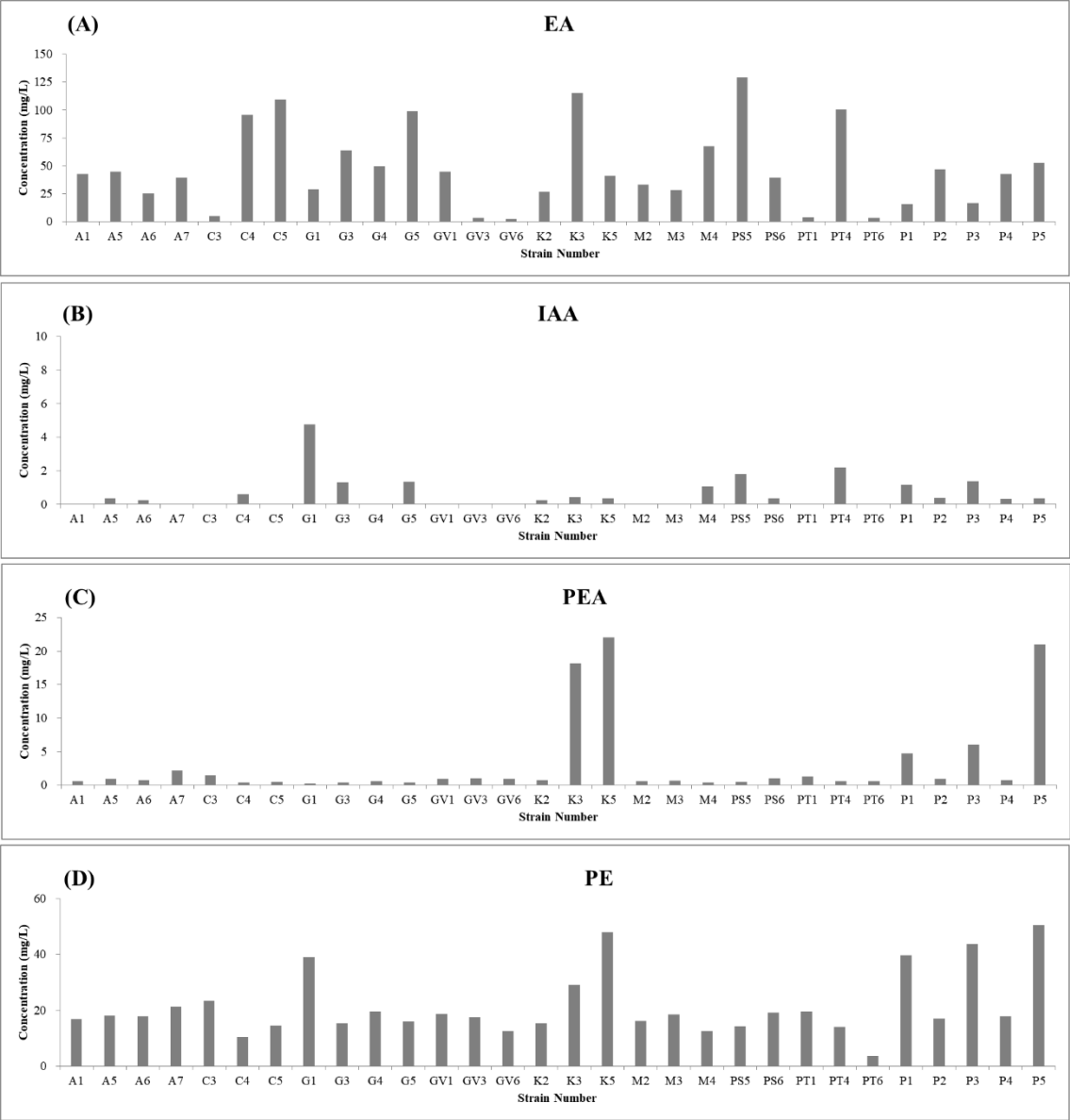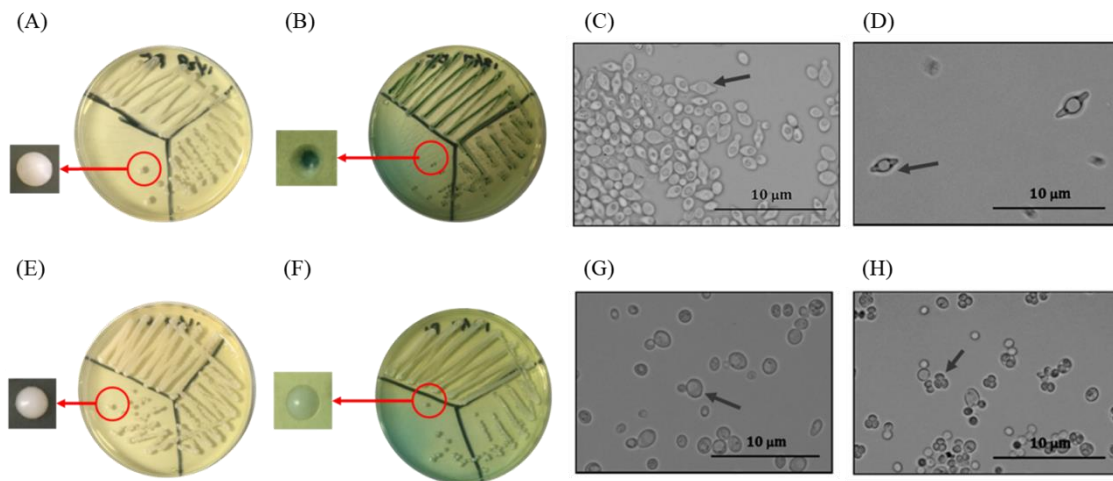# SUPPLEMENTARY INFORMATION

