Amino acid analysis in each style of beer (Physiological fluid analysis method)

Beer is very popular alcoholic beverage fermented from malt, hops and water. Various flavors of beer are produced depending on the brewing method. Yeast metabolizes (ferments) sugars and amino acids to add aroma and taste, but if it is excessive, it becomes bitter and odorous. Therefore, controlling the balance of fermentation is the important point to producing delicious beer [1]. Amino acids are also known to affect the aroma and taste of wort in beer and the adhesion of foam to glasses [2].
This report is an example of analysis of 5 types of beer (Weizen, 2 types of Pilsner, Stout, Beer-taste beverage) from different production areas using LA8080 HIGH SPEED AMINO ACID ANALYZER (AminoSAAYA).
Beer data were showed a different amino acid profile, depending on its style. Amino acid analysis is useful for beer taste / flavor evaluation and quality control.

LA8080 HIGH SPEED AMINO ACID ANALYZER (AminoSAAYA)

1) 善本裕之, et al. 美味しさの鍵を握るビール酵母の魅力を探る. 化学と生物, 2018, 56.9: 605-612.
2) 中村剛. ビール泡品質向上への一貫した取組み. 化学と生物, 2016, 54.3: 212-215.

Analytical Conditions, Sample Preparation

Table 1. Analytical Conditions for Physiological fluid analysis method

Column	#2622PF 4.6 mm I.D. × 60 mm
Ammonia filter column	#2650L 4.6 mm I.D. × 40 mm
Guard column	#2619F 4.0 mm I.D. × 5 mm
Eluent	MCI buffer L-8500 PH-Kit (*)
Flow rate	0.35 mL/min
Column temperature	32～70 ºC
Reaction reagent	Ninhydrin Reagent Wako Amino Acid Automated Analyzer Kit (ID code: For Hitachi) (*)
Reaction reagent flow rate	0.30 mL/min
Reaction temperature	135 ºC
Detection wavelength	VIS 440 nm、570 nm
Injection volume	20 µL

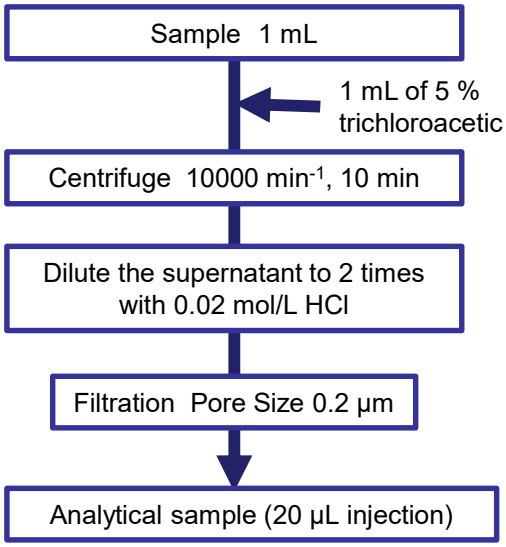

Fig.1 Preparation Method

(*) FUJIFILM Wako Pure Chemical Corporation

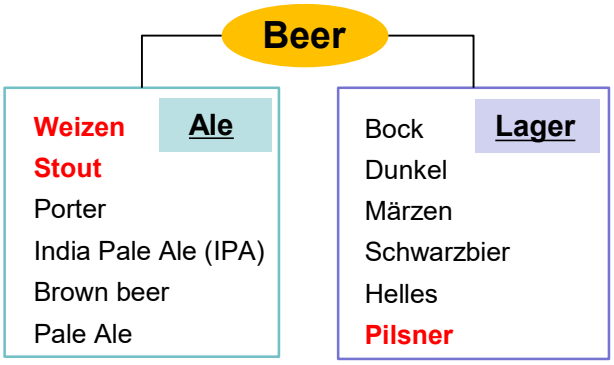

Fig.2 Major beer styles

Ale
Top-fermenting yeast is used and ferments at a relatively high temperature in a short period of time. It features a unique scent like fruits and flowers.

Lager
Bottom fermenting yeast is used and ferments at low temperature.
It features a refreshing taste.

