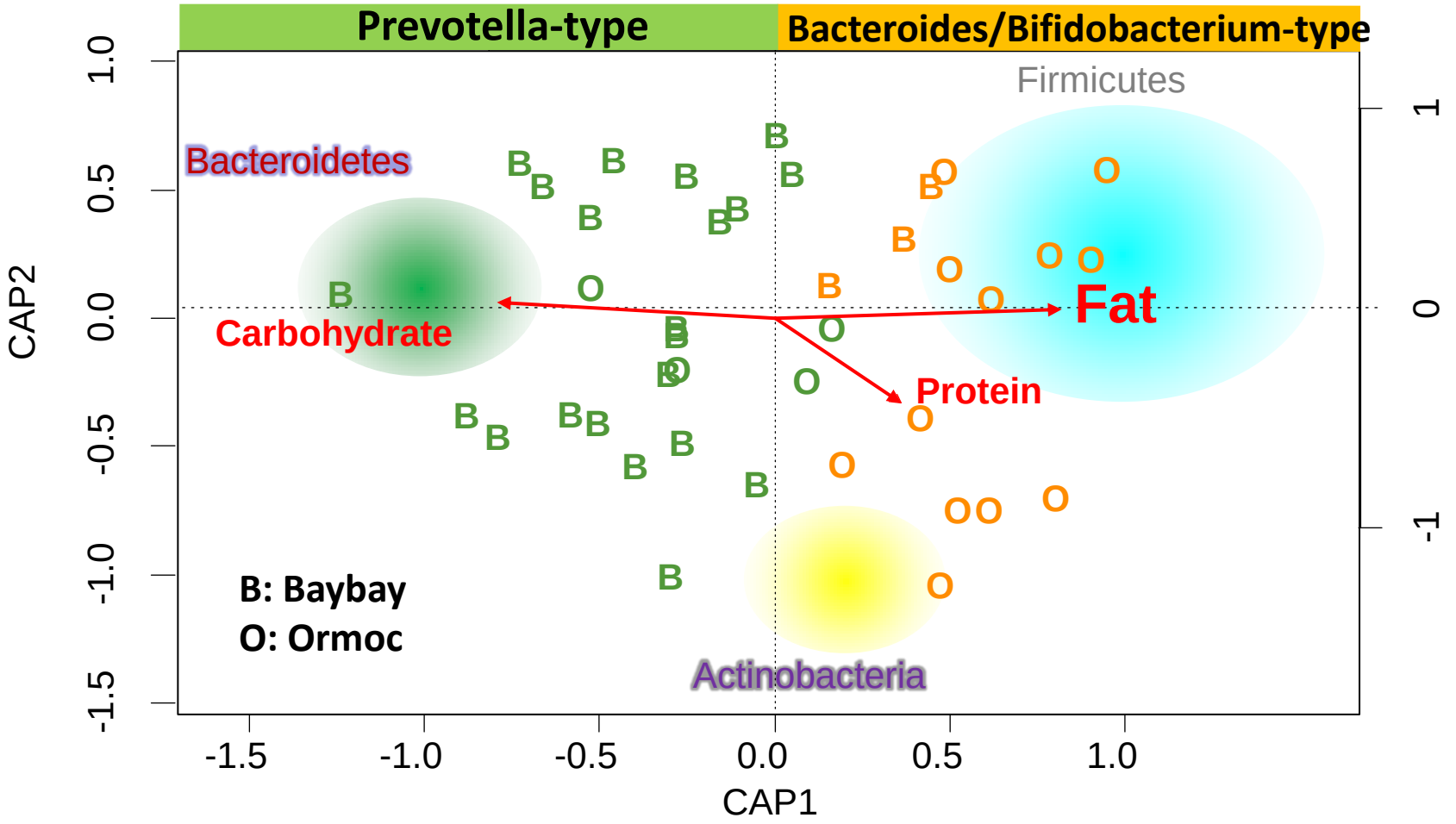
(B)



(C)