Supplemental Figure S1. Screening yeasts by the (A) EA, (B) IAA, (C) PEA and (D) PE of fermented broth.

Supplemental Figure S2. Morphological characterization of yeasts: (A) *H. vineae* P5 colony on yeast extract peptone dextrose (YPD) agar, (B) *H. vineae* P5 colony on Wallerstein Laboratory (WL) nutrient agar, (C) bipolar budding of *H. vineae* P5, (D) *H. vineae* P5 ascospore, (E) *S. cerevisiae* P1 colony on YPD agar, (F) *S. cerevisiae* P1 colony on WL agar, (G) multilateral budding of *S. cerevisiae* P1 and (H) *S. cerevisiae* P1 ascospore.

H. vineae P5 formed smooth, white-to-milky white colonies with slightly raised centers on YPD agar and green colonies with slightly raised centers on WL agar (SFigs. 2(A) and (B)). *H. vineae* P5 cells were ovoid, lemon, or spindle-shaped, and budded bipolarly (SFig. 2(C)); furthermore, each *H. vineae* P5 ascus contained 1–2 ascospores during sexual reproduction (SFig. 2(D)). *S. cerevisiae* P1 formed smooth, white-to-milky white colonies with flat or slightly raised centers on YPD and WL agars (SFigs. 2(E) and 2(F), respectively). Its cells were spherical or oval and budded multilaterally (SFig. 2(G)). During sexual reproduction, each *S. cerevisiae* P1 ascus contained 1–4 ascospores (SFig. 2(H)).

Supplemental Table S1. Descriptive terms of check-all-that-apply analysis for cider

Appearance					
clear	cloudy	brilliant	dark	sediment	sparkling
pink	lemon green	lemon yellow	straw yellow	golden	amber
brown					

Aroma					
fruity	grapefruit	lemon	orange	cassis	strawberry
raspberry	red fruit mix	peach	apple	cherry	banana
melon	pineapple	prune	passion fruit	mango	floral
rose	lilac	acacia	violet	elderflower	jasmine
lavender	spicy	tobacco	tea	coffee	soy sauce
nutty	pepper	butter	chocolate	honey	caramel
popcorn	yeasty	animalic	leather	licorice	vanilla
green/earthy	smoky	moldy	mineralic	earthy	hay
asparagus	green bean	grass	bell pepper	menthol	woody
mushroom	meat	chemical	plastic	fuel	rubbery
sulfur	glue	ethanol	methanol	solvent	oxidized
lactic	vinegar	corky			