Analysis of Amino Acid Standard Solution

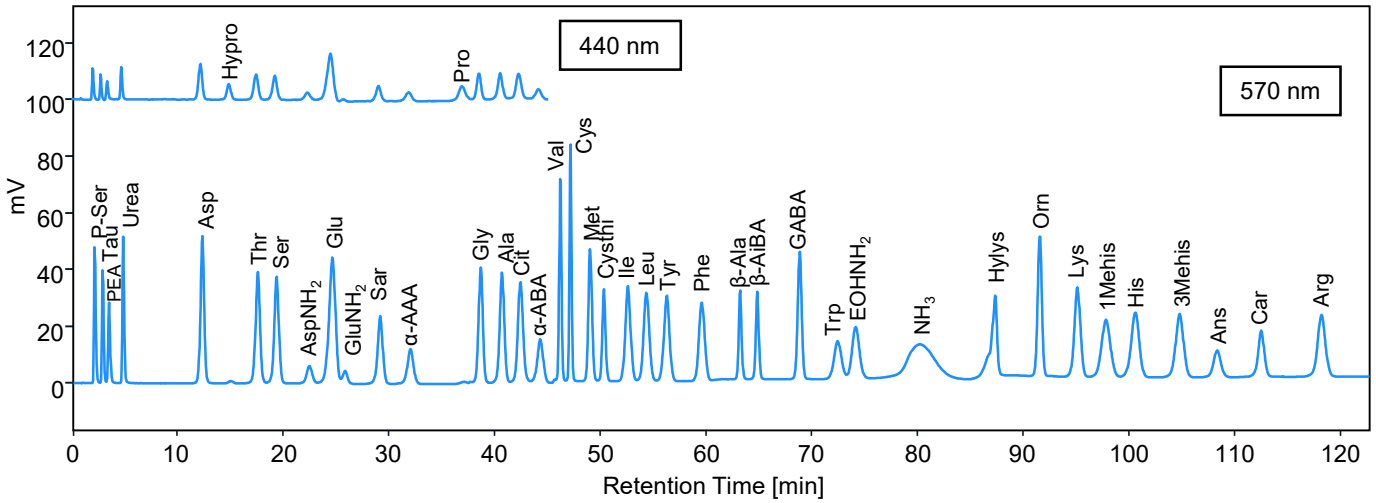

Fig.3 Analysis of Amino Acid Standard Solution

Analysis of beer samples

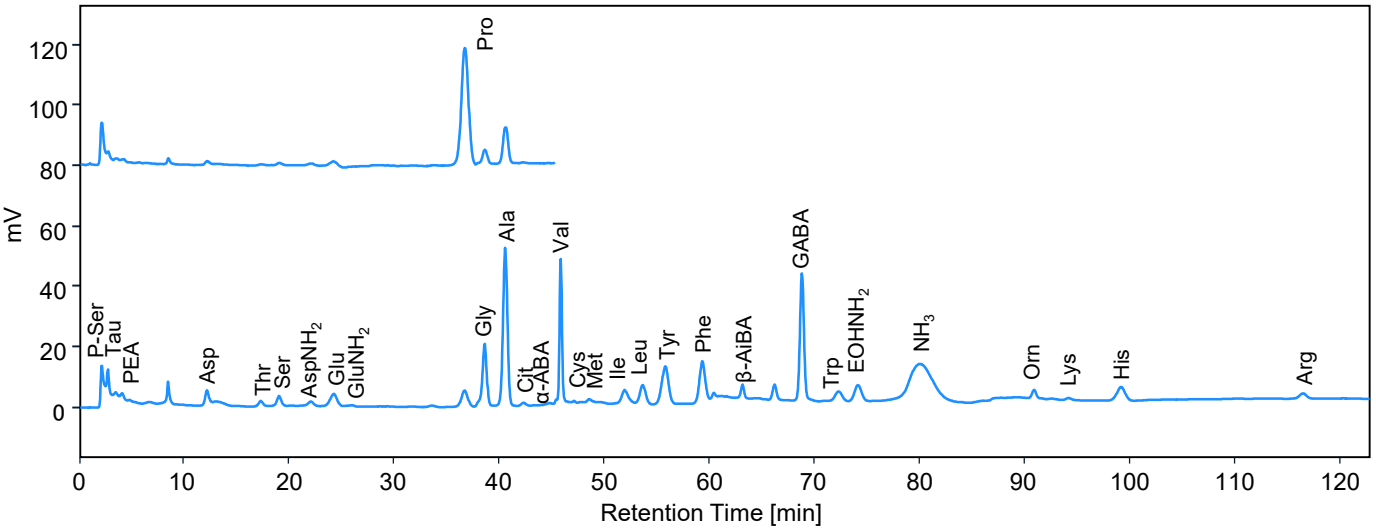

Fig.4 Analysis of Stout type beer (Ireland)