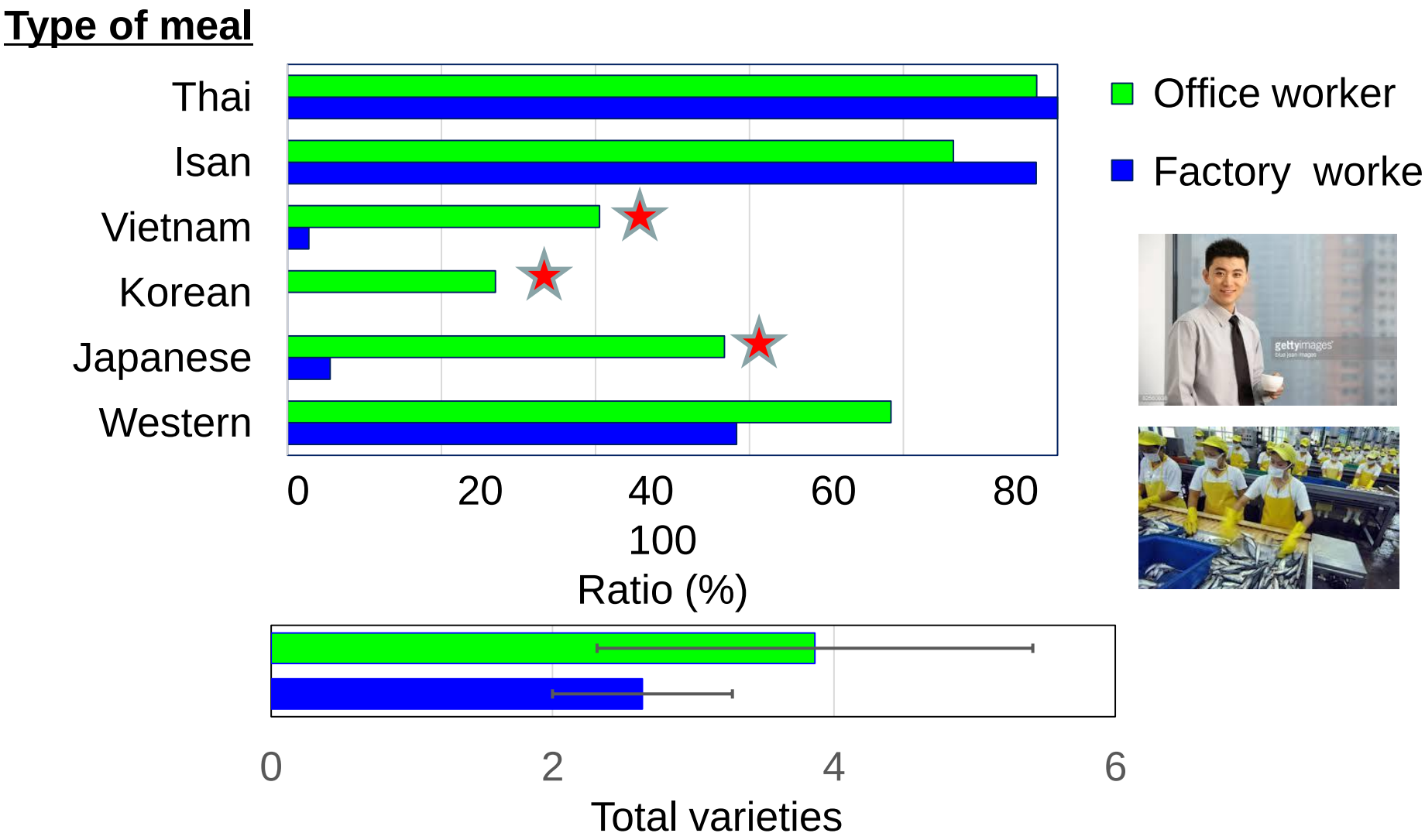


Redundancy analysis to correlate macronutrient intake with gut microbiota

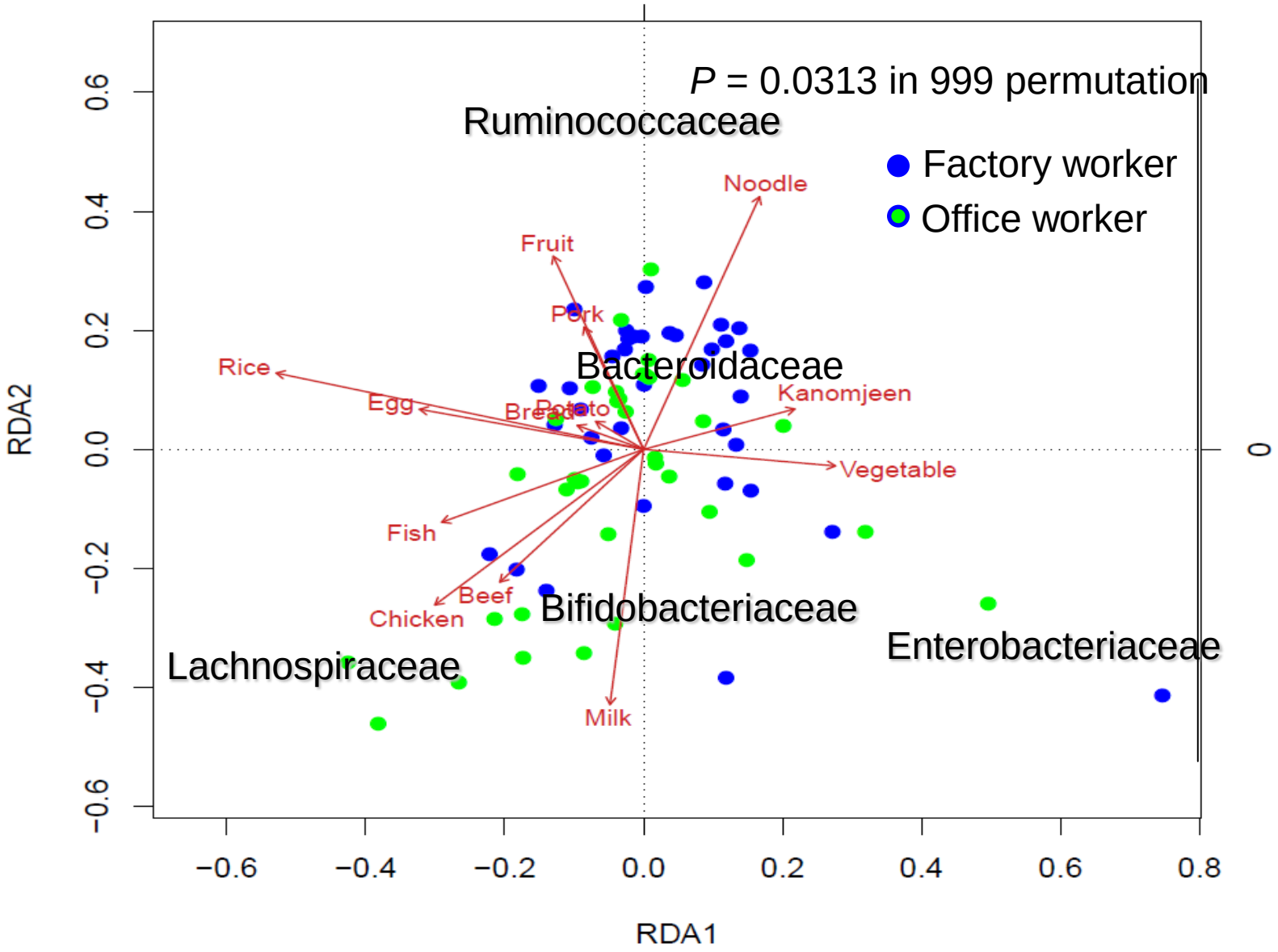


Jiro Nakayama, Azusa Yamamoto, Ladie A. Palermo-Conde, Kanako Higashi, Kenji Sonomoto, Julie Tan, Yuan