Flavor					
sweet	medium sweet	dry	high acidity	medium acidity	low acidity
high alcohol	medium alcohol	low alcohol	bitter		

Texture					
smooth	pungent	stinging	fine bubble	no bubble	full-bodied
light	high astringent	medium astringent	low astringent	complex	burning

Aftertaste					
long finish	short finish	sweet	acidity	bitter	astringent
floral	fruity	herb	woody		

Concept					
comfortable	good quality	expensive	cheap		

Feeling					

upset stomach	degreasing	freshness	flat	round	robust
happiness	long length				

Supplemental Table S2. The analysis condition of GC-FID for main aroma compounds

Parameters	Condition			
Column	DB-WAX，30 m × 0.25 mm，0.25　m (Agilent Technologies, Inc.)			
Injection volume	1 μL			
Injection temperature	180ºC			
Split ratio	30：1			
Flow rate	He，1.2 mL/min			
Oven condition	Rate (ºC/min)	Temperature (ºC)	Hold time (min)	Total time (min)
	-	70	0	0
	5	85	0	3
	45	175	0	5
	2	178	0	6.5
	0.5	180	0	10.5
	35	250	5	17.5
Detector temperature	300ºC			

Supplemental Table S3. Yeast identification based on sequencing of the ITS region

Yeast species	No.	Sources
Candida tropicalis	C3	Cantaloupe
Pichia kudriavzevii	C5	Cantaloupe
Hanseniaspora pseudoguilliermondii	A7	Apple
Hanseniaspora uvarum	G3	Grape
Hanseniaspora opuntiae	C4	Cantaloupe
	G5	Grape
	M4	Mango
	PS5	Passion fruit
	PT4	Pitaya
Hanseniaspora vineae	K3、K5	Kiwifruit
	P5	Plum
Saccharomyces cerevisiae	G1	Grape
	P1、P3	Plum

Supplemental Table S4. Selection frequencies of descriptive terms for cider and the results of Cochran's Q test based on the check-all-that-apply (CATA) method

Sample Code	138	263	377	924	*p*-value
Appearance					
clear *	40 [a]	12 [b]	16 [b]	35 [a]	0.00
cloudy *	0 [b]	21 [a]	15 [a]	0 [b]	0.00
brilliant *	17 [a]	14 [a]	18 [a]	23 [a]	0.21
dark	0 [a]	6 [a]	2 [a]	1 [a]	0.02
sediment	0 [a]	1 [a]	1 [a]	0 [a]	0.39
sparkling *	29 [a]	2 [b]	2 [b]	30 [a]	0.00
lemon green	2 [a]	0 [a]	0 [a]	0 [a]	0.11
lemon yellow *	14 [a]	9 [a]	8 [a]	15 [a]	0.15
straw yellow *	1 [b]	18 [a]	12 [a]	2 [b]	0.00
golden *	17 [a]	10 [a]	16 [a]	20 [a]	0.09
amber	0 [b]	7 [a]	7 [a]	1 [ab]	0.00
Aroma					
fruity *	38 [a]	35 [a]	39 [a]	36 [a]	0.29
grapefruit	0 [a]	4 [a]	2 [a]	3 [a]	0.27
lemon	3 [a]	3 [a]	2 [a]	3 [a]	0.96
orange	2 [a]	6 [a]	5 [a]	4 [a]	0.46
cassis	2 [a]	2 [a]	5 [a]	0 [a]	0.11
strawberry	0 [a]	1 [a]	1 [a]	1 [a]	0.80
raspberry	0 [a]	0 [a]	1 [a]	3 [a]	0.11
red fruit mix	0 [a]	1 [a]	0 [a]	0 [a]	0.39
peach	4 [a]	2 [a]	2 [a]	2 [a]	0.75
apple *	33 [a]	22 [b]	22 [b]	22 [ab]	0.01
cherry	1 [a]	1 [a]	1 [a]	3 [a]	0.52
banana	1 [a]	0 [a]	0 [a]	2 [a]	0.19
melon	1 [a]	0 [a]	0 [a]	1 [a]	0.57
pineapple *	1 [b]	4 [ab]	9 [a]	1 [b]	0.00
prune	0 [a]	2 [a]	4 [a]	0 [a]	0.06
passion fruit	0 [a]	3 [a]	2 [a]	0 [a]	0.06
mango	0 [a]	2 [a]	5 [a]	0 [a]	0.02
floral *	12 [a]	14 [a]	11 [a]	16 [a]	0.60
rose	0 [a]	0 [a]	1 [a]	0 [a]	0.39
lilac	0 [a]	0 [a]	1 [a]	1 [a]	0.57
acacia	0 [a]	0 [a]	1 [a]	0 [a]	0.39
violet	1 [a]	0 [a]	0 [a]	0 [a]	0.39
elderflower	3 [a]	2 [a]	2 [a]	7 [a]	0.09
jasmine	0 [a]	1 [a]	1 [a]	0 [a]	0.57