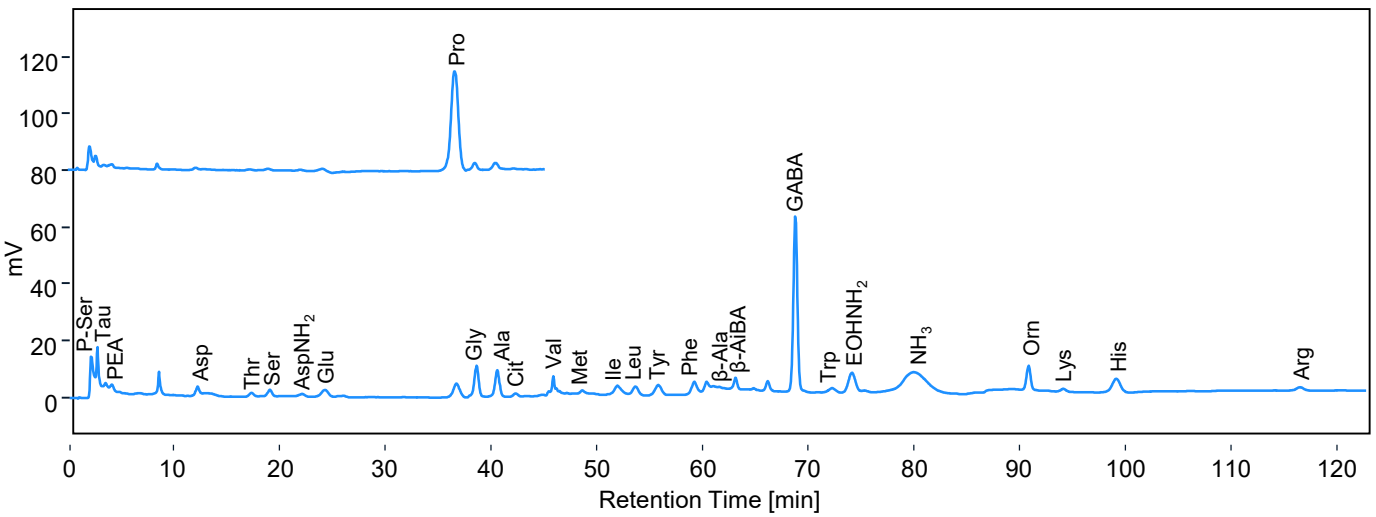

Fig.5 Analysis of Weizen type beer (Germany)