Kun Lee* (2017) Impact of high-fat diet on gut microbiota in children on Leyte island. Frontiers in Microbiology, doi: 10.3389/fmicb.2017.00197

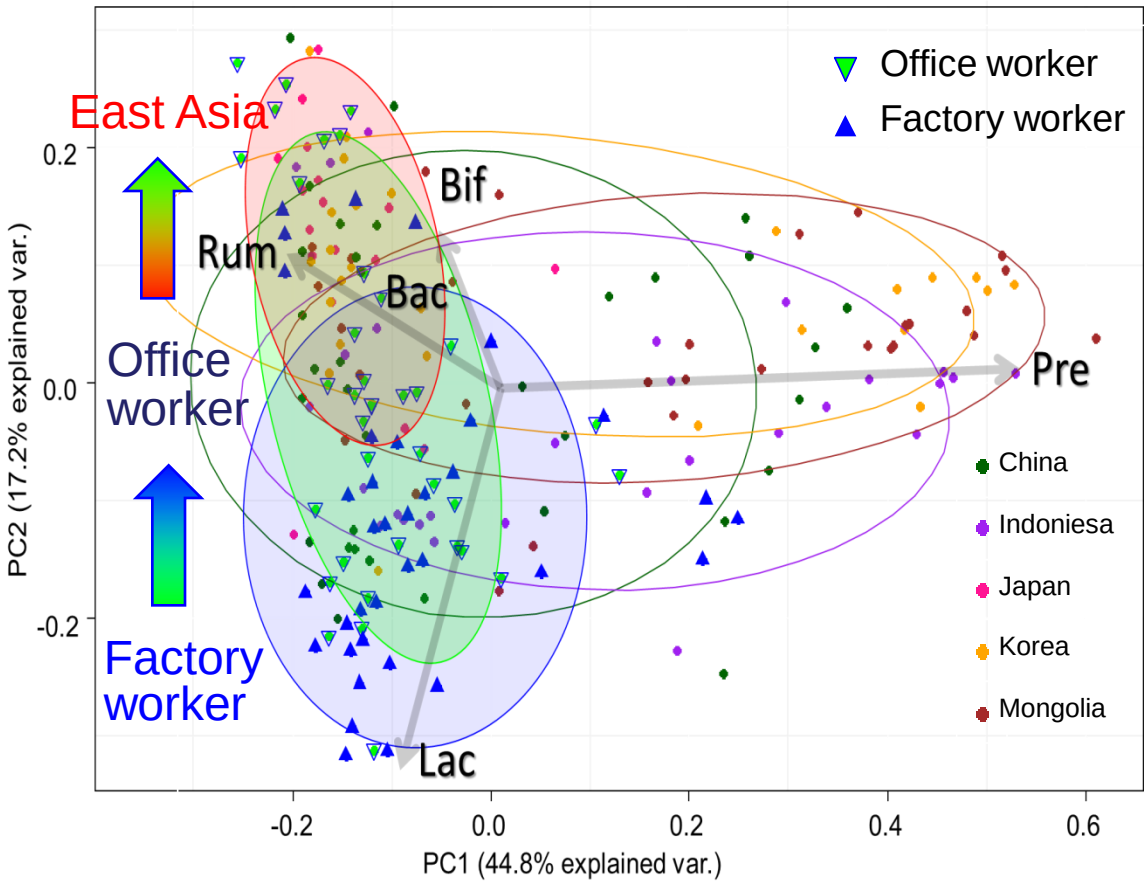
Collision of dietary habits: globalization of diet in Bangkok Thailand