(Continued)

Supplemental Table S4. Selection frequencies of descriptive terms for cider and the results of Cochran's Q test based on the check-all-that-apply (CATA) method (continued)

Sample Code	138	263	377	924	p-value
spicy *	11 [b]	22 [a]	19 [ab]	17 [ab]	0.05
tobacco	0 [a]	0 [a]	1 [a]	0 [a]	0.39
tea	0 [a]	1 [a]	0 [a]	1 [a]	0.57
nutty	3 [a]	0 [a]	0 [a]	0 [a]	0.03
pepper	0 [a]	0 [a]	1 [a]	0 [a]	0.39
butter	4 [a]	1 [a]	0 [a]	3 [a]	0.14
honey *	3 [ab]	12 [a]	12 [a]	2 [b]	0.00
caramel	0 [a]	2 [a]	3 [a]	2 [a]	0.34
popcorn	0 [a]	0 [a]	1 [a]	1 [a]	0.57
yeasty *	0 [b]	10 [a]	7 [a]	7 [a]	0.02
leather	0 [a]	1 [a]	0 [a]	0 [a]	0.39
licorice	0 [a]	0 [a]	2 [a]	2 [a]	0.26
vanilla	1 [a]	0 [a]	1 [a]	1 [a]	0.80
green/earthy *	7 [a]	11 [a]	9 [a]	8 [a]	0.62
smoky	0 [a]	1 [a]	0 [a]	1 [a]	0.57
moldy	0 [a]	0 [a]	0 [a]	3 [a]	0.03
mineralic	1 [a]	1 [a]	3 [a]	2 [a]	0.47
earthy	2 [a]	2 [a]	3 [a]	2 [a]	0.95
hay	2 [a]	3 [a]	1 [a]	2 [a]	0.75
asparagus	0 [a]	1 [a]	0 [a]	0 [a]	0.39
grass	3 [a]	3 [a]	1 [a]	3 [a]	0.71
woody	1 [a]	2 [a]	0 [a]	0 [a]	0.30
chemical *	13 [a]	26 [a]	22 [a]	24 [a]	0.02
plastic	0 [a]	0 [a]	0 [a]	1 [a]	0.39
fuel	0 [a]	1 [a]	1 [a]	0 [a]	0.57
rubbery	0 [a]	0 [a]	1 [a]	0 [a]	0.39
sulfur	0 [a]	1 [a]	1 [a]	0 [a]	0.57
glue	0 [a]	1 [a]	0 [a]	0 [a]	0.39
ethanol *	5 [a]	11 [a]	9 [a]	9 [a]	0.33
methanol	0 [a]	1 [a]	0 [a]	0 [a]	0.39
solvent	3 [a]	3 [a]	2 [a]	2 [a]	0.93
oxidized	0 [a]	1 [a]	2 [a]	0 [a]	0.30
lactic	1 [a]	3 [a]	4 [a]	7 [a]	0.09
vinegar *	5 [a]	9 [a]	8 [a]	8 [a]	0.61
corky	1 [a]	1 [a]	1 [a]	0 [a]	0.80