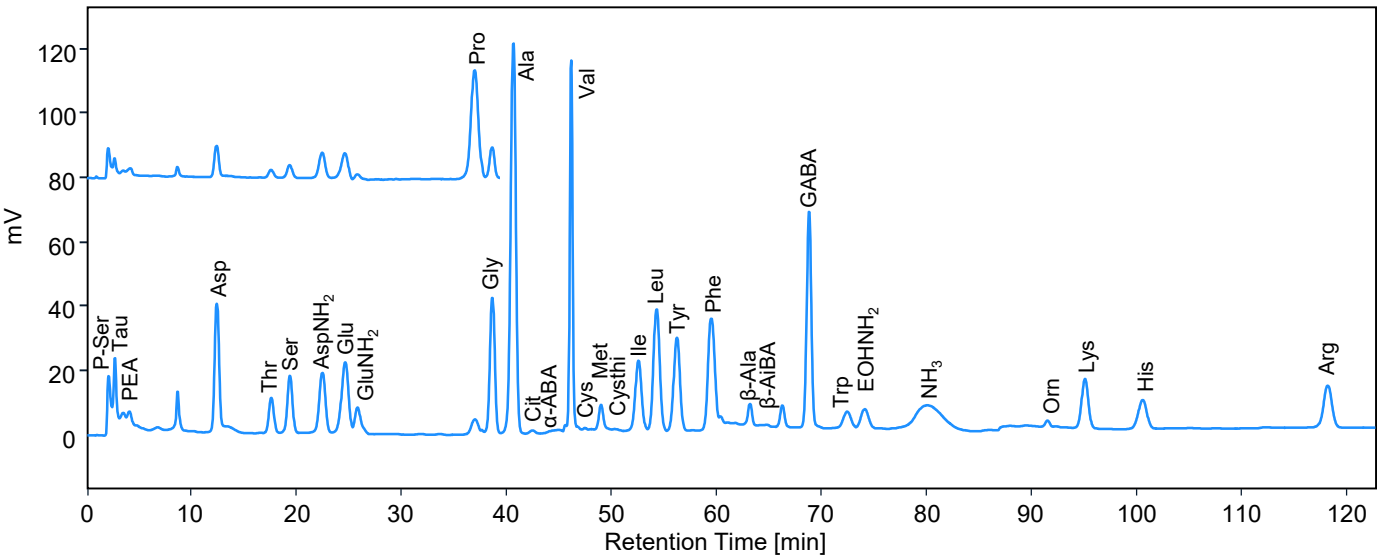

Fig.6 Analysis of Pilsner type beer (U.S.A)

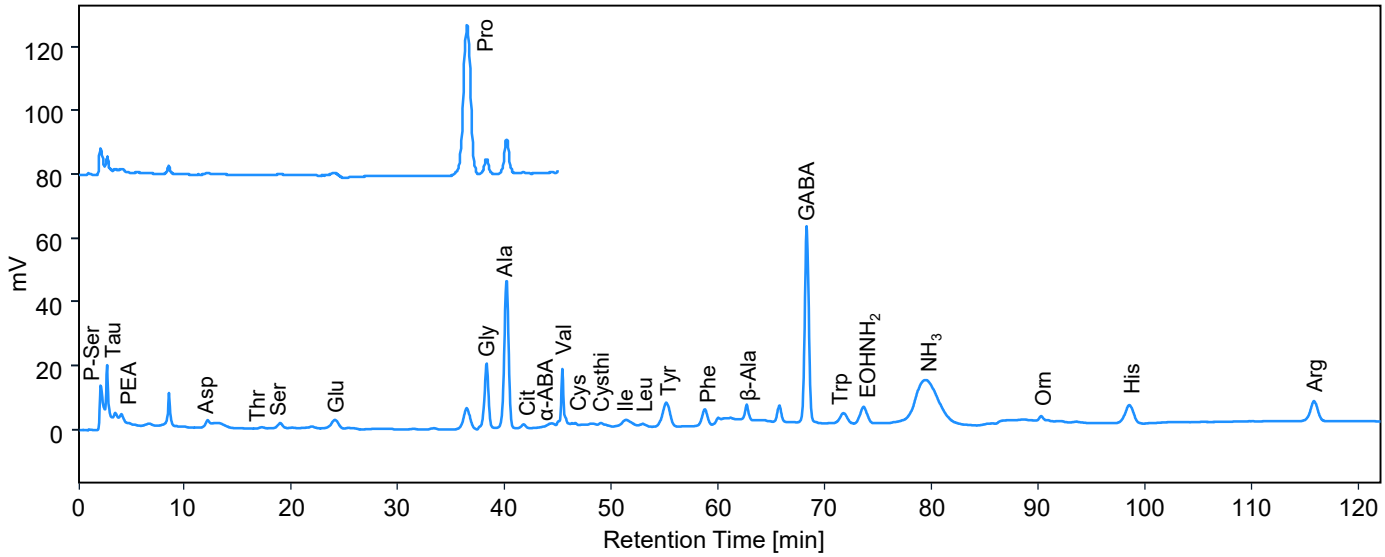

Fig.7 Analysis of Pilsner type beer (Germany)