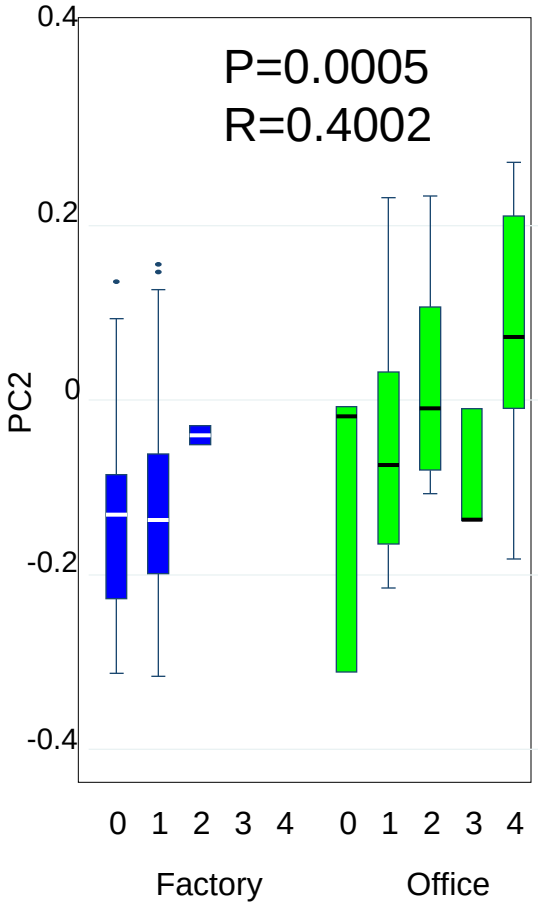


Redundancy analysis showing correlation between dietary habit and microbiota



Shift of Bangkok Thai gut microbiota to East Asia gut microbiota with intake of international diets