(Continued)

Supplemental Table S4. Selection frequencies of descriptive terms for cider and the results of Cochran's Q test based on the check-all-that-apply (CATA) method (continued)

Sample Code	138	263	377	924	*p*-value
Flavor					
sweet *	5 b	13 ab	19 a	3 b	0.00
semi-sweet *	25 a	22 a	16 a	20 a	0.19
dry *	5 ab	0 b	1 ab	9 a	0.00
high acidity	3 a	0 a	0 a	4 a	0.04
medium acidity *	13 a	6 a	4 a	9 a	0.07
low acidity *	9 a	11 a	14 a	13 a	0.56
medium alcohol *	5 ab	11 a	2 b	7 ab	0.03
low alcohol *	18 a	9 a	19 a	11 a	0.03
bitter	0 a	1 a	1 a	1 a	0.80
Texture					
smooth *	10 b	29 a	28 a	8 b	0.00
pungent *	15 a	2 b	1 b	17 a	0.00
stinging *	16 a	0 b	0 b	13 a	0.00
fine bubble *	14 a	5 ab	0 b	14 a	0.00
no bubble *	0 c	16 a	10 ab	5 bc	0.00
full-bodied	0 b	7 a	6 ab	2 ab	0.01
light *	17 a	9 a	9 a	13 a	0.16
high astringent	0 a	0 a	1 a	3 a	0.11
medium astringent	2 a	3 a	1 a	7 a	0.09
low astringent *	17 a	15 a	7 a	12 a	0.07
complex	2 a	2 a	1 a	0 a	0.53
burning	1 a	4 a	1 a	1 a	0.23
Aftertaste					
long finish *	11 a	9 a	10 a	11 a	0.94
short finish *	14 a	14 a	15 a	15 a	0.99
sweet *	7 b	21 a	16 ab	8 b	0.00
acidity *	17 a	6 b	5 b	23 a	0.00
bitter	0 a	3 a	2 a	2 a	0.39
astringent *	4 a	4 a	8 a	11 a	0.09
floral *	1 a	1 a	5 a	2 a	0.19
fruity *	22 a	18 a	19 a	16 a	0.55
herb	0 a	1 a	1 a	1 a	0.80
woody	2 a	0 b	1 a	1 a	0.57

(Continued)

Supplemental Table S4. Selection frequencies of descriptive terms for cider and the results of Cochran's Q test based on the check-all-that-apply (CATA) method (continued)

Sample Code	138	263	377	924	p-value
Concept					
comfortable *	25 [a]	25 [a]	24 [a]	19 [a]	0.43
good quality *	13 [a]	12 [a]	7 [a]	17 [a]	0.08
expensive	0 [a]	1 [a]	2 [a]	1 [a]	0.49
cheap	11 [a]	10 [a]	16 [a]	12 [a]	0.43
Feeling					
upset stomach	0 [a]	0 [a]	0 [a]	1 [a]	0.39
degreasing *	16 [a]	5 [bc]	2 [c]	14 [ab]	0.00
freshness *	23 [a]	11 [b]	12 [ab]	22 [ab]	0.01
flat *	6 [a]	5 [a]	12 [a]	5 [a]	0.11
round *	2 [c]	19 [a]	13 [ab]	3 [bc]	0.00
robust *	3 [a]	5 [a]	8 [a]	3 [a]	0.23
happiness *	3 [a]	7 [a]	9 [a]	4 [a]	0.10
long length	0 [b]	7 [a]	3 [ab]	3 [ab]	0.02

Significant difference ($p < 0.05$) of panelists' selection proportions for each attribute among the four cider samples were determined by Cochran's Q test. 138 = Somersby Apple Cider; 263 = Pure culture; 377 = Co-culture; 924 = Strongbow Gold Apple Cider.