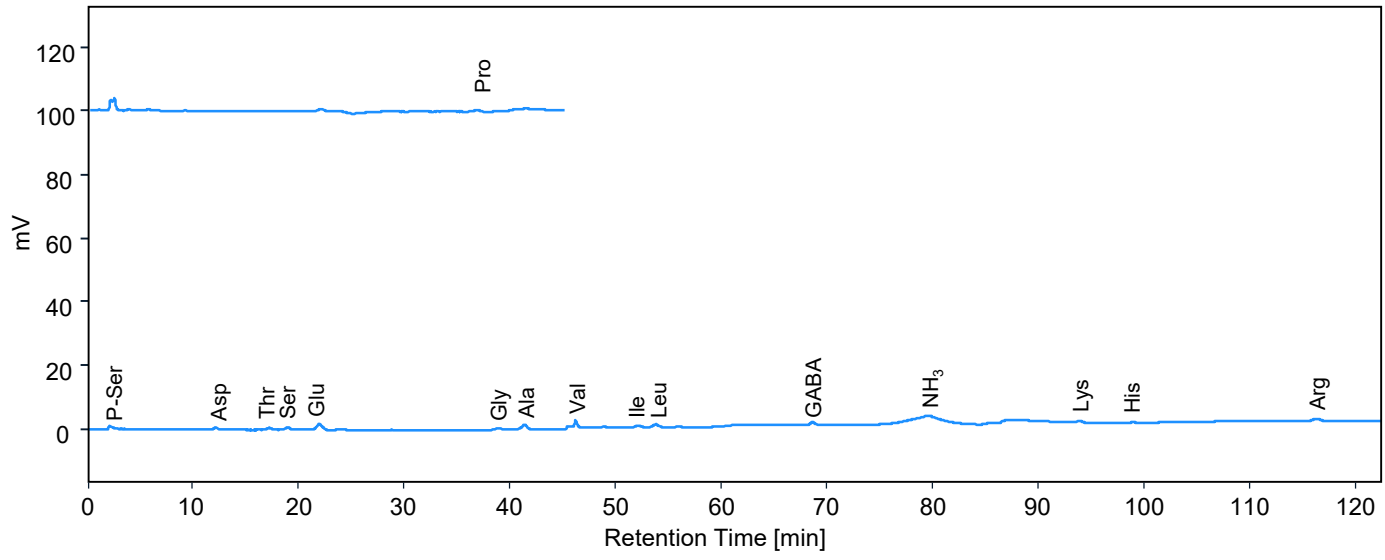

Fig.8 Analysis of Beer-taste beverage (Japan)

Quantitative value of amino acids

- ✓ It was found that the amino acid content differs depending on the style.
- ✓ In particular, proline and GABA were abundant in all beers (Table 2). This is thought to be due to the low consumption order of these amino acids in the yeast fermentation process.

Table 2. Quantitative value of amino acids

Style	Concentration(mmol/L)	
	GABA	Pro
Stout	0.38	2.84
Weizen	0.55	2.61
Pilsner (U.S.A)	0.60	2.69
Pilsner (Germany)	0.55	3.47
Beer-taste beverage	0.01	0.03

List of Amino Acids

Abbrev.	Amino acid	Molecular weight	Std. concentration (nmol/ 20 µL)
P–Ser	Phosphoserine	185.1	1
Tau	Taurine	125.2	1
PEA	Phospho ethanol amine	141.1	1
Urea	Urea	60.1	40
Asp	Aspartic acid	133.1	2
Hypro	Hydroxy proline	131.1	2
Thr	Threonine	119.1	2
Ser	Serine	105.1	2
$AspNH_2$	Asparagine	132.1	2
Glu	Glutamic acid	147.1	2
$GluNH_2$	Glutamine	146.2	2
Sar	Sarcosine	89.1	5
α-AAA	α–Amino adipic acid	161.2	1
Pro	Proline	115.1	2
Gly	Glycine	75.1	2
Ala	Alanine	89.1	2
Cit	Citrulline	175.2	2
α–ABA	α–Amino–n–butyric acid	103.1	1
Val	Valine	117.1	2
Cys	Cystine	240.3	2
Met	Methionine	149.2	2
Cysthi	Cystathionine	222.3	1
Ile	Isoleucine	131.2	2
Leu	Leucine	131.2	2
Tyr	Tyrosine	181.2	2
Phe	Phenylalanine	165.2	2
β–Ala	β-Alanine	89.1	2
β–AiBA	β–Amino iso butyric acid	103.1	2
GABA	γ–Amino–n–butyric acid	103.1	2
Trp	Tryptophan	204.1	2
$EOHNH_2$	Ethanole amine	61.1	2
NH_3	Ammonia	17.0	2
Hylys	Hydroxylysine	162.2	2
Orn	Ornithine	132.2	2
Lys	Lysine	146.2	2
1Mehis	1-Methylhistidine	169.2	2
His	Histidine	155.2	2
3Mehis	3–Methylhistidine	169.2	2
Ans	Anserine	240.3	2
Car	Carnosine	226.2	2
Arg	Arginine	174.2	2

NOTE: All data on this report are examples of measurement; the individual values are NOT guaranteed.