Microbiota profile in Asian cities

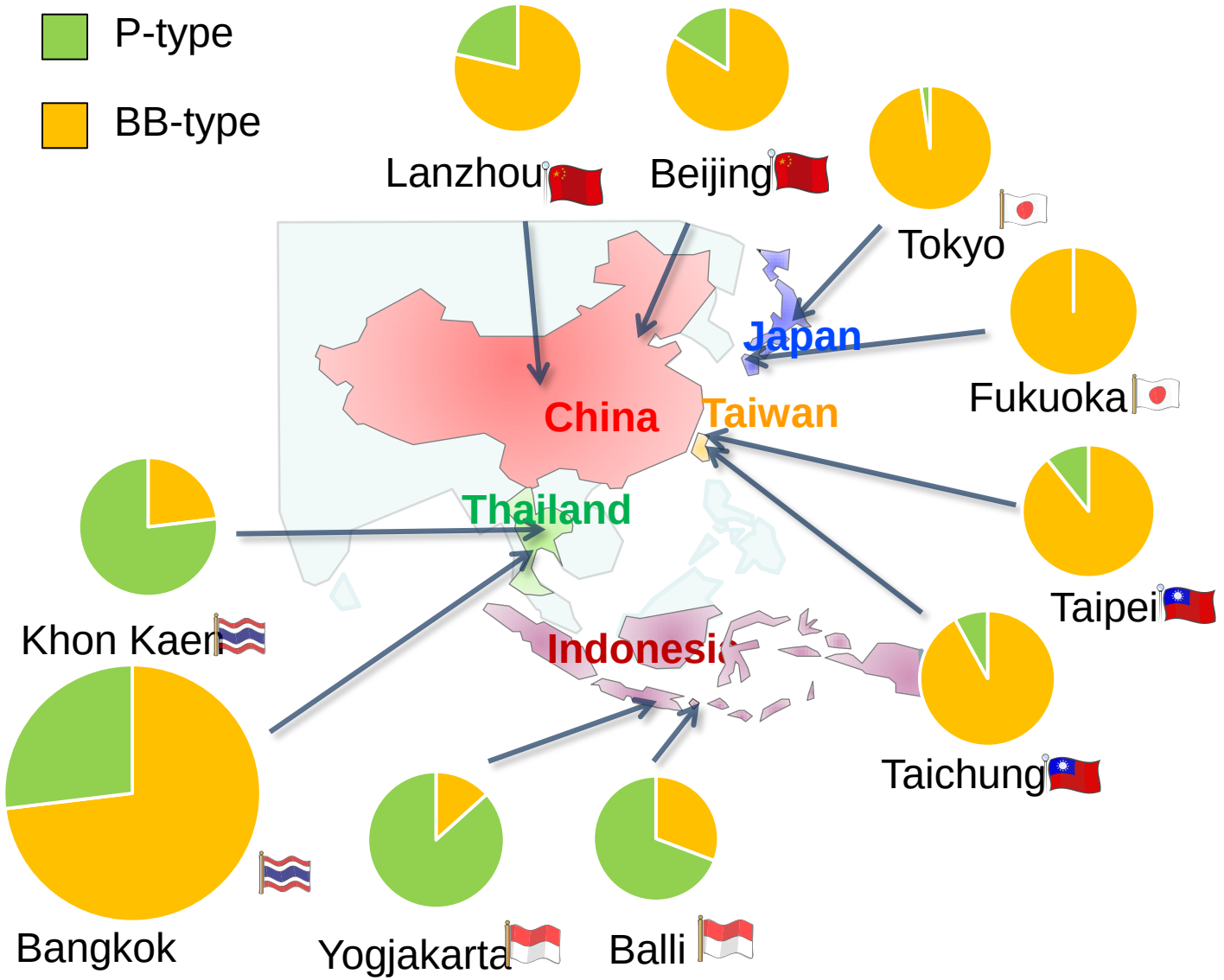


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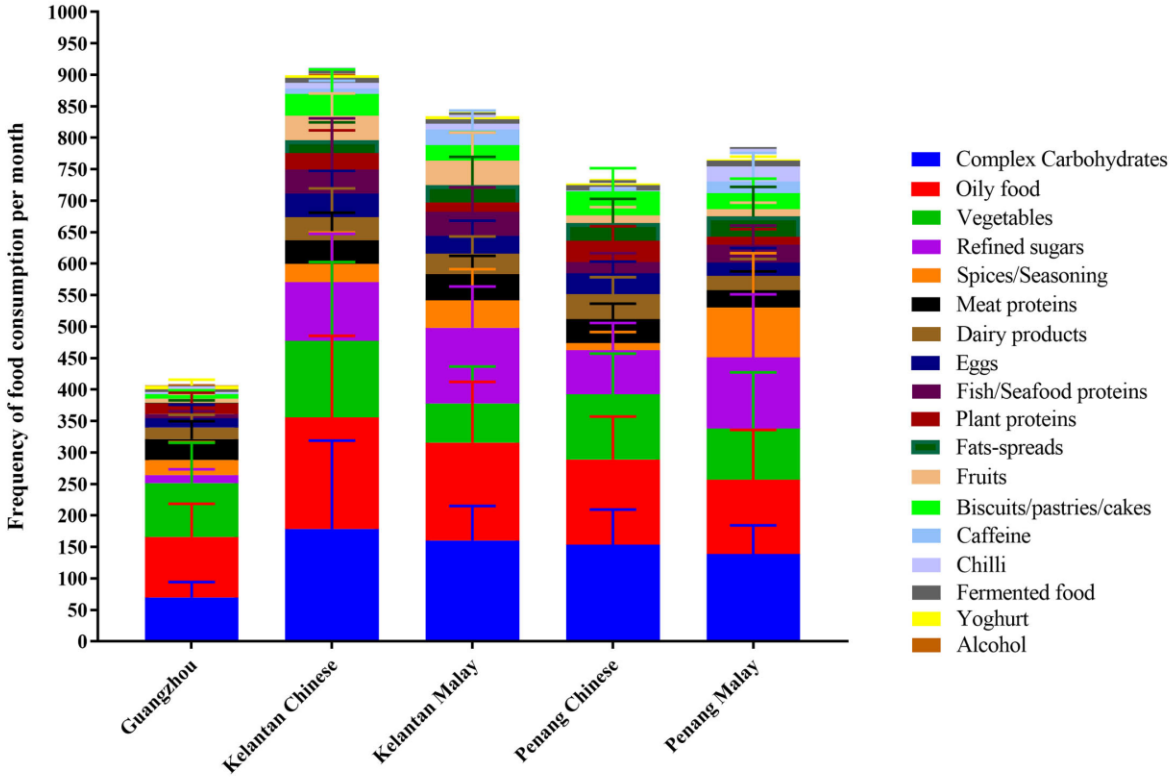
Figure 3.13

Are changes in microbiome profile bidirectional?

Southern Chinese migrated

to

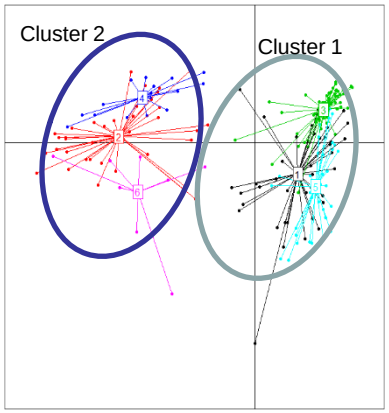
Penang, Kelantan Malaysia



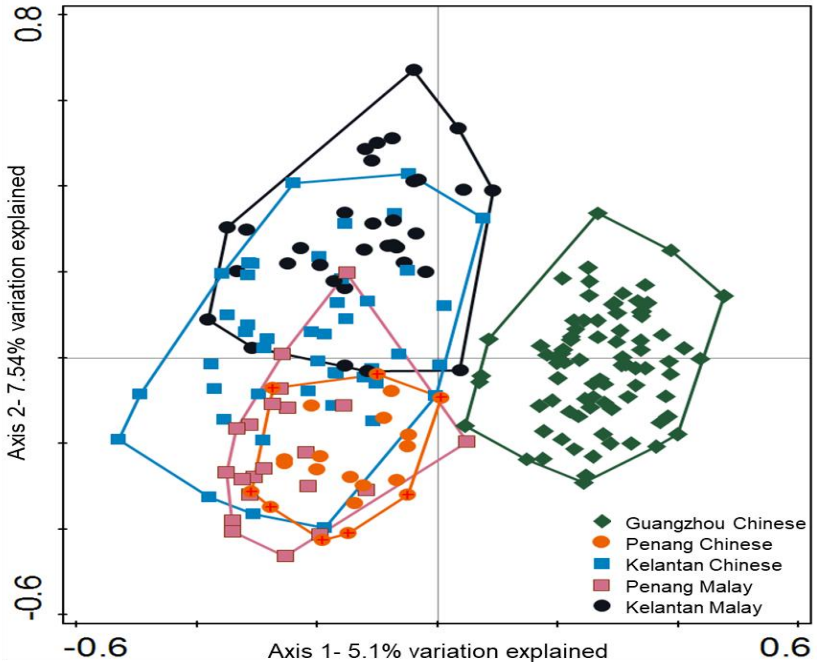
Guangzhou Chinese diet is largely different from Penang & Kelantan Chinese diet

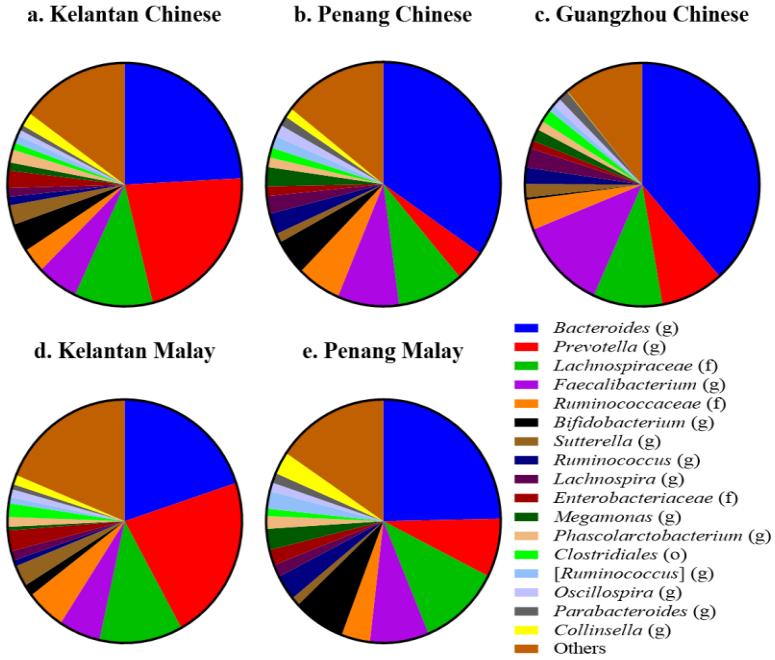
Penang Chinese diet similar to Penang Malay diet, and Kelantan Chinese & Malay

Human migration: Impact of dietary changes on gut microbiota of Southern Chinese



1. Kelantan cluster1
2. Kelantan cluster2
3. GZ cluster 1
4. GZ cluster 2
5. Penang cluster1
6. Penang cluster2





Distance-based redundancy analysis (db-RDA) comparing similarities of two races from three cities. The percentage of variation explained for each axis is shown and Monte Carlo permutation test is significant at p=0.002.

Major gut microbiota are determined largely by diet & life style.

Scientific & clinically demonstrated probiotic effects:

1.Probiotics digest dietary components which are not digestible by the human, and intervene energy metabolism & storage.

2.Probiotics prevent formation of carcinogens from dietary components.

3.Probiotics produce vitamins and other growth factors essential for the host.

4.Through competition and production of inhibitory factors, probiotics supress growth and colonization of gut pathogens.

5.Probiotics strengthen epithelial layer tight-junction, preventing crossover of pathogen and endotoxin, preventing chronic inflammation & related diseases.

6.Probiotics regulate immunity development at young age and enhance immunity in the adults.

7.Through gut-brain axis, probiotics regulate mental stage and functions.

Effect of diet on probiotic effects??

On adhesion, colonization, host-probiotic cross-talk, microbe-microbe interactions

Adhesive Polymers (adhesion of probiotics on GI surface)

Bacteria	Adhesin	**Receptor on intestinal surface**
Escherichia coli	Type 1 fimbriae	Oligomannoside
	Type P fimbriae	Galabiose
	Type K99 fimbriae	Sialic acid
	Type CFA/I fimbriae	Sialic acid
	Type F-41 fimbriae	GalNAc, mucin
	Flagella-MS	Mannose
Vibrio cholerae	Flagella	L-Fucose
Streptococcus sobrinus	Protein	Glucan
Klebsiella pneumoniae	NFA I protein	GalNAcβ1
Lactobacillus plantarum	Protein	Mannose
Lactobacillus johnsonii		Oligomannoside Gangliotri/tetra-osylcer amides

The type of carbohydrate we eat affects the colonization of probiotics in our gut:

Lactobacillus rhanmosus GG (isolated in US, developed in Europe)

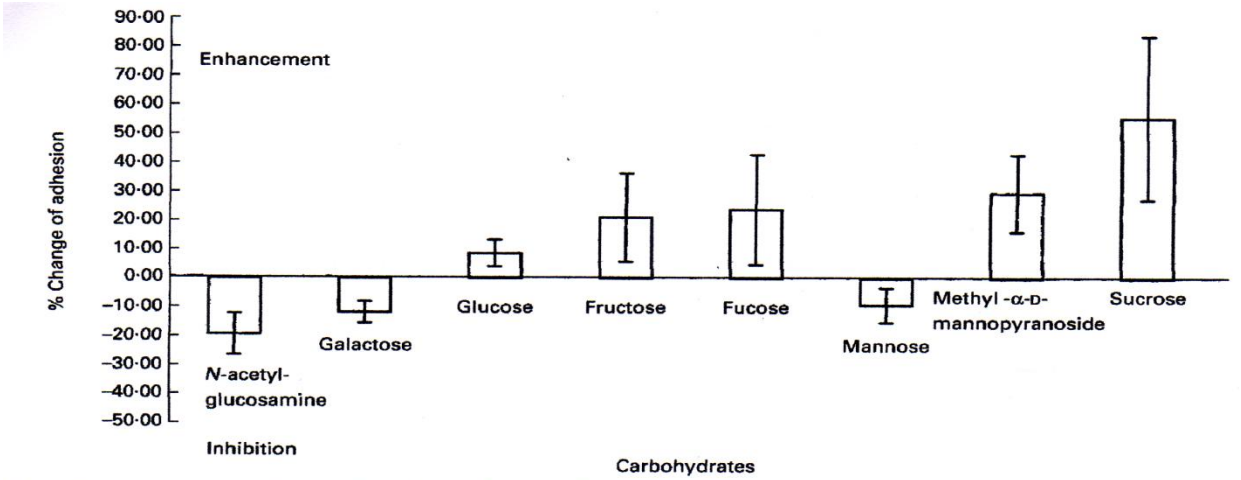


Fig. 1. The effect of carbohydrates on the adhesion of *Lactobacillus rhamnosus GG* to Caco-2 cells. The vertical bars represent the standard deviation.

Lactobacillus casei Shirota (isolated & developed in Japan)

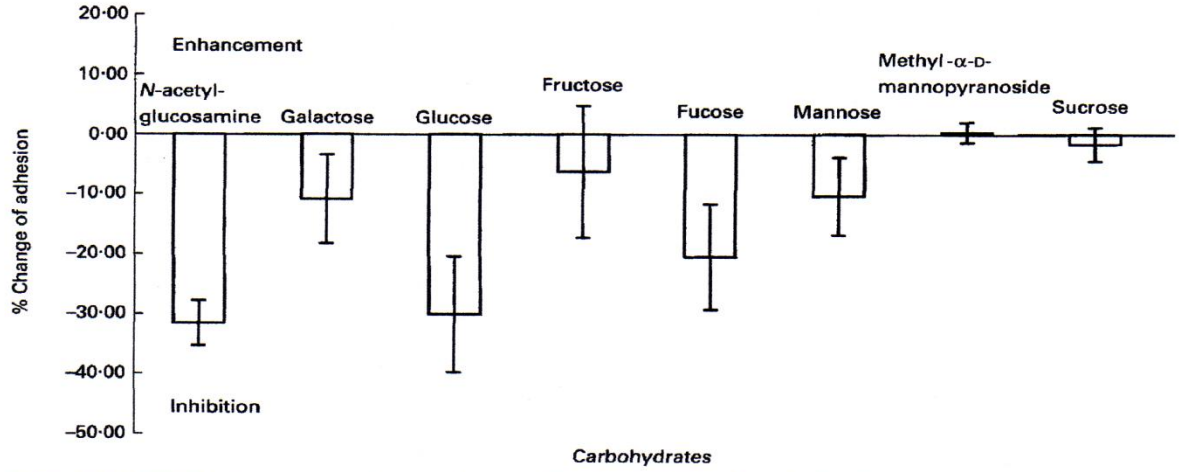
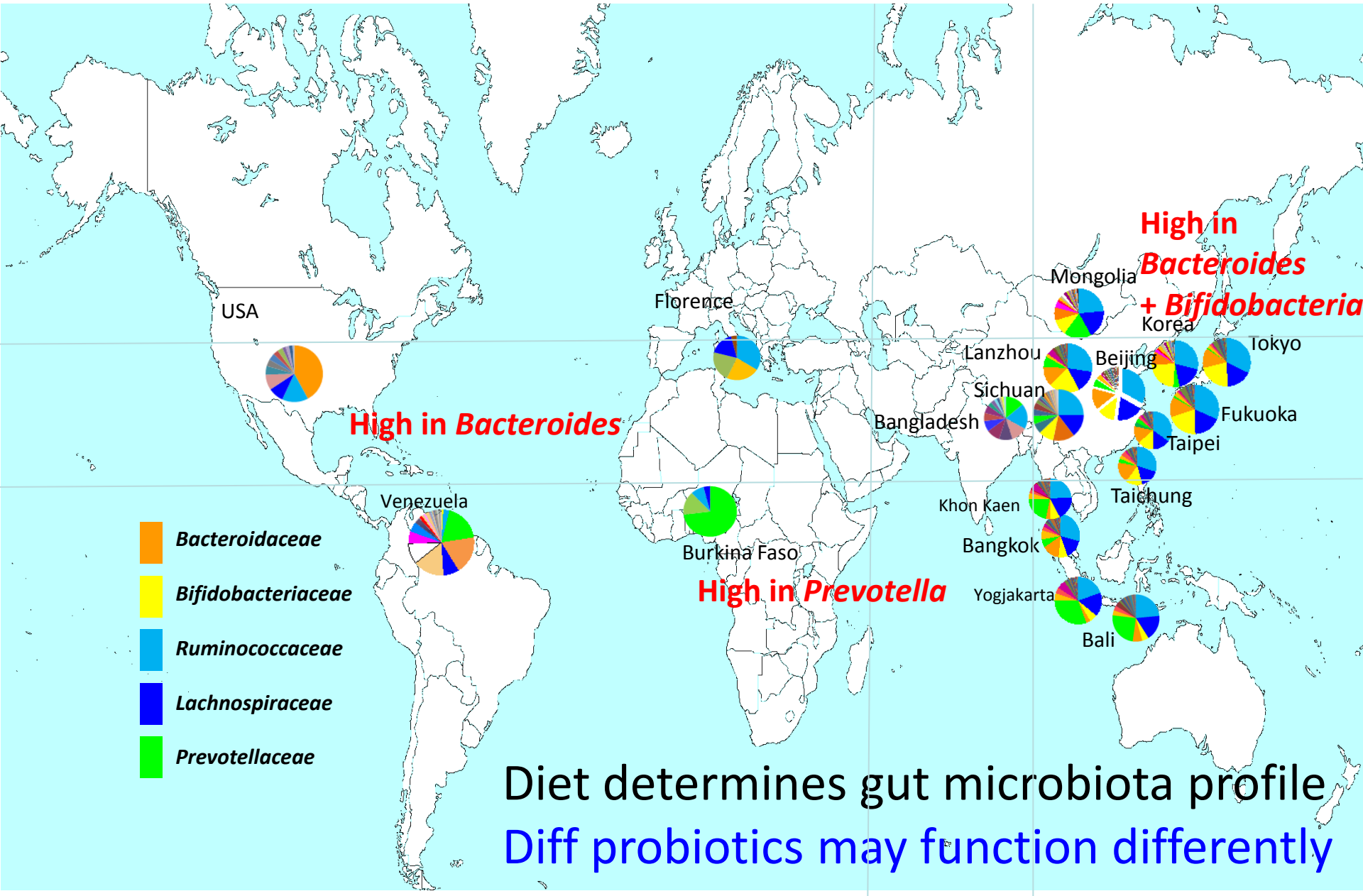


Fig. 2. The effect of carbohydrates on the adhesion of *Lactobacillus casei* Shirota to Caco-2 cells. The vertical bars represent the standard deviation.

Gut microbiota of healthy population worldwide



Diet determines gut microbiota profile

Diff probiotics may function differently


thank you!